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# Message from the Vice President for Research & Community Services

Ethiopian Civil Service University (ECSU) was established to support the transformation drive of building capacity of the public sector both at federal and regional levels through providing specialized education, training, research and consultancy programs and services. The University has been organizing scientific forums such as workshops and conferences with the aim of disseminating scientific research outputs and enriching the same to maintain its quality at different times.

Against this backdrop, the 2022 conference was organized under the theme, 'The Seventh National Research Conference on Public Sector Transformation and Development.' A total of 135 abstracts were collected by the 7th National Research Conference Organizing Committee. Of these, 110 were collected from higher education and training institutions, while 25 were funded by ECSU in the 2013 E.C. (2020/2021) calendar year. A total of 53 full papers were further reviewed for conference presentation eligibility, of which 38 were approved, passing through a rigorous review process. Of these, 36 papers were successfully presented at the conference.

Vol. 2 of this proceeding contains 19 papers of the 36 that were successfully presented during the two-day conference and passed rigorous post-conference presentation revision process. The papers have been enriched through incorporation of comments and suggestions gained during the conference. The papers in this volume are categorized into the thematic areas of the Environment & Development, Public Service Ethics, Reform and Policy Implementation, and Cross-Cutting Issues.

Finally, the VPRCS presents this proceeding with a great pleasure and sense of honor to all relevant stakeholders.

Dr. Alemayehu Debebe

July 2022

# 

# 4. ENVIRONMENT & DEVELOPMENT

4.1. A Retrospective Study on Heavy Metal Contamination of Vegetables Irrigated in Peri-Urban Areas of Ethiopia and their Health Implication to Consumers

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***Abstract***

*Vegetables are the common diet taken by populations throughout the world, being sources of essential nutrients, antioxidants, and metabolites. As a result, their consumption is increasing especially among the urban community. However, they contain a varied concentration of both essential and toxic elements as they are a good absorber of metals from the soil. This retrospective study intends to investigate the levels of Pb, Cd, and Cr in various vegetable species from agricultural fields in peri-urban areas of Adama and Addis Ababa towns and assesses the health risk implication to consumers. The mean concentrations of heavy metals in various vegetable species collected from peri-urban areas of both towns were compared with the standards set for vegetables by FAO & WHO, 2011. Accordingly, Pb and Cd for most of the vegetables and Cr in some vegetables exceeded the FAO & WHO standards in food. In peri-urban areas of Adama the concentration of Pb was high in Lettuce, and Swiss chard, compared with the concentrations of Pb in the other vegetables. However, in vegetables irrigated in peri-urban areas of Addis Ababa, the highest lead ion concentration is detected with Cabbage, Swiss chard, and Lettuce. The highest concentration of Cd was recorded in Lettuce and Spinach that was cultivated in the near vicinity of Adama town. However, the highest mean concentration of Cr was found in Lettuce, and Cabbage cultivated by the Akaki River. In Ethiopia the vegetable consumption is very low (97/g/person/day) as a result, the estimated daily intake of the studied heavy metals through the consumption of the test vegetables obtained is below the provisional tolerable daily intakes (PTDIs) set by Joint FAO/WHO Expert Committee on food additives, and it can be suggested that the consumption of average amounts of these contaminated vegetables does not pose a health risk for the consumers. However, if the consumption of vegetables increases and consumers having an average body mass below 60 kg especially for children, the concentration of heavy metals found in the vegetable is sufficient to pose a health risk.*

**Keywords:** *Vegetable; heavy metal; irrigation; wastewater*

**Introduction**

Vegetables are a common diet taken by populations throughout the world, being sources of essential nutrients, antioxidants, and metabolites (Thompson and Kelly, 1990). They constitute an important part of the human diet since they contain carbohydrates, proteins, as well as vitamins, minerals, and trace elements (Abdullah and Chmielnicka, 1990). As a result, in recent years, their consumption is increased, particularly among the urban community. This is due to increased awareness of the food value of vegetables, because of exposure to other cultures and acquiring proper education (Thompson and Kelly, 2003). However, they contain both essential and toxic elements over a wide range of concentrations as they are said to be a good absorber of metals from the soil (Lokeshwari and Chandrappa, 2006; Eslami *et al.,* 2007).

Some heavy metals such as Cr, Mn, Ni, Zn, Cu, and Fe are considered essential components for biological activities in the body; however, their presence in elevated levels is reported to cause problems to humans (Lokeshwari and Chandrappa, 2006). Living organisms require trace amounts of some heavy metals, including sodium (Na), magnesium (Mg), potassium (K), calcium (Ca), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), copper (Cu), zinc (Zn), selenium (Se) and molybdenum (Mo), but excessive levels can be detrimental to the organism. On the other hand, Pb, Cd, Hg, and as are non-essential and play toxic roles to living organisms and hence are considered toxic elements (Pandey and Madhuri, 2014).

Especially in peri-urban areas the river water used for irrigating vegetables can be polluted by heavy metals such as Pb, Cu, Zn, Fe, Cr, Cd, Hg, etc. The major sources of heavy metals are industrial effluents and indiscriminate disposal of domestic or sewage drainage directed to the rivers untreated or partially treated (Itanna, 2002). Therefore, industrial or municipal wastewater irrigation is a common reality in three fourth of the cities in Asia, Africa, and Latin America (Gupta *et al*., 2008). As a result, heavy metal pollution of agricultural soil and vegetables is one of the most severe ecological problems on a world scale and also in Ethiopia, especially in urban areas. Food chain contamination is the major pathway of heavy metal exposure for humans (Khan *et al*., 2008). The consumption of vegetables is one of the most important pathways for trace metals that harm human health (Sipter *et al*., 2008). Health risks have been evaluated by numerous methods but most commonly, the risk to human health is computed in terms of Target Hazard Quotient (THQ) which is based on the concentration of trace metals in the edible parts of vegetables, in comparison with the reference dose of the metal intake and body weight of the consumers (Pandey *et al*., 2012). This review paper investigates the levels of Pb, Cd, and Cr in five different vegetable species from agricultural fields in peri-urban areas of Adama and Addis Ababa towns, Ethiopia and assesses the health risk due to vegetable consumption.

# Methodology

Literature sources from different published articles were used to show the level of heavy metal contamination of vegetables. To get the representative data on the heavy metal concentration of vegetables in both peri-urban areas of Adama and Addis Ababa, 12 different sampling locations were used and averaged.

**Daily intake of heavy metals (DIM)**

The daily intake of heavy metals was calculated to estimate the average loading rate of metals into the human body systems. According to equation 1, the calculation of the daily intake of metals through the consumption of vegetables considers the mean concentration of heavy metals in the vegetables, daily intake of vegetables, and average body weight (Cui et al. 2004; Khan 2013).

Where, Cmetal = heavy metal concentration in vegetables in mg/kg, Dfood intake = daily intake of vegetable in kg/day/person, and Baverage weight = average body weight in kg.

**Statistical Analysis**

The availability of the significant difference between the heavy metal concentration of each vegetable cultivated in peri-urban areas of Adama and Addis Ababa was compared using an independent sample t-test via SPSS version 22.

# Result and Discussion

## **Heavy metals concentration of vegetables**

### *Lead*

Genetic differences in tolerance and co-tolerance to heavy metals are well known in some species and ecotypes of natural vegetation (Marschner, 1996). The average concentration of lead ions in five different vegetables (Cabbage, Carrot, Lettuce, Spinach, and Swiss chard) from various irrigation sites of Akaki and Awash River channels in peri-urban areas of Addis Ababa and Adama towns of Ethiopia are shown in Table 1.

Table 1: Concentration of Lead (mg/kg) in some vegetables under waste water irrigation

|  |  |  |  |
| --- | --- | --- | --- |
| No | Vegetable type | Mean Concentration of Pb (mg/kg) | |
| 1 | Cabbage | 0.31 | 2.5 |
| 2 | Carrot | 0.18 | 0.80 |
| 3 | Lettuce | 0.59 | 1.19 |
| 4 | Spinach | 0.32 | 0.53 |
| 5 | Swiss chard | 0.57 | 1.69 |
| Cultivated in | | Peri-urban areas of Adama | Peri-urban areas of Addis Ababa |
| \*DET. LIM | | 0.3\* | |

Sources: (\*FAO/WHO, 2001; Eliku T. and Leta S., 2016; Girmaye B., 2014; Asfaw *et al*., 2013; Fisseha I. and Olson, 2004; Amare H., 2007; Yirgaalem *et al*., 2012; Birhane and Fisseha, 2019; Teklay and Abraha, 2018; Minbale et al., 2015; Desta et al., 2017 Desta et al., 2017)

In vegetables irrigated peri-urban areas of Adama, the maximum average concentration of Pb was detected in Lettuce, and Swiss chard that was 0.59, and 0.57 mg/kg respectively. However, in vegetables irrigated by the Akaki River in peri-urban areas of Addis Ababa town, the maximum lead concentration was detected in Cabbage, Swiss chard, and Lettuce that was 2.5, 1.69, and 1.19 mg/kg respectively. In all vegetables, the Pb concentrations on the samples analyzed exceeded the permissible limit of 0.3 mg/kg dry weight (FAO/WHO, 2001), except Carrot from the irrigation channel of Awash River.

### *Cadmium*

Table 2: Concentration of Cd (mg/kg) in some vegetables under waste water irrigation

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Vegetable type** | **Mean Concentration of Cd (mg/kg)** | |
| 1 | Cabbage | 0.23 | 0.04 |
| 2 | Carrot | 0.07 | 0.056 |
| 3 | Lettuce | 0.38 | 0.11 |
| 4 | Spinach | 0.26 | 0.09 |
| 5 | Swiss chard | 0.14 | 0.14 |
| Cultivated in | | Peri-urban areas of Adamaa | Peri-urban areas of Addis Ababab |
| \*DET. LIM | | 0.2\* | |

Sources: (\*FAO/WHO, 2001; aEliku T. and Leta S., 2016; Girmaye B., 2014; Asfaw *et al*., 2013; Fisseha I. and Olson, 2004; Amare H., 2007; Yirgaalem *et al*., 2012; Birhane and Fisseha, 2019; Teklay and Abraha, 2018; Desta et al., 2017; Minbale et al., 2015; Minbale et al., 2019)

The average concentration of Cadmium in five different vegetables (Cabbage, Carrot, Lettuce, Spinach, and Swiss chard) from Akaki and Awash Rivers irrigation systems are shown in Table 2. Accordingly, in peri-urban areas of Adama town, the highest average concentration of Cd was recorded in Lettuce, Spinach, and Cabbage that was 0.38, 0.26, and 0.23 mg/kg respectively. However, the Cd ion concentration of Cabbage, Carrot, Lettuce, Spinach, and Swiss chard in peri-urban areas of Addis Ababa was all below the FAO and WHO standards. Generally, from the five vegetables irrigated by Awash and Kality River water which is contaminated with industrial and municipal wastes, the highest concentrations of cadmium that is above the detection limit of FAO and WHO were observed in Lettuce, Spinach, and cabbage irrigated in peri-urban areas of Adama town.

### *Chromium*

Table 3: Concentration of Cr (mg/kg) in some vegetables under waste water irrigation

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Vegetable type** | **Mean Concentration of Cr (mg/kg)** | |
| 1 | Cabbage | 0.71 | 2.65 |
| 2 | Carrot | 0.08 | 1.71 |
| 3 | Lettuce | 2.14 | 3.67 |
| 4 | Spinach | 1.58 | 0.58 |
| 5 | Swiss chard | 0.12 | 1.9 |
| Cultivated **by** | | Peri-urban areas of Adama | Peri-urban areas of Addis Ababa |
| \*DET. LIM | | 2.3\* | |

Sources: (\*Weight, 1991; Alemayehu *et al*., 2015; Eliku T. and Leta S., 2016; Girmaye B., 2014; Asfaw *et al*., 2013; Fisseha I. and Olson, 2004; Amare H., 2007; Yirgaalem *et al*., 2012; Birhane and Fisseha, 2019; Teklay and Abraha, 2018; Desta *et al*., 2017; Minbale *et al*., 2015; Minbale *et al*., 2019)

The mean concentration of Chromium in vegetables irrigated in peri-urban areas of Addis Ababa and Adama is given in Table 3. As per the result of reviewed articles revealed in Table 3 the maximum uptake of Cr which is above the recommended level of FAO/WHO (2.3 mg/kg) was recorded in lettuce (3.67 mg/kg) and Cabbage (2.65 mg/kg) cultivated in Akaki River. However, the level of Cr in all the remaining vegetables was below the prescribed safe limit of FAO/WHO.

**Irrigation sites Vs Heavy metal concentration of vegetables**

Based on the result fetched from different articles (Figure 1), the concentration of lead in Cabbage, Lettuce, Spinach, and Swiss chard irrigated in peri-urban areas of Adama; Cabbage, Swiss chard, Lettuce, Carrot, and Spinach irrigated with Akaki River in peri-urban areas of Addis Ababa were confirmed as they are all above the recommended safe limit of FAO/WHO (0.3 mg/kg). However, carrots irrigated in peri-urban areas of Adama were below the recommended level of FAO/WHO. According to the independent sample t-test result, the lead ion concentration of all vegetables cultivated in peri-urban areas of Addis Ababa was significantly higher than that cultivated in peri-urban areas of Adama.

Figure 1: Comparison of Pb ion concentration of vegetables cultivated in different areas

As per the review result indicated in Table 2, the concentration of Cd in Carrot, and Swiss chard irrigated in peri-urban areas of Adama; Cabbage, Carrot, Lettuce, Spinach, and Swiss chard found in sampling locations of Addis Ababa were below the recommended level of FAO/WHO. But, Cabbage, Lettuce, and Spinach irrigated in peri-urban areas of Adama were recorded above the recommended level of FAO/WHO (0.2 mg/kg). The mean comparison result of the independent sample t-test indicated that the cadmium concentration of Cabbage, Lettuce, and Spinach cultivated in peri-urban areas of Adama was significantly higher than that cultivated in peri-urban areas of Addis Ababa. However, there is no significant difference between the mean cadmium ion concentration of Carrot and Swiss chard in the two irrigation sites.

Figure 2: Comparison of Cd ion concentration of vegetables cultivated in different areas

As per the result indicated in Figure 3, the chromium concentration of Lettuce, and Cabbage irrigated with Kality River was above the recommended level of FAO/WHO. However, all other vegetables irrigated in peri-urban areas of Addis Ababa and Adama were below the recommended safe limit of FAO/WHO (2.3 mg/kg). According to the independent sample t-test result, the chromium concentration of all vegetables cultivated in peri-urban areas of Addis Ababa was significantly higher than that cultivated in peri-urban areas of Adama.

Figure 3: Comparison of Cr ion concentration of vegetables cultivated in different areas

## **Daily intake of heavy metal (DIM)**

The FAO/WHO recommends a population dietary intake goal of more than 400 g day-1 for vegetables (FAO/WHO, 2004). Many developed countries have campaigned for promoting the consumption of vegetables, especially in the framework of the International Fruits and Vegetables Alliance (FAO/WHO, 2004; Ganry, 2007). Vegetables are more common in the Ethiopian diet. However, the quantity consumed per person is still one of the lowest (97 g/person/day) compared to the other countries even though the price per kilogram in Ethiopia is the lowest of all countries (Fanos and Derbew, 2015; Ethiopian-Netherlands Horticulture Partnership, 2007). The average body mass of the adult population of Africa is 60.7 kg Sarah *et al*., (2012) and the figure will be compatible with the Ethiopian population as well. Therefore, to calculate the daily intake of heavy metal; the average body mass of the population, vegetable consumption per person per day, and concentration of heavy metal (i.e. Pb, Cd, and Cr) in the vegetable is used.

Table 4: Pb, Cd and Cr concentration in different vegetable types

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | Vegetable Type | Heavy metal concentration (mg/kg) | | | | | | |
| Peri-urban areas of Adama | | | Peri-urban areas of Addis Ababa | | | |
| **Pb** | **Cd** | **Cr** | | **Pb** | **Cd** | **Cr** |
| 1 | Cabbage | 0.31 | 0.23 | 0.71 | | 2.5 | 0.04 | 2.65 |
| 2 | Carrot | 0.18 | 0.07 | 0.08 | | 0.80 | 0.056 | 1.71 |
| 3 | Lettuce | 0.59 | 0.38 | 2.14 | | 1.19 | 0.11 | 3.67 |
| 4 | Spinach | 0.32 | 0.26 | 1.58 | | 0.53 | 0.09 | 0.58 |
| 5 | Swiss chard | 0.57 | 0.14 | 0.12 | | 1.69 | 0.14 | 1.9 |

Then the daily intake of heavy metals through the consumption of the vegetables tested was calculated according to the given equation (Cui *et al*., 2004, Khan, 2013).

Where,

Cmetal = heavy metal concentration in plants

Dfood intake = daily intake of vegetable

Baverage weight = average body weight

Table 5: daily intake of heavy metals through consumption of vegetable

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | Vegetable Type | Daily intake (-1) | | | | | | |
| Peri-urban areas of Adama | | | Peri-urban areas of Addis Ababa | | | |
| **Pb** | **Cd** | **Cr** | | **Pb** | **Cd** | **Cr** |
| 1 | Cabbage | 0.49 | 0.37 | 1.13 | | 4.00 | 0.06 | 4.23 |
| 2 | Carrot | 0.29 | 0.11 | 0.13 | | 1.28 | 0.09 | 2.73 |
| 3 | Lettuce | 0.94 | 0.61 | 3.42 | | 1.90 | 0.18 | 5.86 |
| 4 | Spinach | 0.51 | 0.41 | 2.52 | | 0.85 | 0.14 | 0.93 |
| 5 | Swiss chard | 0.91 | 0.22 | 0.19 | | 2.70 | 0.22 | 3.04 |
| PTDI |  | 214\* | 60\* | 25\*\* | | 214\* | 60\* | 25\*\* |

(\*FAO/WHO, 1999; \*\*IOM, 2001)

Therefore as indicated in Table 5, by considering 97 g/person/day as the average consumption of edible vegetables, 60.7 kg as average body mass of adult Ethiopian population, and average concentration of heavy metals in vegetables irrigated in peri-urban areas of Adama and Addis Ababa; the study showed that the daily intake level of Pb, Cd, and Cr by the consumptions of Cabbage, Carrot, Lettuce, Spinach, and Swiss chard.

From the estimated daily intake of the studied heavy metals through the consumption of the test vegetables, it can be suggested that the consumption of average amounts of these contaminated vegetables does not pose a health risk for the consumers as the values obtained are below the provisional tolerable daily intakes (PTDIs) (Table 5) set by Joint FAO/WHO Expert Committee on food additives, 1999. However, if the consumption of vegetable increases and consumers having an average body mass of below 60 kg especially for children, the concentration of heavy metals found in the vegetable is sufficient to pose a health risk.

## **Health impact of heavy metals**

### *Toxicological Status of Lead*

Health effects associated with exposure to lead and lead compounds include, but are not limited to neurotoxicity, developmental delays, hypertension, impaired hemoglobin synthesis, and male reproductive impairment. The most sensitive targets for lead toxicity are the developing nervous system, the hematological and cardiovascular systems, and the kidney. However, due to the multi-modes of action of lead in biological systems, lead could potentially affect any system or organs in the body. The effects of lead exposure have often been related to the blood lead content, which is generally considered to be the most accurate means of assessing exposure.

Overt signs of acute intoxication include dullness, restlessness, irritability, poor attention span, headaches, muscle tremor, abdominal cramps, kidney damage, hallucinations, loss of memory, and encephalopathy occurring at PbB of 100–120 µg/dL in adults and 80–100 µg/dL in children (ATSDR, 2007). Signs of chronic lead toxicity, including tiredness, sleeplessness, irritability, headaches, joint pain, and gastrointestinal symptoms, may appear in adults at PbB of  
50–80 µg/dL (ATSDR, 2007).

### *Toxicological status of cadmium*

Cadmium is toxic to a wide range of organs and tissues, and a variety of toxicological endpoints (reproductive toxicity, neurotoxicity, carcinogenicity) have been observed in experimental animals and subsequently investigated in human populations (WHO, 1992; Jarup *et al*, 1998; ATSDR, 2008; DEFRA and EA, 2002). Intake by humans of food or drink containing cadmium in concentrations above about 15 mg/kg gives rise to acute gastrointestinal symptoms, including vomiting, diarrhea, and abdominal cramps (DEFRA and EA, 2002). However, adverse effects on kidneys as a result of low-level long-term exposure to cadmium are typically considered to be the critical health effect in humans (Jarup *et al*, 1998; FAO/WHO, 2004; WHO, 2004).

Cadmium is efficiently retained in the kidney and liver in the human body, with a very long biological half-life ranging from 10 to 30 years. Even low exposure levels may, in time, cause accumulation, especially in the kidneys. Both the kidneys and liver act as cadmium stores (together storing 50 – 85% of the body burden), with 30–60% being stored in the kidneys; cadmium stored in the liver is gradually released to the kidneys (WHO, 2004).

### *Toxicological status of Chromium*

Chromium occurs most commonly in two valence states trivalent, +3 (III) and hexavalent, +6 (VI). Chromium (III) is the most stable oxidation state and is the form most commonly found in the environment. Chromium (VI) in the environment primarily occurs as the by-product of several industrial processes. Chromium in its trivalent state is an essential element, but at high concentrations, and particularly in its hexavalent state, it is toxic. In humans and animals chromium (III) is an essential nutrient that plays a role in glucose, fat, and protein metabolism through potentiation of the action of insulin (IOM, 2001).

High oral doses (eg, 74–34 mg/kg bw/day (provided as chromium (VI) in drinking water) have been reported to cause reproductive and developmental toxicity in mice, including decreased fetal weight, increased resorption, and increased abnormalities (US EPA, 1998). While the toxicity of chromium (VI) is recognized, several barriers limit the toxicity of chromium. In particular, chromium (VI) is rapidly reduced to chromium (III) after penetration of biological membranes and in the gastric environment. The reduction of chromium (VI) to chromium (III) inside cells may be an important mechanism for the toxicity of chromium compounds (US EPA, 1998). Most hexavalent chromium taken in with food is reduced to chromium (III) in the acid medium of the stomach.

Extensive data on the toxic effects of chromium (VI) resulting from inhalation exposure is available. But, Limited data on the toxicity of chromium VI through the oral exposure route is available.

Generally, nowadays cancer and kidney failure cases are increasing in Ethiopia and the accumulation of above-mentioned heavy metals in the human body is the expected cause of these irreversible health damages. Therefore, to address the problem successfully, it is crucial to study the association between food chain contamination and the existing health problems.

# Conclusion

The main source of pollution of the water body is sewage and irrigation of contaminated water found to contain variable amounts of heavy metals leads to an increase in the concentration of metals in the soil and vegetation. Monitoring of water quality, soil, and the plant is inevitable to prevent potential health hazards of irrigation with sewage-fed water. The mean concentrations of heavy metals in various vegetable species cultivated in peri-urban areas of Adama and Addis Ababa were compared with the standards set for vegetables by FAO & WHO, 2011. Accordingly, Pb and Cd for most of the vegetables and Cr in some vegetables exceeded the FAO & WHO standards in food. From heavy metals recorded above FAO and WHO standard, in peri-urban areas of Adama, the concentration of Pb was high in Lettuce, and Swiss chard compared with the concentrations of Pb in the other vegetables. However, in vegetables irrigated in peri-urban areas of Addis Ababa, the highest lead ion concentration is detected with Cabbage, Swiss chard, and Lettuce. Concerning Cd, the highest concentration was recorded in Lettuce, and Spinach cultivated in the near vicinity of Adama town. However, the highest mean concentration of Cr was found in Lettuce, and Cabbage cultivated by the Akaki River. The FAO/WHO recommends a population dietary intake goal of more than 400 g day-1 for vegetables. However, in Ethiopia, the quantity consumed per person is still one of the lowest (97 g/person/day) as a result the estimated daily intake of the studied heavy metals through the consumption of the test vegetables obtained is below the provisional tolerable daily intakes (PTDIs) set by Joint FAO/WHO Expert Committee on food additives, 1999 and it can be suggested that the consumption of average amounts of these contaminated vegetables does not pose a health risk for the consumers. But, if the consumption of vegetable increases and for consumers having an average body mass below 60 kg especially for children, the concentration of heavy metals found in the vegetable is sufficient to pose a health risk. Therefore, it is imperative to focus on the quality of wastewater released from industrial activities to the river channels and regularly check the heavy metal concentration of vegetables cultivated in peri-urban areas.

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* 1. Domestic Wastewater Treatment Performance Evaluation and Operational challenges at Kality Wastewater Treatment Plant

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# Abstract

*The present study has been undertaken to evaluate performance efficiency of Kality waste water treatment plant and identify operational challenges. The plant operating on two biological treatment methods Up flow Anaerobic Sludge Blanket (UASB) reactor with trickling filter (TF) with an average wastewater inflow of 65248m3/day. Waste water samples were collected for continuous 30 days from influent and effluent of UASB reactor, TF, SC and raw sew age following standard procedures of wastewater examination for the major water quality parameters, such as biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS) and others as per the plant operation and maintenance manual. Samples for heavy metal and biological analysis were collected biweekly. Both quantitative and qualitative research approach were followed for analysis; primary and secondary data sources were used. The performance efficiency of UASB reactor were higher than 55% removal for BOD5 and COD; monthly average TSS removal rate obtained 63% which is lower than design value of 70%. Similarly, the performance efficiency of TF was higher than 75% and 70% for BOD5 and COD respectively. The overall removal efficiencies obtained are 71 – 90% for BOD5, 69 – 86% for COD, 57 – 90% for TSS. The corresponding effluent concentration are 125mg/L for COD, 61.7mg/L for BOD5 and 86mg/L; effluent quality design limit is 100mg/L for COD and 35mg/L for BOD5 and TSS. The overall performance of the plant achieved the national environmental discharge limit of inland water with the exception to solids i.e Chromium and Magnesium; the effluent quality failed to meet the Kality WWTP design standard of reusing for irrigation. The study also identified major operational challenges of the plant in line with raw sewage variability, required input, maintenance and monitoring operation and maintenance tasks. The obtained results were very much useful in identification and rectification of operational and maintenance problems as well as the future expansion to be carried out inthe plant to meet the increased hydraulic and organic loadings. The Kality WWTP effluent quality needs further investigation on the presence of heavy metals and EPA should have a monitoring mechanism by preparing detail guideline on effluent discharge limit.*

**Key words:** *Up flow anaerobic sludge blanket reactor, trickling filter, BOD5, COD, TSS, performance efficiency*

# Introduction

Economic development and increased population have contributed to the increase in the amount of water used and thus the amount of sewage generated. Thereby, in recent years, the problem of water and wastewater management has become a serious concern of urban centers.The two main purpose of wastewater management systems are, and have been since their development: first, to protect and promote public health, by breaking the cycle of disease, and, later, to provide water quality and ecosystems protection, by controlling the environmental footprint of effluent according to environmental discharge limit(Panepinto et al. 2016).The 2017 edition of the United Nations World Water Development Report, entitled “Wastewater: The Untapped Resource”, demonstrates how improved wastewater management key in achieving the 2030 Agenda for Sustainable Development.In the face of ever-growing demand, wastewater is gaining momentum as a reliable alternative source of water, shifting the paradigm of wastewater management from ‘treatment and disposal’ to ‘reuse, recycle and resource recovery’.

The national urban wastewater management strategyoutlined the need of decentralized, cost-effective noble technologies with effluent reuse principle that fit the specific urban context of Ethiopia (MWIE, 2017). As part of this initiative, Addis Ababa Water and Sewerage Authority (AAWSA) upgraded the Kality waste stabilization pond that had design capacity of 7500m3/day to Upflow Anearobic Sludge Blanket reactor (UASB) with Trickling Filter (TF) with maximum treatment capacity of 100000m3/day. At Kality WWTP the treated effluent quality designed to fulfill irrigation use though the biogas is flared without any energy recovery,

UASB reactor is, widely applied anaerobic wastewater treatment technology,proved with higher performance and efficiencies due to its economy of process, energy production, high performance in high hydraulic and organic loading condition, simplicity, flexibility compared to aerobic ones(Seghezzo, 2004)

Evaluation on performance of treatment plants is required to assess the existing effluent quality and/or to meet treatment requirements (Sekhar et al. 2014). The efficiency of sewage treatment plants can be evaluated by measuring the concentration of pollutant in the influent and effluent (Metcalf and Eddy, 2003).

A WWTP operation and maintenance manual should provide system operators with comprehensive guidance, procedures, and the necessary technical references to efficiently operate their facility. Domestic wastewater treatment plant assessment helps to evaluate and improve the accuracy and completeness of the plant’s operation and maintenance procedures ( NJDEP, New Jersey Department of Environmental, 2016).

Kality WWTP has a combination of UASB reactor and TF with SCADA (supervisory control and data acquisition) system for automatic control of operation and maintenance of treatment processes at local level. China Gezhouba Group Co. Ltd. (CGGC) has been managing the operation and maintenance since February, 2020 following operational challenges faced by AAWSA. Currently, there is no mechanism to validate the monthly operational and maintenance report prepared by CGGC. Since the technology is new to Ethiopia, there is no local experience to learn from other than international. This research will fill this gap by evaluating the operational efficiency of each treatment units and later the overall scheme performance. Furthermore, the study will evaluate the compliance of effluent quality to meet treatment requirement and national discharge limit.

The Kality WWTP has faced various operational challenges due to illegal connection from factories and industries and rain water intrusion to the sewer network which affect the performance of treatment processes. Hence, the overall performance of WWTP will decline unless corrective measures taken. Therefore, overall evaluation of kality WWTP helps to improve the operation and maintenance procedures.

## **UASB Reactor Process and Performance**

The up flow anaerobic sludge blanket reactor (UASB) is commonly a single tank process. Wastewater enters the reactor from the bottom, and flows upward. A suspended sludge blanket filters and treats the wastewater as the wastewater flows through it (Lettiga et al., 1983). UASB reactor perform biological treatment with production of methane (however, hydrogen can also be a process product) and biomass through basic mechanisms involving a sequence of steps (hydrolysis, acidogenesis, acetogenesis and methanogenesis) in the absence of oxygen(Kalyuzhnyi et al. 1996). UASB reactor is a well-established process for large-scale industrial wastewater treatment and high organic loading rates up to 10 kg BOD/m3 /d, its application to domestic sewage is still relatively new; it need to be operated and maintained by professionals (Tilley et al., 2014).The UASB reactors need post treatment in order to improve the quality of effluent in accordance with the irrigation standards using conventional process like maturation ponds, waste stabilization ponds, polishing ponds, constructed wetlands, rotating biological contactors, moving bed biofilm reactor, downflow hanging sponge (DHS) (Tawfik et al. 2010), and advanced oxidative processes (Daud et al. 2018).

Experimental study has shown the feasibility of using UASB reactor to treat domestic sewage in tropical area (Lettiga et al. (1983). Performance of full scale UASB reactors for domestic sewage treatment in India when followed by conventional aerobic processes, failed to comply with required effluent standards, while UASB reactor, followed by a DHS system shown higher performance with final effluent concentration of 20mg BOD5/L, 50mgCOD/L and 20mg TSS/L (Hasan et., 2019)

## **Trickling Filters Process and Performance**

A trickling filter consists of a rotating distribution arm that sprays and evenly distributes liquid wastewater over a circular bed of fist-sized rocks, other coarse materials, or synthetic media. The spaces between the media allow air to circulate easily so that aerobic conditions can be maintained. The spaces also allow wastewater to trickle down through, around, and over the media. A layer of biological slime that absorbs and consumes the wastes trickling through the bed covers the media material. The organisms aerobically decompose the solids and produce more organisms and stable wastes that either become part of the slime or are discharged back into the wastewater flowing over the media (Spellman, 2003). The overall performance of the trickling filter is dependent on hydraulic and organic loading, temperature, and recirculation.

Performance of pilot scale TF on domestic wastewater treatment indicated an average percentage reduction of 52–72%, 51–73%, 61–81%, and 74–89% for BOD5, COD, TDS, and TSS, respectively, for the dry season (Rehman et al., 2021). Using cotton stick as filter media in TF used for domestic sewage treatment; the removal efficiency for BOD was 69-78% and for COD as 65-80%. The solids removal in TF system was 38-56% for TSS and 20-36% for TDS (Aslam et al., 2017).

## **Environmental Regulation for Wastewater Treatment Plant in Ethiopia**

Management of municipal waste is one of the priority objectives of environmental pollution control in Ethiopia, as ratified in the environmental pollution control proclamation No. 300/2002. Hence, all urban administrations shall ensure the collection, transportation, and, as appropriate, the recycling, treatment or safe disposal of municipal waste through the institution of an integrated municipal waste management system. In Addis Ababa, the authority formulated Standards for the discharge of effluents into inland waters (EPA and UNIDO, 2003).

# Objective

The general objective of this study is to evaluate the performance (operational efficiency) of the Kality Wastewater Treatment Plant in Addis Ababa city using standard wastewater quality parameters of influent, treatment processes and effluent using standard laboratory test and also to identify operation related challenges. The specific objectives of the current study are to:

1. Characterize raw sewage of Kality WWTP;
2. Determine overall performance of Kality WWTP;
3. Assess effluent quality compliance to inland discharge limit and
4. Examine operational challenges of Kality WWTP

# Methodology

## **Description of Kality wastewater treatment plant**

Kality WWTP was designed and constructed in order to treat a maximum daily sewage amount of 100,000m3(AAWSA, 2017); the average sewage flow of 75,000 m3/d,BOD concentration of 470mg/l, COD = 2BOD typical ratio for domestic sewage, NH3 45mg/l and TSS 600mg/l at 20oC considered. These pollution loads include the trunk sewers as well as the trucked wastewater having an average flow of 700m3/d. Accordingly, the wastewater treatment plant serves a population equivalent of 587,500.

The influent wastewater (trunk sewer and septic truck sewer) is treated in the pre-treatment units for the removal of coarse and fine materials. Pre-Treatment Units include Coarse Screens, Perforated Screens and Grit and Grease Removal Tanks.The main treatment of the wastewater consists of Upflow Anaerobic Sludge Blanket Reactors (UASB) and Trickling Filters (TF). The UASB unit contains 20 UASB reactor cells, grouped in (four (4) lines of five (5) UASB reactors cells each. The trickling filter has a rotary distributor with a plastic UV resistant coated filter media that has a forced ventilation system.The separation of the liquid phase of the treated wastewater from solid phase (sludge) is accomplished in Secondary Clarifiers (SC).In the two biological treatment stages (UASB and TF/SC) the carbonaceous organic load is removed by more than 90% (in total). The excess sludge from the TF/SC system is recirculated to the inlet of the UASBs.The treated effluent from the SC is finally disinfected for pathogen removal according to the final effluent requirements for irrigation (AAWSA, 2017).

## **Sampling Location and Variables**

As depicted in Figure 1 below, parameters considered in this study were operational and monitoring parameters of Kality WWTP treatment units; included Chemical oxygen demand (COD), Biological oxygen demand (BOD), total suspended solids (TSS), Volatile suspended solids (VSS), total nitrogen, Nitrate (NO3- ), Nitrite (NO2- ) ammonium –nitrogen (NH4-N), total phosphorous, Sulphate (SO42+) E.Coli , helminth Eggs and heavy metals.The sampling and sample preservation were based on Standard Methods for the Examination of Water and Wastewater (APHA, 1998) and stored at 4 °C by using Ice box until analysis. Each wastewater sample was designated with date, location, and parameters to be tested and was submitted to laboratory daily for analysis.

## ***Sample Size***

In ths study, samples were collected for 30days. During each day of data collection, samples collected every 2hours at selected sampling location where automatic sampler was not available. At disinfection unit, samples grabbed at the same time of the data collection period. Accordingly, in a given sampling day 12 samples grabs werecollected to prepare the composite sample to represent variation of wastewater flow and characteristic in the measured parameter.

These 12 samples are set of samples grab from every sampling location each day and each set of samples then will be used to prepare the composite sample according to flow proportion. There are 5 sampling location and 30 samples will be taken at one of the sampling locations which will be a total of 150 samples to be tested in the laboratory for selected physio-chemical. One grab sample was taken daily for microbial analysis at the outlet of the disinfection unit with a total of 30 samples.

## **Wastewater Quality Analysis**

The wastewater quality analyses of parameters were measured in accordance to standard method of water and wastewaters (APHA, 1998) refer Appendices II. All samples determinations were done in triplicate homogeneous sample.The laboratory test result presented the mean of triplicate samples with respective standard deviation for all selected wastewater parameters. The data were checked for temporal variability and normality test before applying any statistical analysis method. Test results were examined against the design consideration of existing WWTP facility. Percentage removal of wastewater parameters was computed based on parameters value before and after the designated treatment units. Further the data statistical analyzed using independent t test to compare the mean from secondary source (long term average) with observed monthly data.

## **Method of Data Analysis**

From the laboratory test result, the accuracy of procedures used for wastewater quality parameters validated before any analysis. The results of the data analysis analyzed usingTables;Graphs showing statistical attribute summaries (i.e. percentage, average, maximum, minimum, standard deviations and Pearson’s r correlation) of wastewater quality parameters. One sample T test for normally distributed variable and its counterpart non parametric test (one sample Wilcoxon signed rank test) were used to compare average effluent concentration with standard values i.e the design value and EPA discharge limit.

## **Process Performance Efficiency**

The evaluation of performance efficiency of the plant was undertaken in terms of effluent quality. In wastewater treatment plant, process performance efficiency determined through measuring the concentration of parameter under consideration at influent and effluent from that process. It is expressed in percentage removal of a parameter (Sperling et al., 2020).

# Result and Discussion

## **Sample Characteristics**

## ***Normality test of Major Parameters***

For small sample size (n <50), Shapiro-Wilk test should be used as it has more power to detect the non-normality (Mishra P, 2019); this is the most popular and widely used method. A Shapiro-Wilk’s test (P>.05)(Shapiro &Wilk, 1965; Razali & Wah, 2011) and a visual inspection of their histogram Q-Q plot and box plots showed that the flow data were approximately normally distributed, with a skewness of 1.052 (SE=0.427) and a kurtosis of 1.007 (SE=0.833) (Cramer& Howitt, 2004). Normality test of major wastewater parameter revealed approximate normality by Shapiro-Wilk test indicated (P > 0.05) for COD, BOD5. On the other hand, TSS in most sample ports was not normally distributed.

## ***Pearson’s r Correlation Matrix of Major Parameters***

Pearson product correlation of BOD5 and COD of raw sewage was found to be strongly positive and; statistically significant (*r* = .886, p<.001). This shows that an increase in COD would lead to a higher BOD5 in the sewage sample. Similarly, the linear relationship between COD and TSS was found to be moderately positive and statistically significant (*r* = .593, p < 0.01); an increase in COD would lead to a higher TSS value of sewage. From the analysis flow of raw sewage was found to have moderately negative relationship with COD and TSS parameters; an increase in flow would lead to a lesser COD and TSS parameter. It was also found that TSS parameter was found to have moderately positive relationship with BOD5; an increase in TSS parameter of raw sewage leads to a higher BOD5 parameter.

Table 4‑1 Correlation Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Flow** | **COD** | **BOD5** | **TSS** |
| **COD** | -.391\* |  |  |  |
| **BOD5** | -.168 | .886\*\* |  |  |
| **TSS** | -.319 | .593\*\* | .461\* |  |

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

## **Result and Discussion**

# Raw Sewage Characteristics

Mean daily influent flow to WWTP shows considerable variability over the five months 68,783.3m3/day see Figure 4 – 1. The plant is running below the average design value, 75000m3/day even though the plant attained for few days. Study indicated increased influent flow to the biological treatment plant decreased the retention time and increased the pollutant load in the system (Niku and Schroeder, 1981).

The average daily influent concentration of BOD5, COD and TSS varied and the five months presented in Table 4-2. The influent flow is increasing over time while the BOD and TSS concentration show stability in May. On the other hand, influent COD concentration shows unstable variability though the general trend follows BOD and TSS. UASB reactor is applicable to low strength wastewater (COD > 300mg/l and < 1000mg/l) (Oliveira and Sperling , 2009). The average daily influent BOD5and COD value in April exceeds the design value by 30%. Study indicated variability of influent characteristics affect the performance of treatment units (Kurek et al. , 2018).

Table 4‑2 Raw Sewage Parameters Comparison

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | unit | Design  Value | Daily Value Jan. to April | | | | 30 days |
| Jan. | Feb. | Mar. | Apr. | May 11 to June 9 |
| Maximum flow | m3/day | 100,000 | 68,544 | 77,616 | 74,184 | 78,768 | 70,872 |
| Average flow | m3/day | 75,000 | 62,551 | 69,734.6 | 66,459.9 | 66,754.5 | 65,244.8 |
| Minimum flow | m3/day | 40,000 | 57,576 | 63,072 | 61,440 | 59,136 | 61,080 |
| BOD | mg/l | 470 | 488 | 341 | 427 | 612 | 350 |
| COD | mg/l | 940 | 836 | 600 | 718 | 945 | 594 |
| TSS | mg/l | 600 | 352 | 272 | 267 | 451 | 403 |
| Temperature | oC | 20 | 22.2 | 23.2 | 23.5 | 23.6 | 23.2 |

At Kaliti WWTP, the variability is significantly related to the plant operation below average design capacity as the sewer network is under expansion. Hence it is important to maintain stable flow rates and sewage concentration in the future to ensure stabilized plant performance.

# Operational Efficiency of Kality WWTP

Operational efficiency of Kality WWTP is the aggregated operational efficiency of treatment units. Therefore, operational performance of each treatment unit discussed separately.

### *UASB Reactor*

As illustrated in Figure 4-2 below, 96% of the time (29 out of 30) BOD5 removal efficiency for BOD5exceeded the design value of 55%. Similarly, 90% of the time (27 out of 30) COD removal efficiency of UASB reactor exceeded the design value of 55%. In May 18 and May 19 COD removal efficiency of both COD and BOD5 was below the expected value. From the 30 days test data, influent COD and BOD5 indexes is 0.56 which is normal to meet the nutrient requirements of UASB anaerobic system(CGGC, 2021).

Figure 4‑2Percentage Removal of BOD5 and COD at the UASB Reactor

Pearson product correlation analysis of BOD5 and COD of inflow to UASB was found to be strongly positive and; statistically significant (*r = .856, p < .001*). The COD test can be considered as a means to quickly estimate the BOD5 of a sample (APHA et al. 1998) depending on the correlation coefficient between them. Percentage removal of TSS in the UASB reactor was found below the design standard for 70% of the time (21days out of 30).As shown in Figure 4-2, the maximum of 80% removal of TSS achieved once but the least removal observed was 33%.

Empirical evidences shown the return sludge from TF/SC back to UASB improve the treatment process in terms of percentage removal of BOD, COD and TSS(Pontes et al., 2003); variation in pumping rate of recirculating to UASB reactor were max. of 1416m3/day, min. 1080m3/day and an average of 1250.6m3/day related to performance fluctuation .The UASB reactors do not warrant the removal of remaining organic matter, nutrients, and pathogens that fit for irrigation reuse (Tawfik, 2010); therefore, performance efficiency of the post treatment in TF/SC will be critical to ensure effluent quality standard.

Bivariate regression analysis was performed to tests if COD concentration has significant impact on BOD5 concentration to provide timely intervention. The dependent variable BOD5 was regressed on predicting variable COD to test the hypothesis H1. COD value significantly predicted BOD5, *F (1, 29)=76.252, p< 0.001*. Moreover, the *R2 = .731* depicts that 73.1% of the variance in BOD5 explained by COD concentration of sample from UASB reactor inflow. COD value significantly predicted BOD5, *F (1, 29)=85.2, p< 0.001*. Moreover, the *R2 = .753* depicts that 75.3% of the variance in BOD5 explained by COD concentration of sample from UASB reactor Operational Efficiency of TF/ SC

The design percentage removal of COD of TFwas70%; effluent from TF compared with raw sewage at the inlet as depicted in Figure 4-3.The performance of TF in figure 4-4 reveals the cumulative performance of UASB/TF in removing BOD5measured at TF effluent found very stable and most of the time exceeded the design value of 75%.

Figure 4‑3 Performance Efficiency of TF

Figure 4‑4Percentage Removal of BOD5 by Trickling Filter

The Nitrite (NO2-N) levels exceeding 0.8 mg/l in the secondary clarifier indicates excessive biomass growth or solids accumulation in the filter as observed in Figure4-5 below.The manner in which secondary clarifiers are operated can significantly affect trickling filter performance. Sludge must be removed quickly from the final settling tank before gasification occurs or denitrification causes solids to rise. The sudden drop in TSS in May 24, 26 and 28 was related to sludge discharging.

Figure 4‑5 TSS and Nitrite concentration Comparison at Secondary Clarifier

Study indicated that TF following anaerobic sewage treatment UASB systems without secondary settlers, the typical overall removal efficiencies obtained are 88–97% for BOD5, 80–87% for COD, 78–91% for TSS, and 44–95%; Kality WWTP removal efficiency were also fall in this range. However, the corresponding effluent concentrations were higher than the discharge limit specified in previous studies i.e less than 90 mg/L for COD, less than 40 mg/L for BOD and TSS, and less than 20 mg/L for NH4 + -N.

### *Performance of Disinfection Unit of Kality WWTP*

Performance of the disinfection unit was examined using the microbiological parameters i.e Helminthes eggs and E-coli of the effluent against the design value (AAWSA, 2017). Helminthes eggs counts in the plant effluent should be below 1 and free from E-coli to control health risk during irrigation reuse (Blanca et al. 2017). Biological analysis of effluent sample test revealed that Helminth eggs counts exceeded the design limit of 1 for all 8 biweekly sample tests; the E-coli was not detected in all samples. One - sample T - test was run to assess if the mean Helminthes eggs count of effluent significantly lower than the design value for irrigation reuse. The result revealed that the Helminthes egg amount in effluent significantly higher than the design value (t (8) = 8.632, p < .05).

### *Overall Efficiency of Kality WWTP*

As depicted in Figure 4-6, the effluent BOD5and COD concentration exceeds the design limit of 35mg/l and 100mg/l respectively. The COD removal efficiency of the scheme shows stable performance compared to BOD5 removal. This result reflects the overall operational efficiency of the WWTP generally below the design standard.

During 30 days of analysis, effluent TSS concentration exceeds the design limit 35mg/l which is also reflected in the percentage removal of this parameter considering all process units. Higher percentage of removal required from the scheme for irrigation reuse.

Figure 4‑7 Performance of Kality WWTP in TSS % Removal

Study shown that the typical overall removal efficiencies from similar treatment processes obtained were 88–97% for BOD, 80–87% for COD and 78–91% for TSS. The corresponding effluent concentrations were less than 90 mg/L for COD, less than 40 mg/L for BOD and TSS(Bressan-Ribeiro et al. 2018). In comparison, Kality WWTP overall removal efficiencies were 71 – 90% for BOD, 69 – 86% for COD and 57 – 90% for TSS, the minimum removal efficiency was lower than empirical evidences in all the three parameter. Hence, the average daily effluent quality from Kality WWTP was 125mg/l, >100mg/L for COD, 61.7mg/l for BOD5, >35mg/L for BOD5 and 86mg/l of TSS, > 35mg/l.

One - sample T - test was run to assess if the average BOD5 value of effluent significantly lower than the design value for irrigation reuse. The result revealed that the concentration of BOD5 in the effluent significantly higher than the design value (t (29) = 10.244, p < .01); COD concentration in the effluent significantly higher than the design value (t (29) = 4.445, p < .01)

Table 4‑4*One Sample T - Test Result*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Mean | | Std. Deviation | t | df | Sig. (2-tailed) | Mean Difference | 99% Confidence Interval of the Difference | |
| Lower | Upper |
| BOD5 (mg/l) | | 61.6600 | 14.2548 | 10.2438 | 29.0000 | 0.0000 | 26.6600 | 19.4863 | 33.8337 |
| COD (mg/l) | 125.0967 | | 30.92489 | 4.445 | 29 | 0.000 | 25.09667 | 9.5339 | 40.6595 |
| Note: Test value BOD5 = 35mg/l and COD = 100mg/l | | | | | |  |  |  |  |

A one sample Wilcoxon signed rank test indicated that the median TSS concentration in the effluent (76mg/l, *N* = 30) was significantly higher than the design value 35mg/l, *T* = 465, *z* = 4.784, *P* = .000.

# Compliance of Kality WWTP Effluent Quality to National Discharge Limit

The general effluent quality of Kality WWTP was compared with the national discharge limit set by EPA for inland waters see Table 4 – 4 below. Analysis on basic parameters shows there are cases where the suspended solid concentration exceeds the emission limit. The average amount of Nitrate (as N) found in effluent were very close to the emission limit. Biweekly analysis of metals including some heavy metals indicated chromium having mean value of 3.01mg/l with SD of 1.33 exceeded the emission limit in all samples with exception to one. The other parameters were found within the emission limit set by EPA.

Table 4‑4 Comparison of Kality WWTP Effluent Quality with EPA Discharge Limit

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ***Constituent Group or Parameter*** | | | |  | ***EmissionLimit (mg/l)*** | ***Kality WWTP Effluent mg/l***  ***Mean ± SD*** | |
|  | **Basic Parameters** | |  |  |  |  |  |  | |  |
|  | PH |  |  |  |  | 6 - 9 PH unit |  | 7 - 8 PH unit | |  |
|  | Temperature | |  |  |  | 40 oC |  | 22 - 25 | |  |
|  | Biochemical Oxygen Demand (BOD5) at 20 oC | | | |  | 80 |  | 62 ± 14.3 | |  |
|  | Chemical Oxygen Demand (COD) | | | |  | 250 |  | 125 ± 31 | |  |
|  | Suspended Solids (SS) | | |  |  | 100 |  | 86 ± 39 | |  |
|  | Ammonia (as free ammonia) | | |  |  | 5 |  | 0.049 ± 0.04 | |  |
|  | Nitrate (as N) | |  |  |  | 20 |  | 18.32 ±1.51 | |  |
|  | ***Metal*** |  |  |  |  |  |  |  | |  |
|  | Cadmium (as CD) | |  |  |  | 1 |  | 0.003 ± 0.001 | |  |
|  | Chromium (as total Cr) | | |  |  | 2 |  | 3.01 ± 1.333 | |  |
|  | Copper (as Cu) | |  |  |  | 2 |  | 0.025 ± 0.027 | |  |
|  | Iron (as Fe) | |  |  |  | 10 |  | 4.246 ± 1.273 | |  |
|  | Lead (as Pb) | |  |  |  | 0.5 |  | 0.096 ± 0.036 | |  |
|  | Magnesium (as Mg) | |  |  |  | 100 |  | 106.95 ± 4.267 | |  |
|  | Nickel (as Ni) | |  |  |  | 3 |  | 0.285 ± 0.425 | |  |
|  | Zinc (as Zn) | |  |  |  | 5 |  | 0.099 ± 0.021 | |  |
|  | ***Inorganic Chemicals*** | | |  |  |  |  |  | |  |
|  | Calcium (as Ca) | |  |  |  | 100 |  | 23.069 ± 4.704 | |  |
|  | Sulphate (SO4) | |  |  |  | 1000 |  | 245.7 ± 321.4 | |  |

*Source: Emission limit mg/l taken from EPA and UNIDO 2013*

Since Kality WWTP designed with the aim to reuse effluent for irrigation, the requirement found more stringent than the EPA discharge limit for inland water. Therefore, the effluent from the plant as it is discharged to river complied in terms of basic parameters and inorganic chemicals. The monthly metal analysis shown that Chromium and Magnesium exceeds the discharge limit; others obtained below the limit.

# Operational Challenges of Kality Wastewater Treatment Plant

The Kality WWTP is managed by Chines Company, CGGC, since February 2020. Major operational challenges of the scheme were identified based on prior experience of plant operators, supervisors and laboratory technicians and their current observation.

### *Raw sewage characteristics*

Flow fluctuation is a serious challenge characterized by low flow in dry season having high organic load and difficult to break down sludge properly due to insufficient water quantity; high flow during wet season which flash out the anaerobic microorganisms from reactors and has higher grit amount. In addition to this the runoff washed biofilms in the trickling filter especially during heavy rainfall events.Also, during winter the temperature fluctuation affects the process units associated with low biogas yield from UASB reactor. As a result of poor sewer management, the sewage characteristics sometimes deviate from domestic composition as a result of illegal connection from small factories and industries which in turnaffect the biological treatment process. The scheme is performing below its average flow as the sewer infrastructure under expansion.

### *Input*

For Successful WWTP operation, availability of skill personnel is a key. Training given to employees was not enough and not provided in a continuous base. Most trainingwas focused on general overview than specific to the operation and maintenance routine. The other input required is power frequent interruption disrupt daily plan operation due to absence of dedicated power line and inadequate standby generator. For example, during reconnaissance stage of this study, there was power interruption for a day and the standby generation was not functioning; the WWTP stopped raw sewage inflow and forced to divert to waste stabilization pond. Some laboratory tests performed outside due to limited apparatuses with necessary reagents.Absence of reserve pump/ motors/ generator, heavy oil sensor which the plant didn’t consider during design

### *Maintenance*

In relation to maintenance activity, shortage of spare parts, toolkits and absence of workshops were major challenges whenever there is maintenance required.For example,the bridge mounted at grit removal chamber axis shifted and not working properly.

### *Validation of Operational Report*

Operation and maintenance work at WWTP reported on monthly basis. A comparison was done in May, considering secondary data from Kality WWTP (collected by CGGC in collaboration with AAWSA) and 30 days daily test data. Table 4-5presents the COD and BOD5 removal rates of UASB reactor higher compared to the design rate. However, the actual percentage removal of TSS in the reactor was found below the design standard for 70%. Generally, the actual performance was lower than the reported percentage of BOD5, COD and TSS. The difference lies on the reference inflow considered to UASB which neglect the effect of recirculating sludge. Hence, the actual removal rate overestimated which directly affect feedback to operation and cause excessive load on TF. Following the operational and maintenance guideline should be mandatory to consider the right sample location to evaluate process unit performance.

Table 4‑5 Comparison of UASB Reactor Performance in May, 2021

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Removal Rate May 11- June 9,2021 (Daily)** | **3/ week (CGGC data) May 11- June 9,2021** | **Design removal rate** |
| **COD (mg/L)** | 66% | 71.6% | 55% |
| **BOD (mg/L)** | 73.4% | 82% | 55% |
| **TSS (mg/L)** | 63.4% | 80.9% | 70% |

Similarly, the effluent quality data compared with secondary data and design standard value. Table 4-6depicts two contradicting result on the same parameters. This study validates the operational report result and a considerable difference observed.

Table 4‑6 Comparison of Effluent Quality between CGGC data and 30 days test result

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Design Standard Value** | **CGGC Operation Report of May** | **Removal Rate May 11- June 9,2021 (Daily)** | **Reach standard or not** |
| **COD (mg/L)** | < 100 | 60.11 | 125.1 | No |
| **BOD (mg/L)** | < 35 | 6.44 | 61.66 | No |
| **TSS (mg/L)** | < 35 | 10.78 | 85.8 | No |

# 

# Conclusion and Recommendation

## **Conclusion**

The variability both in sewage inflow amount and sewage concentration affected the various treatment processes at Kality WWTP. The plant has also recirculated sludge pumped to UASB from TF/SC to increase organic loading; optimal pumping rate required based on sludge laboratory test result.The COD test can be used to predict BOD5 concentration to inform UASB reactor operation.

The performance efficiency of UASB reactor was higher than 55% removal for BOD5 and COD which exceeded the design value but lower than 70% TSS removal of 63.4%± 12.The monthly average performance of UASB reactor combined with TF in removing BOD5 were 80% and for COD 76%; higher than the design standard of 75% removal for BOD5 and 70% removal for COD with exceptional drop in performance observed in relation to higherNitrite (NO2-N) levels which indicated excessive biomass growth or solids accumulation in the filter.The overall operational efficiencies of the scheme were 71 – 90% for BOD, 69 – 86% for COD and 57 – 90% for TSS, the observed minimum removal efficiency was lower than similar study. Hence, the average daily effluent quality from Kality WWTP was 125mg/l, > 100mg/L for COD, 61.7mg/l for BOD5, > 35mg/L for BOD5 and 86mg/l of TSS, > 35mg/l.

The microbiological analysis result indicated that Helminth eggs count exceeded the design value even though E-coli were not detected during the study. Moreover, this result restricts Kality WWTP effluent from irrigation reuse.

According to our national environmental discharge limit of inland water, the effluent quality for all basic parameters and inorganic chemicals considered in this study found to be within the limit. However, the metal concentration analysis including some heavy metals indicated that the Chromium and Magnesium concentration found higher than the discharge limit. Even though EPA is the responsible organ for monitoring effluent quality from WWTPso far there is no proper monitoring scheme established.

The major operational and maintenance challenge of Kality WWTP related to variability of sewage characteristics both in quantity and quality. During rainy season rainwater intrusion affected the plant performance which limits the preliminary treatment unit performance; dry season low flow affected the biological degradation process. The other challenges were in line with required input for proper plant operation and maintenance i.e skilled personnel, power interruption and malfunction of generator during power outage, laboratory equipment and related reagents, workshop and associated spare parts. Now AAWSA need to establish proper check and balance mechanism on the operational and maintenance work of CGGC and aim to takeover shortly.

## **Recommendation**

The sewer network should be expanded so as to bring the plant operation to average design capacity; proper infrastructure management scheme required to achieve the design standard of treatment processes which explain the overall operational efficiency of the plant.

The performance of UASB reactor and TF/SC need to be optimized to improve the removal rate of solid nutrients. For this, the recirculated sludge from TF/SC back to UASB reactor need to be optimized as the performance of TF decreased with high organic loading; observed typical challenge of Kality WWTP. The optimal pumping rate needs study through regular monitoring of sludge concentration.The microbiological analysis of effluent from the plant indicated that Helminth eggs need to be removed from wastewater and inactivated in sludge using certain treatment processes.

The Kality WWTP effluent quality needs further investigation on the presence of heavy metals. The EPA discharge limit focuses on industrial wastes but with the implementation of various wastewater treatment technologies in Addis Ababa there is a need to prepare detail guideline on effluent discharge limit. AAWSA need to have a staff capacity building plan through knowledge and skill transfer while international company, CGGC running the operation and maintenance task for two main reasons. The first one is to be able to monitor and evaluate the plant as well as the consultant performance the second is to take over the task in near future.

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* 1. Dynamics of Green Spaces and Urban Heat Island Intensity Nexus in Cities of Ethiopia: Implications for Urban Ecosystem Resilience

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# Abstract

*Understanding the dependence of* *thermal environment on the dynamics of the human-induced system is vital for urban ecosystem resilience. However, studies on the impacts of urbanization-induced dynamics on* *the thermal environment in cities of Africa as well as Ethiopia are scanty. In this study, the responses of* *urban heat island (UHI), and regional heat islands (RHIs) evolution to urbanization-induced green spaces dynamics were explored and compared, in selected major cities of Ethiopia in the period 1990-2020. The hybrid geospatial technique and Mono-window algorithm were used for retrieval of data from series of Landsat images using* *ArcGIS. Moreover, spatial regression models (**SRMs) were employed to investigate the spatial dependence of UHI, and RHI on an urbanization induced ecosystem dynamics. The results asserted that within the past three decades, built-up landscapes substantially augmented while ecosystems dominated by urban agriculture and green-blue systems dwindled at a rapid rate in the order of GS loss > GS gain > GS exchange. The spatial patterns of high-temperature areas (RLST more than 2°C) were significantly correlated with an outskirt expansion rate of each city (p<0.05). Due to this, the segregated UHIs were gradually inter-weaved and interacted with each other and forming RHIs between 2010-2020 in all cities. Besides, the SRMs results show water availabilities, evapotranspiration, and health of greenery were significantly influenced the evolution of UHI over the other factors (p<0.01). The sensitivities of LST to urban forest and greenery were on average increased by 1°C in all cities within 1990 to 2020.* *This study showed the RHI cause-processes-effect nexus in rapid agglomerate cities and provided an insight into the existing green space protection, climate adaptation planning, and green city resilience programs.*

**Keywords:** *urbanization, green spaces, SRMs, RHI, thermal environment, resilience*

# Introduction

According to the SDG report, cities in many countries have become epicenters of many challenges including COVID-19 **(**United Nations, 2021). While, 54% of the world’s population lives in urban areas and this proportion is anticipated to reach 66% by 2050 (United Nations, 2014). Along with this, the percentage of the urban population living in slums globally intensified and sub-Saharan Africa (238 million) ranked second which embraces cities in Ethiopia. Conversely, urbanization can greatly influence the urban thermal environment, and impervious surfaces, such as cement, asphalt, huge building, and concrete have gradually augmented and substituted the natural forest and green surfaces. These dynamics affect many things including the composition, structure, and function of the urban ecosystem (Degefu et al., 2021), the energy flow between the land surface and the atmosphere (Kim et al., 2021), ecosystem productivity through energy imbalance and loss of carbon storage , threatens biodiversity (Callaghan et al., 2021) and pollute the air, soil, and hydrology of urban ecosystem (Deng et al., 2021).

Urbanization also changes the climatic system of the cities in different dimensions (Kc et al., 2021). According to United Nations (2021) report, one of the three warmest years in the history of the world was recorded by 2020, which is an average temperature of 1.2°C above the baseline 1850–1900. Moreover, the most common phenomenon that increases the temperature of a city comparative to its fringe is called the “urban heat island (UHI) effect” (Oke, 1995). The principal contributor of UHI is substantially associated with anthropogenic heat sources, which includes the heat emitted from industrial activity, human metabolism, and vehicle exhausts, in addition to the reduction of offset potential urban forest (Kothencz et al., 2017).

Currently, studies have been conducted from different views and scales of UHI causes, patterns, influencing factors, and effects associated with the urbanization and urban agglomeration process. Besides, most of the earlier studies have analysed the relation between LST and single influencing factors; such as biophysical factors (Sannigrahi et al., 2018), built-up indexes (Guha et al., 2018), population density , and night-time light (Li et al., 2021). Conversely, UHI is the result of a combination of several spatial neighbouring and fundamental factors, thus, a single factor analysis coefficient is not accurately manifested the dynamics and UHI effects.

In Ethiopia, there are a few studies, which are spatially limited and focused on single-factor analysis (i.e., NDVI-LST) and failed to disclose the comprehensive influencing factors-UHI nexus and evolutionary scenarios in cities of Ethiopia. To this end, in this study, we mapped, analysed the spatial distribution characteristics of LST, and scrutinized the responses of UHI to urbanization-induced multiple influencing factors in four fast-growing cities of Ethiopia (Addis Ababa, Hawssa, Adama, and Bahar Dar). Thus, the results can help to understand the dynamics of the thermal environment, develop offsetting strategies to mitigate the adverse effects, and promote green city sustainable development. We, therefore, attempted to answer the following research questions:(1) What is the spatial pattern of UHI in each city? (2) What are the relations between influencing factors and UHI, and what is the contribution rate of each factor? (3) Are the spatial regression models (SRMs) more effective than other statistical methods?

# Methodology

## **Study areas**

The study areas fall in one metropolitan (Addis Ababa), and three regional capital cities (Hawassa, Adama, and Bahir Dar) of Ethiopia (Figure 1). The shapefile of administrative boundaries, obtained from the national statistics agency of the country were used to define the boundaries. The cities were selected based on four main criteria: (i) being the capital and/or regional city, (ii) being the main political, economic, and commercial epicenter of the country (iii) being an active zone of industrialization and rapid urbanization, and (iv) fulfilling the basic classification of urban-rural dichotomy suggested by UN Statistical Commission .

## **Data sources**

In this study, we used Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI thermal infrared images for the retrieval of LST and production of LST maps for representing four time periods of 1990, 2000, 2010, and 2020 respectively. The spatial resolution of the visible and near-infrared bands of Landsat is 30 m, while the spatial resolutions of the thermal infrared bands are 120, 60, and 100 m, for TM, ETM+, and Landsat 8 Thermal Infrared Sensor (TIRS), respectively (<http://earthexplorer.usgs.gov>). Besides, for three decades (1990-2020) LULC dynamics datasets in this study were obtained from (Degefu et al., 2021).

## **Land surface temperature (LST) derived and processing**

LST retrieved was from the thermal infrared band 6 and 10 of the Landsat 5-7 and 8 respective, using the single-channel algorithm (Figure 2). This method has been widely used to compute LST from the Landsat platform than the split-window technique, and multi-angle method because the single-channel equation is the only method that used one thermal channel (Cai et al., 2019).First, the digital numbers were converted into absolute radiance using Eq 1 . Accordingly, the TOA radiance of the thermal band was transformed into at-sensor brightness temperature using Eq 2 (Li et al., 2016).

Eq 1

where Lλ is the spectral radiance, Lmin and Lmax (mW/ (cm2.sr.µm)) are spectral radiances for each band at digital numbers 0 and 255, respectively. For TM 5, Lmin and Lmax were the values 0.124 and 1.530 in (mW/ (cm2.sr.µm)), respectively.

Eq 1

Eq 2

Where TB is the at-sensor brightness temperature in Kelvin; Lλ equals TOA radiance and K1= 607.76 W/ (m2sr µm) and K2=1260.56 W/ (m2.sr.µm) are pre-launch calibration constants.

The generated brightness temperature values as derived from Eq 3 are then converted to emissivity corrected LST in Kelvin using Eq 2. Furthermore, study areas are heterogeneous areas; thus, it is necessary to consider the emissivity effect (ε) in estimating LST. This study was applied the NDVI threshold method to different land covers of our study areas Eq 4-7 (Deilami & Kamruzzaman, 2017).

Eq 4

Where λ is the wavelength of emitted radiance equals 11.5 µm; α = hc/b (1.438×10^-2 mk); b refers to Boltzman constant as 1.38 × 10^-23 J/K; h is the Planck’s constant 6.626× 10^-34 JS; C refers to the velocity of light 2.998× 10^8 m/s, and ε is the surface emissivity.

Eq 5

= () 2  Eq 6

Eq 7 Where εv =0.985 and εn =0.92 (urban surface) (Li et al., 2018); NDVI max and NDVI min are the values of full vegetation and non-vegetation respectively; Pv is the scaled NDVI/fractional vegetation cover; and F = 0.55, which refers to the shape factor for geometric distribution. To this end, the calculated temperature in Kelvin is then converted into centigrade for ease of interpretation using Eq 8.

Eq 8

where K1 = 607.76 W/(m2 \*sr\*μm), and K2 = 1260.56 K in Landsat TM; K1 = 666.09 W/(m2 \*sr\*μm), and K2 = 1282.71 K in Landsat ETM+; and K1 = 774.89 W/(m2 \*sr\*μm), and K2 = 1321.08 K in Landsat 8 TIRS (Jiang & Lin, 2021).

LST data was normalized (Eq 9), which could remove deviations of the extracted temperature outcomes caused by different imaging times and excavate sympathetic of development patterns of regional thermal temperature evolution (Rousta et al., 2018; Yu et al., 2019).

Eq 9

## **2.4 Extraction and compute remote sensing indexes in cities**

To analyze, the influence of remote sensing indexes on LST dynamics; normalized difference vegetation index (NDVI), normalized difference built-up index (NDBI), and modified normalized difference water index (MNDWI) were computed from surface reflectance to represent urban ecosystem dynamics. Besides, the vegetation index (NDVI) and land surface emissivity (g) are essential to estimate LST when using the Landsat Plank’s curve (Guo et al., 2020) using eq 10-12.

Eq 10

Eq 11

Eq 12

## **Spatial regression analysis**

The spatial regression analysis was applied to study the spatial dependence of LST on influencing factors using the ordinary least squares (OLS) model, spatial lag model (SLM), spatial error model (SEM), and geographically weighted regression (GWR) using Eq. 13 and 14. In this study, the global Moran’s I index was also used to describe the global cluster characteristics of the value of LST using Eq 14. Thus, we verified the applicability of the OLS regression using the variance inflation factor (VIF) and found that VIF was less than 5 suggesting that the OLS regression was appropriate if the value of VIF was less than 5 due to the existence of weak multicollinearity among independent variables. Further, the GWR model was used to study the spatial heterogeneity between remote sensing indexes and LST at the local level and validates features unseen in the OLS regressions by using Eq 15-16. The Moran's I analysis, OLS, and SRMs, were investigated using GeoDa 095i. While the GWR model was analyzed using GWR 4.0 software (Chen et al., 2019).

Eq 14

Where xi and xj are the variable values of units i and j, x¯ is the mean of variable x; and Wij is the spatial weight matrix. The values of Moran’s I range from -1 to 1.

Eq 15

Eq 16

Where, Y is the N-by-1 vector of dependent variables: X is the N-by-M matrix of independent variables (NDVI, NDBI, and MNDWI values and constants) and β is the corresponding regression coefficient matrix. μ and ε are spatially autoregressive error terms and random error terms, respectively. and λ are spatial lag terms and spatial error terms, respectively. W is a spatial weight matrix.

# Results

## **Landscape features dynamics and variation of LST in cities**

Figure 2 shows the growth of the built areas of each city in 1990, 2000, 2010, and 2020. In all the cities, the built area has expanded unceasingly from 1990 to 2020. The built area in Addis Ababa was 12606.9ha, 14564.5ha, 18653.5ha, and 29947.9ha in 1990, 2000, 2010, and 2020, sequentially. Adama was followed in terms of expanded area ratio (Figure 2.b). The built area in Adama was 1723.77ha, 2125.44ha, 2279.16 ha, and 3875.04ha in the years 1990, 2000, 2010, and 2020, respectively. It was augmented by 2151.27ha (19.64%)from the initialstudy period. The built area in Hawassa was 1072.62ha in 1990. The city's fringe zone was increased to 3672.27haby 2020 and overall prolonged by 2599.65ha (15.71%) within the last three decades (Figure 2.c). Besides, the built area coverage of Bahir Dar was 2087.91ha, 2609.73ha, 2966.67ha, and 4803.12ha in the years 1990, 2000, 2010, and 2020, respectively (Figure 2.d). In general, the urbanization of Bahir Dar was augmented by 2715.21ha (12.72%) from 1990 to 2020.

Figure 2. Urbanization changes in 1990, 2000, 2010, and 2020 for (a) Addis Ababa, (b) Adama, (c) Hawassa, and (d) Bahir Dar

The mean LST for 2020 was the highest in Hawassa (36.6 °C), while it was the lowest in Addis Abeba (26.14 °C) in 1990. Furthermore, between 1990 and 2020, the LST difference (UHI) between UGS and urban areas increased from 2.06-2.87°C in Addis Abeba, 2.29–6.35°C in Adama, 0.95–5.28°C in Bahir Dar, and 4.5–4.98°C in Hawassa (Figure 3-4). In the present study, regional heat island (RHI) was defined and quantified as ecosystem types that exhibited RLST > 2°C and RHI intensity has been grouped into 5 levels (Table 2). The analysis shows that the area with RLST more than 2°C was gradually increasing from 1990 to 2020 and significantly increased from 2010 - 2020 in all cities and the connectivity of RHI has begun to upsurge substantially and isolated urban heat islands have progressively merged (Table 2). Thus, it may be elucidating that due to the substantial amount of Green space transformed to build up ecosystem and the intensity of RHI increased.

Additionally, figure 4 shows that, since 2010, the intensity of RHI has started to rise from the core area to all directions (Addis Ababa), and towards the north-west- south (Hawassa City), scale up to in two fractured parts in Bahir Dar and expanded to the east and south-west fringe area of Adama city. However, RHI in the Adama city was meaningfully increased, particularly in areas that show low RLST in 2010. This may be due to the implementation of the new urban built program of the government conversed of Greenspaceto a built-up ecosystem near and around peripheral part of cities legally and illegally and the process of fast economic growth and urbanization. From 2010 to 2020, RHI in each city continued to expand. on the other hand, urban forest and greenery and water ecosystem types experienced a low RHI effect which means that these land uses are alleviated to RHI.

Table 2: Area Coverage (in Ha) under different RLST category

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HW | RLST<0 | 0<RLST≤2 | 2<RLST≤4 | 4<RLST≤9 | RLST>9 | AA | RLST<0 | 0<RLST≤2 | 2<RLST≤4 | 4<RLST≤9 | RLST>9 |
| 1990 | 6771.24 | 2286.81 | 3623.72 | 3863.02 | 0 |  | 22475.16 | 25274.25 | 5063.94 | 1105.74 |  |
| 2000 | 7670.52 | 3724.74 | 3886.74 | 1262.79 | 0 |  | 20691.9 | 13468.41 | 18232.92 | 1535.86 |  |
| 2010 | 7196.05 | 3526.65 | 2752.65 | 2631.52 | 438.11 |  | 20308.77 | 24332.31 | 7854.12 | 1301.89 | 122 |
| 2020 | 7922.7 | 5372.01 | 1861.92 | 867.42 | 520.74 |  | 19896.57 | 12408.66 | 18497.7 | 2500 | 616.16 |
| AD | RLST<0 | 0<RLST≤2 | 2<RLST≤4 | 4<RLST≤9 | RLST>9 | BD | RLST<0 | 0<RLST≤2 | 2<RLST≤4 | 4<RLST≤9 | RLST>9 |
| 1990 | 2693.61 | 5031.63 | 2586.41 | 641.26 | 0 |  | 6636.87 | 9863.01 | 4289.4 | 554.58 | 0 |
| 2000 | 3840.21 | 2367.45 | 3117.95 | 1628.30 | 0 |  | 7907.4 | 4540.68 | 5445.27 | 2690.82 | 759.69 |
| 2010 | 2979.45 | 1960.74 | 2693.88 | 2492.19 | 826.65 |  | 6331.77 | 7517.88 | 6253.65 | 1020.56 | 220 |
| 2020 | 4180.23 | 3099.78 | 1597.32 | 1374.3 | 701.28 |  | 4026.6 | 6417.09 | 2786.67 | 3275.46 | 4838.04 |

## 

## **Spatiotemporal characteristics of LST and remote sensing indexes**

The spatiotemporal features of the LST in each city are revealed in Figure 5. While the LST values were not strictly analogous across cities, since each city varies in terms of spatial extent and development endeavors, Thus, the general characteristics of LST would show the synoptical patterns of the cities. Bahir Dar had a three-decade mean LST range of 28.28-34.52 °C, Addis Ababa had a range of 26.07-29.01 °C, Hawassa had a range of 25.02-28.84 °C, and Adama had a range of 28.24-32.88 °C (Figure 5).The frequency distributions of LST were slightly left-skewed in each of the four cities. The frequency distributions of NDVI, MNDWI, and NDBI values were right- and left-skewed, respectively, for all four cities. However, NDVI and NDBI values were significantly different among the cities. The mean value range of NDVI in Bahir Dar (-0.19-0.20), Addis Ababa (-0.18-0.14), Hawassa (0.04-0.27), and Adama (-0.20-0.16). While the mean NDBI varied within the range in Bahir Dar (-0.076), Addis Ababa (0.01-0.23), Hawassa (-0.06-0.23), and Adama (0.06-0.27). In addition, the mean modified normalized difference water index (MNDWI) result shows a negative value in all years for each city.

By 2000, the spatial distribution of the high-temperature zone in Addis Ababa had declined and was spotted in the southwest part of the city. While middle-temperature regions in HW and AA had a regular pattern, their coverage areas were increased significantly. By contrast, the area of middle-temperature regions decreased, in BD and AD. Besides, in all cities, the spatial pattern of the low-temperature regions was stable and mainly covered water bodies, urban forests, and greenery landscapes. In 2010, the low and high-temperature spatial zones of Bahir Dar were increased by 800.07ha and 586.98ha from 1990, respectively, parallelly with a reduction of the middle-temperature areas. On the other hand, the low and middle-temperature zones of Hawassa and Adama cities were increased from past decades, while the high-temperature zone was significantly decreased from 1990 and 2000 coverage, respectively. In Addis Ababa, the areas that cover the middle-temperature regions are relatively decreased, whereas the low-high temperature zones are amplitude by 1027.26ha and 3774.42ha in that order. Furthermore, the proportions of high-temperature regions in Addis Ababa have significantly increased by 3774.42ha since 2000, and the spatial distribution has shifted to the northeast and southeast parts of the city. While in Adama, the coverage of high-temperature regions increased with time and changed the spatial pattern to the north and northeast direction.

## By 2020, the spatial distribution of LST will have significantly changed in all cities.  The proportion of high-temperature regions in Addis Abeba has decreased by 2773ha since 2010, with the spatial concentration concentrated in the city's northeast and southeast.Similarly, the area of low-temperature regions decreased. By contrast, middle-temperature regions had increased. The distribution of high-temperature regions in Bahir Dar was concentrated on the western part of the Abay River (Blue Nile) and spatial coverage was increased by 2168.31ha from 2010. Furthermore, the spatial pattern of low-temperature areas was altered, with water bodies, urban forests, and greenery dominating.

## **Spatial correlation and dependence of LST on remote sensing indexes**

### *Global bivariate Moran's I and spatial regression models*

Table 2 illustrates the global bivariate Moran's I result are positively spatial correlations between LST and NDBI, while negatively correlated with MNDWI and NDVI (all Moran's I values > 0 and p-values 0.001). Moreover, the rate of urban agglomeration causes an upsurge in LST and UHI intensities. Thus, the magnitude of correlation ranged between -0.01 and 0.19, and varied with remote sensing indexes and among cities (Table 4). A positive moderate spatial correlation was found between LST and NDBI (Moran's I: 0.43, 0.31, 0.28 for Adama, followed by that between LST and NDBI (Moran's I: 0.22, 0.19, and 0.18) for Addis Ababa (Table 3).

Table 3: Bivariate Moran's I between LST and remote sensing indexes

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | HW | | |  | AD | | |
| Moran's I | p-value | z-Value |  | Moran's I | p-value | z-Value |
| NDBI | 0.04 | 0.00 | 3.66 |  | 0.10 | 0.001 | 9.59 |
| MNDWI | -0.05 | 0.00 | -4.30 |  | 0.02 | 0.001 | 1.85 |
| NDBVI | -0.02 | 0.00 | -1.57 |  | 0.03 | 0.001 | 3.35 |
|  | BD | | |  | AA | | |
| NDBI | 0.07 | 0.001 | 5.93 |  | 1.76 | 0.001 | 15.04 |
| MNDWI | -0.06 | 0.001 | -5.15 |  | -0.10 | 0.001 | -9.58 |
| NDBVI | -0.04 | 0.001 | -3.89 |  | -0.15 | 0.001 | -13.75 |

### *Multivariate analysis of* *governing factors on LST dynamics*

For analysis, the overall impacts of different factors on LST dynamics were identified and the influential variables on LST in selected cities were standardized. In the meantime, ordinary Least Squares Regression (OLS) analysis was executed on LST with affecting variables in 1990, 2000, 2010, and 2020 for each city. A better determinant coefficient value of the explanatory variable in the OLS analysis shows a substantial influence on LST dynamics. The OLS (SLM or SEM) results indicate that spatial dependence occurs in all regressions (p< 0.01), and the variance inflation factor (VIF) was <5 Hence, there were no multicollinearity problems in the explanatory variables (Table 3). Therefore, the SEM was used for Adama, Bahir Dar, and Hawassa cities, whereas the SLM was selected for Addis Ababa (Table 3). Moreover, OLS regression reveals that the effect of controlling factors on LST is generally small, hence influencing variables mostly affect LST. The dominant governing factors vary among cities. In general, the MNDWI, NDBI, and NDVI coefficient values were significantly (p 0.01) controlling factors on LST dynamics. Besides, the coefficients of concurrently MNDWI were relatively higher for Bahir Dar, Hawassa, and Addis Ababa, but they were relatively lower in Adama. Furthermore, in Adama and Addis Ababa, NDBI has significantly controlled the spatial pattern of LST, and its coefficient in the OLS was 3.1 and 2.06 respectively, followed by NDVI > MNDWI > latitudes > longitude > population density > DEM. While in Hawassa and Bahir Dar, MNDWI was substantially controlled by LST change, and its coefficient was 2.56 and 2.0 and followed the NDVI/NDBI > NDBI/NDVI > latitudes > longitude > population density > DEM pattern, respectively (Table 4). The magnitude and direction of the regression coefficient of the influencing factors changed significantly during urban expansion. However, the direction of the dominant controlling factor on LST significantly did not change. For example, NDBI was the dominant controlling factor on LST for Addis Ababa in 1990, 2010, and 2020, and the coefficient sign was positive, demonstrating the positive effect of NDBI on LST, i.e., LST increased with the expansion of urbanization, except for Addis Ababa in 2000. On the other hand, MNDWI and NDVI were the dominant controlling factors on LST for all cities from 1990–2020, and the sign was negative for all years except Adama in 2020 (MNDWI), indicating the negative effect of the factors on LST dynamics. Besides, the coefficient sign of other factors on LST changed with time but was not significantly correlated (P<0.05) to LST, indicating its minimal influence on LST (Table 4).

Table 4: OLS model of LST- independent variables in different years of selected cities

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| City | Year | Fitting equation of OLS regression | SLM  (W\_Y\_LST) | R2 | SEM  (LAMBDA) | R2 |
| BD | 1990 | LST = 0.18X1-**0.42Xa2**+0.07Xa3+0.3X4-**0.17X5-1.92Xa6-1.58X7**+28.3 | 0.00 | 0.52 | 0.01 | **0.53** |
|  | 2000 | LST = **0.3Xa1-0.53Xa2**+0. 02X3+0.03X4-**0.37X5-2.88X6-2.4Xa7**+31.26 | 0.02 | 0.61 | 0.03 | **0.62** |
|  | 2010 | LST = **0.4X1-0.39X2**+0.02X3+0.3X4-**1.15Xa5-3.07Xa6-2.29Xa7**+34.5 | 0.01 | 0.56 | 0.03 | **0.57** |
|  | 2020 | LST = -0.6X1-**0.76Xa2**+0.6X3+0.3X4+**1.23Xa5-2.1Xa6-1.37Xa7**+32.67 | 0.03 | 0.60 | 0.04 | **0.61** |
| HW | 1990 | LST = 0.06X1+0.8X2+0. 05Xa3-**0. 05Xa4+0.19Xa5-2.05Xa6-2.2Xa7**+25.03 | 0.08 | 0.75 | 0.18 | **0.76** |
|  | 2000 | LST = 0.03X1+0.2X2-0.03Xa3-0.3X4+**0.9Xa5-1.57Xa6-1.45Xa7**-26.7 | 0.04 | 0.67 | 0.10 | **0.68** |
|  | 2010 | LST = 0.02X1-0.01X2-0.01X3-0.04Xa4+**1.59Xa5-1.56Xa6-1.24Xa7**+29.54 | 0.05 | 0.74 | 0.10 | **0.74** |
|  | 2020 | LST = 0.03X1+0.01X2-0.04X3-0.03Xa4-**0.84Xa5-2.56Xa6-2.40Xa7**+28.84 | 0.07 | 0.61 | 0.14 | **0.64** |
| AA | 1990 | LST = 0.47X1-**0.62aX2-0.5Xa3**-0.4X4+**0.17X5-0.86Xa6-0.99Xa7**+26.07 | -0.01 | 0.58 | -0.01 | **0.59** |
|  | 2000 | LST = -0.002X1-0.03X2+0.02X3-0.07X4-**0.09Xa5-1.2Xa6-1.98Xa7**+29.90 | 0.17 | 0.53 | 0.19 | **0.54** |
|  | 2010 | LST = -0.4Xa1+0.57X2-**0.08X3**+0.04Xa4+**0.44Xa5-1.03Xa6-1.76Xa7**+27.65 | 0.21 | **0.61** | 0.22 | 0.60 |
|  | 2020 | LST = -0.01Xa1-0.03X2-0. 07X3-0.04Xa4+**3.1Xa5-1.01Xa6-1.24Xa7**+19.35 | 0.34 | **0.49** | 0.33 | **0.48** |
| AD | 1990 | LST = -0.07X1+**0.63Xa2**+0.18Xa3+0.03X4+**0.12Xa5-0.61Xa6-0.69Xa7**-28.25 | 0.06 | 0.53 | 0.17 | **0.55** |
|  | 2000 | LST = 0.01X1+**0.49Xa2**+0. 6Xa3+0.03X4+**1.8Xa5-0.99Xa6-1.22Xa7**-32.9 | 0.05 | 0.60 | 0.09 | **0.61** |
|  | 2010 | LST = -0.01X1+0.45X2-**0.08X3**+0.03X4+**0.40Xa5-1.56Xa6-1.06Xa7**-29.05 | 0.07 | 0.54 | 0.12 | **0.55** |
|  | 2020 | LST = 0.03X1-**0.24Xa2**+0.04X3+0.03Xa4+**2.06Xa5**-0.23Xa6-**1.16Xa7**+30.79 | 0.13 | 0.39 | 0.14 | **0.40** |

BD: Bahir Dar, HW: Hawassa, AA: Addis Ababa, and AD: Adama

a: The significance of ”a”is that the regression coefficients between LST and influencing factors are higher than 0.5.

### *LST sensitivity to urban remote sensing indexes*

Table 5 shows the sensitivities of LST to remote sensing indexes resulting from OLS regressions. These sensitivities manifested as an increase (+) or decrease (-) in the magnitude of LST with every 0.1 upsurge in given factors, which varied with city and year. For example, in Bahir Dar, LST sensitivities to NDVI increased from -1.37 °C to -2.40 °C; in Hawassa, from -1.56 °C to -2.56 °C; in Addis Abeba, from -0.99 °C to -1.98 °C; and in Adama, from 0.19 °C (not significant) to 0.1.22 °C. LST sensitivities to MNDWI ranged from -1.92 °C to-3.07 °C in Bahir Dar, -1.24 °C to-2.40 °C in Hawassa, -0.99 °C to-1.98 °C in Addis Abeba, and -0.19 °C to-1.22 °C in Adama between 1990 and 2020.It indicated that the small presence of water bodies had an insignificant cooling effect in Addis Ababa and Adama cities, whereas their large presence had a strong cooling effect that could acutely decrease LST, in addition to the offsetting effect of urban forest and greenery found in Bahir Dar and Hawassa (Table 4).

## **Comparison of OLS model and GWR model**

The evaluation of the fitting consequence between the GWR model and the OLS model is shown in Table 5. The GWR analysis confirmed the local impact of NDBI, MNDWI, and NDVI on the dynamics of the LST of each city. Since the analysis of GWR shows the largest R2 and the smallest AIC in the four cities, the goodness of fit of the GWR model was boosted to 0.43, 0.40, 0.62, and 0.55 for Addis Ababa, Adama, Hawassa, and Bahir Dar cities, respectively, from the goodness of fit test fit of the OLS 0.43, 0.40, 0.60, and 0.49 in the earlier order. This means that the GWR was explained by 52% of the LST dynamics on average. while the OLS model explains 48% of LST changes on average. This indicated that the GWR model could better explain LST change at the local level, as the fitting effect for the GWR model was 4% higher than that for the OLS model. Thus, compared with the OLS model, it is reasonable and feasible to use the GWR for analysis of remote sensing indexes and the LST change nexus.

Table 5: Comparison of the fitting effect between the GWR model and OLS model (2020).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | Fitting factors | Bahir Dar | Adama | Addis Ababa | Hawassa |
| GWR | R-Squared | 0.55 | 0.47 | 0.46 | 0.62 |
|  | R2 Adjusted | 0.54 | 0.44 | 0.45 | 0.61 |
|  | Akaike info criterion | 22342.98 | 21291.91 | 22205.14 | 22755.16 |
|  | Schwarz orientation | 22024.40 | 21012.50 | 22129.20 | 22294.5 |
|  | -2 log-likelihood: | 22332.98 | 20954.21 | 22126.96 | 22497.57 |
| OLS | R-Squared | 0.49 | 0.40 | 0.40 | 0.60 |
|  | R2 Adjusted | 0.48 | 0.40 | 0.39 | 0.60 |
|  | Akaike info criterion | 22998.30 | 21986.50 | 22203.10 | 22768.50 |
|  | Schwarz orientation | 23024.40 | 22012.50 | 22229.20 | 22794.50 |
|  | -2 log-likelihood: | -11495.10 | -10989.10 | -11097.20 | -11380.20 |

# Discussion

## **Effects of landscape changes on urban heat island intensities (UHIs)**

Results showed that all the selected four major cities expanded unceasingly from 1990 to 2020. Although, the economic development and population density rate varied substantially among them. For example, Addis Ababa is the only metropolitan in Ethiopia and about a quarter of the urban population in Ethiopia lives in it . scrutinized the spatial patterns of major cities in Ethiopia and found a similar conclusion, that is, urbanization in the major cities of Ethiopia was very rapid. Furthermore, urban agglomerations were meaningfully interrelated with the population growth and rural to urban migration, economic growth, and structural transformation of the major cities of Ethiopia (Dorosh & Thurlow, 2014). According to Degefu et al. (2021), the built-up landscape of major cities of Ethiopia was augmented by 17,341.0 ha (32.2%), 2151.3 ha (19.6%), 2715.2 ha (12.2%), and 2599.7 ha (15.7%) for Addis Ababa, Adama, Bahir Dar, and Hawassa, respectively over the past three periods. Besides, the sensitivity of LST to urbanization-induced landscape change is one of the interesting phenomena in the research era (Chew et al., 2021). Our results also confirmed that the presence of relationships between LST and urbanization-induced influencing factors (Table 7).

Furthermore, high-temperature zones in the cities augmented analogies with this urbanization pattern. The overall expansion of temperature zones also was followed the cities agglomeration from an initially urbanized center to multi-direction outskirt spatial patterns. For example, in 2020, the spatial distribution of High-temperature zones of Addis Ababa, Hawassa, Adama, and Bahir Dar was increased by 3109ha (50%),723ha (23%), 989ha (86%), and 2456ha (66%) from 1990 respectively and resulting in the rapid evolution of the spatial pattern of UHIs.

## **The influences of remote sensing indexes on LST evolution**

The single variable person correlation analysis of LST with the selected seven explanatory variables shows substantial variations of correlations in cities with the time changes (Table 4). Among them, NBDI, MNWDI, and NDVI are consistently affected LST (P<0.05), and the presence of impervious surface augmented against urban forestry and greenery, hence causing a positive sturdier UHI effect (Shiflett et al., 2017; Yanan Wang et al., 2021). Feyisa et al. (2016) showed a positive strong correlation of LST with NDBI, while NDVI indicates a negative relationship (P< 0.05) in Addis Ababa. These finding also shows that built up landscapes in Addis Ababa substantially contributed for evolution UHI effect, whereas urban forest and greenery could regulate the intensity of UHI effect. Sekertekin and Zadbagher (2021) also reported the existence of a strong correlation of NDBI (0.89) with LST and could increase the UHI effect in cities. Thus, rapid urban agglomeration and urban landscapes change (high NDBI) is might be upsurged sensible heat change on the ground (Shahmohamadi et al., 2011), and anthropogenic heat emission (Amberber et al., 2021; Zhang et al., 2011) and the electric consumption of the cities also influenced by LST and NDBI nexus (Kamboj & Ali, 2021) and the strength of UHI evolution (Shahmohamadi et al., 2011).

Further, this study specified that water bodies (MNDWI ) could mitigate UHI intensity by 50% on average (Table 4). The moderated significant negative correlation was found in Hawassa and Bahir Dar, even if it is varied with time changes. The main reason associated with this is the presence of lake Hawassa and Lake Tana has a vital role in the decrease of LST through evapotranspiration of Hawassa and Bahir Dar cities respectively. However, the relative humidity of both cities is slightly higher than in Addis Ababa, which might be led to an increase of moisture content in the atmosphere and warms up the air because water vapor is an efficient atmospheric greenhouse gas (Li et al., 2017). While inconsistency and lowest (negative) correlation of MNDWI and LST were found in Addis Ababa and Adama (Table 4). In addition, it could be significantly affected the quality and quantity of water bodies and positively contributed to change the thermal environment (Yuanyuan Wang et al., 2021). On the other hand, the correlation of LST with other influencing factors is not constantly significant (P< 0.05), and the effect also varied among cities. For example, the relationship between LST and geographical location (latitude and longitude) shows a moderate correlation in Bahir Dar and Hawassa cities positively and negatively respectively. while the contribution of population density and altitude variation to UHI evolution is not significant almost in all cities (Table 4). Conversely, found the contribution of anthropogenic factors on UHI slightly higher than natural drivers in 16 big cities of China.

## Spatial dependence on LST-remote sensing nexus

In this study, multivariate regression analysis on influencing factors on LST found that the interface between spatial dependence on LST varies with urbanization time changes. Overall, the coefficient of OLS analysis in the models might change with time, nonetheless, the sign is constant (i.e., positive or negative effect on LST with time). In contrast, remote sensing indexes (NDBI, MNDWI, and NDVI) became the most dominant influencing factors and significantly determined the spatial distribution of UHI of each city at certain periods (Table 4-5). Moreover, signs of spatial lag model and spatial error model analysis show the influence of the remote sensing indexes on the LST dynamics. On the other hand, the prior studies assessed the dynamics of LST as well as the LST- remote sensing indexes nexus by only using the OLS regression (Yanan Wang et al., 2021). In addition, the error coefficients (LAMBDA) in SEM for Addis Ababa (except in 1990), Adama, Bahir Dar, and Hawassa cities were significantly positive at p < 0.01 in the past three decades, which means that the LST of the cities was positively influenced by neighbouring values. Although the regression coefficients sign of MNDWI and NDVI were negative, the overall OLS equations of each city were similar to the direction of the spatial lag model and spatial error model. shows that the strong positive relations between LST and NDBI. This means that the increasing urbanization significantly contributed to the evolution of urban heat island intensities and the declining offset of urban forest and greenery and water body (Jain et al., 2020).

In this study, we also analyzed the association between LST and seven factors by using the GWR and OLS models for all cities. The OLS model is commonly used to compute the association between LST and influencing factors (Zhu et al., 2020). However, the precision of the model will be reduced when we introduced no significant explanatory independent variables into the model . Thus, we used SLM and SEM models to optimize the fit of the regression equation. The LST was positively spatially correlated with remote sensing index NDBI and negatively related with MNDWI and NDVI as shown by bivariate Global Moran's I. Additionally, on account of spatial autocorrelations, SRMs (SLM and SEM) were found to be more appropriate than OLS regression for assessing the spatial dependence of LST on NDBI, MNDWI, and NDVI. The lag coefficient (W\_ESV) in SLM for Addis Ababa in 1990 was negatively significant (p < 0.01). The error coefficients (LAMBDA) were significantly negative at p < 0.01 in SMEs for Adama, Hawassa, Bahir Dar, and Addis Ababa in the past three decades. The spatial regression results showed that LST dependence on the remote sensing indexes is changing slightly. Besides, in this study, we recognized a spillover (hidden) influence on the LST and remote sensing indexes nexus. Thus, the LST of cities is also affected by other factors in addition to remote sensing indexes. On the other hand, the results and diagnostics of the GWR model that a better predictive power than OLS and SRMs for all selected cities. In addition, the Akaike’s Information Criterion (AIC) value, Schwarz orientation, and -2 log-likelihood which are used to compare the efficiency of models were substantially declined (Table 5-6). Overall, the GWR model generated more reliable results compared to the OLS model across all cities. This finding indicates that local-based models provide more rationale and a realistic relationship between LST and its remote sensing indexes. Such a finding was supported also in earlier studies (Kashki et al., 2021). Besides, GWR is used to detect higher temperature zone where UHI mitigating strategies may need to focus on these factors.

# Conclusions

Urbanization can integrate resources and technology hubs and make life easier. Conversely, it can also cause environmental challenges, for instance, the UHI evolution that can disturb urban ecosystems. Besides, the continuing effects of UHI in rapidly urbanizing cities, further intensified by global climate change, have increased heat stress on the most vulnerable groups of urban residents. We studied the influence of multiple factors on UHI intensity in four major Ethiopian cities located in different climate conditions in the 1990s–2020. Accordingly, Addis Ababa has the most augmented built-up (17,341ha) and the highest evolution rate (578ha/year). The spatial distribution of UHI intensity varied among cities and In 1990, the high-temperature zone was the epicentre of urban core areas. By 2020, high-temperature regions were exacerbated on the outskirts of each city, and the distance between cities disappeared, forming a regional heat island. As time passes, the dominant governing factors in each city change.In general, remote sensing indexes (MNDWI, NDBI, and NDVI) have a significant influence on UHI evolution (p<0.01) followed by geographical location factors (latitudes, longitude, and DEM) and anthropogenic factors (population density)  aligned to time changes. In addition, the following is the impact of landscape pattern on UHI dynamics: built-up > urban agricultural land, > bare land, > urban forest and greenery, > water bodies. This implies that NDVI and MNDWI had a significant role in the UHI intensity adjustment and offset effect. According to the spatial regression model equation of LST in different cities in different years, the coefficient values of the principal governing factors were changed, while their coefficient signs were constant, implying that the effects of these factors on UHI dynamics were also constant and stable. Additionally, on account of spatial autocorrelations, SRMs (SLM and SEM) were found to be more appropriate than OLS regression for assessing the spatial dependence of LST on remote sensing indexes. Besides, the present study recognized that GWR is the better model for analysing the local non-stationarity dependence of LST on dominant influencing factors.

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* 1. Impacts of Climate Variability on Vegetable Production of Urban Farmers of Addis Ababa Metropolitan: Nexus Climate Smart Agriculture Technologies

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***Abstract***

*This study was aimed to examine impacts of climate variability on vegetable production and farmer’s prioritization of climate smart agriculture technologies and identification vulnerable farmers. The study was conducted on vegetable farmers along the little Akaki River in Addis Ababa. Filed data were collected through semi structured survey questioner from 156 respondents which were randomly selected vegetable farmers. Twenty years (1996-2016) climate data were analyzed with qualitative and quantitative descriptive statistics methods. The result of monthly and annual precipitation variability indicated a coefficient of variation (CV) ranging from 23%-73% and 49%-98% respectively. Seasonally CV ranges between 34%-99%, 50%-97% and 20%-84% in Belg and Bega and Kiremt respectively. The result of climate data and respondents perception on local climate variability indicated an increasing trend in temperature and precipitation variability. Vegetable urban farmers perceived that increase in frequency of flood and rain fall (44.9%), drought frequency (13.5%) and temperature (89.7%)) and decreased in the trend of vegetable productivity (86.5%) as the major the impact of climate variability. However changing vegetable variety (31.4%), early planting (26.9%), mixed farming (26.6%), late planting (5.1%), using agro chemicals (4.5%), and agro forestry (1.9%) are the major on-farm climates smart agriculture technologies were identified to adaptation. Shift occupation (37.8%), nonadaptation (36.5%) and non-farm activates (24.4%) were employed by the farmers as off farm adaptation option. In addition, result from vulnerability analysis indicated that absence of direct access to market, inadequate access to weather information, land fragmentation and tenure complications are the major determinants to be vulnerable. Finally, high precipitation and temperature variability affects the vegetable productivity. It is recommended that there should be market for selling vegetable products, accesses of weather information, participatory and, integration of indigenous and modern knowledge on climate variability adaptation should be addressed.***Key words:** *climate smart, climate variability, Impact, urban farmers, vegetable*

# Introduction

Extreme climatic events such as floods and droughts have greater adverse effects on vegetable production (Bita and Gerats, 2013). Moreover, Garrett et al. (2013) reported higher temperatures adversely affect soil moisture, while prolonged droughts and increasing temperatures may help pests and diseases to multiply, thereby, reducing the yield of vegetable crop. The overall effect of climatic variability is the reduction of vegetable growth, yields of crops and reiterate an overall decrease in yields of all the crops mostly maize, groundnut, yam (Deuter, 2008).

The magnitude of the impact of climate variability cannot be underestimated, as it has the propensity to affect the output of most agricultural crops, including vegetables (Lee et al. 2012; Kemausuor et al. 2011; Kotir, 2011). The Fifth Assessment Report of the Intergovernmental Panel on Climate Change has strongly given an indication to the effect that the changing climate is “explicit” and “extraordinary” since the mid-20the century (IPCC, 2014). Climate variability and change are a major threat to food security in many regions of the developing world, which are largely dependent on rain-fed and labor-intensive agricultural production (IPCC, 2001).

The estimated impacts of both historical and future climate change on cereal crop yields in different regions indicate that the yield loss can be up to -35% for rice, -20% for wheat, -50% of sorghum, -13% for barley, and -60% for maize depending on the location, future climate scenarios and projected year (Porter et al., 2014). The urban agriculture contributes a significant role in food supply, employment creation, income generation and environmental management. It is estimated that about 800 million people worldwide are engaged in urban agriculture (UNDP, 2011). It is thought that globally, the urban agriculture produces 15% of all food consumed in urban areas, and that this figure is likely to double within the next 20 years (Porter et al., 2014).

Like other developing countries, Ethiopia is widely considered to be highly vulnerable to future climate change and variability (Conway and Schipper, 2011). According to UNDP (2011) the climate variability in Ethiopia could lead to extreme temperatures and rainfall events, as well as more heavy and extended droughts and floods. Funk et al. (2005) reported that rainfall in Ethiopia is expected to decline in the future and it may also become more irregular. Accordingly, the country is highly dependent on the agricultural sector for income and food security, the erratic monsoon precipitation would adversely affect the lives of the majority of the populations (Haile, 2005).

In Ethiopia, vegetable crops are produced in different agro-ecological zones by commercial as well as smallholder farmers as a source of their income and food season (Deribie, 2015). However, due to perishable and biological nature of the vegetable production process, the vegetable production is a risky practice (Alamerie et al. 2014). Gebremichael et al. (2014) reported, the urban farming is practiced in all 10 sub-cities of Addis Ababa. In the city, the vegetables are produced on more than 300 hectares of land area. There are 6454 vegetable producers and 5765 livestock/dairy owners, with one livestock and 9 vegetable cooperatives in the city (Gebremichael et al. 2014). There are 461 micro- and small-enterprises of farmers, particularly of women, youth and elderly people, engaged in livestock, vegetable and mushroom production. Under the Akaki small scale irrigation scheme, various households have been producing vegetables like lettuce, Swiss charade, carrot, kale, cabbage, potato, cucumber, cauliflower, beans, tomato, pepper and onion along river Akaki. These farmers have supplied about 30% of the vegetable demand of Addis Ababa city. This is done by the farmers even when they face challenges of frequent floods during rainy season (Deribie, 2015).

There are several potential adaptation options to reduce moderate to severe climatic risks in urban agriculture. Adaptation options that sustainably increase productivity, enhance resilience to climatic stresses, and reduce greenhouse gas emissions are known as climate-smart agricultural (CSA) technologies, practices and services (FAO, 2010). Many agricultural practices and technologies such as minimum tillage, different methods of crop establishment, nutrient and irrigation management and residue incorporation can improve crop yields, water and nutrient use efficiency and reduce Greenhouse Gas (GHG) emissions from agricultural activities (Sapkota et al., 2015). Similarly, rainwater harvesting, use of improved seeds, ICT based agro-advisories and crop/livestock insurances can also help farmers to reduce the impact of climate change and variability (Altieri and Nicholls, 2013).

In Ethiopia, urban climate change and variability related studies and documentation of urban vegetable production are very few and have been focused on impacts of climate variability on crop farming system and farmer perceptions about climate variability (Gebrehiwot and van der Veen, 2013). However, there is no study available on the impact of climate variability on vegetable production and climate smart agriculture technologies Addis Ababa city. Hence, the present study is initiated to examine the impacts of climate variability on vegetable production and farmer’sprioritization of climate smart agriculture technologies adaptive strategies along the little Akaki River of Addis Ababa.

# Methodology

## **Description of the Study Area**

This study was conducted in Addis Ababa, Ethiopia urban farms along the Little Akaki River illustrated in figure 1.

**Methods of Data Collection**

The study was required wide range of information with reference to impacts of climate variability on vegetable production, farmers’ perception on climate variability, and adaptation strategies. As stated above, both qualitative and quantitative data were generated using survey questionnaire, secondary data and observation.

The collection of information were made at the individual vegetable farmer household level, at organizational level from subcity urban agricultural office and meteorological agency officers. The researcher were adequately manage and supervise the data collection process and check the quality of the returns to avoid bias and errors on the spot.

***Survey Questionnaire***

Survey questionnaire is one of the most popular data gathering tools and often considered as a heart of survey option, close ended questioners were prepared for vegetable farmers because it would enable to collect data on general backgrounds of the household characteristics and farms, impacts of climate variability on vegetables production and knowledge on climate variability and their adaptive strategies along little Akakai River. Thus, this instrument is found valuable to collect the data from farmers and hence, it will be administered as per schedule.

***The Engagement of the Surveyors***

There were 156 respondents/households who was selected from three Woreda to administer survey questionnaire. Since it is difficult for a single person to collect data from those 156 respondents in given short time, it is crucial to involve field surveyors to collect data. Thus, 3 field surveyors (senior urban agricultural experts and 2 Woreda Developmental Agents (DAs) of Nefasilik Lafto sub-city) were purposively selected. They are purposively selected for the following reasons: (i) for their better expertise on the subject (ii) experience for conducting survey; and (iii) their knowledge about local community including culture and communication.

In addition, during field survey for direct observation and Photographing of the vegetable farm land along the little Akaki Rver, 2 Woreda Developmental Agents (DAs) were purposively selected. The relevance of selecting Woreda Developmental Agents (DAs) to show directions or ways along the river side. The selection criteria were based on their `experience, performance, technical skill and ability to speak local language.

Hence, these field surveyors were given training about the concept of this particular study and data collection methods. Besides, preliminary field visitation and orientation were given before the field surveyors left to collect the data. In all circumstances a monitoring were done in order to ensure reliability of the data.

## **Selection of study sites and informants**

During a reconnaissance survey of the study area, overall information was obtained. Consequently, two sub-cities (Akaki and Nifa Silik Lafto) and four woredas (3, 4, 5 and 6) were purposive selected due to the presence of wider vegetable production practices (observation and discussion with farmers, Woreda and sub-city urban agricultural experts). Yamane (1967) approach was used to determine sample size. After knowing of total urban farmers of the study area. Based on the formula a total of 156 urban farmers was selected for primary data collection. Finally the respondents were randomly selected from purposely identified four woredas.

Where n is the sample size, N is the population size (653), and e is the level of precision (0.05). Exact the sample size of the study was 156 vegetable farmers in the study area.

## **Data analysis**

In this research, both primary data (from vegetable farmers along the little Akaki River) and secondary data (from urban agricultural office of the selected sub-city and National Meteorological Agency) were used as data source. Primary data were collected by using close ended and semi structured interviews, field observation methods (Martin, 1995; Cotton, 1996). Interviews and discussions were conducted in Amharic (the local language) using a checklist of topics. Secondary data on climatic issues of the past 20 years (temperature and rainfall 1996 to 2016) were collected by the National Metrology Agency, other published and unpublished materials and different websites can also be used. The collected data were analysis and summarized by using Statistical Packaging for Social Science (SPSS) version 20 and Microsoft Excel.

# Result and Discussion

## **Socio Demographic Status of the Respondents**

Out of the total respondents (156) of the study area 105 (67.3%) were males and 51 (32.7%) were females. Moreover, 62.2% of the respondent’s age were categorized greater than 41 years. While, only 4.5% were categorized 20-30 years. About 85.3% of the respondents were married, 9.0%, 3.2% and 1.4% were single, divorced and widowed respectively. Therefore, the vegetable production in the little Akaki River is dominated by married farmers and it more sustainably practiced to support their family. This finding agrees with the findings of Soyebo et al. (2005) that agriculture is very much practiced by married people to make ends meet and provide for their children. In addition, 96 (61.5%) of farmers had more than 21 years farming experience, 54 (34.6%) were 11-12 years and 6 (3.8%) of the respondent were experienced for <10 years in the district. Ishaya and Abaje (2008) reported that age is the determinant factor for farmers’ perception of climate change that can target old and experienced farmers because they are better at distinguishing climate change from merely inter-annual varity of weather scenarios.

## **Trend analyses of climatic variables**

### *Trend of temperature variability*

The annual average minimum and maximum temperature record of the study area 230C and 29.90C, respectively. While, the annual average maximum temperature ranging between 25.70C and 320C accordingly, the annual minimum temperature was ranging between 180C and 24.90C in the past two decades is presented in figure 2. This indicated that the existence of the high variability of temperature of the district. The average annual maximum temperature and annual minimum temperature were changed by a factor of 0.157 and 0.071 respectively as per the trend line (figure 2). McSweeney et al. (2008) reported that in Ethiopia the mean annual temperature increased by 1.3°C between 1960 and 2006, at an average rate of 0.28°C per decade.

### *Annual and seasonal rainfall trend and variability*

Total annual rainfall of the study area ranged between 732mm and 1552.3mm. The linear trend shows that the amount of total annual rainfall declining from 1996 to 2016. Annual maximum and minimum precipitation change from the mean average has to be 286.5 mm by -1.014 and 97.80 mm by -1.141changing factors respectively (figure 3).

The average annual precipitation coefficient of variation range of each year was from 49% – 98%. According to W. Hare (2003) CV is used to classify the degree of variability of rainfall events as less (CV < 20), moderate (20 < CV < 30), high (CV > 30), very high CV>40% and CV>70% indicate extremely high inter-annual variability of rainfall. Based on this, five-year interval of annual precipitation coefficient of variation of the study area was summarized table 1.

Table 1. Trends in annual rainfall variability within five-year intervals

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year category | Mean annual rainfall | SD | CV | Degree of variability according to W. Hare (2003) |
| 1996 - 2000 | 102.11 | 83.39 | 83% | Extremely high inter-annual |
| 2001 - 2005 | 96.28 | 64.32 | 68% | Very high inter-annual |
| 2006 - 2010 | 100.57 | 86.93 | 87% | Extremely high inter-annual |
| 2011 - 2016 | 74.07 | 63.83 | 74% | Extremely high inter-annual |

*Seasonal rainfall trends and variability*

Rainfall of Bega season shows that a declining trend by 3.24mm per year over the past two decades (1996-2016). On the other hand Belg and Kiremt rain have a decreasing trend, its amount declined by 2.57 mm and 9.14 mm per year in that order in the period from 1996-2016 (figure 4).

The coefficient of variation (CV) ranging of seasonal rainfall was 34%-99%, 50%-97% and 20%-84% in Belg, Bega and Kiremt seasons respectively in each year-based analysis. This shows that high rainfall variability in all the cases except in Kiremt seasons of the year [1996 (20%), 1999 (24%) and 2007 (29%)]. The highest rainfall variability was observed in Belg season of the past 20 years with coefficient of variation above 60%, followed by the Bega season with coefficient of variation (CV) 50% and above. Moreover, the result of Kiremt season CV (20% - 84%) range indicated that low and very high rainfall variability were occurred in the past two decades. On the other hand, monthly precipitation coefficient of variation (CV) ranging between (23% and 73%). In addition, the five year interval seasonal rainfall coefficient variation shows that in Bega and Belge found in the range between 56%-84.04%, while in Kiremte less than 53%.

Table 2. Trends in seasonal rainfall variability within five year intervals

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Belg seasons | | | Bega seasons | | | Kiremt seasons | | |
| Mean | SD | CV | Mean | SD | CV | Mean | SD | CV |
| 1996 - 2000 | 32.38 | 20.00 | 63% | 58.31 | 43.73 | 81% | 197.18 | 71.85 | 36% |
| 2001 - 2005 | 12.87 | 16.48 | 77% | 68.43 | 58.93 | 87% | 172.76 | 79.44 | 46% |
| 2006 - 2010 | 19.96 | 15.52 | 76% | 53.80 | 31.17 | 67% | 196.93 | 84.31 | 47% |
| 2011 – 2016 | 5.93 | 3.68 | 56% | 35.34 | 35.14 | 69% | 169.20 | 84.09 | 53% |

## **Farmers’ Perception in terms of Temperature and Precipitation variability**

### *Farmers’ Perception on Temperature variability*

Eighty nine present of farmers were perceived an “increase” in temperature, and 0.6% of respondents perceived “no change” in temperature in the past two decades (figure 5). This result is alien with climate data analysis of the past two decades (McSweeney et al. 2008). The reasons for the increase in maximum temperature in the district as perceived by the farmers were partly due to the extent of city expansion coupled with deforestation.

**Farmers’ Perception on Precipitation (rainfall) variability**

Out of the total 156 valid cases 101 (64.7%) of farmers perceived an increase in the precipitation followed by 33 (21.2%) respondents who felt a decrease in the amount of rainfall and 22 (14.1%) of the respondent perceived that there is no change in rainfall amount in the last 20 years. The main evidences of farmers for rainfall variability were the increasing of the frequency of flood, drought and decreasing of surface water availability and irrigation water availability.

**Climate Smart Agriculture Technologies for Adaptation to Climate Variability**

### *On-Farm Adaptation Mechanisms to Climate Variability*

Out of the total 156 valid cases; 49.10% of urban farmers were exercised knowledge smart technology followed 32.10% farmers were adopted nutrient smart technology to offset to the impacts of these shocks as illustrated in table 3.

Table 3 on farm climate smart technology for adaptation to climate variability

|  |  |  |  |
| --- | --- | --- | --- |
| Climate smart technologies | Farmer exercised technologies | Percentage | Total |
| Water smart | Rainwater harvesting | 6.10% | 13.80% |
| Cover Crops Method | 7.80% |
| Nutrient smart | Green manure | 11.00% | 32.10% |
| Inter-cropping / mixed with legumes | 16.60% |
| Agro-chemical | 4.50% |
| Carbon smart | Integrated past management | 1.10% | 3.0% |
| Agroforestry | 1.90% |
| Weather smart | Weather based advisory | 2.20% | 2.20% |
| Vegetation Insurance | 0% |
| Knowledge smart | Improve/ changing variety | 20.60% | 49.10% |
| Late planting | 5.10% |
| Early planting | 18.90% |
| Switching to non-vegetables crops | 4.50% |

### *Off-farm Adaptation Mechanisms of Farmers to Climate Variability*

From the total of respondent 37.8% were exercised shift occupation, 36.5% were ignored the climate variability issue / not practice and 24.4% were adopted climate variability effect by diversification in non-farm activates (figure 6) to tackle climate variability Off-farm.

## **Impacts of Climate variability in vegetable production and farmer’s income**

The impact of climate variability on vegetable productivity was summarized in figure 7. According to urban farmer response the vegetable productivity was affected by frequently happened flood and high rainfall (44.9%), flood (25%) respectively (figure 7). This is due to the landscape and topography of the farm area.

Figure 7. Major effect of climate variability listed by farmers

### 3.5.1 Trend of Productivity of Vegetable in the last 20 years

A total of 86.5% of the respondents was reported that the trend of vegetable productivity was decreased due to the impact of climate variability (figure 8). While 2.6% were reported that no change in productivity and 10.9% were reported increased the productivity of vegetable in the last 20 years respectively. These results also agree with the reports of Kalibbala (2011), he found that climate variability; especially temperature and rainfall variability causes a reduction in vegetable yield. The most commonly produced leafy vegetables in the study area were [kosta (*Beta vulgaris*), Yabshagomen (*Brassica carinata*), slata (*Lactuca sativa*)] that are very sensitive to the climate variability (both temperature and rainfall variations). Moreover, a total of 60.3% of farmers stated that the income earned from vegetable production was decreased. While 39.1% of farmers were reported that there is increasing income from vegetable production and 6% of the respondents stated as no change on income earned from vegetable farming (figure 8).

Figure 8 Trend of the of vegetable productivity and income in the last 20 years respectively

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## ***Vegetable Farmers Vulnerability to climate variability***

According to the survey result, farmers whose land were vulnerable to the impact of climate variability where their farm land topography is sloppy, those having smaller farmland and those who do not have an access to weather information in the district were highly vulnerable. Based on the result, out of the total respondents, 50% of them reported that their land is highly vulnerable to climate variability in terms of flood occurrence, 38.5% indicated that their land is moderately vulnerable and 11.5 % of the respondents reported that their land is not exposed to the climate variability. This finding shows that most of the vegetable farmers in the study area have been having farmland vulnerable to climate variability in general.

On the other hand, 40.4% of the farmers were responded that they have an access to early warning information, 41.7% of them have no access to early warning information and 17.9% of the respondents have no idea about the early warning information. In addition, out of 156 vegetable farmers 59.6% were those who hold sloppy land topography and most vulnerable to climate impacts specifically flooding which occurs in every rainy season compared to those who have owed a flat farm land topography which account 40.4 % of the total respondents.

# Conclusion and Recommendation

## **Conclusions**

The results show that the majority of the farmers has perceived changes in rainfall and experienced the impacts of a changing variability over a period of two decades. The result of monthly and annual CV confirmed that the existing of high rainfall variability with the ranges between (23% and 73%) and (49% and 98%) respectively. Seasonally the highest rainfall variability observed in Belg with CV between 34% and 99%, followed by a Bega CV range of 50% and 97% and in Kiremt season rainfall variability indicated a coefficient of variation ranges between (20% CV and 84% CV). Due to this the vegetable production and the income of farmers have been adversely affected.

The farmers were applied different climate smart agriculture technologies like, knowledge smart (49.0%) nutrient smart technology (32.10%) to offset the impacts of these shocks as on farm adaptive mechanism. While, shift occupation (37.8%), diversify into non-farm activates (24.4%) were used as off farm adaptive mechanism. Based on the result, most of the urban vegetable farmers were vulnerable to climate variability impacts. This is due to farm land topology.

## **Recommendations**

* The city administration and any other concerned body in the city should develop climate smart urban agriculture strategic plan and act on it.
* Land tenure, access to credit, as well as training and extension through services should be considered to improve their adaptive capacity and vegetable productivity of urban farmers
* The establishment of the market will provide an outlet to the farmers to be able to produce more vegetable in the city and the country at large. Again, it will motivate most of the youth to venture into the vegetable market, which will help reduce unemployment among the youth in the area.

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* 1. Impacts of land use land cover and climate changes on hydrology in Muga Watershed, Abay River Basin, Ethiopia

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***Abstract***

*Changes in Land use land cover (LULC) and climate affect watershed hydrology by altering the hydrological process**. This study analyzes the individual and combined effects of LULC and climate change on the hydrological processes in the Muga watershed of the Abay river basin using the Soil and Water Assessment Tool (SWAT) model. The SWAT calibrated and validated based on observed streamflow data. It performed very well with Nash-Sutcliffe Efficiency (NSE) and percent bias (PBIAS) values of 0.79 and 8.2% for calibration, 0.82 and 9.3% for validation, respectively. LULC of 2017 and 2033 showed an overall increase in surface runoff and water production and a reduction in lateral flow, groundwater flow, streamflow, and evapotranspiration, compared to the baseline year (1985). The effect of LULC and climate change on water balance is relatively higher than the impact of LULC change scenario alone, accompanied by an increase of rainfall under RCP 4.5 and 8.5. Due to LULC and climate change, rising surface runoff and decreasing groundwater flow have far-reaching implications for environmental and water resource development. As a result, ecosystems, dams, reservoirs, irrigation canals, and rural livelihoods are negatively affected unless proper integrated landscape management is undertaken.*

**Keywords:** *Climate, Hydrology, Land use/ land cover, SWAT*

**Introduction**

LULC and climate change are the two predominant driving factors that affect water resources (Safriel, 2007). Recently, these threats have become among the most important ecological problems worldwide (Leh et al., 2013; Nkonya et al., 2016).

The potential hydrological impacts of LULC and climate change could lead to unforeseen future water resource crises (Talib & Randhir, 2017). Hence, analysis of the spatiotemporal LULC and climate changes play important roles in water resources management (Mango et al., 2011; Field & Barros, 2014; Afzal & Ragab, 2020; Parry et al., 2007). Climate change has multiple effects on the hydrological cycle, affecting water resources (Swain et al., 2020). Several factors have contributed to major changes in land cover and land use, including population growth, climate variability, and land use policy, which are affecting the hydrological system at both watershed, sub-basin, and regional levels (Bewket, 2003; Legesse et al., 2003; Birhanu et al., 2019).

LULC change, combined with climate change, affects the water resources of the highland areas of Ethiopia (Mango et al., 2011; Setegn et al., 2014). Change in precipitation, temperature, and LULC affects water resources in the form of interception, evapotranspiration, runoff, evaporation, and surface infiltration, thereby affecting the process of watershed hydrology (Bewket & Sterk, 2005).

The influence of climate and LULC change on water availability are exacerbated by a rapidly growing population, putting pressure on water resource availability and adversely affecting nations' agricultural sector and food supplies (Kurukulasuriya & Rosenthal, 2013). Therefore, to adopt and implement adequate water resources management to ensure the sustainable production of water resources, it is important to assess the hydrological response to LULC and climate changes. Moreover, to successfully manage land and water resources and mitigate climate change, it is important to assess the contribution of LULC and climate changes to water resource change.

LULC change affects the hydrological process (Birhanu et al., 2019). Climate change also affects the hydrological process (Bewket & Sterk, 2005; Frankl et al., 2013; Geremew, 2013; Demessie, 2015; Taye et al., 2015) and the management of water resources (Kim & Kaluarachchi, 2009; Jury & Funk, 2013; Schmidt & Zemadim, 2013). Therefore, it is vital to study the impacts of LULC and climate changes on water resource dynamics to provide useful information on sustainable watershed management and land use policies.

In the Abay River basin, water resource is also highly vulnerable to LULC and climate changes (Berihun et al., 2019; Dibaba et al., 2020; Teklay et al., 2021; Woldesenbet et al., 2018). However, most studies focused on the impact of either LULC change (e.g., Andualem & Gebremariam, 2015; Gashaw et al., 2018; Gebrehiwot et al., 2010; Tekleab et al., 2014) or climate change (e.g., Abdo et al., 2009; Dile et al., 2013; Tekleab et al., 2013) on hydrology.

Although several studies have been conducted on the individual and combined impacts of LULC and climate changes on hydrology, there are limited studies on the impact of future LULC and climate change on hydrology, and the context is not yet well understood in the Abay River Basin. Some studies in Ethiopia showed that hydrological processes are more affected by climate change than changes in LULC (e.g., Dibaba et al., 2020; Getachew et al., 2021). Contrary, other studies have found that the impacts of LULC change are more significant than the impacts of climate change (Woldesenbet et al., 2018).

The results of the previous studies did not provide a conclusive impact of LULC and climate change on hydrological processes. The influence of LULC and climate change on natural resources such as soil and hydrology remains a contentious issue and requires further research (Simane et al., 2013; Demessie, 2015). Hence, examining the impact of LULC and climate change on hydrology at a watershed level has a great practical significance (Berihun et al., 2019; Chimdessa et al., 2019; Legesse et al., 2010).

Large-scale irrigation and hydroelectric projects in the Abay river basin are being constructed, including the Grand Ethiopian Renaissance Dam (GERD). This study was conducted in Muga watershed, one of the Abay River Basin tributaries originating from Choke Mountain. The study area and its environs are severely affected by land degradation due to the severity of LULC and climate changes in the area. Moreover, small-scale irrigation projects along the Muga River are currently initiated to improve agricultural productivity and the community's livelihood. However, in the Muga watershed, empirical studies on the impacts of LULC and climate changes on the hydrological process at a local level were not conducted to establish context-specific interventions. Therefore, this study is crucial and necessary for soil and water conservation, land use planning, climate change adaptation, and mitigation interventions. The study also has important implications for the sustainability of local and large-scale water resources development projects and the watershed's management, protection, and rehabilitation from continued degradation, enhancing socio-economic development. The study's main objective was to assess individual and combined impacts of land use/ land cover and climate change on the hydrological process in Muga watershed of the Upper Blue Nile Basin.

**Methodology**

**Study area**

The study watershed, Muga, lies within 10° 05' 00˝ N to 10°43'48˝ N and 37° 49' 12˝ E to 38° 8' 56˝ E (Fig. 1). It is located in the southeastern part of Mount Choke, the Abay River Basin (Teferi et al., 2010). The study watershed covers 705 km2, and the streamflow gauge is located in the middle of the Muga river. As a result, the study area of this study includes the upper section of the watershed (424 km2)that drains into the gauge station. A detailed description of the study area (such as climate, soil, vegetation, LULC, population, and socioeconomics) is published in Belay & Mengistu (2019) and Belay & Mengistu (2021).

**Data inputs**

An integrated method CA-Markov chain, hydrological and climate models were used in this study. LULC and climate change scenarios are considered to assess the effects of LULC and climate change on hydrology in the Muga watershed. The spatial and non-spatial data of the study watershed were published in Belay & Mengistu (2019) and Belay & Mengistu (2021). It was necessary to prepare spatially distributed data to run the SWAT model. Spatial and temporal data, including DEM, soil, land use, meteorological and streamflow data, were used as input for the *SWAT model.*

**The Soil Water Assessment Tool (SWAT)**

The Soil Water Assessment Tool (SWAT) is a physically based and semi-distributed hydrological model developed at the USDA-ARS (Arnold et al., 2012). The model is developed to study small-scale and complex watersheds with varying land use, soil, and slope classes. The SWAT can evaluate the long-term impacts of different land management and climate variability/ change on biomass production, water quality, and sediment and agricultural chemical yields with the capability to study large-scale and complex watersheds for longer (Arnold et al., 2012). It simulates the hydrological cycle daily through water balance for each hydrological response unit (HRU), units with similar soil types, land use, and slope classes (Arnold et al., 2012). The approach for using the Soil and Water Assessment Tool (SWAT) to assess the impacts of LULC and climate change on hydrology is shown in Fig. 2.



**Fig. 2.** Flowchart for LULC and climate change impact assessment using the Soil and Water Assessment Tool (SWAT) in Muga watershed.

**Results and Discussion**

**SWAT Calibration and Validation**

The SWAT model was calibrated over 21 years (1988–2009), and the years from 2010 to 2015 were used for model validation. The model simulations were divided into a warm-up, calibration, and validation. Three years (1985-1987) were used to initialize the model start-up (warm-up period) to minimize the impact of initial conditions on model simulations.

To investigate the sensitivity of the parameter and calibrate the model parameters, an automatic parameter estimation approach, the Sequential Uncertainty Fitting version 2 (SUFI-2) in the SWAT-CUP (SWAT Calibration and Uncertainty Procedures) (Abbaspour et al., 2018), was employed in this study. The observed streamflow data at the gauging station of Muga watershed was used in this SWAT calibration analysis. The SUFI-2 stands out because it accounts for all uncertainty sources within the parameter ranges (Abbaspour et al., 2018). It is widely used (Gebremicael et al., 2013; Dile et al., 2016) due to few required runs to achieve an acceptable result. Calibration is an attempt to improve the model parameter for a particular set of local conditions to reduce the prediction's uncertainty.

A global sensitivity analysis for selected model parameters was implemented. T-statistics and P-Values were used to determine the importance of the relative sensitivity of the parameters. The watershed's global sensitivity analysis results revealed that parameters with more negative and positive T-test values and less than 5% P-values were highly sensitive to streamflow parameters. Initially, thirteen parameters were chosen for this study. Finally, seven sensitive parameters were chosen based on their sensitivity values. The calibrated sensitivity parameters of the SWAT model and the adjusted values obtained are shown in Table 1.

Table 1 contains lists of the most sensitive parameters for streamflow simulation in this study are found. The absolute values of T-stat and P-value were used to rank the sensitive parameters. The T-stat value measures the size of the difference in terms of variability in the sample data. At the same time, the P-value indicates the probability of observing a test statistic at least as large as the one calculated with the assumption that a hypothesis is correct.

**Table 1** List of parameters with fitted values and global sensitivity results for daily flow

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter name | Description | Parameter range | Best sim | Rank | t-stat | P-value |
| A\_CN2.mgt | SCS runoff curve number | 11.23-14.53 | 11.56 | 1 | -23.62 | 0.00 |
| V\_ESCO.hru | Soil evaporation compensation factor | -0.09-0.12 | 0.02 | 2 | 10.46 | 0.00 |
| V\_ALPHA-BF.gw | Base flow alpha factor or recession constant (days) | 0.32-0.51 | 0.42 | 3 | 8.01 | 0.00 |
| R\_\_RCHRG\_DP.gw | Deep aquifer and percolation fraction | -0.25-0.12 | -0.02 | 4 | -3.21 | 0.01 |
| A\_\_GWQMN.gw | Threshold depth of water in the shallow aquifer required for return flow to occur (mm) | 3621.29-3810.43 | 3693.16 | 5 | 2.63 | 0.02 |
| R\_\_GW\_DELAY.gw | Groundwater delay (days) | 0.05-0.64 | 0.07 | 6 | -2.19 | 0.04 |
| V\_\_SURLAG.bsn | Surface runoff lag coefficient | -0.07-0.29 | 0.01 | 7 | 2.18 | 0.05 |

Two commonly used precision statistical measures; The Nash–Sutcliffe efficiency (NSE) (Nash & Sutcliffe, 1970) and the Percentage of Bias (PBIAS), were used to evaluate the performance of the model in this study. The statistical coefficient for performance evaluation shows that the simulation streamflow agrees with the observed, resulting in NSE of 0.79 and 0.82 for calibration and validation, respectively, and percent bias (PBIAS) of 8.2% 9.3%, for calibration and validation, respectively. Thus, the SWAT model has a "very good" performance for the calibration and validation periods, as NSE > 0.5 and PBIAS < + 25% (Moriasi et al., 2007). As a result, the SWAT hydrological model can accurately simulate monthly streamflow with reasonable accuracy.

This analysis considers three conditions: (a) the individual impact of LULC changes on hydrological components, (b) the separate impact of climate change on water balance components, and (c) the combinations of the impact of both on the hydrological components. The simulations were carried out using land uses of 1985, 2002, 2017, and 2033 and two periods of climate change (1985-2017 and 2018-2050).

**Hydrological responses for land use land cover changes in Muga watershed**

The calibrated and validated SWAT model was simulated using the four LULC maps, but all the other SWAT inputs were kept the same in all simulations. This study showed that although changes in LULC lead to increased surface runoff and water yields, a considerable reduction was also observed in streamflow, evapotranspiration, and lateral flow. The mean annual values of water balance components (i.e., mean yearly surface runoff (SURQ), water yield, lateral flow (LQ), groundwater flow (GWQ), and evapotranspiration (ET)) simulated by SWAT under different LULC are given in Table 2. This study showed that the mean monthly streamflow for the rainy season increased from 133.2 mm (1985) to 147.0 mm (2002) and 146.8 mm (2017).

The average monthly streamflow for the dry season has declined from 71.1 mm in 1985 to 43.5 mm in 2002, 48.6 mm in 2017, and predicted 49.0 mm in 2033, whereas the average monthly streamflow for the wet season has increased from 71.1 mm in 1985 to 43.5 mm in 2002, 48.6 mm in 2017, and 49.0 mm in 2033. According to this study, the mean monthly streamflow for the rainy season increased from 133.2 mm in 1985 to 147.0 mm in 2002 and 146.8 mm in 2003. (2017). The average monthly streamflow for the dry season has declined from 71.1 mm in 1985 to 43.5 mm in 2002, 48.6 mm in 2017, and is predicted 49.0 mm in 2033, whereas the average monthly streamflow for the wet season has increased from 71.1 mm in 1985 to 43.5 mm in 2002, 48.6 mm in 2017, and 49.0 mm in 2033.

The average annual streamflow for the LULC 1985, 2002, 2017, and 2033 scenarios is 203.3, 190.5, 195.4, and 198.6 mm, respectively, which revealed that the average annual streamflow decreased significantly during the study period. The decline in mean annual streamflow is due to the expansion of cultivated and urban areas and the loss of forests, shrub-bush, and grasslands. Contrary, surface runoff increased from 190.4 mm in 1985 to 204.6 mm and 220.4 mm in 2002 and 2017, respectively, and is expected to rise to 219.5 mm in 2033. These indicate that an increase in cultivated and urban areas at the expense of forests and shrub-bush lands may be the reason for the increased rate of surface runoff. The results of this study are similar to the previous studies conducted by Gashaw et al. (2018) and Berihun et al. (2019). They reported that surface runoff increased while streamflow was declined due to rapid deforestation of natural forests and expansion of farmland and urban area at the expense of shrub-bushland and grassland.

Groundwater flow was decreased by -4.36% and -9.21% in 2002 and 2017, respectively, and is expected to reduce by 10% in 2033 compared to 1985. Similarly, the average annual ET was decreased from 592.4 mm in 1985 to 580.1 mm in 2002, 583.3 mm in 2017, and expected to be 586.8 mm in 2033, which is 12.3 mm lower in 2002, 9.1 mm lower in 2017, and 5.6 mm lower in 2033 compared to 1985. A possible reason for the decline in the average annual ET is the decline in forests and shrub-bushlands. Similarly, there was a negative trend in the mean annual lateral flow over the Muga watershed, declining by 3.9% in 2002, 8.5% in 2017, and 7.0% in 2033 compared to 1985. According to Ayivi & Jha (2018), a slight decrease in groundwater flow and lateral flow can be attributed to low soil infiltration and high surface runoff.

This study showed that the mean annual water yield increased slightly in 2002 and 2017 in the study watershed compared to 1985. In 2002 and 2017, water yield increased by 2.7 mm and 5.6 mm, respectively, while water yield in the study watershed is expected to increase by 3.8 mm in 2033. The decline of vegetation cover predominantly forest induces an increase in surface runoff and further increases water yield. According to Woldesenbet et al. (2017), the reduction of forest cover leads to higher water yield. Aylward (2005) also reported that water yield was increased with a decline of forest cover, and water yield would increase if forests were cleared.

This study showed that between 1985 and 2017, some parts of forest, grassland, and shrub-bushlands were converted to cultivation and urban, and are expected to continue in the future, which causes a considerable increase in surface runoff and water yield in the Muga watershed. This study shows an agreement with previous studies (Bewket & Sterk, 2005; Shrestha et al., 2018), which reported that the conversion of forested areas to cultivated areas contributed to an increase in surface runoff. The decline of vegetation cover creates less canopy interception, resulting in more rainfall reaching the soil surface (also known as direct rainfall), increasing the potential of infiltration and runoff from the land (Rogger et al., 2017).

This study showed that the mean annual water yield increased slightly by 0.6% in 2002 and 1.2% in 2017 compared to the baseline year, most likely due to the gradual increase in the cultivated land. The increase in surface runoff was due to the decline of forests and shrub-bushlands, leading to higher water yield. The average annual water yield in the future under the LULC change scenario is expected to be almost the same as the baseline period, and it will likely increase by only 0.8%.

The results of this study showed an agreement with other studies (e.g., Bewket & Sterk, 2005; Gebrehiwot et al., 2010; Welde & Gebremariam, 2017) which reported an increase in surface runoff and water yield. For example, Bewket & Sterk (2005) in Chemoga watershed, Abay basin of Ethiopia concluded that forests reduce surface runoff and increase the infiltration and evapotranspiration, while the expansion of agriculture reduces infiltration. Gashaw et al. (2018) also showed that a decrease in groundwater flow and an increase in surface runoff in Andasa watershed in the Abay basin between 1985-2015 were associated with changes in LULC of the watershed. According to Shawul et al. (2019), between 1974 and 2014, an increase in surface runoff and decreased groundwater flow in the upper Awash river basin were associated with LULC change in the basin. Contrary, when agricultural land is plowed, compaction of the lower soil horizons occurs, causing the reduction of infiltration capacity and ultimately more runoff (Jin et al., 2008). In Muga watershed, a rapid change in LULC was observed between 1985 and 2017 due to different proximate and underlying drivers. As a result, the scarcity of land and the need to cultivate more land encouraged the community to cultivate on steep slopes. Cultivation of steep slopes increases, in turn, increases surface runoff and reduces infiltration, affecting water resources availability.

Table 2 Average annual evapotranspiration, surface runoff, groundwater, water yield, and lateral flow change under different LULC scenarios and historical climate data (1985-2018) in the Muga watershed

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | P | STQ (m3/s) | | | | | ET | | | |  | | SURQ | | | | |  | | GWQ |  | | | LQ | | | |  | | WYLD | | | |
| mm | mm | % | Wet | Dry | | | Mm | | | | % | | mm | | % | | | mm | | % | | mm | | | % | | | mm | | | % | |
| 1985 | 1087 | 203.3 |  | 133.2 | | 71.1 | | | 592.4 |  | | | | | 190.4 | |  | | | 208.5 | |  | | | 60.8 | |  | | | | 459.7 | |  |
| 2002 | 1087 | 190.5 | -7.2 | 147.0 | | 43.5 | | | 580.1 | -2.08 | | | | | 204.6 | | 7.46 | | | 199.4 | | -4.36 | | | 58.4 | | -3.9 | | | | 462.4 | | 0.59 |
| 2017 | 1087 | 195.4 | -5.8 | 146.8 | | 48.6 | | | 583.3 | -1.54 | | | | | 220.4 | | 15.76 | | | 189.3 | | -9.21 | | | 55.6 | | -8.55 | | | | 465.3 | | 1.22 |
| 2033 | 1087 | 198.6 | -3.3 | 149.6 | | 49.0 | | | 586.8 | -0.95 | | | | | 219.5 | | 15.28 | | | 187.5 | | -10.0 | | | 56.5 | | -7.07 | | | | 463.5 | | 0.83 |

The surface runoff trend and water yield were inconsistent during the study periods. However, these showed an increasing trend in 2002, 2017, and 2033 compared to 1985. On the other hand, a decline of mean annual streamflow, evapotranspiration, and lateral flow was observed compared to the reference year. According to the study, forest cover had declined historically. As a result, compared to 1985, forest loss will accelerate surface runoff and water yield while decreasing evapotranspiration in the Muga watershed in 2002, 2017, and 2033. The findings of this study were similar to those of previous studies (e.g., Chemura et al., 2020; Ridwansyah et al., 2020), which showed the shift of high evapotranspiration LULC to low evapotranspiration leads to an increment of surface runoff. The reduction in evapotranspiration in 2002, 2017, and 2033 compared to 1985 may be due to the loss of vegetation cover (forests, grasses, and shrub-bush). As a result, surface runoff and water yields are supported.

**Impacts of climate change on hydrology in Muga watershed**

Climate change causes evapotranspiration changes due to increasing radiative forcing, ultimately changing the water cycle system (Field & Barros, 2014). Climatic parameters are expected to increase over Muga watershed in the future, which is reflected in a change of water balance components for the period consists of the years 2018-2050 under RCP4.5 and RCP8.5, as compared with historical climate datasets (1985-2017). The baseline period consists of 1985-2017, and surface runoff was approximately 217.4 mm in the future climate scenario, which is expected to increase to 230.2 mm and 231.5 mm yr-1 under RCP 4.5 RCP 8.5, respectively. This study finding is in line with the study results conducted by Chanapathi & Thatikonda (2020).

In contrast, Dibaba et al. (2020) found that during the years 2021-2050, surface runoff decreased by 7.33% and 12.32% under RCP 4.5 and RCP 8.5, respectively, in the Finchaa catchment, Abay basin of Ethiopia when compared to the baseline period of 1986-2015. The increase in surface runoff directly relates to erosion and sedimentation, affecting erosion and sedimentation. Therefore, the transport capacity of the surface runoff determines the amount of material subject to erosion. Abebe & Gebremariam (2019) reported that reduced surface runoff significantly reduced sediment yield.

This study indicates that average annual rainfall is expected to increase in the 2050s, causing an increase in the amount of streamflow discharge. Similarly, the future temperature is also expected to increase under the RCP 4.5 and 8.5 emission scenarios, which tends to increase ET under simulation LULC 2017 and RCP 4.5 and LULC 2017 and RCP 8.5 compared to historical climate data sets. ET is expected to rise by 10.4% (61.0 mm) under simulation LULC 2017 and RCP 4.5 and 11.3% (66.3 mm) under simulation LULC 2017 and RCP 8.5 compared to historical climate data. Therefore, there is a distinct increase in the prediction of ET given by the climate simulation scenario.

In this study, the expected increase in most hydrologic components is tremendous in the RCP 8.5 simulation scenario than in RCP 4.5. For example, the average projected average annual streamflow will increase by 13.8% and 21.3% under RCP 4.5 and RCP8.5 scenarios, respectively, from the historical baseline period. The average changes in groundwater recharge, surface runoff, lateral flow, and water yield will be 20.1%, 5.9%, 10.4%, 2.5%, and 11.6%, respectively, according to RCP 4.5 with 2017 LULC, compared to the reference period consists of the years 1985-2017. For the same period and the 2017 LULC map, the corresponding increases for RCP 8.5 are 21.4%, 6.5%, 11.3%, 7.0%, and 12.9%. Changes in average annual groundwater recharge, lateral flow, and water yield indicate the effect of trajectories (RCPs) on these hydrological components. The findings of this study are consistent with those of Dile et al. (2013) and Dibaba et al. (2020), who claim that climate change will affect hydrological components and cycle behavior.

Table 3 shows the number of hydrological components under historical LULC 2017 and climate change periods (1985-2017) and (2018-2050). As shown in Table 3, the increasing trend of the study area hydrological components is accompanied by a significant increase in rainfall for RCP 4.5 and RCP 8.5.

Table 3 Hydrological components simulated by SWAT under historical climate data sets (1985-2017) and future climate data (2018-2050) under RCP4.5 and 8.5 using LULC 2017

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Periods | STQ | | ET | | SURQ | | GW | | LQ |  | WYLQ | |
| mm | ∆% | Mm | ∆% | mm | ∆% | mm | ∆% | mm | ∆% | mm | ∆% |
| LULC 2017 & CC 1985-2017 | 193.4 |  | 586.3 |  | 217.4 |  | 190.3 |  | 56.8 |  | 463.3 |  |
| LULC 2017 & RCP 4.5 | 220.1 | 13.8 | 647.3 | 10.4 | 230.2 | 5.9 | 228.6 | 20.1 | 58.2 | 2.5 | 517.0 | 11.6 |
| LULC 2017 & RCP 8.5 | 232.2 | 21.3 | 652.6 | 11.3 | 231.5 | 6.5 | 231.0 | 21.4 | 60.8 | 7.0 | 523.3 | 12.9 |

Note: CC: Climate change; LULC: Land use land cover in 2017

**Combined impacts of land use land cover and climate changes on hydrology**

The water balance of a basin or watershed is an important component of water resource management, affected by many natural and human factors. Changes in these factors can cause an imbalance in the environment, leading to water shortages or flood hazards. Understanding the impacts of LULC and climate change on water resources is significant for water use and distribution and ecological and socio-economic activities (Woldesenbet et al., 2018; Ghodichore et al., 2019). The combined impacts of LULC and climate changes on water resources are evaluated using the climate and hydrological models (e.g., Gadissa et al., 2019; Chanapathi & Thatikonda, 2020; Getahun et al., 2020).

The simulated water balance components under future land use and climate datasets (2018–2050) under RCP 4.5 and 8.5 scenarios were compared with a simulation scenario of LULC 2033 and a climate dataset (1985-2017). LULC was kept constant based on 2017 conditions to examine the impacts of climate change on water balance components. On the other hand, variations of LULC were considered in the SWAT model to compare the individual and combined effects of LULC and climate change. As discussed above, rainfall and temperature variations significantly impact water balance elements such as the increment of evapotranspiration, surface runoff, groundwater flow, lateral flow, water yield, etc.

Table 4 shows the distinct and combined impacts of LULC and climate change on water balance components of the study watershed in the future. The findings revealed that both LULC and climate changes affect the hydrological components of the study area. However, the individual effect of climate played a greater role than LULC.

Compared to the LULC 2017 & CC 1985-2017 simulation, the combined impact of LULC and climate changes is projected to cause the mean annual ET of the study area to increase. The finding of this study indicated that the smallest and highest increase in ET is expected to be under simulation LULC 2033 and RCP 4.5 scenario (10.6%) and LULC 2033 and RCP 8.5 scenario (11.3%), respectively. When the combined impact of future LULC and climate change on ET are compared to the individual impacts of LULC change scenarios (LULC 2033 and CC 1985-2017), temperature and rainfall have a higher impact on future ET than LULC change. The combined effect of changes in LULC and climate is similar to the distinct effect of LULC and climate change, as the effects of the two drivers generally indicate the same direction in ET. However, in future climate change scenarios, ET is slightly higher than simulations under the combined impacts of LULC and climate change scenarios. This implies that LULC and climate change scenarios lead to a considerable increase in ET. The individual and combined effects of LULC and climate change are expected to have nearly equal impacts on ET compared to simulation under LULC 2017 and CC 1985-2017.

The separate and combined effects of LULC and climate change on surface runoff were investigated in this study. As shown in Table 4, the result showed that the average annual surface runoff under simulation LULC 2033 and RCP 8.5 scenario is expected to increase as compared with simulation under LULC 2017 and CC 1985-2017; it is likely to increase by 14.2%. Surface runoff is expected to increase by 10.4% and 9.8% under simulations LULC 2017 and RCP 8.5 and LULC 2033 and RCP 4.5 scenarios, respectively.

Groundwater flow is expected to increase due to the combined effects of LULC and climate change by 20.8% and 22.2% under LULC 2033 and RCP 4.5 and LULC 2033 and RCP 8.5 scenarios, respectively, compared to simulation under LULC 2017 & CC 1985-2018. This study found that climate change had a higher impact on groundwater flow than the LULC change scenario alone. The study also showed a slight effect of LULC alone on groundwater flow, with increased groundwater flow is found in simulations under LULC 2017 and CC RCP 4.5, LULC 2017 and CC RCP 8.5, LULC 2033 and RCP 4.5 and LULC 2033 and CC RCP 8.5 scenarios. However, groundwater flow change under different LULC scenarios was lower than expected. The findings of Pan et al. (2017), Marhaento et al. (2018), and Yan et al. (2016) all came to similar conclusions with the finding of this study. They found that the impact of climate change on groundwater flow would be much higher than the impact of LULC change.

The combined effects of both climate change and LULC change show an increase in water yields in the study area in the future as compared to simulation under LULC 2017 and CC 1985-2017. But there are some differences among the scenarios. The variations in the mean annual total water yield is pronounced for climate change, where the average annual water yield is expected to increase by about 13.8% and 17.2% under scenarios of LULC 2017 and RCP 4.5 and LULC 2017 and RCP 8.5, respectively, which is approximately 2.0% and 5.0% more than under the LULC change scenario alone. The reason can be explained by the increase in precipitation under RCP 4.5 and RCP 8.5. The abundance of water on the soil surface due to excess rainfall makes the water infiltration less likely. Furthermore, surface runoff and base flow increase with increasing infiltration capacity. An increase in surface runoff is expected as surface water does not infiltrate completely.

The lateral flow response to combined future land use and climate change scenario is also evaluated in this study. The simulation results show that under simulations LULC 2033 and RCP 4.5 and LULC 2033 and RCP 8.5 scenarios, the average lateral flow is expected to increase by 3.5% and 9.5%, respectively, compared to simulation under LULC 2017 and CC 1985-2017.

The combined effect of LUCC and climate change was also evaluated by comparing the values of streamflow discharge under future climate and land-use scenarios with simulation values under LULC 2017 and CC 1985-2017. The result showed that the combination of future LULC and climate change scenario considerably affects streamflow discharge compared to LULC 2017 and historical climate datasets. Future rainfall increased by about 20.2% under RCP 8.5, resulting in a corresponding increase of 40.6 mm (21.0%) in streamflow discharge. Similarly, in the context of LULC 2033 and RCP 4.5 scenario, which showed a 17.2% increase in precipitation compared to the historical period, streamflow is expected to increase by 36.4 mm (18.8%). The change in streamflow is about 4.4% and 6.3% higher than the LULC scenario only. The study revealed that the combined effect of future LULC and climate change outperforms the impact of the LULC scenario alone, accompanied by the intensification of rainfalls under RCP 4.5 and RCP 8.5. However, the contribution of LULC change to streamflow change is still substantial. Therefore, the rise of rainfall in the future due to climate change scenarios is expected to promote average annual streamflow discharge and water resource availability in the Muga watershed. Accordingly, increasing streamflow for the future is beneficial for the local and regional water resources infrastructure planning and operation in the study area and downstream areas of the Abay basin of Ethiopia.

Table 4 Predicted mean annual water balance components for different combinations of climate change and LULC scenarios

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenarios | STQ | | ET | | SURQ |  | GW |  | LQ |  | WYLQ |  |
| mm | ∆% | mm | ∆% | mm | ∆% | mm | ∆% | mm | ∆% | mm | ∆% |
| LULC 2017 & CC 1985-2017 | 193.4 |  | 586.3 |  | 217.4 |  | 190.3 |  | 56.8 |  | 463.3 |  |
| LULC 2033 & CC 1985-2017 | 220.1 | 13.8 | 647.3 | 10.4 | 230.2 | 5.9 | 185.6 | -2.5 | 55.2 | -2.8 | 517 | 1.7 |
| LULC 2017 & RCP 4.5 | 232.2 | 21.3 | 652.6 | 11.3 | 231.5 | 6.5 | 231 | 21.4 | 60.8 | 7 | 523.3 | 12.9 |
| LULC 2017 & RCP 8.5 | 236 | 22 | 652.3 | 11.3 | 240 | 10.4 | 234.2 | 23.1 | 65.8 | 15.8 | 540 | 16.6 |
| LULC 2033 & RCP 4.5 | 229.8 | 18.8 | 648.4 | 10.6 | 238.7 | 9.8 | 229.8 | 20.8 | 58.8 | 3.5 | 527.3 | 13.8 |
| LULC 2033 & RCP 8.5 | 234 | 21 | 650.8 | 11 | 248.3 | 14.2 | 232.5 | 22.2 | 62.2 | 9.5 | 543 | 17.2 |

Note: LULC: Land use/ land cover map; RCP 4.5 & RCP 8.5 (2018-2050)

**Conclusions and Recommendations**

Land use/ land cover and climate change affect the hydrological process of the Muga watershed. Therefore, assessing the individual and combined impacts of LULC and climate change on hydrology at the watershed level is essential for policymakers and land managers to develop more effective water resource management and climate adaptation strategies for a watershed. Four-period LULC and two climate change scenarios were considered to assess the individual and combined impact of LULC and climate change on hydrology.

This study showed that LULC change impacted streamflow, surface runoff, groundwater flow, and lateral flow, and the impact on ET and water yields was small. Future LULC change is expected to have the same impact on hydrology as the historical LULC did. The study showed that by the 2050s, surface runoff, groundwater flow, streamflow, lateral flow, and water yield in Muga watershed are projected to increase under RCP 4.5 and RCP 8.5 scenarios compared to the reference climate datasets (1985-2017). This study showed that the impact of future LULC and climate changes on hydrology is relatively higher in the study watershed compared to simulation under LULC 2017 and CC 1985-2017.

This study estimated the impacts of LULC and climate change on streamflow. Hence, streamflow is projected to increase to 40.6 mm (21.0%) and 36.4 mm (18.8%) under scenarios of LULC 2033 and RCP 8.5 and LULC 2033 and RCP 4.5, respectively, compared with the baseline period. The change in streamflow discharge is about 4.4% and 6.3% higher than the LULC change scenario only. The combined impact of changes in LULC and climate on hydrological components is relatively higher than the impact of LULC change scenario alone, which is accompanied by the intensification of rainfalls under RCP 4.5 and RCP 8.5; however, the contribution of LULC change is still substantial.

This study can contribute to selecting and implementing appropriate climate adaptation strategies and soil and water conservation techniques in the study watershed. Furthermore, it is beneficial for planning and operation of local and regional water resource infrastructure in the study watershed. However, examining the impacts of LULC and climate change on hydrology contains uncertainties. Hence, the results of this study will be used to show the individual and combined potential impacts of LULC and climate change on hydrology.

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* 1. N- Shaped EKC in Sub-Saharan Africa: the three-dimensional effects of Governance Indices

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***Abstract***

*Using panel data on 41 SSA countries for the period 1996-2018, the study examined the direct and indirect effects of the three governance indices on environmental quality. In doing so, based on the extended EKC, the study employed the three-stage simultaneous equation modeling to estimate coefficients. In addition, the study inspects an evidence for N-shaped EKC in the region. Consequently, in the lower-income SSA countries, while the institutional governance index has a negative effect on environmental degradation; government effectiveness has indirect negative effects on GHG emissions through green energy consumption. In the Lower-middle-income SSA countries, while Economic governance has a direct positive effect on greenhouse gas emissions; Political and Institutional governances have a direct negative effect on environmental degradation. Moreover, political stability and the absence of violence have an indirect negative effect on GHG emissions through income. In the Upper middle-income SSA countries, control of corruption and the regulatory quality of the government has an indirect negative effect on environmental quality through income and green energy consumption, respectively. On top of that, the study confirmed an N-shaped EKC in the Lower-middle and Upper Middle-income SSA countries. Overall, the difference on the shape of EKC and the inconclusive effects of governance indices on environmental quality might be as the result of income heterogeneity across the region and the mean regression method of data analysis the study used. Accordingly, policymakers should understand the heterogeneous effects of governance indices on environmental quality and work with their policy prescriptions.*

**Keywords**: *Environmental Quality, Greenhouse gas emission (GHG), Governance Indices, Environmental Kuznets curve (EKC), Sub-Saharan Africa (SSA)*

**Introduction**

The environment in which we have been living has provided us with what we can see like rain, what we can feel like heat, and what we can taste like amenity services. Humans, at the very least, need environmental services to survive on this planet. This is because the environment has been delivering ecological balance through mitigation, ultraviolet ray protection, and waste absorption. Nevertheless, human interactions have been creating unfavorable effects on environmental quality (Myers, 1996; L[utahndo](https://www.researchgate.net/profile/Luthando-Dziba?_sg%5B0%5D=LqNqN10gJ2A9O8ruOWaJPDxCIERuYBeYRazTk_u2qqmImky11AjeYV_Wi8pyQIH5-YhNPw4.a0nf1PksP-Qqgp7V0l_FvVWhYlse230BVZmoMltnY1hVOZuuQsfQop6KuRYVFjAIH79MAaqRemkwmAWS8mVRkg&_sg%5B1%5D=1k0YOIhevJ-s1_eisOu7bX-6DwJyy6-2s1vlsdXsijLVi9FGxd_9kKcqxY0LfVxzNKKXUbg.XAwW7vka8LpaIwHXUTb5vRqlcKgv-H1pbAY41b7n-UbkPY6bpk19Tg7UTH7Q8-Bn5VjkjuWZNkZ35UA8c4k16Q) *et. al*, 2018).

Human economic activities are one of the inducing factors for the ever-changing ecosystem. For instance, between 1950 and 2000, global economic activities increased by sevenfold. Particularly, after the industrial revolution, human economic activities raise output by a factor of 100. Moreover, over the last one hundred years, the industrial sector has grown by 40%. On the contrary, In SSA since the 1990s, value-added by the manufacturing sector as a share of GDP has declined. In addition, between 2005 and 2020, there was a continuous fall in manufacturing shares of employment and value addition in the region (Veronica and Nick, 2020).

The growth of the industrial sector in other parts of the world came at a high cost to the ecosystems of the developing countries (Nelson, 2005). Due to the huge release of CO2 emissions into the environment caused by industrial expansion over the last 50-100 years, the land temperature has risen by 0.5°C, causing sea level to rise by 19m in Africa. Moreover, such an increase in temperature has brought a multiplier effect on rainfall variability, crop production, human health, forestry, and other ecosystems services of the region (Grubler, 1995; Nelson, 2005; Edgar *et.al*, 2010; and IPCC, 2013).

# The original Environmental Kuznets curve (EKC) stated that in the early stage of economic growth, GDP per capita growth come at the expense environmental quality. Yet, at later stages, with the possibility of eco-friendly growth, GDP per capita and environmental quality expected go in the same positive direction. Consequently, an inverted U-shaped EKC expected to happen between economic growth and environmental quality in the long-run (Stern, 2018). However, such relationships might turn out to be N-shaped implying beyond certain level of economic growth, environmental quality may tend to decline again (Álvarez-Herranz and Balsalobre Lorente, 2016; Alexandra et.al, 2018 and Sinha et.al, 2018).

# Accordingly, using panel simultaneous equation regression modeling, this study aimed to address the N-shaped relationship between greenhouse gas (GHG) emissions and economic growth in SSA. In doing so, to observe the possibility of heterogeneous effects of economic growth on environmental quality, countries in SSA are divided as Lower income, lower-middle income and upper-middle income countries (WBCLG, 2022)

# Still, the demographic aspects of human interaction can affect environmental quality. In SSA, the population increases by approximately 2.63 percent compared to the previous year ([O'Neill](https://www.statista.com/aboutus/our-research-commitment/2127/aaron-oneill), 2021). Such trends in population growth and urbanization have been putting great pressure on the SSA ecosystem’s biodiversity through increased demand for food, land use, energy, and water, as well as infrastructure development. Specifically, due to the high population growth rate in the region, the energy demand is expected to loom in the coming years. At the continental level, 80% of electricity demand in Africa is covered by fossil fuels. Consequently, such non-renewable energy sources contribute 76% of CO2 emissions in the region (IEA, 2014; Buchanan, 2021).

As a result, it appears that transitioning economic, energy, and social systems is desperately needed in the region to achieve ecologically sustainable economic growth. Yet, attaining such transformation necessitates eco-centric environmental policy changes, like the use of green energies. Furthermore, the success of such policy changes depends on the nature of governance indices—institutional qualities in the region (Dasgupta and De Cian, 2016; FAO, 2017). Nevertheless, climate change studies in the SSA region are limited. In particular, a study by Amuakwa-Mensah and Adom (2017), Jibrilla (2018), Asongu and Odhiambo (2020), Yamegeo *et.al* (2021), and Kamah *et.al* (2021) extended the Environmental Kuznets Curve (EKC) by adding one or more of governance indices as the main determinant of environmental quality. On the contrary, this study also focused on assessing the direct and indirect effects of all governance indices and green energy consumption on the environmental quality across the three income categories of the region.

In general, this study contributes to the current body of research by examining the N-shaped EKC evidence in the SSA region. Moreover, previous studies in the region took pooled panel data and aimed to see only direct effects of some of the governance indices on environmental quality. On the contrary, to observe the possibility of heterogeneous effects of economic growth, green energy consumption, and governance indices on environmental quality, the study classified the SSA region in to three income categories. On top of that, unlike the previous literatures, the study employed the simultaneous equation regression modeling to capture both the direct and indirect effects of green energy consumption and all of the governance indices with the three dimensions: economic, institutional and political governances.To assess the direct and indirect effects of the three governance indices and green energy consumption on environmental quality in SSA;To inspect an evidence for N-shaped EKC in SSA.

**Methodology**

**Type and Source of Data**

The study used Panel data on per capita greenhouse gas emissions and green energy consumption for 41 Sub-Saharan African countries over 1996-2018. The data was extracted from World Bank. Per capita greenhouse gas emissions were used as environmental quality indicator, and the per capita green energy consumption was used as a proxy for green policy changes. Moreover, panel data on Political, Economic, and Institutional governance indices were collected from the Worldwide Governance Indicators (WGI) used to measure institutional qualities of the region from 1996-to 2018.

Besides, based on the 2022 World Bank Country and Lending Groups (WBCLG) classification, the study divided the 41 Sub-Saharan counties into three income categories. The income classifications were low-income economies, Lower-middle economies and Upper-middle economies. Consequently, it was possible to observe the heterogeneous effects of the governance indices and green energy use on environmental quality among different income groups.

The low-income economies were those with a GNI per capita of $1,045 or less in 2020. Under this Income category Burkina Faso, Burundi, Central African Republic, Chad, Congo, Dem. Rep., Ethiopia, Gambia, Guinea, Guinea-Bissau, Madagascar Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Sudan, Togo and Uganda were included. The lower-middle-income economies include those with a GNI per capita between $1,046 and $4,095. Hence, Angola, Benin, Cameroon, Cape Verde, Congo Rep., Eswatini, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Senegal, Tanzania, Zambia and Zimbabwe were classifying under this income group. Last but not least, the upper-middle-income economies were those with a GNI per capita between $4,096 and $12, 69. Consequently, Botswana, Equatorial Guinea, Gabon, Mauritius, Namibia, Seychelles and South Africa were categorized under this income classification.

**Econometric Model: An extended version of Environmental Kuznets Curve**

The original Kuznets curve states pollution emissions per capita (E) is a function of per capita income (Y) in a given economy. The curve states that at the early stage of economic growth as pollution emission increases environmental quality declines. Yet, at the later stages of economic growth, both per capita income and environmental quality are expected to go in the same positive direction (Stern, 2018). Basing this, different scholars tried to test the environmental Kuznets hypothesis by including one or more institutional-quality indexes (Cole, 2007; Villanueva (2012); Lau (2018); Asongu and Odhiambo, 2020). Accordingly, in addition to green energy use, this study further extended the original Kuznets curve by including all of the six institutional qualities indicators under three governance indexes—political, economic, and institutional governance. Consequently, it is possible to observe the direct effects of governance indexes and green energy use on the environmental quality of the region.

Moreover, the Sub-Saharan region is well known for the prevalence of corruption and political instability. Besides, the sustainable use of green energy depends on the regulatory power and effectiveness of the government in the region to ensure the proper implementation of green energy policy. Henceforth, in addition to the direct effects, Political Stability and Absence of Violence/Terrorism and control of corruption can have an indirect effect on environmental performance through per-capita income. On top of that, the indirect effects of Regulatory Quality of the government and Government effectiveness on the environmental quality can be observed through green energy use.

Furthermore, depending on the sign of related to income, EKC will adopt different shapes (Álvarez-Herranz and Balsalobre Lorente (2016) cited on Alexandra *et.al* (2018); Sinha *et.al* (2018) :

* If = 0 then there will be no relationship between GHG emission and income.
* If =0 then there will be a monotonic increasing relationship such that GHG emission increases along with economic growth.
* If =0 then there will be a monotonic decreasing relationship such that GHG emission increases along with economic growth.
* If =0 then there will be an Inverted U-shape EKC
* If =0 then there will be U-shape EKC
* If >0 then there will be an N-shaped EKC
* If <0 then there will be an inverted N-shaped EKC

Bringing all into conclusion, the extended Kuznets hypothesis can be rewritten in a three-stage simultaneous equation modeling as follows;

\_\_\_\_\_\_\_\_\_\_ (1)

+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (2)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (3)

Where:

* Eq. (1) developed based on environmental Kuznets curve literature implying pollution log of emissions per capita as a function of the log of per capita income, the log of square and cube of per capita income, the log of green energy consumption ( and Political governance (PG), Economic governance (EG), and Institutional governance (IG).
* Eq. (2) represents the log of per capita income as a function of the log of green energy use (corruption () and Political Stability and Absence of Violence/Terrorism.
* Eq. (3) represents the log of green energy consumption ( as a function of Government effectiveness ( and Regulatory Quality of the government (

***Working hypothesis***

**Political governance** (PG): It is a process, by which those in the authority are selected, elected, monitored, and replaced (Kakabadse. A and Kakabadse, 2001). Accordingly, it is measured by the average of the indexes of Voice and accountability, political stability, and absence of violence in a given economy. Voice and accountability (VAi) reflect the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and free media. On the other hand, political stability and the absence of violence (PVEi) measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism (WGI, 2021). The expected estimate of VAi and PVEiranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. Hence, it is expected that enhanced political governance is negatively related to greenhouse gas emissions. In addition, to see the negative indirect effects of PVE on GHG emission through income, a positive effect on per capita income due to PVE was expected.

**Economic governance** (EG): It is a process by which public resources are effectively managed and sound policies are implemented (Kakabadse. A and Kakabadse, 2001). Consequently, it is measured by the average of the indexes of Government effectiveness) and Regulatory Quality of the government). While forming and implementing policies, government effectiveness incorporates the quality, perception, degree of independence of public and civil services from political pressures. On the other hand, the Regulatory Quality of the government reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development (WGI, 2021). The expected estimate of GEi and RQi ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. Hence, it is expected that enhanced Economic governance is negatively related to greenhouse gas emission.

**Institutional governance (IG)**: it is a process by which citizens and the state itself respect the societies/institutions (Kakabadse. A and Kakabadse, 2001). Accordingly, it is measured by the average of the indexes of Rule of law () and Control of Corruption (). Rule of law () measures the perception and extents of agents in the economy to abide by the rules, contracts, rights, court rules, and the policies existing in a given society. Likewise, Control of Corruption ()reflects the extent to which public power is used for private gain starting from petty to grand forms (WGI, 2021). The expected estimate of RUi and CCEi ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. Hence, it is expected that enhanced institutional governance is negatively related to greenhouse gas emissions. Moreover, to observe the negative indirect effects of CCE on GHG emissions through income, a positive effect of CCE on per capita income was expected.

**Green energy consumption per capita (EC):** It represents the per capita consumption of renewable energies like hydropower, wind, solar, geothermal, wave, tidal, biomass, landfill gas, sewerage treatment plant gas, and biogases (IEA, 2013). Accordingly, Green energy consumption per capita was used as a proxy for green policy changes in the region. Therefore, the use of such

**Result and Discussion**

**Descriptive statistics**

Table 1 (Appendix 1) presents the descriptive statistics of dependent and independent variables for the three income categories of 41 Sub-Saharan countries. In lower-income economies, the average greenhouse gas emission, economic growth, and green energy use are -6.52 metric tons, 7.24%, and 6.34%, respectively. Similarly, the average indices for the three governance indexes—economic, political, and institutional are -0.87, -0.87, and -0.86, respectively. On the other hand, the maximum level of greenhouse gas emission, economic growth, and green energy use are -4.34 metric tons, 8.38%, and 8.33%, respectively. Likewise, the maximum values for the three indices of governances are -0.20, 0.36, and 0.41, respectively.

In the lower middle economies, while average greenhouse gas emission, economic growth, and green energy use are -6.19 metric tons, 8.17%, and 7.70%, it is -0.62, -0.44, and -0.61 for the three indices of governances, respectively. Moreover, -5.19 metric tons, 9.05%, and 9.0 are the maximum levels of greenhouse gas emission, economic growth, and green energy use, respectively. Still, the maximum values of the three governances’ indices are low in the lower-middle-income economies. Besides, in the upper-middle-income economies, the average levels of greenhouse gas emission, economic growth, green energy use, and the three governance indexes are -4.91 metric tons, 9.58%, 9.53%, -0.02, 0.25, and 0.01, respectively. In addition, the maximum values of such variables in the upper-middle-income economies are -3.38 metric tons, 10.63%, 10.94%, 1.09, 0.99 and -0.97, respectively.

**Unit Root test**

As shown in Table 2, Augmented Dickey-Fuller (1979) (ADF) test was used to examine the stationarity of regressors. Accordingly, in the low-income economies, only economic growth was stationary at a level. Moreover, in Lower-middle income economies; economic governance, institutional governance, control of corruption and regulatory quality of the government are stationary at a level. Still, in the upper-middle economies; green energy consumption is the only variable which is stationary at level. On the other hand, across the three income categories, all of the variables included in the study are stationary at the first difference. In summing up, since some of the variables are stationary at a level while some others are not; there is a likelihood of co-integration among the variables.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Lower-income SSA | | Lower-middle income SSA | | Upper-middle income SSA | |
|  | Level | First difference | Level | First difference | At Level | First difference |
| Variables | ADF | ADF | ADF | ADF | ADF | ADF |
| LNGHG | 50.8838\* | 202.7117\*\*\* | 46.9245\*\* | 151.0732\*\*\* | 24.0733\*\* | 57.1909\*\*\* |
| LNGDP | 64.8038\*\*\* | 201.2933\*\*\* | 13.2274 | 66.9269\*\*\* | 10.4633 | 72.1332\*\*\* |
| LNGDP2 | 63.8916\*\*\* | 199.3934\*\*\* | 12.7339 | 67.1946\*\*\* | 9.8680 | 69.6890\*\*\* |
| LNGDP3 | 63.2559\*\*\* | 197.3065\*\*\* | 12.2888 | 67.1916\*\*\* | 9.4954 | 65.9459\*\*\* |
| LNEC | 59.2150\*\* | 215.6368\*\*\* | 33.0926 | 141.6947\*\*\* | 36.4370\*\*\* | 71.4849\*\*\* |
| PG | 44.9451 | 179.6974\*\*\* | 29.9864 | 182.7534\*\*\* | 19.3856 | 107.6550\*\*\* |
| EG | 45.7568 | 205.2090\*\*\* | 54.1340\*\*\* | 173.8290\*\*\* | 21.7157\* | 75.6850\*\*\* |
| IG | 43.8203 | 165.6418\*\*\* | 59.9860\*\*\* | 175.9315\*\*\* | 14.2401 | 71.9820\*\*\* |
| PVE | 42.1659 | 219.7699\*\*\* | 37.2072 | 203.6880\*\*\* | 29.2641\*\* | 107.1118\*\*\* |
| CCE | 31.4862 | 145.5098\*\*\* | 59.6005\*\*\* | 177.6830\*\*\* | 19.7591 | 69.4327\*\*\* |
| RQE | 51.2903\* | 189.6966\*\*\* | 51.9023\*\*\* | 148.8008\*\*\* | 11.5726 | 67.0873\*\*\* |
| GEE | 52.0835\* | 209.8922\*\*\* | 46.9245\*\* | 151.0732\*\*\* | 23.659\* | 93.6258\*\*\* |

Table 2: Unit root Test Note: \*\*\*, \*\* and \* are 1%, 5% and 10% of significance levels, pectively

***Cointegration test***

Table 3 displays the Pedroni tests which confirm long-run co-integrating relationship among the variables across the three income categories.

Table 3: Panel co-integration tests

|  |  |  |  |
| --- | --- | --- | --- |
| **Pedroni test for Cointegration** | LIE | LMIE | UMIE |
| Modified variance ratio | -3.9109\*\*\* | -4.8211\*\*\* | -3.3886\*\*\* |
| Modified Phillips-Perron t | 3.9958\*\*\* | 2.6606\*\*\* | 3.1589\*\*\* |
| Phillips-Perron t | -5.9474\*\*\* | -6.0861\*\*\* | -1.7161\*\* |
| Augmented Dickey-Fuller t | -6.0381\*\*\* | -7.3929\*\*\* | -2.6511\*\*\* |

Note: \*\*\*, \*\* and \* are 1%, 5% and 10% of significance levels, respectively.

**Model Estimation**

***The N-Shaped EKC and Sub-Saharan Africa***

Table 4 displays the expected estimates of an N-shaped relationship between economic growth and environmental quality across the three income categories. In the lower-income categories, unlike the proposed expectation, there is an inverted N-shaped relationship between income and GHG emission. This indicates that initially, GDP growth reduces environmental degradation up to a certain level of economic growth where later on the relationship instead will be positive before it once again becomes negative. Though it is difficult to implicate, the likely reason for such inverted N –shaped EKC might be due to the dominance of the composition effect over the scale effect that arises as a result of the direct-shift in their economies from agriculture to the service sector. Moreover, it might be due to green technological inflow through foreign direct investment and multinational corporations in the region. Accordingly, the study result goes in line with a report by Uddin *et al.* (2016) and Alexandra *et.al* (2018).

In lower-middle and upper-middle economies, the expected N-shaped EKC was confirmed. In particular, the study indicates that the early stage of GDP growth brings environmental degradation. On the contrary, the later stage of economic growth will bring environmental quality before once again they go in opposite directions. The possible implication for an N-shaped EKC on those economies might be the dominance of the scale effect over the technique and composition effects. Accordingly, the study result goes in line with a report by Álvarez-Herranz and Balsalobre Lorente (2015, 2016), Boamah *et al*. (2017), and Abid (2017)

Table 4: Summary of an N-shaped EKC

|  |  |  |  |
| --- | --- | --- | --- |
|  | **GHG Sign** | | |
| Variable | LIE | LMIE | UMIE |
| Ln GDP | **-** | **+** | **+** |
| Ln GDP2 | **+** | **-** | **-** |
| Ln GDP3 | **-** | **+** | **+** |

+ means that the variable has a significant positive relationship with GHG emissions

- means that the variable has a significant negative relationship with GHG emissions

***Econometric Results***

Table 5 presents both the direct and indirect effects of green energy consumption and the three governance indexes on environmental degradation under the three income categories of SSA. Accordingly, in the lower-income economies, institutional governance directly affects environmental quality positively. Specifically, a 1% increase in IG significantly causes a 0.87% decrease in environmental degradation. Consequently, control of corruption and the existence of rule of Law in such economies might play a crucial role in the reduction of GHG emissions. On top of that, the study confirms the results reported by Castiglione *et.al,* (2012), Amuakwa-Mensah and Adom (2017), Solarin *et.al* (2017), Ali *et.al* (2019), Lau *et.al* (2018), and Yamegeo *et.al* (2021).

Moreover, in lower-income economies, unlike the proposed expectation, green energy use indirectly affects environmental degradation positively through income. This might be because green energy use in SSA is still dominated by traditional biomass which contributes a significant role in GHG emissions. Besides, in lower-income economies, government effectiveness indirectly affects environmental degradation negatively through green energy use. The implication is the quality and degree of independence of environmental laws from political pressures might be another way of tackling environmental degradation in such economies. Accordingly, the study also confirms the results reported by Villanueva (2012), Yamegeo *et.al* (2021).and Kamah *et.al* (2021).

In the lower-middle-income economies, green energy consumption directly affects GHG emissions positively. Specifically, a 1% increase in green energy use directly increases GHG emissions by 2.04%. In addition, alike lower-income economies, green energy consumption has an indirect positive effect on GHG emission through income in the lower-middle-income economies. Consequently, the study result goes against the proposed expectation of a negative relationship between green energy use and environmental degradation.

Moreover, in the lower-middle-income economies, the three dimensions of governance’—EG, PG, and IG have a significant direct effect on environmental quality. In particular, a 1% increase in economic governance results 0.89% increase in GHG. On the contrary, political and institutional governance has a direct negative effect on environmental degradation. Specifically, a 1% increase in political and institutional governance results in a 0.66% and 0.49% decrease in GHG emissions, respectively. Hence, the prevalence of democracy, rule of law, political stability, and control of corruption might be the proper key in reducing environmental degradation for such economies. Consequently, the study result goes in line with Fredriksson *et.al,* (2005), Li and Rueveny (2006), Romuald (2010) and Amuakwa-Mensah and Adom (2017). Still, in the lower-middle-income economies, political stability and the two economic governance indexes have a negative indirect effect on GHG emissions through income and green energy use, respectively.

Like in the other two income categories, green energy use has both direct and indirect positive effects on environmental degradation in the upper-middle economies. In particular, a 1% increase in green energy consumption directly increases GHG emissions by 0.34%. On top of that, control of corruption and the regulatory quality of a government has a negative indirect effect on environmental degradation through income and green energy consumption, respectively. On the contrary, political stability and government effectiveness have a positive indirect effect on GHG emissions through income and green energy use, respectively. Accordingly, the study result goes in line with a report by Li *et.al,* (2015), Eregha and Mesagan (2016), Mavragani *et.al* (2018), *Egbetokun et.al,* (2018), Asongu and Odhiambo (2020), and Yamegeo *et.al* (2021) stating that current governance standards are not improving expected unfavorable effects on CO2 emissions in the region.

Table 5: Green energy use and governance indexes on environmental quality

|  |  |  |  |
| --- | --- | --- | --- |
|  | LIE | LMIE | UMIE |
| Explanatory variables | Dependent Variables | Dependent Variables | Dependent Variables |
| Direct effects | lnGHG | lnGHG | lnGHG |
| LNGDP | -5.49662\*\*\*  (1.970152) | 0.659772  (1.126166) | 2.608784\*\*  (1.17375) |
| LNGDP2 | 0.980422\*  (0.504023) | -0.92652\*\*\*  (0.31104) | -0.82376\*\*\*  (0.2465261) |
| LNGDP3 | -0.05356  (0.03455) | 0.063135\*\*\*  (0.018962) | 0.048132\*\*\*  (0.0128784) |
| LNEC | 0.283724  (0.200986) | 2.039301\*\*\* (0.229667) | 0.345747\*\*\*  (0.0803979) |
| EG | 0.192356  (0.165288) | 0.892436\*\*\*  (0.21635) | -0.13819  (0.1219036) |
| PG | 0.15097  (0.095877) | -0.65537\*\*\*  (0.093844) | -0.09414  (0.2047543) |
| IG | -0.86979\*\*\*  (0.171273) | -0.49334\*\*\*  (0.164211) | -0.13283  (0.1918843) |
| Indirect effects | lnGDP | lnGDP | lnGDP |
| LNEC | 1.164325\*\*\*  (0.01187) | 1.044373\*\*\*  (0.004332) | 0.965021\*\*\*  (0.0064354) |
| CCE | 0.148018  (0.10148) | -0.01402  (0.052818) | -0.60549\*\*\*  (0.0584549) |
| PVE | -0.03547  (0.04945) | -0.21999\*\*\*  (0.040828) | 0.687859\*\*\*  (0.0965739) |
| Indirect effects | LNEC | LNEC | LNEC |
| GEE | -5.77817\*\*\*  (0.425397) | -6.87802\*\*\*  (0.803056) | 6.715784\*\*\*  (2.29982) |
| RQE | 0.326397  (0.489214) | -1.72018\*\*  (0.771048) | -7.13402\*\*\*  (2.342471) |

Note: \*\*\*, \*\* and \* are 1%, 5% and 10% of significance levels, respectively and items in brackets are standard errors

**Conclusion**

The study examined the three-dimensional effects of governance indexes and green energy use on environmental quality across the three income categories of 44 SSA countries for the period between 1996-2018. In doing so, the study used the three-stage simultaneous equation modeling to capture the direct and indirect effects of governance indexes and green energy consumption on GHG emissions. Accordingly, in the lower-income SSA countries, the institutional governance index has a direct negative effect on environmental degradation. Besides, green energy use and government effectiveness have indirect positive and negative effects on environmental degradation through income and green energy consumption, respectively.

In the Lower-middle income economies, while green energy use and Economic governance have a direct positive effect on GHG emissions, Political and Institutional governance’ have a direct negative effect on environmental degradation. Moreover, political stability and absence of violence, and green energy use have indirect negative and positive effects on GHG emissions through income. Additionally, in the Lower-middle income economies, the two economic governance indexes have an indirect negative effect on environmental degradation through green energy use.

Similarly, in the Upper middle economies, green energy use is improving environmental quality neither directly nor indirectly through income. Besides, control of corruption and the regulatory quality of the government has an indirect positive effect on environmental quality through income and green energy consumption, respectively. On top of that, political stability and absence of violence, and government effectiveness have an indirect positive effect on environmental degradation through income and green energy use, respectively

In summing up, across the three income categories, either directly or indirectly, green energy use has a positive effect on GHG emissions. This might be because green energy consumption in SSA is still dominated by traditional biomass. Besides, the inconclusive effects of the three governance indexes on environmental degradation might be due to income heterogeneity across the three groups of countries. Hence, policymakers should and must understand the heterogeneity of the different income categories and work accordingly with their policy prescription.

On top of that, the study also inspects the presence of an N-shaped EKC across the three income categories. Consequently, while an inverted N-shaped EKC exists in the lower-income countries, an N-shaped EKC was confirmed in the Lower-middle and Upper Middle-income SSA countries. Here again, the difference in the shape of EKC might be the result of income heterogeneity across the three groups of countries. Moreover, such inconclusive results might arise due to mean regression method of data analysis the study used. Thus, further classification of income within the three income groups might help to explain well the relationship between income and environmental quality.

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* 1. Perception and Choices of Adaptation Strategies to Climate Change among Female Headed Households: in the case Selected Kebels of Dejen Woreda Amhara National Regional State, Ethiopia, by Fikirtesilasie et al

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***Abstract***

*Rural women in Ethiopia are highly affected by climate change and climate change-induced  
problems. The purpose of this study was to assess the perception of female headed household to climate change, to identify the major climate change adaptation strategies practiced by female headed households and to identify the determinants of female headed household’s choice of climate change adaptation strategies in Dejen woreda. Both qualitative and quantitative data from secondary and primary data sources was used. The primary data were collected from 150 purposively selected female headed households through focused group discussion and through key interview by using semi structured questioner and interview. While, secondary data were obtained from NMSA, governmental office, scientific journal and reports. Descriptive statistics and multivariate probit econometric model was employed for data analysis. The descriptive statistics result shows 89.7% and 88% of the respondents have been perceived increasing of temperature and decreasing of rainfall respectively. The respondents have used five climate change adaptation strategies. These are soil and water conservation, crop diversification, small-scale irrigation, improved crop varieties and adjusting planting/sowing dates. The multivariate probit model results indicated that age, education level, landholding size, family size, annual income, access to information about climate change, perception to climate change, frequency of extension visit and market distance have significantly influenced FHH’s choice of adaptation strategies. The study recommends strengthening of FHHs education through adult education, appropriate utilization of land and family labor, delivery of timely information on weather condition, creating awareness on the negative impact of climate change, building infrastructure and development of transportation system to enhance to choose of climate change adaptation strategies by FHHs.*

**Keywords*:*** Adaptation strategy, climate change, Dejen, multivariate probit, perception

**Introduction**

Female-headed households in Sub-Saharan Africa are more affected by climate change due to limited access to protective social networks, lower levels of access to institutional facilities and labor-saving technologies (Onwutuebe, 2019). Ethiopian populations are highly affected by climate change and have a lower adaptive capacity since they are subsistent smallholder farmers and risk-prone agriculture is their primary source livelihood (Sani, S., Jema, H., and Degye, G., 2016). This indicates that climate change is challenging their economic growth of the country and efforts to move out of poverty (Matewos, 2019). Even though climate change affects both men and women, women are the most vulnerable group societies by climate change (Onwutuebe, 2019). Unless adaptation measures are carefully designed in women’s perspective, reinforcing women’s vulnerability to climate change exacerbates the existing impact (Chanana, 2018).

Even if different studies such as Atinkut and Mebrat (2016), Seid and Tamiru, (2016), Tesfaye and Seifu (2016), (Amare, Z., Ayoade, J., Ibidun, O., and Zelek, M., 2018), Asrat and Simane (2018) and Solomon and Edet (2018) conducted on perception of farmer to climate change and adaptation to climate change. There is a lack of empirical evidence on perception of climate change and choice of climate change adaptation strategies among female headed households (FHHs) have been a major gap. Since mostly the decisions on the choice of climate change adaptation strategies made by male farmers and the representation of women decision making tend to be nominal due to the dominance of masculine norms that expect women to refrain from looking in public gathering (Assefa and van, 2018). This leads to a lack of evidence to generalize the challenges of climate change on women and their response to this climate change.

# Methodology

**Description of the study area**

The study was conducted in the Dejen woreda. Astronomically, the location of the woreda is located between the longitude of 38o 4′ 30′′ E and 38o 15′ 30′′ E, and between the latitude of 10o 6′0′′ N and 10o 17′ 0′′ N, with an elevation of 1500 to 3000 meters above sea level. Agro ecologically the woreda classified into highland, midland and low land climate zone. The average annual rainfall range between 750-1800mm and the minimum and maximum average temperature range between 12-16.5 °C and 27-32 °C, receptively (Kurar station, 2019). Agriculture is the main source of livelihood in the study area and it is characterized by a mixed crop livestock production on the subsistent level. The study area encompasses 21 rural and 2 urban kebeles administrations with an estimated population size of 102,359 (CSA, 2015).

**Research Design**

The study design was a cross sectional survey. The purpose of this study was to asses Perception and Choices of Adaptation Strategies to Climate Change among Female Headed Households in Dejen district.

**Data Type, Sources and Methods of Data Collection**

Both qualitative and quantities data from secondary and primary data source were used. The  
primary data collected using a semi-structured questionnaire by trained enumerators from 150  
female-headed households and through key informants and focus group discussion, from 10 and 3 key informants and focus groups respectively. While the secondary data gathered from National Meteorological Agencies, Dejen woreda Agricultural and Rural Development Office and Kebeles, scientific journals and different reports. In the study area since the number of female-headed households are small using census methods and take the whole female headed households as respondents. As to the methods of data analysis both descriptive statistics and multivariate probit model were employed. Descriptive statistics such as mean, standard deviation, frequency, percentage, maximum and minimum value were used.

***Econometric model estimation***

A multivariate probit model was employed since FHHs adopt a bundle of interdependent climate change adaptation strategies to maximize their expected utility and to deal with a multitude of climate-induced risks and constraints than adopting a single strategy (**Sani *et al*., 2016**). This model is a generalization of the probit model used to estimate several correlated binary outcomes jointly (Greene, 2002). Assuming that all choice of climate change adaptation strategies were correlated either positively or negatively (Belderbos, R., Carree, M., Diederen, B., Lokshin, B. and Veugelers, R., 2004). MVP also indicates women variation in the choice of climate change adaption strategies and estimate choice or failure to choice climate change adaptation strategies jointly. Following Donkoh, S., Azumah, S., and Awuni, J.A., 2019) for this study, as mentioned in the above multivariate probit model was used to analyze determinants of climate change adaptation strategies choice of respondents. The observed outcome of climate change adaptation strategy choice can be modeled by the following random utility formulation. It is characterized by a set of m binary dependent variables *Yhpj* such that:

**  (1)

(if the women adopt)  (2)

Where *j*=1, 2 …m denotes the climate change adaptation strategies available *X*hpjis a vector of explanatory variables denotes the vector of the parameter to be estimated, and are random error terms distributed as a multivariate normal distribution with zero mean and unitary variance. It is assumed that a rational woman has a latent variable, which captures the unobserved preferences or demand associated with the *jth* choice of adaptation strategy. This latent variable is assumed to be a linear combination of observed household and other characteristics that affect the adoption of adaptation strategy, as well as unobserved characteristics captured by the stochastic error term. Given the latent nature of the variable estimation is based on the observable variable which indicates whether or not a household adopts a specific climate adaptation strategy. Since the adoption of several adaptation strategies is possible, the error terms in equation (1) are assumed to jointly follow a multivariate normal distribution, with zero conditional mean and variance normalized to unity. The off-diagonal elements in the covariance matrix represent the unobserved correlation between the stochastic component of the *jth* and *mth* type of adaptation strategies. This assumption means that equation (2) gives a multivariate probit model that jointly represents the decision to adopt or not adopt a particular adaptation strategy. This specification with non-zero off-diagonal elements allows for correlation across error terms of several latent equations, which represent unobserved characteristics that affect the choice of alternative adaptation strategies.

**Result and Discussion**

**Women perception of climate change**

The descriptive result indicated that about 89.7% of FHHs perceive an increase of temperature. To verify women farmers’ perceived long-term change in temperature, the historical average annual minimum, and maximum temperature data obtained from NMA data of Kurar station from 1986 to 2017 were analyzed. The trend analysis between the mean maximum and minimum annual temperature and time indicated that mean maximum and minimum temperature in the study area increased by 0.12 ‎°C and 0079°C each year, respectively. The result is similar to (Asfaw, A., Simane, B., Hassen, A., and Bantider, A, 2018)). While 88% of FHHs perceive the rainfall is decreasing. To validate the perception of women on the decreasing of rainfall historical total annual rainfall data obtained from NMA data of Kurar station the period of 1986-2017 years were analyzed and the rainfall decreased by 3.37 mm per year. The result is in agreement with (Teshager, M., Adgo, E., and Tilahun, T, 2014).

***Climate change adaptation strategies used by women***

In Dejen woreda FHHs adopt five climate change adaptation strategies to reduce the negative impact of climate change within their probability such as soil and water conservation (75.2%), crop diversification (73.2%), small scale irrigation (71.1%), improved crop varieties (64.9%) and adjusting planting/sowing date (65.6%).One of the major challenges that FHHs were facing in the study area in striving for development is environmental degradation, manifested in the degradation of land resources through soil erosion, land sliding and moisture stress in the woreda leads to soil and water conservation techniques are the most and widely adopted by women in the study area.

***Econometric Model Results***

Before running the multivariate probit model necessary tests for the existence of econometric problems such as multicollinearity problems and outliers were performed using appropriate test statistic. To detect whether there is a multicollinearity problem or not, the two tests variance inflation factor (VIF) and contingency coefficient were carried out for continuous and dummy variables, respectively. Contingency coefficient value with 0.75 or more shows a strong degree of association between dummy variables. The contingency coefficient values close to zero indicates the absence of series association between dummy variables. Accordingly, the mean value is VIF 1.30 (Appendix Table 1). For dummy variables also included in the model correlation coefficient were below 0.75 (Appendix Table 2). These results indicate that there was no serious multicollinearity problem in the data set since VIF and correlation coefficients are less than 10 and 0.75 for continuous and dummy variables, respectively (Dormann *et al*., 2013). Therefore, all the hypothesized continuous and dummy explanatory variables were included in the model.

Since the respondents are more likely to choose more than two climate change adaptation strategies simultaneously, as well as there is potential interdependence between these different climate change adaptation strategies multivariate econometric model was carried out. The model estimated jointly for five categorical dependent variables namely adjusting planting/sowing date, using improved crop variety, crop diversification, small scale irrigation and soil and water conservation practice. The correlation coefficients of the error terms in the MVP model had positive signs, indicating that there is interdependence between different climate change adaptation strategies choices chosen by the respondents. Wald chi2 (55) = 275.56, Prob> chi2= 0.000 is significant at 1% significance level; this implies that the coefficients are jointly significant and the explanatory power of the factors included in the model is satisfactory. Furthermore, likelihood ratio test of the null hypothesis of independence between the climate change adaptation strategies decision (ρ21 = ρ31 = ρ41 = ρ51 = ρ32 = ρ42 = ρ52 = ρ 43 = ρ53 = ρ54 = 0) is rejected at 1% level of significance(chi2(10) = 94.6326 Prob> chi2 = 0.000).This indicated that the independence of the disturbance terms (independence of climate change adaptation strategies choice) is rejected since they are interdependence and they have significant joint correlations for two estimated coefficients across the equations in the model.The likelihood ratio test also indicated that the goodness-of-fit of the model therefore, in this study adopts the alternative hypothesis of the mutual interdependence among the multiple climate change adaptation strategies. Accordingly, the correlation among the decisions to adopt different climate change adaptation strategies may be due to their complementary or substitutional correlation between them (Tongruk and Wainaina, 2019). In this study, the correlation between different climate change adaptation strategies positive and the positive sign indicates that there was a complementary and interactive correlation between significantly correlated adaptation strategies (Table 2).It indicates all five sets of adaptation options are complementary to each other.

Separately considered, the ρ(rho) values indicate the degree of correlation between each pair of dependent variables. The maximum likelihood ratio test indicated that there are significant and joint positive correlation between ρ21 (improved variety and adjusting planting/sowing date), ρ31(crop diversification and adjusting planting/sowing date), ρ32(crop diversification and improved variety), ρ43(small scale irrigation and crop diversification), ρ53(soil and water conservation and crop diversification) and ρ5(soil and water conservation and small scale irrigation). The signs of correlationcoefficients indicate the complementary nature of different climate change adaptation strategies choices.

The marginal success probability for each adaptation strategy is estimated below. The model result also shows that the probability of respondents choosing of adjusting planting date, improved crop variety, crop diversification, small scale irrigation and soil and water conservation were 65.6%, 64.9%, 73%, 71% and 75%, respectively (Appendix Table 3). The joint probability of choosing all climate change adaptation strategies was 41.9% and this justified by the respondents simultaneously adopts most of the climate change adaptation strategies. The joint probability of failure to choose all climate change adaptation strategies was 8.2% and less than the probability of success to choose adaptation strategies (Appendix Table 4)

**Determinants of FHH’s choice of climate change adaptation strategies**

**Age**: The ages of FHHs affect the probability of adopting small scale irrigation and soil and water conservation practices as climate change adaptation strategies positively and significantly at 1% and 10% significance level, respectively. This finding is consistent with the finding of Amare and Simane (2017) and (Kwon, S.A., Kim, S. and Lee, J.E, 2019) they found that experiences and cumulative knowledge and skills are growing along with age and on the same vein, being aging helps women to anticipate the consequences of climate change and to implement climate change adaptation strategies. On the contrary, Moges **and** Taye (**2017**) found that age of farmers negatively and significantly influences the adoption of soil and water conservation practices as climate change adaptation strategies. The possible reason might bethe younger household has less exposure to climate change than the aged one.

Education level: As expected, education level influences the probability of adopting **crop diversification** positively and significantly at 10% significance level**.** The result is consistent with the findings of (Belay, A., Recha, J.W., Woldeamanuel, T. and Morton, J.F, 2017) and (Lan, L., Sain, G., Czaplicki, S, 2018). As explained by them education helps to obtain information on climate change and it is more appropriate to process and use this information and equipping FHHs with knowledge and skills that would help them in making decisions related to choosing climate change adaptation strategies.

***Land size ownership***: land size owned by FHHs were positively and significantly influence the choice of adjusting planting date, using small scale irrigation and soil and water conservation practice as climate change adaptation strategies at 5%, 10%, and 1% significance level, respectively. This finding conforms with prior expectation and the findings of (Ali, A., Rahat D.B. and Erenstein O, 2016), (Kgosikoma, K.R., Lekota, P.C. and Kgosikoma, O.E, 2018) and Tesfaye and Seifu (2016) who found that land size influence positively and significantly the decision of adopting adjusting planting date, small scale irrigation and soil and water conservation practices as climate change adaptation strategies. As explained by them the possible reason might be land ownership plays a pivotal role for the households to adapt climate change through digging well, rainwaterharvestingandconstructingsmall dams. FHHs also with larger farms have more land to allocate for constructing soil bunds, terracing and improved cut off drains to reclaim their farmland through sustainable soil and water management techniques to enhance land production and productivity and to increase their adaptive capacity.

***Family size of the household*:** As expected family size has a positive and significant influence on the likelihood of FHHs using adjusting planting dates, improved crop variety and crop diversification as climate change adaptation strategies. The result is similar to the finding of (Sani, S., Haji, J. and Goshu, D, 2016) and Ali and Erenstein (2017). As explained by them the possible reason might be large family size is linked with a higher labor endowment, which would enable a FHHs household to accomplish various agricultural tasks that are labor-intensive.

***The annual income of women***: Annual income of the FHHs households has a negative and significant influence to use irrigation as a climate change adaptation strategy at 5% significance level. The possible reason might be when FHHs have a high amount of income they want to migrate rural to urban towns rather than to invest in agricultural activities and they consider it as adaptation measure by itself and may delay other responses. This finding is in agreement with the findings of, Shiferaw (2014), Ibrahim (2014) and (Kwon, S.A., Kim, S. and Lee, J.E, 2019).

***Information to climate changes***: as expected information to climate change positively and significantly influence the probability of adopting adjusting planting date, improved crop varieties, crop diversification, small scale irrigation and soil and water conservation at 1%, 5 %, 5 %, 1 %, and 1% significances level, respectively. The result was confirmed with the findings of (Fisher *et al*, 2015), (Makate, C., Wang, R., and Makate, M, 2016) and (Kinuthia, 2018). The possible reason might be information is an important precondition for FHHs to update the knowledge on climate change meaning that women who are aware of climate change conditions have higher chances of taking adaptation measures in response to observed climate changes.

***Perception of climate change:*** The perception of climate change influence positively and significantly the likelihood of adopting adjusting planting/sowing date, improved crop varieties, crop diversification and small-scale irrigation at 5%, 1%, 5% and 1% significance level, respectively. The result is consistent with prior expectation and the findings of (Montle and Teweldemedhin, 2014); Sani and Chalchisa (2016) and Chete (2019)) who found that perception of climate change positively and significantly influence the probability of adoption of Small scale irrigation, Crop diversification and adjusting planting date and improved crop varieties as climate change adaptation strategies, respectively. The positive association between perception of climate change and choice different climate change adaptation strategies implies that adaptation to climate change is a process that initially requires perceiving the climate has been changing and then identifies the necessary adaptations strategies to be implemented.

***Frequency of extension contact***: The result indicates the frequency of extension visits to the households has positive and significant influenced using adjusting planting date and improved crop variety as climate change adaptation strategies at 10% significance level. This result is similar to prior expectation and the finding of (Taruvinga, A., Visser, M. and Zhou, L, 2016) and (Dang, H.L., Li, E., Nuberg, I. and Bruwer,J, 2019). As explained by them the more contact with extension agent are more likely to be aware of the climatic condition as well as knowledge of various adaptation practices and persuade them to adopt those strategies through setting up experimental demonstration farms, which helps to them to employ those strategies.

***Distance from the nearest market:*** It influences negatively and significantly the likelihood of adopting improved crop variety, crop diversification, small-scale irrigation, and soil and water conservation practices as climate change adaptation strategies at 10% for the former and 5% significances level for the rest of adaptation strategies. The result is in line with prior expectations and the finding of Musa (2016); (Opiyo, F., Wasonga, O.V., Nyangito, M.M, 2016); (Belay *et al*, 2017) and GC and Yeo (2019). The possible reason might be Proximity to market is an important determinate to climate change adaptation, since it served as a means of exchanging of in formations.

**Conclusions and Recommendations**

According to the Likert scale measurement among 150 FHHs 89.7% and 88% of the respondents perceived increasing temperature and decreasing of rainfall, respectively. FHHs adopt different climate change adaptation strategies to adapt to the negative impact of climate change so as to sustain and improve their livelihood. The study pointed out that 75.2%, 73.2%, 71.1%, 64.9% and 65.6% of female headed household were using soil and water conservation, crop diversification, small scale irrigation, improved crop varieties and adjusting planting/sowing date, respectively. A multivariate probit model was employed to identify determinates of FHHs climate change adaptation strategies choices. The results of the model showed that there are complementary correlations between improved variety and adjusting planting/sowing date, crop diversification and adjusting planting/sowing date, crop diversification and improved variety, small scale irrigation and crop diversification, soil and water conservation and crop diversification and soil and water conservation and small-scale irrigation.

According to the econometric model result, the adjusting planting date was positively and significantly influenced by landholding size, family size, and access to climate change information, perception of climate change and frequency of extension contacts. Using improved crop varieties also positively and significantly influenced by family size, access to climate change information, perception of climate change and frequency of extension agent and crop diversification positively and significantly influenced by family size, information to climate change and perception to climate change. Moreover, a household using of small-scale irrigation positively and significantly influenced by age of the households, landholding size, information and perception to climate change and finally soil and water conservation positively and significantly influenced by age of the household, landholding size and information to climate change. In order to enhance young women, climate change adaptation in the woreda development agents and extension workers could create awareness on the negative impact of climate change.

Encouraging the provision of adequate and effective formal and informal education to the rural FHHs is important to enhance their choice of climate change adaptation strategies and facilitation of time arrangement for its provision since women are busy at their farm during day time and at night homework’s and could be given at peak seasons.

Table 1: Determinants of women Choice of climate change Adaptation Strategies

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | AJPD | | IMPVCOPVRTY | | CRODV | | USEIRG | | SOILWC | |
| Variables | Coef. | Robust Std. Err. | Coef. | Robust Std. Err. | Coef. | Robust Std. Err. | Coef. | Robust Std. Err. | Coef. | Robust Std. Err. |
| AGE | -.009 | .0176 | -.016 | .017 | .014 | .019 | .053\*\*\* | .019 | .043\* | .025 |
| YEAREDUC | -.076 | .063 | -.046 | .060 | .118\* | .068 | .045 | .068 | .051 | .066 |
| LANHSIZ | .627\*\* | .259 | .228 | .291 | .447 | .302 | .709\* | .394 | .824\*\*\* | .284 |
| TOTALFZ | .227\*\* | .106 | .302\*\* | .118 | .225\* | .127 | -.065 | .108 | .094 | .108 |
| TLUF | .025 | .074 | -.033 | .089 | -.034 | .100 | -.007 | .075 | .075 | .079 |
| ANNULINCO | -.044 | .037 | -.044 | .036 | -.038 | .038 | -.093\*\* | .039 | .028 | .046 |
| INFORCC | 1.526\*\*\* | .416 | .795\*\* | .332 | 1.44\*\*\* | .424 | .685\* | .378 | .732\* | .384 |
| DHPRCC | 1.352\*\* | .605 | 1.74\*\*\* | .514 | 1.22\*\* | .577 | 1.16\*\*\* | .444 | .499 | .479 |
| RCR | -.240 | .282 | .0083 | .2754 | -.040 | .272 | -.379 | .307 | -.169 | .295 |
| DAYPRYR | .018\* | .011 | .019\* | .011 | -.0008 | .0109 | .0141 | .013 | -.012 | .011 |
| DITACEMEKT | -.064 | .045 | -.088\* | .047 | -.125\*\* | .055 | -.095\*\* | .049 | -.133\*\* | .052 |
| CONSTANT | -1.99 | 1.524 | -1.17 | 1.52 | -1.94 | 1.45 | -1.32 | 1.54 | -3.25 | 2.18 |
| Predicted probability | | .656 | .649 | | .732 | | .711 | | .752 | |
| Predict probability success | | | | |  | | .419 | |  | |
| predicted probability of failure | | | | |  | | .082 | |  | |
| Log pseudolikelihood | | | | |  | | -264.26 | |  | |
| Wald chi2(55) | | | | |  | | 275.56 | |  | |
| Prob> chi2 | | | | |  | | 0.0000\*\*\* | |  | |
| Number of observations  Number of drawing | | | | |  | | 150  5 | |  | |

\*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%

Source: Own survey result, 2018

Table 2 continuous…

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Estimated correlation matrix of adaptation strategy | | | | | |
|  |  |  |  |  |  |
|  | 1 |  |  |  |  |
|  | .867\*\*\* (.065) | 1 |  |  |  |
|  | .515\*\*(.258) | 623\*\*\*(.124) | 1 |  |  |
|  | .114(.320) | .231(.189) | .551\*\*(.215) | 1 |  |
|  | .039(.273) | .189(.171) | .411\*\*(.171) | .592\*\*\*(.224) | 1 |
| Likelihood ratio test of rho21 = rho31 = rho41 = rho51 = rho32 = rho42 = rho52 = rho43 = rho53 = rho54 = 0: | | | | | |
| chi2(10) = 94.6326 Prob> chi2 = 0.0000\*\*\* | | | | | |

\*\*\*, \*\* indicate significance at 1%, 5%.

Note: Coefficient and robust standard errors in the parentheses

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* 1. Effects of Forest cover change on land surface temperature, and annual precipitation in Sub-Acobo Watershed of Southwestern Ethiopia

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***Abstract***

*Forest conversion, in case of deforestation, is a major driver of climate change in the current decade. As a result, this study was conducted in Southwest Ethiopia's remnant forest, using Landsat images from 1978-2018 then classified by ENVI-5:0 and the CA–Markov modeler to predict future extent. Temperature and precipitation data were collected from Ethiopian metrological stations from 1969 to 2018, but used IPCC (AR4) global climate models for future scenarios. The Kapha coefficient ranged from 0.87-0.95, indicating that image classification is perfect. The simulated image accuracy results (84.5%t) were also accurate, followed by good Kno results (89-99 %), indicating that the simulation was successful and the CA-Markov model was effective to predict future spatial and temporal land cover trends. Over the last 40 years, forest cover has lost 35.17 % (36366.8 ha) and is expected to continue losing 13.2% (8,728.5 ha) until 2050. Leads the upswings of temperatures by 1.3°C (1978-2018) and are expected to rise by 1.4°C by 2050. However, average precipitation decreased via 10.1 mm (1978-2018) and expected to decrease by 10.5 mm till 2050. In addition, the length of the rainy season has also decreased from eight to five months (1978 to 2018). We concluded that the forest cover had changed, resulting in micro and macroclimate variability in the area. Indicated 100 ha of forest conversion leads to -0.02239 mm precipitation and 0.00677 °C increment. Therefor policymakers, upstream and downstream stakeholders, should work together to protect it.*

**Key words:** *Forest cover, surface temperature, annual precipitation*

**Introduction**

Globally, forest cover change has posed a threat, particularly in developing countries such as Ethiopia, which has a lower forest cover (Teketay, 2001; Wassihun et al., 2019). The loss is primarily caused by anthropogenic land use and land cover change and greenhouse gas effects (Hailemariam et al., 2016). From the history of Ethiopia, the majority of the highland area has experienced a high level of land use land cover change because of forest conversion into agricultural (Assefa & Bork, 2014). Ethiopia lost an average of 140,900 ha or 0.93% per year, between 1990 and 2010 (Wood et al., 2019)ood, et al., 2019).The natural vegetation cover of the southwest reduced in the case of settlements and cultivated area expansion, however much of the deforestation occurred in the last two decades because of demographic pressure (Bewket & Abebe, 2013). The Afromontane rain forest in southwest Ethiopia is a remnant of the country's largest evergreen forest, which covers a vast area and have high potential for climate stabilization in the area (Tadesse et al., 2014). According to the current study, temperature was increased but precipitation was reduced dramatically due to a variety of factors (Shaver et al., 2000). These factors include forest cover change reduction and global greens gas emission ( Sutcliffe, 2009; Wood et al., 2019). Particularly forest cover change due to agricultural expansion and investment activity, which is carried out without regard to the climatic impact and ecological potential of these natural forestlands have a grate factor for precipitation variability and temperature increment ( Sutcliffe, 2009). For the reason that , many hectares of forest have been converted into agricultural investment (Wood et al., 2019) because deforestation accounts for 15%–25% of annual global GHG emissions. However, this figure may rise to 70% in African countries due to a lack of policy incentives to reduce deforestation (Meshesha et al., 2016a).

Climate change rapidly increased due to the concentration of greenhouse gases in the atmosphere in case of greenhouse gases emission and land cover conversion (Cardinale et al., 2012; Hooper et al., 2012). Forest cover change are saver effects since have a bio-geochemical (adding up of CO2 to the atmosphere and decreasing carbon storage in the trees hence reduce CO2 fertilization ) and bio-geophysical effects ( increasing surface albedo and decreasing evapotranspiration)(Alawamy et al., 2020). Hence Surface air temperature is projected to rise due to the rise of greenhouse gases in the air. This leads to more evaporation and, subsequently, more water vapor is likely to become available in the atmosphere. Therefore, an increase in the intensity as well as the frequency of extreme precipitation events ,this may lead to an increase in the frequency of natural disasters such as floods, soil erosion, and water hazards in one area but their reduction of availability in another area due to wind effects (Nayak et al., 2018). Many researchers stated that deforestation in Ethiopia has resulted in an increasing average land surface temperature (LST) (Abera et al., 2021), and as temperatures at the Earth's surface rise, more evaporation occurs, increasing overall precipitation. As a general rule, a warming climate is expected to increase precipitation in many areas; however, the amount of precipitation is affected by the winds blowing over the land surface because they carry more water vapor due to shifts in wind patterns; some areas are warming more than others; and some have experienced low precipitation (Wan Mohand then d Jaafar et al., 2020). The clarification of land cover change effects on climate variability is critical because land cover conversion in the case of deforestation is a key driver of ecosystem devastation and a great land-atmosphere interaction leads to temperature and precipitation variability in this area(Meshesha et al., 2016b; Senbeta et al., 2008). Consequently, this study was important, to indicate the current extent and notice the future land cover transformation, by the change detection technique of land cover dynamics based on time and space, their by analyzing this effect on rising temperatures and changing rainfall patterns. Because climate variability is already affecting agricultural production and quality, threatening people’s economic stability of Ethiopia (Moat et al., 2017).

The aim of this study is to determine the forest cover change extent and the impact of land-cover change on temperature and precipitation variability of this area.

**Methodology**

**Location and description of the study area**

The study area is located in Southern Nations, Nationalities, and People's Regional State of Ethiopia which is found in Sub- Watershed of Acobo within the geographic coordinates of 5.33° to 7.26°N latitude and longitudes from 34.88° to 36.14°E (Figure 1). It is located 640 km from Ethiopia's capital, Addis Ababa, on the way to South Sudan, under the Baro Acobo Sobat basin, one of the tributaries of the White Nile, which provides half of the flow of the White Nile at Malawkal in Sudan and the forest is found overhead the Jebal Aulia Dam of North Sudan, (Denu et al., 2016).

**Land Use/ Land cover change trend assessment**

***Satellite data and processing***

The current strategies for monitoring the effect of climate variability ecosystem component caused by humans and other related factors are land-use and land-cover conversion analyses (Eguiguren et al., 2019). To do this, space-borne imagery to monitor land-use and land-cover dynamics was regularly applied (Abera et al., 2021; Meshesha et al., 2016b; Tewabe & Fentahun, 2020). In the same way, it was used a set of different time-series satellite data in 1978, 1988, 1998, 2008, and 2018, acquired from the United States Geological Survey (USGS) Landsat Archive (https://earthexplorer.usgs.gov) of earth explorer. Using a different ID (Land sat 2, 5, 7, and 8), sensor (Multispectral scanner, Thematic mapper, Enhanced thematic mapper, and Operation Land Image) with a raw 055 and path 183 and 170 with a low cloud cover (0.5 to 2%), and spatial resolution of 30 m x 30 m and 60 m x 60 m. It was selected this year because forest cover change has been occurring because of many driving agents in the forests, like investment (from 1986 to 2018) and new settlement organized by the government (1984 to 2018), in addition other settlers since 1979 from all the corner of the country were settled and made a pressure on the forest environment.

***Software tools and model applications***

Remote sensing application for  land cover dynamics  was  the most applicable method and mapped the  land cover changing aspects with a minimum error today  because  it was difficult to estimate by conventional  means (Hamza & Raghuvanshi, 2017; Meshesha et al., 2016b). It was used remote sensing software ENVI 5:0 for image pre-processing, training and classification, and interpreting imagery acquired from the Landsat image based on the emitted and reflected radiation.  In addition, the geographical information system (GIS) was used for manipulating, area calculation, UTM WGS 1984 (36 N) projection, and for the finalization process.

The model Markov Chain Analysis was the best and frequently used for land change simulation by developing a transition probability matrix (Guan et al., 2011; Sultan et al., 2018). This model was frequently applied in the world to analyze temporal change and spatial dynamics (Demissie et al., 2017; Dibaba et al., 2020; Meshesha et al., 2016b), and it was good for projecting land cover dynamics for future scenarios (Hamad et al., 2018). This model was found entrenched in IDRISI (CA–Markov), Land Change Modeler because this model has high efficiency in predicting the magnitude of change in the future (Kamusoko et al., 2009). Accordingly, it was used this software for the simulation of land cover change for the prediction until the 2050 future scenario for the estimation of the future land dynamics extent.

**Classification of images and verification of their accuracy**

***Image Pre-processing***

The image data was improved by suppressing unwanted image misrepresentations. Based on this, the acquired image was projected to the 36 N system zone using the Universal Transverse Mercator (UTM), followed by pre-possessing of the Landsat image for accurate classification and computing meaningful information from remotely sensed data. Image enhancement was primarily accomplished by modifying the images to clarify and make them more suitable for classification. Radiometric pre-processing was used to address pixel variations (via ENVI, calibrate restart), geometric corrections to eliminate geometric distortion between OLI and TM sensors (via ENVI Ortho-rectification), and Quaic and Flash atmospheric correction to reduce the atmospheric effect and noise. ENVI 5:0 used filtering for edge enhancement.

The regional and zonal forest conservation and natural resource offices provided a map of the forest, which was geo-referenced and used to develop a ship-fill using Arc GIS to clip the region of interest. It was used layer stacking, followed by mosaicking, to combine all of the years into a single file. Gap filling of Landsat 7 image using build-masking approach was completed similarly to others (Assefa & Bork, 2014; Guan et al., 2011). After correcting the environmental variables, it processed this all, to the same geographic extent, cell size, and coordinate system. The classification was done after enhancing and correcting, the environmental variables. ENVI 5:0, remote sensing software used for supervised image classification techniques using the Mahalanobis distance extracted procedure (A fast-supervised tactic). This was done after processing the spectral signature of each region of interest concerning the land cover category. This study began with the classification of five land use categories after Quick and Flash atmospheric correction of the Landsat image. For this, the image was pre-classified based on a supervised classification that took place in the year 2018 and then misclassified areas were corrected by imposition and relocating the samples in ArcGIS. This classification includes natural forest, semi-forest, coffee plantations, grass/ shrubs, and agricultural lands (Table 2). However, it was found the wetland class category which was very small in land size (<900m2) because pixels with probabilities lower than 30 x 30-pixel dimensions were not classified (Charlot et al., 2015; Guan et al., 2011).

The accuracy of this spatiotemporal classification was determined by collecting 450 ground-truth points with a GPS navigation system (which was only used in 2018) and converting them into a vector file to overlay on the region of interest in ArcGIS software using overlay functions. The accuracy assessment of the past-classified map with the current ground truth data, on the other hand, was uncertain. As a result, it was used previous maps and Google Earth Engine (2008), but image accuracy assessments for 1978, 1988, and 1998 were not possible due to a lack of clear Google Earth images. Then, it was used the land history information gathered from local peoples (1978, 1988, and 1989). To ensure the accuracy of the future land cover dynamics (2050 classification), it was followed two steps: The first step was, to simulate the map of 2018 from the 2008 validated map. The second step was comparing the simulated with the actual land use and land cover classified image of the year 2018 and then validated by the ground truth data. After validation, a likelihood of the pixel changing or remaining unchanged into another class was mapped by creating the transitional suitability maps and then predicting the future land cover map for 2050 (Hamza & Raghuvanshi, 2017; Kamusoko et al., 2009).

Classification accuracy was determined by comparing the ground truth and visually interpreting remotely sensed data. These were weighed by extracting 65, 70, 80, 95, and 140 reference points from satellite images for grassland, coffee plantation, agriculture, semi forest, and natural forest, respectively, in pixel points of the classification category. The result was unified by the lookup table approach as an error matrix with a rule of thumb of 50 minimum sample points (Congalton, 2001). However, for the projected land-use type, it employed the Kno and KLocation, standard testing methods, to test the accuracy of the model.

***Change analysis***

The land use/ land cover dynamics over the period were done in many parts of Ethiopia by many scholars (FAO, 2010; Kim, 2016), dominantly using remote sensing data analysis techniques to determine the land cover dynamics. Therefore, the land use/land cover change detection percentage, rate, and decadal loss  were computed based on the standard equation (Barbier, 2007; Feuillette et al., 2016; Kindu et al., 2016) (Eq.1, 2, and 3).

Percentage change (%) = Final (A) -Initial (A) x 100…………………….…….Eq (.1)

Initial (A)

Rate change (ha/year) = Final (A) - Initial (A)..…………..….…….…….……...Eq (.2)

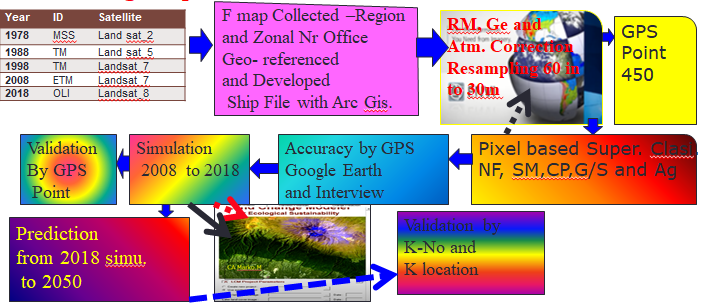
No: of Years

Decadal change = Final (A) - Initial (A) ……...….……….…………….……….Eq (.3)

***Climate data***

At a broader level, the World and Regional Climate Database(GCM & RCM), derived from monthly temperature and precipitation, has been used by numerous researchers to study the effects of land cover change on climatic variability but these data are more appropriate at a larger scale and it is not logical to use them for small scale areas (Antonić et al., 2001; Hijmans, 2004).

As a result, temperature and precipitation data from 1969 to 2018 provided by the Ethiopian Meteorological Services Agency (NMSA, 2019) were used to determine the temporal variation and calibration of these climatic factors. To do so, the Ethiopian Metrological Services Agency provided locally available precipitation and temperature data covering the period from 1969 to 2018. These data were gathered from 17 different metrological stations (Maji, Coky, Tepi, Yeki, Bebeka, Sheshenda, Masha, Shwabench, Shewagimra, Aman, Mizan, Gorie, Gambella, Dima, Bonga, Wishwish and Masha (NMSA, 2019), for this forest region, which was utilized in the same way as others (Kroeger & Casey, 2007). The metrological data from 12 weather stations (Tepi, Yeki, Masha, Bebeka, Sheshenda, Shwabench, Shewagimra, Aman, Mizan, Gambella, Gorie, and Maji) because they contain the least missing data with a long historical record (20 to 50 years) and are all located within or near the Forest Coffee's margins. When necessary, the remaining five weather stations were used to fill data gaps using correlation techniques, with a cut-off of 0.2 considered a significant fit for filling missing values. This was arranged within the period from 1969 to 1978, 1978 to 1988, 1988 to 1998, 1998 to 2008, and from 2008 to 2018.However, for the future climatic variability assessment, the IPCC fourth assessment report (AR4) global climate models (GCMs) was used that were gathered up to 2050 downloaded from the WorldClim database (www.worldclim.org). It was generated at a 30 arc-second spatial resolution (1 km) through an interpolation algorithm using long-term average monthly climate data from weather stations (Figure 2). ArcGIS was used for the interpolation of raster grids and the output was also validated using root mean square errors.



**Emissivity**

**Radiance** to **Brightens**

**DN to radiance**

**Thermal band**

**Metrological data**

**Computing**

**Interpolating by Arc GIS**

**Clipping by Arc GIS**

**Selection detailing**

**World Climatic Data 1950-2050**

**Station data (1969 -2018)**

**LST**

**Analyses**

Figure 2. Structural Frame Work

The potential impact of forest cover change on land surface temperature (LST) is quantified by multiyear averaged difference between unchanged forest and nearby non forest, as quantified in equation (1): For this Pixl based LST data estimation Landsat image were used (Section 2.2) basd on the spectral radiance (Lλ) at the satellite level related to the Termal Bandas of the Image . Finaly ANOVA F-tests (p-value < 0.01), and mean test by Tukey, HSD (honesty significant difference) technique was made for both curent(with in land cover) and temporial vartation using R softwar.

ΔLST = LST forest – LST non-forest…….Eq.(1)

# Results and Discussion

The land use and land cover image classification has more than 85% total accuracy based on the reference data for the years between 1978 to 2050. This means all land use types are well represented in the classified images and the high accuracy of our classification means the output of our analysis high probability of reliability and thus suitable for use in decision making process. The Kapha coefficient analysis ranged from 0.87 to 0.95, which indicate that the image classification is nearly accurate and thus an excellent classification and a better result (e.g., Kapha 0.842 to 0.902 deemed better). The simulated image of the 2018 accuracy results also showed a good prediction, with an overall accuracy of 84.2 % and a Kapha coefficient of 0.85. Based on this, the Kno and Location result was 89% and 99% respectively, indicating that the simulation model correctly identified and specified the location on the simulated model, which showed the CA- Markov model, was successful and good enough to predict future spatial and temporal land cover trends.

**Detection of temporal land covers changes**

The forest coffee cover change detection was an imperious factor for climatic variability that forest alterations to other land cover provided valuable information on the impact environmental components. From the result, forest cover loss between 1978 to 1988 were 11,052.6 ha, from 1988 to 1998 22080.6 ha, from 1998 to 2008 3234.4 ha and from 2008 to 2018, were 8,728.5 ha (Table 1 and Figure 3). This finding is in line with the works of other author who reported in the country that forest cover reduced since 1991 (by 33.5%) due to the expansion of agriculture (23.68%) on the expense of forest (Negassa et al., 2020).

The result indicates that Forest Coffee first converted into semi-forest, which later on change into mainly agriculture or used for various investments. Similar findings also indicated, such alterations have been common in the past in this forest region and will continue in the future (Sutcliffe, 2009). The highest conversion rate of forestland to other land cover detected from 1988 to 1998 was estimated at 2208 ha/yr., because of the starting phase of agricultural investment and land garbing by government-sponsored settler. Followed by the first decade (1978 to 1988), 1105.2 ‘ha/year, and the rest also indicated a considerable conversion rate 793.2 ha/year (2008-2018), 601.6 ha/year (1998 to 2008), and 323 .2 ha/year (2018 to 2050) (Figure 9). A decrease in the LULC conversion rate over the last decade (2008 to 2018) could be attributed to a decrease in settlers, which has also influenced the future LULC conversion rate.

Our model showed that 35.17 % of forest cover is reduced over the last 40 years, and that this trend will continue until 2050 with 13.2 % of forest cover being lost over the coming 32 years (from 2018-2050). Natural forest cover, and grassland, which were converted into agriculture, and investment land. It appears that increasing investment and the rise population due to settlement has a significant impact on the forest and grassland of the area. Coffee investment grew at a rate of 1056 hectares per year from 2008 to 2018, and agriculture is expected to grow at a rate of 1232 hectares per year until 2050, harming forest coverage and affctec the total climatic patrn in the area . This result agrees with the prior studies in Southwestern Ethiopia since 1980, which showed a 36 % reduction in forest cover and hence temperature and annual rain fall was extremely affected(Aerts et al., 2011; Tadesse et al., 2014). Agriculture and investment, on the other hand, showed an increased trend, except grassland, which was found decrease. This change in the inter period has a significant impact on c temperature and precipitation and thus contribute to global warming (IPCC, 2006).

Table 1. Land covers change from 1978 to 2018 and the expected future amount

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| LULC  Name | Land cover change (ha) | | | | | |
| 1978 | 1988 | 1998 | 2008 | 2018 | 2050 |
| Natural forest | 128223 | 117170.4 | 97871.8 | 91855.2 | 83126.6 | 72134.1 |
| Semi forest | 7694.64 | 9847.81 | 22521.5 | 25303.7 | 25571.6 | 28443 |
| Coffee plantation | 0 | 3446 | 9289.31 | 12893.6 | 23456.1 | 31134.6 |
| Grass and Shrubs | 9190.0 | 7903.04 | 6005.14 | 4688.2 | 1234.3 | 444.7 |
| Agriculture | 4070.5 | 10810.89 | 13490.3 | 14437.2 | 15789.5 | 17021.5 |
| Total | 149178.2 | 149178.1 | 149178 | 149177.7 | 149178.2 | 149178.1 |

**Temperature variability in relation land cover**

It was observed that surface temperature (LST) was induced by forest cover change and it was observed that the nearby land cover are higher mean temperature that increased by 6.13ºC(Agriculture) as compared to nearby unchanged forest, which the potential impacts are estimated at locations in the vicinity of observed forest changes. The Δ LST indicated different effects of forest and non-forest in regulating local temperature as a consequence of their different biophysical properties (Table 2). In this way, Δ LST provides an a priori estimation for the potential impact of forest cover change on temperature, using the existing vegetation before any forest

**LULC Dynamics effects on temporal Temperature and precipitation**

This study found that the mean annual temperature increased over the research period and expected to continue to rise, whereas the mean annual precipitation reduced (Figure 4 and Table 2). From the result mean temperature in the study area increased by 1.3° C over the last thirty years (1988 to 2018), and expected to rise by 1.4° C by 2050 (Figure 30 and 33). Many studies also indicated a similar trained exists in the area (Abebe, 2017; Asfaw et al., 2018; Chemura et al., 2021). These effects increased over the last 50 years, and they expected to worsen in the future (Asfaw et al., 2018; Wolff et al., 2018). Ethiopia, like other Sub-Saharan African countries, was extremely vulnerable to the effects of climate change, which already being felt due to the declining productivity of agricultural products((Gebrehiwot & van der Veen, 2013).

Table 2. Current (2018) land surface temperature (LST) and Temporal variation of the tow variables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| LULC | Current variation of  LST (2018) | | Temporal variation | | | |
|  | | Variables | Years | | 100 ha  loos |
| Average  LST ºC | Deference  Forest-LULC |
|  | |
| 1978 to  2018 | 2018 to 2050 | Effects |
| Natural forest | 18.1 | 0a | Temperature(°C) | 1.3 | 1.4 | +0.00677 |
| Semi forest | 18.12 | +0.02a |
| Coffee investment | 19.1 | +1b | Precipitation (mm) | 10.1 | 10.5 | -0.0223 |
| Grass and Shrubs | 24.2 | +6.1c |
| *Agricultural land* | *24.23* | *+6.13d* |
|  |  |  |  |  |  |  |

Mean comparison with Tukey HSD, which indicate: The same alphabetical letters show no significant difference between the mean but different letters indicate a significant difference between the mean at 5% significant level.

The average precipitation decreased by at least 10.1 mm between 1998 and 2018, and expected to decrease by another 10.5 mm between 2018 and 2050 (Figure 5). This was in contrast to some East African research findings, which anticipated increased yearly rainfall but increased dry spells (Antonić et al., 2001). Although several studies in Ethiopia demonstrate considerable annual and decadal rainfall variability, a scarcity of data makes detecting long-term trends of rising or decreasing annual rainfall problematic (Locatelli et al., 2020). There was no statistically significant trend observed in this region of Ethiopia from the current study or previous studies, and the increasing annual rainfall reported elsewhere could be largely due to increased rainfall in the southern part of Ethiopia during the October–December period (Antonić et al., 2001; Asfaw et al., 2018; Williams et al., 2012). Our climatic model output, on the other hand, was related to the precipitation pattern of Gore, a nearby meteorological station that had been recording precipitation data since 1953 and showed a decreasing mean of precipitation (Williams et al., 2012).

***Relation climatic conditions with Forest covers change rate***

Even though other factor contributes for climatic changeability this study shows that changing land use from forest to other land cover increases the temperature. The result indicated that, the rate of minimum and maximum temperature was increased from 1978 to 1988 by 0.045 and 0.041 in °C /year because of the reduction 1105.2 ha/year, and expected to increase by 0.0406 and 0.043 in °C /year respectively from 2018 to 2050 due to 343.5 ha/year forest into other land cover conversion (Table 3).

Precipitation also reduced by 0.256 mm/year rate from 1978 to 1988 and 2018 and will b/e reduced by 0625 mm/year rate in the coming 32 years because of the this forest cover reduction by 1105.2 and 1134.8 ha/year reduction (Table 3). In addition the respondent observed and suggested that the rainy seasons were also reduced from 8 month in 1978 to an average of 5 month in 2018 and the trained will expected to continue until 2050 and affect the too total welfare in the area.

|  |  |  |  |
| --- | --- | --- | --- |
| Rate of Description | Rate | | |
| 1978-1988 | 1988-2018 | 2018-2050 |
| Natural forest/year | -1105.2 | -1134.8 | -343.5 |
| Minimum temp. °C /year | -0.045 | -0.05 | -0.0406 |
| Maximum temp. °C /year | -0.041 | -0.0466 | -0.043 |

Table 3. Forest covers change rate effect on precipitation.

|  |  |  |  |
| --- | --- | --- | --- |
| Rate of Description | Rate | | |
|  | 1978-1988 | 1988-2018 | 2018-2050 |
| Natural forest/year | -1105.2 | -1134.8 | -343.5 |
| Average precipitation mm /year | -0.256 | -0.293 | -0.0625 |

Similarly many scholar sated that climate change increased dramatically (IPCC 2006), increased by 1.5 . °C in the last 50 years, and they expected to worsen in the future (Asfaw et al., 2018; Wolff et al., 2018). Ethiopia, like other Sub-Saharan African countries, was extremely vulnerable to the effects of temperature increment (Budyko, 1974; Gebrehiwot & van der Veen, 2013). Likewise the other study showed that changing forest to other land cover reduces rainfall by 50% due to temperature increment which affects clouds formation (Garcia-Carreras & Parker, 2011) . Other also indicated that deforestation caused regional declines in precipitation ((Guzha et al., 2018)) because Forests were understood to create rain within a locality and region (Bennett & Barton, 2018). However, other showed complete deforestation would slightly increase rainfall in some parts of Africa but dramatically affect rain pattern of seasonality and amount across the continent of Africa (Duku & Hein, 2021),

1. **Summery and Conclusion**

Forest cover conversion is the primary driver of climate change in the current decade. As a result, this work is revealing the current extent of land cover change and detecting future land cover conversion in the southwestern Ethiopian forest using space-borne data and a change detection technique. The amount of forest cover had been decreased by 35.17 % (36366.8 hectares) over the last 40 years, and this trend is expected to continue until 2050, with 13.2 % (8,728.5 ha) of forest cover being lost over the next 32 years. This has had a detrimental influence on the average temperature in the research region, which has risen by 1.3°C in the last thirty years (1988 to 2018), and is anticipated to climb by 1.4°C by 2050. However, average precipitation fell by 10.1 mm between 1988 and 2018, and is anticipated to fall by another 10.5 mm between 2018 and 2050. The rainy season has also lowered from eight months in 1978 to five months in 2018, and predictable to continue through 2050, affecting the overall well-being of the area.

We concluded that the forest cover had altered and the area had undergone significant changes as a result of the interaction between natural processes and human activities. These pressures had an impact on the region's micro and macroclimates. As a result, policymakers, upstream and downstream stakeholders should be concerned about developing appropriate measures and long-term conservation policies.

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* 1. Provisions for Sustainable Urban Agriculture In Addis Ababa: The Urban Planning Perspective

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# Abstract

*Various researchers have identified urban planners, urban planning policy and the other elements of the planning policy context as posing serious problems for urban agriculture. “Urban Planning reform” has been suggested as a solution to common problems faced by urban farmers. Hence, the aim of this study is to investigate the role of urban agriculture for sustainable landscapes in the urban planning perspectives. Therefore, this study might help to reduce the misconceptions about the role of urban planners in envisioning and effecting community changes by describing what urban planning is and what urban planners do upon urban agriculture in order to make urban Agriculture as integral components of the land use planning in the City Structural Plan. The analysis of the study was based on both the primary data (by using various tools including interview, questionnaire Survey, observation, Focus group discussion) and secondary documents that were collected from the concerned agencies, and various institutes of urban administrations at sub-city and city level with respect to city structural plan in all case study sub-cities as well as Digital maps through GIS and Remote sensing. Furthermore, the analysis result also confirmed that less attention has been given to urban agriculture as integral parts of the land use planning. Thus, this research concludes that there is laxity in promoting and enhancing urban agriculture for sustainable landscapes including balcony agriculture in different residential buildings like condominiums and apartments in urban planning perspective. Finally, this research recommends “Start Planning and Design with Urban Agriculture as an integral component of City Plan.*

**Key Words:** Urban Agriculture, Edible-Urbanism, Urban Planning, Structure Plan, Sustainability

**Introduction**

Urbanization is a world‐wide phenomenon: if more than 55% of the world population is living now in cities (Véron, 2020), the rapid growth of towns concern specifically developing countries. Their annual urban growth rate is 3.6% between 1950 and 2005, compared to only 1.4% in industrialized countries. Urban growth in developing countries is scarcely well planned, because of the lack of adequate infrastructures, of financial means, and because of fast and uncontrolled migrations from rural areas. Urban planners’ priorities in these poor countries are less the landscape maintenance than the ways to contain the increasing informal habitat, to improve the offer in transportation or other basic services (health, education, security) and to manage the waste production (Parrot *et al.*, 2008). Nevertheless, developing country cities, especially in Africa, are also remarkable for the spatial importance of agriculture near and even inside the cities. This Urban Agriculture often occupies a significant part of urban and peri‐urban spaces and faces a strong duality between the rapid and often uncontrolled consumption of land by urban activities and the conservation of land for agricultural production: in fact, Urban Agriculture in poor countries is often increasing in terms of total production (Cour, 2017).

In recent years, there has been a tremendous upsurge of interest in growing food in urban environments including Addis Ababa City Administration. This has primarily been in response to concerns about food prices, food miles, and the negative impact of current industrial agriculture practices on the environment. It has also been because people want better access to good life, healthy, and affordable food, and to enjoy cultivating beautiful green spaces and meeting local people in their own community through *good urban design and planning.* The emphasis has also been on how urban agriculture landscapes are built on more sustainable goals and values. *The urban planning and design strategies* will be expected to aid in designing new urban agriculture landscapes so as to meet the rising demand and to look at the capacity to expand the idea of the sustainable city. *The planning process for an urban agriculture system* is currently overly complex simply because it is new to the City development process for most stakeholders in both private and public sectors and because many ordinances and laws exist that limits its potential as a viable ***ecological,*** *social, cultural, and market-economy-driven* system in the city. And, it’s really is a complex system of connections that are in need of being harnessed or linked in order to create thriving urban agriculture enterprises and successful, productive landscapes. Making decisions about ***urban food citie****s* needs to be done with the community members who will be directly involved in ***making sure the food system*** that is set up by those decisions carries on.

Furthermore, in the particular case of ***food cities***, as urban sprawl consumes fertile land, agriculture is increasingly being confined to the countryside, where production has adopted industrial practices during last century. In consequence, the heavy dependence of cities on vast areas of rural land to feed their inhabitants (Deelstra & Girardet, 2000) is ***exacerbating the spread of hunger in many cities of the world*** (Halweil & Nierenberg, 2007). Although cities were once considered land of opportunity and improved living conditions (Orsini et al., 2013), more than ever ***poverty and malnutrition*** are turning out to be urban phenomena (Mougeut, 1999). In consequence, how to supply the world’s increasing population with enough and adequate food is becoming an impending concern (Kremen et al., 2012). Hence, Cities require well ***designed and planned*** urban agriculture in structural plans as ***an integral component*** to satisfy urban communities so as to mitigate the challenges of food security systems. Cities are inevitably called to spearhead the pathway towards a more just and sustainable world, so re-examining how to feed adequately the whole urban population is becoming one of the quintessential challenges of this century (Ackerman et al., 2014; Morgan, 2015). Growing concern about ecological issues has aroused interest in the production of organic and locally-grown food. Likewise, urban agriculture is emerging in different formats as ***a planning and design response*** which often embraces practices of these latter alternative movements to the global food model. However, it is also valued for leading human beings to a healthier lifestyle, creating social bonds in local communities, ***revitalizing decrepit vacant lots*** and as a leisure activity. Meanwhile, in a very different context, agriculture has never stopped being an extended practice in cities of the Third World including ***Addis Ababa, Ethiopia*** as a livelihood strategy for millions of people to address food insecurity.

On the other hand, the physical development of the city has been influenced by periods of sporadic growth, with inefficient land use and costly infrastructure development. This pattern of settlement has encouraged land speculation and corruption in the process of poor ***land administration and management***. The municipality is estimated to have a total area of 540 km², of which 14.2 km² are considered rural. The land base will continue to experience significant pressures as the city’s population grows over the next few decades. Urban population growth in Addis Ababa and other urban centers in Ethiopia are far outpacing economic growth, resulting in large demand of food security through ***urban Agriculture*** and poverty alleviation. Thus, the City may need to consider ***agricultural production*** in its respective areas or urban fringes to improve the income and the ***food security level*** of households. Despite the fact that during the last ten years, sustainable urban agriculture and urban food systems have rapidly moved from being ***a ‘fringe interest’*** to attracting the attention of ***policymakers and urban planners*** in many cities including Addis Ababa, both in developing and developed countries so as to install ***edible city solutions*** through ***edible urbanism.*** Feeding our urbanizing world has become an ***imperative, especially in light of the climate emergency***, and city actors are increasingly responding to the challenge in the City Planning.

Therefore, ***Planning and design*** of urban agriculture is moving from just a practice for earning an income and small food-producing activities to a more sustainable practice that focuses on promoting local food production that is central to creating vital urban communities. It needs to become even more central to city planning as food security and food safety become issues that cities need to address along with the increase in population that is creating a strain on a global level with regards to food availability and health. In current practice, the term ***urban agriculture***does not necessarily mean that food production itself is based on a sustainable methodology or procedure but when combined with an ***ecological-based*** approach it does. With the recognition of natural resource decline and the advance of environmental degradation in cities today, urban agriculture is taking on new meaning in bringing ecological-based systems back into the city as a vital part of the solution to creating more sustainable cities. This does require a paradigm shift in thinking about *Urban Agriculture for satisfying Food* *Security* as *an integral part of the city’s* framework.

Urban agriculture is widely practiced as an informal economic sector across many African cities (Bryce son and Potts 2005). Even though it is a viable activity to complement food supplies from rural areas to cities, and is a means of income and food expenditure for many urban dwellers, particularly for the poor, its contribution has been ***underestimated*** (Mougeut 2000). Urban Agriculture producers are also often discouraged and ignored by the society and in policy reforms (Mougeut 2000). As (Deelstra and Girardet, 2004) put it, ***“urban designers and planners*** tend to think that urban food growing is messy business and have little understanding of peoples’ need to grow food in cities being manifested on the 10th plan of Addis Ababa City Administration enacted in 2017. It has been given less attention in designing and planning this important ***land use*** category in the processes ***as an integral component***. However, the twenty-first-century sustainable city emerging approach requires the merging of urbanism with sustainable food systems. The urban planning and design strategies for agricultural urbanism are about re-inviting food back into the city and reconnecting people with their local and regional food systems to promote a healthier and more sustainable lifestyle. It is also very important to note that in addition to needing water, food is a basic human need for human existence. Food is also essential to economic growth. Food provides a new perspective for answering the question about how we make our cities more livable places. Along with integrating a more comprehensive ***ecosystem-based approach*** to the redesign of our cities and towns to handle the ever-increasing complexity of the urban realm, integration of an economically viable urban food system needs to become an integral part of the urban ecosystems that frame the foundation of the sustainable city. ***The time has come for urban planners and designers to act as change agents*** and design for integration of natural systems with urban systems into city infrastructure. That infrastructure needs to include urban agriculture as an integral part of an economically viable food system within a city.

An economically viable urban food system would result from an ***ecological and biological based city-planning*** and design model that would focus on health ***(human and city)***, community ***(support and connectivity)***, and ecosystems ***(natural and manmade)***. Current urban design and planning is focused on the fragments rather than a cohesive whole. A new way toward designing integration is emerging through ecological-based urban agriculture. This ***integrative process***, also known as ***integrated systems thinking***, focuses on solutions based on the interconnectedness of the systems as a whole unit, rather than separate units. This study was outlining a framework of information to aid in the creation of urban agriculture landscapes that promote ecological biodiversity and social-economic sustainability. Furthermore, Consideration for creating these landscapes needs to accommodate planning and design strategies that integrate social, ecological, and economic values to achieve the best results. Plus, driving deeper into planning and policy, information was unfolded on how to incentivize and design a regenerative landscape that benefited the community and local ecology. An emphasis now must be on how urban planners and designers are the ***change agents*** for this ***new edible green infrastructure*** in today’s cities like Addis Ababa.

The time has come for ***urban planners and designers to act as change agents and design*** for the integration of natural systems with urban systems into ***edible city infrastructure*** of which urban agriculture would be part of a food system network. Current urban design and planning is focused on fragments and pieces rather than a more cohesive whole. A new path toward designing integration is slowly emerging in some planning circles through the ***lens of ecological-based urban agriculture***. This integrative process, also known as ***integrated systems thinking,*** focuses on solutions that are based on the interconnectedness of the systems as a whole unit rather than the separate units. the case study in this research has demonstrated that designers would be taking action and making changes through food landscapes that reflect an integrative systems-oriented approach that may help provide a guide for building a more **sustainable city**. This study has been illustrated how current situations and urban agriculture landscapes in the city were transforming our ideas on the integration of food into the city through the ***designing and planning of edible city solutions approach.*** In this connection Tinker in 1994: vii Cited in (Teferee, 2003) stated that: ***“Despite its critical role in producing food for the city dwellers around the world, urban food production has largely been ignored by scholars and agricultural planners; government officials and policy makers at best dismiss the activity as peripheral and at worst evict farmers, claiming that urban farms are not only unsightly but also promote pollution and illness.”*** In this regard, Addis Ababa City Administration is currently striving for giving emphasis up on urban Agriculture so as to maintain food security.

With the fast growing population in the cities like Addis Ababa, inflation and unemployment, the problem of food insecurity is ***a grave concern***. According to (Alem & Kohlin, 2013) the coping mechanisms include cutting back on consumption, working longer hours, engaging in less incentive and high energy consuming works as well as producing commercial crops and keeping livestock within their vacant space. As (MoFED, 2006) reported, urban poverty is currently becoming a growing concern, especially in large towns of Ethiopia; ***larger proportion goes to Addis Ababa***. Some sources have also clearly shown that there are insignificant efforts being made by the city administration in designing and planning of urban agriculture for sustainable landscapes. As the result ***of poor design and planning of Urban Agriculture***, the following challenges are highly perceived through observation and rapid appraisal in the city including: weak urban agricultural productivity, widen yield gaps, less sustainable yield in farms, and inefficiency of resource use.

However, the potentials of urban agriculture in Addis Ababa is very high, The City Government has recognized urban agriculture as one of the important tools to end poverty (Thomas P.Z. Mpofu, 2013). Planning and Design Urban Agriculture has been carried out in most sub-cities of Addis Ababa; but, it is not known why those urban dwellers of the sub-cities chose to engage in such a venture, and what constraints they are facing. Various qualitative evidences (Mkwambisi et al, 2011) suggest that urban agriculture has a positive impact on ***improving malnutrition, keeping microclimate balance, increasing food security*** level of households, ***increasing income as well as providing very rich micronutrients*** for household consumption. Though there are various directives and standards to design urban agriculture in the city level, there have not been any pragmatic rules guiding Urban Agriculture in Addis Ababa City Administration. This partly has been due to lack of evidences about the design and planning of urban agriculture for sustainable landscapes in the newly revised city plan. On the other hand, (Mohamed, 2002) studied “*urban agriculture initiatives in Addis Ababa on selected vegetable producing cooperatives”,* and (Tewodros, 2007) also studied the “*livelihood dependence on urban agriculture in Addis Ababa*”. However, there is ***no still an in-depth empirical study*** that characterizes the ***planning and designing of urban agriculture in Addis Ababa so as to maintain sustainable landscapes.***

Therefore, this research has been intended to fill the gaps related to the use, state and challenges for the ***planning and design Urban Agriculture for the sustainable landscapes in the city administration*** in reference to the newly revised City Plan (2017-2027). Besides, the study would facilitate and pave the way to come up with proper solutions and strategies to plan and design quality urban agriculture landscapes in the city. The study aimed at investigation and evaluation of stark realities in the ***planning and design of Urban Agriculture*** for sustainable landscapes in realizing ***edible city solutions approach*** via the transformation from ***Petropolis to Agropolis*** landscapesin Addis Ababa. The specific objectives are;

* To evaluate the existing planning strategies of urban agriculture for sustainable landscapes in the City Administration.
* To identify the determining factors affecting spatial planning and design quality of urban agriculture for sustainable landscapes transformation of Petropolis to ecopolis/Agropolis.
* To explore the development of edible city solutions through quality planning of Urban Agriculture in making sure sustainable livelihoods of the Urban Community through the transformation from Petropolis to ecopolis/Agropolis landscapes.
* To assess the spatio-temporal variation in the extent to which urban agriculture is being practiced in Addis Ababa in the past two consecutive structural plans (2002-2017).
* To set edible city solution for urban agriculture for sustainable landscapes in Addis Ababa.

**Methodology**

**Research Approaches and Strategy**

The study with mixed approaches will employ the case study strategy. The case study approach advocates the use of multiple sources of data and methods of data collection, (Yin, 1994:55). The deductive approach to data collection will try to employ both quantitative and qualitative sources as ***mixed imbedded*** and will be used concurrently, so as to enable *‘triangulation’*. The former uses open-ended questionnaire and measurements and the latter includes structured/unstructured interviews, FGDs, observations and analysis of documents including aerial photographs/digital map to examine the urban agriculture in relation to urban planning and design. These methods will help to examine the role of urban planning and design for sustainable landscapes and edible urbanism in Addis Ababa in creating regenerative and edible city solutions

**Sample Design**

The government offices will be selected from target urban centers of Addis Ababa based on the sample size results yielded by formula for survey questionnaire, FGD and key informant interview. The target public offices are 1) Urban Planning Office/Commission 2) Office of Urban Greenery and Beautification 3) Urban Renewal and Land Banking Agency in Municipal Administrations 4) Addis Ababa Environmental and Urban Forestry Authority and 5) Land Development and Management Bureau. Three focus groups from these five target public offices each with 12 participants (a total of 60 participants) comprising professionals and officials will be selected for discussions in each case study Urban Centers with urban agriculture activities from inner city to sub-urbs. Besides, a total of 12 officials (3 from each target sub-city urban centers) will be interviewed. On the other hand 384 participants (yielded by unknown population formula) from each sub-city making a total of 399 participants are planned to participate in survey for questionnaire.

As it is clear that sample size depends on the type of research and size of population under study among other things, here Kothari Statistical Formula for unknown population in the context of the research type (hence those who are involved in urban agriculture productivity population is not yet come to be known) is used. This formula is: **,** if population size is infinite or not known (Kothari 2004: 179). ***Where,*** N = Population; n = Sample size; z = Standard normal variable at the required confidence level; p = Estimated characteristics of target population; q = 1-p; d = Level of statistical significance or margin of error. To calculate sample size researcher’s used characteristics of p and q to be the same for inclusion of maximum possible sample size at 5% level of significance. Accordingly, sample size is calculated and found to be 384 households. This figure is multiplied by number of study areas in the City Administration and it yields a total of 399 sample size.

**Types and Sources of Data**

In this study both quantitative and qualitative type of data will be used from primary and secondary sources. The quantitative data will be gathered from the government offices and through survey questionnaire and field measurements as well as spatial Data. Qualitative data will be collected through theoretical literatures, unstructured interview, and observations/visual survey as well as FGDs and via document analysis.

**Methods of Data Collections and Data Sources**

The data collection methods will be conducted in two phases. First by classification and identification of ***Urban Agricultural activities and development*** in the study areas from inner to suburbs will be done. Then, the residents and experts’ opinion will be assessed through FGD, questionnaire survey and interview. The identification, usability and classification of urban agriculture fields will be carried out in the same phase. Multiple methods of data collection will be adopted in the field including customers (questionnaire Survey) at Woreda and Neighborhood level, physical survey/measurements along with support of Google Earth, ***Arial Photograph or Digital Map & GIS/Line/Nortek Maps at (plot, block) that clearly show the trend of spatial Expansion***, key informant interview, visual observation/visual survey at all scales, FGD and secondary data (GIS maps, Google Images, Line maps, Nortek and Master Plan documents and Related Documents).

***Methods******Spatial Data Collections***

To perform and analyze the sustainability of urban agriculture through time for three sub cities, different data are use like Landsat5, landsat7, and Ortho-photo. The time interval taken to do this task was between 10 years interval, 1999, 2010, and 2018.

***Spatial Data source***

The data sources that are used to do this project were from USGS **(U.S. Geological Survey)** Earth explorer and geospatial information institute organization, and summaries as follows. WGS (World Geodetic System).

*Table 3.2: Spatail Data Source*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Data** | **Datum** | **Resolution** | **Year** | **Sources** |
| Landsat 5 | WGS84 | 30m | 1999 | USGS **(U.S. Geological Survey)** |
| Landsat 7 | WGS84 | 30m | 2010 | USGS **(U.S. Geological Survey)** |
| Ortho-photo | Clarke 1888 | 25cm | 2018 | Geospatial institute |

The methods that we follow to did this project was, after downloading satellite image layer stack, radiometric correction, geometric correction, and finally classification have been done. The supervised and unsupervised classification has been done on 5 different classes, like: agriculture, bare land, built up, forest and water body that are actually exist on the land.

***Radiometric correction***

The radiometric corrections have been done for Landsat5 and Landsat 7, which used to visually interpretable and to identifiable. Haze reduction and noise reduction was done for this process. Scanline correction was also done for landsat7 satellite images.

***Geometric corrections***

The satellite image and Ortho-photo have different datum. In order to make it in the same datum the Landsat 5 and Landsat7 were converted from WGS84 to clarke1888.

**Methods of Data Analysis and Presentation**

The purpose of data analysis, in this study, is to make wise use out of the bulk of data from the fieldwork amenable to the need of addressing the research questions. This involves the examination, categorization and tabulation of the evidence. Data analysis processes will start by coding, re-coding, classifying. Statistical software as SPSS, GIS, AutoCAD, Archi-CAD and Excel will be utilized. Matrix rating technique in SPSS will be utilized to compare results from each case analysis in reference to identified urban agriculture planning and design situations. This is to identify the roles of urban planning and design on ***urban agriculture for sustainable landscapes in the City so as to make sure edible urbanism.***In addition to the analysis of interviews and questionnaires; line maps, ***GIS,*** Nortek and digital maps, photographs, aerial photos and secondary written documents will be interpreted in relation to the key issues of the research questions and will be incorporated as part of the case reports.

**Review of Related Literature**

**Urban agriculture: Concepts and Definitions**

Urban agriculture is a recent phenomenon as compared to rural farming. According to (Mpofu, 2013) cited in (Henock, 2014), food production in urban settlements of ancient civilization has always been part and parcel of the urban economy. Different authors like (Mougeut, 2001) described urban agriculture in various ways on the basis of location or time of agricultural activities. (Deelstra and Girardet, 2004) put urban agriculture broadly as any agricultural production which includes horticulture, forestry, fishery, poultry and livestock mainly in public open spaces within or fringe of cities. (Renevan, 2006) concludes that “*urban agriculture is an industry located within or on the fringe of a town, which grows or raises, processes and distributes a diversity of food and nonfood products, using largely human and material resources, products and services found in and around that urban area*”.

According to (Mpofu, 2013) cited in (Henock, 2014) one of the economic significance of urban agriculture is its capacity to create income, food supply, employment opportunity and environmental management. Low and middle-income farmers practice urban agriculture mainly to survive and achieve a combination of nutritional and socio-economic benefits, mainly to provide supplementary food and /or income. Generally, urban agriculture is not easily defined, as a large variety of urban farming systems exist internationally, with varying characteristics depending on local socio-economic, geographic and political conditions. The most widely used definition of Urban Agriculture was developed by (Luc Mougeut, 2001). Using technical criteria of Urban Agriculture he explained that, “*(u)rban agriculture is an industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows and raises, processes and distributes a diversity of food and non-food products, (re- )using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area.”*

**Urbanization and Food Insecurity**

Food insecurity is a complex, multifaceted phenomenon that varies along a continuum of a successive stage as it becomes more severe. It is likely that the proportion of the global population not producing food will continue to grow, as will the number of middle and upper income consumers whose dietary choices are more energy and greenhouse gas emission intensive (and often more land intensive) and where such changes in demand also bring Rapid urban growth and growing urban poverty should raise concerns particularly about African urban food security, supply and distribution systems. The urban poor are particularly vulnerable to variations in food and fuel prices and in income since food (often ***over 60 percent***) and fuel (often ***more than 10 percent***) make up a large part of their household expenses. It is estimated that the rise in food prices between 2007 and 2008 increased the number of people living in extreme poverty in urban areas in East and South Asia, the Middle East and Sub-Saharan Africa (SSA) by ***at least 1.5 percent*** (Baker, 2008).Although prices of food and fuel have declined in the latter half of 2008 and early 2009, they still remain much higher than they were for much of this decade. Though the food security situation in SSA improved from 2009 to 2010, nearly half of the region‘s population remains food- insecure. By 2020, the number of food insecure people in the region is projected to exceed 500 million (USDA, 2010). The FAO points out that the urban poor are disproportionately affected by rising food prices. There are two main reasons offered for this. First of all, city dwellers are more likely to consume foods that are tradable commodities (wheat, rice), and thus more exposed to market changes. Conversely, in rural areas, diets are often made up of traditional staples such as roots and tubers. Second of all, city residents have much less access to land and other inputs required to grow one‘s own food (FAO, 2008). This naturally increases their exposure to fluctuating prices and leaves them with few options to react to changing prices.

**Agropolis as Edible City Solutions**

Edible City Solutions (ECS) as Agropolis focus on urban productive landscapes including the wide range of different forms of urban farming, building integrated farming, agro-forestry, aquaculture, biomass production for energy, among other productive and ornamental purposes and services combined with closed loop systems for sustainable water, nutrient, and waste management, (Suhana E. Reddy etal, 2019) *(Figure 2.1)* above.

*Figure* ***2.1:*** *Examples for nature-based ECS and benefits. 2019*

Our ECS concept amplifies the benefits provided by nature-based solutions from supply of ecosystem services such as cooling, air, and water cleaning, habitat services, or recreation effects towards provisioning services that address ***food security***, poverty alleviation, and inequality in urban areas. The elements of this ***'Edible Green Infrastructure Concept'*** includes edible urban forests, edible urban greening, different gardens and parks, school gardens, allotment gardens, community and domestic gardens, edible green roofs and vegetable rain edible green walls and facades, but not intensive urban agricultural practices. Our ECS concept includes also these practices managed in a ***sustainable way such as commercial indoor farming.***  high-yield commercial gardening, biomass feedstock, aquaculture, and livestock and new innovative cropping techniques in urban areas, such as hydroponics or ‘organoponics’. Commercial urban rooftops and vertical farming offer an untapped potential to systemically integrate farms into buildings and drive economic resilience of cities. Beyond the effects on social integration and environmental sustainability ECS present opportunities for significant improvements to food supply, zero-km food, and local economy, (Suhana E. Reddy etal, 2019).

**From Petropolis to Ecopolis/Agropolis—Edible Urbanism**

One of the primary tasks at the start of the 21st century is to try and map out what is *necessary* in order to try and expand the boundaries of what becomes politically *possible*. The challenge is to find ways of making cities function differently from the way they do today without increasing the new task facing of *urban planners, civil engineers and managers*, in close cooperation with the general public, is to create ***spatial structures*** that satisfy the needs of city people whilst also assuring their ***ecological and economic resilience.*** (Herbert Girardet, 2010*)* we need to provide secure habitats that allow us to move about our cities efficiently, and we want them to provide pleasant spaces for work, recreation and human interaction. We want urban environments that are free from pollution and waste accumulation. But we also need to get to grips with the impacts of cities beyond their boundaries. It is often said by urban analysts that cities should be seen as the places where solutions to the world’s environmental and climate problems can most easily be implemented because as places where most people live closely together they have the potential to make efficient use of resources.

It is also in cities where people interact most strongly and where key decisions, and particularly financial decisions, are being made all the time. (Daftary Steel et al., 2015) this is where the concept of ***‘Ecopolis’*** – the ecologically as well as an economically restorative city – needs to assert itself, drawing together the various themes discussed in this text into one comprehensive concept. Of course, modern cities tend to be much larger than traditional human settlements and this makes reintegration into their local hinterland much more difficult. The reality is that far more people have to be accommodated in cities today than a couple of hundred years ago and this needs to be taken account of in developing concepts for creating resilient human settlements fit for the 21st century. In addition, vast amounts of money are still spent on importing fuels to our cities from distant places. Could the creating of resource efficient cities, largely powered by renewable energy, help rebuild urban economies and bring jobs back to our cities? Creating environmentally regenerative cities is a challenge that urban administrators and educators have not really had to deal with until now. This challenge has been made more difficult since the privatization of services in recent years has reduced the capacity of city administrations to create integrated urban systems. To initiate projects for restoring the health of forests, soils and aquatic ecosystems that have been damaged by urban resource demands certainly goes beyond strictly urban policy initiatives. Creating parameters for appropriate action will involve both political and business decisions – with a spectrum ranging from transnational, to national and to urban levels of decision making. It involves drawing up novel legal frameworks and addressing the profit logic of companies involved in natural resource extraction, like from ***urban agriculture as edible city solutions***. Hence, planners and designers should shoulder this responsibility to create regenerative cities so as to maintain sustainable cities.

**Planning for Urban Agriculture: Edible Urbanism**

The city planner’s role in urban agriculture has changed over time. During World War II, the federal government and many local governments encouraged people to establish victory gardens, including both backyard gardens and allotments on public spaces (Taylor & Lovell, 2014). In the 1970s, some municipalities supported community gardens as a ***strategy for urban revitalization*** to combat White flight and suburbanization. In the last decades of the 20th century, however, urban planners by and large established restrictive zoning that inhibited urban agriculture (Vitiello & Brinkley, 2013). Other regulations restrict composting and farm stand sales of food produced onsite. Some regulations require tall and expensive fences and lighting around both private and public urban gardens in the principles of Edible Urbanism.

On the other hand, ***Urban Planners*** use a variety of strategies to support urban agriculture, including creating a supportive policy environment; incentivizing urban agriculture; and offering programming, funding, and public land in support of urban agriculture. It is important to briefly discuss these in greater detail below (for a more detailed overview of ***planning’s role in fostering urban agriculture***, First, to create a conducive policy environment, some municipalities have adopted goals and strategies in their comprehensive plans to support new opportunities for noncommercial urban agriculture (e.g., Seattle), including food production in citywide sustainability plans (e.g., Baltimore) and written plans specifically about urban agriculture (e.g., Minneapolis; Hodgson, 2012) in USA. Similarly, Various cities have amended zoning ordinances and building codes to formally legalize the keeping of bees, poultry, and goats (Butler, 2012; McClintock, 2012) and the cultivation of crops and permanent food-producing plants, like fruit and nut trees, in front yards and planting strips (Huang & Drescher, 2015). However, many cities from around the world have relatively limited amounts of land permanently protected for urban agriculture and little to no staff support for programming or garden coordination and management through proper urban planning.

**The integration of Urban Agriculture into urban planning**

“The process of formulating and implementing land policies is not only politically and technically difficult, it can also be costly. Cities do not develop according to ***planners’ wishes*** – to the contrary, in the present and past, cities have always shown their own dynamic of development. In many cases this has led to crowded, ill-ventilated, unplanned, unwieldy, unhealthy cities “ulcers on the very face of our beautiful island” as expressed by (Howard, 1902) for the situation in Britain (Howard Ebenezer, 1902). Howard’s Garden City proposals addressed many aspects of the food system -production, distribution, collective preparation and consumption, and waste recycling- as integral to the city (Kameshwari & Jerome L. Kaufman, 2000) an idea that only now is recovering again (Groppo, Paolo (ed.), 1997). In many reports on ***urban planning*** in developing countries the rapid urban development and population increase are highlighted which make the recent trend different from what happens in the western world. Harare's infrastructure, for example, has been unable to cope with this influx of people (Ebbie and Alex Mugova, 1996). Rapid, largely unchecked, urbanization like for example in Kumasi, Ghana, has called an end to its claim of being the *'Garden City of West Africa'*. As a result, land use patterns have become very complicated and no good concepts are in sight (Pender, Judith, 1998).

Therefore, urban planning instruments need to be adapted to the relatively new situation instead of using out-dated, old-fashioned, post-colonial planning instruments, which are not even used anymore in the countries of origin (David & Clark Giles, 1997). Conflicts between customary and modern land tenure systems cannot be avoided. Most of the conflicts have to do with the transition from communal land to freehold land tenure. This leads to fundamental changes in land use. The role of Land Boards and traditional authorities in manipulating and interpreting local land rights is unclear, (Richard, Matthew J., 1991). *Key problems identified are for example:* ***Urban poverty and food security***, ***the urban land market and Issues related to sustainable urban development***. A basic question is: how to increase access to land for the poor or how to integrate the urban poor into the urban land market? The dilemma is: recognition of and interest in urban and per urban agricultural production (UPA) is generally low among ***planners and politicians***. Thus, a consistent approach to (UPA) Urban and Peri-Urban Agriculture is rarely found, (FAO 2000). Little international co-operation in the field of land legislation is happening and innovative approaches from developing countries are missing. There is a lack of both international comparative studies on land legislation as well as internationally knowledgeable advisers (Österberg and Tommy, 1998).

Although public awareness for farming activities in cities is slowly increasing, agriculture is still in many cases “by definition” ***not practiced in cities***, and is often seen as ***“economically unimportant”*** or ***“a temporary phenomenon”.*** The terms ***“agriculture” and “urban planning”*** seem to be incompatible. Agricultural activities tend to be shifted to outskirts of cities, far away from markets and infrastructure without analyzing economic, environmental and interrelation with other sectors. ***Urban agriculture is often informal.*** This refers to the land occupied, the labor market, and the sales of the produce. No official authority deals with informal activities. For one or another of these reasons, urban planners tend to exclude agriculture from their terms of reference. Nevertheless, leaving the urban farming sector out of planning activities creates many problems in the cities of the South. Urban agriculture is a reality and in many cases a response to crisis and a coping strategy of the urban poor, (Jacobi Petra, Axel Drescher & Jörg Amend 2000).

Finally, the challenge for ***urban planners*** is to integrate *coping strategies of the urban poor*, which are closely related to the informal land market in many countries-- into their planning strategies. This requires the definition of rules and standards but also ways to increase the supply of and access to land by the poor and implementation of land legislation to enable sustainable urban development. Recently, gender aspects have entered into the discussion of planning and agriculture in cities. Women, as major players on all levels of the urban food system, in production, marketing, processing and street food vending have a basic interest in being considered as an important interest group for urban planners, (Tinker, Irene, 1997).

***Basic principles of and tools for urban planning of Agriculture***

“Urban planners shape patterns of land use and the built environment in and around cities to solve and prevent challenges of urbanization, including providing shelter, food and other basic necessities of life, protecting and conserving the natural environment, and assuring equitable and efficient distribution of community resources, including land. Planners in less-developed countries experience the added challenges in practice of sometimes chaotic planning policy, an outdated planning legacy with European origins ill-suited to less developed country communities” ( Quon, Soonya, 1999). The most commonly used planning tools include comprehensive general plans, master plans, strategic plans and structure plans (David & Clark Giles,1997) including: Master plans, Structure plans, Land zoning and Land subdivision regulations. Experience has shown that ***general and master plans*** tend to be static or assume slow growing cities. It is worth mentioning that a more appropriate and dynamic planning tool for developing countries is ***structure planning as post modernism*.** It provides a broad framework for local decision-making and it involves public participation (Dowall, David & Clark Giles, 1997)*.* The ***Structure Plan*** sets out a framework for development of a community. It requires projections of future demands and needs of the community such as housing, infrastructure, employment, transport, local markets etc., but also environmental aspects like waste management. As for master plans the long-term planning approach is a disadvantage in rapidly growing cities of developing countries.

**The Importance of Urban Agriculture to Sustainable City Development**

Urban agriculture has been practiced throughout the world for thousands of years and is an integrated urban form in many places. It is practiced in many areas that city planning is concerned with: on city streets, in public gardens, parks and schools, and in community gardens and offers many benefits to city life. Urban agriculture and the food system more broadly, is an integral part of the physical, economic, social and spiritual well-being of places that planners care about (Balmer, 2005). The potential benefits of urban agriculture include Urban agriculture as a means to food security, Urban agriculture as a means to a productive city, Urban agriculture as a means to an environmentally healthy city and Urban agriculture as a means of building resilient cities.

**Best practices**

***Feeding cities: Singapore's approach to land use planning for urban agriculture***

Commercial urban agriculture is typically restricted to agriculture land use, green or open spaces, or under-utilized or undeveloped land. As urbanizing cities face the double threats of urban food insecurity and land scarcity, multi-functional urban land uses that integrate rather than separate agriculture from other land uses could be a critical adaptation for the sustainability of future cities ([Ching Sian Sia](https://www.sciencedirect.com/science/article/abs/pii/S2211912420300304#!), 2020). With less than 1% of land in agricultural use, the high-density, city-state of Singapore is testing integrative approaches to where and how food can be grown in the city. The shift toward land use multiplicity is prompting cross-agency collaboration in policy development. We learn something that agricultural use of land and describe emerging policy trends in Singapore are related to cross-agency collaboration and land use multiplicity. More examples of agriculture co-located with other land uses are needed to understand opportunities and challenges related to multi- or shared-use spaces particularly for tenure rights. Resolving regulatory and legal constraints will enable high and low tech farms to produce substantially more food in the city realized in Singapore.

The highlights of Urban Agriculture in Singapore are: Urban land uses integrating agriculture with other land uses could be a critical adaptation for future city sustainability, urban agriculture policy is improved by collaboration across government agencies and sectors, Singapore policies support integrated urban food production through high-tech intensification, Development of Agrifood Innovation Park can house actors across the food ecosystem.

***Urban and Peri-urban Horticulture in Democratic Republic of Congo***

A city like Kinshasa needs daily some 500 tons of fruits and vegetables for a weak consumption level of 50 grams per capita. Besides providing essential food for a balanced diet of the family, UPH has developed into a real commercial activity providing, according to certain sources, more jobs than in any other sector of the informal or formal economy. It is estimated that employment rate is 1 to 50 inhabitants. From a small plot of 100 to 250 People get a net income up to 200 US dollars per month, which exceeds the wage of a public employee. The farmers field school has been adopted as a training and extension methodology to ensure disseminate Good Agriculture Practices, product safety and environment preservation.

***Kigali: Crops Added to City Master Plan to enhance food security***

The master plan of the city envisages farming spaces where each residential plot must allocate at least 20% of the surface to farming activities. The Government unveiled a six-year agriculture strategic plan that seeks to support the country's efforts to achieve food and nutrition security. The country will focus more on investing in expanded agricultural research, ensuring farmers access to the market economy and improved infrastructure, implementing sustainable agriculture, and improving food security, said Gerardine Mukeshimana, Rwandan minister of agriculture and animal resources in Rwandan capital city Kigali. The small central African country plans to boost agriculture production by scaling up land for crop production from the current 635,603 hectares to 980,000 hectares in 2024 while irrigated land surface will increase from the current 48,508 hectares to 102,284 hectares by 2024, the ministry said.

***Towards a sustainable Public Food Service in Copenhagen***

The original contribution of the ***City of Copenhagen*** is to demonstrate how it is possible to predispose a leverage effect of public food service to improve food consumption among the population, with a specific focus on the children and teenagers. By contrast with other cities that plan to reinforce sustainable food production, Copenhagen is focusing on food consumption and foresees the role of Public Food service in food education.

With an annual investment below 2% of the total food expenses, paid in over 10 years and including a permanent structure, the city has ***created an innovative training resource to empower municipal staff, starting from cooks***, to be able to prepare high quality meals with organic ingredients, without increasing the price. Indeed the city has chosen to invest more in human resources and know-how, by setting people at the centre of economy.

**Lessons Learnt from the Review of Best practices of Edible Urbanism**

One of lesson drawn from the empirical review is that Commercial urban agriculture is typically restricted to agriculture land use, green or open spaces, or under-utilized or undeveloped land in Singapore city. As urbanizing cities face the double threats of urban food insecurity and land scarcity, multi-functional urban land uses that integrate rather than separate agriculture from other land uses could be a critical adaptation for the sustainability of future cities. This would be taken as exemplar for ***integrating urban agriculture as component of Land Use Planning*** as being addressed above. Hence, the highlights of Urban Agriculture in Singapore are: Urban land uses integrating agriculture with other land uses could be a critical adaptation for future city sustainability, urban agriculture policy is improved by collaboration across government agencies and sectors, Singapore policies support integrated urban food production through high-tech intensification, Development of Agri-food Innovation Park can house actors across the food ecosystem.

On the other hand, a city like Kinshasa needs daily some 500 tons of fruits and vegetables for a weak consumption level of 50 grams per capita. Besides providing essential food for a balanced diet of the family, the City Administration has developed into a real commercial activity providing, according to certain sources, more jobs than in any other sector of the informal or formal economy. It is estimated that employment rate is 1 to 50 inhabitants. From a small plot of 100 to 250 People get a net income up to 200 US dollars per month, which exceeds the wage of a public employee. Therefore, the farmers’ field school has been adopted as a ***training and extension methodology to ensure disseminate Good Agriculture Practices, product safety and environment preservation*** through proper urban planning and design Agriculture for sustainable landscapes. The empirical review also shows, the ***City Administration of Kigali*** has decided that the ***master plan*** of the city should envisage farming spaces where each residential plot must allocate at least ***20% of the surface to farming activities.*** The City Government unveiled a six-year agriculture strategic plan that seeks to support the country's efforts to achieve food and nutrition security. The country will focus more on investing in expanded agricultural research, ensuring farmers’ access to the market economy and improved infrastructure, implementing sustainable agriculture, and improving food security.

Similarly, best practice also indicates that the original contribution of the ***City of Copenhagen*** is to demonstrate how it is possible to predispose a leverage effect of public food service to improve food consumption among the population, with a specific focus on the children and teenagers. By contrast with other cities that ***plan*** to reinforce sustainable food production, Copenhagen is focusing on food consumption and foresees the role of Public Food service in **food education.** With an annual investment below 2% of the total food expenses, paid in over 10 years and including a permanent structure, the city has ***created an innovative training resource to empower municipal staff, starting from cooks***, to be able to prepare high quality meals with organic ingredients, without increasing the price. Indeed the city has chosen to invest more in human resources and know-how, by setting people at the centre of economy.

Therefore, the global experiences have addressed that urban agriculture should be integrated to the structural plan of the city so as to maintain food security and sufficiency by realizing the transformation from Petropolis to Agropolis/ecopolis.

**Integrating Agriculture into Urban Planning and Design: A Framework for Edible Urbanism**

Urban development planning is currently adopting different progressive approaches, such as ecological models, new urbanism, collaborative and communicative models, city perspectives and new life models. Each of these provides specific ways and connections that could facilitate and stimulate the integration of urban agriculture. Planning for urban agriculture needs to go through a three-step process. The first step is to ensure legal provision through policy formulation which delivers the planning policies, regulations and legislation as the framework to regulate and guide urban land use for agricultural activities (Mubvami, T.; Mushamba, S.; De Zeeuw, H., 2006). A second step is to establish an official body to reinforce polices programs, strategies and action plans. The third step is to identify, allocate and designate land according to availability and accessibility guidelines into master plans, structural plans and land-use zoning with provisions for ensuring tax incentives, tariffs and promotion of urban agriculture (Sanchez, G.G, 2013).

Tools such as site plans, master plans, local plans, neighborhood plans and subject plans all serve to guide public safety, movement and transportation, community and individual health, and the use of private and public land (Mubvami, T.; Mushamba, S.; De Zeeuw, H., 2006). However, they do not specifically address food security. The most important issue for urban food production is its official recognition as urban land use, security of tenure, as well as access to land and other resources (Lovell, S.T. 2010). Access to land is especially relevant for marginal and minority groups, and this could be mitigated by offering more publicly-owned open space for community gardens (Hou, J.; Johnson, J.; Lawson, L. 2009). As not all city areas are well-suited for growing food, availability of land based on biophysical factors for urban agriculture could (DeKay, M. 1997) be identified by developing land-use inventories and land suitability analyses using geographic information system (GIS) technologies (Mendes, W.; Balmer, K.; Kaethler, T.; Rhoads, A., 2008) Access to sunlight is an important factor to be considered, particularly within the context of new construction and tree growth. Water supply is also a consideration not only for crop production but also to clean and even process fruits and vegetables on site. Further considerations include resource availability, transportation systems, market connections and waste disposal systems (Midmore, D.J.; Jansen, H.G, 2003).

A conceptual framework for integrating urban agriculture into planning and enhancing city sustainability is presented in (Figure 2.10) below. It builds on the four pillars of the sustainability concept, namely, ***Spatial*** (represented by food security and nutrition, poverty alleviation, improved health status, social cohesion and community building), ***Social*** (represented by Cross-Generational and Cultural Integration, Physical Activity, Reducing Obesity, Creating Safe Places, and Building Social Capital), ***economic*** (represented by income and employment generation, local development and enterprise) and ***ecological*** (represented by providing urban greens pace, reduction in the ecological footprint and enhancing urban habitat’s biodiversity and other environmental issues), allowing urban agriculture to flourish in the city. This requires land use and planning to come together to address current sustainability challenges and respond to the factors that are already driving the presence of urban agriculture in the city through the principle of Edible Urbanism. See figure 2.10: Conceptual and theoretical Framework for Edible Urbanism illustrated above.

**Results and Discussion**

**Characteristics of Respondents**

The purpose of the study demanded that data be generated both from urban farmers and institutions who are directly involved in managing city development and urban agriculture. The institutions interviewed were the Addis Ababa Plan Commission, City Administration Environment and Urban Forest Commission, Addis Ababa Agriculture Agency on Urban and Peri Urban Agriculture and Federal Agency for Urban Job creation and Safety-net for Development.

Table 4.1: Number of Respondents Interviewed

|  |  |
| --- | --- |
| **Institutions / Community** | **Number of Respondents** |
| Addis Ababa Plan Commission | 2 |
| City Administration Environment and Urban Forest Commission | 2 |
| Ministry of Agriculture Officials | 2 |
| Addis Ababa Agriculture Agency on Urban and Peri Urban Agriculture | 10 |
| **Total (Key Informants”’ Interview)** | **16** |
| Urban Farmers (Bole) | 128 |
| Urban Farmers (Akaki) | 143 |
| Urban Farmers (Nifas Silk) | 128 |
| **Total (Questionnaire Survey) Farmers** | **399** |
| **Grand Total** | **415** |

Source: Author ‘s Construct, March, 2021.

In all, a total of 399 respondents were interviewed as questionnaire survey. Four (16) key informants from the four institutions responded to several questions related to urban agriculture development and city development issues within their respective agencies in the perspectives of Urban Planning.

* 1. **Demographic Characteristics of farmers**
     1. **Age and Sex of Respondents**

To plan effectively for the urban farmers, the various age and sex structures were looked at. 89, 87 and 86 percent of respondents from Bole, Akaki and Nifas Silk are males. This clearly attests to the fact that in Addis Ababa is a male dominated activity. From Table 5.2, the survey revealed that women do not dominate urban farming in the three sub-cities. No woman was identified in the major sites in Addis Ababa whiles in Nifas Silk only 14% constitute women. This is much different from other African countries like Kenya and Rwanda where women dominate the sector.

Table 4.2: Age and Sex Structure of Urban Farmers.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age | Akaki | | | Bole | | | Nifas Silk | | |
| Male (%) | Female (%) | Total | Male (%) | Female (%) | Total | Male (%) | Female (%) | Total |
| 15-19 | 5 | - | 5 | 6 | - | 6 | 2 | - | 3 |
| 25-29 | 17 | - | 17 | 12 | 2 | 14 | 15 | 3 | 18 |
| 30-34 | 44 | 3 | 47 | 43 | 6 | 49 | 39 | 5 | 43 |
| 35-39 | 5 | 5 | 10 | 5 | 1 | 6 | 10 | 1 | 11 |
| 40-44 | 10 | 3 | 13 | 13 | 2 | 15 | 12 | 2 | 14 |
| 45-49 | 3 | 2 | 5 | 7 | - | 7 | 5 | 2 | 8 |
| 65+ | 3 | - | 3 | 3 | - | 3 | 3 | 1 | 4 |
| Total | 87 | 13 | 100 | 89 | 11 | 100 | 86 | 14 | 100 |

Source: Author ‘s Field Survey, March, 2021.

Over 95, 94 and 97 percent of respondents in Akaki, Bole and Nifas Silk respectively were in the economically active working group. Almost all the farmers interviewed indicated their desire to continue in this economic venture since it was their main source of livelihood.

* 1. **Educational Status**

The survey showed different patterns of educational status. In Addis City Administration, as many as 51 percent of respondents have had education up to the middle/ Junior High School level, 12 percent up to the Senior High or Vocational level, 6 percent up to the tertiary level and 35 percent have received no formal education. In Bole none of the urban farmers interviewed had attained tertiary educational status whilst 55 percent had had education up to the middle/ Junior High School level. Table 4.3 gives an indication of the levels of educational attainment of respondents in Bole, Akaki and Nifas Silk. Despite the fact that 35 percent, 32 percent and 33 percent of urban farmers in Bole, Akaki and Nifas Silk are illiterate a high percent of over 65 percent can read and write. This is really encouraging looking at the fact that most of these farmers use agro-chemicals in their operations and technological inputs to increase productivity.

Table 4.3: Educational Levels Attained

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Levels | Bole | | Akaki | | Nifas Silk | |
| Absolute figure | Percent | Absolute Figure | Percent | Absolute figure | Percent |
| Primary | 19 | 15 | 38 | 27 | 21 | 17 |
| Secondary | 40 | 32 | 43 | 30 | 38 | 30 |
| Vocational | 15 | 12 | 16 | 11 | 15 | 12 |
| Tertiary | 9 | 6 | - | - | 10 | 8 |
| Illiterate | 45 | 35 | 46 | 32 | 42 | 33 |
| Total | 128 | 100 | 143 | 100 | 128 | 100 |

Source: Author‘s Field Survey, March, 2021.

**Employment and Occupational profile of Urban Farmers**

***Occupational Status***

Urban farming provides employment to some youths who are unemployed because more hands are needed on the farm. 44, 45 and 42 percent of farmers in Bole, Akaki and Nifas Silk respectively employ on the average 3 people to assist them on their farms. Farmers, vegetable sellers, suppliers of agricultural input and entrepreneurs and all involved in the value chain gain and provide employment to many people and income generation contributing substantially to national development and sustainable livelihood. With regards to the occupational characteristics of the three sub-cities, 86 percent of respondents interviewed in Bole are self-employed and 8 percent are casually employed and 6 percent are students. Out of these figures, 15 percent are engaged in commerce, 7 percent are engaged in service, 77 percent engaged in agriculture as their main source of employment. In Akaki 90 percent are self-employed and 6 percent are casually employed and 4 percent are students. Agriculture is the main source of employment for 83 percent, for commerce and service 6 and 11 percent respectively. The remaining 21, 6 and 6 percent in Bole, Akaki and Nifas Silk respectively involved in commerce are petty traders and some also sell the produce from their farms. There are other artisans like electricians, mechanics, cleaners, cooks and masons who are also engaged in urban agriculture before and after work each day. In Bole, Akaki and Nifas Silk 7, 11 and 14 percent of the respondents are artisans or engages in services who work on their farms before and after work.

Table 4.4: Types of Economic Activities

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Types of Economic Activities | Bole | | Akaki | | Nifas Silk | |
| Absolute figure | percent | Absolute Figure | Percent | Absolute Figure | Percent |
| Commerce | 21 | 16 | 9 | 6 | 8 | 6 |
| Service | 9 | 7 | 16 | 11 | 18 | 14 |
| Agriculture | 98 | 77 | 118 | 83 | 102 | 80 |
| Total | 128 | 100 | 143 | 100 | 128 | 100 |

Source: Author‘s Field Survey, March, 2011.

Depending on the season and demand for their produce, urban farmers in Akaki, Bole and Nifas Silk earn about Birr 25,000 in the dry season (November to March) and about Birr 15000 when there is abundance in the system. Since the vegetables require lot of water, during the rainy season many of the farmers produce more leading to reduction in the price. ***Box 4.1*** indicates the benefits some derive from urban agriculture. Farmers in Bole, Akaki and Nifas Silk are the major ones who normally enjoy all year farming. The rainfall pattern and presence of treated water and surface water like river in Akaki is favorable as compared to Bole and Nifas Silk Sub-Cities. Those in Akaki with the help of treated Water can farm throughout the year still using the watering cans.

**Box 4.1 Urban Agriculture as a livelihood strategy (Key Informants)**

**Abdisa Shumi**: A 66-year-old farmer who owns about 5000m2, cultivating mainly vegetables was a security supervisor when he retired at the Teaching Hospital six years ago. He relates, I am a pensioner and after working for about 16 years earn an allowance of Birr 4800 monthly. I couldn‘t have survived on this meager income up till now. I can now earn about Birr 1000 every month and have been able to acquire a parcel of land at Akaki. I am able to take care of myself and family from this parcel daily.

**Adem Mohammed**: One farmer, who is a horticulture farmer, was delighted that he was engaged in urban agriculture. He has been able to employ three more people to assist him on the farm. He explains ―these parcels keep me and family going every time. I am able to care for my children education, give employment to others and even my wife who sells the produce from the farm.

**Urban Agriculture farming characteristics**

All the farmers interviewed in the three sub-cities are engaged in vegetables and crop farming. This they attribute to the fact that there is not enough land for them to engage in crop farming and horticulture at the same time. In Bole, Akaki and Nifas Silk, the average farm size is less than 5000m2 making it difficult for farmers to expand their production. Even though land is not the only factor, the relative small farm sizes leads to the underutilization of other resource like labor in their production. The farmers live within the communities and the farthest distance is about 2.5 km. The main crops cultivated in the urban areas are Lettuce, Corn, wheat, Spring onions, cabbage, green/sweet pepper, White onion and cauliflower. The availability of water and profits on vegetable production is the main reason why these farmers engage in it. Vegetable farming continues in the urban areas in the rainy seasons, in farm sites together with treated water and river surface water. Farmers also cultivate some wheat, and teff alongside which are used for subsistence. On the issue of whether farmers are part of an organization or group, the study revealed that in Akaki 60 percent are members of an organized farmer group as compared to 50 percent in Bole. Some of the benefits derived from joining the association are access to farm inputs and credit especially for urban farmers in the three Sub-cities in terms of Safety nets.

***Farming constraints***

There are some issues that are mitigating against the activities of urban farmers. Some of the major constraints are: Pest and disease threats to crops, Inadequate access to credit, Marketing of produce, High cost of inputs (fertilizer, pesticides, farm implements, seeds), Limited access to land and tenure and Inadequate access to safe and cheap irrigation facilities (pumps). In Bole, Akaki and Nifas Silk Sub-Cities some pests which farmers are finding it difficult to identify are now attacking their lettuce, cabbage and spring onions. About 55, 63 and 47 percent of the farmers in Bole, Akaki and Nifas Silk have lost huge sums of money this season to this development even though they could not quantify their cost. Water and land is another major constraint in Nifas-Silk as compared to Akaki. All the farmers in Bole and Nifa-Silk have land as their topmost constraint.

**Urban expansion and loss of agricultural land in the study areas**

The urban agriculture area covers only some *7600 hectares* but, because of its objectives, the study deals with total area of ***19,393.29 hectares*** in 1999 declined to ***8,333.17 hectares*** in the three study sub-cities in 2018 as being illustrated on the maps below. This includes all the urban expansion that has taken place in different parts of the three sub city during the period in between 1999 and 2018. As shown in Table 4.5 below, it is clear that *land use* in the three sub-cities is not well planned. Over time, the older part of the city has become increasingly congested while the city has expanded outwards haphazardly covering agricultural land on the fringe area. ***Urban land use*** is dominated by residential areas, which occupy more than 70 per cent of the study area (and 55 per cent of the municipal area). Most of this residential area is unplanned; only 20 per cent is planned with open spaces and with relatively good basic infrastructure.

Bare-land covers 15 per cent of the land area, which is linked to the rapid economic transformation and emergence of secondary and tertiary activities. The main reason for this increase in bare land is that, initially, when industrialization (industrial parks) took place, there was a shortage of land for construction. This demand caused an increase in land values, and land-occupiers who had previously used their ***land for agriculture now offered*** it for construction, causing a large conversion of ***agricultural land into bare land***. The demand subsided, resulting in an increase in vacant land which is used neither ***for urban development nor for agriculture.*** The area under plantation (tree crops) covers 20 per cent of the study area. One reason for this is people protecting their land (in the city area) from encroachment by planting trees whilst they wait for increases in land values. Another reason is that plantation crops are quite remunerative and the city provides an assured market; these factors helped increase the area under plantation. It is also favoured over crop cultivation in and around the city region because more care and protection are necessary.

*Figure 4.3 Conceptual framework of urban intensification and expansion (urban growth), 2018*

Industry covers 150 hectares of land in the city, representing quite a high proportion by traditional Ethiopian standards, and the commercial area of the city occupies 120 hectares. This is mainly in the central part of the city and along the major roads. Interestingly, the area used for recreational purposes, utilities and services (categorized as “other”) is almost negligible in the study areas, which indicate that little attention is paid to these facilities despite the significant increase in population.

The three Sub-cities have recorded a significant increase in the built-up area mainly due to population growth and development in the secondary and tertiary sectors. But this expansion has been ***haphazard and unplanned***, and even the most recent residential areas are ***unplanned***. This has contributed to severe road traffic congestion and overflowing drains. Significantly, despite the growth in population and the increase in the **built-up area through** the transformation of ***urban agricultures to build up areas***, there has been little change in utilities and services in the city. It is evident from the table 5.5 that the city is expanding mainly to thenorth-east and south-east, where the study areas are located.The spatial analysis clearly demonstrates that Addis Ababa is among the fastest growing cities globally due to rapid population growth and rural-to-urban migration. Rapid urbanization which is often characterized by the expansion of urban areas into peri-urban areas leads to conversion of various ***land use and land cover*** (LULC) classes including agricultural land to urban uses. *Figure 5.1* below unveils that the agricultural land has got abruptly transformed to built-up areas as the changes being illustrated on the map.

Furthermore, the consequence of the rapidly expanding urban systems is the urban encroachment into valuable agricultural and forest lands and therefore affecting ***the resilience of social-ecological systems.*** The loss of ***prime agricultural land*** to urbanization and associated urban growth can cause problems such as air pollution, competition for water, and ***conflicts over farm practices*** and the associated decline in ***agricultural productivity.*** *Figures 5.2, 5.3, and 5.4* are clearly illustrating that the rate of urban expansion has been reported to be highest in Akaki, Bole and Nifas Silk Lafto respectively. With this regard, there is documented evidence that indicates the loss of ***agricultural lands to urban development*** in other parts of the City Administration. In Addis Ababa, the estimated extent of agricultural land lost to urban between ***1999 and 2018 amounted to 8,333.17 hectares*** transformed to ***built-up areas***. This is the manifestation that urban agriculture is not being considered as an ***integral component of structural planning and lands use planning*** as being illustrated on the maps below.

Furthermore, the capacity for integration of different data sets brings the potential for comparison of community generated information alongside formal research survey data. For example, in exploring existing ***land uses*** and area boundaries by identifying areas of conflict and potential future land use development being transformed to built-up areas within 1999 to 2018. It describes how GIS has assisted in visualizing the spatial transformation from urban vegetable production areas to built-up areas in each sub-city in Addis Ababa as being illustrated on the LULC maps below,

The above figure 5.4 above clearly demonstrates that the areas are unplanned and eaten by Urbanization. It also illustrates the spatial transformation of Urban Agriculture to built-up areas within 20 years period. This clearly unveils that less attention has been given for urban agriculture as an integral components of land use planning , in terms of urban planning perspective *(see figure 5.5 above for more).*

As discussed above, in Addis Ababa urban population growth is exerting more pressure on the agricultural lands in the peripheries of the city administration, leading to ***accelerated land use change.*** This might also be due to the fact that the majority of rural migrant workers preferring to live in peri-urban areas to engage in farming for survival. Based on the fact that majority of the rural-to-urban migrants are poor, reports indicate that they likely to settle in peri-urban areas where the cost of living is lower and attainment of a home is much more quickly than in the completely urban areas. Peri-urban areas also attract low-income urban residents pushed out by increasingly high costs of living in urban centres and middle-class urban people seeking a more rural lifestyle or cheaper land to establish their residence. As a consequence, the rural-to-urban migration affects urban agriculture by increasing the population in the receiving areas, usually peri-urban areas, which could lead to the conversion of part of agricultural land to settlement and hence reduce food production. Unemployment rates are increasing over time from 10 % in 2010, to 20% in 2021.

Therefore, the LULC change maps as indicate on figure 5.4, 5.6 and 5.7 that the unprecedented rate of urbanization and the sprawling pattern of development have resulted in the quick disappearance and/or total alteration of ***fertile agricultural lands*** in urban and peri-urban areas in the study areas, ***Akaki, Bole and Nifas Silk Lafto*** Respectively. It was estimated that approximately 19,000 hectares of land in the sub-cities would be converted into various land uses/development between 1999 and 2021. Such loss could be due to urban settlement and sprawling which result in the outward expansion of built-up areas beyond visible and invisible city borders into green areas mainly used for farming. Urbanization in Addis Ababa is altering traditional livelihood strategies and displacing agricultural land uses in many areas opined that population growth rate in both urban and rural areas is not commensurate with the quantity of land supply. Expansion of cities affects the areas surrounding them (i.e., the suburbs) by altering the natural resource base and converting vegetal land cover to new uses, thus challenging the environment and dwellers’ livelihoods.It is obvious that urban agriculture is inevitably linked to ***urban planning and management***. Making cities pleasant, liveable places, where resources and the necessities of life are accessible to all citizens, are issues of concern to ***urban planning professionals.*** Because urban planners realize these aims through environmental control and the development of desirable land-use patterns, they can influence the availability, accessibility and usability of land (all key issues for Urban Agriculture). Conversely, that Urban Agriculture can provide solutions to some urban planning goals is becoming better recognized. The Urban Agriculture tide is on the rise, and cannot be forced back. Because of its inevitability, Urban Agriculture must be addressed by urban land-use planners and managers. However, the existing situation vividly demonstrates that less attention has been given to urban agriculture as an integral component of the land use planning in the study areas (see figure 5.4, 5.6, and 5.7 respectively).

Another important feature of the city’s ***land use change*** is the large increase in the amount of bare land. The northeastward and southeastward urban expansions are mainly residential and have caused losses to existing plantations, horticulture and crop production. Similarly, city growth towards the east has been curtailed by the restricted area. Recently, rapid urban expansion has been taking place along the route to Adama and Dessie road in a northeast and south-easterly direction, and some major industrial parks have developed. Some ***unplanned residential*** areas surround these industries and others have emerged in the south-east. Most of these developments have taken place on bare land. To the north-east, along Laga-Tafo road, ribbon-like urban development is taking place. This is marked by small industrial units and, in-between the built-up areas, bare land has developed. In the central part of the city, along the main roads, there has been a significant increase in the commercial area due to the conversion of ***unplanned residential*** areas into markets. Despite significant increases in the commercial and industrial land use classes; these still occupy only 7 and 9 per cent, respectively, of the total study area. The expansion of the residential area of almost 75 per cent between 1999 and 2018 was noted above. Another feature of urban land use distribution in Akaki is the 12 per cent land area lying bare for future urban construction. At present, this land is used neither for urban development nor for agricultural purposes as the landoccupiers await increases in land values.

However, there are opportunities for urban planners sympathetic to Urban Agriculture to help create circumstances that are more permissive for Urban Agriculture, and to identify and facilitate access and use of land resources. Traditionally, urban planners have based planning policy recommendations on studies of the urban geography, demographics, land use and economy. If Urban Agriculture is identified as a sector worthy of study, it can gain greater attention and response in policy and receive more resources. Land usable for Urban Agriculture may be identified through linking land data sets with available services and facilities. Identifying or freeing land that is available and accessible may be assisted by clarifying and formalizing ***land use and land tenure arrangements,*** or redistributing available lots to those in most need. Informally, ***planners can assist farmers*** by alerting them to urban land developments or alterations, or land availability, and promoting communication between land occupiers and urban farmers. However, planners can make the strongest formal contribution through policy reform, and through presenting new ideas about the urban area and appropriate urban activities, and overcoming their own biases against Urban Agriculture to consider as integral parts of land use planning in City Structural Plan.

**Urban Agricultural Land Transformation in the study areas**

Land is in a continuous state of transformation as result of various natural and human-made processes. The study of land transformation requires a comprehensive understanding and monitoring of all the factors which cause it. During the study period, case study sub-cities not only expanded in size but there was also a significant interchange of land between land use classes. Table 5.3, which was prepared using GIS techniques, shows which kinds of land use changes were responsible for land transformation as indicated below. As being explained in the literature review and the analysis results unveil that Addis Ababa’s, urbanization process goes along with increasing urban poverty and polluted environment, growing food insecurity and malnutrition, especially for children, pregnant and lactating women; and increasing unemployment. Urban agriculture represents an opportunity for improving food supply, health conditions, local economy, social integration, and environmental sustainability altogether. Urban agriculture is present throughout the world in a diversity of farming systems. Urban dwellers ranging 25–30 % are involved worldwide in the agro-food sector. No exception for Addis Ababa that facts and figure clearly indicate, urban agriculture will gain in recognition for its benefits and services because urban population and rural–urban migration are increasing in the City Administration.

The actual scarcity of knowledge on urban agriculture has somehow hindered the relevance of this activity. Here, author reviews the social, cultural, technical, economic, environmental, and political factors affecting urban agriculture with examples taken in Addis Ababa. Author also discusses the definition, benefits, and limitations of urban agriculture. Food security benefit of urban agriculture is evidenced by 100–200 million urban farmers worldwide providing the city markets with fresh horticultural goods. Urban agriculture favors social improvement since the poor’s spend up to 85 % of their income in food purchase and most urban farmers belong to poorest populations. Sociologically urban farming favors both social inclusion and reduction of gender inequalities, as 65 % of urban farmers are women globally, however not more than 14% of women are farmers in Addis Ababa. Urban agriculture has ecological benefits by reducing the city waste, improving urban biodiversity and air quality, and overall reducing the environmental impact related to both food transport and storage. However, the rate of urban morphological transformation of urban agriculture to other land use is very high from 2006 to 2011 as indicated *table 4.6.below.*

The production of horticultural goods shows the main benefits of urban agriculture. Fruit and vegetable crops give high yields, a more efficient use of agricultural inputs, high added value, and rapidly perishable products that can easily substitute the rural production in the local market. Urban horticulture is the most competitive branch of urban farming due to the high cost of urban land and with the need of high water- and fertilizer-use efficiency. Traditional urban horticulture systems are classified in four types: allotment and family gardens, simplified extensive systems, shifting cultivation, and intensive systems. Author describes also innovative systems including organoponics and simplified soilless cultures.

***Land use land cover class (LULC) Changes and Urban Agriculture***

The table below clearly indicates that the urban agriculture is spatially ***shrinking from 7176 ha*** in 2003 to ***996.1ha by 11.9%*** in the city administration. Therefore, this figures calls for ***re-planning the city*** by focusing urban agriculture as an integral component. One of the key informant Saida Bekri is also confident like her neighbor Shibeshi that she can benefit from the backyard farming activity. She says that the urban agriculture is not only an issue of food-security but it is also a matter of connecting with nature and the blissful spirit of her family’s farming background.

Table 4.7: Land use land cover class (LULC) in the City Administration Land use Planning

|  |  |
| --- | --- |
| **LULC classes** | **Description of each LULC class** |
| Built-up area | Include areas with all types of artificial surfaces, including residential, commercial, industrial area, transportation network and other built infrastructure |
| Urban agriculture | this includes cultivated lands, community lands along the river banks that are used for agricultural purpose |
| Urban forest | Include areas of dense vegetation cover, such as areas covered with both indigenous and exotic trees like Eucalyptus tree, grass and shrub areas |
| River and riverside | It includes rivers, streams, riverside or buffer greens and other water bodies |
| Urban parks | An urban park refers to a specific piece of ground, excluding natural parks, within the city/town and set apart for recreational use by the public. It may be planted with trees, lawns and other shrubbery and include facilities for sport, entertainment, and recreation purpose |

Source: Azagew and Worku Environ Syst Res, 2020

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 4.. 8: Land use land cover of urban green infrastructure in 2003 and 2016 | | | | | |
| **Urban green infrastructure** | **2003** |  | **2016** |  | **Percentage** |
| **and built-up area** | **Area/ha** | **LUP (%)** | **Area/ha** | **LUP (%)** | **of change** |
| Green infrastructure |  |  |  |  |  |
| Urban forest | 12,168 | 23.4 | 10,301.5 | 19.7 | − 3.7 |
| River and river buffer green | 1144 | 2.2 | 4026.5 | 7.7 | + 5.5 |
| **Urban agriculture** | **7176** | **13.8** | **996.1** | **1.9** | **− 11.9** |
| Urban parks | 468 | 0.9 | 938.7 | 1.8 | + 0.9 |
| Total | *20,956* | *40.3* | *16,262.8* | *31.1* | − 9.2 |
| Built Up Area | 31,044 | 59.7 | 36,029.2 | 68.9 | + 9.2 |
| Total Area | 52,000 | 100 | 52,292 | 100 |  |

Source: Azagew and Worku Environ Syst Res, 2020

Therefore, the importance of transforming urban farming in our city as ***planning perspective*** is to combat our growing food demand as well as our on-going concerns around food scarcity due to recent droughts, and even the Covid-19 pandemic as a new normal, which limited production by delaying the recent harvest. On the other hand, the Ex-Deputy Mayor of Addis Ababa City Administration recently (2020) called on anyone with formal education, or a passion for urban agriculture, to share ideas for urban farming. He promised to make land available to put these ideas into action. The dark cloud of Covid-19 has created an added impetus for investing in urban farming. Most farmers in rural areas are unable to bring their perishable produce to the market because agents or middlemen are not picking them up due to fear of catching the virus. The disruption of the food chain has exposed the dependence of urban centers on food from rural areas, and the risk that this poses for increasing food insecurity ever. Hence, this could be taken as an opportunity to properly ***plan*** as ***integrated land use planning*** so as to maintain sustainability as urban agriculture in urban planning perspective.

Therefore, to ensure that these ***emerging initiatives as a new normal*** are sustainable in the long run, it is important to link the government’s efforts with experts in urban agriculture, as well, as farmers and the youth. If residents use the space they have to grow different edible vegetables it will ease the pressure to put food on the table in any difficult situations as ***edible city solution***, edible urbanism principle.

***Barriers and Drivers of Urban Agriculture in relation to Urban Planning***

***Barriers***

Urban farmers indicated several constraints impeding their activities First, almost all (90%) of the surveyed urban Farmers were considered land access and tenure insecurity as well as ***Lack of official support in city planning policy*** as a constraint for their urban vegetation and horticulture activities. The main reasons included land unavailability (40%), the lack of policy regulation (30%), the difficulty in leasing land (20%) and others (a combination of the aforementioned reasons as well as a lack of security and a lack of space). However, the majority (55%) of Farmers indicated that municipalities are not willing to solve the land access issue.

Table 4.9: Constraints of Urban Agriculture

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Constraint** | **No of Respondents (N: 399)** | **%** |
| 1 | Lack of accessible land | 200 | 50 |
| 2 | Lack of available land | 160 | 40 |
| 3 | Urban development pressures | 143 | 36 |
| 4 | Lack of secure tenure on land | 200 | 50 |
| 5 | Lack of acknowledgement of urban agriculture in planning policy | 120 | 30 |
| 6 | Lack of official support in city planning policy | 299 | 75 |
| 7 | Lack of by-laws to support urban agriculture | 219 | 55 |
| 8 | Presence of by-laws that prohibit or discourage urban agriculture | 159 | 40 |
| 9 | Lack of will or support for UA among politicians | 191 | 48 |
| 1 0 | Lack of will or support for UA among government staff | 199 | 50 |
| 11 | Lack of Clean and reliable water sources | 259 | 65 |
| 12 | Ineffective or inconsistent means to enforce or regulate urban agriculture | 120 | 30 |
| 13 | Lack of programs or technical support services for urban agriculture | 100 | 25 |
| 14 | Lack of infrastructure (e.g., markets, transportation routes) | 40 | 10 |
| 15 | Lack of information and education among practitioners | 100 | 25 |
| 16 | Lack of Financial Capital | 323 | 81 |
| 17 | Lack of knowledge of environment | 80 | 20 |

*Source: Field survey, 2021*

A high number of farmers (81%) indicated the lack of financial capital as a constraint for Urban Agriculture. The main reasons cited included the lack of credit for urban agricultural activities (30%), the high interest rates of financial institutions (25%), the lack of collateral to obtain credit (22%), the lack of a deferred period for reimbursements (3%) and others (8%), such as the absence of an agricultural bank and the difficulty in obtaining credit as finance sources. ***On the other hand,*** most urban farmers (65%) considered the lack of access to clean and reliable water as a constraint for irrigating urban farms. The main reasons included the unavailability of equipment for irrigation (80%), the pollution of river water in wells (20%), seasonal rainfall patterns (15%) and others (5%), such as no control over water, floods, and leaching in rainy season.

***Similarly,*** a majority (60%) of the farmers considered the high costs of inputs as a constraint for urban agricultural activities. The main reasons were the frequent rupture of inputs such as fertilizer and pesticide (55%), the shortage of input providers on the market (40%), and others (7%,), such as the lack of a government subsidy, the market uncertainty and the lack of money. More than two-thirds considered market functioning as a constraint to agricultural activities. The reasons were the low prices in general (70%), unreliable relationships with traders (10%), the distance from farms to markets (5%), unreliable relationships with brokers (3%), and others (12%) such as the lack of clients, the lack of control over vegetable imports, the bias against local produce among customers, as well as the lack of contracts with hotels, restaurants and consumers. Furthermore, only 5% of the urban farmers considered their partnership with neighbors (urban farmers or people on the immediate outskirts) as a constraint. similarly, about three-quarters (70%) of the farmers are considered the lack of farming skills (improved technics and pest management) as a constraint for urban agriculture. A high number of farmers (95%) considered the lack of commitment from public authorities as a constraint for agriculture, about half (50%) of the farmers considered labor shortage as a constraint, but only 5% of them thought that the labor shortage could be addressed. Finally, and last, theft and robbery (35%) and diseases such as malaria and diarrhea (60%) were two other factors considered by the farmers as constraints to urban agriculture.

To prioritize the constraints the farmers scored them from the most important to the least important *(Table 5.5).* Lack of official support in city planning policy as an integral component, Land access and tenure insecurity, lack of financial capital and the lack of plantation (tree crops) covers 6 per cent of the study public authorities’ commitment were the first set of three constraints identified by the farmers. The second set of constraints comprised the lack of access to clean and reliable water and the high cost of inputs. The third set included the market functioning, the lack of farming skills and to some extent diseases.

***Drivers in integrating Urban Agriculture in to Urban Planning***

The above ***analysis result (table 4.9 above)*** unveils that many changes were required to overcome the constraints that were in place. Against the identified constraints, the gardeners suggested solutions that might drive the development of Urban Agriculture. First, regarding the land access and tenure insecurity, possible solutions included the promotion of inter-communal partnership to provide cities with large areas for Urban Agriculture (50%), the enhancement of ***urban planning mainstreaming zoning*** (30%), and negotiating with public and private institutions to lease their open spaces for an extended period (20%). Regarding the lack of financial capital, farmers suggested to adapt loan access conditions (collateral and deferred period for reimbursements) to the agricultural sector (40%), to reduce the financial institutions’ interest rates (30%), and encourage cooperative formation between the farmers to access loans (25%), and others such as the creation of an *agricultural bank* (6%) to be an integral component of the land use plan.

Therefore, the analysis results and review unveil that urban planning is currently adopting different progressive approaches, such as ***e****cological models, new urbanism, collaborative and communicative models,* city perspectives and new life models. Each of these provides specific ways and connections that could facilitate and stimulate the integration of urban agriculture. Planning for urban agriculture needs to go through a three-step process as being explained in the review. 1st step is to ensure legal provision through policy formulation which delivers the planning policies, regulations and legislation as the framework to regulate and guide urban land use for agricultural activities. 2nd step is to establish an official body to reinforce polices programs, ***strategies and action plans***. The 3rd step is to identify, allocate and designate land according to availability and accessibility guidelines into structural plans and land-use zoning with provisions for ***ensuring tax incentives***, tariffs and promotion of urban agriculture.

However, analysis result above in ***table 4.9 depicts*** that they do not specifically address food security. The most important issue for urban food production is its official recognition as ***urban land use,*** ***security of tenure,*** as well as access to land and other resources as the drivers of Sustainable urban agriculture. ***Access to land*** is especially relevant for marginal and minority groups, and this could be mitigated by offering more publicly-owned open space for community gardens. As not all city areas are well-suited for growing food, availability of land based on ***biophysical factors*** for ***urban agriculture*** could be identified by developing land-use inventories and land suitability analyses using geographic information system (GIS) technologies. Access to sunlight is an important factor to be considered, particularly within the context of new construction and tree growth. Water supply is also a consideration not only for crop production but also to clean and even process fruits and vegetables on site. Further considerations include resource availability, transportation systems, market connections and waste disposal systems. A conceptual framework for integrating urban agriculture into planning and enhancing city sustainability*.* It builds on the four pillars of the sustainability concept, namely, ***social, economic, ecological and spatial,*** allowing urban agriculture to flourish in the city. This requires ***land use and planning*** to come together to address current sustainability challenges and respond to the factors that are already driving the presence of ***urban agriculture in the city***.

**Understanding planning institutions, policy and decision making process**

In Bole Sub-City, almost all concerned Departments were involved in urban agriculture. Some of the Departments therefore have a representative who is part of the small scale enterprises on Urban and Peri Urban Agriculture in the outskirts. However, in Akaki, the main institutions are the associations, In the three sub-cities, there is no comprehensive plan or document on Urban Agriculture. It is however mentioned in part in the bye law of the Addis Ababa City Administration of 2019/20 which supports backyard farming.

However, open-space farming requires permission from the City Administration Urban Agriculture Agency and Environment and Urban Forest Commission as well as health Bureau. This is to help ensure that the land is not polluted and prevent the consumption of contaminated food. The bye laws of the Addis Ababa City Administration do not support or prevent open space farming since its bye laws are not enforced. It is therefore clear that, the bye laws of AACA for instance is not to ban or promote urban agriculture but to ensure that they maintain good sanitary conditions in the City. Because it was not significant ***land use planning component in City structural Plan.*** The Laissez-faire ***style of urban planning*** is predominant in the City Administration. In Akaki, there is no bye law on urban agriculture. The AACA does not frown upon or encourage the practice of ***urban agriculture*** in the City as essential part of land use planning in the process of ***maintaining edible city solutions.***

***Recognizing and permitting urban agriculture***

Urban agriculture is considered only in as far as such ***urban planning*** includes some kind of ***'green belt'*** concept as ***edible urbanism***. Apart from earmarking such ***'buffer'*** zones, ***urban planners*** tend to exclude ***agriculture from their terms of reference.*** Urban agriculture is not a ***distinct land use*** in the three sub-cities areas but considered as part of ill planned ***agriculture land use.*** Urban agriculture activities in the three sub-cities according to officials of Urban Agriculture Agency, and the City Administration Plan Commission are an informal‖ or illegal‖ activity. This is because it is not regulated by these institutions and monitored by them. The reality is that ***urban planners*** and other officials have no constructive ideas about agricultural activities within and around the city. Some of the officials think looking at the land value of lands in the urban centers and the waste water used it should not be allowed in and around the city center. They consider allotment vegetation and gardening as 'recreation', farms around the city as rural activities and officials who even ***recognize urban agriculture tend to see it as happening in future urban areas'.***

***Locating urban agriculture activities***

Urban agriculture tends to be carried out on urban land that is not immediately needed or suitable for ***urban development.*** In Bole, Akaki and Nifas Silk sub-cities where major urban agriculture takes place are on undeveloped government lands. Other places include areas liable to (seasonal) flooding, areas zoned for public open space, road and railway reservations, speculative land (to fetch higher prices for urban development). It depends on the determination of land Occupiers (including governments) to get the maximum surface areas for construction and to develop and maintain public open space (parks), whether little or much land remains for urban agriculture. Soils are not important as Urban Agriculture tends to generate 'man-made soils'. Almost by definition, markets are very near for Urban Agriculture.

**Understanding spatial land use planning practices for Urban Agriculture**

The main institution responsible for the preparation, implementation and monitoring of land use planning in the three Sub-Cities and the City as a whole is the City Administration Plan Commission and Urban Agriculture Commission. Land use (Layout) Plan or detailed planning scheme, zoning and site plans are the main tools used for ***spatial land use planning for urban agriculture.*** The Land use Plan indicates the various uses that the land can be put to. Zoning also gives the Sub-Cities the opportunity to determine the use of every land including urban agriculture. However, urban agriculture is not recognized as a ***land use category*** in the City Administration Structural Plan, categorized under environment in hided manner. It is supposed to be captured as part of the major land use which is agriculture. ***This is one major setback for integrating it into city development that has been*** recognized as poor side of ***Urban Planning perspective.*** Even though some form of guidelines exist guiding land development in the study areas, there is none on urban agriculture. The City Administration Plan Commission has provided some guidelines to be followed when developing a parcel of land for residential, commercial, industrial and education but this is ***silent on urban agriculture.***

**Integrating urban agriculture into city development**

City development as conceptualized by the planning officer at the Bole and Akaki Sub-Cities refers to “a conscious effort to create harmony and cohesion between social, economic and environmental activities for sustainable living condition.” The official also is perceived sustainable city development as “a city with vibrant economic activities, reliable infrastructural activities, clean environment and efficient social service delivery.”

Interaction with the various institutions involved indicates that much education on the benefits and contribution of ***urban agriculture*** is needed. There is the need for research institutions and all concerned with ***Urban Agriculture*** to help sensitize policy makers, and all the institutions which can contribute to ***integrating urban agriculture into city development on its pivotal role.*** Although urban agriculture may be well known by ***policy-makers and planners,*** in many cases this knowledge does not automatically contribute in their recognizing urban agriculture as an important element of ***the city economy and land-use system***. However, some city officials see urban agriculture as merely ***a left-over ‘of rural habits***, which is only temporary until the people accustom themselves to urban life, as a marginal activity with little economic importance, as a health risk and source of pollution that has to be removed. The trend analysis of urban Agriculture from ***1999 to 2018*** above have clearly unveils that the agricultural lands were occupied by building structure, and are manifestation of less attention for urban agriculture *(See digital Maps for 1999, 2010 and 2018 as shown above.).* For now, it will be difficult for city authorities in the three Sub-Cities to incorporate Urban Agriculture into its development agenda. The ***Land use plans*** or schemes that exist do not include urban agriculture as a land use category since it is still seen as a ***rural activity***. Further, the Sub-Cities do not own lands that it can make available to the urban farmers to use. In Bole, Akaki and Nifas Silk all the major farm sites are undeveloped government lands which are not sustainable. Whenever the institutions involved want to expand and develop this parcel of land, the farmers will be ejected making it difficult for others to invest in the sector. Farmers ejected from ***Koye-Fache areas*** in Akaki Sub-City are typical example in cutting down the livelihoods of the residents without creating other options of sustainable urban economy.

**Institutional Analysis for Urban Agriculture**

There are various institutions apart from the City Plan Commission and Urban Agriculture Commission involved in urban agriculture in Bole, Akaki and Nifas Silk Sub-Cities in the City Administration. The key stakeholders that contributed immensely to the success of this study are the Plan Commission, Urban Agriculture Commission, Different Farmers Associations and Small Scale enterprises on Urban and Peri-Urban Agriculture, Federal of Job Creation and Urban Development Safety-Nets Agency. In AACA, different associations and Farmers, Federal of Job Creation and Urban Development Safety-Nets Agency and Urban Agriculture Commission on Urban and Peri-Urban Agriculture are the main institutions in charge of urban agriculture. It comprises of other Decentralized departments in each sub-cities, NGO(s), the media, research institutions and farmers among others.

***Addis Ababa Multi-stakeholder Forum on UPA***

crucial aspect to consider is the wide range of stakeholders encountered in urban settings. Urban agriculture is taking place in a multi-sectoral environment and it is easy to miss some key stakeholders in a participatory process. The identification and involvement of different stakeholders is often driven by the underlying objective of the study, which often lies within a specific sector. It is very unusual to find vertical integration of study objectives across different sectors in the existing array of Urban Agriculture case studies inn the city administration. Key informants interview reveals that in order to overcome this limitation, multi-sectoral teams are important when working in urban settings, with ***“Rapid Visual Appraisal”*** exercises in study sub-cities in Addis Ababa. The wide range of stakeholders also contributes to the presence of conflicting interests and tensions between different stakeholders. External interventions may be used by certain stakeholder groups to strengthen their position by capturing the benefit flow and denying participation to other groups. Alternatively they may negotiate compliance with their wishes as a condition of benefit. To avoid this, the author has to adopt a position of ***“critical neutrality”,*** a term used by author in the description of the ***Rapid Visual Appraisal approach***. The research approach used successfully in such a complex context should produce information which is relevant to different stakeholder groups, it should be transparent and participatory and easy to assimilate in order to allow people with different educational backgrounds to engage.

Therefore, the Multi-stakeholder Forum on Urban Peri-Urban Agriculture was held in 2021 to respond to the need of Urban and Peri-Urban Agriculture and seek ways of integrating it into ***urban policies and planning*** through stronger participation of key stakeholders. This was organized by the Urban Agriculture and Food Security Commission in collaboration with the City Administration.

***Design & Planning of Edible Landscapes (As Public Open Space)***

The main objectives of the Multi-stakeholder Forum were to articulate stakeholders ‘interests in Urban Agriculture reach a consensus on key issues and make decisions on how to translate decisions into actions. Discussion and decisions at the forum were based on the premise that: Urban agriculture will continue to be practiced in Addis Ababa and its surroundings as in other African cities because of its contribution to the livelihoods of urban poor and to respond to the increasing demands for its products and the benefits of urban agriculture can be maximized while minimizing the associated health and environmental risks if the practice is institutionalized, regulated and integrated ***into urban planning agenda.***

Key issues pertaining to urban agriculture were discussed. Among them included the human health, environmental quality and urban development implications of current Urban agriculture practices, the types and locations of Urban and peri-urban agriculture sites, SWOT analysis was also carried out and major gaps and intervention areas needed to effectively promote the production system. A consensus was therefore reached and it was agreed that research development and policy issues are the priority. The City Administration farmers groups on ***Urban and Peri-Urban Agriculture,*** therefore formulated a strategic action plan for urban agriculture in Addis Ababa. In coming out with the policy document, a policy seminar was held to create awareness among policy makers on the importance of Urban agriculture to urban food security and local economic development and to discuss strategies for minimizing the perceived risks associated with the Urban and Peri-urban agriculture practices.

***The City Administration Plan Commission***

The Plan Commission is charged with the preparation of ***land use plans (structure plans)*** to direct and guide the growth and the sustainable development of human settlement in the City. It has been creating awareness about the need to ***obtain urban planning and development permits*** as well as the right procedure to use. It should have also made assessment of zoning status of lands and proposals of re-zoning where necessary and processing of development/building permit application documents for consideration by the ***Statutory Planning Committees.*** The major tool used to check development is the layout/schemes prepared. ***Site plans*** are also prepared to be in line with the schemes this help to ensure that development conform to the scheme. The building inspectorate is charged to ensure that people comply with this in the City Administration. The Plan Commission did indicate that the people are involved in ***plan preparation and implementation***. As required by law, the Commission is to publish any scheme twenty one days for people to comment about it but people do not attend or visit their officers to add their inputs.

***Integrating Agriculture into Urban Planning***

The Analysis Results and literature review unveil that ***urban planning*** is currently adopting different progressive approaches, such as ecological models, new urbanism, collaborative and communicative models, city perspectives and new life models. Each of these provides specific ways and connections that could facilitate and stimulate the integration of urban agriculture. An ***urban Planning perspective*** for urban agriculture needs to go through a three-step process. *The first step is* *to ensure legal provision through policy formulation which delivers the planning policies*, *regulations and legislation as the framework to regulate and guide* ***urban land use for agricultural activities***. *A second step is to establish an official body to reinforce polices programs, strategies and action plans*. The third step is to identify, allocate and ***designate land according*** to availability and accessibility guidelines into ***city plans***, structural plans and land-use zoning with provisions for ensuring tax incentives, tariffs and promotion of urban agriculture.

Tools such as site plans, structural plans, local plans, neighbourhood plans and subject plans all serve to guide public safety, movement and transportation, community and individual health, and the use of public land. However, they do not specifically address food security. The most important issue for urban food production is its official recognition as ***urban land use,*** security of tenure, as well as access to land and other resources. Access to land is especially relevant for marginal and minority groups, and this could be mitigated by offering more publicly-owned open space for community gardens. As not all city areas are well-suited for growing food, availability of land based on biophysical factors for urban agriculture could be identified by developing land-use inventories and land suitability analyses using ***geographic information system (GIS) technologies***. Water supply is also a consideration not only for crop production but also to clean and even process fruits and vegetables on site. Further considerations include resource availability, transportation systems, market connections and waste disposal systems. A conceptual framework for integrating urban agriculture into planning and enhancing city sustainability is presented in ***Figure 4.9 below.*** It builds on the three pillars of the sustainability concept, namely, ***social*** (represented by food security and nutrition, poverty alleviation, improved health status, social cohesion and community building), ***economic*** (represented by income and employment generation, local development and enterprise) and ***environmental*** (represented by providing urban green space, reduction in the ***ecological*** footprint and enhancing urban habitat’s biodiversity), allowing ***urban agriculture*** to flourish in the city. This requires ***land use and planning*** to come together to address current sustainability challenges and respond to the factors that are already driving the presence of urban agriculture in the city as ***edible city solutions*** as ***edible urbanism principle***.

Furthermore, observations and key informants interview witnessed that Urban and peri-urban agriculture can have negative effects (i.e., ecosystem disservices) to the city ecosystem. So, urbanists and landscape planners have promoted urban agriculture and food systems with ***little attention to ecosystem disservices***. At present, increased urbanization, environmental degradation, population growth and changes in food systems require a novel concept that considers trade-offs between ecosystem services and disservices. Considering the Sustainable Development Goal of ending hunger and all forms of malnutrition by 2030 as being explained in the review, as well as the food revolution of feeding up to ten billion people, edible urbanism is a supportive component in reaching these goals. In this comment, ***edible urbanism*** via an ***edible green infrastructure*** (EGI) approach is examined against current urbanistic concepts that have common food production systems in Addis ***Edible urbanism integrates*** three main principles of sustainability by fulfilling ***food security, resilience and social inclusion.*** It links site-specific, best-practices by integrating (***edible green infrastructure)*** EGI-based governance with modernised food production techniques.

In accordance with ***Sustainable Development Goal*** to ***“end hunger, achieve food security, improve and promote sustainable agriculture,”*** As being explained in the literature, there is growing consensus by which this fundamental human need can be sustainably secured for all. Addis Ababa City Administration has started to implement initiatives to re-design food provisioning. It is worth mentioning that most cities depend heavily on the global trade of food, and face a number of concerns in making urban food production transition due to the lack of arable land covered by factories, commercial buildings, housing and roads. It has become nearly impossible to convert this space back to agricultural production. ***Therefore, recommendations for future edible urbanism are established. See figure 4.9: Planning and Design Urban Agriculture for sustainable Landscapes. It is the*** *Conceptual framework Model for integrating urban agriculture into sustainable city landscapes.* On the other hand, Planting different ***Fruits and Vegetables at parcel or plot level*** and excercising ***Balcony agriculture*** at condominium and apartment builfdings are very essential to maintain food security***. This is typical example of tronsforming Petropolis to agroplis landscapes in the inner city.***

**The Intersection of Planning, Urban Agriculture, and Food Justice**

The analysis results discussion on urban agriculture in the planning field is largely celebratory. There is, however, a growing critical analysis of urban agriculture in the wider scholarly literature informed by deep attention to food justice as being explained in the review and analysis We show here how a critical analysis can assist planners in prioritizing food justice in their urban agriculture efforts. The study focuses on urban agriculture in the Addis Ababa. Therefore, There is no a large body of research on urban agriculture in the international city of Addis Ababa, among other places in relation edible city solutions as edible urbanism. We do not address literature from other parts of the world given the unique social, political, economic, and land use contexts in the Addis Ababa.

***Design & Planning of Edible Landscapes***

The focus group discussion and the interview results transcribed shows varieties of assessments for planning edible landscapers in the three sub-cities including ***Site Assessment****:* analyzing physical attributes such as site location & adjacencies; growing region, climate, & microclimate; and resource availability such as water, soil, and solar energy. ***Client/User Assessment***: understanding the needs/desires, the existing or intended patterns of use, and the maintenance capabilities of the client/users. And ***Programmatic Assessment***: recognizing the functions attributed to the landscape other than food-growing.

**Land Constraints and Planning Factors that Perpetuate Constraints to Urban Agriculture**

Understanding how urban planners effect community land-use changes, it is possible to understand how urban planners can specifically facilitate and support Urban Agriculture. The practice of farming in cities faces both inadvertent and deliberately-imposed constraints, specifically related to land. These constraints can be linked directly or indirectly to planning and management interventions in urban and peri-urban areas, and consequently fall within the jurisdiction of urban planners and managers. The planning institution, policy framework and cultural norms and attitudes of planners, politicians and the public each can impose or perpetuate these constraints. The presence or absence of these factors can collectively be described as the “degree of support” a city administration offers ***Urban Agriculture.***

**Constraints to Urban Agriculture: Issues Pertaining to Land**

Key informants and focus group discursions transcribed show, While not all urban agriculture activities require land (for example, land may not be of primary concern for zero-grazing livestock-keeping, mushroom farming and food-processing activities), land is a crucial factor for many ***Urban Agriculture*** horticultural and cropping activities. As it has been observed in the literature: *The existence, prevalence and growth, if it occurs, of food production in urban environments is seen as being predominantly about the use of space in densely settled locations... With the exception of small numbers of animals kept in buildings and backyard plots, land is the fundamental resource required for farming, and issues of zoning, access and tenure are seen as critical to the contributions it may be able to make to household food security and to the livelihood composition of the urban poor*

Key issues for urban farmers are the availability of, access to, and usability of land.

***Availability***

As being explained in the review and key informants, in areas of rapid urbanization, undeveloped land for agricultural use may not be available or may be difficult to identify. Urbanization may displace farming activity (by replacing farming with more economically lucrative land uses), or prevent new farming from starting (by erecting buildings and structures that effectively preclude farming). Agriculture usually cannot provide the economic returns of industry or housing, and urban development pressures may compel or even force land holders to sell their urban plots. Land speculation may lead to the purchase of city lands, distorted land prices and strange development patterns. Displacement from central plots may mean that farmers must farm at a distance from their homes, markets and transportation routes. Because planning decisions, such as locating transportation routes or permitting land uses in particular areas, can influence the value of urban land, planners can influence the pattern of urbanization, and consequently, influence ***Urban Agriculture opportunities***. How much land is available for farming in a community may not be known. Traditional techniques for land description and classification, such as aerial photo interpretation, may underestimate or miscalculate available lands and the extent and prevalence of Urban Agriculture. Not knowing the ownership or tenure arrangement of properties, because of a lack of records or frequent change of hands, can further confuse of how much land is available for farming in a community, or how prevalent is the practice of Urban Agriculture.

The analysis results above indicate that A lack of available plots of land does not often dissuade urban farmers, especially where Urban Agriculture is officially illegal anyway. Urban farmers tend to be opportunistic, and find ways to use the smallest plots or strips of land and water in creative ways. This leads to farming on land originally set aside for other purposes (e.g., ditches, road verges, parks and buffers), or lands that are hazardous and therefore undevelopable (e.g., steep slopes, flood-prone, erosion-prone), or lands that have been abandoned or contaminated by past uses, sometimes without the farmer being aware of the hazard. Such opportunistic use of land can undermine community planning and lead to conflicts between competing users, environmental degradation, and unregulated production and processing that may be hazardous to consumers.

***Accessibility***

Some authors assert that land availability is less a problem than access to land, where access means “capable of being reached” by farmers. Access to land is one of the most, if not the most, significant constraint to urban farmers. Access to land must be distinguished from availability of land; land may be available or present in a city but not accessible to farmers because of political or social constraints to its use or redistribution. Access may refer to the land itself, or to the use of the land. Land may be far from where farmers live, and public transportation and roads inconvenient or not available. Available land may be too costly for farmers to rent. Farmers may lack the social or political connections necessary to learn about or gain access to the plots that are available. It has noted that the poor have a limited range of coping mechanisms in cities, especially newcomers lacking an extended network of support, and therefore have restricted access to land for food and fuel. Often farmers rely on a complex network of social and political connections to contend for available land. ***Inequitable land distribution systems***, ingrained resistance to farming in sub-cities, or planning policies and legislation that make Urban Agriculture an illegal land use can all prevent farmers’ access to land. In some communities, discrimination based on gender may prevent equal access by women and men to land, credit or financing opportunities. There may be socio-cultural restrictions on who can own or use land, and different kinds of land tenures available. Land access may be further constrained by missing or inaccurate records of who uses or has the right to use particular plots.

***Usability***

The inherent qualities of a plot of land, and the facilities and services available to it, determine whether parcels of land that are otherwise both available and accessible can be used for farming. A plot’s biophysical characteristics (soil, hydrology or microclimate), or physical dimensions (size, shape, location) may make it unfit for agriculture. A plot may be available to farmers only for a short amount of time, therefore constraining what kinds of agricultural activities can occur on the site, and what technologies might be applicable to the site. Services, such as water for irrigation, and inputs or market facilities, transportation infrastructure both for export and for farmers’ access are external factors that can determine a plot’s usability. Agriculture in the study sub-cities suffers greater ecological and economic pressures than rural agriculture, requiring more intensive and better controlled production to stay competitive and safe. Without inputs or technology, farming small urban spaces may simply not be economical or worthwhile.

**Planning Factors that Impose or Perpetuate Land Constraints**

What is the role of the planning policy context and players in imposing or perpetuating these land- related impediments to Urban Agriculture? It has been observed that Planners do not currently plan for urban land to be used for food production... Community-based projects such as gardens must be seen as viable alternatives to the current system that cannot ensure food quality, accessibility, or affordability. However, in order to develop effective and sustainable alternatives, there are a range of policies, plans and initiatives which Addis Ababa City governments must endorse and implement. Planners and the planning policy context can impose and perpetuate the identified land constraints in three main ways:

* Through the **institution of planning**, both the institutional structure (that is, the organization of and relationships between people who plan at local and regional levels of government) and the institutional capacity (resources and will) to effect changes;
* Through the **policy framework** (that is, the products of planning: legislation, planning policy and by-laws);
* Through **cultural norms and attitudes** of the key players in the planning process: planners, decision makers, and the public.

***Planning Institutions***

The institution of planning collectively refers to the parties involved in planning communities, the way that responsibilities for planning are organized and divided, and the resources devoted to carrying out decisions. Below, author discusses how the organization and resources of the planning institution can contribute to these land constraints.

***Responsibility for Urban agriculture***

Without an **agency or organization with specific responsibilities** to regulate, aid, support, monitor and facilitate research on Urban agriculture, Urban agriculture “falls between the cracks” of typical municipal sectorally-organized government, or is subject to confused and conflicting jurisdiction. It has been asserted the need for adequate governance (“where ‘governance’ refers to the exercise and sharing of power”) and institutional capacity to carry out effective environmental planning and management, and provide urban services, public education, and remain accountable to the public, an assertion that carries over to ***Urban agriculture.*** Respondents from the survey of urban planning professionals illustrated the potential confused and conflicting responsibility for urban agriculture. In the surveyed sub-cities, a wide range of participating agencies from different levels of government share responsibility for different stages of urban agriculture. Of the sub-cities surveyed, most had 2 or more parties responsible for policy development, identifying appropriate locations, registering or permitting, or monitoring urban agriculture, or providing extension services for urban agriculture. Commonly, it is the responsibility of urban planners to identify locations for urban agriculture, while sub-cities are largely responsible for permitting urban agriculture activity. Respondents did not express concern about this disjointed responsibility for various aspects of urban agriculture; although “responsibility” was not a key constraint offered in the survey, neither did survey respondents volunteer this observation.

***Regulating and Supporting Urban agriculture***

Different officials from the study sub-cities informed that the ability of and opportunity of the planning institution to effect changes in communities collectively may be considered ***“institutional capacity.”*** How supportive the institutional capacity is of Urban agriculture may be measured by the human and other resources devoted to Urban Agriculture, for such things as enforcing policy (regulating Urban agriculture) and providing programs and extension services (supporting Urban agriculture) as determinant component of land plan of the city administration as the perspective of Urban Planning..

***Enforcing Policy***

Key informants interview shows that urban farming activities may suffer from a presence of ***prohibitive, or a lack of or inconsistent enforcement of supportive*, land use or** urban agriculture **policies**. Where urban agriculture is illegal and this ban enforced, urban agriculture can suffer disruption and uncertainty. However, where urban agriculture is illegal but resources or staff to monitor policy infractions are lacking, ***urban agriculture may benefit from lax and haphazard enforcement***. In study sub-cities, the rate of urban expansion is so rapid that land development occurs beyond the capacity of planners to track, let alone direct, changes. This lack of control may provide opportunities for illicit urban agriculture to flourish, but it may also pose a threat to peri-urban agricultural areas that are sacrificed to haphazard settlement in different directions of the study sub-cites.

**Inconsistent and inequitable enforcement** may be as problematic as a lack of enforcement of land-use policy. Where some citizens cannot keep as many livestock as their neighbors, local resentments and a general lack of faith in planning policy can build. On the other hand, selective enforcement of prohibitive policy may benefit urban farmers. It has been found a tolerant official attitude toward urban agriculture, in spite of legal bans. It has also been noted that city officials did not tend to prosecute urban agriculture offenders in Addis Ababa, and tolerance of urban agriculturein the face of prohibitive policy has a strong link to the cultural norms and attitudes of the parties involved. ***Farmers’ lack of awareness of or disregard for municipal by-laws or pertinent policy and legislation*** can make policy enforcement difficult. Farmers may be unaware of what by-laws are, or of those specifically pertaining to urban agriculture, especially if by-laws are relatively new or poorly advertised. Farmers may be confused by policy and legislation that is not enforced consistently; when perceived as unfair and uncertain, it may be disregarded.

***Keeping Land and Agricultural Records and Statistics***

Key informants interview and focus group dictation transcribed unveil that Land management in the study sub-cities is hampered by *a* ***lack of clear records of land ownership or land tenure***. Such records can help planners distinguish clearly between public and privately occupied lands, determine property values and rents, and track who owns and who uses parcels of land. Without records, land transactions are difficult to control. In the sub-cities surveyed, statistics about urban agriculture are rarely collected. Addis Ababa keeps limited statistics and records; only in the peri-urban three sub-cities, did one respondent claim that statistics are kept on agriculture extension efforts, and of farmers associations and cooperatives. This lack of record-keeping implies that planners either have no access to information about Urban Agriculture in their community or do not use or seek out information on ***urban farming*** as a basis for developing planning policy. Record-keeping may be complicated by different understandings of what is meant by ownership, tenure and use. Ideas of distinct land ownership, and use with compensation (e.g., rents paid), may be foreign concepts to people who reach agreements about land use based on first use and continued occupancy.

***Providing Support, Services and Financing***

The FGD Transcribed indicates that the provision of information services, agricultural inputs, and programs that lead to agricultural demonstration projects, or in other capacities, to providing credit and loans to urban farmers are all further demonstrations of institutional capacity to encourage and promote Urban Agriculture. Many of the survey respondents identified *an* ***absence of support, programs, services and financing and credit being offered to farmers*** as key constraints to why Urban Agriculture does not occur or to why it is not more prevalent. Certainly, although planners may not be in a position to offer or fund or administer these services, they are in a position to identify the need for such services, and to rally support.

**Synthesis of Planning-Factors: Categorizing City Support for urban agriculture**

The literature review and informants interview show that the links between ***urban agriculture and urban planning need to be conceptualized***, or made apparent, and that more thought needs to be given about the role of urban agriculture in sustainable communities. The author has offered here that a way to link the ***urban planning constraints and implications*** for the level of support that a city offers for ***sustainable urban agriculture***. Determining this ***“level of support”*** is proposed for two reasons: *1) to assist community leaders and planners in understanding constraints to urban agriculture in their own local areas, and 2) to assist in research on planning and urban agriculture, by providing researchers with a common way to talk about local challenges in terms of urban agriculture.*

As was noted above, to improve circumstances for urban agriculture one needs to understand why it occurs, and how prevalent it is, as well as the political, social, and economic conditions helping or hindering it. Categorizing sub-cities in this way can highlight relationships between city planning and government and urban agriculture activities. As well, categorizing sub-cities can allow comparison to be made of the relative support sub-cities offer to urban farming. Such comparisons can draw attention to approaches used by other sub-cities to combat similar problems, and help city administrators and planners set goals for improving urban agriculture conditions so as to make sure ***sustainable urban farming.*** Finally, In the following section, the ***sustainability of urban agriculture is being tested in urban planning perspectives***.

**Assumptions of Logistic Regression for Testing Urban Agriculture in Urban Planning Persictive**

Logistic regression is popular in part because it enables the researcher to overcome many of the restrictive assumptions of OLS regression (Agresti, 1990). The logistic regression handles non-linear effects even when exponential and polynomial terms are not explicitly added as additional independents because the Logit link function on the left-hand side of the logistic regression equation is non-linear. The dependent variable need not be normally distributed (but does assume its distribution is within the range of the exponential family of distributions, such as normal, Poisson, binomial, gamma). Logistic regression does not require that the independents be interval or the independents be unbounded (Kleczka, 1980). Logistic regression assumes that error terms are independent and all relevant variables are included in the regression model. The logistic regression assumes a linear relationship between the Logit of the independents and the dependent. Logistic regression uses maximum likelihood estimation (MLE) rather than ordinary least squares (OLS) to derive parameters (Hair et al, 1992).

***Appropriateness of Logistic Regression Model***

There has been explained so far, Logistic regression can be used whenever an individual is to be classified into one of two populations. Binary logistic regression uses a dichotomous dependent variable, which is appropriate in this case because the aim is to distinguish between two groups of sustainable Urban agriculture in the perspective of urban or city planning, those who are feeling ‘sustainable’ or ‘unsustainable’ in relation to ***edible city solutions*** or ***edible urbanism***), which is quite behavioral, perceptual, observational and would be based on the extent to which each individual farmers perception, observation and understanding (by two words may be sustainable or unsustainable, yes or no, like or dislike). Backward and forward variable selection procedures were used to identify the important variables affecting the ***sustainability of urban agriculture***

Therefore, Logistic regression is used to obtain odds ratio in the presence of more than one explanatory variable. The procedure is quite similar to multiple linear regressions, with the exception that the response variable is binomial. The result is the impact of each variable on the odds ratio of the observed event of interest. The main advantage is to avoid confounding effects by analyzing the association of all variables together.

Therefore, the binary logistic regression model was applied to determine factors that explained why some urban farmers define their productivity in terms of ***sustainable (Yes=1)*** and ***unsustainable (no=0)***. When dealing with a dichotomous dependent variable (response variable) - the main interest is to assess the probability that one or the other characteristic is present (Peng et al, 2002). The logistic regression model answers the question what determines the probability that the answer is *sustainable, or unsustainable*. The special features of the model guarantee that probabilities estimated from the logistic model will always lie within the logical bounds of 0 and 1. In other words the probability that customers picked at random is defined urban agriculture in relation to planning perspectives as sustainable or unsustainable, Sustainability is not a continuous variable but a discrete one. The logistic regression model can be expressed mathematically as shown above. The selection of predictory variables was based on the review literature, observation; standards and norms on maintain sustainability of Urban Agriculture through proper planning.

***Determinants for the sustainability of Urban Agriculture in the Perspective of Urban Planning***

The sustainability phenomenon is regarded as an important aspect of life. In the urban agriculture domain, sustainability and farmers productivity in particular, plays fundamental role in determining the perceived success of urban agriculture. Identifying and satisfying the needs of urban farmers is critical for the existence and competitiveness of the food security and sufficiency in the study sub-cities of Addis Ababa City Administration. It has been added greater impetus to the importance of urban farmers’ good feeling, perceptions and satisfaction, to the effect, that it is now essential for the efficient production of crops and vegetables in terms of sustainable agriculture in urban planning perspective.

In the urban agriculture, farmers as producer’s satisfaction has remained an elusive and challenging issue for some considerable time. The study results unveil somewhat surprisingly it is an aspect of food production that until now has been given little priority. Unsustainability is widely experienced by farmers in agriculture sector and may be caused by many aspects but is largely attributable to overrunning input costs, delayed completion, inferior quality and less commitment of government authorities in assisting farmers. The study results also revealed that farmers’ strategic decisions may also have an impact on their own productivity levels. Decisions such as choosing an appropriate inputs, access to clean and reliable water, access to farm land and tenure security, lack of considering farms land in ***city structural plan*** can result in poor farming performance and ultimately lead to ***unsustainability of urban agriculture.*** It has also been argued that, although urban agriculture is unique in some aspects, there were 13 broad dimensions of sustainable urban agriculture that are applicable universally, which include: *farm land as integral component of Land use Plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture*, *Official support for city planning,* *Technical support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*, *Balcony agriculture* and *strong Institutional setup.*

***Sustainability of Urban Agriculture*** is viewed as the degree and direction of discrepancy between Urban Farmers’ perceptions and expectations and is often seen as an antecedent of producers’ satisfaction. ***Farmers’ satisfaction*** is generally seen as the difference between productivity and actual farming performance and is related positively to sustainability. Farmers’ perspective depends on the features of the urban agriculture service offered and the quality of the gardening service interaction.

**Test of Linear Associations**

***Correlation Analysis***

Table 7.5 below provides a matrix of the correlation coefficients for the 13 variables (*farm land as integral component of Land use Plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture*, *Official support for city planning,* *Technical support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*, *Balcony agriculture* and *strong Institutional setup* and ensuring sustainability of urban agriculture and satisfaction of urban farmers. Underneath each correlation coefficient both the significance value of the correlation and the sample size (399) on which it is based are displayed. Each variable is perfectly correlated with itself (obviously) and so r = 1 along the diagonal of the table. All the variables are correlated to each other at p<0.01 level of significance. However, the correlation coefficient of all the variables included in the model is not greater than 0.60 which implies that there are no multicollinearity and endogeneity problems. The conclusion is that all these variables can be confidently used in the logistic regression model that this research applies. This also shows that the dependent variables can be used for further inferential statistics. The table 6.5 below and the figure 4.10 clearly illustrates very weak multicollinearity that it has not been exceeded R-value=0.60, so that logistic regression model is going to be adopted.

Similarly, as being illustrated on the figure 6.2 above; the results of the *farm land-Land use Plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture*, *Official support for city planning,* *Technical support service for urban agriculture*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*, *Balcony agriculture technique* revealed no concerns for multicollinearity; then it has been analyzed the data again. An examination of the scatter-plot indicated the concentration of the data points along the bottom of the X-axis revealed that farmers who rated the overall sustainability of farming could have anywhere from unsustainability to 100% sustainability toward the dimensions of efficient urban agriculture. Similarly, farmers with higher productivity on the dimensions of sustainable urban agriculture could have no overall sustainability to 100% sustainability.

*Table 4.10: Pearson Correlation in between Independent Variables to Test Multicollinearity*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Pearson Correlations | | | | | | | | | | | | |
|  | farm land-Land use Plan | Public Authorities commitment | Land access | Tenure Security | Planning enforcement | support for city planning | Technical support | water supply | Financing Opportunities | Access to inputs | Access to Power | Market access | Balcony agriculture |
| Farm land-Land use Plan | 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| Public Authorities commitment | .392\*\* | 1 | . |  |  |  |  |  |  |  |  |  |  |
| Land access | .313\*\* | .266\*\* | 1 |  |  |  |  |  |  |  |  |  |  |
| Tenure Security | .355\*\* | .244\*\* | .386\*\* | 1 |  |  |  |  |  |  |  |  |  |
| Planning enforcement | -.052 | .354\*\* | .352\*\* | .236\*\* | 1 |  |  |  |  |  |  |  |  |
| support for city planning | -.049 | -.037 | .022 | .321\*\* | .314\*\* | 1 |  |  |  |  |  |  |  |
| Technical support | -.395\*\* | -.021 | -.081\*\* | -.021 | .358\*\* | .053 | 1 |  |  |  |  |  |  |
| water supply | .391\*\* | -.074\*\* | .008 | -.330\*\* | -.307\*\* | .018 | -.198\*\* | 1 |  |  |  |  |  |
| Financing Opportunities | -.037 | -.341\*\* | -.164\*\* | -.261\*\* | -.152\*\* | -.079\*\* | -.077\*\* | .346\*\* | 1 |  |  |  |  |
| Access to inputs | -.350\*\* | -.067\* | -.310\*\* | -.482\*\* | -.024 | -.232\*\* | .089\*\* | -.046 | .358\*\* | 1 |  |  |  |
| Access to Power | -.346\*\* | -.070\* | -.385\*\* | -.470\*\* | -.030 | -.355\*\* | .382\*\* | -.352\*\* | .302\*\* | .459\*\* | 1 |  |  |
| Market access | -.387\*\* | -.162\*\* | -.218\*\* | -.386\*\* | -.054\* | .001 | .015 | .099\*\* | .395\*\* | .093\*\* | .206\*\* | 1 |  |
| Balcony agriculture technique | -.068\* | -.074\*\* | -.201\*\* | -.353\*\* | -.058\* | -.015 | .039 | .312\*\* | .109\*\* | .041 | .300\*\* | .304\*\* | 1 |
| \*\*. Correlation is significant at the 0.01 level (2-tailed).  \*. Correlation is significant at the 0.05 level (2-tailed).  Source: SPSS, 2021 | | | | | | | | | | | | | |

***Logistic Regression Result on the Determinants of Sustainable Urban Agriculture in Planning Perspectives***

In this model, the dependent variable was the sustainable Urban Agriculture in terms of farmers productivity ensuring system responsive to ever changing edible city solutions’ requirements and expectations (coded as unsustainable ***(no)=***0, and sustainable ***(yes)*** =1). Within 13 main independent variables, (*farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture*, *Official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*, *Balcony agriculture technique*) (coded as unsustainable very much=1, unsustainable =2, and neutral =3, sustainable =4 and sustainable very much =5) were included in the model and the probability of these variables are examined as shown in the table below. These probability values are the values of the Wald test to determine whether the parameters are meaningful. As indicated in table below, the positive signs on the beta ‘β’ coefficients indicate that all the 9 variables (explanatory) are positively affecting the level of sustainability farming performance; whereas 4 variables (explanatory) are negatively affecting the level of sustainable productivity of urban agriculture. The effect is statistically significant at level of significance (P<0.05), some are also the response variable with p-vale >0.05. This doesn’t mean that they are not correlated with response variable, so that this is for only statistical model relationship.

***Tests of Associations***

In order to identify factors that influence edible urbanism that farmers get from the Urban Agriculture Agency of the City Administration, Binary Logistic Regression Model mainly Odds Ratio and the regression coefficient was used and the goodness of fitness of the model was also checked by using Hosmer Lemeshow Test. The result of binary logistic regression model is presented in Binary Logistic Regression Model mainly by using Odd Ratio. The Farmers’ overall satisfaction in terms of sustainability ensuring system responsive to ever changing farmers’ requirements and expectations was assigned a value of 1 if the respondents reported ensuring sustainability ***(yes)*** and 0 ***(no)*** otherwise not sustainable. The reference category of each dichotomously measured dependent variable has a value 1 is indicated as the first and the others category are compared to that of the reference category. If odd ratio value is less than one it implies that individuals in that category have a lower probability in certifying sustainability than farmers in the reference category. The Wald Chi Square statistic, which tests the unique contribution of each predictor, holding the other predictors constant, that is illuminating any overlap between predictors.

From the result of binary logistic regression model the following interpretations are -.013, -.009, -0.049 and -.010 are the decrease in log odds of internal customers in relation to *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture* respectively with respect to those of who feel sustainable, neither feel sustainable nor unsustainable, farmers overall feeling sustainability in the reliable farmers productivity; the odds ratio 0.989, 0.992, 0.979 and 0.99 means that the odds ratio of *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture* have decreased by factors of 0.989, 0.992, 0.979 and 0.99 respectively with respect to those of who have felt sustainable, neither felt sustainable nor sustainable, Farmers who have felt sustainable compared to those who are feeling sustainable with Reliable productivity ensuring system responsive to ever changing farmers’ requirements and expectations by keeping other variables constant.

0.0095, 0.092, 0.3423, 0.053, 0.0386, 0.0511, 0.03, 0.0423 and 0.107 are the increase in log odds of farmers as producers with respect to those of who medium and high on farmers overall feeling of sustainability in relation to Reliable production ensuring system responsive to ever changing farmers’ requirements and expectations with respect to *Official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*, respectively; the odds ratio 1.0115, 1.0983, 1.411, 1.066, 1.0456, 1.031, 1.047, and 1.112means that the odds of Farmers feeling of sustainability in relation *Official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access* respectively have increased by factors of 1.0115, 1.0983, 1.411, 1.066, 1.0456, 1.031, 1.047, and 1.112 respectively with respect to those of farmers overall feeling sustainability of food security and production who were medium and high level farmers with Reliable productivity ensuring system responsive to ever changing farmers’ requirements and expectations. -.013, -.009, -0.049 and -0.010 are the decreased in log odds of professionals as external customers with respect to those of who are facing weak *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture* respectively; the odds ratio 0.989, 0.992, 0.979 and 0.99 means that the odds of urban farmers good feeling and perception have decreased by factors of 0.989, 0.992, 0.979 and 0.99 with respect to those of who were weak *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture* keeping other variables constant.

0.0095, 0.092, 0.3423, 0.053, 0.0386, 0.0511, 0.03, 0.0423 and 0.107 are the increase in log odds of farmers as producers of crops and vegetation with respect to those of who medium and high on Reliable farming performance ensuring system responsive to ever changing farmers’ requirements and expectations; the odds ratio 1.0115, 1.0983, 1.411, 1.066, 1.0456, 1.031, 1.047, and 1.112 means that the odds of farmers as producing agents feeling sustainable have increased by factors of 1.0115, 1.0983, 1.411, 1.066, 1.0456, 1.031, 1.047, and 1.112with respect to those of who were medium and high on *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access* respectively compared to those who are low on urban farmers feeling of sustainability for keeping other variables constant.

Table 4.11: Logistic Regression Analysis Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Predictory Variables/Determinants** | **B Av** | **Wald** | **Sig.** | **Exp(B) Average** |
| Farm land as integral component Land use Plan | .0095 | 0.666 | 0.4265 | 1.0115 |
| Public Authorities commitment | -.013 | 0.453 | 0.567 | .989 |
| Tenure Security | .092 | 1.544 | 0.410 | 1.0983 |
| Land access | .3423 | 17.8 | 0.000 | 1.411 |
| Planning enforcement | .053 | 16.087 | 0.050 | 1.066 |
| support for city planning | .0386 | 1.9342 | 0.2748 | 1.0456 |
| Technical support | .0511 | 0.953 | 0.430 | 1.0456 |
| water supply | 0.03 | 0.285 | 0.694 | 1.031 |
| Financing Opportunities | -.009 | 0.345 | 0.630 | 0.992 |
| Access to inputs | -.049 | 4.652 | 0.021 | 0.979 |
| Access to Power | .0423 | 1.134 | 0.301 | 1.047 |
| Market access | .107 | 1.543 | 0.021 | 1.112 |
| Balcony agriculture technique | -.010 | 0.023 | 0.910 | 0.99 |
| Constant | -5.623 | 212.037 | 0.000 | .004 |

Notes: (3) \*\*\* Level of significance at p<0.05,

Source: Logistic Regression analysis result, SPSS, 2021

Increasingly, the regression result is also interpreted that table 5.3 above displays the odds ratios derived from the logistic regression’s coefficients. The odds ratios can be interpreted as the probability of the dependent variable occurring (Farmers expectations and sustainability upon reliable production of ensuring farmers performance) or farmers overall feeling of sustainability) due to the increase in one unit of the corresponding independent variable. Based on the odds ratio result, it is also predicted that if Public Authorities commitment in planning increases by one unit, farmers level of productivity in urban agriculture are 1.0115 times more likely to be produced at level of significance (p>0.05). If ***financing opportunities*** increases by one unit, farmers good feeling and urban agriculture sustainability’s are 1.411 times more likely to be increased at level of significance (p <0.05). If land access and tenure security increase by one unit, the sustainability of urban agriculture is 1.047 times more likely to be sustainable at level of significance (p >0.05). If access to water supply for irrigation increase by one unit, farmers overall feeling of sustainability are 1.112 times more likely to be increased but not statistically significant. The determinants of sustainable urban agriculture in relation to planning perspectives in their order of importance based on the odds ratio result from the most important to the less important is as shown in the table 5.3 above. Order of importance for professionals satisfaction as external customers based on odds result from most important to less important is *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture,* *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*

Furthermore, the Logistic regression analysis result confirmed that the probability of getting better feeling of sustainability as farmers efficient utilization production is being revealed by increasing contributory factors or dimensions of sustainability of urban agriculture as ***edible city solutions*** including *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture,* *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access* as well**.** So, this is also clear manifestation of the strong correlation between farmers’ productivity and sustainability of urban farming as contributory factors stated above. So, the analysis result unveiled that every unit of the predictory variable including *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture,* *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply* and the likes increase the sustainability of Urban Agriculture in the momentum of edible urbanism as already being addressed above.

The Logistic Regression result (Sigmoid curve) (Predicted Logit against Respondent No of ID) clearly illustrates that majority of the respondents were shown the feeling of unsustainability upon the the current situation of urban agriculture as an integral components of city planning land use. Respondents’ clear feeling of unsustainability and sustainability was rated against each dimensions of urban agriculture sustainability including *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture,* *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access*

Therefore, improvement in each dimensions of urban agriculture sustainability will improve the the farmers level of production food security of the city administration as ***edible city solutions.*** Please look at the relationship between the response variable (dependent) and predictory variables (independent) in the ***derived model below:***

ϴ=ln(P/1-P)=-5.623+.0095X1+.092X2+.3423X3+.053X4+.0386X5+.0511X6+.03X7+ 0423X8+.107X9

ϴ = Probability of the farmers agrees that are felt sustainable in the agricultural production improvements, also could be taken farmers overall feeling of sustainability in terms of Reliable food security as ensuring system responsive to ever changing farmers’ requirements and expectations (probability / sustainable **(yes)** = 1, unsustainable **(no)=**0) as edible city solutions. The assessment on the other hand found main 13 variables including Farm land as integral component Land use Plan(X1), Tenure Security(X2), Land access(X3), Planning Enforcement for UA(X4), Market access (X5) access(X6), Access to Water Supply(X7),, support for city planning(X8), and technical support service(X9), are variables that are statistically significant at level of significance P-value (P<0,05) from the logistic regression analysis result. So changes in each of the predictory variables (Xs) might change the other variables, or their P-values are greater than the common alpha level of 0.05, which indicates that they are not statistically significant to the model. This doesn’t mean that they are not correlated with response variable; hence, this is for only statistical model relationship.

So, all the variables including *farm land-Land use Plan in the city plan*, *Public Authorities commitment*, *Land access and tenure Security*, *Planning enforcement for Urban Agriculture,* *official support for city planning,* *Technical Land support service for UA*, *Access to Clean and Reliable water supply*, *Financing Opportunities*, *Access for agricultural inputs*, *Access to Power generation*, *Reliable market access* are found to be significant. Therefore, the changes in *official support for city planning and Technical support service for UA* might change farmers’ overall perception of sustainability and the likes in the edible city solutions of the city administration. In the same manner the changes in *farm land-Land use Plan in the city plan* and *Public Authorities commitment* in the farmers good perceptions associated with Reliable food security ensuring system responsive to ever changing farmers’ requirements and expectations can change the other predictory variables as far as the sustainability of urban agriculture is concerned.

***Logistic Function Curves (Probit and Logit)***

On the other hand, The logistic regression analysis result has also unveiled that a logistic growth curve is an S-shaped (sigmoid) curve (Predicted Probabilities against predicted Logit) (see figure 6.3) that can be used to model functions that increase gradually at first, more rapidly in the middle growth period and slowly at the end, leveling off at a maximum value after some period of time in relation to better feeling of sustainable urban agriculture.

The initial part of the curve is exponential; the rate of increasing the probability of better farmers overall feeling and good perceptions accelerates as it approaches the midpoint of the curve. At the midpoint (K/2), the increasing rate begins to decelerate but continues to grow until it reaches an asymptote equal or less than 1, K which is called the ***"Carrying Capacity"*** for the farmers overall feeling sustainability for urban agriculture in city administration. This type of curve is frequently used to model the quality of farming and surplus food productions’ so as to make sure the sustainability of urban agriculture where there is an initial exponential growth period followed by a leveling off as more of the sustainability reaching its maximum capacity is as the contributory factors or some other factor limits further development in to farmers effective and efficient food productions in the agriculture sector. This S-shaped (sigmoid) curve has also shown the relationship between response variable and predictory variables that exhibit a progression of improvement for sustainability from small beginnings that accelerates and approaches a climax over time.

**Relative Weight Factors Affecting Farmers Perceptions in Their Order of Importance**

Table 6.5 below provides a logistic regression analysis for relative weight factors comprising 12 main variables including age, access to credit, farm land size, income, experience in farming, gender, economically active members, education, Capacity Building, awareness of UA, extension visits, feeling of farmers, in relation to farmers perception of ensuring system and sustainability of urban agriculture. This result clearly shows the order of importance to improve the urban agriculture as edible city solutions/edible urbanism. So, it is illustrating that farming and other characteristics that influencing the perceptions of farmers that are supposed to be used to adopt new agricultural technologies to install sustainability.

Table 4.11: Logistic Regression Analysis Results for Farmers Perception in Relation to Relative Weight Factors

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Relative Weight Factors of farmers perception** | **B** | **Wald** | **Sig.** | **Exp(B) Average** |
| Farmers Age | 0.01675 | 1.573 | 0.028 | 1.0185 |
| Access to Credit | 0.055 | 1.59 | 0.320 | 1.2772 |
| Farm Land size | -0.113 | 0.74 | 0.621 | .9900 |
| Income | 0.0065 | 1.0815 | 0.4315 | 1.010 |
| Experience in Farming | -0.0175 | 0.3655 | 0.654 | 0.983 |
| Gender | -0.0003 | 0.400 | 0.562 | 1.000 |
| Economically active members | .004 | 005 | 0.943 | 1.004 |
| Education | 0.059 | 0.634 | 0.165 | 1.491 |
| Capacity Building/***Received training*** | 0.0735 | 2.634 | 0.050 | 1.0773 |
| Awareness | 0.085 | 3.35 | 0.047 | 1.0903 |
| Extension visits | 0.1025 | 4.38225 | 0.028 | 1.1085 |
| Attitudes of the farmers towards the risk | 0.1205 | 7.9355 | 0.047 | 1.131 |
| Land occupation | -0.0375 | 0.5655 | 0.754 | 0.9983 |
| Constant | -6.748 | 294.440 | .000 | .001 |

*Notes: (3) \*\*\* Level of significance at p<0.05,*

*Source: Computed from survey data, 2021*

*Table 4.11* displays the odds ratios derived from the logistic regression’s coefficients. The odds ratios can be interpreted as the probability of the dependent variable occurring (overall farmer’s perceptions) due to the increase in one unit of the corresponding independent variable. The result shows that if training as capacity building increases by one unit, farmers perceptions are 1.131 times more likely to be more important to be perceived and this is significant at p <0.05.

If the income of the farmers (this variable strives to determine whether income of the farmer increases by one unit, farmers perceptions are 1.0903 times more likely to be improved, which shows the level of importance and this is significant at p <0.05. The farmers’ age is significantly influences on the decision for adoption of new agricultural technology. In this study, the result used to confirm whether farmers’ age is statistically significant in influence on the decision for adoption of new agricultural technology. If farmers age increases by one unit, farmers perceptions are 1.1085 times more likely to be important to be improved and this is significant at p <0.05, which clearly demonstrates the order of importance. Age of the farmer either male or female had strong positively influence on the adoption of innovative technologies in farm land cultivation. Since in the study area most of them are in the middle age farmers and they tend to be more innovative and more apt to adopt new technology due to their longer planning and lower risk aversion characteristics. As being explained above, Coefficient of age has statistically significant. as age increases, the farmers have more likely to adopt new techniques in their cultivation and follow and increase the perspectives of urban planning for sustainable urban agriculture. Similarly, education also statistically significant indicates that the farmers who have more educated encourage them to adopt new farming techniques in the urban agriculture sector. Because of the higher educated farmers can easily understand the applications of new machines and other inputs like new varieties of seeds, fertilizers and chemicals. If Capacity Building/training increases by one unit, farmers perceptions are 1.07725times more likely to be important to improve and this is significant at p >0.05. If access to credit increases by one unit, farmers perceptions are 1.2772 times more likely to be important to be satisfied and demonstrates it level of importance to increase good perception, however this is significant at p >0.05. It is also obvious that farm size has significantly influences on the decision for adoption of new agricultural technology. In this study, the hypothesis used to confirm whether farm size is statistically significant influence on the decision for adoption of new agricultural technology. If farmers ageincreases by one unit, farmers perceptions are 1.1085times more likely to be important to be improved and this is significant at p <0.05, which clearly demonstrates the order of importance.

On the other hand, the coefficient of land occupation of urban farmers has negative sign reveals that farmers who were cultivated their urban land, they have less probability to adopt new farming practices than who have cultivating the farming production in their occupied land. Its coefficient is also significant The coefficient for size of cultivating land has positive sign shows that farmers who were cultivated *crop and vegetation* in more hectares they have more interested to adopt new farming techniques and also it is statistically significant at 0.01 level. As expected, the adoption of new technologies and farming experience of crop and vegetation was positively and significantly correlated each other indicated that the farmers’ getting more and more experience in crop and horticulture cultivation, they have more probability to adopt new types of technologies. Because, experienced farmers are less risk averse and willing to adopt an innovative technology that is perceived to come with high financial rewards and improve their lot. On the other hand, *farmers’ experience* is significantly influences on the decision for adoption of new agricultural technology. In this study result is used to confirm whether farmers’ experience is statistically significant in influence on the decision for adoption of new agricultural technology. If *farmers’ experience* increases by one unit, farmers perception improvements are 1.04 times more likely to be important to be increase and this is significant at p >0.05, however, it is not statistically significant.

In conclusion, the relative weight of factors of farmers perception in relation to sustainable urban agriculture is underlined from the above result in their order of importance from the most important to the less important is as follows: Access to Credit, Attitudes of the farmers towards the risk, Extension visits, awareness, training received/Capacity Building, Farmers Age, income, economically active, gender, farm land size, and education of the farmers. This means that for better farmers perception for urban agriculture sustainability should give priority for the variables as per their order of importance.

Therefore, urban agriculture is here to stay and is defined as the growing, processing, and distribution of food and other products through intensive plant cultivation through proper land use planning in and around the city. Growing food and non-food crops in and near city contributes to healthy communities by engaging residents in work and recreation that improves individual and public well-being. Urban agriculture in the land use planning of the city structural planning integrates multiple functions in densely populated areas offering an ***alternative land use***. In addition to food production, urban agriculture also offers a wide range of other functions such as energy conservation, waste management, biodiversity, nutrient cycling, microclimate control, ***urban greening, economic revitalization***, community ***socialization, human health, preservation of cultural heritage, and education***. On the other hand, analysis result also uneils that it does not specifically address food security. The most important issue for urban food production is its official recognition as ***urban land use,*** ***security of tenure,*** as well as access to land and other resources as the drivers of Sustainable urban agriculture. ***Access to land*** is especially relevant for marginal and minority groups, and this could be mitigated by offering more publicly-owned open space for community gardens. As not all city areas are well-suited for growing food, availability of land based on ***biophysical factors*** for ***urban agriculture*** could be identified by developing land-use inventories and land suitability analyses using geographic information system (GIS) technologies. A conceptual model for integrating urban agriculture into planning and enhancing city sustainability is presented in ***figure 5.13 above****.* It builds on the four pillars of the sustainability concept, namely, ***social, economic, ecological and spatial,*** allowing urban agriculture to flourish in the city. This requires ***land use and planning*** to come together to address current sustainability challenges and respond to the factors that are already driving the presence of ***urban agriculture in the city***.

**Conclusion and Recommendations**

**Summary**

The analysis results clearly unveil that urban agriculture is a real activity, but it seems that the urban planners in Addis Ababa in last 2 decades have not fully created conditions for that activity to develop itself. So the areas used for Urban Agriculture are normally planed for other uses, and only tolerated or even banished from the areas where it has implanted itself. From personal observations, these unplanned, opportunistic occupations of urban areas for Urban Agriculture tend to be locational or environmentally problematic: the use of low-quality water to irrigate crops, the use of potentially contamined soils, the growing of food near heavy road traffic with corresponding air pollution and safety constraints, and the occupation of public or private properties without the consentient of the occupiers, are some of the problems the Author has saw in his research in Addis Ababa urban agriculture. So, the need is there and the problems too; seems to be the perfect combination to work on both, and from what he saw so far, well planned and managed urban agriculture areas are the appropriate solution.

Likewise, empirical reviews and best practice from around the world show that more and more cities in the world have developed and still are developing planning Urban Agriculture schemes, not only because of the situations mentioned above but also - accordingly with schools underlined in the review like ***“urban metabolism”*** “resource recycling and conservation, therapy and recreation, education and safe food provision, community development, green architecture, and open space management” issues on mind. As being explained in the review and the analysis results indicate that the City Administration recognizes agriculture as a compatible activity within the green infrastructure mentioning that “green spaces are areas with functions of ***ecological balance***, ***open air recreation***, leisure, sports and culture, ***agriculture or forestry****”.* Other strategy also mentions that the green infrastructure within urban perimeters comprise public or private green spaces of collective use, with the functions of Regulation of the urban hydrological cycle; Improvement of air quality; and Biodiversity conservation. Urban Agriculture has in fact the potential to help all these issues, but also to contribute to their deterioration; it all depends on how it is done. Nevertheless there’s one important issue to be also considered: the maintenance costs of the public green spaces including urban agriculture. With Urban Agriculture, those costs are not passed to the public authorities but on the farmers using that land; so if they farm in order to achieve hydrological efficiency goals, good water quality and biodiversity conservation, Urban Agriculture is effectively a good option to be considered within the green infrastructure as edible city solutions (EDS) as edible urbanism.

**Discussion and Findings**

The analysis results unveil that “the process of formulating and implementing land policies is not only politically and technically difficult, it can also be costly. Sub-Cities in Addis Ababa City Administration did not develop according to ***planners’ wishes***; to the contrary, in the present and past, trends have always shown their own dynamic of development of ill planned urban forms in relation to urban agriculture. Howard’s Garden City proposals addressed many aspects of **the food system** -production, distribution, collective preparation and consumption, and waste recycling- as integral to the city, an idea that only now is recovering again. As being explained in the contextual backgrounds and the analysis results show that on ***urban planning*** in Addis Ababa, the rapid urban development and population increase are highlighted which make the recent trend different from what happens in the other world. Addis Ababa's infrastructure, for example, has been unable to cope with this influx of people in terms of food security.

Therefore, urban planning instruments need to be adapted to the relatively new situation instead of using out-dated, old-fashioned, Modern planning instruments, which are not even used anymore in the each sub-city. ***Urban poverty and food security***, ***the urban land market and Issues related to sustainable urban development***. A basic question is: how to increase access to land for the poor or how to integrate the urban poor into the urban land market? The study result vividly indicates that The dilemma is: recognition of and interest in urban and per urban agricultural production (UPA) is generally low among ***planners and politicians***. Thus, a consistent approach to Urban and Peri-Urban Agriculture is rarely found. Little co-operation in the field of land legislation is happening and innovative approaches from City Administration are missing. There is a lack of both National comparative studies on land legislation as well as City level knowledgeable advisers in the ***perspectives of Urban Planning.***

Although public awareness for farming activities in sub-cities is slowly increasing, agriculture is still in many cases “by definition” ***not practiced in broadly***, and is often seen as ***“economically unimportant”*** or ***“a temporary phenomenon”.*** The terms ***“agriculture” and “urban planning”*** seem to be ***incompatible***. Agricultural activities tend to be shifted to outskirts of cities, far away from markets and infrastructure without analyzing economic, environmental and interrelation with other sectors. ***Urban agriculture is often informal.*** This refers to the land occupied, the labor market, and the sales of the produce. ***No official authority deals with informal activities.*** For one or another of these reasons, ***urban planners tend*** to exclude ***agriculture from their terms of reference***. Nevertheless, leaving the ***urban farming sector*** out of ***planning activities creates*** many problems in the sub-cities of the City Administration. Urban agriculture is a reality and in many cases a response to crisis and a coping strategy of the urban poor. The Analysis results unveil that in the three Sub-Cities best and highly productive soils are gradually becoming built-up areas, thereby losing the potential for food production forever. Urban agriculture is often shifted to marginal soils and therefore can never meet the goal of high productivity.

It is also worth mentioning that high costs of green open space and solid waste management tend to modify thinking of planners and authorities: a more “agricultural” approach or an approach to public-private partnerships can help to reduce costs. Moreover, local authorities in sub-cities start to recognize the role of urban agriculture for poverty alleviation and local economic development, enhancing urban food security, offering recreational services to urban citizens, etcetera. On the other hand, different literature sources show that Land remains one of the controversial issues related to Urban Agriculture, but access to land is mostly more crucial than the availability of land. Urban land management (as any other land management) should aim to put urban land resources into efficient and sustainable use as being explained in the literature. This requires, first of all, recognition of the prevailing problems and acceptance of urban livelihood strategies including ***urban farming*** as an integral component of Urba land use planning, but also realization of benefits and opportunities created through productive use of green open spaces in the built environments.The analyses results on the other hand demonstrates that the challenge for ***urban planners*** is to ***integrate coping strategies of the urban poor***, which are closely related to the ***informal land market*** in the three sub-cities the Addis Ababa City Administration into their ***urban planning strategies***. This requires the definition of rules and standards but also ways to increase the supply of and access to land by the poor and implementation of land legislation to enable sustainable urban development. Recently, gender aspects have entered into the discussion of planning and agriculture in the City Government. Women, as major players on all levels of the urban food system, in production, marketing, processing and street food vending have a basic interest in being considered as an important interest group for urban planners as one of the ***edible city solution*** strategies and ***edible urbanism principle***.

The study result also shows that Women as another important urban dweller group are hardly ever mentioned in the planning process. Urban farms could play an important role in community building and the education process. In spite of little recognition of urban agriculture in literature on urban planning, urban planners are dealing with other issues closely related to urban agriculture, e.g. squatter settlement development and urban poverty alleviation. We can learn from the experience. Furthermore, the study result demonstrates that City development as conceptualized by the planning officer at Bole, Nifas-silk and Akaki Sub-Cities refers to ***“a conscious effort to create harmony and cohesion between social, economic and environmental activities for sustainable living condition.”*** The official also has perceived sustainable city development as ***“a city with vibrant economic activities, reliable infrastructural activities, clean environment and efficient social service delivery.”***

The analysis results show that Interaction with the various institutions involved indicates that much education on the benefits and contribution of ***urban agriculture*** is needed. There is the need for research institutions and all concerned with ***Urban Agriculture*** to help sensitize policy makers, and all the institutions which can contribute to ***integrating urban agriculture into city development on its pivotal role.*** Although urban agriculture may be well known by ***policy-makers and planners,*** in many cases this knowledge does not automatically contribute in their recognizing urban agriculture as an important element of ***the city economy and land-use system***. However, some city officials see urban agriculture as merely ***a left-over ‘of rural habits***, which is only temporary until the people accustom themselves to urban life, as a marginal activity with little economic importance, as a health risk and source of pollution that has to be removed. The trend analysis of urban Agriculture from ***1999 to 2018*** above have clearly unveils that the agricultural lands were occupied by building structure, and are manifestation of less attention for urban agriculture *(digital Maps for 1999, 2010 and 2018 above.).*

Finally, the study results unveil; it will be difficult for city authorities in the three Sub-Cities to incorporate Urban Agriculture into its development agenda. The ***Land use plans*** or schemes that exist do not include urban agriculture as a land use category since it is still seen as a ***rural activity***. Further, the Sub-Cities do not own lands that it can make available to the urban farmers to use. In Bole, Akaki and Nifas Silk all the major farm sites are undeveloped government lands which are not sustainable. Whenever the institutions involved want to expand and develop this parcel of land, the farmers will be ejected making it difficult for others to invest in the sector. Farmers ejected from ***Koye-Fache areas*** in Akaki Sub-City are typical example in cutting down the livelihoods of the residents without creating other options of sustainable urban economy.

On the other hand, the analysis reults unveils that urban agriculture is a practice widely used in the past, and is still in common use in traditionally in the city without organined planning processes. It is one of the most exciting concepts of sustainable development since it addresses almost all areas of sustainability. It is able promotes self-reliance, community, and local economy while reducing many environmentally harmful practices from modern farming practices” as being explained in the review The study results aslo demonstrates that the sustainability discussion, and recent serious, worldwide problems in agriculture, especially in edible landscapes, urban and per urban agriculture offer at least partly, a solution. Evidence suggests that Urban Agriculture complements rural agriculture and increases the efficiency of the City food supply in that it: Provides products that suburb agriculture cannot supply as well, UPA is a reality and has to be considered as an important activity near and inside City administration as edible city solution. Therefore urban and per urban food production is, in many cases, a response to various factors including: inadequate access of the urban poor to rural food supplies; inadequate measures to support food production; problems of transport and distribution of food in urban sectors; and Insufficient purchasing power of the urban poor. Taking the highly complex urban-rural linkages into consideration, it is important to direct future development efforts towards improved urban food security through strengthening the ***rural - peri rban - urban network.***  This principle is becoming more and more important in the ongoing City administration Urban agriculture initiates as components avoiding food insecurity. The City Administration should have to give emphasis to make it as an integral part of the land planning.

***Planned Urban Agriculture in Addis Ababa***

There are for some years now a great number of initiatives involving the creation of small-scale ***pedagogic kitchen-gardens*** in the open spaces of schools; one of the most known and coherent is the program “***Biological agriculture and composting in schools”,*** run by the Municipality of Addis Ababa, since 2015. Another initiative is the municipally-owned and managed sites for public access to the or ***“Pedagogical allotments”,*** where the public can visit and learn farming techniques or even farm their own plot; “***Kality Pedagogical Farm***”, in Addis Ababa, is one of the first examples and the ***“Social and Pedagogical Allotments”*** in School areas. Both are very well known locally, with a great number of visitors the first and farmers the second. Other situations are consequence of Condominium housing operations, that involved the destruction of informal urban agriculture sites, replaced afterword by a planned space; one of the examples of this situation is the areas, where the municipality, with the technical support, the success of that operation is pushing those entities to create more of those spaces through the city. Another example is designed public parks that contain an area for kitchen-gardens or allotments; almost all of them recent, one good example is the “Urban Park” at municipality. But maybe the older program of planned area for urban agriculture is one in residential areas, where for now more than 15 years, “public allotments” are run by the local municipality, and still in use.

***Employment and Occupational profile of farmers***

Agric is the main source of employment for 70, 80 and 87 percent of respondents in Bole, Akaki and Nifas-Silk respectively. Depending on the season and demand for their produce, urban farmers in Bole, Akaki and Nifas-Silk earn about Birr 25000 in the dry season and about Birr 20000 when there is abundance in the system. This is therefore a major source of livelihood for urban farmers and helps to reduce the incidence of poverty among some of the urban poor. If it is considered as an integral component of structural plan land use component, the productivity might increase.

***Urban Agriculture farming characteristics***

All the farmers interviewed in the three sub-cities are engaged in crop farming and horticulture. This they attribute to the fact that there is not enough land for them to engage in crop farming, vegetation and horticulture at the same time. Furthermore, there are no lands designated for urban agriculture in the study areas. In Bole, Akaki and Nifas-Silk, the average farm size is less than half hectare making it difficult for farmers to expand their production. Farmers use watering cans to carry water from a water source which mostly comprise of hand dugouts, streams and pipe system as well as hardly treated water. There exist farmers organization/groups in the various sites studied even though some are not functioning now. The major constraints affecting the operations of farmers are crop disease, lack of input, water, credit and marketing.

***Understanding planning institutions, policy and decision making process***

In the three sub-cities, there is no comprehensive plan or document on Urban Agriculture. Even though the Addis Ababa Plan Commission on Urban and Peri-Urban agriculture has revised the 2002 bye law and presented to the Addis Ababa City Administration, it has not been approved yet. Guidelines on urban agriculture in Addis Ababa City Government have been prepared and presented to policy makers yet still much attention have not given to it. Similarly, there is no bye law on urban agriculture in the Sub-Cities as well.

***Recognizing and permitting urban agriculture***

It has also been explicitly addressed in the analysis, urban agriculture activities in the three sub-cities according to officials of Addis Ababa City Administration Plan Commission is ***an informal or illegal‖*** activity. This is because it is not regulated by these institutions and monitored by them. This is considered only in as far as such urban planning includes some kind of ***'green belt'*** concept. Apart from earmarking such ***'buffer'*** zones, ***urban planners*** tend to exclude agriculture from their terms of reference. This is clear manifestations that less attention has been given urban agriculture as an integral parts of structural plan land use.

***Understanding spatial land use planning practices***

Land use (Layout) Plan or Detailed planning scheme, zoning and site plans are the main tools used for spatial land use planning. The Land use Plan indicates the various uses that the land can be put to. Zoning also gives the City Administration the opportunity to determine the use of every land. However, urban agriculture is not recognized as a land use category in the City Administration.

***Integrating urban agriculture into city development***

The Land use plans or schemes that exist do not include ***urban agriculture*** as a land use category since it is still seen as a rural activity. Further, the City Administration plan Commission do not own lands that it can make available to the urban farmers to use. In Bole, Akaki and Nifas-Silk all the major farm sites are government lands which are ill planned and not sustainable. *(See Figure 6.1 above).* Although urban agriculture may be well known by ***policymakers and planners***, in many cases this knowledge does not automatically in their recognizing urban agriculture as an important element of the city economy and land-use system, as one of the pressing changes that imped city development.

***Gender and urban agriculture***

The analysis results unveil that Women have limited access to agricultural land and only 13 percent participated in Urban Agriculture. When provided with adequate land, however, women were more efficient producers than men, which agree with them, who commented that women’s role in agriculture covers all the production stages, which include acquisition, processing and preparation. Urban Agriculture in Addis Ababa is dominated by men and high-income people who are able to invest and undertake ***Urban Agriculture as a ‘luxury’ livelihood strategy***, and are able to access information, private and expensive agricultural consultants/experts and agro-input.

***Petropolis to Agropolis-Edible Urbanism***

The abnalysis results and review clearly shows that Commercial urban agriculture is typically restricted to agriculture land use, green or open spaces, or under-utilized or undeveloped land in the city. As urbanizing city face the double threats of urban food insecurity and land scarcity, multi-functional urban land uses that integrate rather than separate agriculture from other land uses could be a critical adaptation for the sustainability of future city development. This would be taken as exemplar for ***integrating urban agriculture as component of Land Use Planning*** as being addressed above. Hence, the highlights of Urban Agriculture are: Urban land uses integrating agriculture with other land uses could be a critical adaptation for future city sustainability, urban agriculture policy is improved by collaboration across government agencies and sectors, policies support integrated urban food production through high-tech intensification, Development of Agri-food Innovation Park can house actors across the food ecosystem.

On the other hand, Besides providing essential food for a balanced diet of the family, the City Administration should develop a real commercial activity providing, according to certain sources, more jobs than in any other sector of the informal or formal economy. It is estimated that employment rate is 1 to 50 inhabitants. Therefore, the farmers’ field school has been adopted as a ***training and extension methodology to ensure disseminate Good Agriculture Practices, product safety and environment preservation*** through proper urban planning and design Agriculture for sustainable landscapes. The analysis results also shows, the ***City Administration*** should have to decide that the structural ***plan*** of the city should envisage farming spaces where each residential plot must allocate at least ***20% of the surface to farming activities.*** The City Government also should unveil a five to ten year agriculture strategic plan that seeks to support the city’s 's efforts to achieve food and nutrition security. The City Administration will focus more on investing in expanded agricultural research, ensuring farmers’ access to the market economy and improved infrastructure, implementing sustainable agriculture, and improving food security.

Therefore, the global experiences have addressed that urban agriculture should be integrated to the structural plan of the city so as to maintain food security and sufficiency by realizing the transformation from Petropolis to Agropolis/ecopolis.

**Conclusion**

The study has demonstrated that urban and peri- urban agriculture creates opportunities for poor people to generate income and improve livelihood security; at the same time, these activities can adversely affect existing livelihoods, particularly on the very poor. In fact, while access to water is a crucial requirement for year-round vegetable production, the marginal water quality affects people and the official perception and sustainability of informal irrigation in urban and peri- urban areas.

Urban Agriculture should be incorporated into the planning process at an early stage. There is a growing realization that the design of the scarce open space in the City Administration can (and must) be different. Setting up urban agriculture is one thing, but guaranteeing urban agriculture in a dynamic surrounding such as the city is another. The availability of sufficient land must be secured for an extended period of time. It is therefore clear from the study that adoption of polices by ***Urban Planners*** is key to the realization of urban food security and sustainable city development. In order to realize the full potential of urban agriculture, there is need to develop a policy and institutional framework for the sector. This would enable urban farmers unlock critical technical and financial support services. Also, urban agriculture would be carried out in designated and safe places. This would be mutually beneficial to the farmer as well as the unsuspecting consumer who would be guaranteed of safe produce being considered as edible urbanism.

On the other hand, the study concludes that It’s difficult to known, for the Addis Ababa reality, the contribution that Urban Agriculture gives to the reduction of energy consumption; as far as we known no studies or life-cycle analysis have been conducted, but this a very exciting field of research and the Author hopes that in the near future, good figures will come to the debate. he also has seen that not all informal Urban Agriculture realities are positive (due to safety, soil or water contamination, property and other reasons), but planned programs, which tend to be well-managed and with a concern or obligation of organic production mode, are more interesting for social cohesion, food production and environmental effectiveness reasons. Most of the planned urban agriculture programs in the City are created by municipalities or municipal agencies, but bottom-up initiatives are also sprouting, in very positive local governance, social inclusion and sustainability attitudes. So, even if the contribution of the planned Urban Agriculture to the de-carbonization of the urban society is not too big when compared with other sectors like public transportation, electric cars, or renewable energy, it also has a word to say in that process, and is for sure one for urban functions with social, territorial and environmental interests, where further work and research are to follow in the years to come.

Therefore, urban agriculture has potential to make cities more socially and ecologically sustainable, but urban planners have not had effective policy levers to encourage this. The study concludes that it aims to learn how to use land inventories to identify city land with the potential for urban agriculture in order to plan for more sustainable communities through edible urbanism and edible city solutions. It enables the integration of urban agriculture into planning and policymaking as well as advances both ecological and social dimensions of local sustainability agendas. The City administration local governments may consider the use of a land inventory should contemplate*: (1) using the inventory process itself as a way to increase institutional awareness and political support for urban agriculture; (2) aligning urban agriculture with related sustainability goals; (3) ensuring public involvement by creating participatory mechanisms in the design and implementation of the planning for urban agriculture; (4) drawing on the expertise of institutional partners including universities industry linkages*

Finally, it has been concluded that Commercial urban agriculture is typically restricted to agriculture land use, green or open spaces, or under-utilized or undeveloped land in the city. As urbanizing city face the double threats of urban food insecurity and land scarcity, multi-functional urban land uses that integrate rather than separate agriculture from other land uses could be a critical adaptation for the sustainability of future city development. This would be taken as exemplar for ***integrating urban agriculture as component of Land Use Planning*** as being addressed above. Hence, the highlights of *Urban Agriculture* are: Urban land uses integrating agriculture with other land uses could be a critical adaptation for future city sustainability, urban agriculture policy is improved by collaboration across government agencies and sectors, policies support integrated urban food production through high-tech intensification, Development of Agri-food Innovation Park can house actors across the food ecosystem. The study also has concluded that besides providing essential food for a balanced diet of the family, the City Administration should develop a real commercial activity providing, according to certain sources, more jobs than in any other sector of the informal or formal economy. It is estimated that employment rate is 1 to 50 inhabitants. Therefore, the farmers’ field school has been adopted as a *training and extension methodology to ensure disseminate Good Agriculture Practices, product safety and environment preservation* through *proper urban planning and design Agriculture for sustainable landscapes.*

**Recommendations**

The ideal starting point for urban agriculture planning is a community engagement process through which planners identify how urban agriculture contributes to the social, economic, and environmental goals of a community. Local and regional governments play important roles in legitimizing urban agriculture as a recognized land use or community development strategy. By identifying existing community needs that urban agriculture can address, inventorying necessary local resources, and evaluating current policies and legislation, local governments can work to effectively integrate urban agriculture considerations into the plan-making process. Community health goals and policies can support access to fresh fruits and vegetables through community gardening, sales of produce from urban farms, and education and outreach to residents about the benefits of healthy, fresh foods.

***Regulating Urban Agriculture in the Structural Plan***

A commonly cited barrier to urban agriculture has been its absence from, if not prohibition by, local zoning codes. However, a growing number of communities are revising zoning standards to formally acknowledge community gardens and urban agriculture uses as permitted uses in existing zoning districts. Some have created new zoning districts to set aside specific areas for community gardens or urban farms. Others have included urban agriculture as a desirable amenity within planned unit development (PUD) project guidelines or in conservation subdivision regulations.

Ordinance provisions often acknowledge different intensities of urban agricultural activities. A common distinction is between gardens that grow food for personal consumption (or donation) and market gardens or urban farms that grow food for sale. Some communities draw additional distinctions based on size or the range of permissible activities on site. Use standards may address elements such as setbacks, hours of operation, storage, accessory structures, odor and noise, fencing, lighting, composting, and whether animals or on-site sales of produce are permitted. Some places have standards for accessory agriculture-related structures such as greenhouses and hoop houses, and others have added ordinances allowing for the keeping of urban livestock, including bees, chickens, and goats. Other local policies besides zoning can be used to sanction or encourage specific activities related to urban agriculture. These policies include land-use policies that permit public land to be used for gardens or farms, land disposition policies that permit surplus municipal properties to be acquired by for urban agriculture, and policies and regulations that strengthen the infrastructure for widespread urban agriculture.

***Understanding planning institutions, policy and decision making process***

Policy makers should be aware of the benefits of Urban Agriculture and should encourage (1) collaboration between practitioners and researchers, and (2) support to urban farmers to continue producing safe and nutrient-rich products for both home consumption and city markets. Policy makers should ensure that the needs and benefits of UPA are taken into account in physical planning (land tenure, water availability, drainage). They should investigate whether Urban Agriculture is a viable strategy to improve food security among the urban poor who are not cultivating, and advise municipalities accordingly. Coordination among the various sectors involved should be encouraged from the urban, local level up to municipalities and the national level. Moreover, all sectors, as well as representatives of the producers themselves, should participate in policy research and formulation. It is therefore important for the planning institutions, policy and decision makers to have knowledge of some key issues to formulate a comprehensive plan.

***Understanding spatial land use planning practices***

City planners will also need to focus attention on strategies to promote physical activity. Urban residents need to be encouraged to exercise, both through promoting healthier environments in which to do so and reinforcing the positive health benefits of regular exercise. These actions should be combined with educational campaigns and community activities to advocate exercise. In terms of physical planning, urban agriculture should not result in agricultural land becoming part of residential and commercial land uses. It is also important to reorient the sense of socio organization in the area of study, in order to achieve an integrated city, which is habitable and sustainable, by organizing agricultural activities in the City. Regulations remain restrictive as long as things cannot be settled locally. Zoning plans for urban environments are often obstructive. Fortunately, an increasing number of municipalities are able to find ways to fit in more flexibility and tailor-made work into the spatial planning policy.

***Integrating urban agriculture into city development***

* To integrate urban agriculture effectively into city development it is imperative for the following to be addressed.
* An analysis of existing and future ***city planning ideas***, norms and regulations for land and water use (land use plans, territorial plans, strategic plans) is very critical; Inclusion of UPA in zoning plans;
* Construct in each of the cities a "urban territorial map", including ***a spatial classification*** of different (peri) urban land and water bodies and its uses. In order to do this effectively, there is the need for the Metropolitan and research institutions to collaborate.
* Elaborate a classification and land use map of different urban and peri- urban spaces (using GIS) since wet lands and ―green belts‖ in the cities are encroached on always;
* Analyze and classify spaces where UA could be converted into a sustainable and viable land use (compared to other forms of land use);
* The various actors farmers, consumer groups, agro industry, market-groups, NGO and community based organizations need to be brought on board. There is the need for a participatory analysis of demands and ideas for land and water use;
* Research institutions, AACA need to analyze the potential of land and water use for agricultural production, processing and marketing and its implications for urban planning;
* Describe the actors and the ***urban planning process,*** its objectives, strategies and policy instruments;
* Propose structures, practical instruments for a better incorporation of UA in urban planning.
* The registration of land for agricultural activities by farmers is suggested by the study to help curtail the loss or fear of losing their farmlands.
* There is an urgent need to carry out the Master Plan Renewal to secure the agricultural lands, particularly the government owned farm settlements in the state.
* It is very important to consider vertical development as against the dominant horizontal development to curtail the increasing land demand and supply that will edge out land for agriculture.
* Integrating UPA into residential layout designs remains an option towards maintaining secure tenure for farmers and farming activities.
* There should be proper compensation for forced eviction, encroachment, and conversion of farmlands into housing development and physical infrastructure, and relocation must be organized for the affected farmers to continue their farming practices.
* Public interest in locally grown food, coupled with an awareness of the positive environmental, social, and economic impacts of agricultural uses on urban areas, has inspired many city residents to pursue small-scale agricultural activities on public lands.
* As the community gardening and urban agriculture movements gain popularity and the benefits become more apparent, many local governments have adopted policies and regulations that sanction or support community gardens and urban farming. Urban Agriculture as integral components of ***Land Use Planning*** in city plan.
* ***Urban Agriculture should be integrated as an integral component of Land Use Planning, which*** is quite essential for sustaiable urban landscapes. Hence, *Urban Agriculture* are: Urban land uses integrating agriculture with other land uses could be a critical adaptation for future city sustainability, urban agriculture policy is improved by collaboration across government agencies and sectors, policies support integrated urban food production through high-tech intensification, Development of Agri-food Innovation Park can house actors across the food ecosystem.

**Transforming inner City Petropolis to Agropolis (Edible Urbanism)**

* As the community gardening and urban agriculture movements gain popularity and the benefits become more apparent, many local governments have adopted policies and regulations that sanction or support community gardens and urban farming. Urban Agriculture as integral components of ***Land Use Planning*** in city plan.
* The global experiences have addressed that urban agriculture should be integrated to the structural plan of the city so as to maintain food security and sufficiency by ***realizing the transformation from Petropolis to Agropolis/ecopolis.***
* Planting Different ***Fruits and Vegetables at parcel or plot level*** and excercising ***Balcony agriculture*** at condominium and apartment builfdings are very essential to maintain food security***. This is typical example of tronsforming Petropolis to agroplis landscapes in the inner city.***
* On the other hand, The most important issue for urban food production is its official recognition as ***urban land use,*** ***security of tenure,*** as well as access to land and other resources as the drivers of Sustainable urban agriculture. ***Access to land*** is especially relevant for marginal and minority groups, and this could be mitigated by offering more publicly-owned open space for community gardens.
* A conceptual Model for integrating urban agriculture into planning and enhancing city sustainability is presented in ***figure 6.2 below****.* It builds on the four pillars of the sustainability concept, namely, ***social, economic, ecological and spatial***, allowing urban agriculture to flourish in the city. This requires ***land use and planning*** to come together to address current sustainability challenges and respond to the factors that are already driving the presence of ***urban agriculture in the city***. ***Please look at Figure 6.2 above:*** The Edible Urbanism Model as edible city Solution for sustainable Urban Agriculture for sustainabler landscapes in Urban Planning Perspective

Generally; ***planning urban agriculture for sustainable landscapes broadly consider***s, ***Urban Agriculture*** should be included in the ***Land use plan*** as an element of urban landscape in ***City Plan being revised in 2017-2027*** in consideration with urban agricultural spaces in realizing the changes from ***Petropolis to Agropolis.*** That means that urban agriculture is preferred as urban land use compared with Land use like mixed uses, residences, administrations or other urban infrastructures building if, and only if:

* Urban Planners recognize that Urban Agriculture has, for the urban life and development, *specific functions that cannot be easily substituted*. Then, this research *consists* in analyzing the different functions assumed by Urban Agriculture through urban planning and Design.
* Planning and Design urban Agriculture contributes to urban sustainable landscapes in the city development, which mean landscapes where “spatial, social, ecology, economy and well‐being are balanced and strengthen each other”.
* Planting different ***Fruits and Vegetables at parcel or plot level*** and excercising ***Balcony agriculture*** at condominium and apartment builfdings are very essential to maintain food security***. This is typical example of tronsforming Petropolis to agroplis landscapes in the inner city.***

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# PUBLIC SERVICE ETHICS, REFORM & POLICY IMPLEMENTATION

* 1. Language use policy in multilingual Ethiopia

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***Abstract***

*The main objective of this article was to describe how languages have been used in multilingual context in terms of the existing language policy comparison in the Oromia special zone surrounding Addis Ababa/Finfinne (OSZSA/F). To achieve the intended purpose, a descriptive qualitative research design for survey was used. Thus, the data were collected randomly and proportionally from the participants through qualitative questionnaires, official reports, and interviews. The data were analyzed and compared using the descriptive tools; spreadsheets or data analysis programs using computer. Hence, the actual language used among linguistic groups between Afan Oromo and Amharic mother-tongue speakers was compared with the existing language policy. As a result, the two linguistic groups were controversial in the language use behaviors and norms that may lead to the development of dualism social relationships. However, this study is trying to advocate positive social relationships and create a universal trust among the divergent linguistic groups unlike the current conflictual relationships between the well-connected populations. In addition, both monolingual and multilingual language policies were hardly practical and have been challenged in multilingual Ethiopia. Therefore, the ‘integrative language policy’ that shall accommodate both linguistic norms of the Hosting community (HC) and the National Capital (NC) city in the principal domains is incredible in the study area and beyond.*

**Keywords:** *Addis Ababa, hosting community; language policy; language use*

**Introduction**

This work was inspired on a study of language use and its policy from an urban sociolinguistic perspective among young people. One of the key aspects of sociolinguistics is the study of patterns of language use in the urban multilingual context. The essence of urban language use has been studied in ‘domains of language use’ the model coined by Joshua Fishman, an American sociolinguist (Fishman, 1972:24). Moreover, Holmes and Wilson verified that this domain is a very useful model to give a broad generalization, particularly when describing code choices among bilingual and multilingual speech communities (Holmes & Wilson, 2017:23). Additionally, it makes it easy to compare varieties in similar domains in different speech communities (Holmes, 2013:42).

Besides, there are five types of language learning domains like family, religion, friendship, school, and employment which could be easily influenced by social factors such as interlocutors, setting, and topic (Fishman, 1972:24; Bichani, 2015:20). Similarly, there are other various kinds of pressures like language policy itself, urbanization, demographic, historical, political, and religious factors that create inequalities in language use in various areas of public domains have been identified by scholars (Romaine, 2000: 58); Labov, 2002:14); Paulston, 1994:4) & Giles et al., 2016:24).

Moreover, language use domains are growing towards a model or a theoretical construct (Romaine, 2000:44 & Wamaitha et al., 2018:3) itself. In addition, the integration of some other constructs like diffusion theory (Labov & Cooper, 1991: 197-198; Maegaard et al., 2013:8; Dearing & Cox, 2018:2;), social mobilization (Paulston, 1994e:4), communication accommodation (Giles et al., 2016), and ethno-linguistic vitality (Ehala, 2010:11-12) theories are also expanding their scopes in sociolinguistics and language use policy studies. Therefore, as integrative constructs these theories shall primarily link to language policy and urbanization (Haberland, 2020:4) as factors in the formal language use domains.

However, communication accommodation theory (CAT) alone is a predictive construct, which more preferred, to describe how individuals and groups adjust their language use and preference in domains (Giles et al., 2016:24) to highlight on convergent vs. divergent accommodative behaviors both linguistically and psychologically. In this framework, OSZSA/F was described as the suburbs of Addis Ababa, where social mobilization (Paulston, 1994e) and land transfers are highly growing; and demanding an integrated master plan (Kassa, 2013:15) for its formal expansion and language use policy practices.

The study area, OSZSA/F was formed in 2008 from former Shoa zones, as the urban fringes of Addis Ababa city (Oromia Constitution, 2008). Also, *‘Finfinne’* and *‘Shagger’* are names used by the indigenous people, before the city was named ‘Addis Ababa’ in 1886 by Menelek II and his Queen Taitu (Tufa, 2008). Also, it was an agent that facilitated to further centralize the state in Addis Ababa and to connect it with the provinces (Yates, 2020).

However, Addis Ababa/Finfinne and its suburbs ought to demonstrate the summary of the Ethiopian people’s whose lingo-cultural identity could be well represented in the future. Recently, it is pivotal for its affluence for socio-economic and political potential where such conflicts related to divergent interests of linguistic and cultural identity usually arise among the national capital and the hosting community. This could be defined in the *inner, outer and expanding* concepts of linguistic circle (Holmes & Wilson, 2017:108). For example, the circles of Amharic dominance could be described from inner Addis Ababa, outer Oromia, to expanding Somali, Tigray, Afar, and South regions. Ethiopia is not only a linguistically diversified country that hosts more than 80 language and a multi-scriptural country that uses Arabic, Chines, Ge’ez, and Latin scripts. However, hese and other linguistic variations are also being politicized among divergent scholars and linguistic groups from Ethiopianism and federalist views. Even, the Ethiopian federalism system could be defined as a *linguistic federalism* and the recent identity politics and *dualism positions* might have been evolved from this system.

Similarly, the two areas and mother tongues of Afan Oromo and Amharic were geographically convergent and however; linguistically divergent. Indeed, the hosting community in the OSZSA/F and population in the Addis Ababa/Finfinne were well-connected, though the two city administrations employ altered language use policy.

On the other hand, the usual concerns in designing language policy are *purely an urban affair* and its implementation was also not considering the peripherals. For instance, the urban inhabitants in Addis Ababa have de-urbanized their hosting community and they have created a socio-cultural frontier between themselves (Getahun, 2009; Debelo & Soboka, 2022). Nowadays, Addis Ababa is a melting pot, where the Amharic language is dominant; though it never achieved a full national status (Smith, 2008:13). Above all, urbanization is a fundamental factor that helps as an agent for linguistic diffusion from towns to rural together with top-down language policy and planning (Cooper, 1976: 197-198).

Moreover, the study of actual language use towards envisioning better language policy and planning in urban multilingual Ethiopia was overlooked. Similarly, the study area is a home for lingo-cultural identity politics and hence its study was discounted. This study was conducted among multilingual groups in the region that Afan Oromo has been officially designed and where language contact with Amharic is principal. As a result, in this work both Afan Oromo and Amharic were the main first targeted languages though other languages were also considered as second targeted languages; in relation to language use policy practices.

Further, from early youthful time the researcher has observed issues in language use and preferences between Addis Ababa and its surroundings. Also, the researcher own academic background and interests in sociolinguistics, sociology and education enabled him to set up this work with a desire to make a contribution to the field of urban sociolinguistics at large and urban language use policy in particular.

First, this study was intended to answer the question of, how Afan Oromo, Amharic, and other languages were used and to indicate its implications in the suburbs of Addis Ababa/Finfinne. Secondly, the key objective of this article is to describe the actual language used in multilingual context; in relation to language policy practices in the study area.

**Methodology**

Research designs and methods are neither useless nor perfect. However, researchers are ought to substantiate why they prefer to use some methods, designs and techniques. For the current study, a survey type of research design with its elements and steps were identified and constructed. It is a descriptive cross-sectional survey category that employed a qualitative design that involves qualitative questionnaires, survey of official reports and observation. Secondary sources were also reviewed qualitatively. Even though some quantitative data were found in the records package to describe sample size, the critical analyses indicate the qualitative design category.

The sample population was drawn from urban young adolescents; in the 14 preparatory schools of Burayu, Gelan, Legatefo, Sebata, and Sululta towns with 3,731 moderate size and finite total population. The young urban students who participated in this study were believed that they would provide an excellent sample for the intended investigation. Moreover, these young adolescent, preparatory students were the representatives of the community in the study areas and their families that could be surveyed through door to door contacts.

Based on step by step approach (Cochran 1977; Canada, 2010); sample size determination techniques were performed using the precise statistical formula for the finite population. According to (Canada, 2010:171) and an estimate with a margin of error of ±.10 at a 95% confidence level for the area as a whole is sufficient for the finite, moderate, and smaller sized populations if a response rate is more than 65%. Moreover, a different level of precision may be specified for different domains. For instance, a ±3% margin of error for a national survey, ±5% for provincial estimates, and a margin of error of ±10% for sub-provincial estimates (Canada, 2010:164) are sufficient. In the case, strata were formed among sub-provincial areas of five towns.

Finally, the sample size was computed based on a preliminary estimate of the proportion P = 0.5 is assumed and the response rate ® of 65% is also expected if z=1.96 (Canada, 2010). On the other hand, *sociolinguistic data is more homogenous*, less sample size is sufficient and samples for linguistic studies tend to be much smaller than those found with other types of surveys and social science variable data (Milroy & Gordon, 2003: 44-45). Thus, the final sample size ‘n’ was computed using the stratified formula,

n =  z2 p (1-p)

e2

R

and the result is a conservative sample size. Therefore, the required sample size is n = 148 that proportionally distributed across the five towns and administered through random selection among the strata. Then, the data were collected from the participants through qualitative questionnaires, surveying official reports, and interviews. Recently, the importing and exporting of qualitative into quantitative data programs such as spreadsheets or data analysis programs using the computer are increasing (Creswell, 2018). Thus, mainly data were analyzed and compared using the descriptive tools; spreadsheets or data analysis programs using computer*.* Last but not least, the reliability analysis for the language learning domain questionnaire was conducted by total language use domains since the items seemed to measure the same construct i.e. language use, a number of items = 10, N=148. The result was .934 Cronbach's alpha based on standardized items.

**Literature Review**

Language policy is a recent discipline whose design and implementation are unfixed among multilingual urban society. It is a politically motivated social linguistic system. Also, its study explores several questions interrelated to language use, language status, and language identity (Rajagopalan, 2009:142 & Spolsky, 2019:13). Therefore, the speed of urban expansion by itself raises the need of reshaping state-led language policies and planning (Kaplan, 2017:16-17); for multilingualism is increasing in the city. However, multilingual policy is failing to fulfill the intended purpose in the modern community and its implementation indicates, it is only another form of assimilation (Bonotti, 2007:185). Similarly, monolingual language policy was also never achieving the national status in the multilingual community like Ethiopia (Smith, 2008:13).

Indeed, states cannot be linguistically neutral as multilingualism causes a considerable challenge to form a democratic state. In the same way, state formation and nation-building were often accompanied by strong policies of linguistic homogenization, as evinced most notably in Ethiopia, France and USA (Batibo, 2005; Smith, 2008). It is also a norm that to plan language is to plan society (Cooper: 1989:190). Ethiopia was also unified as a country politically and ideologically but not as socially or culturally like Nepal (Simpson, 2011:99), which may need a political and ideological resolutions that related to its *linguistic federalism* flora. According to Cooper, the linguistic and scriptural diversity in Ethiopia is a part and product of imperial conquest, which brought together diverse ethno-linguistic groups within a single political administration that rejected multilingualism except promoting Amharic only (Cooper, 1976; Cooper, 1989).

On the other hand, the language policy that the Derg developed was also useless as the Emperor's policy of assimilation has essentially been continued (Bekale, 2011). Similarly, the FDRE language policy was also impractical to be equally implemented in the Addis Ababa (Derib and Getachew 2006:22-3) city. As Zelealem also pointed out, the applicability of the current Ethiopian language policy which guarantees the use of each and every language in education is in question and criticized (Zelealem, 2012:45-46). Moreover, the study by Hussein also confirmed, that the ‘historico-political factors’ were influencing language policy implementation in Ethiopia in the pedagogy and political administrations (Hussein, 2008:2).

Similarly, according to Cooper, the root causes and complications of all these problems are combining the divergent linguistic nationalities under a single nation-state (Cooper, 1976:29). Also, the former USA Ambassador to Ethiopia David Shinn as cited in (Getahun, 2009) believed that the second cause is growing from the interests of the urban population have on the peripherals population, particularly in the Addis Ababa and its area.

Thus, in the future issues in languages, state formation, nation-building, and language policy will be also intertwined and ought to serve the linguistic interests of the urban population and its hosting community simultaneously.

**Results and Discussion**

First of all, results and descriptions of the total daily language used in any domain and frequencies of language used in the several selected domains and language perceptions among the participants were presented and discussed. The results and findings were compared with the existing language policy and its implementation. Finally, integrative language policy for divergent linguistic groups was suggested.

**Daily language used in any domains**

Patterns of daily language used and or code choice among different linguistic groups by their mother tongues were examined. As a result, there were significant differences among participants with their code choices and patterns of language uses on the daily bases.

Figure 2: Daily language use vs. participants’ mother tongues in any domains

As the data in the Figure 2, revealed that the daily code choices among the participants’ mother tongues were significantly varied. Respectively, the three languages Amharic, Afan Oromo, and English were seemed to be the main languages among the participants in the study area in the different language learning domains; even though their usages differ among themselves. However, it was observed that language moves from own mother tongues to other languages had occurred among all linguistic groups.

**Language used in the particular domains**

The data in Figure 2 only found language use differences but could not reveal how often languages were used in the particular domains among participants. Hence, it was presented in the Figure 3. As a result, the main data in this article has been analyzed by considering how often Afan Oromo, Amharic, English and other languages were used in the several domains. Thus, significant language use differences were observed in the domains, among linguistically divergent participants (Figure 3). This finding also proved the principle, that minority languages are usually used in the informal domain, whereas dominant languages are often used in the formal domains (Cooper, 1976:188; Holmes & Wilson 2017). Across several language use domains, education in and out of school is a key domain in which language policies perform their socially regulating role (May & Mccarty et al., 2017:11).

As a result, Amharic was used always and significantly higher than all targeted languages in all domains. While Afan Oromo was used significantly lower than Amharic in all domains and no difference from used English in the friendship, and school domains. English was also significantly used higher than Afan Oromo and other Ethiopian languages and less than Amharic in the language skill domains. In summary, when and where Afan Oromo usage was higher; Amharic usage was lower and the vice versa in domains. This could also imply the contradictory relationships between the two languages; as the use of Spanish and French opposed to English (Romaine 2000: 44 & Spolsky, 2019:7) in USA and Quebec in Canada.

**Language used in the school domain**

In the OSZSA/F only three languages Afan Oromo, Amharic, and English were used in the formal language use domains, though their usage differed among themselves (Figure 3 & Figure 4). For instance, as the data from official reports and participants’ responses revealed, state schools were mostly using the regional language Afan Oromo, whereas private primary schools were using Amharic and English for their instructions (Figure 4 & Figure 5).

Figure 4: Patterns of language used for medium of instruction in OSZSA/F

\**BID=Barnoota idileen duraa*= meaning KGs. Gov=Government. Source: Official reports

However, in Ethiopia, the paper by (Alemayehu & Takele, 2016) still recommends the policy of a single common instructional language for all schools in the country, which may be contrary to the multilingual language policy mentioned in a new Ethiopian language policy manuscript that designed recently (FDRE-LP, 2020 & Bekale, 2011). However, the data in this work revealed, that *dualism positions* in code choices for education as instructions were observed *than claiming common interest* for a single instruction.

Moreover, language choice among upper and lower social linguistic classes was formed in the government and private schools. Similarly, even the study by Cooper (1976) before 49 years described that Afan Oromo was used significantly more than Amharic among daily labourers whereas; Amharic was used among few managers in the respective factory workers in the Addis Ababa area.

Nevertheless, as data from qualitative questionnaire and interview indicated; almost all the participants from Afan Oromo and Amharic mother tongues confirmed that they had positive attitudes toward one’s own languages to improve proficiency in it. However, as it was observed in the formal language use domain, linguistic behavior was divergent between the two mother tongues. Thus, the linguistic behaviors of both Amharic and Afan Oromo mother-tongue speakers were psychologically convergent and divergent in formal language use and preferences (Figure 3, 4 & 5). Generally, Amharic was perceived merely as a language of *communication accommodation*, whereas Afan Oromo was *an identity marker*; as Danish and German were used for identification and content communication respectively (Thomas, 2007).

A number of urban communities reveals reluctant, non-accommodative, and avoidant language use behaviours and norms (Giles et al. 2016) in accommodating multilingual identities. These linguistic behaviours and norms seem to be consistent, as old as the capital city and continued to the recent days among urban dwellers. It was sometimes forcefully, implicitly, ideologically, and systematically imposing. For instance, previously Cooper (1976:187-190) described the characteristics of the language policies implementations in Ethiopia. Accordingly, language policies in Ethiopia have been enacted into law and have been put into practice by administrative decisions. Additionally, some authors like (McNab 1989; Cooper, 1989; Cohen 2000) also categorized the former language policy, with the strong measures that taken by the imperial to assimilate all other Ethiopian languages towards Amharic.

However, the longtime process of rejection of multilingualism and the project of assimilationist policy to Amharic did not have the expected success. Rather, the systematic policy package has created dualisms and controversial positions among elites and the community at large that continued to these days. Consequently, in terms of linguistic identity, the marked effect of the Amharic only policy makes Afan Oromo a language without a city in major urban areas like Addis Ababa (Getahun, 2009:6). Additionally, for a long time, the policy banned not only usage in public spheres but also restricted the flourishing of linguistic identity, and Amharic by itself has never achieved a full national status (Smith 2008:13).

However, in the study area, rather the two *divergent monolingual language policies* which may not help for the flourishing of both distinctive linguistic groups; were practiced. However, the campaign and operation of bilingual policy would be suitable between National Capital (NC) and hosting community (HC) areas.

Wardhaugh et al., (2015) also observed that many countries are in a problem; applying the multilingual policy in practical for actual language use in the different domains. Though countries advocate a multilingual policy for language use, they were not successful in maintaining sustainable multilingual behaviour in their respective capital cities. As a result, some language nationalities were trying to separate from the mainstream as an independent region or country like Quebec in Canada and Bangladesh in India (Spolsky, 2019:7). Besides, in Africa, monolingual norms and monoglossic ideologies are terminating and multilingual education is implementing. However, as trends in the literature revealed of them; both monolingual and multilingual language policies are hardly implementable and complicated in a single state to preserve group multilingual identity (Batibo, 2005 & Spolsky, 2019).

Moreover, it could be argued that multilingualism could not be a linguistic identity; rather it is being eroded and replaced by dominant urban languages at the same time. This implies that the development of monolingualism is the norm in the capital city and its suburbs in the absence of language revitalization in the formal language learning domains. Lastly, multilingual language policy in an urban area is also a lying two-faced policy system.

Nonetheless, Bekale (2011) discussed several classifications of language policy and suggested a predictive model language policy at the national level in Ethiopia. However, again Smith argued that, even though there are a variety of models/policies for addressing language in a multilingual society, none seems immediately ideal and languages always have a political nature (Smith, 2008:28).

To sum up, accommodating the hosting communities’ language in formal domains of the national capital may be vital to maintain a lingo-cultural identity and well-being of indigenous groups, particularly children and youth (Steele, 2020) which also could contribute to sustainable peace and development. Thus, the bilingual language policy between *National Capital and Hosting Community* [NC+HC] will be indispensible; if their languages are a chalk and cheese. In our case, in the Addis Ababa [Amharic + A/Oromo] + English; whereas in OSZSA/F [Afan Oromo + Amharic] + English models could be a solution. Likewise, in the Jigjiga city any [Mother Tongues + Af-Somali] + English, in Hawasa city any [MTs + Sidamu] + English may be an ideal language choice model to be used to reduce language-based conflicts and to build trusts among linguistically divergent communities. This shall be defined as an *urban* *bilingual language policy* in the major cities and together multilingual policy at a country level.

**Conclusion and Recommendation**

In terms of language use, language preferences, and language policy implementation; dualism positions were growing between Addis Ababa/Finfinne and its area among Afan Oromo and Amharic mother tongues in the language learning domains and particularly in private and state schools. Besides, in multilingual Ethiopia, both monolingual and multilingual language policies were practiced but unsuccessful and both of them have been resisted by these divergent linguistic groups. This could be a serious threat if it comes to the capital city and its surroundings when the languages of the two areas are like chalk and cheese. Similarly, the existing language policy practices in NC and HC have less hope to maintain a bi/multilingual identity in practice. Rather, *two divergent monolingual language policies* were being practiced in the Surroundings of Addis Ababa. Additionally, linguistic diversity is a non-stop challenge for any government in the urban speech community. Thus, this kind of determination sometimes may need political actions and resolutions; in addition to designing a better language policy.

Moreover, both the previous and the current studies proved that Amharic is still an important urban language. Also, the study investigated that multilingual ethno-linguistic identities were being re-constructed into monolingual identities in the area. Similarly, it was also observed that where and when the linguistic diversity increases among the participants the use of Amharic as a lingua franca was increasing, whereas the usages of other languages were decreasing. Furthermore, as the analysis of language used in a number of language learning domains revealed, the processes of language shifts from other languages to Amharic were observed among the participants. Hence, the other mother-tongue speakers were shifting to Amharic firstly and secondly to Afan Oromo, even though Afan Oromo mother-tongue speakers were also shifting to Amharic themselves.

In addition to contributing to the body of literature, the study is suggesting the *bilingual* in urban areas and *multilingual* language policy at a country level. This type of integrative language policy is believed that it shall *construct a special trust* among the divergent linguistic communities in the Addis Ababa/Finfinne area. Therefore, the study was directing the stakeholders and policymakers from actual practice to policy design. Consequently, recommendations were accessible to language planners, the Addis Ababa city government, and the Oromia regional state and city administration of the OSZSA/F.

Finally, future researchers may plan to expand the study of urban sociolinguistics at large and politics of language and identity, language changes, and language attitudes in particular; all in relation to migration, urbanization, and conurbation variables.

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* 1. The influence of Organizational Justice on Organizational Commitment of Instructors in the Public Universities in Amhara region

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***Abstract***

*The purpose of this study was to examine the influence of organizational justice (OJ) on organizational commitment (OC) of instructors in the public universities in Amhara region. Descriptive survey and correlational research design were employed. The size of the population was 2170. Of these, 740 instructors were taken into the sample using item-respondent proportion method. Standardized questionnaire was used to collect the data. Inferential statistical analysis techniques were used to analyze the data. The result of one sample t-test indicated that OJ and OC were observed to a little extent and some extent in the workplace as perceived by instructors. With regard to OC, instructors were moderately committed to carry out their jobs due to their emotional attachment with their universities and sense of responsibility. There was positive and statistically significant relationship between OJ and OC with standardized correlation coefficient (r=.754) at p<.05. The result of multiple regression indicated that 56.5 % of the variance in OC is predicted by the three dimensions of OJ with a significant model at F (3, 736) = 219.952, p= .000. Thus, it is concluded that OJ had significant effect on OC of instructors. Therefore, it is suggested to improve the status of OJ and OC through involving instructors in the decision-making process related to their job.*

**Key words***: Amhara region; Organizational commitment; Organizational justice; Public Universities*

**Introduction**

Though there are different factors that have their own contribution to improve the function of the organizations, OJ and OC play vital roles in enhancing performance in organizations including educational institutions. Organizational justice (OJ) is one of the numerous job-related attitudes which is concerned with employees’ perception of fair treatment in the organization (Fernandes & Awamleh, 2006). It is conceptualized in terms of distributive, procedural and interactional justice (Cohen & Spector, 2001). Distributive justice is viewed as workers’ perception about the fairness of outcomes and its distribution (Toremen & Tan, 2010). On the other hand, procedural justice is the fairness of procedures used to determine the outcomes that employees receive. Interactional justice is concerned with the perceived fairness of interpersonal treatment of individual receives from the decision makers (Niehoff & Moorman, 1993).

Studies have shown that organizational attitudes and behavior can be directly linked with employee’s perception of justice (Roch & Shannock, 2006). Employees want to be treated with respect, and their contributions to be matched with the outcomes received. When employees perceived as they are fairly treated in the work place, they are more likely happy to support their organizations. Similarly, having the procedures that are consistent, unbiased and good interaction between employees and leaders are basic elements for ensuring justice (Judge & Colquitt, 2004).

OC is another job related component which is viewed as the desire of employees to stay in the organizations and get committed towards organizational goals and values. It also refers to the measure of strength of the employees’ identification with the goals and values of their organization, having strong faith in it and showing considerable effort to continue in the membership of the organization (Saglam, 2003). Affective commitment refers to an emotional attachment and involvement with an organization while continuance commitment denotes employees’ perceived costs associated with leaving an organization (Meyer, Allen & Smith, 1993). They also conceived normative commitment as an individual’s feeling of responsibility to support an organization.

Committed employees are contented, dedicated and work enthusiastically. Employees with a high level of OC have a strong belief in the goals of the organization and demonstrate high performance to attain the goals of the organizations (Balay, 2000), while organizations who have employees with low level of OC will not be successful in achieving its purposes (Kaya & Selcuk, 2007). Organizations must continually seek ways to keep their employees and work groups effective because the success of the organization depends on its ability to create conditions that attract best people to work there. This indicates that employees who are committed are more committed compared to employees with low commitment.

Employees want to stay in the organization as much as they are fairly treated in the system. In an effort to keep employees committed to their job, organizations need to establish system that treats employees fairly (Akanbi & Ofoegbu, 2013). According to various researchers, employees will remain within the organization when they perceive fair treatment, while the reverse state increases turnover that leads to decrease in the performance of individual and reduce the level of OC (Tremblay, Cloutier, Simard, Chenevert, & Vandenberghe, 2010). This shows that OJ has the potential to affect the commitment of employees in the organizations (Imamoglu, 2011).

Employees with a sense of equality and a feeling that they are rewarded fairly for their contributions to the organization are satisfied (Srivastava, 2015). Individuals with a higher level of OJ perception have a higher commitment to their institutions. In this respect, the results of the study revealed a positive relationship between employees’ feeling of justice and commitment (Yazıcıoglu & Topaloglu, 2009). When employees have perceptions of fairness in the organizations lead to an increase in their work commitment.

Based on the discussions made so far about the dimensions of OJ and OC as well as their relations, a new conceptual framework has been developed for this study.

Currently there appears to be an increasing interest among scholars in OJ and OC. Many studies indicated that employee exhibits workplace aggression (Kennedy, Homant, & Homant, 2004) due to lack of fair treatment in the organizations. These situations lead to increase turnover intention and interpersonal deviance (Cohen & Spector, 2001), exhibit counter productive work behavior (Spector & Fox, 2002) and low commitment, and eventually, they may pursue to leave the organization (Aslam, Ilyas, Imran, & Rahman, 2016). These indicate that employees who are deprived of justice in the organizations will be susceptible to stress, dissatisfaction, lower level of commitment, and aggression leading to low productivity.

Concerning commitment, the findings of many studies indicated that low level of commitment leads to turnover and attrition (Joiner & Bakalis, 2006), and counterproductive behavior (Dalal, 2005). A survey conducted by Bosman, Buttendach, and Laba (2008) showed that high level of employee turnover was associated with poor function of the organization and increased the cost involved in selecting and training the replacements. These can cause loss of work progress, productivity, organizational status and poor relationship with customers (Alzubi, 2018).

Although some studies have been conducted on OJ and OC (Alemu, 2014; Endale, 2019; Endris & Dawit, 2019; Tesfaye, 2004), sufficient studies have been done on the causal relationship between these variables in the context of Ethiopian higher education institutions in general and in the public universities of Amhara region in particular. This study, therefore, examined the influence of OJ on OC of instructors in the public universities of Amhara region.The research questions are;

1. What is the perception of instructors towards OJ and OC in the public universities of Amhara region?
2. What is the relationship between OJ and OC in the public universities of Amhara region?
3. What are the influences of OJ dimensions on OC in the public universities of Amhara region?
4. Are there significant differences among instructors in perception of OJ and OC in the four generations of universities in Amhara region?

**Methodology**

**Research Setting**

This research was conducted in the public universities of Amhara region that were categorized into four generations based on year of establishment. That is, two universities in the 1st generation, three universities in the 2nd generation, two universities in the 3rd generation, and three universities in the 4th generation were found.

**Research Design**

Since this research aimed to assess instructors’ perception about the status of OJ and OC as well as examine the relationships between these variables, descriptive survey and correlational research design were found appropriate. Therefore, descriptive survey and correlational research design were employed using quantitative methodology.

***Population, Sample and Sampling techniques***

Initially, six universities were selected from the specified strata for manageability reason. Namely, University of Gondar from the 1st generation, Wollo and Debre Markos Universities from the 2nd generation, Debre Tabor University from the 3rd generation, and Injibara and Debarq universities from the 4th generation were selected using stratified random sampling technique.

Then, a total of 21 colleges were selected from the six universities to determine the size of the population and subpopulations of the study. Specifically, five colleges from the University of Gondar, four colleges from Wollo University, four colleges from Debre Markos University, four colleges from Debre Tabor University, two colleges from Injibara University and two colleges from Debark University were selected randomly. In this regard, a total of 2170 instructors found in the selected universities were considered as the population of the study.

Although there is no single criterion to determine the sample size, the researchers used 20 respondents per each item to determine the sample size of the study based on the recommendation of Tabachnick and Fidell (2007). Accordingly, the sample size of this study was 740 since the number of items under the dimensions of the variables in the questionnaire were 37. After determining the total sample size of the study, the sample size of each stratum was determined based on the size of their population using proportional sample allocation formula developed by Pandey and Verma (2008) as given below. i.e.



Where;

nk = Sample size of kth strata

Nk = Population size of the kth strata

N = Total population size   
 n = Total sample size

Therefore, 740 instructors were taken into the sample from the selected universities using proportional stratified random sampling technique as shown in Table 1.

Table 1: Summary of population and sample of the study

|  |  |  |  |
| --- | --- | --- | --- |
| Strata | Name of universities | Population size of each university (Nk) | Sample size of each university (nk) |
| 1st generation | University of Gondar | 731 | 249 |
|  | Wollo University | 280 | 95 |
| 2nd generation | Debre Markos University | 430 | 147 |
| 3rd generation | Debre Tabor University | 427 | 146 |
|  | Injibara University | 145 | 49 |
| 4th generation | Debark University | 157 | 54 |
|  | Total | N= 2170 | n= 740 |

***Data Gathering Instrument***

Standardized questionnaire was used to collect the data with the intention to increase the reliability of the results. The questionnaire has three parts containing close ended items. The first part of the questionnaire consisted of an item related to respondents’ universities in which they were working in. The second part of the questionnaire contained 19 items developed by Niehoff and Moorman (1993) with the intent to assess respondents’ feeling towards OJ in the workplace. These items were organized into three dimensions such as distributed justice, procedural justice and interactional justice. The third part of the questionnaire measured respondents’ perception about OC. It was measured using 18 items organized in three dimensions–affective commitment, continual commitment and normative commitment developed by Meyer et al. (1993).

***The reliability of the Questionnaire***

Pilot test was conducted on 90 selected instructors of Bahir Dar University to assess the reliability of the questionnaire. The distribution of sample for pilot test was followed the same procedures as in the main sample of the study. Cronbach Alpha was used to test the internal consistency of items. The reliability coefficients of the instrument with Cronbach Alpha (α) = (.92, .87 & .94) and (.83, .82 & .88) for items concerning the dimensions of OJ and OC respectively. This indicates that items in the respective dimensions with reliability coefficients >.80 are considered as internally consistent to measure OJ and OC (George & Mallery, 2010).

**Data Analysis Techniques**

Inferential statistical analysis techniques were used to analyze the data using SPSS software version 23. Specifically, one sample t-test, structural equation modelling, multiple regression and one-way ANOVA were used to analyze the data collected through the questionnaire.

**Results and Discussions**

This section presents the results of the study according to the themes of the research questions. It began with testing the construct validity of the respective dimensions of latent variables and measurement model fit through conducting exploratory and confirmatory factor analyses.

***Factor analyses***

Although there is no clear criterion to decide what is large or small, items with factor loadings ±.33 and above are considered to meet the minimum level of threshold based on the recommendations of Ho (2006). The result of exploratory of factor analysis indicated that 32 items in the respective dimensions of OJ and OC had high factor loadings above the minimum threshold of ±.33.

Based on the results of the construct validity, the three dimensions of OJ and three dimensions of OC were identified as indicators. Taking the identified dimensions of the two latent variables, the measurement model was constructed using AMOS version 23 as shown in Figure 2.

After testing the construct validity, confirmatory factor analysis was carried out to assess the parameter estimates of the latent variables and the overall fit of the measurement model to the data. Although there is little agreement among scholars on the type of fit indices and their cutoff points, relative chi-square (CMIN/DF), goodness fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index (TLI), comparative fit index (CFI) and root mean square error of approximation (RMSEA) were used to evaluate the fitness of the measurement model to the data. Hence, the measurement model satisfied all of the fit indices as indicated in Table 2.

Table 2: Summary of the fitness indices against the criteria of the measurement model

|  |  |  |
| --- | --- | --- |
| Criteria | Obtained values | Threshold |
| Relative chi-square (CMIN/DF) | 2.580 | <3 |
| Goodness of fit index (GFI) | .988 | >.90 |
| Adjusted goodness of fit index (AGFI) | .968 | >.90 |
| Normed fit index (NFI) | .978 | >.90 |
| Incremental fit index (IFI) | .984 | >.90 |
| Tucker-Lewis index (TLI) | .971 | >.90 |
| Comparative fit index (CFI) | .984 | >.90 |
| Root mean square error of approximation (RMSEA) | .044 | <.05 |

The maximum likelihood estimates of regression and standardized regression weights confirmed that all the path coefficients in the model are significant at p< .05 as shown in Table 3.

Table 3: Unstandardized and standardized regression weights of the measurement model

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameters/dimensions | | | Unstandardized | | | | Standardized |
| Estimate | S.E. | C.R. | P | Estimate |
| Distributed justice | <--- | OJ | .428 | .053 | 8.081 | \*\*\* | .363 |
| Procedural justice | <--- | OJ | .574 | .050 | 11.380 | \*\*\* | .553 |
| Interactional justice | <--- | OJ | 1.000 |  |  |  | .763 |
| Affective commitment | <--- | OC | .663 | .041 | 16.059 | \*\*\* | .615 |
| Continuous commitment | <--- | OC | .882 | .045 | 19.707 | \*\*\* | .774 |
| Normative commitment | <--- | OC | 1.000 |  |  |  | .850 |

As it has been indicated in Table 3, the unstandardized regression weights of all the dimensions of OJ and OC ranging from .363 (distributive justice) to .850 (normative commitment) and which are significant with the critical ratio test greater than ±1.96 at p < .05. This shows that all dimensions in the measurement model were internally consistent and structurally valid to measure the respective OJ and OC constructs.

**Status of Organizational justice and Organizational commitment**

Table 4: A one sample t-test for the dimensions of OJ and OC

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dimensions | Mean | Std. | Test value | Mean difference | t-value | Sig.(2-tailed) |
| Organizational justice |  |  |  |  |  |  |
| Distributive justice | 13.49 | 2.797 | 12 | 1.486 | 14.455 | .000 |
| Procedural justice | 10.99 | 3.954 | 15 | -4.008 | -27.572 | .000 |
| Interactional justice | 19.51 | 4.004 | 21 | -1.493 | -10.146 | .000 |
| Organizational commitment |  |  |  |  |  |  |
| Affective commitment | 22.19 | 5.753 | 18 | 4.195 | 19.834 | .000 |
| Continuance commitment | 15.48 | 4.621 | 18 | -2.516 | -14.811 | .000 |
| Normative commitment | 14.89 | 3.359 | 12 | 2.893 | 23.433 | .000 |

N=740, df = 739, \*Sig. <.05

The results in Table 4 indicated that the mean score of distributive justice (13.49) is greater than the test value at (t = 14.455). The positive mean difference and t-value also confirm that the observed mean score is significantly higher than the test value at p<.05, df =739. This means that instructors fairly perceived the state of distributive justice in the workplace. On the other hand, the mean scores of procedural justices (10.99) and interactional justice (19.51) are less than the respective test values at (t = -27.572) and (t = -10.146) respectively. This indicates that procedural justice and interactional justice are observed to a little extent in the universities.

With regard to OC, the results of one sample t-test indicated that the mean scores of affective commitments (22.19) and normative commitment (14.89) are higher than the respective test values at (t = 19.834) and (t = 23.433). The positive mean differences and t-values also confirm that the observed mean scores are significantly greater than the test values at p<.05, df =739. This implies that instructors are moderately committed to carry out their job due to their emotional attachment with their universities and sense of responsibility to serve their universities. Conversely, the mean score of continuance commitment (15.48) is lower than the test value at (t = -14.811). This means that instructors are committed to a little extent to do their job due to continuous commitment.

**The relationship between Organizational justice and commitment**

*Table 5: Standardized Correlation coefficient of OJ and OC*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Latent variables | | | Unstandardized | | | | Standardized |
| Estimate | S.E. | C.R. | P | Estimate |
| OJ | <--> | OC | .658 | .054 | 12.238 | \*\*\* | .754 |

Table 5 showed that statistically significant relationship is observed between OJ and OC with standardized correlation coefficient (r=.754) by the critical ratio test greater than ±1.96 at p<.05.

**The influence of Organizational justice on Organizational commitment**

*Table 6: Regression of organizational commitment on the dimensions organizational justice*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dimensions of OJ | Adjusted  R2 | Unstandardized Coefficients | | Standardized  Coefficients | | |
| B | S.E. | Beta | t-value | Sig. |
| Constant | .565 | 1.272 | .091 |  | 13.947 | .000 |
| Distributive justice | .503 | .021 | .634 | 23.687 | .000 |
| Procedural justice | .091 | .013 | .185 | 6.859 | .000 |
| Interactional justice | -.105 | -1.84 | -1.85 | -6.827 | .001 |

As shown in Table 6, the results of multiple regression indicated that 56.5 % of the variance in OC is predicted by the three dimensions of OJ with a significant model at F (3, 736) = 219.952, p= .000. The regression coefficient of the dimensions of OJ are found significant as (.634, .185 and -1.85) for distributive justice, procedural justice and interactional justice respectively. This shows that all dimensions of OJ significantly contribute to predict OC.

**One-way ANOVA for the generations of universities**

Table 7: One-way ANOVA on differences in perception of OJ and OC among instructors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Generations of universities | Sum of Squares | df | Mean Square | F | Sig. |
| OJ | Between Groups | 190.763 | 3 | 63.588 | 49.989 | .000 |
| Within Groups | 936.215 | 736 | 1.272 |
| Total | 1126.978 | 739 |  |
| OC | Between Groups | 124.201 | 3 | 41.400 | 32.624 | .000 |
| Within Groups | 933.983 | 736 | 1.269 |
| Total | 1058.184 | 739 |  |

\*Significance level at .05 level

The result of one way ANOVA indicated that there were statistically significant differences among instructors in their perception of OJ at F(3, 736) = 49.989, p = .000 and OC at F(3,736) = 32.624, p = .000 in the four generations of universities. This shows that instructors in the four generations of universities perceived the status of OJ and OC in different way.

**Results and Discussion**

The finding of this study indicated that OJ was observed in the in the public universities to some extent or to a little extent. Specifically, distributive justice is found moderately in the workplace while procedural and interactional justice are observed to a little extent as shown in Table 4. The finding of this study is similar with the works of Awang and Ahmad (2015) and Nguni, Sleegers, and Denessen (2006) that distributive justice is observed to some extent in the workplace. Other researchers also reported as distributive justice moderately observed in the organizations (Mahrani, Kamaluddin, & Takdir, 2013; Wajdee, Gurvinder, & Shehadehmofleh, 2018) that enable employees rewarded fairly according to their contribution. The findings of Gulluce, Ozer and Erkili (2015) and Wajdee et al. (2018) are similar with the result of the current study related to procedural justice and interactional justice.

The finding of this study indicated that instructors have moderate level of affective commitment and normative commitment but they have low level of continuous commitment in their universities. The works of Endale (2019), and Tesfaye (2004) are similar with the findings of this study related to affective commitment and normative commitment. In the same way, the findings of Endris and Dawit (2019), Mahrani et al. (2013) and Gulluce et al. (2015) are also similar with the findings of this study concerning affective and normative commitment. With regard to continuous commitment, research conducted by Mahrani et al. (2013) indicated that employees demonstrated a modest level of continuance commitment in the workplace. The result of this study is supported by the findings of other studies on the status of continuance commitment as perceived by employees (Karanja, 2016).

Employees want to stay in the organization as much as they are fairly treated in the system. The result of this study indicated that there is significant relationship between OJ and OC. This finding is congruent with the result of Ghafori and Golparvar (2009) that OJ had positive and significant correlation with OC because staff perceived their leader to be fair, respectful and unbiased in their dealings. Similarly, other studies conducted in different organizations indicated that OJ is significantly related to OC (Yazıcıoglu & Topaloglu, 2009). When employees’ rewards are equal to the inputs, they will develop the feeling of fair treatment while the reverse situation leads to a state of mistreatment. Employees become committed when they develop the feeling of fair treatment, but the opposite feeling does not bring this result (Imamoglu, 2011).

Justice is vital if employees are to be committed to the organization. The findings of the previous studies also indicated that OJ had significant effect on OC similar to the findings of the current study. Concerning this, Imamoglu (2011) reported that OJ had significant effect on OC. In the same way, other researchers also supported the significant influence of OJ on employees’ level of commitment in the workplace (Cropanzano, Bowen, & Gilliland, 2007). Moreover, the findings of other studies proved that employees’ perceived justice had significant effect on employees’ commitment towards their job (Rezaiean, Givi, Givi, & Nasrabadi, 2010). Therefore, it is possible to say that the fairness of outcomes distributed within the organization and its function improve the level of commitment of employees to the organizations.

Furthermore, the finding of the current study is also congruent with the works of Ogunyemi and Ayodele (2014) and Sarnecki (2015) in that OJ is an important factor determining employees’ commitment in the workplace. Likewise, various studies conducted in various areas proved that OC tends to improve for those employees whose leadership give them the opportunity to partake in decision-making (Steyrer, Schiffinger, & Lang, 2008). This finding was consistent with that of Bakhshi, Kumar, and Rani (2009) and Baotham (2011) who reported that fairness in organization makes employees committed in the workplace.

**Conclusions and Recommendations**

**Conclusions**

The purpose of this study was to examine the effect of OJ on OC of instructors in the public universities in Amhara region. Based on the finding of this study, it is concluded that OJ had significant effect on OC of instructors though procedural and interactional justices were observed to a little extent in the universities.

**Recommendations**

* Department heads need to involve instructors in the decision-making process that are related to their job.
* Department heads need to collect accurate and complete information before making decisions about instructors.
* Instructors should be committed enough to serve their universities with a sense of responsibility and emotional attachments.
* Instructors shall be committed enough to serve their institutions without considering perceived costs associated with their job.
* Further studies need to be conducted on OJ and OC in the context of Ethiopian universities with large sample size to generalize the results.

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* 1. Authentic Leadership and Employees’ Commitment to Organizational Change with Mediating Role of Trust: The Case of Selected Public Organizations in Addis Ababa

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***Abstract***

*Prevalence of authentic leadership, trust and employees’ commitment are considered as vital elements for a healthy and successful sailing of the 21 century organizations. The purpose of this study was to find out the effect of authentic leadership on employees’ commitment to organizational change with a mediating role of employees’ trust in leadership. To that end, an explanatory research design with quantitative approach was used. Data were collected from 400 employees of four selected federal organizations. Data analysis was done using mean, logistic regression and MANOVA from the SPSS software version 21. Findings of the analysis revealed that authentic leadership has a statistically significant positive effect on employees’ commitment, where as its effect through the mediation of trust is trivial and statistically insignificant. Besides, the direct relationship between authentic leadership and employees’ trust was found to be negative and statistically significant. On top of that, the studied organizations exhibit small difference in their levels of authentic leadership, trust and commitment. The researcher concluded that, the nature of leadership in the studied organizations is dominated by transactional leadership style; that was why the relationship between authentic leadership and trust is found to be negative. Finally, it is recommended that public organizations should give special emphasis to development and practice of authentic leadership qualitieswhich could make employees’ develop embedded trust and exert extra effort to ensure success of their organizations.*

**Key words:** *Authenticity, leadership, trust, employees’ commitment, organizational change*

**Introduction**

Leadership is the most important factor in organizations expected to be agile and sensitive to the organization’s internal and external environments where new customer and stakeholder demands and preferences are popping in a never-ending fashion (Beats, 2006, Kotter, 1996). To effectively lead such organizations, leaders of the 21st century organizations are advised to acquire knowledge, develop skills and held an attitude that enable them cope up with the changing demands of their organizations via chameleon-like adaptability mechanisms (Brauns, 2015, Goffee&Jones, 2005). To enable the organization stay competitive and customer savvy, leadership needs to develop qualities that enable it attract competent employees and get them rally around the organizations’ mission, values, vision and goals. Scholars in the area of organizational behavior and leadership have long been searching for approaches and styles of leadership that could serve the organizations’ and the employees’ best interests (Walumbwa, Avolio, Gardner,Wernsing, & Peterson, 2008, Schien, 2004). Such approaches include transformational leadership, servant leadership, ethical leadership, spiritual leadership and authentic leadership. Among the others, authentic leadership is a recently developed approach to leading organizations. Just like its antecedents, authentic leadership is also embedded with strong ethical values that enable leaders prioritize the interest of others over their own egocentric tendency (Northouse, 2016, Avolio& Gardner, 2005, George, 2003).

Authentic leadership qualities guarantee the development of trustful relationship between employees and leaders. This positive psychological capital enables leaders to be seen by employees as credible and predictable. Hence, employees feel comfort, safety, security and confidence. This situation intrinsically motivates employees to willingly participate in realizing any change vision or strategic plan needed to be implemented by the leader (Westover, 2014). Under such leadership environments, employees commit themselves to engage in exerting discretionary effort so as to see the vision realized(Dramićanin, 2019, Soumyaja, Kamlanabhan, & Bhattacharyya, 2015).

Since 1991, the Ethiopian public sector has been engaged in changing itself to have a form and content that enables it meet the changing demands and preferences of its customers and stakeholders. The public sector reform program (PSRP) followed the top down approach and was designed with five subprograms which were believed to have potential to create competent management and staff, rule of law based and customer centered service delivery, fair and open process and accountability to the public(Bezabih, 2007). In order to identify the success level of federal public service organizations in reform implementation, the federal civil service commission has evaluated them based on some indicators. As a result, organizations were ranked as high, medium and low performers. This study was conducted with the assumption that the cause of higher level of performance in reform implementation could be prevalence of authentic leadership that creates mutual trust between leaders and employees of the organizations and breed employees’ commitment to realize the planned change.

Authentic leadership is one of the recently developed leadership approaches believed to have potential to ensure organizations’ successful performance. Authentic leadership is characterized by orientation towards people, admittance of mistakes and taking accountability as well as absence of manipulation of employees (Northouse, 2016, Henderson & Hoy, 1982). Thus, employees get chance to know the extent of competence of the leaders in terms of discharging their responsibilities and ensuring organizational success, the leaders’ tendencies towards benefiting their employees and the leaders’ level of integrity(George, 2003).

The stringent challenge in change leadership and management is handling employees’ reaction to a newly introduced change program, especially when that organizational change is introduced by the leaders (Schein, 2004, Kotter, 1996). Prevalence of authentic leadership is believed to ease this obstacle by creating a trustworthy relationship between leaders of the organization and the employees. Trust is a powerful psychological and emotional capital that forces employees to commit themselves to realization of change in their organization. Trust make employees rationally and heartily believe that the introduced change is vital for survival and success of their organization, to benefit customers and stakeholders, as well as a means to enhance employees’ benefit packages (Mayer, Davis, & Schoorman, 1995). As a reciprocal behaviour, employees found out a just cause to dedicate their blood and sweat to their organization’s success (Sinek, 2014, Simonsen, 1997).

Public sector organizations play a life giving and sustaining role in any nation. They provide inputs to national and organizational policies and engage in implementing those policies when they get ratified and legitimized by the responsible body of the government. Proper implementation of those policies impact peoples’ lives in all economic, social and political perspectives (Evans, 1995). Hence, prevalence of authentic leadership is of necessity to public organizations of countries that strive to build democratic governance (Walumbwa et al., 2008).

Ethiopia is one of the countries endeavoring to build democratic governance and customer sensitive public service delivery. Almost for the past three decades, the country has invested a lot of effort and resources to civilize and modernize its public organizations (Gebre, 2014). The public service reform program was a comprehensive national package meant to address all the actors and processes in the public service delivery’s value chain. To that end, the reform program was implemented by uniformly applying different change management tools such as strategic planning and management (SPM), management by objective (MBO), performance-based management system (PBMS), business process reengineering (BPR) and balanced score card (BSC). Nonetheless, implementation of the public sector change program has shown remarkable changes and improvement in very few public service organizations while majority of the organizations in the sector witnessed no visible positive difference in their service delivery (Kassa&Zekarias, 2020, Worku, 2019, Getachew& Commons, 2006).

Empirical studies conducted on public sector change in Ethiopia emphasized on appropriateness of the applied planned change management approach, relevance of the service delivery policy, leadership styles and commitment, issues of institutional capacity, employees’ competence and organizational culture (Solomon, 2013, Tilaye, 2007, Bezabih, 2009). However, none of them have focused on the importance of leadership authenticity to generate employees’ trust in leadership and its effect to realize employees’ commitment to organizational change. Therefore, the main purpose of this study was to analyze the effect of authentic leadership through the mediating role of employees’ trust in leadership and the resultant employees’ commitment towards organizational change. To that end, the following specific objectives were designed. The specific objective of the study are;

1. To analyze the direct effect of authentic leadership on employees' commitment to organizational change.
2. To examine the effect of authentic leadership on the trust of employees in leadership.
3. To analyze the mediating role of employees’ trust in leadership on the relationship between authentic leadership and employees’ commitment to organizational change.
4. To scrutinize if a statistically significant difference exists in the levels of leadership authenticity, employees’ trust in leadership and employees’ commitment to organizational change among the studied organization.

**Methodology**

The positivist philosophical world view which considers reality as objective and subject to numerical measurement is adhered to in this study (Creswell, 2009, Gray, 2004). This world view allows the researcher to collect quantitative data in order to understand PAL and the mediating role of ETL on ECOC in the public sector. Thus, the research approach used in this study is purely quantitative. In that sense, the three constructs namely: PAL,ETLand ECOC are measured numerically.

**Data type, population and sampling**

Only quantitative primary data were used in this study. The population was determined to compose employees of four federal organizations viz. Ministry of Education (MoE), Ministry of Labourand Social Affairs (MoLSA), Federal Civil Service Commission (FCSC) and the National Bank of Ethiopia (NBoE). These organizations were systematically selected from the list of 15 federal organizations that were ranked by the Civil Service Commission (FCSC, 2019) as high performers in reform implementation. The total number of employees of the selected organizations, with educational status of a diploma and above was found to be 1,462. The formulae developed by Yamane (1967, p. 886) as cited in Israel, (2003, P.4) was used to calculate a representative sample size. The formula runs as: n=N/1+N (e2). Accordingly, 1,462/1, 462+1(0.05\*0.05) =399.73 which is approximated to 400. The share of respondents for each organization was calculated by applying the proportional sample allocation strategy.

## Table 1: Proportional distribution of the sample to selected organizations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Name of the organization** | **Number of employees** | **Proportional allocation** | **Sample size** |
| 1 | MoE | 308 | 308 \*400/1,462 | 84 |
| 2 | FCSC | 286 | 286\*400/1,462 | 78 |
| 3 | MoLSA | 203 | 203\*400/1,462 | 56 |
| 4 | NBoE | 665 | 665\*400/1,462 | 182 |
| **Total** | | **400** | | |

Source: Own calculation, (2021).

A simple random sampling technique was used to determine employees who actually involve as actual respondents of the study.

**Instrumentation**

Data collection instruments employed in this study were three validated questionnaires on PAL, ETL and ECOC.The first one was used to measure leadership authenticity based on the three dimensions identified by Henderson and Hoy (1982) as prevalence of self over role, non-manipulation and accountability. To that end, the leadership authenticity scale was adapted to the context of public sector leaders’ authenticity. This instrument is composed of 32 items where the first dimension, silence of self over role, takes nine of them, the second dimension, non-manipulation, is measured by 13 items and the last dimension, accountability, is measured by ten items.

The second questionnaire was the trust measurement scale as developed by Mayer, Davis, and Schoorman (1995). This questionnaire has three dimensions targeted at measuring employees’ ’trust in leadership. These are ability, benevolence and integrity. It is totally composed of 17 items, six on ability, five on benevolence and six on integrity. And finally, the third validated instrument is the one developed byHerscovitch and Meyer (2002) to measure employees’ commitment to organizational change. Like the aforementioned instruments, this scale also measure employees’ commitment to change via three dimensions namely affective commitment, continuance commitment and normative commitment. The instrument is composed of 18 items whereby all of the three dimensions are measured by six items. These three validated instruments were compiled together as one instrument composed of 67 items.

All the three questionnaires were self-translated in to Amharic language by the researcher and they were again back translated in to English language with the help of a language expert. This method of back-translation of a questionnaire; English to Amharic and then to English; help ensure coherence and accuracy of the translated items. After translation was completed, the instrument was distributed to ten employees of the public sector whose educational background aligns with that of the employees selected for this study. Based on results of the pilot test, the researcher made some modifications specially to avoid redundancies and vagueness of some items. Finally, the instrument was distributed to the sampled 400 respondents.

**Data analysis**

After all data get encoded in to the SPSS software version 21, assumption tests on sample size, multi-collinearity, linearity, normality, homoscedasticity and outliers was conducted. Results of the tests revealed that the data meets all requirements for regression analysis. Consequently, the data were first analysed using descriptive statistics to find out the overall mean scores on each dimension of the three constructs (PAL, ETL & ECOC). And finally, objectives of the study were addressed by using regression analysis and MANOVA (Pallant, 2010, Field, 2009). The regression analysis was done based on Baron and Keny’s (1986, p.1177) model of step-wise mediation analysis by:

1. regressing the dependent variable on the independent variable.
2. regressing the mediator on the independent variable.
3. regressing the dependent variable on both the mediator and the independent variable.

Besides, the status of direct and indirect predictive effect of PAL on ECOC via mediation of ETL is interpreted based on Chine 1998, and Hock and Ringle 2006, Cited in Garson (2016, p. 80) who described that R2 values of .67 and above are substantial, .33-.66 are moderate and .19 and below are weak.

**Literature Review**

Even though the authentic leadership concept is a recently developed one, there are various studies conducted to understand its effect on organizational performance, the employees’ commitment to their organizations and the relationship between employees and leadership. The earliest study done on leadership authenticity and employees trust was the one conducted by Henderson and Hoy (1982). This study was mainly aimed at developing authentic leadership scale by studying organizational life in 42 elementary schools in New Jersey. Findings of this study revealed that there is significant positive correlation between authentic leadership and leaders’ concern to their status, employees trust and esprit. Besides, the study indicated presence of significant positive relationship between leader’s authenticity and employees trust and esprit, while, there is negative relationship between status concern and authentic leadership.

More recently, Dramićanin (2019) conducted a study to find out the influence of authentic leadership on commitment of employees of travel agencies. Findings of this study indicated that there is a significant positive influence and relationship between authentic leadership qualities and employees commitment. This enables organizations to retain talented employees and attract other pools of potentially competent employees from the market. Based on these findings, the researcher concluded that, authentic leadership is the solution to the challenge in managing organizations in this dynamic, complex and uncertain environment where everything changes very fast. Besides, authenticity is being true to oneself and to others, is a win-win solution to unethical practices and business scandals that organizations are facing. This enables to ensure high dedication of employees towards realization of the mission, vision and goals of the organization by simultaneously enabling employees to go up on the career ladder (Sinek, 2014).

Likewise, in their study on authentic leadership and organizational commitment with the mediating role of positive psychological capital, Rego, Lopes and Nascimento (2016), defined positive psychological capital as having four dimensions namely hope, optimism, self-efficacy and resilience. Their findings indicated that authentic leadership could significantly influence employees’ self-efficacy, optimism and hope. However, resilience was found to be more influenced by personal characteristics’of individual employees’ rather than by the authentic leaders’ pattern of positive behavior. Finally, they concluded that presence of authentic leadership is vital for the accumulation of this positive psychological capital. The positive psychological capital in its turn is important to win employees’ commitment to organizational change initiatives. However, even though there is conceptual interdependence and similarity between development of positive psychological capital and trust in leadership, Rego, Lopes and Nascimento (2016), did not address the mediating effect of trust in leadership on employees’ commitment to change as is operationalized in the current study.

Ahmed et al. (2019) conducted a study on impact of perceived authentic leadership on employees’ positive emotions during organizational change in the telecom company of Pakistan. These authors found out that perceived authentic leadership has a significant effect on the positive emotions of the employees during any organizational change process. They also affirmed that trust in the leader mediates the role authentic leadership has in generating positive emotional reactions to organizational change.

All the aforementioned empirical studies have tried to show the relationship between authentic leadership and employees’ engagement in promoting their organizational performance. However, non-of them have considered the extent of authentic leadership practiced by the public sector leaders and its effect to create employees’ trust in leadership and the employees’ commitment to organizational change. Therefore, findings of the study at hand have contributed to fill this research gap by scrutinizing prevalence of authentic leadership and its effect in generating employees’ commitment with a mediating role of ’ trust in the selected Federal reform champion organizations in Ethiopia.

**Definition of variables and conceptual framework**

**Prevalence of Authentic Leadership (PAL):**This construct has three dimensions (Henderson & Hoy, 1982, p.6). These authors defined leadership authenticity as “the extent to which subordinates perceive their leader to be maximizing the acceptance of organizational and personal responsibility for actions, outcomes and mistakes, to be non-manipulating of subordinates; and to demonstrate a salience of self over role.”

**Employees Trust in Leadership (ETL):**Trust is defined as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party.”Ability, benevolence and integrity are the commonly used factors in many literatures related to organizational trust (Mayer, Davis, &Schoorman, 1995, p. 712).

**Employees’ commitment to organizational change (ECOC):** Meyer (2001, Cited in Herscovitch& Meyer, 2002, p. 475), defined commitment as “a force or mindset that binds an individual to a course of action deemed necessary for the successful implementation of a change initiative.” It is measured based on three dimensions viz. affective commitment, continuance commitment and normative commitment.

**Conceptual framework of the study**

**ETL**

-Ability

-Benevolence

-Integrity

a b

**PAL**

-Salience of self over role

-Absence of manipulation

-Accountability

**ECOC**

-Affective

-Normative

-Continuance

C

Figure1: Conceptual model of the study.

Source: Developed by the researcher based on literature review, (2021).

Based on the aforementioned definitions of the three constructs in the study, the conceptual model displays that prevalence of authentic leadership (PAL) measured in terms of salience of self over role, absence of manipulation and accountability creates employees’ trust in leadership (ETL)which makes employees believe in the leaders’ ability, benevolence and integrity. Finally, via the mediating role of ETL, PAL is expected to result in employees’ commitment to organizational change (ECOC) which is again considered in terms of affective, normative and continuance types of commitments.

**Results and Discussion**

The direct effect of prevalence of authentic leadership (PAL) on employees’ commitment to organizational change (ECOC)

Prevalence of authentic leadership (PAL) with its unique characteristics of salience of self over role, accountability and absence of manipulation is assumed to have positive influence on the level of employees’ commitment to organizational change (ECOC) which is again determined as having three dimensions namely affective commitment (AC), continuance commitment (CC) and normative commitment (NC).

Binomial logistic regression was used to analyze the total effect of PAL on ECOC. The model summary result depicted in Table 2 shows that there is positive correlation (R) between PAL and ECOC. However, the predictive effect of authentic leadership on employees’ commitment to organizational change (R2) is 3.8%.

Table 2: Model summarya

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | R | R Square | Adjusted R square | Std. error of the estimate |
| 1 | .196a | .038 | 0.36 | .55228 |

1. Predictors: (constant), PAL

**Model parameters**

The coefficients in Table 3, demonstrate contribution of the predictor variable (PAL) to the outcome (ECOC) and its significance level. The beta value (b=.197), with standard error of (SE=.072) tells us that there is a positive relationship between PAL and ECOC. That is, presence of one unit of PAL in the organizations increases the ECOC by .197, which is significant at P<.05.

Table 3: Coefficientsa of the direct effect of PAL on ECOC

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | | Unstandardized coefficients | | Standardized  coefficients | t | Sig. |
| B | Std. error | Beta |
| 1 | (Constant) | 2.498 | .181 | . 156 | 13.819 | .000  .003 |
| PAL | .197 | .072 | 3.035 |

1. Dependent variable: ECOC

On top of having statistical significance, the beta value is required to be different from zero and greater than the standard error. In the case at hand, the beta value .197 is greater than the standard error .072. Likewise, the t value 3.04 which is statistically significant at p<.05 tells us that the beta value is different from zero. Thus, it could be concluded that PAL has significant positive contribution to create ECOC in the studied organizations.

This finding aligns with what was proposed by different authors on PAL’s statistically significant effect on ECOC (Dramićanin, 2019;Henderson & Hoy, 1982).These authors found out that PAL plays great role to create employees’ commitment and serve as a strategy to retain professionally competent employees with whom the organizations’ mission, values and vision are well entrenched. In other words, PAL creates a win-win relationship between an organization and its employees(Northouse, 2016, Sinek, 2014, George, 2003, Walumbwa et al., 2008). That is, the organization benefits from retention of its competent and well equipped employees whereas the employees also benefit due to their ability to go up the career ladder of the organization (Parish & Cadwallader, 2008, Herscovitch & Meyer, 2002, Simonsen, 1997).

However, analysis of demographic data of the study at hand revealed that 49% of the respondents were aged 28-37 years and majority of the respondents (58%) have served their organizations for 6 months -5 years only. This shows that the studied organizations’ employee retention capacity is low. Besides, the organizations’ total mean score on PAL is 2.75. This indicates that there is weak level of PAL in the organizations. That is why the effect size (R2) has remained at 3.8%. Therefore, it could be concluded that the higher the level of PAL in an organization, the higher will be its employees’ commitment to their organization’s success in reform implementation. This conclusion is similar with that of Ahmedet al. (2019), which found out that authentic leadership has impact on employees’ positive emotions during organizational change.

**The effect of prevalence of authentic leadership (PAL) on employees’ trust in  leadership (ETL)**

The complexities and dynamism in today’s organizations urged for more positive leadership capabilities and authenticity to restore confidence in all levels of leadership and build trustful relationship between leaders and subordinates (Goffee& Jones, 2005, George, 2003). Besides, the need for trustworthy relationship between leaders and subordinates in an organization become crucial due to leaders’ act of violation of legally and ethically assigned responsibilities. Authentic leadership is proposed as a vital leadership approach to ensure employees’ trust in leadership (Northouse, 2016, Sinek, 2014).Organizations led by authentic leaders develop work environments of high level of trust which is fun, supportive, motivating, productive and comfortable (Hurley, 2012, Avolio& Gardner, 2005).

The model summary result on the effect of PAL on ETL as exhibited in Table 4shows that there is positive correlation (R) between PAL and ETL. However, the predictive effect of PAL on ETL (R2) is 1.6%.

Table 4: Model summary aon the direct effect of PAL on ETL

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | R | R Square | Adjusted R square | Std. error of the estimate |
| 1 | .128a | .016 | 0.14 | .76721 |

1. Predictors (constant): PAL

**Model parameters**

Coefficients of the analysis as shown in Table 5indicate contribution of the predictor variable (PAL) to the outcome (ETL) and its significance. The beta value -.245 shows that there is a negative and statistically significant relationship between PAL and ETL, with a p-value of .014. The effect of PAL on ETL is predicted by the model and the beta coefficient is explained as one unit increase in PAL will result in decrease in the level of ETL by .245 which is significant at P<.05.

Table 5: Coefficients aof the effect of PAL on ETL

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | | Unstandardized coefficients | | Standardized  coefficients | t | Sig. |
| B | Std. error | Beta |
| 1 | (Constant) | 3.423 | .276 | -. 128 | 12.389 | .000  .014 |
| PAL | -.245 | .099 | -2.465 |

1. Dependent variable: ETL

Even though direction of the change in ETL is negative, the beta value is greater than the standard error (0.99). Besides, the t value -2.465 tells us that the beta value is different from zero. Thus, it could be concluded that PAL has significant negative contribution to decrease ETL in the studied organizations. This finding violates the theoretical proposition about existence of positive relationship between PAL and ETL. Rather, it aligns with Hurley’s(2012) and Avolio and Gardner’s(2005) stipulation that organizations led by unauthentic leaders are characterized by low level of trust, threatening, divisive, unproductive and tense work environments. It is also inconsistent with findings of previous empirical studies about the importance of authentic leadership to make fundamental difference in organizations by helping people find meaning and connection at work through greater self-awareness; by restoring and building optimism, confidence and hope; promoting transparent relationships, decision making and positive ethical climates (Sinek, 2014, Henderson & Hoy, 1982).

The indirect effect of prevalence of authentic leadership (PAL) on employees’ commitment to organizational change (ECOC) with mediating role of employees’ trust in leadership (ETL)

Employees’ emotional reaction to change is a decisive factor of whether the change will succeed or fail. In fact, their reaction is shaped by the level of trust employees have in the organizations’ leadership (Ahmedet al., 2019). Presence of authentic leadership is vital for accumulation of positive psychological capital in the forms of optimism, hope and self-efficacy. The positive psychological capital in its turn is important to win employees’ commitment to organizational change initiatives (Rego, Lopes & Nascimento, 2016). These authors stated that trust has positive and statistically significant effect on employees’ commitment.

Table 6: Model Summary a

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | R | R Square | Adjusted R square | Std. error of the estimate |
| 1 | .173a | .030 | 0.25 | .50122 |

1. Predictors (constant): PAL, ETL
2. Dependent: ECOC

The model summary result depicted in Table 6 shows that there is significant correlation (R) between PAL and ECOC. However, the predictive effect of PAL and ETL on ECOC (R2) is 3%.

Table 7: Coefficients a

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | | Unstandardized coefficients | | Standardized coefficients | t | Sig. |
| 1 |  | B | Std. error |
| Constant | 2.331 | .215 | 10.843 | .000 |
| PAL | .209 | .065 | .166 | 3.197 | .002 |
| ETL | .049 | .034 | .074 | 1.432 | .153 |

1. Dependent variable: ECOC

Table 7 presented the beta values of PAL (.209) and ETL (.049). These results indicate that a one unit increase in the level of PAL will result in increase in the level of ECOC by .209, which is statistically significant (P=.002); and one unit increase in ETL results in .049, which is trivial and statistically insignificant (p=.153) increase in the level of ECOC. This result shows that, ETL does not mediate the predictive effect of PAL on ECOC. To further check statistical significance of the mediation result, a Soble test was applied by using a web page calculator as it is presented in Figure 2 and Table 8.

PAL

ETL

ECOC

a= -.245 (.099) b=.049 (.034)

a\*b= indirect effect=-0.012005

c=.209 (.065)

Figure 2: Mediation analysis of ETL on PAL’s effect on ECOC.

Source: Developed by the Researcher, (2021).

The Soble test result revealed that the indirect effect of PAL on ECOC through the mediating role of ETL (a\*b) is -.012005 and the p-value is 0.21; which is greater than the standard cutoff point of statistical significance at p<.05.

Table 8: Soble test analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Input** | Soble test: | **Test statistic** | **Standard error** | **p-value** |
| a=.245 | 1.2453889 | 0.00963956 | **0.21298883** |
| b=049 | Aroian test: | 1.1757688 | 0.01021034 | 0.23968728 |
| Sa=.099 | Goodman test: | 1.32904795 | 0.00903278 | 0.18383215 |
| Sb=.034 | Reset all | Calculate | | |

Source: Researcher’s own calculation using the Soble test calculator, (2021).

Therefore, the indirect effect of PAL on ECOC through ETL is not statistically significant. Rather, PAL has a statistically significant effect without involvement of the mediator. As a result, the researcher scrutinized the implication of low level of PAL with a mean score of 2.75 and wondered on presence of other styles of leadership that dominate the studied organizations’ and could have negative relationship with the level of ETL. On his study of transactional leadership style and its effects on organizational commitment using employees’ trust as a mediator, Mehmood (2016) found out that employees’ trust on the leader does not predict the level of ECOC. Rather, there is a statistically significant relationship between transactional leadership style and ECOC, without the need to develop ETL.

This finding indicates that the leadership style dominantly prevailing in the studied organizations is not authentic but transactional. It also aligns with findings of the study done by Yasir, Imran, Irshad, Mohamad and Khan (2016), which revealed that the relationship between transactional leadership style and ETL is negative and statistically insignificant. It is believed that through its contingent reward mechanism, transactional leadership could create higher levels of ECOC. Similarly, a study conducted by Wei, Yuan and Di, (2010) found out that there is negative relationship between transactional leadership style, characterized by limited information sharing, tense relations and supervisor’s strict control on individual behavior of the employees and employees’ trust in leadership.

Therefore, it could be concluded that presence of a relatively higher level of ECOC in the studied organizations is caused by the transactional leaders’ carrot and stick approach which emphasis on rewarding employees who stick to the required behavior and punishing those who do not.

**The levels of prevalence of authentic leadership (PAL),employees’ trust in leadership (ETL) and employees’ commitment to organizational change (ECOC) in the studied organizations**

All of the organizations included in this study namely MoE, FCSC, MoLSA and NBoE were ranked as high performers in reform implementation (FCSC, 2019).To find out if any statistically significant difference exists among the studied organizations, a multivariate analysis of variance (MANOVA) was conducted using the variable “organization” as predictor and PAL, ETL and ECOC as outcome variables. Moreover, size of the difference among the studied organizations was interpreted using Cohen’s (1988) categorization i.e. <.01 =trivial; .01-.05=small; .06-.07 =medium and .08 =large.

Table 9: Descriptive statistics of multivariate analysis of variance (MANOVA)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Organization** | **Mean** | **Std. deviation** | **N** |
| PAL | MoE | 2.858 | .43893 | 78 |
| FCSC | 2.7208 | .43016 | 73 |
| MoLSA | 2.7772 | .42290 | 52 |
| NBoE | 2.7268 | .36361 | 166 |
| Total | 2.7537 | .40286 | 369 |
| ETL | MoE | 2.6214 | .83181 | 78 |
| FCSC | 2.5794 | .69723 | 73 |
| MoLSA | 2.5860 | .71438 | 52 |
| NBoE | 2.9337 | .75828 | 166 |
| Total | 2.7486 | .77248 | 369 |
| ECOC | MoE | 3.0148 | .53625 | 78 |
| FCSC | 3.0032 | .53347 | 73 |
| MoLSA | 3.1036 | .54454 | 52 |
| NBoE | 3.0491 | .47131 | 166 |
| Total | 3.0404 | .50750 | 369 |

Source: Own analysis based on field survey, (2021).

Results of the MANOVA indicated that there is no sensible difference between the mean scores and standard deviations of the studied organizations’ level of PAL and ECOC. There is only a slight difference in mean scores of ETL in the case of NBoE which is 2.9337; while MoE, FCSC and MoLSA scored 2.6214,2.5794 and 2.5860 respectively. This difference is depicted by Figure 3.

**Means plot**



Figure 3: The means plot of the organizations’ level of ETL

Source, own developed based on field survey, (2021).

Box’s test was used to check the null hypothesis that “the observed covariance matrices of the dependent variables are equal across the groups.” It tells us whether the data violates the assumption of homogeneity of variance-covariance matrices. In the current study, the significance value is p=.216. Therefore, since it is greater than .05, the assumption of homogeneity of variance-covariance is satisfied. That is, there is equality of covariance matrices in PAL, ETL and ECOC across the studied organizations.

Table 10: Box’s test of equality of covariance matrices a

|  |  |
| --- | --- |
| Box’s M | 22.789 |
| F | 1.243 |
| df1 | 18 |
| df2 | 186501.953 |
| Sig. | .216 |

1. Design: Intercept + organization

Source: Own analysis based on field survey, (2021).

The other test used in MANOVA is the Leven’s test of equality of error variances. In the case at hand, the significance values for the three dependent variables used in the study are all greater than .05. That is; PAL (p=.436), ETL (p=.712) and ECOC (p=.650). Therefore, the assumption of equality of error variances is met.

Table 11: Levene’s test of equality of error variances a

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | F | df1 | df2 | Sig. |
| PAL | .911 | 3 | 365 | .436 |
| ETL | .458 | 3 | 365 | .712 |
| ECOC | .547 | 3 | 365 | .650 |

1. Design: Intercept + organization

Source: Own analysis based on field survey, (2021).

**Tests of between subjects effects**

Results of the multivariate test showed that there is statistically significant difference among the studied organizations in terms of their PAL, ETL, and ECOC. However, it does not tell as where that statistically significant difference lays for sure. To that end, a test of between subjects’ effects was conducted and the results are presented in Table 12.

Among the different multivariate tests namely Pillai’s Trace, Wilks’ Lambda, Hotelling’strace and Roy’s largest root, the Wilks’ Lambda statistics is the most commonly reported one. Accordingly, Wilks’ Lambda effects in the current study showed that F=2.498, p=.008, Wilks Lambda=.94; and Partial eta squared=.02. The result shows that there is a statistically significant difference in ETL among MoE, FCSC, MoLSA and NBoE. Besides, the size of the difference is determined to be .02, which is a small effect size as per Cohen’s standardization.

Table 12: Multivariate analysis **a** of variance (MANOVA)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Effect | | Value | F | Hypothesis df | Error  df | Sig. | Partial Eta. Square |
| Intercept | Pillai’s Trace | .987 | 9029.350b | 3.000 | 363.000 | .000 | .987 |
| Wilks’ Lambda | .013 | 9029.350b | 3.000 | 363.000 | .000 | .987 |
| Hotelling’s trace | 74.623 | 9029.350b | 3.000 | 363.000 | .000 | .987 |
| Roy’s largest root | 74.623 | 9029.350b | 3.000 | 363.000 | .000 | .987 |
| Organization | Pillai’s Trace | .060 | 2.479 | 9.000 | 1095.000 | .008 | .020 |
| Wilks’ Lambda | .941 | 2.498 | 9.000 | 883.597 | .008 | .020. |
| Hotelling’s trace | .062 | 2.509 | 9.000 | 1085.000 | .008 | .020 |
| Roy’s largest root | .051 | 6.175 c | 3.000 | 365.000 | .000 | .048 |

1. Design : Intercept + organization
2. Exact statistic
3. The statistic is an upper bound on F that yields a lower bound on the significance level

Source: Own analysis based on field survey, (2021).

At this level, since we are looking at a number of separate analyses, the researcher is methodologically advised to set an alpha level that is higher than the conventional level of .05. This was done by applying the Bonferroni adjustment which proposes that the conventional alpha point should be divided to the number of dependent variables used in the MANOVA (Pallant, 2010). The Bonferroni adjustment is required in order to avoid occurrence of Type I error which results in rejection of a true null hypothesis due to the lower level of the conventional cut off point (.05). In the current study, there are three dependent variables namely PAL, ETL, and ECOC. Hence, a higher P value could be calculated as .05/3=.017. That is, any p-value which is lesser than .017 indicates presence of statistically significance difference among the studied organizations.

Table 13: Tests of between subjects effects

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Dependent variable | Type III sum of squares | df | Mean square | F | Sig. | Partial Eta squared |
| Corrected model | PAL | .633a | 3 | .211 | 1.303 | .273 | .011 |
| ETL | 10.417b | 3 | 3.472 | 6.059 | .000 | .047 |
| ECOC | .372 c | 3 | .124 | .480 | .696 | .004 |
| Intercept | PAL | 2358.663 | 1 | 2358.663 | 14568.818 | .000 | .976 |
| ETL | 2219.821 | 1 | 2219.821 | 3873.401 | .000 | .914 |
| ECOC | 2860.974 | 1 | 2860.974 | 11061.006 | .000 | .968 |
| Organization | PAL | .663 | 3 | .211 | 1.303 | .273 | .011 |
| ETL | 10.417 | 3 | 3.472 | 6.059 | .000 | .047 |
| ECOC | .372 | 3 | .124 | .480 | .696 | .004 |
| Error | PAL | 59.093 | 365 | .162 |  |  |  |
| ETL | 209.179 | 365 | .573 |
| ECOC | 94.409 | 365 | .259 |
| Total | PAL | 2857.737 | 369 |  |
| ETL | 3007.329 | 369 |
| ECOC | 3505.923 | 369 |
| Corrected total | PAL | 59.726 | 368 |
| ETL | 219.596 | 368 |
| ECOC | 94.781 | 368 |

1. R squared=.011 (Adjusted R square=.002)
2. R squared=.047(Adjusted R square=.040)
3. R squared=.004(Adjusted R square=-004.)

Source: Own analysis based on field survey, (2021).

The row of the tests of between subjects effects in Table 13 which contains the independent variable,Organization, indicates that there is no statistically significant difference among the organizations in PAL (p=.273) and ECOC (p=.696). These two dependent variables have trivial size of difference which is .011 and .004 respectively. However, there is a perfect statistically significant difference among the studied organizations in their level of ETL (p=.000). The size of the difference stated as partial Eta squared is also .047 which could be approximated to .05 that meets Cohen’s medium level of effect size.

Results in the tests of between subjects effects exhibited that the MoE, FCSC, MoLSA and the NBoE have statistically significant difference in the case of ETL. To find out where that statistically significant difference in ETL lays among the organizations, a post hoc test with Tukey’s HSD was conducted. Table 14 demonstrates results of the multiple comparisons. Accordingly, there is statistically significant difference between MoE and NBoE (p=.015), FCSC and NBoE (p=.005). Whereas the difference in the level of ETL between NBoE and MoLSA is not statistically significant (p=.021).

**Multiple comparisons**

Table 14: Tukey’s HSD (Honestly significant difference)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | (I)  Organization | (J)  Organization | Mean d/f (I-J) | Std. Error | Sig. | 95% confidence  Interval | |
| Lower | Upper |
| ETL | MoE | FCSC | .0420 | .12328 | .986 | -.2761 | .3602 |
| MoLSA | -.0354 | .13553 | .994 | -.3143 | .3852 |
| NBoE | -.3123 | .10392 | .015 | -.5809 | -.0441 |
| FCSC | MoE | -.0420 | .12328 | .986 | -.3602 | .2761 |
| MoLSA | -.0066 | .13737 | 1.000 | -.3612 | .3479 |
| NBoE | -.3544 | .10632 | .005 | -.6288 | -.0800 |
| MoLSA | MoE | -0354 | .13553 | .994 | -.3852 | .3143 |
| FCSC | .0066 | .13737 | 1.000 | -.3479 | .3612 |
| NBoE | .3478 | .12031 | .021 | -6583 | -.0373 |
| NBoE | MoE | .3123 | .10392 | .015 | .0441 | .5805 |
| FCSC | .3544 | .10632 | .005 | .0800 | .6288 |
| MoLSA | .3478 | .12031 | .021 | .0373 | .6583 |

1. Based on observed means
2. The error term is Mean square (error)=.259
3. The mean difference is significant at the.05 level.

Source: Own analysis based on field survey, (2021).

Therefore, results of theMANOVA confirmed that NBoE and MoLSA are slightly better than MoE and FCSC in terms of the level of ETL. However, they do not have statistically significant difference in the levels of PAL and ECOC. Over all, it could be concluded that the studied organizations exhibit below average mean score levels in PAL and ETL. Though the total mean score for ECOC is 3.04, greater than the total mean scores of PAL (2.75) and ETL (2.74), it is still a little bit higher than the average.

**Conclusion and Recommendation**

**Conclusion**

Authentic leadership creates trustworthy relationship between leaders and employees of an organization. The trust employees have in their leadership and vice versa enable the organization to identify its real level of competence and commitment to implement organizational goals and objectives. Besides, authenticity born trust produces affective commitment of employees towards achievement of the organization’s objectives. Employees dedicate their sweat and blood to the organization’s success not because they ought to, but because they want to.

This study was aimed at analyzing the effect of PAL on ECOC with a mediating role of ETL. Findings show that PAL has positive and statistically significant direct effect on ECOC. Similarly, PAL has statistically significant positive effect on ETL. Besides, the indirect effect of PAL on ECOC with a mediating role of ETL is negative and statistically insignificant. However, the direct and indirect predictive effects of PAL on ETL and ECOC are very weak.

All of the studied organizations namely MoE, FCSC, MoLSA and NBoE have almost similar levels of mean scores on PAL and ECOC. However, a statistically significant difference was found out in the studied organizations’ level of ETL in which it was relatively higher in the case of NBoE.

Findings of this study are not consistent with findings of previous studies which indicated that PAL has significant positive effect on ECOC when it is mediated by ETL. The reason behind this difference is that the studied organizations are not applying authentic leadership in actual terms. Their leadership style is more aligned to the characteristics of transactional leadership where employees do not have trust in their leaders but, they are committed to organizational programs and goals as a result of the carrot and stick approach followed by transactional leaders. In other words, leaders of the organizations use strict follow up mechanisms to see whether employees are aligning with requirements of the planned change; and reward those who admit to the ongoing change and punish those who do not fully engage in implementing the launched organizational change. As a result, the organizations have lower levels of employee retention capacity. That is why majority of the employees they have are too young with few years of service.

Even though the studied organizations are identified as reform champions outshining in the federal public sector, absence of leadership authenticity and employees’ trust in leadership could make them incapable to retain committed employees and thrive via the rapidly changing internal and external environments.

**Recommendations**

Considering, the importance of authentic leadership in creating embedded trust between leadership and employees and its reciprocal effect to develop employee commitment; institutionalizing the authentic leadership approach should be considered as a viable option for public sector organizations to do away with the challenges and limitations they are facing due to unethical behaviour and corruption. This is so because public sector organizations are driven by the purpose to serve the public interest with honesty and integrity. Authentic leadership demand leaders to simultaneously be true to themselves, to their followers and the public. Hence, leaders versed with authentic leadership quality prioritize humanity over any other matter; they never manipulate their followers and voluntarily admit their failures. In organizations where authentic leadership style prevails, there is a trustworthy relationship between leaders and followers that could make them stand unified towards accomplishment of missions and objectives of their organizations. As a higher standard of good behavior, authentic leadership enables ethics and morality to bloom in the public sector. Since authentic leaders naturally prioritize public interest over their positions, they could easily be versed with real customer cantered service delivery.

Authentic leadership as a root concept includes servant leadership, transformational leadership, and spiritual leadership qualities. Hence, due to its comprehensive nature and its intimacy with the concept of democratic governance, academic institutions that teach leadership and governance should include authentic leadership in their leadership curriculums. Besides, institutions mandated to provide practical trainings and consultancy on leadership should train and consult leaders on the skills that enable them develop authentic leadership qualities and competences.

Since, authentic leadership is a recently developed leadership concept; further studies should be conducted to practically understand how authentic leadership could enhance employee retention and organizational performance, customer satisfaction and public trust on the government agencies.

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* 1. Research Quality in Higher Education Institutions (HEIs): Implications for Public Sector Transformation and Development

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# Abstract

In this era of accountability, HEIs are expected to maintain research quality and be frontiers of public sector transformation and development by way of using public ideas and evidences and testing them, generating deeper ideas and evidences; and delivering transformative outcomes- better services for the public, and invigorating development endeavors. This study investigated the practices of maintaining HEIs’ research quality taking three Ethiopian universities as a case. A mix of both quantitative and qualitative approaches was used to collect data using a questionnaire and interview guide questions.

*The results have shown that emphasizing quantity of research reports and/or publications, researching quality (while researching); research roundedness or situatedness quality; and methodological quality vis-à-vis the purpose of the study were the major practices prevailing at the three case universities. The practices, however, did not lead to systemic installation of ensuring quality; to usability of the findings by pertinent sectors; and to epistemic reflexivity to improve future researches by going beyond the number of research reports, publications, and citations. Pragmatic soundness, relevance to policies and practices, usability, fitness of- and for- purpose, and action-ability and/or applicability of research results in a real-world setting were, therefore, hardly achieved. The observed practices imply that research results of the HEIs could hardly contribute for producing quality evidences as the basis for authentic and informed decision making to transform public sectors to improve their efficiencies and productivities.It has, therefore, been recommended that Ethiopian HEIs should go beyond quantitative targets, fixations, dubious practices, and fragmentations. They should devise strategies for systemic installation to maintain academic research quality, to achieve fitness of- and for- purpose (usability), and stand answerable to taxpayers by adding values for the bucks and for the bungs.*

**Key words:** *Higher Education, Research Quality, Public Sector,Transformation, Development*

# Introduction

## **Conceptual and Theoretical Background**

Quality research is a driver to produce quality empirical evidences to enhance public sectors’ efficiencies and productivities. It is a tool to fine-tune pre-reform measures of performances in the effort to measuring public sectors’ performances, efficiency, and to isolating the effects of specific institutional reforms on efficiency from other external influences. It is also through quality research that evidences are generated to improve public sector performances by way of: 1) decentralizing political power and spending responsibility to low level constituencies, 2) putting in place appropriate human resource management practices, and 3) increasing the scale of operations mainly in the education and health sectors (Curristine, Lonti, and Joumard, 2007).

Particularly nowadays, following a growing interest in using research evidence to inform policies, practices, and transformation agendas, research quality has become an area attracting a lot of interest. Consequently, there is a heightened attention to care for the quality of research itself. Quality research is all about evidences, consistencies, and consensuses on purposefulness and standards of research undertakings and reporting. Consensus standards are needed to facilitate the knowledge translation process, as research quality and evidence must be assessed and deemed sufficient prior to dissemination and knowledge utilization initiatives (CIHR, 2004; Davis et al., 2003). Basically, there is a need to make sound inferences and valuable conclusions from analyses of data in any research. The ways of judging research quality and the criteria to use for that has, therefore, become a concern of researchers, policy makers, managers, supporters, and evaluators of the research activities regarding, implicitly or explicitly. This is because researchers can claim that their investigation is indeed a disciplined inquiry if they can set explicit quality standards to achieve (Dornyei, 2007) impact on policy, practice and public transformation.

This line of thought has come with the purpose to promote high standards, prompted by the desire to ensure efficient, effective and consistent use of the public/taxpayers’ money and to demonstrate accountability. The current accountability landscape also calls for moving beyond fixation practices with methodological quality, to address the ‘fitness for purpose’ of research (Boaz & Ashby, 2003) and ‘fitness of purpose’ itself.

Fitness for purpose refers to fitting customer specifications, needs, and priorities. It deals with quality as fulfilling the purposes or missions of all parties involved in and affected by the program and /or the services we render (Firdissa, 2009; Sallis, 2002).

For Jaroonkhongdach et al. (2014) the criteria for research quality are principal  
components of the process for creating research-based knowledge founded on epistemic quality. Epistemic quality for Grunwald (2011) involves providing and assessing the reasons for adopting, rejecting, or revising findings, views and/or perspectives so as to determine knowledge claim justifications and provide transparency and inputs for future undertakings. Epistemic quality also relates to engaged knowledge, which Bennet et al. (2015) considers as knowledge Proceeding- representing the process and action part of knowledge; experiential learning; living knowledge, and I-knowledge knowledge. I-knowledge is embodied within and informs practitioners’ practices in the world and are achieved by epistemic reflectivity which also transforms tacit knowing into explicit knowledge as can be seen from Figure 1.

Figure 1. Transforming Tacit into Explicit Knowledge (Firdissa, 2010: 73, adapted from McNiff, 2002: 102-103)

It is through explicit knowledge that deep knowledge which endows the practitioners with authentic understanding, meaning, intuition, insight, creativity, judgment, and the ability to anticipate the outcomes of their actions beyond the surface and shallow knowledge dealing respectively with simple information; and information that has some depth of understanding, meaning and sense-making; and yet lack profound understanding, meaning, intuition, insight, creativity, judgment, and the ability to anticipate outcomes of actions-all of which are basis for decision-makers to developed and integrate into their actions (Bennet et al. 2015).

Deep knowledge also sustains reflective rationality, which entails empowerment, ownership and commitment of the practitioners as opposed to the technical rationality that is based on the idea of power control and are produced through the technical interest in research centers and/or administrative offices (Firdissa, 2010).

Remarkably, public transformation requires authentically informed decision making, which could result from epistemic quality. Epistemic quality in turn brings reflective rationality resulting in living knowledge, I-knowledge, and engaged knowledge as can be seen form Figure 2.

*Figure 2: Interplay among epistemic reflectivity, epistemic quality, reflective rationality, empowered practitioners, living knowledge, I-knowledge, engaged knowledge, informed decision making, and public sector transformation*

As Jaroonkhongdach et al. (2014) further indicates several researchers in various disciplines such as Bryman (2006) in social science, Carter and Little (2007) in health studies, Creswell (2005) in education, and Shohamy (2004) in applied linguistics have attempted to propose their touchstones in judging research quality. These researchers, although working indifferent fields, share a common concern for research quality. The common concerns of these and others on the issue have contributed for the intent and actions of assessing research quality, which has eventually taken a paramount importance in academic communities as part of accountability.

The current public sector landscape in many countries, including Ethiopia, has shown a growing interest in and demanded a quest for accountability, transparency and value for money, particularly in education as it has a potential power for greater equity, mobility and social cohesion; and for enhancing skill formation and development it adds to human and social capital. From a research accountability perspective, such assessment can suggest recommendations to improve the conduct and value of research (Moyer & Finney, 2005, cited in Jaroonkhongdach et al. 2014). From a research utility perspective, it can help us be better informed of findings that can be useful for our practices. For instance, in education, research that is of quality can increase our understanding of learning and teaching (Kervin et al., 2006, cited in Jaroonkhongdach et al. 201), leading to improved teaching strategies or techniques.

Assessment of the quality of educational research is now playing an increasingly important role in determining the funding to support research and the work that public universities conduct. Several different national models of assessing educational research in higher education have evolved in different countries, with varying levels of consultation with the academic community. Some countries are contemplating to setup new systems or revising existing systems, others are continuing the status quo, but there overall seems to be an increased impetus to set up national systems of assessing research quality in all disciplines. In many countries universities are subsequently ranked according to research assessment exercises.Furthermore,  
individual academics are ranked (formally or informally) through such assessments, rankings that reflect what is usually only one component of their overall performance in a job that usually involves teaching and service or administration components as well (*Besley, 2009)*.

Assessing the quality of research brings to the fore a number of issues. One issue that emerges when assessing any form of research is defining what counts as research. Another issue involves who the research is intended for–the users, audience or stakeholders? A further issue is the form of measurement used, who conducts the measurement and the assessment, and what the results are used for (Ibid).

As the same source indicates, two kinds of evaluations are apparent when dealing with what counts as research quality. The first is the neoliberal with emphasis on individual performance and is linked to promotion and tenure– its knowledge workers are treated on an old industrial, factory type model. The newer model of formative evaluation utilizes peer review mechanisms and expert panels to shape knowledge cultures that implies a very different view of knowledge workers and knowledge institutions and can provide a feedback loop to researchers on strategic priorities and/or at critical levels. Other questions arise, such as to what extent does educational research inform teaching in higher education, and pedagogic practices in schools and how we think of and treat learners of any age–young people or adult learners. With the emergence of the knowledge economy, the diversity of what counts as research especially now that knowledge cultures and the creative economy have taken on increasing importance, there becomes a renewed emphasis and significance of the ‘soft’ social and human sciences (*Besley, 2009;* Peters & Besley, 2006).

This study, therefore, sets out to explore research groundedness/situatedness quality, research process/researching quality, and research results/presentation quality and driving implications to transform public sectors. In doing so, practices of maintaining research quality, views on- and factors affecting research quality have been given due attention. Whereas research process, results, practices, and factors affecting research quality seem the usual practice; research groundednes calls for clarification. Research groundedness deals with the level of sensitivity of the research to philosophical, theoretical, methodological, and conceptual contexts, settings and insights from which emergent propositions are drawn.

## **Problem statement**

There is research limitations-, and the available ones are inconclusive- with regarding research quality in higher education institutions in general, and their implications for public sector transformation and development in particular. Equally, judging the criteria and indicators for research quality is not a simple linear task. Consequently, measuring research quality is complex and involves an understanding of the history of science, the development of information and pertinent technologies, the increasing importance of the knowledge-based economy, the rise of global science, and the corresponding increasing imperative felt by higher education institutions and governments to find ways of measuring and benchmarking research quality both in national and cross-national terms (Besley, 2009).

As a result, installing systemic and sound assessment practices to maintain the quality of research has never been a simple linear task. It involves an understanding of the history of science, the development of information and pertinent technologies, the increasing importance of the knowledge-based economy, the rise of global science, and the corresponding increasing imperatives felt by institutions and governments to find ways of measuring and benchmarking research quality both in national and cross-national terms (Besley, 2009).

Consequently, there is far less consensus on how we might assess the wide range of research approaches employed by public policy researchers (Boa & Ashby, 2003), academics, and practitioners. This, then has resulted in contests over the differences of perspectives, disciplines, methodological approaches, and in some fields there is a lack of consensus as to what ‘counts’ as good quality research (Boaz & Ashby, 2003). Consequently, one specific sets of standards may not ensure academic research quality across disciplines and approaches; and strategies for making research reliable and valid may not be simply a technical issue but need consideration and justification (Jaroonkhongdach et al. 2014).

This is because, each research approach has its own views and standards of research and the variables that are studied in one research project may not be similar to the ones studied in another. It is, therefore, difficult to judge the quality of one by using the criteria of the others (Collingridge & Gantt, 2008; RCN, 2010).

Moreover, many previous studies that had looked at research quality were mainly from two perspectives: as a measure of research productivity and performance (e.g. citation analysis) and as a guide for research quality development, such as reviewers’ comments analysis (Jaroonkhongdach et al. 2014) rather than their effects on policy, practice and public sector transformation.

Notwithstanding the constraints, nonetheless, it is essential for academic researchers to have relevant quality benchmarks, and practical guiding criteria to establish their research quality considering ‘reliability’, ‘validity’, and the constructivist view of knowledge and perspectives, that is, the multiple meanings of individual experiences (Jaroonkhongdach et al., 2014).

Research manuals and guidelines of many higher learning institutions bear sets of standards, procedures, and aspects of effective research writing and/or reporting. They, in most cases, however, deal with general and mechanical issues of writing, rather than quality matters. In the same vein, the design and evaluation of academic research have been the exclusive preserve of academics who tend to judge research quality in terms of internal and external validity, reliability, generalizability, replicability, and positivistic perspectives rather than on pragmatic stances of research use, uptake and impact.

The practices of maintaining academic research quality in Ethiopian universities, therefore, look dubious, sporadic, inconsistent, and fixations to specific needs (like quantitatively reporting findings, and publications for graduation and/or promotion purposes) with little value in practice. Consequently, there is a doubt whether the observed practices have led to systemic installation of- and widespread debates and contests- about research quality within Ethiopian HEIs.

As a result, research findings reported by post-graduate students and by faculty members are judged differently by different examiners in different universities and/or institutions. The current answerability landscape, nonetheless, demands going beyond positivistic academic enterprises and addressing post-positivistic pragmatic stances wherein public concerns and goals are taken care of.

## **Objectives of the study**

The study aimed at investigating the practices of maintaining research quality in Ethiopian universities by way of exploring micro and macro level attitudes, practices and empirical evidences. More specifically, the *key summary words of each objective statement* include”

* practices of maintaining research quality;
* whether the observed practices have led to systemic installations; and
* publicity of research quality.

## **Basic Research Questions**

To achieve the objectives set out, the study tried to find answers to the following research questions.

1. What are the practices of maintaining research quality in Ethiopian universities?
2. To what extent the observed practices have led to systemic installation within the universities to achieving pragmatic purposes?
3. To what extent have issues of research quality been widespread/publicized and contested in Ethiopian universities?

# Methodology

Quantitative and qualitative data[[1]](#footnote-1) were collected from three purposively selected Ethiopian universities. For the sake of anonymity, the universities have been labeled as U1, U2, and U3. They were selected based on their age, and productivity in offering postgraduate programs. The main focus of the study was [academic research](https://www.lawinsider.com/dictionary/academic-research) carried out by post-graduate students and by teaching faculty members at the universities or affiliated institutions respectively as requirements for graduation and academic career development.

Two data gathering tools were utilized in the course of the research work: closed and open-ended questionnaire and an interview guide questions. The questionnaire was dispatched to 160 people in Colleges of Education and Behavioral Studies (CEBS), and Teaching of English as a Foreign Language (TEFL) at the three universities: U1(71), U2(46), and U3(43) that were selected using purposive and availability sampling techniques. The compositions of thepeople include postgraduate program (PGP) research instructors, directors, coordinators, thesis/dissertation examiners, and students; and journal assessors at the three universities. The reason for including journal assessors within the criterion was due to the fact that nowadays post-graduate students are demanded to publish their research findings in a journal article as a requirement to obtain educational qualifications; and faculty members are also required to publish their research findings in peer-reviewed journal articles as part of their career and to get promotion to the next rank.

The interview guide questions were presented to seven professionals (two research vice presidents, one each at U2 and U3; three research directors, one each at three universities; and two senior journal assessors- one each at U1 and U2).

Coding of the interviewees and that of the respondents was made as soon as the data were collected. In coding the interviewees, the interviewees and their respective universities were brought together: I1U1, I2U1; I1U2, I2U2, I3U2; and I1U3, I2U3 standing respectively for interviewees 1 and 2 at U1; interviewees 1, 2, and 3 at U2; and interviewees 1, and 2 at U3.

In the same vein, coding of the respondents was made by assigning numbers for those who properly filled in and returned the questionnaire. As just 143 respondents properly filled in and returned the questionnaire, codes were given: R1-R143 (i.e., R1-R64, R65-R105, and R106-R143 respectively to respondents from U1, U2, and U3).

Whereas the data gathered through the closed questions of the questionnaire were analyzed quantitatively, those gathered through the open ended questions of the questionnaire and by the interview guide questions were analyzed qualitatively. Basically, the qualitative data served to give meanings to the observed states of the affairs regarding the practices of maintaining academic research quality, and to add depth to the overall results and thereby “putting fleshes on the bones” (Dornyei, 2007: 39). Finally, an informal reconnaissance deliberations were made with three professionals presenting the results with a purpose to derive implications of the findings on research quality in the HEIs for public sector transformation and development. This was also supplemented with my own readings, experiences and reflections on the effect of quality research on public sector transformation and development.

In the overall deliberations and analyses, emphasis was given to [academic research](https://www.lawinsider.com/dictionary/academic-research), which is carried out by: a) post-graduate students with a purpose of reporting their results in a thesis and dissertation, and/or publishing in a journal article as a requirement to obtain educational qualifications; and b) by faculty members at universities or affiliated institutions as part of their academic careers and/or with the intent of publishing the results in peer-reviewed journal articles (Law Insider, nd. P.1).

# Results

Whereas 160 copies of the questionnaire were dispatched at the three universities, just 143 copies (64, 41, and 38 respectively from U1, U2, and U3) were properly filled in and returned. The return rate was 89%. Of the respondents, 124 (86.71%) were males whereas just 19 (13.3%) were females showing male dominance. This is a sign that the number of females is by far fewer than that of male counterparts in teaching as well as in research posts at HEIs in Ethiopia.

Qualification wise, the majority (56%) of the respondents were master’s degree holders, followed by doctorate degree (27%) holders; and the rest were studying for their doctoral degree. This shows that the respondents had exposures to academic research agendas, as completion of masters and above degrees demand intensive research study and research undertaking in Ethiopian context.

Whereas 116 of the respondents properly indicated their roles/posts within their respective universities, 27 did not do that.

Table 1: Respondents’ Roles/posts within their Universities

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | **Role/posts** | **Universities** | | | | | | |
| U1 | | U2 | | U3 | | sum |
| N | % | N | % | N | % |
| 1 | Graduate Research course instructors | 6 | 5 | 6 | 4 | 5 | 4 | 17 |
| 2 | Research/graduate program directors | 3 | 2 | 3 | 2 | 3 | 2 | 9 |
| 3 | Research/graduate program associate deans | 3 | 2 | 2 | 1 | 2 | 2 | 7 |
| 4 | Journal assessors | 5 | 4 | 5 | 4 | 4 | 3 | 14 |
| 5 | Graduate program students | 43 | 31 | 16 | 12 | 10 | 7 | 69 |
|  | Sum | 60 | 45 | 32 | 23 | 24 | 18 | 116 |

Table 1 shows that 60 (45%), 32 (23%), and 24 (18%) of the respondents were respectively from U1, U2, and U3 with a varying roles. As the Table further shows, 69, 17, 14, 9, and 7 were respectively graduate program students, graduate research course instructors, journal assessors, research/graduate program directors, and research/graduate program associate deans at the three universities. Of the 43 graduate program students at U1, seven were basically employees of other universities and pursuing their post graduate study at U1 when the data for this study were collected. Inasmuch as universities in the country have similar and/or comparable practices under national guidelines, this may have implication towards the results.

The predominance of U1, particularly on the number of graduate program students was due to the fact that it is the oldest and the largest learning institution in Ethiopia entrusted with training high level manpower for the economy and professionals working in the rest of the HEIs in the country.

Requested to indicate their years of experiences at their respective universities, 138 reacted and five was a missing system, as can be seen from Table 2 below.

Table 2: Respondents’ years of experiences at their universities

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Frequency | Percent |
| Valid | Under 3 | 24 | 17 |
| 3-6 | 38 | 27 |
| 7-10 | 35 | 24 |
| Above 10 | 41 | 29 |
| Total | 138 | 97 |
| Missing | System | 5 | 3 |
| Total | | 143 | 100 |

Table 2 Shows that 29%, 24%, and 27% of the respondents indicated that they had experiences of above 10, 7-10, and 3-6 years respectively at their respective universities. This shows that the respondents had moderate experiences to judge the practices and/or issues of academic research quality.

Moreover, five questions regarding the tasks/practices to maintain research quality were presented to the respondents to indicate their choices by circling “1” for *never* “2” for *sometimes*, and “3” for *frequently*. The results have been presented in Table 3 below.

Table 3: Practices of maintaining academic research quality in HEIs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SN | Tasks/practices | N | Minimum | Maximum | Mean | SD |
| 1 | Using Peer review of research proposals | 139 | 1 | 3 | 2.36 | 0.60 |
| 2 | Using Validation group/peer advice during the research process at critical stages | 139 | 1 | 3 | 2.20 | 0.64 |
| 3 | Validation by comparing different findings | 139 | 1 | 3 | 2.24 | 0.68 |
| 4 | Considering research as ‘fitness for purpose’ | 136 | 1 | 3 | 2.24 | 0.64 |
| 5 | Considering research as fitness of purpose | 135 | 1 | 3 | 2.16 | 0.75 |
|  | ***Average*** | ***138*** | ***1*** | ***3*** | ***2.24*** | ***0.66*** |

Table 3 shows that the minimum response was 1(Never) and the maximum was 3 (frequently). The result on average shows that the mean is 2.24 with SD of 0.66. The results fall almost close to “sometimes” and by far below “frequently”. This means, using peer review of research proposals, using validation group/peer advice during the research process at critical stages, validation by comparing different findings, considering research as ‘fitness for purpose’ for which it was designed, and considering research as fitness of purpose were practiced *sometimes*. Particularly, considering research as ‘fitness of purpose’, which deals with usability of the findings was the lowest with a mean of 2.16 and SD 0.75.

It has also been learnt from a further exploration during interviews that using double-blind assessors was the major practice for journal publications of the research findings of post-graduate students as a requirement to obtain educational qualifications, and that of faculty members as part of their career development. Similarly, using internal and external examiners for proposals and final presentations of theses, and dissertations of masters and PhD students respectively, and using colleague advices of faculty members’ research results were the traditional and customary practices to maintain academic research quality at Ethiopian HEIs. Even these practices were said to be infrequent, dubious, sporadic, and inconsistent across institutions and times.

Three of the interviewees argued that it was in rare cases to use competently professional external examiners for postgraduate proposal development and thesis presentations (I2U1; I2U2, and I2U3). Though this needs to have been substantiated with some sort of evidence, it is an indicative of disquiets regarding the selection of external examiners for graduate research proposal examinations.

They further indicated that efforts were made to give trainings to postgraduate program students, and staff on how to prepare proposals and conduct academic research. They, however, were not clear on how well maintaining academic research quality was specifically targeted by the said trainings. Two interviewees rather reiterated the customary practices that targeted quantitative reporting, journal publications, graduate program research undertakings, editorial, content (refereeing), and presentation qualities to be the training areas employed in many HEIs (I1U1, and I3U2).

Furthermore, a question on researching quality and epistemic reflexivity was presented to the respondents to indicate their common observations of the practices at their respective universities, as can be seen from Table 4.

Table 4: Researching quality Vis-à-vis Epistemic Reflexivity Practices

|  |  |  |  |
| --- | --- | --- | --- |
| Common Practices | | Frequency | Percent |
| Valid | Researching Quality | 58 | 41 |
| Epistemic reflectivity | 48 | 33 |
| Don't know | 24 | 17 |
| Others | 3 | 2 |
| Total | 133 | 93 |
| Missing | System | 10 | 7 |
| Total | | 143 | 100 |

Whereas 10 (7%) was a missing system, 58(41%), and 48(33%) respectively choose *researching quality*, and *epistemic reflectivity* as common practices at their universities, while 17% and 2% indicated respectively *don’t know* and *others*. The results have shown that researching quality (while researching) was given more importance than epistemic reflexivity. The fact that researching quality is valued highly implies that postgraduate students and faculty members exert utmost effort for completing their research undertakings and make very little conscious efforts to improve future research quality and uptake based on the current research findings.

Moreover, eight questions were presented to the respondents to order the prevailing perspectives and/or practices on academic research quality by writing *“1” for the highest, and “8” for the lowest.*

Table 5: Ranking the prevailing perspectives/practices on academic research quality

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Prevailing perspectives/practices: | Emphasis Rank | | | | | | | | Total |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | Research productivity/performance | 65 | 4 | 5 | 8 | 8 | 8 | 9 | 26 | 133 |
| 2 | Research presentation/writing up quality | 45 | 9 | 6 | 6 | 8 | 8 | 8 | 46 | 135 |
| 3 | Research groundedness/situatedness quality | 57 | 15 | 5 | 7 | 6 | 9 | 5 | 31 | 135 |
| 4 | Usability of research findings | 34 | 8 | 17 | 7 | 10 | 6 | 7 | 47 | 135 |
| 5 | The research methods used vis-à-vis purpose of the study | 54 | 21 | 5 | 11 | 10 | 5 | 1 | 28 | 135 |
| 6 | Methodological quality | 54 | 15 | 22 | 7 | 4 | 3 | 4 | 25 | 134 |
| 7 | Adequacy of reporting | 41 | 3 | 7 | 11 | 7 | 15 | 15 | 36 | 135 |
| 8 | Relevance to policy and practice | 35 | 7 | 9 | 6 | 9 | 7 | 11 | 51 | 135 |

As can be seen from Table *5; 65,* and 57 of the respondents indicated respectively thatresearch productivity/performance and research groundedness/situatedness quality stand 1st within the list. Furthermore, 54 of them chose research methods used vis-à-vis purpose of the study and methodological quality to stand first. The Table further shows that 45, and 41of the respondents respectively ranked research presentation/writing up quality, and adequacy of reporting to stand 1st in the list. On the extreme side, relevance to policy and practice, usability of research findings, and research presentation/writing up quality were rated last (i.e. 8th) in the list respectively by 51, 47, and 46 respondents.

The respondents were further requested to rank the extent to which views on academic research quality were widespread among pertinent university communities. They were requested to show their rankings on a scale ranging from 1 to 5, where, 1, 2, 3, 4, and 5 stand respectively for Very low, Low, Undecided, High, and Very high. As can be seen from Table 6 below, 103(72%) of the respondents properly reacted to the specific question.

Table 6: Degree of the prevalence of views on academic research quality among pertinent HEIs’ communities

|  |  |  |
| --- | --- | --- |
| Views on academic research quality | Frequency | Valid Percent |
| Very low | 16 | 16 |
| Low | 29 | 28 |
| Undecided | 25 | 24 |
| High | 30 | 29 |
| Very High | 3 | 3 |
| Total | 103 | 100.0 |

As can be depicted from Table 6, 29% and 28% respondents respectively rated the extent to which views on academic research quality were widespread among pertinent university community as high and low. Twenty four percent of the respondents also rated the case as *undecided.* The fact that 28%, 24%, and 16% (in sum 68%) of the respondents respectively rated as low, undecided, and Very low portends that the extent to which views on academic research quality were widespread among pertinent university communities was negligible.

Related to the above issue, a question on whether contests and/or debates about academic research quality were existing at among the university communities was presented to the respondents.

*Table 7: Presence of contests and debates on academic research quality*

|  |  |  |
| --- | --- | --- |
| Present? | Frequency | Valid Percent |
| Yes | 73 | 70 |
| No | 14 | 14 |
| Don't know | 15 | 14 |
| Others | 2 | 2 |
| Total | 104 | 100.0 |

As can be seen from Table 7, 70% of the respondents indicated their agreement that there were contests and/or debates on quality of academic research at HEIs. This indicates that the quality of research has become a debatable agenda of the day in in the three universities in particular and in almost all the universities in the country at large.

Finally, the results from the participants in the reconnaissance and my own readings, experiences and reflections on the issue have shown that public sector transformation and development for efficient performance in services, production and development demand quality evidences. The participants reiterated the findings that the inconsistencies, quantitative-driven, and skimpy epistemic reflectivity might not lead to achieve fitness of- and for- purpose; feed into bottom up initiatives; boos ownership from the side of lower-level leadership and employees; and contribute to administrative transformation of public sectors so as to improve their efficiencies and productivities.

# Conclusion and Recommendation

**Conclusion**

The study investigated the practices of maintaining academic research quality, whether the observed practices led to systemic installation of ensuring quality, and the extent to which issues of academic research quality were publicized and contested in Ethiopian HEIs. The results have shown that targeting research quantity and productivity; focusing on researching quality; and emphasizing research groundedness/situatedness quality, research methods used vis-à-vis purpose of the study, and methodological quality were the major prevailing perspectives and/or practices for maintaining academic research quality at the three universities. On the other hand, usability of academic research findings and their relevance to policy and practice; and considering research as ‘fitness of purpose which is about usability of the findings were negligible.

Moreover, the results have shown that views on research quality were moderately widespread among pertinent university communities, though not to the expected level, And yet, 70% of the respondents indicated that there were contests and debates about the quality of academic research quality at HEIs in Ethiopia.

Furthermore, using double-blind assessors/using anonymous assessors for journal publications of the research findings of post-graduate students as a requirement to obtain educational qualifications, and that of faculty members as part of their career and to count for promotions to the next rank were prevalent. Similarly, faculty peer reviews and advices at critical stages, examination of theses, and dissertations respectively of masters and PhD program students were the major practices of maintaining research quality in Ethiopian HEIs. Even these were said to be infrequent, dubious, and inconsistent across institutions and times. Cumulatively, there were bizarre and doubts in putting in place agreed upon procedures and practices of maintaining academic research quality at the three universities in particular and in Ethiopian HEIs at large.

More specifically, there were noticeable shortfalls in: a) considering academic research as fitness of purpose; b) applying academic research findings; c) maintaining academic research relevance to policy and practice; and d) practicing epistemic reflectivity. Moreover, the results have shown that even the observed practices of maintaining research quality did not lead to systemic installation of predictable and agreed upon sound procedures for maintaining academic research quality.

The fact that the respondents had masters and above degrees, and experiences of over 10 years at their respective universities shows that they had satisfactory level of acquaintance with-and understanding about-issues of academic research quality. Equally, the fact that pertinent communities within the universities including the researchers had moderate awareness and consequently engaged in considerable contests and debates about research quality further confirms that the respondents were acquainted with research environments and could judge the practices and/or issues of academic research quality. The respondents’ acquaintance with research environments was mainly due to their roles as post-graduate students as well as workers at universities (research course instructors, research program directors, research program associate deans, and journal assessors).

The observed acquaintances, nonetheless, had not been augmented with guarantying systemic installation and applicability of the findings to real world settings. More specifically, focusing on quantity, and researching quality (while researching); emphasizing research groundedness/situatedness quality; and methodological quality vis-à-vis the purpose of the study did not lead to u*sability of the findings, and* to systemic installation of ensuring quality, which is all about pragmatic validity*.*

Notably, the quantitative foci of post-graduate students’ and faculty members’ works respectively on meeting qualification- and career development- requirements were motivated by the neoliberal view, which is linked to promotion-and tenure-driven through quantity rather than quality.

Moreover, the practices did not enhance epistemic reflexivity to consider post-research possible uptakes to improve future researches by going beyond the number of research reports, publications, and citations. The researchers hardly made effort to provide and assess the reasons for their findings and/or knowledge claim. No evidence to enhance epistemic quality wherein the researchers are expected to provide and assess the reasons for adopting, rejecting, or revising findings, views and/or perspectives so as to justify their findings and provide transparency and inputs for future undertakings (Grunwald, 2011). By implication there is a tendency to consider their findings just as a product to be reported as a requirent. No evidence of enhancing engaging knowledge as process, as a lived knowledge, and an I-knowledge to transform tacit knowing into explicit knowledge; and eventually inform authentic and informed decision making to as the basis for transforming public sectors in right directions.

No or low conscious efforts were made after research works were completed to improve future research and to advance epistemological stances from the point of view of academic research. This, then, led to neglect the pragmatic roles of research results to further advance pertinent knowledge; to revive its relevance to policy and practice; to go beyond quantitative reports; and to validate research results by employing group/peer advices at critical stages during research processes, and in the end by comparing different findings with the purpose to ascertain research fitness for-and of- purpose intents.

The observed practices of maintaining academic research quality were full of inconsistencies, quantitative-driven, and targeted reporting and publications as end results with no/low epistemic reflectivity. There was no conscious effort for systemic installation, which in turn remained sporadic, lacked action-ability and/or applicability, and showed negligible concerns to further improve research findings. Concomitantly, publicity and contests about research quality were just surface symptoms, detached from pragmatic fitness for-and of- purpose, and there were negligible accountability moves for the bucks and for the bungs.

For the fact that the quality of research has become a debatable agenda of the day in in the three universities in particular and in almost all the universities in the country at large, practices of mainlining- and publicity of academic research quality have strong linkage shown with unbroken double arrow. On the other hand, there were weak linkages (shown by broken arrows) between the observed practices and systemic installation; between systemic installation and publicity and contests; and between the observed academic research quality and systemic installation and publicity. It can, therefore, be concluded that the observed practices to maintain, to install, and to contest research quality did not meet the intents that constitute the conception of 'quality' as *fitness for purpose*, which has been taken in Ethiopia at face value by the public and by policy makers.

In the same vein, the practices did not match with the f*itness of purpose* of research, which deals with practicality and usability of the research findings, uptake and impact in real life contexts. In both cases, the practices hardly fulfilled the purposes and expectations of all parties involved in and affected by the expected academic research quality. The foci of academic research in Ethiopian HEIs was, therefore, reporting and/or publishing for qualification- and career development-requirements. This, therefore, implies that research findings in Ethiopian HEIs are (in most cases) left on shelves and/or published for academic purposes without being put for utility as a return for investment and/or adding value for the betterment of policies and practices.

As a result, fixations, dubious practices, and fragmentations prevailed rather than systemic installation, devising strategies for maintaining academic research quality, and pragmatically achieving soundness and standing answerable to taxpayers’ investments by adding usable values.

Cumulatively, the trend entails a supremacy of technical rationality, which is based on the idea of power control and are produced through the technical interest in research centers and/or administrative offices, as opposed to the desired reflective rationality which entails empowerment, ownership and commitment of the practitioners themselves to generate authentic evidences for decision making.

# Recommendations

Basically, the efficiency and productivity of public service depend on authentically informed decisions backed by quality evidences. The findings, nonetheless, have shown inconsistencies, quantitative-driven, and skimpy epistemic reflectivity to enhance- and /or based on- epistemic quality in knowledge claims that in turn could put back stages for future research undertakings and deepening of knowledge. The case entails that the researchers lack engaged knowledge, experiential learning; and a living I-knowledge- knowledge embodied within and that informs their practices beyond reporting their research findings to administrative offices as a requirement.

In short, the results imply low epistemic reflectivity, low epistemic quality, and a supremacy of *technical rationality-*eventually leading to habituate externalized-, surface-, and shallow- knowledge resulting in dubious decisions and unpredictable happenstances (see Figure 3).

Figure 3: Backwash of observed level of epistemic reflectivity, epistemic quality, and a supremacy of technical rationality

By implication, with dubious decisions and unpredictable happenstances, it would be unlikely to achieve fitness of- and for- purpose of quality; to feed into bottom up initiatives; to boost ownership from the side of lower-level leadership and employees; and to contribute for the desired transformation of public sectors so as to improve their efficiencies and productivities. It has therefore, been recommended that:

1. the three universities in particular and all HEIs in Ethiopia at large should guarantee the quality of academic research for pragmatic usability and relevance to policy and practice towards public services transformation as a return to public investment;
2. university leaders should exert conscious efforts to enhance pragmatic academic research quality by considering formative research models in which case feedback loop is provided to researchers (faculty members and postgraduate students) on strategic priorities and/or at critical stages to achieve fitness of- and for- purpose. This calls for going beyond the accustomed practices of checking formats, and focusing on research productivity/performance (number of reports, publications, and citations);
3. the researchers along with their leaders should put in place predictable strategies for systemic installation for pragmatic validity, and epistemic reflectivity (post-research to improve future research) by going beyond quantitative reporting to its intrinsic merit and academic impact (an assessment of value through use); and
4. inasmuch as the current study is a derivative of the implications of HEIs’ research quality for public sector transformation and development, further studies could focus on the effect of paucity of quality research on public sector transformation and development.

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* 1. **The Influence of Organizational Culture on Employees’ Commitment in Civil Service Organizations: The Cases of Selected Cities in Ethiopia**

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***Abstract***

*The main objective of this study was to examine the influences of organizational culture on employees’ commitment with the mediating role employees’ job satisfaction. In order to achieve this objective, the study employed descriptive and explanatory research designs to describe the situation and examine the cause and effect relationship of the cases under the study respectively. For collection of data, the survey questionnaire was administered to 400 randomly selected employee respondents who were permanently working in the civil service organizations in the selected study areas. The data analysis has been executed using both descriptive and inferential statistics. The study has found that the practice of organizational culture in the civil service organization is at moderate level relatively with more customer orientation. In regard to employees’ job satisfaction, it was found at moderate level with 61% exhibited with more intrinsic scale compared to extrinsic ones which assures more job satisfaction of employees with nature of jobs they perform than the associated benefits. It was also noticed that the job satisfaction level of employees increases as the level of job grades raise up. The study also found that employees have higher affective commitment which reveals more emotional attachment to the organization compared to continuance and normative forms of commitment. The level of employees’ commitment increases as the job grades of employees goes up in the civil service organizations. The regression analysis reveals that organizational culture has significant influence on the job satisfaction and commitment level of employees in the civil service organization which was realized that the employees’ job satisfaction partially carries the influence of organizational culture to employees’ commitment. Therefore, it is very important for civil service organizations to give due attentions to the improvement of their current organizational culture and enhancing the job satisfaction of employees to get more commitment from employees for realization of the organizational goals.*

**Keywords**: *Organizational culture, Employees’ commitment, Job satisfaction, Civil service organization*

**Introduction**

Employees are the greatest resource in organizations and play an important role through their involvement and commitment to make the organization competitive (Sempane, Rieger & Roodt, 2002). Employees who are committed are liable to increase their performance and devote their time to the organization success. Organizational commitment is often described as the key factor in the relationship between employees and organizations (Raju & Srivastava, 1994). Satisfied employees by means of an affective orientation or a positive attitude, achieve a positive result in relation to his/her job, in general, or to specific personal aspects (Smith, Kendall and Huh, 1969) and they would being to try new ideas and could participate more in the decisions that need to be made (Kivimaki & Kalimo, 1994). This results in improved communication among employees and workforce support for the organization, organizational commitment and job satisfaction (Lok & Crawford, 2004). The existence of job satisfaction is the result of organizational culture that comprises new approach of leadership style, the value, and belief and perception practice in the organization. Organizational culture is the shared understanding of the beliefs, values, norms and philosophies of how things work in the organization (Wallach, 1983). Many organizational cultures are presented by the scholars to handle and manage different organizational situations. In regard to defining and discussing different characteristics of organizational culture, Cameron & Quinn (20110); Lok & Crawford (2004) mentioned some of the important characteristics of organizational culture, which should have to address the phenomena of organizational effectiveness success through the contribution of committed employees.

It can be also clearly realized that the success of organization can nearly always be ensured through the contribution of unreserved efforts of employees who are working within it. This is possible if the organization has employees who have been satisfied in their current jobs and show the highest commitment for ensuring their organizational competitiveness. It also shows that how strongly employees are involved in and identify with the organization highly depends on conducive culture being exercised within the organization (Awan & Mahmood, 2011). Moreover, the commitment of employees traced directly back to the good organizational culture practiced. Therefore, having effective and good organizational culture for the organization is critical to retain competent and committed employees to ensure the competitive survival of organizations. Also Awan & Mahmood (2011) depict that employee commitment can be affected by the quality of the leadership exercised, and culture practiced in the organization.

Every organization functions within a unique culture and it becomes more widely recognized in contemporary discussions of organizational effectiveness that managers and their subordinates have to develop understanding of their cultural contexts if their organizations needs to perform effectively (Cameron & Quinn, 2011; Harrison & Stakes, 1992). The main focus of the organization should be also how to relate organizations more closely with their cultural settings in order to enhance optimal performance. This requires the ability of organizations to satisfy their workers in order to increase their commitment to contribute for the optimal performance of their respective organizations. If the organizations fail to plan and lack ability to satisfy their employees, this may lead employees to frequently leave the organization which will lead a given organization always to have inexperienced employees that might lead to inefficiency and ineffectiveness in accomplishing its goals. Ideally, organizations are expected to have staff of well experienced and well educated experts to successfully perform and achieve their goals. In this regard, many researchers have discussed the positive aspects of organizational commitment and its effects on work productivity, motivation, turnover intention, and absenteeism, and that it is a powerful tool for employees and organizations to increase productivity and effectiveness (Kuvaas, 2006; Genevičiūtė-Janonienė & Endriulaitienė, 2014). However, the study by Bersisa, et al (2016) confirmed that most civil service institutions in Ethiopia have less satisfied employees with lower commitment as a result of poor remuneration and benefit packages to benefit and motivate them on the tasks they perform in their respective positions. This could make the public organizations to hold employees who are not committed and losing well experienced ones from time to time which is believed to adversely affect the competitive survival of organization in meeting the changing service demand of citizens.

Many studies were also investigating the relationship between organizational culture and organizational commitment which found that there a positive relationship between organizational culture and organizational commitment (Acar, 2012; Brewer & Clippard, 2002). Organizational culture has been identified as a major driver behind employee longevity (Desselle, Raja, Andrews, & Lui, 2018). A corporate culture was realized as a significant tool for improving organizational commitment, and the better the adjustment between stated and perceived values, the better the organizational commitment (Brewer & Clippard, 2002). In addition, Messner (2013)found that there was a positive relationship between organizational culture and organizational commitment, recommending the design of a corporate culture change strategy, in order to increase organizational commitment in India’s IT services. In regard to the relationship between organizational culture and employees’ job satisfaction, the study by Cameron & Freeman (1991) has found that organizational culture has a significant impact on several key organizational variables such as employee satisfaction, employee performance, turnover and so forth. Again, Dima et al (2019); Elizabet (2017); Ahn & Inanlou (2017) have studied the effects of organizational culture on employees commitment as well job satisfaction.

In aaddition,, in the body of literature, there is evidence that assures the impact of organizational culture on individual attitudes and behaviors of which job satisfaction has been shown to be directly impacted by organizational culture (Lund, 2003; MacIntosh & Doherty, 2010; Schein, 1985). Concerning the relationship between job satisfaction and employee commitment, Huang & Hsiao (2007) stated that job satisfaction is the precursor of commitment which may benefit both changing human behavior outcomes and increasing commitment. They further explained that people will be more committed to their work if they felt satisfied and appreciated.

Furthermore, Aamodt (2007) indicate that satisfied employees tend to be committed to an organization, and employees who are satisfied and committed are more likely to attend work, stay with an organization, arrive at work on time, perform well and engage in behaviors helpful to the organization success. The discussions on relationships of organizational culture, job satisfaction, and employee commitment lead to examining the mediating of these variables in the existing relationships. Girma & Tesfaye (2018) have also studied the effect of organizational culture on employees’ commitment with mediating role of job satisfaction in this relationship by considering employees in a public enterprise of Oromia Forest and Wild Life. However, all these studies did not systematically investigate whether the employee's job satisfaction plays a mediating role in the relationship between organizational culture and employee commitment in Ethiopian Civil Service organizations.

Therefore, it has been found as very essential to fill this gap by thoroughly examining whether the job satisfaction plays a mediating role in the relationship between organizational culture and employees’ commitment toward the achievement of the organizational goals. This study attempted to attain the following specific objectives:

* To identify the most dominant type of organizational culture practiced in the Ethiopian civil service organizations;
* To determine the level of employees commitment and job satisfaction in their current organizations;
* To examine the effect of organizational culture on employees’ job satisfaction and commitment; and
* To analyze the mediating role of job satisfaction in the effect of organizational culture on employees’ commitment.

# Methodology

This section deals with the methodology considered to meet the objectives of the study that comprise the approach of research that fits the intended purpose. In addition, it covers the target population and sample size, sampling techniques, methods of data collection and analysis techniques that to be applied in the study.

## **Research Design and Approach**

This study employs a combination of descriptive and explanatory research design in the way to align with the objectives of the study. A descriptive study was employed with the aim to describe the current practice of organizational culture, employees’ satisfaction, and commitment. The explanatory design was used to examine the factors that significantly explain the employees’ job satisfaction and commitment. The descriptive and explanatory research designs were accompanied with quantitative approach which is subject to rigorous quantitative analysis in a formal and rigid fashion (Kothari, 2004).

## ***Target population, Sample Size and Sampling Technique***

The population in this study comprises the employees who are currently working in selected civil service organizations in five selected cities of Ethiopia. Employees who are currently working in civil service organizations are sources of information to measure employees’ job satisfaction, commitment, an organizational culture. In order to ensure an acceptable standard, the sample size is determined by using the following proportional formula of Kothari (2004) since the targeted population is not clearly specified.

n = z2pq = (1.96)2 (0.5) (0.5) = 384

e2 0.052

Where;

n : sample size

P%: is the proportion belonging to specified category (positive response)

q%: is the proportion not belonging to the specified category (opposite response)

e = the margin of error, which is 5%.

Thus, the sample sizes of 384 with an additional 16 more respondents to compensate the missing respondents, which makes a total of 400 employees as a sample. In this study multi-stage sampling technique has been employed. At the first stage, cities are clustered as Western, Eastern, central and Southern and Northern of which representative clusters (Central, Eastern and Western cities) were selected by using simple random sampling technique (lottery method). To this end, five major cities such as Addis Ababa and Adama from Central cities, Dire Dawa, and Harar from Eastern Cities, and Assosa from Western cities have been selected. Secondly, five institutions have been selected from each city by using simple random sampling technique. In this regard, institutions of finance, labor and social affairs, transport authority, women, children and youth, education have been selected to identify the participant employees. At third stage, 80 permanent employees have been selected using systematic sampling technique from five institutions in each of the selected cities. However, finally 15 respondents did not return the distributed questionnaire, due to which the analysis has been executed on the basis of data properly collected from 385 respondents.

## **Methods of Data Collection**

For the collection of data in relation to employees’ satisfaction, a structured questionnaire of employees’ job satisfaction towards its intrinsic and extrinsic scales was used. The survey questionnaire was adapted by condensing 100 items of the Minnesota Job Satisfaction Questionnaire. For addressing the commitment level of employees, 24-items questions pertinent to three dimensions of commitment such as “Affective”, “Continuance” and “Normative” has been designed and used. In addition, data were collected from employees in regard to their current organizational culture with five dimensions using a questionnaire comprising of 29 items. The questionnaire used in this study was a 5 Point- Likert scale that has been translated from English into the local language (Amharic) for respondents to easily understand and give their responses accordingly. Trained enumerators were used to administering questionnaires for selected employee respondents in each of five cities.

## **Methods of Data Analysis**

After completion of survey data collection, the completeness of data have checked and then variables were properly coded and then entered in to SPSS to process the results. With help of SPSS, both descriptive and inferential statistical results were generated for the quantitative data. Using descriptive analysis such as frequency, measures of central tendency and dispersion, the study indicated the level of employees’ satisfaction and commitment, as well as the nature of organizational culture. For descriptive univariate analysis using mean values computed from the 5-likert scale, the study followed the decision rule recommended by (Andrew, 2017). To this end, the study used the following ranges of mean values for discussion in the discussions to the results of analysis.

Table 3.1: Decision rule for univariate analysis

|  |  |  |
| --- | --- | --- |
| Low level | Moderate level | High level |
| 1≤ Xi ≤ 2.5 | 2.5< Xi ≤3.5 | 3.5< Xi ≤ 5.0 |
| 20% ≤Xi ≤50% | 50% < Xi ≤70% | 70% < Xi ≤ 100% |

Source: Andrew (2017)

From the inferential data analysis, the study employed correlation analysis to assess the magnitude and directions of associations among variables in the study and multiple regression analysis models to examine the factors that significantly determine the employee's job satisfaction and commitment in civil service organizations. In addition, the study used mediation analysis to examine the mediating role of employees’ job satisfaction in the relationship between organizational culture and employees’ commitment. Furthermore, ANOVA has been applied to test the average satisfaction and commitment difference among employees of different categories and job grades (position levels) in the organizations.

# Literature Review

This section r covers the definitions for basic concepts, the organizational culture, job satisfaction, employees’ commitment and the mediating role of job satisfaction in the relationship between organizational culture and employees’ commitment.

## **Concept of Organizational Culture**

According to Schein (2004), organizational culture can be considered as what the organization has or what the organization is depending on whether it is being treated as a construct or a metaphor. Meanwhile, according to Moorhead & Griffin (2013), organizational culture is defined as a set of acceptable values is always right, which helps a person in the organization to understand the actions that are unacceptable and which actions are unacceptable and values are communicated through stories and other symbolic ways. According to Sashkin & Rosenbach (2013), elements of organizational culture include: Managing change, coordinated teamwork, goal achievement, customer orientation, and building strong culture.

***Managing change*: -** This area of action concerns how well the organization is able to adapt to and deal effectively with changes in its environment. All organizations are open, to some extent, to be influenced from their environments; that is what it means when we refer to organizations as "open systems." This fact has become even more obvious today, in times of rapid technological and social change, than it was in the past.

***Achieving goals*:** - All organizations must achieve some aims or goals for clients or customers. Having a clear focus on explicit goals has been proven repeatedly to have a very strong relationship to actual success and achievement.

***Coordinated teamwork***: - Long term organizational survival depends on how well the efforts of individuals and groups within the organization are tied together, coordinated and sequenced so that people's work efforts fit together effectively.

***Customer orientation*: -** While organizations often have specific product or service goals or a standard of quality or a type of product or service for which the organization is known, the crucial question is whether these internally-derived and defined goals match or fit with what clients or customers want of the organization.

***Cultural strength*: -** A strong culture will provide greater stability of organizational functioning. When the culture is based on values that do not support the functions of managing change, organizational achievement, customer orientation, and coordinated teamwork--or when the values actually work against the effective performance of these functions--then a "strong" culture might actually hamper organizational survival.

## **The Concept of Employees’ Job Satisfaction**

Job satisfaction can be defined as a positive effect towards employment (Mueller & McCloskey, 1990) and it is arguably a fairly stable evaluation of how the job meets the employee’s needs, wants, or expectations (Fisher, 2003). Job Satisfaction has been playing a leading role in management research (Petty et al., 1984; Fisher, 2003). Many studies share that satisfied employees will perform their work more effectively, which is the basis of many theories of performance, reward, job design and leadership (Shipton et al., 2006). In a simpler term, job satisfaction is ‘the extent to which people like their jobs (Peterson & Wilson1992). Besides, Saiyadain (2007) viewed job satisfaction as an employee’s end-state of feeling after accomplishing a task. This feeling may lead employee to have either a positive or a negative attitude towards the job. In this regard, Herzberg et al (1959) brought attention to the following two distinctive categories of employees’ job satisfaction in the workplace in relation to the theory of job motivation.

**Intrinsic factors:-** are matters related to the self-actualization of the worker, that is, the need for a sense of self-accomplishment on the job or, as commonly labeled, intrinsic job satisfaction. Intrinsic job satisfaction is derived from the composite of intrinsic factors experienced in the job. Intrinsic job factors are factors such as responsibility, self-defectiveness, skill development, and observed accomplishment associated with doing the work.

**Extrinsic factors:-** reflected by Ewen, Smith, Hulin, & Locke ( 1966); Warr (1991) as factors such as company policies, supervision, external rewards which are reflected in satisfaction with pay, and workload and define the external context and reward systems.

## **Concept of Employees’ Commitment**

Commitment has been defined and measured in many different ways O’Reilly & Chatman (1986) defined organizational commitment as “the psychological attachment felt by the person for the organization; it will reflect the degree to which the individual internalizes or adopts characteristics or perspectives of the organization”.

### *Models of Organizational Commitment*

According to Meyer & Allen (1991), organizational commitment reflects at least three general themes: “affective attachment to the organization”, “the perceived costs associated with leaving it” and “the obligation to remain with it”. These three approaches are referred to as “affective”, “continuance” and “normative” commitment. Common to these three approaches is the view that commitment is a psychological state that characterizes the employee’s relationship with the organization and has implications for the decision to continue membership of it. These psychological states also have different implications for work-relevant behavior.

**Affective commitment: -** refers to the employee’s emotional attachment to, identification with, and involvement in the organization. Employees with a strong affective commitment continue employment with the organization because they want to. According to Lerner (1982), the antecedents of affective commitment generally fall into four categories: (1) personal characteristics, (2) structural characteristics (organizational), (3) job-related characteristics, and (4) work experiences. Although various research studies have been conducted to link demographic characteristics such as age, tenure, gender, and education to commitment, the relations were neither strong nor consistent, the reason being too many variables such as job status, work rewards and work values moderating the relationship.

**Continuance commitment:** refers to an awareness of the costs associated with leaving the organization. The potential costs of leaving an organization include the threat of wasting the time and effort spent acquiring nontransferable skills, losing attractive benefits, giving up seniority-based privileges, or having to uproot the family and disrupt personal relationships Meyer and Allen, 1991. Apart from the costs involved in leaving the organization, continuance commitment will also develop as a function of a lack of alternative employment opportunities (Meyer & Allen, 1991).

**Normative commitment: -** reflects a feeling of obligation to continue employment. Employees with a high level of normative commitment feel that they ought to remain with the organization. Wiener (1982) suggests that the feeling of obligation to remain with an organization may result from the internalization of normative pressures exerted on an individual prior to entry into the organization (family or cultural orientation), or following entry (organizational orientation). However, normative commitment may also develop when an organization provides the employee with “rewards in advance” (eg paying college tuition) or incurs significant costs in providing employment (e.g. head-hunting fees or the costs associated with job training). Recognition of these investments causes employees to feel an obligation to reciprocate by committing themselves to the organization until the debt has been repaid (Scholl, 1981).

## **Relationship between Organizational Culture, Job Satisfaction, and Employees Commitment**

There are many studies investigating the relationship between organizational culture and organizational commitment that found there is a positive relationship between organizational culture and organizational commitment (Acar, 2012; Brewer & Clippard, 2002). Organizational culture has been identified as a major driver behind employee longevity (Desselle, Raja, Andrews, & Lui, 2018). A corporate culture is a significant tool for improving organizational commitment, and the better the adjustment between stated and perceived values, the better the organizational commitment (Brewer & Clippard, 2002). In addition, Messner (2013)found that there was a positive relationship between organizational culture and organizational commitment, recommending the design of a corporate culture change strategy, in order to increase organizational commitment in India’s IT services. In regard to the relationship between organizational culture and employees’ job satisfaction, the study by Cameron & Freeman (1991) has found that organizational culture has a significant impact on several key organizational variables such as employee satisfaction, employee performance, turnover and so forth.

Furthermore, in the body of literature, there is evidence that assures the impact of organizational culture on individual attitudes and behaviors of which job satisfaction has been shown to be directly impacted by organizational culture (Lund, 2003; MacIntosh & Doherty, 2010; Schein, 1985). Concerning the relationship between job satisfaction and employee commitment, Huang & Hsiao (2007) stated that job satisfaction is the precursor of commitment which may benefit both changing human behavior outcomes and increasing commitment. They further explained that people will be more committed to their work if they felt satisfied and appreciated.

In addition, Aamodt (2007) indicate that satisfied employees tend to be committed to an organization, and employees who are satisfied and committed are more likely to attend work, stay with an organization, arrive at work on time, perform well and engage in behaviors helpful to the organization success. The discussions on relationships of organizational culture, job satisfaction, and employee commitment lead to examining the mediating of these variables in the existing relationships. To this end, the study by Girma & Tesfaye (2018) stated that job satisfaction does act as a fully mediating role in the relationship between organizational cultures and organizational commitment and suggesting that effective improvement in job satisfaction is a critical aspect of the organizational success.

Commitment plays a large role in the decision-making process when deciding to continue or discontinue membership in the organization. Employee commitment also plays a role in organizational performance and effectiveness. Studies have shown a strong correlation between organizational culture, organizational commitment, and job satisfaction. However, all these studies did not systematically investigate how organizational culture can influence the job satisfaction and commitment of employees. In addition, whether the employees’ job satisfaction carries the influence of organizational culture to the commitment of employees was not yet well studied from the context of Ethiopian civil service organizations. Thus, this study examines whether the employee's job satisfaction plays a mediating role in the relationship between organizational culture and employee commitment in Ethiopian Civil Service organizations using the following framework.

**Employees’ Commitment**

**Organizational Culture**

* Managing change
* Achieving goal
* Coordinated teamwork
* Customer orientation
* Culture strength

**Employees Job Satisfaction**

# Figure 2.1: Conceptual framework of the study

*Source: Cameron & Freeman (1991); Girma & Tesfaye (2018); Huang & Hsiao (2007)*

# Results and Discussions

This section presents and discusses the major findings in relation to the research questions stated.

## **The Current Dominant Dimension of Organizational Culture Practiced in the Public Organizations**

This section presents the condition of organizational culture practiced in public organizations considering the five dimensions such as *managing change, achieving goal, coordinated team work, customer orientation, and building strong culture*. The actual practice from the perspective of each of these dimensions in the public institutions has been presented and discussed as in Table 4.1 below.

# Table 4.1: Summary of Organizational Culture Dimensions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dimensions | Minimum | Maximum | Mean | Percent (%) |
| Manage Change | 1.00 | 5.00 | 3.09 | 61.74 |
| Achieving goal | 1.00 | 5.00 | 3.08 | 61.59 |
| Coordinated team work | 1.00 | 5.00 | 3.13 | 62.60 |
| Customer Orientation | 1.00 | 5.00 | 3.16 | 63.18 |
| Building strong culture | 1.00 | 5.00 | 3.11 | 62.18 |
| Composite mean –Organizational culture |  |  | 3.11 | 62. 26 |
| Number of Participants = 385 | | | | |

Source: Field survey, 2021

Table 4.1 clearly shows that the aggregate organizational culture of public organizations has been found on average 3.11 (62.26%) which is at moderate level which requires more efforts to strengthen in the future. The study also found that relatively customer orientation dimension of organizational culture has been mostly practiced in public organizations compared to other dimensions. This implies that civil service organizations are on the way of directing their service delivery with the focus of their customers.

## **Employees Job Satisfaction**

In order to measure the overall job satisfaction level of employees, the MSQ standardized questions were used with composite score of the 36 items in which two subscales such as intrinsic and extrinsic were considered. The intrinsic satisfaction scale was measured using 15 items under 5 dimensions that measure feelings of employees about their job tasks and for the extrinsic satisfaction scale, 21 items under 6 dimensions were considered.

### *Intrinsic Satisfaction Level*

Intrinsic factors are matters related to the self-actualization of the worker, that is, the need for a sense of self-accomplishment on the job. Intrinsic job satisfaction measures feelings of employees about the nature of their job tasks (Johnson, 2004). In the study this feeling of employees was measured with the use of 15items under 5 dimensions. Thus, table 4.2 below presents theintrinsic satisfaction level of employees that was computed with the use of these dimensions.

# Table 4.2: The Intrinsic job satisfaction level employees

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Dimensions* | Minimum | Maximum | Mean | Percent (%) |
| Ability utilization | 1.00 | 5.00 | 3.15 | 62.92 |
| Achievement | 1.00 | 5.00 | 3.12 | 62.48 |
| Recognition | 1.00 | 5.00 | 2.67 | 53.39 |
| Responsibility | 1.00 | 5.00 | 3.21 | 64.27 |
| Advancement | 1.00 | 5.00 | 3.15 | 62.99 |
| Composite Mean- Intrinsic satisfaction | 1.00 | 5.00 | 3.06 | 61.21 |
| Total Participants =385 |  |  |  |  |

Source: Field survey, 2021

Table 4.2 portrays the intrinsic job satisfaction level of employees in the organization where they are currently working. In this regard, the overall intrinsic satisfaction of employees has been found 61.21% which can be labeled as moderate. This in general implies that the feelings of employees toward the nature of their job tasks is at moderate level which requires attention to improve the situation to advance the satisfaction level of employees. Among five dimensions of the intrinsic satisfaction, the responsibility dimension has been rated relatively high with 64.27%. This implies that the practices of making employees being responsible for planning their job, provision of chance to them to make decision on their own and permitting employees to work alone on the job without regular supervision by officials relatively good that to be strengthened to the future. On the other hands, the situation in recognition dimension of intrinsic satisfaction has been rated low. This clearly reflects that the way organizations give credit and recognition for the work employees performed need further improvement and attention to enhance the satisfaction of employees on the basis of their successful accomplishment. This is due to expectation of employees for feedback from their immediate supervisor to know whether they are considered as performed well and one of the factor that determine their job satisfaction (Lester, 2013).

### *Extrinsic job satisfaction*

Extrinsic job satisfaction measures feelings about external aspects of the job and mainly related with external factors such as company policies, supervision, and reward systems in relation to the job tasks (Kalleberg, 1977). In this regard, the study adopted 6 dimensions that measured with use of 21 items to examine the extrinsic satisfaction level of employees as presented in Table 4.3.

# Table 4.3: Extrinsic Satisfaction level of employees

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dimensions** | Minimum | Maximum | Mean | Percent (%) |
| Company policies and practices | 1.00 | 5.00 | 2.89 | 57.96 |
| Compensation | 1.00 | 5.00 | 2.59 | 51.91 |
| Coworker | 1.00 | 5.00 | 3.64 | 72.76 |
| Supervision-human relationship | 1.00 | 5.00 | 3.19 | 63.99 |
| Supervision-technical | 1.00 | 5.00 | 3.07 | 61.34 |
| Working conditions | 1.00 | 5.00 | 2.79 | 55.86 |
| ***Composite mean-Extrinsic Satisfaction*** | 1.00 | 4.65 | 3.032 | 60.64 |
| Total participants= 385 |  | | | |

Source: *Field survey (2021)*

Table 4.3 indicates 60.63% level of the overall extrinsic satisfaction of employees which can be rated as moderate level. The extrinsic satisfaction of employees with the co-worker dimension is relatively the highest with 72.76%. This implies that the current spirit of cooperation among employees, and the chance to develop friendliness relationship in the organizations make employees satisfied. On the other hand, the compensation, working condition and organization policy dimensions of extrinsic satisfaction are relatively low with the 51.91%, 55.86% and 57.96% respectively. Unless improvements are made on these dimensions, these could negatively influence the overall satisfaction of employees in the organizations.

### *Overall employees job satisfaction*

An overall satisfaction measure is a degree the feelings of individual with the all dimensions of intrinsic and extrinsic satisfaction scales. According to Johnson (2004), combinations of intrinsic and extrinsic rewards predict levels of job satisfaction and influence employees’ decisions to remain in the profession. In this regard, Table 4.4 below presents the overall satisfaction of employees that comprise both intrinsic and extrinsic scales.

# Table 4.4: The overall job satisfaction of employees

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Minimum | Maximum | Mean | Percent (%) |
| Overall employees job satisfaction | 1.00 | 4.82 | 3.05 | 61.00 |
| Total participants = 385 |  | | | |

*Source: Field survey, 2021*

Table 4.4 depicts 61% of the overall employees’ job satisfaction which is at moderate level. This shows that organizations have to exert more effort to increase their employees’ satisfaction to increase organizational performance. The job satisfaction of employees has been examined by their employment category and position level in table 4.5 and 4.6 below to see if there are significant variations.

Table 4.5: Satisfaction of employees by job category

|  |  |  |
| --- | --- | --- |
| Employment category | Mean | Percent (%) |
| Expert | 3.23 | 64.6 |
| Leader | 3.05 | 61 |
| Other | 2.96 | 59.2 |

Source: Field survey, 2021

Table 4.5 shows that the satisfaction level of leaders has been found 61% which is less than that of expert (64%) though more than others (59.2%). However, this difference is not statistically significant at 5% significance level as shown below in Table 4.6.

Table 4.6: ANOVA Test Result on Overall Employees Job Satisfaction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | .656 | 2 | .328 | .499 | .607 |
| Within Groups | 250.218 | 381 | .657 |  |  |
| Total | 250.873 | 383 |  |  |  |

Source: Field survey, 2021

Table 4.6 presents the ANOVA test result for the difference in overall job satisfaction among employees of different categories. Accordingly, it was confirmed that there is no statistically significant difference among employees of expert, leaders and other categories in their overall job satisfaction at 5% significance level (Sig = .607 > 0.05). In addition, the employees’ job satisfaction has been analyzed and tested on the basis of the position of employees in the surveyed organizations as follows.

Table 4.7: Employees’ job satisfaction by the level of positions

|  |  |  |
| --- | --- | --- |
| Level of positions | Mean | Percent (%) |
| Level I - Level IV | 2.58 | 51.6 |
| Level V - Level VIII | 3.03 | 60.6 |
| Level IX -Level XII | 3.04 | 60.8 |
| Level XIII & Above | 3.24 | 64.8 |

Source: Field survey, 2021

Table 4.7 shows the overall job satisfaction level of employees by their level of positions. In line to this, the overall satisfaction level of employees increases as the level of position increases. It increases from 51.6% at level I - level IV to 64.8% at level XIII and above. This implies that the establishment of systems of employees’ promotion from one level to the subsequent level can increase satisfaction to employees. This difference has been tested by using ANOVA and has been found statistically significant at 1% significance level as depicted in Table 4.8 below.

Table 4.8: ANOVA Test Results for the Difference of Overall Employees’ Job Satisfaction among their Levels

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Overall employees job satisfaction | | | | | |
|  | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 10.210 | 3 | 3.403 | 5.374 | .001 |
| Within Groups | 240.663 | 380 | .633 |  |  |
| Total | 250.873 | 383 |  |  |  |

*Source: Field survey, 2021*

## **The Level of Employees’ Commitment**

According to Meyer and Allen (1997:3), commitment can be defined as “a psychological state that characterizes the employees’ relationship with the organization and has implication for the decision to continue membership in the organization”. Most organizations, especially service providing institutions are facing the challenges of getting committed employees who are competent and ready to give in their best in the pursuit of the objectives of the organization. Sharma and Bajpai (2010) assert that the high levels of effort exerted by employees with high levels of organizational commitment would lead to higher levels of performance and effectiveness of both the individual and the organizational performance levels. In this regard, this study has examined the level of employees’ commitment considering three elements such as Affective, Continuance, and Normative dimensions as discussed hereunder. In this regard, the perception of respondents from the three dimensions has been computed and presented in Table 4.9 as follows.

# Table 4.9: Aggregate employees’ commitment

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Minimum | Maximum | Mean | Percent (%) |
| Affective Commitment | 1.00 | 5.00 | 3.61 | 72.2 |
| Continuance Commitment | 1.00 | 5.00 | 2.94 | 58.8 |
| Normative Commitment | 1.00 | 5.00 | 3.26 | 65.2 |
| Composite mean- Employees commitment | 1.00 | 5.00 | 3.27 | 65.4 |
| Total participants= 385 | | | | |

*Field survey, 2021*

Table 4.9 presents the summarized commitment level of employees in the civil service institutions. As a result, overall commitment level of employees has been found on average 3.27 or 65.4% which can be considered as moderate level. Among the dimensions of employees’ commitment, affective dimension with 72.2% has been found relatively the highest one which confirms that the employee’s emotional attachment and involvement in their current organization is promising. This can be also confirmed on the low level continuance commitment (58.8%) which implies that the attachment of employees to the organization is not on the basis of the gains received or not due to fear for cost of leaving. The commitment level of employees has been analyzed on the basis of the job category of employees as presented in Table 4.10 hereunder.

# Table 4.10: The Commitment of Employees by Job Category

|  |  |  |
| --- | --- | --- |
| Current employment category | Mean | Percent (%) |
| Expert | 4.00 | 80 |
| Leader | 3.28 | 65.60 |
| Other | 3.25 | 65.00 |

Source: Field Survey, 2021

The result above shows that the commitment level is higher for experts than leaders and other category employees (messengers, custodial, etc). This could be due to attachment of experts on to their jobs on the basis of their skill, knowledge and experience. This variation has been tested by using ANOVA and has been found statistically significant at 1% significance level as presented in Table 4.11 below.

Table 4.11: The ANOVA Test result on Variations of Employees Commitment across Job Category

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 4.399 | 2 | 2.199 | 4.908 | .008 |
| Within Groups | 170.732 | 381 | .448 |  |  |
| Total | 175.131 | 383 |  |  |  |

*Source: Field survey, 2021*

The test result clearly shows that the variation of employees satisfaction level across the job category is statistically significant at 5% significance level (Sig= .008 < .05).

**The Effect of Organizational Culture on Employees’ Job Satisfaction and Commitment**

This section discusses the influence of organizational culture on employees’ job satisfaction and commitment. The influence which organizational culture could impose on employees’ job satisfaction and commitment has been analyzed using the multiple regression analysis. This analysis has been executed separately considering employees’ job satisfaction and commitment as two different dependent variables though dimensions of organizational culture has been adopted as independent variables in both cases. Before running multiple regression analysis, preconditions need to be fulfilled. To meet this requirement, correlation analysis has been executed to check the association of each of independent variables among themselves and also with dependent variables (Table 4.13). The Multicollinearity problem has been also checked by using Variance Inflation Factor (VIF) and found its value less than 10 for all variables which ensure the absence of any problem in this regard. In addition, the adequacy of model was tested by employing ANOVA test before using the results for interpretation and found that the (Sig . < 0.05) confirms that the model is adequate by ensuring that the coefficient (B) is non-zero at least for one of the independent variables in the model (Table 4.14).

# Table 4.13: Results of Correlation Analysis

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Manage Change | Achieving goal | Coordinated team work | Customer Orientation | Building strong culture | Overall employees job satisfaction | Overall employees commitment |
| Manage Change | Pearson Correlation | 1 | .701\*\* | .757\*\* | .677\*\* | .674\*\* | .604\*\* | .640\*\* |
| Sig. (2-tailed) |  | .000 | .000 | .000 | .000 | .000 | .000 |
| Achieving goal | Pearson Correlation | .701\*\* | 1 | .776\*\* | .716\*\* | .712\*\* | .640\*\* | .641\*\* |
| Sig. (2-tailed) | .000 |  | .000 | .000 | .000 | .000 | .000 |
| Coordinated team work | Pearson Correlation | .757\*\* | .776\*\* | 1 | .808\*\* | .776\*\* | .628\*\* | .603\*\* |
| Sig. (2-tailed) | .000 | .000 |  | .000 | .000 | .000 | .000 |
| Customer Orientation | Pearson Correlation | .677\*\* | .716\*\* | .808\*\* | 1 | .842\*\* | .670\*\* | .623\*\* |
| Sig. (2-tailed) | .000 | .000 | .000 |  | .000 | .000 | .000 |
| Building strong culture | Pearson Correlation | .674\*\* | .712\*\* | .776\*\* | .842\*\* | 1 | .653\*\* | .637\*\* |
| Sig. (2-tailed) | .000 | .000 | .000 | .000 |  | .000 | .000 |
| Employees job satisfaction | Pearson Correlation | .604\*\* | .640\*\* | .628\*\* | .670\*\* | .653\*\* | 1 | .698\*\* |
| Sig. (2-tailed) | .000 | .000 | .000 | .000 | .000 |  | .000 |
| Employees commitment | Pearson Correlation | .640\*\* | .641\*\* | .603\*\* | .623\*\* | .637\*\* | .698\*\* | 1 |
| Sig. (2-tailed) | .000 | .000 | .000 | .000 | .000 | .000 |  |
| \*\*. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | |

The results of correlation analysis in the table shows that the response variables (employees’ job satisfaction and commitment) are significantly correlated with all predictors (dimensions of organizational culture) at 1% significance level. Correlation becomes significant here, since higher value of correlation coefficient represents better prediction of dependent variable with lowest possible errors.

According to Senthilnathan (2019), high level of multicollinearity (VIF ≥ 5) becomes possible, approximately when Coefficient of Correlation (r ) ≥ 0.9 (for positively correlated predictors) or r ≤ -0.9 (for negatively correlated predictors). However, in this study all predictors, to each other, have the coefficient of correlation (r) < 0.9, implies that the correlation does not cause the problem of multicollinearity. Hence, this confirms that interpretation can be possible with the correlation coefficient of the predictors on the outcome variable to examine the effects using the Multiple Regression Model. In order to perform the regression model, the Model summary has been checked to see what proportion of the changes in outcome variable is explained by the predictors included in the model. In addition, ANOVA table has been checked to ensure the adequacy of the model and ensured that the use of multiple regression model is adequate to predict the effect of predictors on outcome variable as indicated in the Table 4.14

# Table 4.14: Model Summary and ANOVA Result (Dependent variable: Employees’ Commitment)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model Summary** | | | | | | | | | | |
| Model | | | R | R Square | | | Adjusted R- Square | | Std. Error of the Estimate | |
| 1 | | | .720a | .518 | | | .512 | | .47257 | |
| **ANOVAa** | | | | | | | | | | |
| Model | | Sum of Squares | | | df | Mean Square | | F | | Sig. |
| 1 | Regression | 90.714 | | | 5 | 18.143 | | 81.239 | | .000b |
| Residual | 84.417 | | | 378 | .223 | |  | |  |
| Total | 175.131 | | | 383 |  | |  | |  |
| a. Dependent Variable: Overall employees commitment | | | | | | | | | | |
| b. Predictors: (Constant), Building strong culture , Manage Change , Achieving goal , Coordinated team work, Customer Orientation | | | | | | | | | | |

The model summary table confirms that 51.8 % of the variations in dependent variable (employees’ commitment) is explained by the predicator (organizational culture in terms of change management, achieving goal, coordinated teamwork, customer orientation, and building strong culture). In addition, the ANOVA table assures that the regression model is adequate to regress the response variable over the predicators. Furthermore, Table 4.25 below shows the summary of model and ANOVA result for the use of regression analysis to examine the effects of dimensions of organizational culture on employees’ job satisfaction.

# Table 4.15: Model Summary and ANOVA Result (Dependent variable: Employees’ job satisfaction)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model Summary** | | | | |
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .723a | .523 | .517 | .56258 |
|  | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ANOVAa** | | | | | | |
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 131.240 | 5 | 26.248 | 82.934 | .000b |
| Residual | 119.634 | 378 | .316 |  |  |
| Total | 250.873 | 383 |  |  |  |
| a. Dependent Variable: Overall employees job satisfaction | | | | | | |
| b. Predictors: (Constant), Building strong culture , Manage Change , Achieving goal , Coordinated team work, Customer Orientation | | | | | | |

The model summary in Table 4.15 indicates that 52.3 % of the variations in dependent variable (employees’ job satisfaction) is explained by the predicator (Dimensions of organizational culture). Besides, the ANOVA table result confirms that the regression model is adequate to regress the response variable over the predicators in the model. As a result, the following Table 5.16 summarizes and presents the result of regression analysis that indicates the dimensions of organizational culture that significantly influence the employees’ job satisfaction and commitment in the civil service organizations.

Table 4.16: The Results of Multiple Regression Analysis on Effects of Dimensions of Organizational Culture on employee’ Job Satisfaction and Commitment

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | **Employees’ Commitment** | | **Employees’ job satisfaction** | |
| t | Beta (β) | T | Beta (β) |
| (Constant) | 11.501 | 1.225  (.006) | 4.944 | .627  (.127) |
| Manage Change | 5.138 | .263\*\*\*  (.053) | 2.868 | .174\*\*\*  (.061) |
| Achieving goal | 4.330 | .200\*\*\*  (.046) | 3.795 | .209\*\*\*  (.055) |
| Coordinated team work | -1.363 | -.078  (.057) | -.352 | -.024  (.068) |
| Customer Orientation | 1.805 | .108\*  (.060) | 3.662 | .260\*\*\*  (.071) |
| Building strong culture | 3.042 | .167\*\*\*  (.055) | 2.413 | .157\*\*  (.065) |

*\*p< 0.1, \*\*p< 0.05, \*\*\*p< 0.01*

*Source: Field survey, 2021*

The regression analysis result shows the effects of dimensions of organizational culture on both employees’ job satisfaction and commitment. To this end, the three dimensions of organizational culture such as manage change, achieving goal, and building strong culture have statistically significant effect on employees’ commitment at 1% significance level, while customer orientation has the effect on employees commitment at 10% significance level. This clearly shows that the three dimensions such as **manage change**, **achieving goal** and **building strong culture** have high influence on the commitment level of employees in the civil service organizations. As it can be seen from the table, a one unit change of current change management effort of the organization can increase the commitment level of employees by 5.138 units when other factors remain constant. Again, a unit change in current efforts of achieving goals could increase the commitment level of employees by 4.33 units, while other factors remain constant. Besides, a unit change in current efforts of building strong culture would increase the commitment level of employees by 3.042 units, in the constant of all other factors.

In regard to the influences of dimensions of organizational culture on employees’ job satisfaction, manage change, achieving goal, and customer orientation dimensions of organizational culture have statistically significant effects on employees’ job satisfaction at 1% significance level, while the effect **building strong culture** has 5% significance level. By checking the regression coefficient ß, one could understand that the larger the value of ß is, the higher the effect of independent variables on dependent variable (Nunnaly, 1978). To this end, it is possible to understand that the influence of four dimensions of organizational culture such as manage change, achieving goal, customer orientation, and building strong culture have strong influence on job satisfaction level of employees. The results clearly show that a unit change of current efforts on managing change would increase the job satisfaction level of employees by 0.174 units when other factors remain constant. A unit change in current efforts of achieving goal could increase the satisfaction level of employees by 0.209 units, while other factors remain constant. In addition, a unit change in current efforts of customer orientation and building strong culture would increase the job satisfaction of employees by 0.26 and 0.157 units respectively.

Therefore, the regression analysis in general confirms that if no measures are taken to improve the current level of four dimensions of organizational culture such as manage change, achieving goal, customer orientation and building strong culture,the commitment and job satisfaction levels of employees will not be changed. Thus, the civil organizations have to give more attentions in exerting efforts in order to take initiatives to improve the indicated dimensions of organizational culture since these are the most significant factors in influencing the commitment and job satisfaction levels of employees.

## **The Mediation Role of Job Satisfaction in the Relationship between Organizational** **Culture and Employees Commitment**

The proposition that job satisfaction mediates the relationship between organizational culture and employee commitments was tested by meditation analysis techniques developed by Baron and Kenny (1986). To this end, Table 4.17 below presents a series of regression analyses performed to test this mediating role. In model 1, the result indicates that the aggregate organizational culture has a positive significant effect on the dependent variable/employee commitment (β = 0.626, P< .001). This assures that step 1 of the mediation analysis is fulfilled. Step 2 of the analysis provides evidence for a significant relationship between the independent variable and the mediator variable. The result of model 2 in the table below shows that aggregate organizational culture has a significant positive effect on job satisfaction of employees (β = 0.763, P< .001), indicating that step 2 of the mediation analysis is also satisfied.

# Table 4.17: Regression statistics for the employees’ job satisfaction as a mediator between the relationship of organizational culture and employee’s Commitment

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Model 1**  **(Path c)** | **Model 2**  **(Path a)** | **Model 3**  **(Path b &c’)** |
|  | Employees  Commitment | Job Satisfaction | Employees Commitment |
| Organizational Culture | 0.626\*\*\* | 0. 763\*\*\* | 0. 372\*\*\* |
|  | (0. 032)  t= 19.370 | (0.038)  t = 20.084 | (0.043)  t=8.718 |
|  |  |  |  |
| Job Satisfaction |  |  | 0. 333\*\*\* |
|  |  |  | (0.040)  t= 8.286 |
|  |  |  |  |
| \_cons | 1.321\*\*\* | 0.673\*\*\* | 1.097\*\*\* |
|  | (0.104)  t= 12.764 | (0.122)  t= 5.532 | (0.099)  t= 11.068 |
| *N* | 385 | 385 | 385 |
| *R*2 | 0.496 | 0.514 | 0.573 |

*Standard errors in parentheses*

*\*p< 0.1, \*\*p< 0.05, \*\*\*p< 0.01*

Model 3 in the above table indicates performing step 3 and step 4 of the mediation analysis simultaneously. Step 3 confirms that job satisfaction (the mediator variable) is significantly related to employee commitment (β = 0.333, P<.001). Once job satisfaction is entered into the regression, the effect of organizational culture on employee commitment is reduced from β = 0.626 to β = 0.372, which is step 4 of the mediation analyses. This represents a 40.58% reduction which implies that employees’ job satisfaction partially mediates the relationship between organizational culture and employees’ commitment in the civil service organizations.

## **Conclusion and Recommendation**

**Conclusion**

The main objective of this study was to examine whether the job satisfaction of employees carries the influence of organizational culture to on employees’ commitment. In line to this objective, the study has examined the dimensions of organizational culture practiced, the level of employees’ commitment and job satisfaction level of employees in the civil service organizations and drawn the conclusion as follows.

The practice of organizational culture in terms of managing change, goal achievement, coordinated team work, customer orientation and building strong culture were found at moderate level which yet requires more attention and efforts to bring change since the quality of work place in terms of organizational culture has paramount importance in any organizational setting. Concerning the job satisfaction of employees, the intrinsic satisfaction level of employees which measures feelings of employees about the nature of their job tasks, and extrinsic that measures feelings about external aspects of the job were found at moderate which imply much to be done to advance the job satisfaction level of employees in the civil service organizations. The job satisfaction of employees increase as the job grade increases and the difference has been found statistically significant. This informs that employees to be given opportunities of promotion to higher job grades or positions on the basis of their performance and experiences to get more satisfaction in their jobs.

It has been found that employees have relatively higher affective commitment than the continuance and normative dimensions which indicates that they have more emotional attachment with their current organizations than their feeling of economic benefits and obligations. Besides, it was noticed that the level of employees’ commitment increases as increase in their level of job positions or grades which has statistically significant difference. This indeed confirms that periodical promotion of employees to higher positions on the basis of their performance and experience can create more commitment. The study has also assured that the dimensions of organizational culture such as manage change, achieving goal, customer orientation and building strong culture have statistically significant influence on the employees’ job satisfaction and commitment. Furthermore, the employees’ job satisfaction has been found as playing a mediating role in carrying the influence of organizational culture on the commitment of employees.

## **Recommendations**

On the basis of the major findings, the following recommendations were forwarded.

* It has been noticed that the practice of organizational culture that enhances the quality of work place is at moderate level. Therefore, leaders in the civil service organizations have to work hard on improving the current conditions of organizational culture through:
* Managing change by having collective discussion with employees to convince them on importance of the change to the organization and employees to make them believe that their concerns and anxieties during periods of change are heard and taken into considerations.
* Measuring the performance of individuals and teams and rewarding them on the basis of how well goals have been achieved. In addition, it is very important to participate individuals and teams in defining specific goals of the organization to enhance goal achievement efforts.
* Focusing on resolving the problems of customers related with the services they receive to their satisfaction and develop the culture of recognizing those employees who show maximum efforts to satisfy customers.
* Building strong culture by allowing employees to have access to timely and accurate information about what is happening in the organization and the reasons these new events. Besides, employees should be encouraged to not compromise the organization’s policy and procedures to reach operational goals.
* The overall employees’ job satisfaction has been found yet at moderate level which requires more effort due to the fact that the performances of organization and employees commitment highly rely on their satisfaction. Therefore, it is imperative for organizations to make the adoption of organizational policies consistent at a time while making decisions that affect individuals, revising the compensation schemes on the basis of the life cost, and improving the work conditions by fulfilling all required work facilities.

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# 6.CROSS-CUTTING ISSUES

* 1. Audience Perception of Edutainment Roles of the Ethiopian Civil Service University Community Radio

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# Abstract

*The main purpose of this study is to assess the audience perception of edutainment role of Ethiopia Civil Service University Community Radio. Descriptive survey design* *was employed as a research approach. Relevant primary data was collected by interview and questionnaires from respondents selected by convenient and purposive sampling.* *Cluster sampling followed by proportional and random sampling techniques was used to select 382 survey respondents and purposive sampling technique was used to select 15 interview respondents*. *The data were analyzed using descriptive statistics and thematic analysis.*  *Findings indicated that almost all the community had very good perception towards the edutainment programs transmitted from the community radio. The radio program tried to cover many community events and interests. However, radio transmission signal quality is weak, and the programs transmitted from the community radio lacks sound clarity. The transmission time of the program is not suitable to the audience, since the audience are more likely to listen to the radio during early morning. Besides, air time allocation to different programs are not fairly allocated since more than 60% of the air time was devoted to entertainment programs.*

**Key Words:** *audience, perception, edutainment, community, community media*

## **Introduction**

Community radio is the third tier of media outlet alongside public and commercial media. It is a widely recognized sector to advocate the participation and representation of a specific community whose issues and concerns are under served and overlooked by commercial and public media (Rennie,2006). As defined by UNESCO, Community media is *“a non-profit service that is owned and managed by a particular community, usually through a trust, foundation, or association. Its aim is to serve and benefit that community. It is, in effect, a form of public-service broadcasting, but it serves a community rather than the whole nation”* (Fraser and Estrada,2001). This indicated that community media enables the local Community to produce and broadcast their own programs as well as participating in the operation of the radio station. Community media provide the communities with access to information and voice, facilitating community-level debate, information and knowledge sharing as well as providing input for the public to make an informed decision-making (Steven,2011).

Edutainment is the mixture of education with entertainment (Colace, et al.,2006). Various scholars defined edutainment in different ways. To mention a few, (Shulman and Bowen 2000) described edutainment as *to encourage entertaining learning with the way of interaction and communication, exploring by creating learning awareness, trial and error*. (Charsky, 2010), also stated that Edutainment is applied in order to teach learners how they should use their own knowledge, analyzing things that they learn, combining things that they perceive or evaluating things that they learn.

Ethiopian Civil Service University Community Radio (ECSUCR) was established to serve the university and the surrounding community for five hours per day. The radio station transmits information in the form of entertainment and education to the university and nearby community for the purpose of achieving political, economic, social and cultural development (Community voice,2019). program genres that are broadcasting in the station encompasses women programs, sport, research, health, cultural events, debate and discussion, entertainment, environment, and news. (Community voice,2019). In all these programs, audiences are at the heart of this community media.

The intention of every mass media is to disseminate information in the form of entertainment, information and education to its targeted audience. Hence, it is critical for media to consider and appropriately segment their target audience, in order to produce programs to the right audience. Onabajo (2002), assumed that more station knows about the demographic and psycho graphic information of its target audiences, the better chance they have at meeting their needs.

Media help to shape the perceptions and communication of the audience directly or indirectly (Croteau et al., 2009). People form perceptions according to what the media presents to them (McCombs & Maxwell, 2005). perceptions are affected by many factors. The study conducted by Severin (2001) stated that various psychological factors influence perceptions and they include past experience, cultural expectations, motivations, moods, needs and attitudes. Feldman (1999) also described perception as the sorting out, interpretation, analysis and integration of stimuli involving our sense organs and brain. Khan (2010) in his study found that community radio plays an important role in enabling the masses aware about their basic rights and duties. (Nadew and Gissila,2009) also conducted audience study survey and collect their feedback about the programs being transmitted on radio and found that there was a need of direct participation of audience in the program for effective community participation.

The study conducted by Amin (2010) on his part conducted a study on journalists’ perceptions and attitudes towards Arab media in Egypt. The study found that press freedom in Arab countries and the performance of Arab journalists are still threatened by a censorial political culture. Matthes (2011) also studied affective underpinnings of hostile media perceptions, focusing on exploring the distinct effects of affective and cognitive involvement in Austria. He found that affective involvement can explain the hostile media effect over and beyond cognitive involvement.

In Ethiopian context, some empirical studies have been carried out on assessing public perception on media. For instance, Netsanet, et al., (2018) conducted a study on audiences’ perceptions of informative programs broadcasted from Jimma Fana FM 98.1 radio station in Jimma and found that audiences had a positive inclination towards the informative programs aired from the media. The study conducted on media preferences and perceptions of instructors at Bahir Dar University found that instructors use news on daily basis (Bisrat,2014). Milkesa (2010) in his part studied the role of Zami 90.7 and Sheger 102.1 FM radios for social development in the capital city Addis Ababa. His findings depicted that programs transmitted by private FM radios are educative, entertaining, socially responsive as well as commercially profitable.

As far as to the researcher knowledge, there is no study which has been conducted on the audience perception towards edutainment role of community radio. Therefore, it is worthy to study the audience perception of ECSU community towards the edutainment role of ECSUCR. This research attempted to answer the following three research questions:1) What are the perceptions of the community radio audience on ECSUCR edutainment programs? 2) How do the audience evaluate the effectiveness of the edutainment programs broadcasted by ECSUCR? and 3) To what extent does the target audience listen to ECSUR?

# Methodology

## **Research Design**

The focus of the study is to assess the perception of the audience towards ECSUCR edutainment role. To obtain the necessary data for the study, descriptive survey design was used. Descriptive survey research is the most popular in communication research specially to study the opinion of the audience towards media programs.This method combines both quantitative and qualitative data to give us relevant and accurate information.. Bhattacherjee(2012) noted that survey is a research method involving the use of standardized questionnaires or interviews to collect data about people and their preferences, thoughts, and behaviors systematically. It is an ideal research design to measure the perception of the audience on the edutainment programs, broadcast by the community radio.

***Population and sampling Techniques and Instruments***

The population for this study is the listeners of the ECSUCR who are found inside the campus (staff and students) and around the campus (district 09 from Bole sub-city and district 11 from Yeka sub-city). The two districts were selected because they are nearby to the community radio and are also beneficiaries of the community services from the university. In order to know the total population for this study, the number of populations are collected from different sources. The list of employees is collected from ECSU human resource directorate, while the list of students is from the bi-annual magazine prepared by ECSU public and international relation directorate. However, the total population of the two districts are from the two districts administration office. The population inside campus is9,049(1,372 employees and 7,677 students) while the total residents around the campus is 49,472(23,492 residents live in district 09, Bole Sub-city and 25,980 residents live in district 11 Yeka sub-city). The total population is84,501.

In order to select participants for the study, different sampling techniques were employed. Participants from inside the campus was selected using cluster sampling method. The employee respondents were clustered based on academics and administration, and student respondents was clustered based on year of enrollment. Subsequently, individual respondents were taken proportionately. The selection of participants from the two districts was conducted based on convenient sampling.

The sample size of the respondents was calculated through Kothari (2004)formula.

n = z2.p.q.N/e2 (N-1) + Z2.p.q

n = (3.45)2 \*0.5\*0.5\*84,501 **/** (0.05)2 (84,501-1) + (1.96)2\*0.5\*0.5 = **382**

Table 1፡Summary of audiences’ Population and Sample

|  |  |  |  |
| --- | --- | --- | --- |
| Population and sample of the study area | | | |
|  | | Population | Sample |
| Inside the Campus | ECSU Staff | 1,372 | 9 |
| ECSU Students | 7677 | 50 |
| Around the campus | District 09, Bole sub-city | 23492 | 153 |
| District 11, yeka Sub-city | 25,980 | 170 |
| Total | | 58,521 | 382 |

Source: own survey,2021

Therefore, to carry out this study, a total of 382 participants will be selected from both inside the campus and around the campus listeners. So, a convenient sampling of 382 participants are our target population should be enough to give us the confidence levels what the researcher needs.

For an in-depth interview purposes, a total of 15 participants was selected purposely. The participants were drawn from volunteers working in the community radio, community radio staff and audience.

Data were collected through questionnaires and interviews. Questionnaires distributed to participants in order to assess the perception of the listening audience on the radio programs’ content, style, and timing of broadcasting and the effectiveness of the community radio to deliver edutainment programs to the community.

The interviews were conducted to media personnel and audience in order to get deep insight into how the community radio serve the audience; the perception of the audience on the community radio and the overall operation of the community radio.

Data obtained by questionnaires was analyzed using by descriptive statistics, and data collected through interview was analyzed using thematic analysis.

# Literature Review

## **Defining Community media**

The definition of Community radio can be defined differently by different media scholars. According to Tabing (2002), a community radio station is one that is operated in the community, for the Community, about the community and by the community. The author asserted that community radio is owned and controlled by the community and serving the community. Howley (2005) in his part defined community media as grassroots or locally oriented media access initiatives predicated on a profound sense of dissatisfaction with mainstream media forms and content, dedicated to the principles of free expression and participatory democracy, and committed to enhancing community relations and promoting community solidarity. In this definition, community media is emerged from dissatisfaction with mainstream media and to provide an alternative channel to the community. Similarly, Jallov (2012) described community radio as “…the voice of the voiceless and the space for alternative political and socio-cultural thinking and action.” This implies that the potential of the community media is the ability to be a voice for those who don’t have heard their voice in another media stations. Unlike commercial media which is the sole objective is to serve its audience with commercial purpose, community media can amplify the voice of the voiceless without looking for profit.

The World Association of Community Radio Broadcasters (AMARC) states community radio as “not-for-profit radio which serves the community in which it is located or to whom it is addressed, hence encouraging the expression and participation of the community in the station. AMARC stipulates three key elements of community radio as follows:

1) Not for profit.

2) Community ownership and control.

3) Community participation.

Although media scholars defined community media differently, most of them seem to agree on features such as geographical areas; active participation of the community in program production, media ownership and not for profit-making as well as the direct involvement of volunteers in different operations of the radio station.

Community radio described in different terminology. The term community radio is not uniform all over the world. For the most part, community radio is often called as ‘local’, ‘alternative’, ‘independent’, or ‘free’ radio (Fraser and Estrada, 2001). Whereas Europeans recognized as associative radio, free radio, neighborhood radio or community radio. In Latin America they refer to as popular, miner’s radio or peasant radio educational radio. Asians termed as radio for development and community radio. Oceanians recognized as aboriginal radio, public radio and community radio while in Africa they refer to local radio and bush radio (Mainali, 2008).

The term, ‘community’ is different to different authors. Mtimde et al. (1998: 12), defined as either a geographically based group of persons and/or a social group or sector of the public who have common or specific interests. “In Ethiopia, the Ethiopian Broadcasting Authority’s (EBA)directive for the operation of Community radio (2012), states a community as having a common interest that can be living in a specific geographical area or a group of people with common interests, who are not necessarily living in one defined territory such as higher education institutions.

Generally, Community Media is owned and controlled by the community, and enhancing public participation and giving access to the voices of the community; encouraging diversity, creativity. It is also giving a vital counterbalance to the increasing globalization and commercialization of the media. (Aqrabawi, Zaidah and Kuttab, 2006)

**Function of Community Radio**

Based on several scientific studies, AMARC conducted assessment on the effectiveness of community radio in 2007. Accordingly, community radio is effective in the following aspects:

* **Development goals achievement**. Community radio has added the advantage of attaining development.
* **Women Empowerment**. Community radio is to become the agent of social change at the grass root level. It encourages women to actively participate in their communities and to become citizens whose voices are heard
* **Ensuring proper governance**. Community radio is essential to ensure good governance. It enables the local community to question their leaders on matters related to their live hood.
* **Ensuring inclusion of the marginalized**. Community media helps to fulfill the information and communication needs of the marginalized society. It plays a crucial role in facilitating community level debate, encouraging public participation, facilitating inclusion and cultural diversity.
* Conflict resolution. Community radio play a key role in conflict prone countries to resolve conflict and to build peace.
* **Disaster prevention/relief**. Community media can play a very effective role in the management of disasters by educating people about consequences, hazard warnings, gathering and transmitting information about affected areas, and also alerting the government for rescue and relief.

To sum up, community radio gives the community to voice their own issues, concerns, cultures, traditions and languages. It also provides access to voices in the community and encourages diversity, creativity and participation.

## **Role of Media**

Based on the relevance of the content delivered, the role of the media includes providing education, entertainment, and information. Relevance requires that content be readily accessible and meaningful to broad segments of society and that the information delivered be adapted and disseminated in formats and languages that diverse social groups can understand and act on (Zulburti in Girard, 2003). Media play a crucial role of informing, educating and entertaining the audience for a long period.

*Information***:** - one of the main functions of the media is to inform the public by transmitting current news and information. There are regular news reports on TV and radio everyday all around the world.

*Education*: -media offers formal and informal education to the society.

*Entertainment:* - another important function of media is entertaining the audience. Most people watch television programs and listen to the radio programs for fun, which is how broadcasters attract a broader range of viewers besides informing news.

### *Edutainment*

It combines the words’ education with entertainment (American Heritage Dictionary) In other words, it is the mixture of education with entertainment (Colace, et al.,2006). The media are designed to educate the audience through entertainment. For the first time, the term was used by Walt Disney as early as 1954.It encompasses content uses to teach with entertainment. The dissemination of edutainment programs can be takes place either in classroom or media to influence viewers; opinion and behaviours. The goal of edutainment is to make learning enjoyable and fun. *(*Rapeepisarn, K.;Wong, K, et al.,2006). According to Shulman and Bowen (2001), edutainment is defined as to encourage entertaining learning with the way of interaction and communication, exploring by creating learning awareness, trial and error.

Edutainment can be organized either by purpose and content includes informal education which is to improve learners’ life control, and skills education which is to give experiences, like simulations or by target group includes motivation-oriented (learners who have same interest), and age-oriented (learners who have same age) *(*Rapeepisarn, K.; Wong, K, et al.,2006).

## ***Perception***

Media play a crucial role in offering education, entertainment, information to the audience and the public at large. This study is related to media’s edutainment role in the form of education and entertainment to the audience, specifically how the audience perceive and interact with the ECSUCR messages. This study includes a key element of audience perception. According to Nelson, Richard Alan (1996), perception can be defined as the process of attaining awareness or understanding of sensory information. It is the process of “receiving, collecting, and action of taking possession, apprehension with the mind or senses.” Lahlry (1991) in his part defined perception as the process by which we interpret sensory data. It is what people perceive about a certain event, issue, organization, state, or anything in a ray of knowledge, information, cultural background or experience. Diana (1989) discussed the role of perception in making public opinion and this is related to the perceptions of others which help and influence public opinion formation.

Severin (2001) depicted that perception is influenced by various psychological factors such as past experience, cultural expectations, motivations, moods, needs and attitudes. Due to these reasons, perception plays an essential role in making some issues important and some are unimportant. Different people react to the same message in a very different way, and this is all related to the process of decoding; that, how people process specific information. However, sometimes exposure to selective content on media plays a very significant role in making up perceptions towards certain issue, according to Turner and West (2007), Selective exposure “is a method for reducing dissonance by seeking information that is consonant with current beliefs and actions”. Since excessive amount of media choices are available currently, media consumers prefer to select medium and media contents supporting their position and needs over those supporting other positions. The Present study exclusively investigates how the ECSU community perceive the media contents produced related to edutainment issues; the extent of their perceptions match with the media role entertainment and education role to the ECSU and the surrounding community.

Media audiences also give specific attention to communication messages. As Folarin (2005) observes that human brain has to select which information to pay attention to at any given time in order to avoid confusion. In other words, if people are confronting unsympathetic material, they do not perceive it, or make it fit for their existing opinion.

He added that audiences tend to perceive and decode communication messages in the light of our previous experiences and current dispositions and our needs, moods and memories. This suggests that individuals who received a miracle after watching a televangelism programs would always want to tune in to such broadcast in the future. Again, relatives and friends who see such miracles or transformation in the life of the individual would likely identify when such broadcast comes again on air.

Media messages also perceived and retained where the messages are favorable to the self-image of the individuals. The relevance of the message to the social conditions of the individual would also affect his retention. Therefore, these processes which are linked influences the individual’s perception of the media station.

**Theoretical Framework**

Scientific studies on media and communication are complete if and only if they are guided by theories. The theories help us to describe, predict and find the link between audience and media. Therefore, the application of use and gratification, and it is important to discuss some important theories related to audience perception and media.

**Use and Gratification Model**

According to this model, audiences use the media for its own gratification. The audiences are active and not manipulated by the creator of media texts. The driving force behind audience’s consumption of media messages is individual users’ interest. (Webster, 1998). In this regard, media use mainly relies on the perceived needs, wishes, satisfactions and motives of the respective audience member (McQuail, 2003).

The use and gratification perspective can be viewed as more focused on what people do with the media; how media are used to satisfy cognitive and affective needs(Rubin,2002).Hence,this theory can be treated as what people do with the media rather than what media do to the people.The researcher understands that there is an active audience in Ethiopian Civil Service University community since majority of them are literate.

**Reception Theory**

In this theory, audiences are studied with respect to the meaning bring out from media product. In other words, it is how the audience understand the messages aired by media in relation to individual and societal backgrounds. The interpretation of media message is an integral part in this theory. “Interpretation is a process of negotiation between texts and audiences situated with specific social and cultural contexts.” (Fourier,2005). The interpretation of media messages is not carried out equally by media audiences. The differences come out from different factors. As William (2003) stipulated that audience ability to interpret media message is determined by a range of individual, social, cultural factors. Audiences also do not simply receive media messages even when the media is instrument in shaping attitude, opinion, and beliefs. Instead, people interpret media messages in the context of stored knowledge.

## **Background about Ethiopian Community Radio**

Many researches showed that the beginning of university or campus-based community radio was started in the U.S.A in the 1960s and was soon to spread to Canada, Europe and then to Africa. In Africa university radio stations first established in several universities across South Africa (Fraser and Estrada, 2001). Student radios are a form of Community Radio station serving institutional communities like organizations, universities and colleges.

Community Radio in Ethiopia is a very recent phenomenon relatively to the Community Radio history in the world. The idea of community radio traced back to 2002 symposium which was organized by Oxfam Canada in Addis Ababa under the theme of “promoting community radio in the Horn of Africa” (Ayele,2007). In the symposium, a hundred participants from eight countries participated and shared their experiences. Following the symposium, some groups tried to establish community radio in Harar, Sidama and Gulelie community radio before the formulation of policies and proclamations.

The practices of community radio pushed the government of Ethiopia to enact broadcast law in 2006. Following the amendment of the community radio proclamation, the Ethiopian Broadcasting Authority (EBA) issued the first license for Kore community which is founded in southern part of Ethiopia and broadcasted in 2010 (Getahun,2006). According to EBA (2018) report, 50 community media received license from EBA. Nine of them including Ethiopia Civil Service University Community Radio are higher education institution and the rest are geographical based community radio.

**Ethiopian Civil Service University Community Radio**

ECSUCR got its license from Ethiopian Broadcasting Authority in April 2011 and begun broadcasting in April,2016(ECSU community voice,2019). The ECSUCR serving the community with in and around the university for five hours per day. The radio license is issued under Broadcasting Proclamation No 533/07 Article 16 radio broadcasting license and registered under No 33/2003 with ownership of community radio allotted frequency of 100.5. The radio station has a social agenda and deals with local issues which are not covered by public and commercial broadcasting. The radio station transmits information in the form of education, entertainment and education to the university and nearby community for the purpose of achieving political, economic, social and cultural development” (Community voice,2019).

According to ECSUCR manager, Mrs. Mehret Kassa,the community radio begun its work with four staff members. After the university appointed a manager for the community radio, the numbers of voluntary staffs were increased and the programs went into air also increased to around nineteen. During that time, the university motivated voluntary staffs through transport allowance and short-term training programs. However, after 2017, the number of voluntary staffs were reduced following the ECSU management decided to stop transport allowance payment to voluntaries who come from different parts of Addis Ababa. Subsequently, the number of programs were also reduced by more than half(eight). Currently,9 programs including daily news went into air by five permanent and three voluntary staffs (Mrs. Mehret Kassa, Personal Interview, February 25, 2021). The program genres that are broadcasted from the station encompasses women programs, sport, research and study, health, wisdom buffet, ethio-hut, let’s consult, entertainment, environment, and daily news. (Community voice,2019). In all these programs, the targeted listening audiences are at the heart of this community media. An important consideration here is when the ECSUCR presents edutainment programs to its listening audience, how the listening community perceived and influenced by the contents delivered by the community radio.

According to the manager, the community radio has its own board of directorate leading by the university president. The board of the community radio is quite different from the university senate. However, the department of community radio is not directly accountable to the board of directorate since the community radio is organized under community service directorate in research and community service wing.

Chart1: Organizational structure of Community Radio

Chart one indicated that the organizational structure is too tall. Many numbers of levels leading the department. This might take long time for those who need urgent decision-making at the highest-level management. The department also lacks manpower and certain important equipment to offer high-quality broadcasting service to its audience. These limitations might have their own negative effect on its program production process.

# Data presentation and Analysis

### Demographic Profiles of the Respondents

The demographic characteristics of the respondents (sex, age, occupation and educational qualification and marital status) were presented below. Nearly two third (68%) and 32% of the respondents were male and female, respectively. Around two third (64%) of the respondents are single and the rest (36%) are married. With regard to occupation of the respondents, 33% and 26% of the respondents were civil servants, students and self-employee respectively and the remaining 10% are unemployed. Respondents also further requested the educational qualification. In responding to this item, respondent have varying levels of educational status ranging from primary education to third degree education. However, majority (68%) of the respondents have first degree.

Table 4.1. Demographic Profiles of Respondents

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sex | | Age | | | | Marital Status | | | | Occupation | | | | | Education | | | | | |
| Male | Female | 18-25 | 26-30 | 31-35 | >36 | | Single | Married | Divorced | | Civil servant | student | Self-employee | others | | primary | High school | Diploma | 1st degree | 2nd degree and above |
| Respondents in Percent | 68 | 32 | 14 | 37 | 31 | 18 | | 63.47 | 36.53 | - | | 36 | 33 | 26 | 10 | | 8 | 9 | 10 | 68 | 5 |

Source: Own survey, 2021

The above table indicated that 68% were male while 32% were females and most of the respondents within the age groups of 26-30 years and 31-35 years. The educational background of these respondents ranged from high school to PhD level and most of the respondents were civil servants and students.64% of the respondents are single and the rest36% are married.

**Weekly Program Genre and Time Coverage**

The program genre is a good indicator to determine the types of programs aired by the community radio. The station has 5 transmission hours (from9:00 AM to 2:00 PM) per day, even though the Ethiopian Mass media Authority awarded fourteen hours airtime. Nine programs including daily news are broadcasting from the community media. In terms of their role, all these programs fall under the category of information, education and entertainment.

Table2: Weekly Program Genre and Coverage of ECSUCR

|  |  |  |  |
| --- | --- | --- | --- |
| No | Program Genre | Broadcasting Time/week) | Coverage in Percent |
| 1 | Information | 6:30 | 18.58 |
| 2 | Education | 7:00 | 20 |
| 3 | Entertainment | 21:30 | 61.42 |
| 4 | Total | 35hours (2100 minutes) | 100 |

Source: Own survey, 2021

As presented in the above table2, more than 60% of the programs were failed under the category of entertainment genre;20% educational and the rest 19% in daily news and information. This shows that the station has many free times and the free times are covered by music.

## **Frequency of Media Consumption**

Table 3. Frequency of Media Consumption

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Questions | | | | | | | | | |
| Do you listen to ECSUCR? | | | How frequently do you listen ECSUCR? | | | | When do you tend to listen radio? | | |
| yes | No | Sometimes | Daily | Once a week | Monthly | Specify others | Morning | Afternoon | Evening |
| 20% | 45% | 35% | 25% | 35% | 28% | 12% | 27 | 20 | 54 |

Source: Own survey, 2021

As table 3 revealed that nearly half of the respondents (45%) didn’t listen to ECSUCR and 35% of the respondents listen to the station sometimes and the rest 20% of the respondents listen to the community radio. During the interview conducted with the audiences, almost all the interviewee said that *“they are not aware of the existence of the station and some of them know but busy with work and education during the time of transmission*”. The manager of the community media also shared the same concern. She said that “…even though *we have nice programs relevant to the need of the community, I am afraid we are not listened by the community”*

Regarding the frequency of listening to the community radio, 25% of the respondents tune into the community radio daily;35% of respondents listen the station once a week;28% of respondents replied that they listen once per month, and 12% rarely listen to the radio station.

Respondents also further requested the listening patterns of any radio and more than half of the respondents (54%) listen radio during evening, Just over quarter (27%) in the morning and 20% in the afternoon. One of the informants said that “*I want to listen the radio early morning(12:00-2:30local time) and at evening but the ECSUCR is not in air during that time… generally, I thought that the transmission time (3:00-8:00 hours) is not favorable for us(students) and to employees as well.”*

## **The Importance of Edutainment programs for the Audience**

Table 4: The importance of edutainment programs for the Audience (%)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S.No | Programs | Non  Important | Slightly  Important | Neutral | Important | Very Important |
| 3.1 | Entertainment | 6 | 9 | 22 | 28 | 35 |
| 3.2 | Sport | 21 | 31 | 23 | 17 | 8 |
| 3.3 | Research and Study | 1 | 8 | 31 | 40 | 20 |
| 3.4 | Women (Zekre Enest) | 19 | 24 | 37 | 11 | 9 |
| 3.5 | Let’s consult (Enemekaker) | 8 | 13 | 23 | 45 | 11 |
| 3.6 | Wisdom Buffet (Tebebat Bufie) | 15 | 14 | 20 | 16 | 35 |
| 3.7 | Health | 5 | 7 | 22 | 48 | 18 |
| 3.8 | Ethio Hut (Ethio gojjo) Gojo (focused on Tangible and Intangible Assets) | 1 | 24 | 26 | 32 | 17 |
| 3.9 | Environment | 2 | 28 | 52 | 8 | 10 |

Source: Own survey, 2021

As can be observed in table 4 above, item 3.1 asked respondents if the entertainment program is useful for them or not. Answering to this item,28% important,22% moderately important to them respectively. Item 3.2also asked respondents whether sport is important for them or not. Responding to this item,31% slightly important and 22% moderately important to them. In responding to item 3.3., four in ten (40%) and 37% of the respondents respectively answered that research and study is important and moderately important to them. In responding to item 3.6, more than one third (35%) and two in ten (20%) of the respondents answered very important and moderately important, respectively. Respondents were also further requested if health program is useful for them or not. In responding to this, nearly half (48%) and 22% of the respondents responding important and moderately important to them respectively. In responding to item no 3.8, nearly to one third (32%) and more than quarter (26%) of the respondents responding important and moderately important to them respectively. Item 3.9 were also further asked respondents if environment program is important or not. In answering to this item,52% and 28% of the respondents moderately important and slightly important to them respectively.

Respondents further requested how women program is useful to them and responding that 37% and 24% respectively moderately important and slightly important program to them. Furthermore, respondents also asked how let’s consult program is important to them. In answering to this question,45% important and 23% moderately important.

From the above data analysis, it is evident that the respondent’s response positively inclined towards very important to the items’ wisdom buffet and entertainment whereas, let’s consult each other, research and study, ethio-hut and health are fallen under the category of important to the community. Programs like environment and women forum are moderately important to them, and sport is slightly important to the community.

One of the key informants stated that wisdom buffet, entertainment and ethio-hut are the key attributes why I listen the ECSU community radio. I am really entertained by music selection such as nation and nationalities music, African music, international music and old Ethiopian music.

## **The Perception of the Audience on ECSUCR programs**

Table 5. The Perception of the audience to ECSUCR programs (%)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S.No | Items | Strongly disagree | Disagree | Neutral | Agree | Strongly Agree |
| 4.1 | The contents of the edutainment programs are relevant to the community | 8 | 19 | 26 | 38 | 9 |
| 4.2 | The community radio presents edutainment programs with thorough and an in-depth analysis | 7 | 36 | 32 | 18 | 7 |
| 4.3 | The edutainment program enables the community to observe different Ethiopian cultures and traditions | 8 | 17 | 35 | 23 | 17 |
| 4.4 | The community media enables the members of the community to participate in community radio | 23 | 31 | 21 | 15 | 10 |

Source: Own survey, 2021

Table 5 above depicted that nearly four in ten (38%) and quarter (26%) of the respondents agreed and moderately agreed to the contents of the edutainment programs relevance to the community. Over one-third (36%) and near to one- third (32%) respectively disagreed and moderately agreed to the edutainment programs of the community radio presented in thorough and in-depth analysis. The respondents were also asked in item 4.3 if the edutainment program enables the community to observe different Ethiopian cultures and traditions. In responding to this item,35% moderately and 23% agreed to the edutainment program enabled them to observe different Ethiopian cultures and traditions. Respondents were also requested whether they are actively participated in the community radio program production and transmission or not. In answering to this,31%disagreed and 23 very disagreed to the participation of the community in community radio. Results from interview with the audience said that “*I listen to the community radio sometimes yet I didn’t hear the voice of the community in the community radio.”* The manager of the community radio also shared the idea of the listener and said that *“at the beginning most of the programs run by volunteers but after transport allowance stopped, the number of volunteers decreased and now most of the program prepared and transmitted by paid journalists”*

From the above data analysis, one can conclude that the contents of the program relevance to the community was agreed by the respondents while disagreed with through and in-depth analysis of the edutainment program as well as the active participation of the community in the community radio.

## **ECSUCR Program Effectiveness**

The community radio whether it is effective or not it can be measured in terms of program presentation style, time and diversification of the programs.

Table 6: ECSUCR Program Effectiveness (%)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Program Effectiveness | | Strongly disagree | Disagree | Neutral | Agree | Strongly Agree |
| 5.1 | The community radio discusses issues and present programs in exciting and thrilling ways | 9 | 6 | 46 | 21 | 18 |
| 5.2 | The programs presented have social and cultural diversity | 17 | 14 | 23 | 40 | 6 |
| 5.3 | The community media presenting diverse music and genres | 10 | 12 | 17 | 52 | 9 |
| 5.4 | The different programs aired on the station are targeted the interests of the community | 3 | 38 | 46 | 7 | 6 |
| 5.5 | Radio programs are presented on a regular time | 8 | 47 | 32 | 6 | 7 |
| 5.6 | Transmission time of the radio programs are suitable to the community | 56 | 32 | 7 | 3 | 2 |
| 5.7 | The community radio signal quality is appropriate | 54 | 36 | 3 | 4 | 3 |

Source: Own survey, 2021

As indicated in table 6 above, 46% and 21% respondents replied that moderately agreed and agreed respectively to the community radio discusses issues and present programs in exciting and thrilling ways. For item5.2, respondents asked if the programs presented have social and cultural diversity to them. In replying to this item, 40% and 23% of the respondents agree and moderately agreed that the programs have social and cultural diversity. Additionally, 52% of the respondents agree; 17% moderately agree to the community media presenting diverse music and genres.

As to programs broadcast by the community media meets the interest of the community, 46% and 38% moderately agreed and disagreed respectively to the community media meet the interest of the community. In regard to the radio programs presented on regular time,47% disagree and 32% moderately agreed with presenting radio programs on regular time. Respondents also further asked whether the transmission time of the radio programs are suitable to them or not. In replying to this item,56% and 32% strongly disagree and disagree with the suitability of the transmission time to them. For item 5.7, 54% and 36% strongly disagree and disagree respectively to the community radio sound quality appropriateness.

# Conclusion and Recommendation

## **Conclusion**

From the above analysis it is obvious that almost all the programs are important to the ECSU community. Programs like, Wisdom buffet, ethio-hut, entertainment, health, research and study, let’s consult, environment and women transmitted from the community radio are important. Besides the contents of the programs are also relevant to the audience of the community radio. However, nearly to half of the community do not tune into ECSUCR since they are not aware of the station and busy with work and education during the time of transmission. Regarding the frequency of listening to the community radio, most of them listen the community radio once a week. The transmission time (9:00 AM to 2 PM) was not also suitable to the audience since the audience are more likely to listen to the radio during early morning (before working hours) and at evening especially the resident students inside the campus and the community around the campus. The station transmitting nine regular programs in addition to daily news per week. Each program has its own day and time allocation. However, more than 60% of the air time was devoted to entertainment programs. Community participation in radio program production and transmission is generally low and almost all programs produced and transmitted by professional journalists rather than by the community members. Even though radio program tried to cover many community events and problems, preparation of the program through the voice of the community is low. The community radio signal quality is also weak, and the programs transmitted from the community radio lacks sound clarity.

## **Recommendation**

Based on the findings of the study, the following four recommendations are drawn.

* The radio program transmission time is not convenient to the community. Therefore, it is better if the programs should extend the air time somewhere around in the morning and evening
* The station should be devoted most of its airtime to other community related programs rather than music and entertainment.
* Almost all the radio programs are running by professional journalists. Therefore, in order to air the community events and interests in their own voice, the radio station should attract more community members with in and around the campus to actively engage in radio program production. This enables talented community to involve in radio program production and transmission.
* The transmission signal of the community radio should be replaced by more advanced transmission signal in order to increase sound quality of the community radio.

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# Challenges for Reintegrating Female Victims of Human Trafficking: From the Voice of Ethiopian Female Migrants Returned from the Kingdom of Saudi Arabia (KSA) in case of Jimma Town

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***Abstract***

*The purpose of this study is to explore the challenges of reintegrating female victims of human trafficking: from the voice of Ethiopian female migrants returned from the Kingdom of Saudi Arabia (KSA). The data for the study were collected from returned female migrants (n=7) and experts of labor and social affairs office (n=2) using snowball and purposive sampling respectively. The study used a phenomenological design and the data were gathered through unstructured interview. The researchers organized and thematically categorized the data using explicitation. The findings of the study revealed that the challenges that hinder the returned migrants from successfully reintegrate in their society. The major challenges were lack of access to market, lack of support, the perception that the returned migrants have towards reintegration, lack of training opportunity, dissatisfaction with current work, and the highest expectation and value of the society towards the returned migrants. The other were life difficulty in Ethiopia, miss-match of the prior information and actual issues about their country, the low economic status of the returnees and the miss-match of the previous and current job of the returned migrants. It was concluded that to make the returned migrants successful in their reintegration process, the commitment of the returned migrants plays a great role than the other factors. Therefore, the responsible bodies should work on strengthening their commitment and matching their reintegration process with their previous experience is a crucial issue.*

**Key words:** *Reintegration, challenges, females, human trafficking*

**Introduction**

Human trafficking is the situations of exploitation in which a person cannot refuse or leave due to threats, violence, coercion, deception or abuse of power, which is a kind of modern slavery (IOM, 2018). According to the International organization of migration (IOM, 2012), traffickers use persuasive mechanisms to initiate people to decide for migration and made people to discuss the issue on social grasping and at household level. Use hardship/poverty as an instrument to persuade people and propagate about lucrative living conditions at the place of destination. Being female was a guarantee for traffickers to exploit them for a longer period (Aghatise, 2004). As the report of International labor organization (ILO) indicated that by the year 2016, approximately 40.3 million people were in modern slavery, including 20.9 million individuals who are victims of forced labor and 15.4 million individuals who are victims of forced marriage (ILO, 2017). According to the 2020 report of ILO, more than 271,642,105 people were migrated from their homeland in 2019 as the global level due to different reasons, which accounts 3.5 percent of the total population (ILO, 2020).

While migrant workers make an enormous development contribution to both their countries of origin and destination, many particularly those with irregular status suffer from human and labor rights violations. The problems and challenges are worse for irregular migrants, particularly for women. Many women use temporary contract migration to escape from unwanted marriages, abusive relationships, poverty, and dependence on patriarchal structures in their home country (Nisrane et al., 2020). However, at the same time, foreign countries can leave migrant domestic workers vulnerable to multiple forms of exploitation because of their gender, class, race, religion and nationality (Nisrane et al., 2020). The study of IOM (2019) further elaborate that the vulnerability may be due to the loss of financial and interpersonal resources during their previous experience of exploitation or lack of support when reintegrating who returned back into their countries of origin. The study also indicates that individuals, who have previously been victims of one form of modern slavery, will frequently become victims again.

In Ethiopia, both migrants and residents are at risk for trafficking-related human rights violations driven by an exploitation of vulnerabilities for the men, women, boys, and girls who are trafficked (Choi et al., 2017). According to Gezie et al. (2019), almost half of the returned Ethiopian migrants were victims of human trafficking. As the study of ILO (2018) indicted, migration to Arabian Gulf countries by female is the largest migration flow from Ethiopia, followed by migration to South Africa, North America and Europe. The majority of Ethiopian females who migrate to the Arabian Gulf had a low level of education, and are single or divorced with children (Demissie, 2018), which makes reintegrating into the socio-economic situation in the home country upon return relatively more difficult for female than male returnees. Specifically, deportation of migrants has severe consequences for the migrants, their families, local communities and their sending states (Kibria, 2004 cited in ILO, 2018).

Ethiopian returnees from the Kingdom of Saudi Arabia (KSA) since the decree was issued (since April 2017) were around 390,000; of whom 349,083 have been registered since April 2017. Since May 2017, IOM has electronically registered 342,341 returnees whose profiles are presented in the reports of IOM (IOM fact sheet, 2020). Most of them (92%) returned involuntarily, empty-handed and have faced different economic and psychosocial challenges. They experience severe hardships during their stay and during return, which caused them medical and psychological problems (IOM factsheet, 2020). About 56 percent of the returnees were unemployed (ILO, 2018) and 60 percent of all current Ethiopian migrants are females (Kuschminder & Siegel, 2018), which is also true for the regional state of Ethiopia too.

With respect to the regional state of Ethiopia, the Oromia regional state accounts the lion share having 106,704 returned migrants followed by Amhara, the southern people nation and nationalities (SPNN) of Ethiopia, Afar and Addis Abeba (IOM, 2020). According to the data obtained from the Jimma Zone Social affairs office of Oromia Regional state, the Zone registered 756 returned migrants from the KSA countries in the year 2020. Despite the fact that a situation and need assessment of Ethiopian returnees from Saudi Arabia conducted by the ILO (2018) documented a range of challenges hindering returnees’ economic reintegration, such as lack of financial support to initiate micro or small enterprises (92%), lack of training (58.7%), lack of business development services (28.4%); and lack of access to government services (41.2%) (ILO, 2017). The returning migrants quickly shift from being the primary provider for a family to becoming a dependant (ILO, 2018).

Moreover, the assessment of ILO (2018) revealed that there was a gap between the returnees’ expectations and the implementation of their sought actions. Based on their account of events, immediately after their return, the matter became a high priority in the national agenda and received the attention of the government and donor agencies. However, the focus and attention faded over time.

Generally, returnees who did not appropriately reintegrated with the socio-cultural environment are found to be vulnerable to substance abuse, alcoholism, and prostitution. It is more likely to result in another migration and vulnerability to develop socially undesirable conducts (Birara, 2017). Therefore, this study attempt to see the challenges of successful reintegration of victims of human trafficking in case of female migrants returned from the KSA to Jimma town guided by the following research question.

What are the challenges that faced returned female victims of human trafficking in their ways of reintegration in their homeland?

**Methodology**

**Study Design**

In the study, phenomenological research design was used. Because phenomenology is concerned with understanding social and psychological phenomena from the perspectives of people involved and it is concerned with the lived experiences of the people involved, or who were involved, with the issue that is being researched (Groenewald, 2004). Therefore, the study used this design to gather data concerning the lived experiences of female returned migrants from the KSA and experienced different challenges in their ways of successfully reintegrating in their homeland.

***Sources of Data***

The researcher used primary data to obtain sufficient information on the challenges of successfully reintegrating female victims of human trafficking who returned from the KSA to Jimma town.

***Data Gathering Method***

According to Saldana (2016), the collections of data in phenomenological studies use face to face, semi-structured, and one-on-one interviews. The researcher collected the data from both in-depth interview and memos. The researchers used in-depth interview to collect the necessary information from the victimized females who are key informants of the study and the experts who are working on migration. The in-depth interview allowed participants to tell the stories of their lived experience with a few initial questions and then follow-up probing and prompting to get to the deep and rich data required. The study used unstructured interview guides using their mother tongue, Afan Oromo and Amharic that help the interviewees to give detailed information. The memo (Lofland & Lofland, 1999) was also taken while we were conducting an interview with the participants to retain the data gathered. It is the researcher’s field notes recording what the researcher hears, sees, experiences and thinks in the course of collecting and reflecting on the process.

***Procedures of Data Collection***

To undertake the interview first, the researcher made a clear understanding on the purpose of the study and their level of engagement. Following that, the researcher secured the returnee‘s consent of participation in the study. Finally, the researcher conduct the interview in Afan Oromo language at calm and suitable place preferred by the participants. Each interview was recorded using audio recorder. After each interview, the researcher transcribed and then translated the collected information into English language. The translated data was organized, coded and analyzed according to their sub-theme and main themes.

***Population***

The population of the study was all females who were returned from the KSA and trying to reintegrate successfully in their homeland.

**Target Population**

The target population was the returned females who were victims of human trafficking and considered as successful but facing challenges in their ways of reintegration in Jimma town.

**Sample and Sampling Techniques**

According to Flora (2017), there are no specific rules when determining an appropriate sample size in qualitative research, for phenomenological studies, but usually at least six, and others put the range at three to five, maxing out at eight. Therefore, the researcher used purposive (snowball sampling) because the data was collected from key informants who are knowledgeable, have had experiences relating to the phenomenon to be researched (Hycner, 1999 cited in Groenewald, 2004) and the direct victims of human trafficking who were returned from the KSA and trying to successfully reintegrate in the town. Accordingly, seven key informants and two experts from the town social affairs office, totally nine individuals took part in the study and the data was reached the level of saturation.

**Techniques of Data Analysis**

For the data analysis, the study used explicitation. Explicitation implies an investigation of the constituents of a phenomenon while keeping the context of the whole (Hycner, 1999). The study also applied transcription, translation, coding as well as developing and identifying sub-themes and main themes. Transcription is the recording of speech, which reflects transcribers’ analytic bias and shapes the interpretation and evaluation of speakers, relationships and contexts depicted in the transcript (Jaffe, 2007). According to Slembrouck (2007), transcripts to be transparent and transcription to be a manual task, that produces an accurate rendering of recordings. Accordingly, the researcher transcribed the interview of nine individuals each takes from 18 to 39 minutes. The transcriptions were conducted in their mother tongues of two languages, Amharic and Afan Oromo.

In translating the data in phenomenological research, achieving some degree of scientific credibility, expressing the phenomenon suggestively and integrating phenomenological concepts within our writing is vital. Phenomenological writing needs to describe and describe the phenomena said from the participants well. According to Jaffe (2007), whatever method of writing up is used in phenomenological studies, the key is the researcher trying to capture the complexity and ambiguity of the lived world/experience of individual being described. Therefore, the researcher tried to capture the complexity of the lived experiences of individuals being described.Moreover, the study applied open-coding, axial coding and selective coding to give meaning for the transcribed data and finally the emerged themes were categorized in to sub-themes and main-themes.

**Limitation of the Study**

The study was intended to conduct on the ‘successfully reintegrated victims of human trafficking: the lived experience of Ethiopian female migrant returned from the KSA in case of Jimma town’. However, we have identified the returned migrants who were considered as successful and whom they are leading their own life/business independently with the help of the town social affairs office, the data that we gathered from the respondents pushed us to change our title. Finally, we have changed our title to the ‘challenges for reintegrating female victims of human trafficking: from the voice of Ethiopian female migrants returned from the KSA in case of Jimma town’. As mentioned above, since the intention was on success factor and the data obliged us to the challenges of reintegration, other researchers should conduct in detail to further find out both the success factors and the challenges too. This study can help other researchers to focus on the gap of this study for further studies. Moreover, it is impossible to generalize the finding of the study since the study was conducted only in Jimma town.

**Results**

The study identified ten sub themes that hinder the female victims of human trafficking from successfully reintegrate in Jimma town. Each factor is identified and discussed as follows.

***Access to market***

Most of the respondents did not have an appropriate workstation that attracts customers, due to unbalanced demand and supply; there were many coffee-tea shop runners here and there. In addition, the prevalence of COVID-19 endangered different small business runners due to the closing of their shop and their customers were not able to visit them. In supporting this idea, int. 01 (pseudo name or code of the participant) said, “Though I have worked hard, the workstation was not appropriate to generate income; there was a serious challenge that encountered me in my business due to shortage of market and money”. Even though the government can secure right place for returned migrants, which is accessible to market, still they could not get workstation.

***Lack of support***

Lack of support can be from the government, NGOs or other civic organizations, however here we have identified the support provided by the government and NGOs. As the collected data indicated, the government bodies did not follow the returned migrants. Respondent Int. 01/20 said, “I have never seen anything given from the kebele to the returned migrants in terms of organizing, giving workstation and any other support, except talking**”.** The government also did not allocate budget independently to support the returned migrants and the available budget was the recurrent fund budget. Therefore, the only option of getting the money is through taking loan from Oromia credit and saving share company. In addition, as most of the respondents of the interview indicated, the direction provided by the federal government and the regional state, did not go with the actual implementation being applied by the Jimma town administration; it was very poor, problematic and associated with rent seeking. Supporting this idea Int.05/35.E indicated, “in case of supporting the returned migrants, they support their relatives and based on the relationship that they have with them”. Int.05/35.E also said, “Lack of support from the local government was a series issue and there were unfair treatment and unequal support. Int.2/4.B also elaborate the idea and said “the reason why the returned migrants refrain from doing their own business in their homeland is because of the taxation of the government imposed to them and the request for trading license”. Both the tax and the trading license require a lot of money and difficult to pay the money since their work station was not secure as a result of rented house. Due to the fact, some of the returnees went back to the Arabian countries through human trafficking. Generally, the role of the government is reserved to facilitating and creating awareness; it is not beyond that.

With respect to the NGOs, rather than the government some NGOs support the returned migrants by providing them 5000 to 20,000 birr. However, they were not satisfied with the money that they got and most of them spent the money since they did not have the workstation. They were not also satisfied with the provided money. For example Int.01/24.A said, “I only provided with twenty thousand Birr”, and Int.2/4.B said, “The Catholic Organization suddenly called and gave me five thousand Birr (5,000), which was surprising because I did not expect to take such a very few money from a huge NGO since the money did not help me to run my own business”.

**The of the returned migrants themselves**

The returned migrants lack patience to follow and fulfill the requirements expected from them to be reintegrated by the town administrations, most of the time after organized in a group they lack agreement to work together; they sometimes frequently came to office and disappear. Even, they did not attend the training that supports them or they send only one person from the group members. They depend only on their self-interest.

**Training opportunity**

The government as well as the NGOs was giving short term training, which help them to begin their own work or to be employed by other employers and certifying them. However, except few respondents most of them were not benefitted from the outcome of the training. As Int.06/23. F explained about the training “We simply took the certificate of the training from the government and returned to our home; the given certificate did not give us any profit”. In the contrary, Int.2/12. B has taken training on females’ beautification for three months with her own cost since she has such experience in the Saudi Arabia and now leading her life with the job of female adornment.

**Dissatisfaction with current work**

Most of the respondents were not happy with their current job because their monthly income was very few and it was from 15-60 US dollars. This was further discussed by Int.3/1.C. She said, “I am not happy with the income, which I get per month, because when I compare the foreign country with our country in-terms of the living condition, life is very difficult here in Ethiopia than abroad and it is too expensive”. The house rent and food were very expensive; the licensing process, its payment and taxations were also preventing us from running our own business and the profit was very low. In addition, Int.2/23.C more clarified the situation and said, “In current work just we are eating for living and working for living”. In general, as it was mentioned by Int.4/1.D, “there was no income, no market, and small businesses were endangered by Covid-19”.

**The highest expectation of the society**

Even though the society welcomed them when they return from the foreign country, most of them consider that as they came back with abundance of money, like as they brought the money, which was full of sack. Such perceptions hindered them from engaging on different small activities that they want to do because the society would not expect from them to do small activities and even some times, they expect to buy a car and so on. In support of this idea Int.2/24.C said, “They consider me as I was Diaspora and have a lot of money but I have no money in my bank account, which humiliated me to see the eyes of my society until I became familiar with the issue”.

**Life difficulty in Ethiopia**

Most of the respondents did not have an appropriate workstation, which is one of the most difficulties that the returned migrants are currently facing. For instance: Int. 03: said, “Because of lack of workstation, we spent the money we brought from foreign country”. Moreover, Int. 03: added, “In most cases, we hate the life condition in our country because we are unable to see any change in our life in Ethiopia”. According to the respondents ideas the issues that make the life difficult to them were house rent, government taxation, license and its process for trading *(Int.3/7.C)*. These were some of the challenges that made the life bitter to the returned migrants, and force them to hate and leave their country again through different mechanisms like human trafficking. In addition to this Int. 03 explained that, “…. Because of such difficulties even one person went to Dubai three or four times”.

**Miss-match of the perceived information about their country**

As Int.08: indicated most of the time the returned migrants were wrongly perceived, as everything is available in the shelf of the office, which was sent from the higher level. Because they thought that as the government allocated a huge amount of money for the returned migrants. According to Int.08 the idea that the returned migrants have in their mind and the practical thing that they observe was quite different; as a result they entered in to hopelessness. Moreover, the returned migrants were wrongly perceived when they were in abroad. As int. 08 indicated, they came with different miss-conception. They consider that as the money is going to be given for them including the house they live in, which is quite different from the actual practices and which lead them to became hopeless.

**The Economic Status of the Returnees**

Regarding, the current economic status of returnees, most of the returned migrants have no money on their hand. Some of them come with some amount of money, but in order to run their own business and lead their life in a better way and independently they did not get workstation. From the given interview, we can see that the monthly income of the returned migrants ranged from fifteen dollars to sixty dollars. For instance, Int. 03 said that, “I was employed here two months ago and they paid only fifteen dollars ($15)”. Here, from her monthly income, we can conclude that it is very difficult to survive or lead the life by earning fifteen dollars with the current economic situation in this country. As a result, the retuned migrants forced to re-think to migrate to Arabian country again. On the other hand, the maximum income of the respondents was sixty dollars ($60) per month. Example: Int. 04: said, “I have the probability to get two US dollars ($2) per day”. This means she gets sixty dollars ($60) per month. So, as compared to Int. 03 to some extent she can struggle to survive and lead her life, however, it is still very low income with the current economic situation.

**Miss-match of the experience of the returned migrants with the current jobs**

All the respondents except Int.01 came with the experience of housemaid, which was completely different from the available or current jobs in Jimma town. On the, contrary, Int.02 who returned back to the homeland came with the experience of women’s beauty salon and now, she has been working leading her life with the same experience of women’s beauty salon.

**Discussion, Conclusion and Implications**

**Discussion of the Result**

As it was discussed in the above section, the challenges that hinder the returned migrants from successfully reintegrate in their homeland has ten sub themes. These were lack of access to market, lack of support, the perception of the returned migrants themselves, lack of training opportunity, dissatisfaction with current work, acceptance of the society, life difficulty, miss-match of the perceived information about their country, the economic status of the returnees and the miss-match of the experience of the returned migrants with the current jobs.

The returned migrants did not have an appropriate workstation that attracts customers since their workstation is far from the main route, and due to many coffee-tea shops, there was unbalanced demand and supply. The support provided by the government was also very poor; the government bodies did not follow and support the returned migrants. As it was mentioned in the analysis part, the following idea of the interviewee best describes the situation. Int. 01/20 said, “I have never seen anything given from the kebele to the returned migrants in terms of organizing, giving workstation and any other support, except talking**”.**

The returned migrants themselves were unable to follow, ask and initiate the government officials to reintegrate in their homeland using the opportunities provided for them. Rather they sometimes ask about their issue and forget for a long period. As Int.08 described they only visit their office if there were some benefit only. Therefore, they were unable to get any support from the government.

Even though the training was provided by both the government and NGOs, after the training was given Int.09 said, “There was no follow up and support to actually apply the results of the training”. The outcome of the training was not fruitful. As we have identified most of the returned migrants engaged in different works were dissatisfied with their current work due to the expensive cost of living, lack of access to market, low income, etc. In addition, though there was no problem with respect to the society in accepting them when they return back from the foreign country, the society consider them as they have a large amount of money and did not encourage them to run a small business. The returnees have also wrongly informed about their country and they considered that as everything was ready including the workstation, to begin their own business, however the reverse is true and they were desperate of their coming. Therefore, they were planning to go back again to the place where they came back. Moreover, because of low income, the returned migrants were spending the money they brought and their economic status was declining. Due to the aforementioned obstacles, they were not able to use their money effectively except few of them. Similarly, the experience that they have obtained from foreign country did not go with their current job, which harmed them from having a successful reintegration. However, those who have similar experiences were benefitted from their business since they know about how to become successful and profitable when compared with the other.

**Conclusion and Implications**

To make the returned migrants successful in their reintegration process, the commitment that they have to improve their life plays a great role than the support provided by different organizations. Due to the fact, the responsible bodies should work on strengthening their commitment by facilitating different awareness creating training opportunities, and giving them advise too. In addition, the experience brought from the foreign countries and the current experience/work has the horizontal relationship and plays a great role for the successful reintegration. Therefore, the town administration should also facilitate the working condition and work station based on the experience they brought from the KSA.

In addition, there were many challenges that hinder the returned migrants from successfully reintegrated in their homeland. These were access to market, lack of support, the perception of the returned migrants themselves, lack of training opportunity, dissatisfaction with current work, High expectation of the society, life difficulty, miss-match of the perceived information about their country, the economic status of the returnees and the miss-match of the experience of the returned migrants with the current jobs. Therefore, it is better to identify the challenges that hinder the returned migrants from successfully reintegrate in their homeland and applying an appropriate and successful reintegration of the migrants in Jimma town is an important issue. If the responsible bodies are willing and have the interest to reintegrate the returned migrants in their homeland, they can use and apply the finding of this study and work on the challenges.

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* 1. Impact of Married Women Migration to Middle East on Families Left Behind

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## ***Abstract***

*The study on the impact of married women migration to Middle East on families left behind attempted to reveal what the positive and negative impacts are on migrants’ family. Here, it mainly tried to look the economic and social dimensions of family members after the women migration by taking remittance and absence of the women into consideration in the context of patriarchal society like ours. Having this in mind, the main objective of this study was to describe the impact of married women migration to Middle East on the family members left home. A cross-sectional design was utilized employing qualitative data collection methods such as in-depth interview, key informant interview (KII) and focus group discussions (FGDs). Purposive or snowball sampling technique applied to select samples of the study. Aggregately 69 samples were included in the study of which 17 for in-depth interview, 12 for KII and five FGDs with averagely eight discussants. The finding disclosed various impact of married women migration on family members left home such as lack of health and care, poor academic performance for children, loosening of couples and family’s relation, workloads on remaining families and labor shortage in community. On the other hands migrants’ family also tried to improve their economy by buying motorbike and land, build house and teach their children. Moreover, the finding also disclosed that illegal migrations via smugglers are more preferable than the legal due to complex and costly nature of legal migration. Therefore, both the positive and negative impacts of migration on family members left behind needs viable attention from concerned body to sustain the positive and reduce the negative by paying more attention for job opportunity in the origin and vulnerable members of the family left behind.*

***Key Words:*** *Gender division of labor, Married Women migration, Middle East, Patriarchal Society and Smugglers.*

**Introduction**

Migration is the movement of people from one place to another across the world (Wakessa, 2014). This movement has been taking place for a long time and its magnitude increased in the modern era. More than ever before, migration today touches all states and people due to globalization (International Organization for Migration, 2018). According to Cohen and Sirkeci (2011), in the contemporary world, many humans continue to migrate annually. Some of them are motivated to escape a situation, seasons (eg. in colder winters Englishmen migrate to southern Europe), and others move to look for temporary or seasonal employment and supplement low incomes and limited opportunities.

According to World Bank (2015) projection more than a billion or 1 from 7 people globally migrate, and international migration accounts for more than 240 million (UNDESA, 2016). According to the World Bank’s Migration and Remittances Fact Book (2016) more than 250 million people or 3.4%, which exceeds the global population growth rate, live outside their countries of birth. International migrants were 173 million in 2000, 220 million in 2010 and reaching 258 million in 2017 (IMR, 2017).

Africa has a long history of internal and international migration that migrants moving within and beyond the continent (Deotti and Estruch, 2016). In 2015, over 16 million Africans were living in another African country, while 16 million were living in other regions. Since 1990, the number of African emigrants has more than doubled, thus, their number grew from 2000 onwards due to free movement agreements, porous/leaky borders, and migration and displacement drivers. Accordingly, in 2015, Africans outside their region were in Europe (9 million), Asia (4 million) and Northern America (2 million) (IOM, 2017).

The international migration stock of Ethiopians living abroad increased over the years. There were 1.8 million migrants in Ethiopia in 2015 from which 753,462 were emigrants to the rest of the world. Asia and North America hold 224,658 and 211,630 migrants respectively. Saudi Arabia placed at the top of the Asian countries with 123,669 migrants. MoLSA indicates that around 460,000 Ethiopians have legally migrated to the Middle East mainly Saudi Arabia, Kuwait, and Dubai between 2008 and 2013 (International Labor Organization, 2017).

In Ethiopia, lack of job opportunity and low economic growth, pressure from family, peer and smugglers, labor demand in destination, periodic drought and environmental shocks, hunger, poverty, search of better living to support families, and lack of awareness about impacts of migration has increased migration (ILO, 2017 & GOAL Ethiopia 2017).

Around 86% of migrants are women from rural areas with limited educational background looking for employment opportunities in order to improve their lives and families. More than half in either legal or illegal migration to the Middle East are female. This is due to the greater opportunities (promoting policies) they have for legal labor migration to the Middle East (Poston and Micklin, 2005). Thus, migration to the Middle East has a gender dimension where the majority of migrants are female (ILO, 2017).

There were 21,256 employment contracts for Ethiopians to work in the Middle East from 2008 to 2009 (MOLSA, 2010). From this 82 % were females from which Saudi Arabia (61.9 percent), Kuwait (33.16 percent), and Bahrain (3.22 percent). Thus, around half of a million females migrate from Ethiopia to the Middle East each year (ILO, 2011).

However, it is difficult to know the exact numbers, large numbers of married women migrate from Ethiopia to abroad to engage in domestic activities. Many works of literature in Ethiopia highly focus on causes of rural-urban migration and its key role in changing the social, economic, cultural and political sphere of the country, impact of migration on migrants’ life and migration as livelihood diversification, impacts of husbands’ migration on families left behind, etc. The issue of married women migration to the Middle East in Ethiopia especially in Areka town is a new fashion and studying its impact on family members left behind worth attention. Thus, the aim of this study was to describe the impact of married women migration on family members left home.

Migration has both positive and negative impacts on migrants and members of family left at home. Regarding positive impacts, migration has viewed as economically benefiting the family at home by improving households through investments in health care and education whereas, the negative impacts are its social cost on family members at home. For instance, it has adverse effects on education, health, labor supply response, and social status on family members especially women, children, and elder. However, the impact of migration on the family at home is complex, multi-channeled, context-dependent, migrant (gender & age) and duration of migration dependent (D´emurger, 2015).

Migration to the Middle East is most significantly a female phenomenon and motivated by gender-specific domestic work opportunities in the Middle East, thus feminization of migration is also highly evident in Ethiopia (Kuschminder, Andersson and Siegel, 2012). Males and females have clearly demarcated societal expected roles in a patriarchal society like Ethiopia. The movement of one of the couple may result in bringing change in the role of the other that in turn may have various behavioral and socio-economic impacts on the rest of the family members left home. Thus, the impact of one of couples migration on family left behind varies with who migrate (father or mother).

Various studies on the issue of migration ever conducted at global, regional, and national levels focus on rural-urban, causes and consequence of migration, child trafficking and abuse of migrants during migration. For instance causes and consequences of child trafficking (Yishak and Asrat, 2018), rural-urban Migration and its consequence on urban living (Habtamu, 2015) and assessing the socio-economic impact of rural-urban Migration (Mefekir, 2017). In addition to the limitation of literature on researches on international Female migration and its impact, many of the migration research remained within the country and almost all study was done on migration loose gender dimension.

Abebe (2012) conducted on women migration to near east in the case of Eritrea, tried to understand migration in cultural context, but he has not shown its impact on social, economic and other aspects of families left at home rather the effectiveness of women in saving and sending back remittance. He only illustrated migration from its positive impact (remittance). Yared, Alemayehu & Seid (2016) studied the Ethiopian youth migration to the Middle East and its impacts on migrants’ sending community and tried to look at factors for migration in the study area. Gudeta (2014) conducted research on the causes and consequences of human trafficking in Ethiopia taking women return from the Middle East as a case study. He only focused on the causes and consequence of human trafficking rather than the situation of family at the origin. Understanding, the impact of women migration on family member left at behind makes this study unique.

Therefore, gaps in existing literature justifies carrying-out this study. However, there are ample studies on migration carried out in the country in both internally and internationally, women migration or migration to the Middle East are more or less focused on the situation of migrants on the journey, its impact on the community and impacts of migration on migrant returnees without looking the issue from gender perspective. But, migration is beyond migrants and its effects are near/direct to the family of migrants as well. According to Cohen and Sirkeci (2011), migration is complex that it is about security and situations. It is about sending households that are homes to migrants and about the communities where those households are found. It is local as well as it is about international flow and global processes. Migration is again beyond the present and the person to understand the history and socio-cultural setting of migrants. These all favor looking migration from gender dimension in relation to its impacts on families at home. That is why this study attempted to describe the impacts of married women migration on families left at home was not studied so far in the study area. Therefore, this study was conducted to reveal the impact of married women migration on family members left behind and to answer the following research questions:1, What are the economic impacts of married women migration on the family members left behind? And What are the social impacts of women migration on the family members left behind?

# Methodology

## **Research Design**

A research design is the systematic planning and directing of the research. In empirical research it aimed at answering specific research questions and must specify the data collection process, the instrument development, and sampling process (Kumar and Singh, 2015). Accordingly, the study was descriptive and cross-sectional that studies the impacts of married women migration on the family members left behind at a time.

## **Description of the Study Area**

The study was conducted in Areka town, Wolaita Zone, Southern Nations, Nationalities and Peoples Regional State (SNNPRS). The town was established in 1955 E.C and now it has 4 kebeles. It is relatively located on the South of Yukara, West of Tadisa, East of Dubo and North of Worimuma that are rural kebeles of the surrounding woreda (Boloso Sore) (Municipality Office 2018/9).

Areka town is one of the city administrations in Wolayita zone at a distance of 29 km from the zonal capital, Wolita Sodo and 183 km from Hawassa, a capital city of SNNPRS and 300 km from Addis Ababa, capital of Ethiopia. Areka town has a total population of 50, 275 from which 26, 341 are males and 23, 934 are females. The total number of the household of the town is 11, 692 (Areka city Administration 2019).

### *Sample Size and Sampling Techniques*

As it was difficult to get the sample frame of the family members left behind, the sampling technique for this research was purposive. Individuals who have knowledge because of position/Special exposure to the subject matter and stakeholders working with this issue were selected, but the exact size of sample determined by data saturation point.

## ***Study Population***

The target population of this study was the family members left behind after the married women migrated to the Middle East. It is difficult to know the exact number of the family left home in the town after the women migration due to the absence of complete information compiled by the concerned bodies.

## **Methods of Data Collection**

### *In-depth Interview*

In-depth interviews were conducted with husbands and other family members left home in order to extract their experiences and to collect information about the social and economic impacts of women migration on family members left home.

### *Key Informant Interview*

This type of interview carried with those who have the knowledge and are experts on the issue. They were selected from the community, NGOs and GOs who are concerned. Totally, 12 key informants three from each were interviewed to extract rich data regarding women in relation to migration and families left behind as well as the situation of married women migration in Areka town.

### *Focus Group Discussion/FGD*

People with almost the same character or social background gathered to deal with the stimulant the researcher rose to dig the collective views about the issue identified. It is a way of learning from every body’s faces and speech. Five FGDs each in average consisted of eight participants were participated.

### Instruments of Data Collection

To conduct this study, the researcher used interview and discussion guides to dig out data on the impact of women migration on family members left behind. The interview guide was semi-structured due to its advantages. The semi-structured interview helps to fix the areas of information required and extract pertinent data as well as guides the process. The tool written in English translated into the language of participants by the researcher. The tools incorporated economic and social aspects of migrants’ family.

## ***Sources of Data***

Both primary and secondary data sources extracted to conduct this research. Primary data sources were collected using in-depth interview, key informant interview (KII), focus group discussions (FGDs) whereas, secondary data collected from different related documents. Moreover, international, regional and domestic laws and policies relevant to the issue under study were analyzed.

## **Method/s of Data Analysis**

The thematic analysis used to analyze the data. Themes developed based on the research objectives and emerging issues for this purpose. The data collected by using the tools listed above organized, broken into manageable units, coded, synthesized and searching for patterns; the main themes identified and the categories brought together and rearranged under the themes.

## **Trustworthiness/Credibility**

Qualitative research uses trustworthiness and credibility (truth value), for qualifying their research. This assured by using well-established research methods, triangulation, encouraging participants, iterative questioning, peer scrutiny, member checks and scrutiny of previous research findings (Guba, 1981).

**Literature Review**

However, migration studied by social scientists for a long time, the theoretical and empirical knowledge of migration has not developed to a considerable extent (de Haas 2014). The followings are some of theories contextually define the problem under study:

## **Structural functionalism**

Parsons (1966:11) delineated a number of functional prerequisites of a social system. Some of which are relevant to this study are as follows: First, social systems must be structured so that they operate compatibly with other systems. Second, to survive, the social system must have the requisite support from other systems. Third, the system must meet a significant proportion of the needs of its actors. Fourth, the system must elicit adequate participation from its members. Fifth, it must have at least a minimum of control over potentially disruptive behavior (Rtizer 2011:245). However, the focus was on large-scale systems and their relationship to one another (societal functionalism) and he concern with the maintenance of order within the social system, the concept is very useful to understand the basic unit of society i.e. family in the case of migration. These propositions can define the purpose of the study in a different context. Accordingly, to sustain the system must compatibly structure, but if the base for social system-family fails (in case of migration), it is too difficult for others. The families that lack support from another system because of low participation and parental absence face challenge to function. The children and other family members out of control in areas where norms violated and conflict become disruptive. Due to women migration, the family fails to fulfill what expected from them and finally it challenges the normal function of the social system.

In order to better understand migration from Family point of view, the theory proposes that Society as a complex System; parts integrate together to promote solidarity and stability. The theoretical framework focuses on how the institution of family functioning properly to maintain its solidarity and stability within the family structure. Thus according to functionalist’s perspective, the family is at the heart of society. Therefore, due to women migration, the family lacks the above advantage and that is why the study framed under this concept.

## **Theories concerning the links between Parent-child relationships**

According to O’Connor and Stephen (2007), the various ways that parents shape their children’s development have been a theorizing source by scientists. There is also growing concern about the sizeable and perhaps growing proportion of children with substantial educational, social and health problems, coupled with a belief that modifying the family environment may be a potent means of improving children’s lives and life chances. To them theories concerning the links between parent-child relationships and child outcomescan be traced into three:

**Social Learning Theory**

Social learning theory argues that a child’s real-life experiences and exposures directly or indirectly shape their behavior. The fundamental tenet is that moment-to-moment exchanges are crucial; if a child receives an immediate reward for his/her behavior, such as getting parental attention or approval, then s/he is likely to do the behavior again, whereas if s/he is ignored (or punished) then s/he is less likely to do it again.

***Attachment Theory***

Attachment theory is concerned with fundamental issues of safety and protection. It focuses on the extent to which the relationship provides the child with protection against harm and with a sense of emotional security. The theory proposes that the quality of care provided to the child particularly sensitivity and responsiveness leads to a secure or insecure attachment. Attachment relationships carried to forward influence expectations for other important relationships.

***Parenting Styles***

Parents bringing new offspring into the world and care for them until they care for themselves. It is essential for adults to invest extensive time, effort, and material resources in nourishing and supporting them especially by mothers until they are able to survive as adult members of society (Paul 2008). In my case, as the mother migrates to three or more years or rounds leaving infants at home in patriarchal societies like ours in which fathers gendered in public rather than domestic role, children lack a lot of advantages. The children grow without knowing what is right and what is wrong. This is because there is no exposure or life experience from which they learn a lot. In generally they lack care, safety, and protection due to the absence of their mother.

## **Family System Theory (FST)**

FST views families as living organisms and stresses boundaries, rules, expectations, and behaviors that maintain equilibrium and the status quo. If changes in one part of the family occur, other parts need adjustment. The family is also part of other systems in the community, so changes in one family will create imbalance and lead to changes in other systems that surround that family (Powell and Cassidy 2007). FST preferred as a theoretical frame to view families in the context of one of the members, especially in my case women migrate. Therefore, FST expected as the fitting theoretical framework for the impact of married women migration to the Middle East on families at home.

## **Theory of role conflict**

The concept of role conflict defined as the concurrent appearance of two or more incompatible expectations for the behavior of a person. Role conflict leads to role strain (Biddle 1986). Role conflict is also simultaneous, incompatible demands from two or more sources that require choice (Rowlands 2010).

## **Theory of role strain**

This perspective emphasizes the potential negative consequences that the stress and competing demands of multiple roles may have for individuals (Goode 1960; Mui 1992 cited in Reid and Hardy 1999:1). Therefore, role strain refers to a situation in which an individual overburdened with multiple roles. The migration of a given family member particularly a women shifts her societal expected roles to family members left home.

# Results and Discussion

Women migration to the Middle East in Areka town has a positive and negative impact that influences the economy, family relation, children and community (Interview with FGD). It is parallel with (IOM, 2018 & Franse and Kuschminder, 2009) which disclosed that international migration has both positive and negative impacts. It has various negative social consequences. One of the**se** is the overburdening of husbands at home and out of home activities. The following life experiences of the study participants after the migration of their wives are evidence for this.

*“I have two children who are 11 and 6. It is three years for their mother leaving Ethiopia. I exposed to multiple roles like caring for children, shopping, cooking and engaging in daily work for income that is shining the shoes, thus, most of my time consumed by different social roles. I have my own idir and I cover two of her idir which she become a member of before her migration. All of them need equal participation in any ceremony or weeping. For instance, during weeping, it is required to pay the determined amount personally at home of mourning or locally known as “merdo house.” It is time-consuming and needs a budget, thus sometimes I jump over or drop one and participate in the other. Finally, I stopped one of her idir because of time and budget constraint. I also sometimes switch off my daily work and participate in other social aspects. In reality, I found it is difficult to nurture children because it is culturally or traditionally associated with the gender of women or mother. Now I am sick and most of the time under stress due to difficult and multiple roles.” (A 32 years old husband)*

*Another 28 years migrant’s husband revealed the issues as follows:*

*“We have one child who is 6 years old. I drive a motorcycle and at the mid-time, I follow him at school or after school at home. At morning, I prepare food for us and send him to school, and then sometimes I wash clothes and clean home. In the remaining time, I drive my motorcycle, and then I go to the market to purchase food for us and cook at night. I also participate in any social networks that require participation like “idir” or “iqub”, weeding and mourning. When he is sick, I leave all of my expected roles and care for him. I am so busy to uphold these all that I am stressful.”*

These findings seemed to support role strain theory in sociology (Goode, 1960; Mui, 1992 cited in Reid and Hardy, 1999). Dissolving family relation, shortage of labor supply, bad perceptions of community on migrants’ family, children lacking care and love of their mother and divorce are others (40 years KI) which is differ from Kerime and Degefa (2016) and Girmachew (2014) who argued that remittances improve the living standards of the family left behind by changing consumption of goods, house construction and maintenance, access of health service and education.

## **Women Migration in Areka Town**

The major factors that initiate women migration in the town are the legalization of female migration, poverty, a job opportunity in abroad and widely dispersed smugglers (Interview). The findings some extents differ than IOM (2017) which stated that migration increases due to free movement agreements, leaky borders, and migration and displacement drivers. Promoting policies is the reason for migration (Poston and Micklin, 2005). The women migration in the study area is due to gender-based jobs opportunity in the destination. This is parallel with ILO (2017), migration to the Middle East has a gender dimension. The lived evidence tells as follows:

*“Married women migration to the Middle East in Areka town, now a day is the newly emerging issues that many women are not at home. The town has known for its lion share of married women migration to the Middle East in southern Ethiopia (Areka town labor and social affairs).”*

## **Impact of Women Migration on Economy of Families**

The core aim of women migration is to generate remittance by which to invest on family members and to build assets. But, what determines the effectiveness of remittance is good management of husband or other families at home, the success of the migration, good relation between couples and parents. The evidence from the research participants assured that there are families that changed their life by building the assets.

*“Majority of migrants are not educated or have a low academic background and those who have no continuous income. It is amazing that some of them send up to 30,000 Eth/n birr periodically. They buy motorbike, land, and house for their husbands and brothers. Before, they have nothing even to eat. Since they were low in academic background and have no income before, and after a few years they become a source of well-increased income, thus migration has economic value.” (27 years old key informant)*

One of the study informants also supported the above ideas and forwarded as follows:

*“I got information about the benefits of sending the wife to the Middle East for employment from my village. Then I sent her to Beirut by paying 8000 ETB for smugglers after she gave me birth a baby boy. Migration changed my family economy. She has been sending me 15,000 ETB every three months since she migrated up to now. I cover the basic needs of our family and teaching our child, buying cattle in rural as well as save for the future to change our business when she returns.” (A 28 years old migrant’s husband)*

The findings from FGDs also explained the economic importance of migration as follows:

*“It is obvious that we are observing many of migrants’ family building good houses, buying motorcycle and building other assets like land in urban, teaching their children, and improving the lives of the family in different aspects.”*

These agrees with ILO (2010) that migration enables a considerable number of people to find jobs overseas and generating large flows of remittances. Remittances are the most tangible benefit of migration that improves housing, nutrition, schooling, and health care as well as to create human capital by financing education of children, and improving food security for poor households. But it is disagreeing with Yared et al (2016) who found that many migrants to the Middle East return with empty hands and left their family in debt.

## **Impacts of Women Migration as Being Burdens on Families**

The evidence indicated that the patriarchal nature of the study areas makes the negative impact of married women migration worse. The following life experiences of the study participants after the migration of their wives are evidence for this.

*“...I exposed to multiple roles like caring for children, shopping, cooking and engaging in daily work for income that is shining the shoes, thus, most of my time consumed by different social roles. I have my own idir and I cover two of her idir which she become a member of before her migration. All of them need equal participation in any ceremony or weeping. For instance, during weeping, it is required to pay the determined amount personally at home of mourning or locally known as “merdo house.” It is time-consuming and needs a budget, thus sometimes I jump over or drop one and participate in the other. Finally, I stopped one of her idir because of time and budget constraint. I also sometimes switch off my daily work and participate in other social aspects. Thus, I found it is difficult to nurture children because it is culturally or traditionally associated with the gender of women or mother.” (A 32 years old husband)*

*Another 28 years migrant’s husband revealed the issues as follows:*

*“We have one child who is 6 years old. I drive a motorcycle and at the mid-time, I follow him at school or after school at home. At morning, I prepare food for us and send him to school, and then sometimes I wash clothes and clean home. In the remaining time, I drive my motorcycle, and then I go to the market to purchase food for us and cook at night. I also participate in any social networks that require participation like “idir” or “iqub”, weeding and mourning. When he is sick, I leave all of my expected roles and care for him. I am so busy to uphold these all that I am stressful.”*

Migration required the husband to fulfill different activities such as care for children, engagement in economic and social aspects. Finally, migration affects the health of family and the development of children. These all are similar to family system theory that views families as living organisms that if changes in one part of the family occur, other parts need an adjustment (Powell and Cassidy, 2007).

## **Impact of Women Migration on Children**

The household time reallocation due to migrant’s absence negatively affects the health of family members left behind which lead to greater psychological pressure and poor feeding, especially in the case of children, in the absence of main caregiver (D´emurger, 2015). This is also true in the study areas that family members especially children are negatively affected by the women’s migration. The following quotes from the study participants are evidence concerning this.

*“A woman who had two children migrated to Middle East/Beirut illegally by deciding with her husband. When her husband found it is difficult to administer and care for the children, he himself internally migrated. The children lacked caregiver and finally, both have died. After a few months of her migration, she caught on the journey since she is an illegal migrant and deported or returned back to Ethiopia. At the end when she reaches home she has found both of them died.” (50 years old key informant)*

*“It is very difficult for children living without a mother. However, she sends remittance and I care for our child she is not happy to eat, does not want to stay at home thus she searches her mother in the village. As a result, she always becomes sick, loses weight and under the bad state. When the mother returned to the mid she asked why you left me at home and have gone somewhere.” (A 32 years migrant’s husband)*

The above informant also explained that the children might grow by losing the love of her/his mother due to migration.

*“The mother migrated before three years when both of our sons are very infants. Both were crying and not feeding well until they forgot her. Usually, the elder asks me where she had gone. Thus, they exposed to different diseases and frequently I take them to the hospital. Once upon a time when they were sick, I had nothing to take them hospital again and cried. After a while, many people collected to ask me and I explained the situation. Finally, the government offered free card for medical treatment because I am poor. After their maturity for school, they started class in a government school. They eat launch with me here (a place where I am shining the shoes) and play full of the afternoon until I stop working. This is because there is no one at home who cares for them.” (35 years old Migrants husband)*

These supports Parsons’s (1966) who stated that social system must have at least a minimum of control over potentially disruptive behavior (Rtizer, 2011). These findings correspond with Pajaron (N.d.) that the impact of parental migration conditional on the gender of the left-behind child, the gender of the household head and gender bias of the household head.

Generally, as the mother migrates to three/more years in patriarchal societies like ours in which fathers gendered in public rather than domestic role lacks a lot of advantages. The children grow without knowing what is right and what is wrong. This is because there is no exposure or life experience from which they learn a lot. They grow without gaining appropriate care, safety, and protection due to the absence of their mother.

## **Impact of Women Migration on Family/Marital Relations**

Migration developed suspicion between couples. This is due to the commonly held assumption that migrants probably have sexual relation with another partner in abroad and their husbands publically or secretly marry another woman here which led to divorce. The following empirical evidence-based quote is a vivid witness for this.

*“I sent my wife five years ago. She returned at mid-time but she asked me to check our health status at the hospital because she suspected me with someone in the village. When I refused, she returned without staying a single night with me and now we have no communication.” (A 48 year’s old informant)*

*“It is obvious that both of the couples suspect each other. Usually, the husbands arrange sexual relation with another partner immediately. Family members and friends whom she assigned to follow him forward information to her. When she asks him with elders, most of the husbands respond that how I know with whom she stayed.” (Both of Female and Male FGDs)*

The migration of married women developed another happening. The living evidence that supports this:

*“After a man sends his wife, he gains remittance from her in which he processes other women as a smuggler and as a husband to her again. This is because he knows the process in one way and he has money to sponsor. If there is instance both of them come at the same season/time one in Areka town and the other in a nearby town and contact all of them in secret. Finally, it is inevitable that the information becomes public and the previous/legal wife who gave birth to his divorce.” (A key informant interview)*

One of FGDs also explained many couples end in divorce.

*“Almost all migrants migrate for more than three years or one round. Since she stays many years, there is loose of trust between couples. It is also difficult to lead a life alone after experiencing marriage and both are suspecting each other either one of them making sexual relation with others. That is why many migrants are divorced.” (One of Male FGDs)*

The findings similar to Antman (2012) who found that migration affects spouses and its outcomes lead to divorce. It is also concurrent with Compernolle (2017) that migration threatens the marital relationship, but it depends on the larger assumptions about marriage and the nature of migration.

# Conclusion and Recommendation

## **Conclusion**

This study conducted to describe the impacts of married women migration on family members left behind, with a focus on husbands, children, spouse, parents, and others in Areka town, Wolaita Zone, SNNPR, Ethiopia. The study found that women migration to the Middle East has various positive and negative economic as well as social impacts.

The positive impacts are that some family of migrants were able to get a better income, built assets and engaged into new business, fulfilled basic needs and sent their children to better schools by the remittance. The negative economic impacts were when families fall in debt and bankruptcy when the migrants could not get employment with better income abroad and unable to send the expected remittance for the family members to pay back the money borrowed from moneylenders to pay for smugglers and facilitate their journey.

Similarly, the study identified that married women migration has a number of the negative social consequences on the husbands, children and the migrant women themselves. The one of is the shift of all the domestic roles of the wives to the husband especially when there are no other adult members in the house that can share part of these roles from the husband and children. While such role shift has an implication for changing the rigid gender divisions of labor in a patriarchal community like in Areka town which in turn resulted in role strain for the husband. Thus, he forced to leave some of these important roles of the family.

Women migration also has many impacts on dependent families especially children. The evidence from the study disclosed that women migration in generating remittance has a positive impact on children living and academic performance. In relation to this, what matters is whether the responsible person at home cares for them or wastes what sent. But, children lack care, love, safety, security and life experience when their mother migrated and fathers are as such committed to follow them like what their mother do culturally.

The findings again revealed that conflict between couples as well as among couples and their parents were common. The couples suspect each other either that he or she may have other sexual partner and poor management or sending a low amount of remittance. This is because when the women migrated and the husbands immediately arrange another secret marriage. This emanates from the commonly held assumption that the migrant women sells her womb in abroad or have sexual relation with foreigners. After all, one of them needs to check their health status and divorce is common if one of them refuse to do so. The study also disclosed there was a conflict between husbands and migrants parents when the husbands consume remittance alone. This kind of quarrel happen between couples when husbands of migrants arrange a secret marriage with others, drink and waste what she sent which in turn leads to divorce.

The result of the study also indicated that many potential migrants who are under the age of the 18 migrate to the Middle East from Areka town due to the assumption/experience that migration is the only option for poor. They arrange marriage at an early age for the sake of sponsorship. Then, they become enjoyment for smugglers on the journey and finally become sick which if burden for their family. On the other hands, many of them migrated dropping class makes the issues the worst and diminishing the number of literate females in the future.

In the study area almost, all migrants prefer illegal ways of migration. This is due to the legal one is process full and more costly than the illegal. The legal ways require multiple criteria such as age more than eighteen, educational background above grade eight, TVT and home maid training, and should pass COC exam.

In conclusion, the migration of married women to the Middle East has both positive and negative impacts. These touches or influences economic, social and political aspects of family members left behind.

## **Recommendations**

Migration is one of complex problem especially married women migration because it has a lot of positive and negative impacts on different aspects of a family. Thus, narrowing a complicated problem like the impact of married women migration is a difficult task. It needs a thorough understanding of its complex nature of impacts on various aspects of family members. Policy frameworks have considered this nature of the problem. Efforts have made to think about the situation of the family left home after the women migrated from government and other stakeholders to offer a viable solution to the problem, thus the followings are possible recommendations in this study.

* The investigations revealed that the lack of job opportunity and poverty are the major factors for women migration from Ethiopia, especially in the study area. Paving job opportunities and giving special attention to female has to be taken by the government and concerned body in order to broaden the options of women to support themselves and their families within their country instead of considering migration as the only option they have. Steps should be taken are first, educating and training women based on the easily affordable work areas. The second one is opening job opportunities accessible to married women in the country. Third, expanding credit association as well as saving institutions in order to make them effective. These are because due to women migration many dependent family members were vulnerable.
* The other important point the study come up is the majority of migrants to the Middle East are migrating alone leaving other family members at home. They leave infants feeding breast, elder who are needy and sick, and husbands. The remaining family members overburdened by different extra loads that are worse if there were no other family members with them who help migrants’ family. Many infants are under psychological and physical risk. Others are dying because of the lack of main caregivers. Here, what I recommend is first, organizing care centers with the concerned body (like government, NGOs, and agencies working in migration) in different areas for children and elders. Second, the government has develop legal instruments concerning the family situation before the women migration that limits who can migrate and who cannot be based on the family situation. Thus, the government and stakeholders of the issue have to think about the impacts of married women migration on families left home in instruments of international, regional and national migration. Therefore, the instruments have considered the year of infants left home, the health status of all family, representative of a family and the family relation (whether the process is by common consensus or not).
* Many migrate after arranging an immediate marriage to gain sponsorships (migrant women) and to consume remittance (migrants’ husbands). If migration is must and many lack money to process it, the government and any concerned body should open free options/government sponsorship by dealing with receiving countries or sending agencies. The other is many migrants are under the age of 18 and due to above problem marry someone. As a result, many returns are not healthy and do not want to have sexual relation with their husband. This needs free option and on the other hand strict follow up between the country of origin and destination. The regional, as well as national instruments, also have considered the marital status of the family/couples and ages of migrants because many husbands send their first wife and again sending another woman by the remittance they gain from the previous wife. This, in turn, increases polygamy. Therefore, it needs legal interpretation from the concerned body and formulation of new suitable instruments.
* The main source for divorce in migrants’ family is suspecting one another. Thus, as they return one of them needs a medical check. When a husband or his wife refuses to do so divorce is common. Therefore, there should be medical check offered by the concerned body when the women are migrating and returning on both couples. Therefore, it is the responsibility of stakeholders such as a church, government, civil societies, and NGOs because the marriage is going easily divorced, the country’s plan is failing and family members are easily endangered.
* Women migration to the Middle East is not following legal ways rather illegal because the legal one has complex process and costly than illegal. Due to widely practicing of the illegal migrations, the whole community members are under dilemma and do not know even the existence of legal one, and prefer the illegal through smugglers. Therefore, it needs large awareness creation from government especially labor and social affairs, Women and Children Office, Police and NGOs as well as the right measurement on smugglers and any other bodies who engage in illegal migration. The other is here it requires to cooperate working of different institutions from the Goti/kebele to agencies. Making information campaign among the communities to make awareness regarding the perception of communities towards migrants and their families is equally important. This is because many community members perceive that migrants sell their womb/rent out in abroad and as their family sold their wives/daughters as well as the husbands could not manage his family.
* The women migration to the Middle East is also developing the attitude that learning is valueless among community especially female/girls. The significant numbers of women are migrating by dropping out their academic class, the number of women is diminishing due to migration and migrant returns are sick because of the difficult work environment, but the payment is low. Therefore, sending and receiving countries should set common agreement on payment amount, academic status, working hours, and health insurance.
* After all, that I recommend is our government need to undertake comprehensive action-oriented research on family situations after the women migrated the Middle East in order to alleviate the problem in a sustainable way.

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* 1. Family-Friendly Workplace Practices Availability Accessibility and Adequacy in Addis Ababa Civil Service Organizations

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# Abstract

*The increasing number of women in the workforce is a global phenomenon, and Ethiopia is no exception. Working mothers have always shouldered a more significant share of the household burden, yet they have incredible contributions in the paid work-force. The purpose of the study was to identify the availability, adequacy, and accessibility of the existing family-friendly workplace policies for working mothers in their workplace. The study employed a mixed data collection method. The findings indicated that the existing family-friendly workplace practices are far from adequate. Working mothers are working in harsh corporate cultures that are not accountable for creating real opportunities to move up and regain their confidence after delivery, and these, in return, are impacting their productivity in their paid work. The study recommends that organizations should apply Family-friendly and inclusive policies in the workplace to help them unleash their full potential in the paid work-force without ignoring their indispensable responsibility at home.*

**Keywords; -***family-friendly workplace practice, working mothers, adequacy, accessibility, availability*

**Introduction**

In almost all societies around the world, women are assigned by custom to be the primary caregivers to infants and children (UNDP, 1995), the outside world was male dominant, and the male was the only provider of his family. However, now adays, studies show rising employment of women. Recently, women have worked as much as men, if not more. According to Bongaarts (2015), when paid and unpaid work such as household chores and caring for children are taken into account, women work longer hours than men, an average of 30 minutes a day longer in developed countries and 50 minutes in developing countries.

International Labor Organization (ILO) conventions have protected several aspects of decent work (family-friendly workplace) as critical for reconciling work and the family life of workers (Jayasekaran & Miguet, 2020). According to the definition of UNICEF, Family-friendly policies are those policies that help balance and benefit both work and family life that typically provide three types of essential resources needed by parents and caregivers of young children: time, resources, and services (UNICEF, 2019).

In Ethiopia, the share of women engaged in the labor force was 77 percent in 2017. However, their engagement in the paid labor force does not save women from carrying on a disproportionate share of the unpaid household and caregiving responsibilities at their house especially, for women with child/ children, working outside has made their situation worse (The International labor office et al, 2017).

Ethiopia has ratified 23 conventions, including 8 Fundamental conventions of international labor organizations. This study examines the availability, adequacy, and accessibility of family-friendly workplace practices in Addis Ababa civil service organizations.

Studies conducted worldwide regarding trends of women employment such as (The World’s Women, 2015; Mavis & Ummu, 2012; Delina &Prabhakara, 2013) and (ILO, 2013) have shown an increment in the rate of women employment. In Ethiopia, the case is not different 50% of the Ethiopian population comprises women, and they are actively involved in all aspects of their society’s life (Gender at work, 2015). In a study conducted by Fitsum (2014), it was revealed that employment is getting better though it is insignificant.

As the studies mentioned above show, women’s employment in the paid labor force is becoming a global phenomenon. As a result, over the past three decades, a rising stream of research on women’s joint role as wives, mothers, and paid employees(multiple roles)has inspired the interest of researchers such as (Tijdens &Klaveren, 2012);(Abdul, Allahdino & Roshan, 2012);(Green & Russo, 2004); (McBride, 2008); (Tang &Tang, 2001) and (Lahelma *et al.*, 2002). In addition, a study conducted by women at work (2010) indicated that, unlike old days, women who have children besides household chores (unpaid work) have begun to engage in skilled and unskilled labor work. Nonetheless, working outside the home as a professional worker or unskilled laborer does not ease the workload at home (Lahelma *et al.*, 2002).

In another study by (Hochschild 1989) & (Tang & Tang 2001), it was argued that while women have taken on more masculine work roles, they continue to bear many of the responsibilities in their homes. Finally, a study by Kassa (2015) strengthens this finding in his study, despite the subordinate status women have in the society and their exclusion from most of the privileges and opportunities that are available to their male counterparts, women’s contribution to the survival of the household economic and social development of the society as producers and reproducers is indispensable.

Being a working mother is identified to have both positive and negative impacts. Different researchers have studied the positive impact of being a working mother. Gender at work (2015) indicated that jobs could benefit women, families, businesses, and communities. Jobs boost self-esteem and pull families out of poverty (International Labor Office, 2007). Family-friendly policies pay off in healthier, better-education of children. It was also stated that in places where women’s paid work has increased, as in Latin America and the Caribbean, gains have made significant contributions to overall poverty reduction (ILO, 2010).A report by UNICEF also argue that Greater gender equality and sustainable growth are linked to better workforce productivity, and the ability to attract motivates and retains employees (UNICEF, 2019)

On the other hand, problems in children’s development, stress, and less income were the negative impacts of being a working mother. According to Tijdens & Klaveren (2012), women’s earnings often decline when they have children. Furthermore, in a study conducted by (Abdul, Allahdino & Roshan, 2012), it was found that early separation of mothers due to job harmed child’s social, psychological, and emotional development.

Momentum for change is growing in several countries to adopt a family-friendly policy that reconciles the positive and negative impacts of being a working mother (Jayasekaran & Miguey, 2020); this includes Flexible work hours, child care subsidies, on-site daycare, unpaid leave, and distance working. However, even if a report of ILO ( 2019) indicate that the number of women embracing full-time careers in Ethiopia has increased dramatically, there has not been much said regarding what the the government has done to help working mothers balance their work, and family life in civil service organizations

Therefor this study intends to assess the availability, accessibility, and adequacy of family-friendly workplace policies that are believed to increase working mothers’ performance at their paid work without undermining their caregiving role.

## **Methodology**

## **Research design**

The study employed a concurrent mixed-data collection method in that it involved working mothers who are currently working in the civil service organization of Addis Ababa and federal public organizations. A qualitative method of data collection was used to collect primary data from officials; an unstructured interview guide was a primary data collection instrument for this part. Finally, thematic analysis was used to analyse the qualitative data. For the quantitative part, the participants were working mothers who are currently working in a public organization at the same time raising their child/ children; they were included in the study through a systematic sampling technique; finally, the data was analyzed using descriptive statistics.

**Study site**

The study was carried out in Addis Ababa, Ethiopia. More than any other city in Ethiopia, the presence of many public organizations and employees is the primary reason to conduct the study in Addis Ababa. The study included three sub-cites from the Addis Ababa city administration, namely Yeka, Arada, Gulele and three federal public organizations, namely Aabet hospital, Trade & industry minister, mining, and petroleum minister.

**Participants of the study**

This study involved two groups of participants. The first group was get keepers who are believed to have information regarding the right and facilities working mothers are entitled to, and these were mothers and children affairs in each sub-cities and personals under building and construction office in each minister bureaus since they are in charge of the daycare service in these offices. The second group was working mothers working in public organizations and raising their child/ children (preschool children) simultaneously.

**Sampling techniques**

For the qualitative study, the Purposive sampling method was used. For the quantitative study, systematic sampling was used. First, the sample size for this study was determined by considering the standard deviation set at a 95% confidence level (1.96). Then (50%=0.5) response was picked, and the confidence interval was set at (0.05= +/-5) using the formula below 384 respondents were included in the study.

N=z2 (p) (1-p)/c2

Where

Z=standard normal deviation set at 95% confidence level

P=percentage picking a choice or response

C confidence interval

N= (1.96)2(0.5) (1-0.5)/ (0.05)2

N= (3.8416) (0.5) (0.5)/0.0025

N=0.9604/0.0025

N384.16

N= 384

**Data-collection instrument and tool**

An unstructured interview guide consisting of open-ended questions was used for the qualitative study to collect data from get keepers an in-depth interview was held with working mothers and officials in each of the selected study sites. For the quantitative part Questionnaire developed by the researcher based on united nations children’s fund(UNICEF), four sets of decent (family-friendly) workplace policies which are (1) paid parental leave to care for young children, (2) support for breastfeeding (3)Affordable, accessible and quality child care (4)Child benefits was used

**Method of data analysis**

Thematic analysis, which is used to analyze, classify and present themes that relate to the data (Boyatzis, 1999), was used to analyze the data collected qualitatively in duing the analysis the researcher employed a six-phase approach to thematic analysis (Braun & Clark, 2006), which involved: familiarization with the data; generating initial codes; searching for themes; reviewing themes, defining and naming themes. For the quantitative research, since the aim was to assess the availability, accessibility, and adequacy of the existing family-friendly workplace practices, a fundamental descriptive statistical analysis was computed, and results were presented using a table. Finally, results obtained from the two data collection methods are compared for any divergences or convergences.

**Results and Discussion**

**Qualitative results**

Unstructured interviews were the primary technique used to collect data for qualitative study. For example, to describe the available services, adequacy, and accessibility of the family-friendly workplace practices that could help working mothers utilize their full potential in the workplace without jeopardizing their caregiving role, working mothers, as well as those considered to be in charge of the available services for these workers, were interviewed accordingly, a total of 30 interviews were conducted. Out of this, 20 participants were working mothers, and the rest were get keepers. Interviews were recorded and transcribed both by the leading researcher and assistant researcher, and then the principal researcher translated all transcribed data alone; this helped the researcher to get to know the interviews that did not involve the researcher.

The analysis method chosen for the data gained through the interview was thematic analysis, well known for its flexibility (Braun & Clark, 2006). The researcher employed a six-phase approach to thematic analysis (Braun & Clark, 2006), which involved: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes. Based on this Method, four themes were identified concerning the data and the study's objective. These thematic categories include 1, inaccessible but available service 2, the challenge at workplace 3, the challenge at home 4, what should be done. The table below demonstrates the main themes and the sub themes extracted from the data collected through interview.

|  |  |
| --- | --- |
| Main themes | Sub theme |
| 1. Inaccessible but available service | 1. Lack of transportation to take my child with me 2. Remote residence 3. Lack of awareness 4. Service is in adequate |
| 1. Challenge at workplace | 1. Dizziness 2. Body presence mind absent 3. Quarrel with immediate supervisor/ boss or co-worker 4. Not being able to make it on time |
| 1. Challenge at home | A. Limited or no time to spend with kids  B. Fatigue all house hold chores await me  C. Economic impact  D. Social impact  E, Health impact  F, Quarrel with husband |
| 4. what should be done | A. Free nearby daycare  B. Shift work, emergency leave  D. Transportation for infants  E. Extended maternity leave |

Table 1 main Themes and sub themes

## ***Theme 1 Inaccessible but available services***

Throughout the interview, participants explained that even though some of the services that are believed to help working mom handle their multiple roles, such as daycare, and emergency leave, exist, many either are not aware of the emergency leave / የእክል ፍቃድ/ or access to the daycare is not as simple as it should be as the interviewee in Gulele sub-city explained.

*“Serving all employees is not easy we only accept children of working mothers between 4 months to 3 years of age many employees complain about this. The other reason is our daycare can only serve up to 20 children, and we only have five nannies.”*

Similarly, the following quote was extracted from a working mom interview conducted in Yeka sub-city as she described,

*“Our daycare is not working for the time being due to covid19, but before the pandemic, we used to accept children up to 3 years of age; we only give priority for those working mothers who have an infant regardless of their working position.*

Another reason this daycare is not accessible, according to this interviewee, is

*“Most of the sub-cities employees live in the outskirt of Addis traveling by public bus carrying the baggage for their child is very tiresome sometimes impossible.*

*For example, before the pandemic, I had a 7-month infant. I live around Tafo mission. I feel shame when I do not sit on the bus because someone would stand and leave their seat for me; seeing the man stand the entire journey is uncomfortable. On top of that, the food and the milk I carried for my baby will be spoiled or spilled. Thus, I decided not to bring my baby again.”*

An interview with personnel in the Bole sub-city, on the other hand, revealed that

*“Our daycare is currently not working, and it is not only due to the pandemic. Even though we were the ones who began onsite daycare from all the sub-cities, our daycare was not well planned; it was tiny, the building was not made for daycare, it had a bad smell, and the ground was humid. Bringing a child in that daycare was the last resort for the working mothers in our organization. Nobody would bring their child if they were not really in need of it”*

According to this interviewee,Lack of awareness is another barrier to not taking advantage of the 7-day leave known as የእክል ፍቃድ, which is especially true for janitors and other support staff they will either leave without permission or consider it as a favor they owe to their supervisors.

***Theme 2 challenge at workplace***

***Dizziness***

“Dizziness” was repeatedly mentioned as the most challenging issue working mothers face at the workplace; even though the contributing factor for the dizziness differs for each working mother, almost all the interviewed participants who breastfeed usually feel dizzy.

The quote below was taken from the interview; it emphasizes a view of working mothers from trade and industry ministers on this topic.

*“Coming to work early morning and being active and cooperative is very difficult for me. Because of breastfeeding and household chores that await me when I get back home, there are nights I do not even get sleep for four hours. Sometimes my baby does not want to sleep. Even if my husband is there, it is all my responsibility. So, I will usually be dizzy, especially in the morning.”*

The other issue repeatedly mentioned by working mothers as a workplace challenge is being in a “mind absent body presence*” situation.*

 A working mother in abet hospital explained that.

*“My biggest fear is for my patients. I usually warn myself to be active in my work, but I find my mind at home with my child and other household issues; there are times my friends remind me of the medication time since that day I usually use alarm application because I do not trust myself anymore”.*

Similarly, a working mom in vital events and registration in the Gulele sub-city stated that

*“One day, my housemaid called me and told me that she wanted to go. It was 3 pm. I was so worried for my children I could not figure out why she wanted to go while still, I am at work amide this confusion; I made a mistake twice which led me to disagreement with the customer I was serving.*

***Quarrel with immediate supervisor***

Quarrel with immediate supervisor/boss or coworker is another issue raised by working mothers. According to the interview, working moms are usually required to leave and sometimes make unauthorized absences.

 This working mother states this issue as

“*getting a leave sometimes is not because you deserve it, it is based on the closeness you have with the boss or the kind of boss you have determine whether you get that leave if she/ he has a good virtue and is considerate he/ she will decide that you get that permission and if the boss is not considerate or you are not friends, she/ he will forbid you what it ought to be your right this has been a source of a quarrel between a boss and a working mother for so long*

***Not being able to make it on time***

Coming late is the central issue working mothers explained as a significant workplace challenge. The following quote was taken from a working mother interview conducted in the Gulele sub-city; it illustrates how workplace responsibility can be affected by multiple responsibilities at home.

“*I am a team leader; I know I have to be a role model, I should not be late, but sometimes I cannot be on time no matter how I try. I have three children 2 of them are in kindergarten. I always wake up around 5 pm, cook and pack their lunch box, help them get dressed for school, serve breakfast, breastfeed the little one, and finally, I will leave the house without having breakfast*. *Sometimes I cannot*take*the public bus, so I should tolerate a long queue to get a taxi. It will be too late when I get to work,* *but I do not give up. I will* *try the next day. I might make it or worse, but I will still* *try it the next day.*

As the quotations above illustrate, working mothers’ multiple roles at home affect how they behave, act, and perform at their workplace. Likewise, as the interviewee explained, being a working mother also affects their time with their children and causes fatigue, eventually jeopardizing their health. On top of that, economic impact, social impact, health impact, and disagreements with their spouses are the significant issues reputedly mentioned by the interviewees as a challenge at home.

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 As the quotations above illustrate, working mothers’ multiple roles at home affect how they behave, act, and perform at their workplace. Likewise, as the interviewee explained, being a working mother also affects their time with their children and causes fatigue, eventually jeopardizing their health. On top of that, economic impact, social impact, health impact, and disagreements with their spouses are the significant issues reputedly mentioned by the interviewees as a challenge at home.

***Theme 3 Challenge at home***

***Limited or no time to spend with kids***

The interviewed customers stressed how working outside and inside the house limits their time with their child/ children.

A working mom in the mining and petroleum minster office states that

*“Working outside highly impacted the time I should spend with my children. Since my home and my workplace is very distanced, I always leave the house while my children are asleep and when I get back after work, sometimes I find them asleep sometimes I get them awake, but I cannot sit and be with them because I have to do household chores for tomorrow so that my maid will only take care of them. This is my everyday life. There was a time my oldest son was admitted to hospital for a month; doctors told me that had I had seen what happened to him on time, this would not have happened to him.”*

Similarly, the interview revealed thatfatigue is a significant issue all working moms mentioned as the biggest challenge they face because of being a working mom.

This is a quote taken from a janitor in the Gulele sub-city

*“My work here is very tiresome. I wake up early in the morning, prepare food for my children, and be at work before 1; 00 am in the morning. Then, when I get back home, all the chores await me. I cannot afford to have a housemaid so that I do everything alone. As a result, I always feel exhausted and sick; I even do not eat my breakfast. Therefore, I wish my husband provide us alone so that I can only do the household chore.”*

***Economic impact***

The economic impact is one of the frequently mentioned challenges working mothers face at home. For example, a working mom in the Bole sub-city argued that

*“Working outside, in fact, help me get additional income; however, the loss I encounter overweight the gain, so I always feel I would rather be a stay-at-home mother and take care of my children than work here. For example, had I been a housewife, I would use household consumptions wisely, and the money I pay for a housemaid and brokers would have been saved.”*

***Health impact***

Constant fatigue, sleep deprivation, not eating well, and stress being a working mom has harmed some but has improved their health condition. A working mom in the Bole sub-city states that

*“Working outside for me is not something I do with delight. My daughter was raped while I was at work. Because of covid19 she had not gone to school she was playing outside with her peers she was only five this will remain my biggest regret throughout my life”.*

In contrast, an interview with a working mother from abet hospital reveals that

*“Working outside for me has brought so many good things in my life. I am healthier and happier than before.”*

When comparing who claims to be healthier and happier for being a working mom based on their working and economic conditions, almost every professional employee interviewee claims they are happy because they work outside. On the contrary, those considered supporting staff like janitors and guards argued that working outside negatively affects everything except their economy.

***Quarrel with a spouse***

Most interviewees state that working outside impacted their marriage and has put them in constant quarrel with their husbands. According to an official in the children and women’s affairs bureau in the Bole sub-city, two working mothers were obliged to quit their job because of everyday disagreements with their husbands. as the interviewee explained, some do not want their wife to work outside, and some, even if they do not mind her working outside, prefer her to take care of the kids and the house then work outside.

# Quantitative finding

The purpose of the quantitative study was to assess the existence, adequacy, and accessibility of service provision for working mothers to help them unleash their full potential in the workplace and maintain a family-work balance. In this part of the chapter, the data that has been collected quantitatively will be presented. First Profile of Questionnaire Respondents’ socioeconomic Demographic characteristics is presented. The second table depicts the challenges and the coping mechanisms of working mothers. The third table shows the existing service. The fourth and the fifth table respectively show adequacy and accessibility of the existing service.

Table2. Demographic characteristic of respondents

|  |  |  |
| --- | --- | --- |
| Socioeconomic &Demographic features | Percentage | Frequency |
| Educational Qualification  Below 12  12th complete  Diploma  First Degree  Master’s Degree  PhD Other  Total | 8.68  7.89  3.42  65.79  14.21  0  100 | 33  30  13  250  54  0  380 |
| Age  18-25  26-35  26-45  46 and above  Total | 3.16  82.37  14.47  0.00  100 | 12  313  55  0  380 |
| Occupation  Professional employee  janitor  security  Other  Total | 81.58  8.95  6.84  2.63  100 | 310  34  26  10  380 |
| Monthly income  1000-3000  4000-6000  7000-10000  Above 10000  Total | 18.42  65.79  12.63  3.16  100 | 70  250  48  12  380 |
| Family Type  Nuclear  Single parent  Extended  Total | 63.16  8.42  28.42  100 | 240  32  108  380 |

## ***Demographic characteristic of respondents***

 As shown in table1 the majority, 65.79% or 250 out of the total 380 respondents, are first degree holders while 14.21% have master’s degrees the rest 20% are below grade 12/or grade12 completed or have a diploma. Regarding respondents’ age, while82.37% fail on the age range of 26- 36, 14.47% are above 36 the remaining 3.16% are below 25. Concerning respondents’ occupation, 81.58% are professional employees the rest 18.42% are supporting staff (janitor, security guard, and others). Just like their occupation, respondents’ monthly salary is also different 250 respondents’ out of the total 380 or 65.79% earn 4000-6000 while 12.63 get between the 6000-10000 very few 3.16 earn above 10000. The rest earn below 3000 monthly. Respondents also differ in the type of family they have. While 63.16% have nuclear family, 28.12 have extended family the remaining 8.42% are single parents.

## ***Challenge and coping mechanism***

Respondents were asked which means of transportation they often use to go to their workplace. While a significant number of respondents’ 86.05% use public buses (service), 9.47% go by foot, and 4.47% percent use family and their care provided by the government. Concerning household responsibility of respondents’, 85.26% claim all household chores are their responsibility 11.31 %of respondents said they only take care of the kids and cook. Very few 3.42% participants, on the contrary, said they are free from any of those responsibilities. 68.42% said housemaid supports them, 29.47% of respondents are supported by family member minimal number of respondents’ 2.11%, on the other hand, are supported by their husband.  While participants are at the workplace, 52.89% of respondents said housemaid takes care of my child/ children 18.42%, on the other hand, leave their child/ children for family member 4.21% of respondents however either leave their child/children alone or will ask the neighbors to watch them 9.74 % of them take their child to the onsite daycare or another daycare in their village. The rest, 14.74%, said they are school-aged. Thus, they will be at school while their parents are at work.

The study participants have a different reason for working outside despite the challenge they face for handling such multiple responsibilities. For 89.47%, it is because they do not survive if they do not work; for 7.11%, it is a passion that keeps them at work, and for the remaining 3.42, it is because they do not want to be a stay at home mothers. Similarly, they were also asked if they could quit their job if needed while 8.95% said yes, the rest, 91.05%, Said they could not quit their job.

 Participants were also asked to compare the tension and anxiety level of housewife mothers and working mothers 76.58% said working mothers live in more tension and anxiety than housewife mothers. On the other hand, the remaining 23.42 % did not agree. On the other hand, Participants of the study were asked if they have ever encountered any physical or mental problem in case of overwork load16.32% said yes the rest 83.68% said they have never encountered any of the mentioned problems. Finally, for the question asked to assess whether participants feel they can balance family life and work, 7.89% said they had balanced the two, but a significant number, 92.11% or 350 participants of the total population (380), said they are not able to balance the two.

Table 4.Items describing the existence of service for working mothers in their workplace

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | the following services are available at my workplace | Value | missing | Strongly disagree | disagree | neutral | Agree | Strongly agree | Total |
| 1 | Onsite daycare | Freq | 0 | 0 | 0 | 0 | 0 | 380 | 380 |
| percent | 0 | 0 | 0 | 0 | 0 | 100% | 100% |
| 2 | Shift work | Freq | 4 | 376 | 0 | 0 | 0 | 0 | 376 |
| percent | 1.05 | 98.9 | 0 | 0 | 0 | 0 | 98.9 |
| 3 | Breast feeding room | Freq | 0 | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 0 | 100 | 0 | 0 | 0 | 0 |  |
| 4 | Emergency leave | Freq | 0 | 209 | 0 | 0 | 78 | 93 | 380 |
| percent | 0 | 55 | 0 | 0 | 20.5 | 24.4 | 100 |
| 5 | Transportation for working mothers to take their child to the onsite daycare | Freq | 0 | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 0 | 100 | 0 | 0 | 0 | 0 | 100 |

## ***Existence of family friendly practice***

The study’s general objective was to assess the existence, adequacy, and accessibility of family-friendly policies at the workplace for working mothers; to do this; lists of mandatory family-friendly workplace services were given for participants to check whether they are available in their workplace. In the second category, the same inventory was given to participants to indicate to what extent those services were adequate. Finally, the same lists were given to them to show how easily the available services can be attained. Table4 shows lists of services that are believed to be available in every organization. The first question was checking the availability of onsite daycare; for this question, all 380 of 380 participants strongly agreed on onsite daycare in their workplace. Regarding shift work, 376 participants disagree on the existence of shift work in their workplace.

A separated room for breastfeeding or pumping is not available, which was confirmed by 100% of study participants. As the finding in the qualitative study indicates, breastfeeding moms breastfeed inside the onsite daycare if they bring their child if they do not bring their child to the onsite daycare; however, they breast bump in the toilet. Emergency leave is another fundamental right any working person deserves, especially a working mom; as the table above indicates, 24.4% and20.5% strongly agree and agree consecutively on the existence of emergence leave; however, a significant number of respondents disagree. This finding was also similar to the qualitative finding. In the qualitative finding, it was found that since the immediate boss usually grants an emergency leave, informally; getting an emergency leave depends on how close you are to the boss and the kind of boss one has.

Finally, the existence of transportation for working mothers to take (infant or children) to the onsite daycare was assessed, and100% of the study participant disagreed on the existence of this service. Inconsistent with this finding, the qualitative finding revealed that most working mothers who bring their child to the onsite daycare use public transport, which is usually very overfilled and unsuitable for the child.

Table 5 Items describing accessibility of existing service for working mothers in their workplace

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | I can **easily get** the following services in my workplace | Value | missing | Strongly disagree | Disagre | neutral | agree | Strongly agree | total |
| 1 | Onsite daycare | freq | 0 | 79 | 0 | 0 | 0 | 301 | 380 |
| percent | 0 | 21 | 0 | 0 | 0 | 79 | 100% |
| 2 | Shift work | freq | 0 | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 0 | 100 | 0 | 0 | 0 | 0 | 100 |
| 3 | Breast feeding room | freq | 0 | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 0 | 100 | 0 | 0 | 0 | 0 | 100 |
| 4 | emergency leave | freq | 9 | 269 | 0 | 0 | 0 | 102 | 371 |
| percent | 2 | 71 | 0 | 0 | 0 | 27 | 100 |
| 5 | Transportation for working mothers to take (infant or children) to the onsite daycare | freq | 0 | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 0 | 100 | 0 | 0 | 0 | 0 | 100 |

## 

## **Accessibility of the available family friendly workplace practices**

The above table shows lists of services and how accessible they are. Regarding the accessibility of the onsite daycare, 301 participants strongly agreed on its accessibility; however, 79 participants disagreed. This finding goes in line with the qualitative finding. In the qualitative study, even if there is an onsite daycare in their workplace, most working mothers cannot access it due to different reasons 1, lack of transportation, the capacity of the daycare 3, age of a child (a child only between 4 months up to age three are prioritized) 4, covid19 almost all onsite daycares are closed except the one located in Gulele sub-city. Regarding the emergency issue, 27% OF respondents strongly agreed on the accessibility of emergency leave; however, a significant number of participants 71%disagreed on its accessibility. Similar to this finding, the qualitative study found out that most supportive workers and even professional employees are not aware of the emergency leave ( የእክል ፈቃድ) or most of the time, this kind of leave permission is granted by the immediate boss if they do not have a good relationship with the boss or if the boss is not considerate an emergencleavewouldbeinaccessible

Table 6 Items describing adequacy of existing servicee for working mothers in their workplace

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No | The following services are **adequately** available at my workplace | Value | Strongly disagree | Disagree | agree | neutral | Strongly agree | Total |
| 1 | Onsite daycare | freq | 255 | 0 | 102 | 23 | 0 | 380 |
| percent | 67 | 0 | 27 | 6 | 0 | 100% |
| 2 | Shift work | freq | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 100 | 0 | 0 | 0 | 0 | 100% |
| 3 | Breast feeding room | freq | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 100 | 0 | 0 | 0 | 0 | 100% |
| 4 | emergency leave | freq | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 100 | 0 | 0 | 0 | 0 | 100% |
| 5 | Transportation for working mothers to take (infant or children) to the onsite daycare | freq | 380 | 0 | 0 | 0 | 0 | 380 |
| percent | 100 | 0 | 0 | 0 | 0 | 100% |

## 

## ***Adequacy of the available family friendly workplace practices***

The above table shows the degree to which the existing services are adequate. 102% of the total population strongly agreed on the adequacy of the onsite daycare while 6% remained neutral the rest 76% strongly disagreed on the adequacy of the onsite daycare. This finding is consistent with the finding of the qualitative study, among the problems mentioned during the interview regarding the problems of the onsite daycare by working mothers 1, very few nannies; 2, the nannies are not professionals 3, shortage of bed 4, lack of hygiene, some of the daycares were not built for this purpose and leakage in the building are the major one.

**Conclusion and Recommendation**

## **Who takes care of your child/ children while you are at work?**

While participants are at the workplace, 52.89% of respondents said housemaid takes care of my child/ children 18.42%, on the other hand, leave their child/ children for family member 4.21% of respondents however either leave their child/children alone or will ask the neighbors to watch them 9.74 % of them take their child to the onsite daycare or another daycare in their village. Similar to this finding, a study by UNICEF indicated that globally, over 35.5 million children under five are being left at home without adult supervision. More precisely, according to the organization report, In parts of Ethiopia, more than 50% of rural girls aged 5-8 provide unpaid care daily; this includes caring for siblings "when parents work, often grandparents or older children plug the childcare gap" (Samman et al., 2016, Pp 40). Similarly, in 53 low- and middle-income countries, accounting for nearly 20% of the world's under-fives, on average, 20% of children under five were without adult care for at least an hour in a given week, either left alone or in the care of a sibling under the age of ten (Huebener et al,2016).

**Which household chores are yours?**

Concerning household responsibility of respondents', 85.26% claim all household chores are their responsibility 11.31 %of respondents said they only take care of the kids and cook. Very few 3.42% participants, on the contrary, said they are free from any of those responsibilities. 68.42% said housemaid supports them, 29.47% of respondents are supported by family member minimal number of respondents' 2.11%, on the other hand, are supported by their husband. In line with this finding, a study conducted by the Bongaarts (2015**)** argued that when both paid and unpaid work such as household chores and caring for children are taken into account, women work longer hours than men, an average of 30 minutes a day longer in developed countries and 50 minutes in developing countries.

***Child care facility***

Onsite daycare is the most widely implemented of the family-friendly policies in the studied organization. According to the finding of this study, 100% of the study participants strongly agreed on the existence of onsite daycare in their workplace. However, the mere existence of the facility does not indicate the implementation of family-friendly practices in the organization. Furthermore, participants argued that accessing the daycare for some is challenging, and a significant number of the study participant believe it is far from adequate. These findings (it is inadequate, and it is inaccessible) have also been mentioned in the qualitative study, and they were linked with three core reasons 1, material and human resources 2, inconvenience of a public bus to take their infant or child to onsite daycare 3long distance between workplace and home.

*These findings are compatible with the report of UNICEF; according to its study finding*, working parents in many countries face barriers to accessing good quality childcare and early education. In 67 low- and middle-income countries, 69 percent of children (nearly 57 million) do not attend early childhood education programs (UNICEF, 2019)

***practices to encourage breastfeeding***

Breastfeeding is an internationally recognized labor right. WHO and UNICEF recommended exclusive breastfeeding for at least six months after childbirth and continued breastfeeding for at least two years (Gartner, 2005). However, in Ethiopia, the paid maternity leave lasts 16 weeks; after that, no law guarantee breastfeeding breaks for those working mothers who choose to breastfeed once they return to their work after delivery ( after four months). The study also identified that a separated room for breastfeeding or pumping is not available, which was confirmed by 100% of study participants. As the finding in the qualitative study indicates, breastfeeding mothers breastfeed inside the onsite daycare if they bring their child if they do not bring their child to the onsite daycare; however, they breast bump in the toilet and dispense it since there is no safe place to store the pumped milk.

 In contrary to this finding, in a global study of UNICEF (2019) on family-friendly policies, it was identified that 39 % of surveyed organizations have one or more policies supporting breastfeeding. 57% of the studied organizations provide a room for breastfeeding or expressing breastmilk, while fewer organizations (2019) provide information and other nutritional support, such as the services of a lactation consultant for breastfeeding women. Some interviewees in this study mentioned that providing a dedicated room for breastfeeding or a clean space for storing expressed breastmilk (2019). Globally, returning to work is a crucial reason why mothers choose not to breastfeed or to stop breastfeeding early (Rollins, Nigel, et al., 2016)

***Paid Maternity leave***

` Paid leave for working mothers is the most widely implemented family-friendly policy in the studied organization. Maternity protections include the right to at least 14 weeks of paid maternity leave with adequate cash benefits to ensure mothers can support themselves and their children during leave (ILO, 2020). In line with ILO Recommendation No. 191, companies are encouraged to provide at least 18 weeks of leave with full pay (ILO, 2020) even if it is not adequate maternity leave in Ethiopia is almost equals to ILO recommendation and 100% of the study participants agreed on the availability and accessibility of 16 weeks of paid maternity leave. According to ILO'S study on International Labor Standards and Instruments, only just over half of the countries that have ratified ILO Convention 183 on maternity protection meet the ILO minimum standard requiring at least 14 weeks of maternity leave, let alone the ILO recommended 18 weeks( ILO, 2020)

**Conclusion**

Family-friendly policies matter because they help children get a better start in life and help parents find the right balance between their commitments at work and home (Chzhen, Gromada &Rees, 2019). Both the qualitative and the quantitative study's findings supplement each other. In the entire study site, the only available family-friendly workplace practice is onsite daycare; however, accessing the daycare for some is very difficult, and a significant number of the study participant believe it is inadequate. This finding has an implication for the policymakers and those in charge of executing the policy. Applying family-friendly policies at the workplace enhances working mothers' performance in their workplace without jeopardizing their caregiving responsibility at home.

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* 1. Public health care alternatives through traditional medicine in Ethiopia: The legal dimension in focus

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***Abstract***

The article explores possibilities of saving deteriorating traditional medicinal knowledge and practices in Ethiopia. Due to poor legal and institutional protection afforded to traditional medicinal knowledge and practice, Ethiopian traditional medicinal practitioners apply self-policing method of protection, which is unreliable and less effective method to transfer the knowledge for the future generation. This study attempts to find out legal solution to elicit undisclosed traditional medicinal knowledge and enrich public domain. With a view to assess the usage and the practice of traditional medicinal knowledge, certain purposely selected traditional medicinal clinics were visited, practitioners, and their clients were interviewed, empirical data collected from actual and potential beneficiaries, regulatory agencies were visited, and heads were interviewed. The principles and theories of patent system are scrutinized; the potency of Ethiopian patent law to address issues of traditional medicinal knowledge is explored. The study reveals that Ethiopian traditional medicinal knowledge may be protected through utility model certification, but serious positive government action should be taken. This includes revision of patent proclamation with a view to attract traditional medicinal practitioners to get legal protection and disclosure of privately held medicinal knowledge to the regulatory agency – the Ethiopian Intellectual Property Office that can grant utility certificate.

# Introduction

It is commonly believed that medieval Ethiopia had enjoyed a highest level of “civilization” analogous to the then ‘advanced’ nations.[[2]](#footnote-2) Today Ethiopia is at the development threshold. Though under development is a cumulative effect of diverse socio-economic and historic factors, the failure to preserve “known wisdom,” or recognize and reward creative talents takes forefront among the evils that had disrupted continuity of the progress. Plausibly, as old wisdom ‘dies’ with the inventor, public domain of knowledge remains weak. The primitive nature of the regulatory method to protect one’s invisible property and the consequential loss of invention with the inventor has led known wisdom and the invention to perish thereby making developmental ladder to “grow” downwards.[[3]](#footnote-3) Frequent ‘new beginning, not only makes the innovation very expensive, but also causes the progress of innovative acumen to remain at the very basic level.

Though diminishing from time to time and largely unrecognized by law, indigenous wisdom is still dominant in traditional medicines.[[4]](#footnote-4) Ethiopia is blessed with traditional medical wisdom and traditional medical practitioners who claim having curative remedies for all health care issues.[[5]](#footnote-5) Traditional medicine includes variety of knowledge and practices.[[6]](#footnote-6) Though traditional and not published in scientific journals, people have been using traditional medicines and rely on their curative potential for centuries.[[7]](#footnote-7) Traditional medicines are affordable, accessible, and acceptable by the people who rely on their curative potential.[[8]](#footnote-8) Some traditional doctors grow medicinal plants and others harvest them from natural forests.[[9]](#footnote-9) Depending upon the nature of disease, the interest of patients, traditional medicinal practitioners blend leaf of a medicinal plant with another one or use its, root, or fiber to cure human beings or animals.

However, herbal medicine practitioners exert utmost efforts so that the formula of making traditional medicine is kept secret.[[10]](#footnote-10) When gathering herbs, practitioners endeavor to avoid detection. Even in the marketplaces traditional doctors venture to avoid formulaic piracy.[[11]](#footnote-11) Unless a given traditional medicine belongs to local community, or popularly known, privately held traditional medicine are not known to the public. Only owners of the traditional medicine know the curative herb and its chemistry, and the methods of preservation and use.[[12]](#footnote-12) It is this secretive method of protecting one’s right to ownership of the medicine creates the danger of loss of the invention.[[13]](#footnote-13) Customarily, it is believed that some traditional doctors disclose their medicine to their kin, but knowledge of techniques of identifying or producing the medicines and the kind of diseases which the medicine may cure, is not simple enough to master. This obviously causes loss of the knowledge.

The rationale behind keeping traditional medicinal knowledge secret is plausible. Disclosure means direct loss of business or money. If the medicine or its formula is known, no one would pay to get the service. Traditionally, in Ethiopia there was no known rule to sell or license the invention. Innovation and creativity can be effectively protected by a patent system, but for centuries, most developing nations, including Ethiopia, had no comprehensive patent law and exhibited weak or no enforcement mechanisms.[[14]](#footnote-14) This, presumably, has led inventors to apply self-policing mechanisms – maintaining a secretive atmosphere associated with their invention. The danger of secrecy is loss of the invention with the inventor, as the knowledge and creative formula may not adequately transfer to the new generation. The existence of traditional doctors and their medicine confers psychological confidence to the native people. It is exceedingly difficult or in some cases impossible to get an alternative to “gifted” people with extra-ordinary talent and innovational wisdom - loss of talented people means loss of their innovational mind and the wisdom. To local people who rely on the wisdom of traditional doctors, death of the doctor means loss of health care system.[[15]](#footnote-15)

The purpose of this Study is not simply to assess the causes and motives of invention or deal with all possible cause and remedies for “backwardness,” but to pinpoint possible contributions of patent system as a legal solution to keep up an uninterrupted progress by protecting economic and moral interests of traditional medicinal innovators. The patent system, especially utility model certificate can best circumvent loss of traditional medicines. A traditional doctor may perish but fruits of his/her intellect should remain immortal and enrich the public domain by keeping continuity of knowhow from generation to generation.

After illumination of the provocative general concepts expressed in Part I, Part II shades light in some of the problems associated with intangible properties in Ethiopia. Part III addresses the general principles, nature, and patentability requirements. Patent doctrines developed by the legislature and judiciary elsewhere are used to pinpoint the extent of protection that can be afforded to inventors and the safeguards available to the public against patent monopoly.[[16]](#footnote-16)

Empirical data collected from traditional doctors and surrounding community from Southern Nations and Nationalities Regional State, Addis Ababa, and Amhara Regional State is used to examine the practice and hurdles that the traditional medicine practitioners have been enduring. This work specifically attempts to reveal how the recognition and availability of legal protection can effectively contribute for the sustenance of traditional medicinal know-how.

The study is qualitative in approach and socio-legal in form. It is a mix of the traditional doctrinal research methodology and sociological research methodology. In compliance with doctrinal research methodology relevant statutes, court cases, secondary sources are briefly summarized. Further empirical data was collected from purposely selected traditional medicinal practitioners and beneficiaries. After visit and interview of heads of Ethiopian Intellectual Property Office (EIPO), Directorate of Modern and Traditional Medicine Research Center of Ethiopian Public Health Institute (EPHI), and Ethiopian Food and Drugs Authority, ten traditional medicinal practitioners were selected by applying snowball sampling methods from Addis Ababa, Amhara and Southern Nations, Nationalities, and Regional States. Traditional medicinal clinics were visited, and the practitioners were interviewed. On the days of visit almost all of the traditional medicinal clinics had several patients waiting to get medication. Some of the patients informed that they had already exhausted conventional medication and resorted to TM and practices, and got better result. Others chose traditional medicines because they could not afford for conventional medication.

**Survey of Views of Actual and Potential Beneficiaries of Traditional Medicines**

With a view to substantiate doctrinal findings with empirical facts, this work has considered actual facts regarding application of traditional medicines and practices through visitation of traditional medicinal clinics, interview of traditional medicinal practitioners, government agencies and collection of views of actual and potential beneficiaries of traditional medicines. Empirical data was collected from purposely selected sites in Addis Ababa, Southern Nations and Nationalities Regional State, and the Amhara National Regional State. The practice in Addis Ababa is reflective of national picture. Amhara Regional States practice was selected because there was widespread public discourse regarding traditional pest that was claimed to destroy invasive weed (Emboch) spreading on Lake Tana and other Ethiopian lakes. The alleged “traditional medicine “was developed by Mergeta Belay Adamu, but dispute arose regarding the efficacy the invention was allegedly disregarded. As justification for the refusal to honor the claimed invention supposedly would have national impact, firsthand information was needed. In so doing relevant information pertinent to the practice and use of traditional medicines was collected. Visit to the Southern Nation and Nationalities was needed because the original idea for this investigation arose from the prevailing situation in loss of traditional medication and the practice.

The data collected from people with diverse background and socio-economic status reveals 68.5% of the respondents had experience of using traditional medicine of some sort and visited traditional medicine practicing clinics. Consequently, 98 % of the respondents suggested for legal protection to be given to traditional medicines and indigenous knowledge and plea for preservation of traditional medicine for the future generation. Due to numerous causes and reasons public attitude towards use of traditional medicines is not uniform. While 58 % of the respondents witness that the pubic still has good impression toward traditional medicines and rely its curative potential, while the rest of the respondents have expressed either they do not know about public impression or view the fact that the public has no confidence in traditional medicines.

In accordance with the empirical data Ethiopian traditional medicinal knowledge is on continuous deterioration. The cause of deterioration ranges from absence of legal protection, climate change, non-awareness of the possibilities of getting patent or availability of other methods of legal support, lack of attention from the government agencies, non-availability of scientific research facilities, non-cooperation from the traditional doctors due to fear of piracy, emersion of traditional medicinal knowledge and the practice with spirituality and belief of the practitioners.[[17]](#footnote-17)

Most of the respondents believe that the legal owner of the traditional medicine is the practitioners,[[18]](#footnote-18) whole some believe that the local community and government partake in the ownership. The latter may appear true if the medicinal knowledge was under public domain. This work deals only with undisclosed traditional medicines that are held by traditional doctors or their kins. The local community or the government does not know about the nature and quality of the undisclosed traditional medicines. Unless positive action is taken to elicit the undisclosed medicinal knowledge, the knowledge cannot sustainably enrich public domain. Traditional medicinal practitioners and respondents of questionnaire suggest for immediate government regulation to save the deteriorating tradition medicine and the practice.[[19]](#footnote-19) With a view to expose privately held indigenous medicinal knowledge to light, a clear legal and institutional protection should be afforded. This could be effectively assured through patent system or utility model certificate.

**Patenting an Invention: Nature, Rationale, and Procedural Requirements**

Patent system shields the interest of inventors by affording monopolistic use of the invention for a limited period of time.[[20]](#footnote-20) It also shields public interest by enriching public domain through disclosure. Negative effects of monopolistic holding of an invention necessitated the fulfillment of rigorous patentability requirements.

A patent is a document that can be granted by a government agency evidencing that the inventor mentioned therein is authorized to make, use, sell or offer to sell a given invention in exclusion of any other person.[[21]](#footnote-21) The right to exclude others from making, using, offering for sale, selling or importing the invention confers a monopoly right to the patentee.[[22]](#footnote-22) It is an incentive for invention. As invention usually demands cost and risk of loss, the exclusionary incentive is thus “the fundamental purpose of the patent grant….”[[23]](#footnote-23) The right to exclude others is an essential feature of real property right that the patent law shares.[[24]](#footnote-24) One author suggests:

The right conferred by the patent grant is . . . “the right to exclude others from making, using, offering for sale, or selling” the invention …or “importing” the invention. What is granted is not the right to make, use, offer for sale, sell or import, but the right to exclude others from making, using, offering for sale, selling or importing the invention.[[25]](#footnote-25)

In market economics, monopolistic system is impermissible, but monopolization for the purpose of stimulating further invention is pro-competitive and legal. Patent system stipulates privileges of innovation and declares restrains on the public. In this regard learned authors remark as follows:

“. . . patent laws are generally seen to operate as part of an interdependent mix of incentives and restraints that bestow benefits and impose costs on society and individuals alike. Some see patents as facilitating innovations, access, and competition. Others see patents frustrating these important interests. Most see some mix of these effects but debate about how best to increase the good and decrease the bad.[[26]](#footnote-26)

Monopolistic holding carries some societal cost as it does not permit market competition, but the long run benefit of the invention ought-weighs its short run “evil.” Thus, the motive behind patent grant is “… to encourage innovation and its fruits, new jobs and new industries, new consumer goods … new designs and technologies into the public domain through disclosure.”[[27]](#footnote-27) With a view to achieve these ends,the law encourages inventors to come up with a novel invention rather than reproduction of what is already under public domain.[[28]](#footnote-28)

The social cost that the public must bear on account of the monopolistic holding of a patented invention has necessitated the granting process to be very strict. Kitch suggests patent protection not to be granted without good reason. To him, patent monopoly is a “… reward that should be given only for worthy achievements, for the achievements of genius.”[[29]](#footnote-29) Worthiness of an invention is the most important requirement to get the privilege of exclusive use of fruits of a given innovation. A patent is an incentive to the disclosure and it “simply cannot reach [if the disclosure] does not teach.”[[30]](#footnote-30) For the purpose of teaching the disclosure should be sufficiently clear to remake the invention without further research.[[31]](#footnote-31) Each *claim* should demonstrate how the invention works. The disclosure serves various functions. First, the inventor clearly limits the scope of the invention and the patent monopoly cannot be extended beyond the disclosure. After parent grant, if anyone purports to make, use or sale a disclosed invention the inventor can stop the “trespasser.” The other advantage is that third parties will have fair notice that a given invention is already made and would not waste their resource by working to reach at the wisdom that is already known. Disclosure thus avoids duplication of efforts.

More importantly, the disclosure enriches the asset of public knowledge and serves as a means of maintaining uninterrupted progress in the science and art.[[32]](#footnote-32) Thus, the aim of patent shield is not simply benefitting the innovator but safeguards public interest by acquainting the generation with the tested knowhow.[[33]](#footnote-33) The public can use fruits of the invention, as all the required information is under possession of the government agency, the office patent. After lapse of the limited time, anyone can make or use of the wisdom.

It is believed that “[t]he goals of patent protection is promoting innovation,” [[34]](#footnote-34) which in turn enriches public domain. Inventor’s options should be respected but the law and institutions should encourage innovators to disclose their invention to the public through patent registration and enjoy monopolistic holding until lapse of the time granted by law. The disclosure would enable innovators to practice their creation openly without fear of piracy under the shield of law. Disclosure should be made in a way that an ordinary person in the art would be able to remake the invention. All the important procedures and techniques of the invention shall be well described in a way it can teach experts in the field to remake. The description requirement requires innovators to pinpoint each of the elements necessary to make the invention and processes involved therein. It should guide persons skilled in the art to create the invention without further research and experiment. Disclosure of inventive elements is viewed as *quid pro quo* between the government and the inventor.[[35]](#footnote-35) The inventor shall disclose the best method of making the claimed invention. Concealment of material information would cause denial of the protection. He/she cannot enjoy monopolistic holding while withholding the best mode of making the invention. For the purpose of protection, the invention need not necessarily be something completely new. Modification of an existing item may be patented. The modifier shall spell out the part of the invention that he/she actually claims. This requires assessment of prior art. The burden of proof of concealment of the best mode is on the third-party petitioning for the invalidity of the patent. If the concealment of best mode is proved, the patent may be invalidated or if it is under the process of prosecution, the application will be denied. Disclosure also helps assess the fulfilment of other requirements of patentability. The kind and the extent of patentability requirements need not be the same in all jurisdictions. The requirements may depend upon the nations thirst for invention.[[36]](#footnote-36)

Further, patent protection can be granted only to a useful invention.[[37]](#footnote-37) Usefulness is gauged by the possible service that the invention would offer. Therefore, a probable or future possible use of an invention cannot warrant the protection. Before conferring the right of monopolistic holding the agency granting patent assesses the kind and extent of usefulness. The applicant for patent must prove how his/her invention would tackle an existing evil.[[38]](#footnote-38) A worthy invention shall be a novel one.[[39]](#footnote-39) Determination of novelty of an invention is one of the perplexing tasks of patent system. The inventor or person applying for patent must prove that the invention is new. An invention can be protected by law if and only if it is “…new and would not have been obvious to persons of ordinary skill in the art.”[[40]](#footnote-40) The most important method of proof ‘newness’ is describing the prior art and disclosing special features of the claimed invention. Then the onus shifts to the challenger of the patentability of the invention.

For the purposes of novelty, the invention need not be absolutely new, having no features of the existing one. Nowadays, it is hardly possible to innovate without holding some features of prior art. Even Sir Isaac Newton witnessed how a prior invention accelerated his own novel discoveries, in a famous statement: “If I have seen far, it is by standing on the shoulders of giants.”[[41]](#footnote-41)

To sum up, a given patent is viewed anticipated by a prior art, if and only if all the elements of claims of the new invention corresponds to the prior art. If the new inventor makes a very useful modification or if the new invention has suppressed some form of mischief of the exiting invention (the prior art), the new invention is assumed that the claim is not anticipated in the prior art, and hence eligible for patent. Anticipation normally requires claim interpretation, which can be by persons having ordinary skill in the art.

An inventor of a novel item should be cautious enough in protecting his/her rights. He/she should bring the invention to the attention of the Patent Office within a defined period time-limit specified in the patent proclamation – in most legal systems within one year of the invention. If the inventor keeps on using the invention, sells it or offers for sale for more than one year of its invention, he/she loses the right of patent protection. As noted above, patent protection is not a necessary consequence of invention, but a privilege that the law offers for the purposes of encouraging people to engage in inventive venture that would trigger progress of science and art. Thus, if the inventor keeps quiet for more than a year the assumption is that he/she has waived his/her privilege, and the invention falls under public domain. However, public release of an invention for the purpose of testing or laboratory experiment cannot be viewed as sale. Similarly, if an invention is published in journals, or publicized otherwise, for a year or more before the date of application for patent, patent protection cannot be granted. A publication for a period exceeding one year anticipates the invention. The rationale behind the one-year statutory bar seems to encourage inventors disclose their invention as soon as possible. Man is mortal by nature and quick disclosure guarantees the potential for saving an invention from “death” with the inventor. Invention of any kind enriches public domain; it should be added to public knowledge at the earliest possibility and put the public at the safe side.

An inventor has no duty to get patent protection. He/she can deliberately abandon the possibility of patent protection, by using, selling, or offering for sale an invention. The inventor can also can secretly hold the processes making the invention, while using, selling, or offering for sale the thing invented. If the processes of making the invention is not disclosed, it would remain as trade secret. Secret withholding of an invention cannot be taken as abandonment of rights on the invention. An abandoned invention cannot be patented at any time. The usual issue in this regard is whether some kind of interruption taken as abandonment. It depends upon the cause of the interruption and the time of gap. [[42]](#footnote-42)

The other intricate task in proving patentability of a given invention is *non-obviousness*.[[43]](#footnote-43) Non-obviousness requirement is “the heart of patent system and the justification of patent grants”[[44]](#footnote-44) It is “a condition in which an invention cannot receive a valid patent because a person with ordinary skill in that technology can readily deduce it from publicly available information.”[[45]](#footnote-45) The non-obviousness requirement is an extension of novelty. While novelty focuses on the newness of the invention, non-obviousness is about non-implication of the already invented discovery or the already existing and known invention. Almost all patent laws require non-obviousness for patentability.[[46]](#footnote-46) The inventor must exert his/her innovative acumen to create a new thing – he/she cannot enjoy monopoly over an invention that is already in the public domain or that makes no contribution to the already existing knowledge. Things in the public domain are the property of everyone and should not fall under exclusive use of a single person. A trivial contribution thus cannot permit a person to have the benefit of patent monopoly.

For determination of the fulfilment of non-obviousness, courts may consider some secondary considerations: commercial success of the invention at hand, long felt need and failure of others, the extent of copy that the claimed invention discloses, or effort exerted by the inventor to copy the existing invention, and acquiescence of the former inventor. If the former inventor, for instance, licenses the purported invention, this is acquiescence and may be considered in judging obviousness.

A validly granted patent is considered as the property of the patentee until the limited time specified in the patent law expires. In WTO member states this time is 20 years while in non-member countries the length of protection may vary.[[47]](#footnote-47) A patent is an intangible property of a patentee; like any property it may be assigned or transferred to another person. In most cases patentees license their invention to a company that develops the patented invention. The patentee can also sell the invention or develop it by him/herself. While the patent protection is in force, no one can make, use, sell or offers for sale or import a patented invention. Any act contrary to this requirement infringes the right of patentee and the law imposes strict legal consequences. First the court may order for preliminary and permanent injunction and the infringer may be forced the patentee in the form of damages and loss of profit.[[48]](#footnote-48)

**Utility Model System**

In minor inventions, like traditional medicines, the rigorous patentability requirements are hard to meet, and the likelihood of getting legal protection is minimal. Minor inventions are so usual in developing economies and play pivotal role in alleviating socio-economic problems of poor communities that rely on local creativity. Further, patent standards are gauged globally. Consideration of global yardsticks is an uphill battle to win for traditional minor inventors. To Ethiopian traditional inventors who are not conversant with competitive technology and scientific methods, patent protection is unreachable. With a view to address the need for protection most developing and some developed nations have devised alternative of patent system that can possibly safeguard the interest of traditional innovators.

To encourage traditional innovators that may not be able to meet the stringent patentability requirements, most developing world and some developed nations have devised utility model system. In utility model, the requirements of legal protection and procedures for getting certificate of protection can be shaped in consideration of national situation. The standards of gauging utility model is not universal. Thus, considering local situation, nations can relax the requirements for legal protection for minor inventions. Standardization of utility model protection may be shaped in consideration of the volume of available minor invention, the need for further invention and motivation needed for potential innovators.

Therefore, a slight modification to an officially known wisdom may not be denied utility model protection. In Ethiopia, a minor invention that meets the requirements of novelty and industrial applicability, may be protected under utility model. But a simple change to shape of an item, proportions, or material of a patented object or one that is already under public domain cannot be protected through utility certificate. However, where an innovative knowledge, which is under public domain has been improved either in quality or function, a known old invention may be protected on account of the useful improvement.[[49]](#footnote-49) But a “… mere replacement of elements in a known combination by other known elements having an equivalent function, which does not thereby produce an improvement in its use or the effect of its intended functions,” cannot be protected.[[50]](#footnote-50)

A utility model certificate holder can enjoy all the benefits of the utility model protection until the laps of the time stated in the utility certificate. In Ethiopia, a utility model certificate holder can enjoy the consequences of invention within five years of acquiring the certificate, with the possibility of extension of five more years.

**Current Mechanism of Regulation of Traditional Medicines in Ethiopia: Secret Holding**

Before the enactment of the first historic patent proclamation in 1995,[[51]](#footnote-51) Ethiopia did not have a comprehensive patent legislation. In absence of patent law that can effectively guard traditional medicinal wisdom, unless a certain piracy fell under the rules of unfair competition law, there was no meaningful protection. Mere duplication of an invention by a competitor did not satisfy the requirements of the unfair competition and hence the real inventor remained with no legal protection. Anyone who was able to duplicate a given invention did it without the need to “waste time” by endeavoring to make a novel creation. As a result, inventors or owners of inventions had to take care of their own invisible property. The usual measure of protection was to keep the invention secret, as far as possible.

The rule of “secrecy” however cannot be effective in all cases and situations. In developing nations where weak law enforcement prevails, secretive holding of a valuable inventive formula is hard to maintain.[[52]](#footnote-52) In absence of legal protection, it cannot surprise an inventor to see his/her invention being extensively produced or offered for sale in the market. Competitors normally endeavor to “pick” secret information from any source in any way. In Ethiopia, the absence of trade secret law makes secrecy form of protection ineffective. The condition is practically worse where the owner of trade secret is illiterate to whom the law and legal rights are obscure.

Secret holding of an invention may not be desired at least for two reasons. First, the inventor may pass away without intimating the inventive formula. Moreover, trade secret system by itself is not helpful to enrich public domain as quickly as possible. Further, proof of piracy in trade secret law is very difficult and does not normally prevent independent creation and reverse engineering. The most important advantage of trade secret is unlimited use of the right. This means, by maintaining secrecy, the innovator can use the creation for ever until the secrecy is lost.[[53]](#footnote-53) But in case the inventor dies without disclosing the formula to the next of kin or other “reliable” people, the secret formula would perish with its holder. Therefore, patent system appears the best solution to save innovations from banishment and at the same time, the 15 years patent monopoly that most patent laws afford would best pay the creative intellect of the innovator.

Though too late, the Ethiopian intellectual property law system is in progress. The Proclamation Concerning Inventions, Minor inventions, and Industrial Design (herein after the Patent Proclamation) affords four kinds of protections: patent, patent of introduction of foreign issued patents, utility model certificates and certification of industrial designs. Though the time of protection varies, all these privileges shield inventor’s interest and encourage the inventor to disclose inventive formula and relevant information to enhance the public domain.

**Exploring Patentability of Privately Held Traditional Medicines in Ethiopia**

The patentability requirements of Ethiopian patent law mirror the enumerations of advanced patent systems.[[54]](#footnote-54) In Ethiopia, an invention may be patented if and only if it is “…new, involves an inventive step and is industrially applicable.”[[55]](#footnote-55) In the first place, patent protection can be granted only to new inventions. How is an invention is viewed as a new one? Do traditional medicines fulfill the newness yardstick? These are some of the critical issues in determining patentability of a traditional medicine. The notion of ‘newness’ has factual and time considerations. First, newness of an invention is portrayed in terms of novelty. As briefly pointed out in the preceding Section, an invention may be taken as novel, if and only, if the claimed invention is not anticipated by the prior art.

Thus, newness test necessarily requires assessment and explanation of prior art. Under Ethiopian patent law prior art comprises of “everything disclosed to the public, anywhere in the world, by publication in tangible form or by oral disclosure, by use or in any other way, prior to filling…,”[[56]](#footnote-56) an applicant therefore should provide sufficient description of prior invention of similar nature anywhere in the world.[[57]](#footnote-57) In other words, the applicant has to assess all similar works anywhere on the globe and prove how his/her invention is different from available invention in the worldwide, or suppresses the mischief of prior invention.[[58]](#footnote-58) Could Ethiopian traditional doctors, often with poor educational preparation and hardly assisted by modern laboratories, trace inventions anywhere on earth and decide whether their medicinal knowledge and practice is new? This appears unlikely. Obviously, overwhelming majority of Ethiopian traditional doctors have been practicing traditional medicine for long period of time.[[59]](#footnote-59) Apart from the modern medicines, that traditional doctors are not aware of, it is virtually impossible to poorly educated traditional medicinal practitioners to assess and explain prior arts anywhere on earth. This plainly explains that Ethiopian traditional medicines are unpatentable.

Next, the Ethiopian patent law requires a new invention to involve inventive step.[[60]](#footnote-60) Thus, the claimed invention should not be so obvious to the ordinary experts in the field. An obvious invention is not a novel one; it is implied in the invention that is already patented or under the public domain. Unless a prior art is sufficiently described in the patent application and chemical elements of the medicines is scientifically explained, it is hard to take a given traditional medicine a novel one. Further, newness or novelty suggests that the invention should not be of a trivial nature. Proof of newness necessarily demands investigation of qualities of the claimed invention. The claimed invention therefore must be scientifically tested in labs and the applicant has to prove that the invention is absolutely different from existing products of similar nature.

However, the Ethiopian traditional medicine practitioners are not in a position to test the claimed invention. Ethiopian traditional doctors have no modern laboratory facilities. They can get assistance of university researchers or the facility available at the Ethiopian Public Health Institute. However, most traditional doctors have no trust on the researchers or available facilities.[[61]](#footnote-61) Laboratory test requires the traditional medicine practitioners to show the herb and the methods of preparing the medicine. In fact, traditional medicinal doctors are not willing to reveal the herbs unless assurance is given from the government.[[62]](#footnote-62) Some practitioners so far approached or requested by research centers are not willing to collaborate with researchers or university research centers.[[63]](#footnote-63) The non fulfilment of inventive step too makes a traditional medicine unpatentable. This obviously, not only causes further deterioration of traditional knowledge, but also hurts scientific research that gears toward improving traditional inventions including traditional medicines.

Next, newness naturally has time element. An inventor seeking patent protection of his/her invention shall file for patent claim as early as possible. The term “new” institutively does not support unwarranted delay in seeking protection or old innovations that have been in use from the time immemorial. Expeditious disclosure serves public interest as it would avoid or lessen the possibility of loss of the already acquired knowledge. The inventor should seek patent protection immediately after he/she is sure that the invention can be patented. Any unwarranted delay would affect public interest for advancing human knowledge. As indicated in the preceding part, in United States, an inventor is expected to apply for patent within a year of the completion of testing of the invention. The Ethiopian law does not express an exact time within which the inventor has to file for patent,[[64]](#footnote-64) but the Patent Proclamation expresses unpatentability of invention if it had been in use or offered for public for more than a year. If the invention is not offered to the public or not used in any way, the one-year period of limitation does not run. Hence, undisclosed invention that is not in use or offered to the public in any way can be patented any time whenever the inventor needed one.

The newness requirement does not suggest non-disclosure for all purposes and in all cases. For instance, disclosure of the invention for the purpose of trial cannot affect the newness requirement. Further, the inventor may offer the thing invented to the public for promotion or mass trial. If the inventor files for patent within 12 months of such disclosure, the disclosure cannot affect the newness requirement.[[65]](#footnote-65)

When we come to traditional medicines, it takes long time to realize an exact time in which the invention was discovered. The practitioners themselves may not be aware of an exact time in which the idea of medicine was planted in their mind.[[66]](#footnote-66) The newness requirement and complexity of the patentability requirements make virtually unpatentable. Consequently, traditional inventor unless some form of positive intervention taken by the government will adhere to the traditional *self-help* method of protection. Unless protected or incentivized in some way, would a traditional inventor who holds age old invention disclose his/her secret formula for nothing? It seems absolutely no. In this way all the undisclosed secret inventions would stay in secret holding and, possibly, pass away with its inventor or holder.

**Could Undisclosed Traditional Medicines Protected Under Utility Model Certificate in Ethiopia?**

Unlike patent, which is international in character and universal in content, utility model system allows consideration of national situation in affording protection to current and potential innovators. Accordingly, a nation can design its utility model system in a way it can attract the emerging minor innovators for limited period of time. In Ethiopia, “[a] minor invention that possesses novelty and industrial applicability [can be protected through utility model.]”[[67]](#footnote-67) The Proclamation has deliberately skipped “inventive step” as a requirement for utility model protection. Thus, an invention, supposedly obvious in the prior art, can be protected in utility model certificate, provided it is novel and meets industrial applicability tests. To determine newness of a minor invention for utility model protection too, explanation of prior art is a mandatory requirement. To get utility model protection thus the inventor must prove that the claimed invention is a novel one. However, the scope of the newness is assessed nationwide – not worldwide. This is one of the relaxations that a minor inventor can enjoy. Further, though not so frequent, the scope of newness standard may be limited to local level – not the whole State. Though the Ethiopian patent law does not express district or regional level standards, the legislation can be shaped in this way. This limited standardization appears relevant to traditional medicines and traditional practitioners that relay on local situation.

The exemption of Ethiopian minor inventors from the requirement of inventive step, allows utility certificate to a slightly modified minor item to get utility certificate. For example, modification, to a publicly known wisdom is eligible for utility model protection.[[68]](#footnote-68) Are traditional medicines minor inventions and protectable under utility model? The expression, “minor invention” intuitively signals the invention is not absolutely novel, but it has a slightly better quality from an existing invention. It may be a slight improvement to a known item. The minor invention should have an element of novelty in Ethiopia. However, as the utility model protection is not trans-boundary, we do not have to consider a superior item elsewhere outside Ethiopia. Minority of invention may be defined in terms of service it renders, its quality or suppression of a non serious problem. But it should possess some form of quality that is absent in prior similar inventions. Traditional medicines, apart from accessibility and affordability hold other qualities that modern medicines lack or have distinctive qualities that other medicines or modern medications do not have.

The Ethiopian utility model law does not require fulfilment of inventive step. An obvious invention however has to fulfil other vital requirements: newness and industrial applicability. This however does not mean that the standards of novelty and industrial applicability are assessed parallel to the method of assessing for patent grant.

What is a prior art in the case of traditional medicine, and how it can be assessed? Apart of limitation in scope of the prior art consideration, the methods of assessing prior arts for utility model appears identical to patent. A person who comes up with a thing that would alleviate societal problem should not only prove the qualities of his/her invention, but also should show how his/her invention is different from identical inventions, if any. In doing so, the applicant should explain the characteristics of prior art and how his/her invention suppresses the mischiefs of the prior art. For traditional medicinal practitioners it appears hard, if not impossible, to find out a similar invention and explain distinctive qualities of prior art and special qualities of his/her own invention. If an Ethiopian traditional medicinal practitioner cannot explain prior art and prove the new qualities of his/her own invention, fulfilment of novelty requirement cannot be ascertained. This certainly makes unproven traditional invention unprotectable.

On top of the difficulty or inability to prove novelty of traditional medicines, Ethiopian traditional medicine practitioners are exceedingly suspicious of piracy and don’t trust the law and government agencies that are entrusted with regulation of traditional medicine practice.[[69]](#footnote-69) Traditional doctors have no trust in third parties, including government agencies, research centers. Distrustful character of some traditional medicine doctor is a huge problem to the regulatory agencies and scientific researchers.[[70]](#footnote-70) In some instances, lake of trust of traditional medicinal practitioners is based on strong spiritual belief that the medicine works in highly secretive environment.[[71]](#footnote-71) Some traditional medicine practitioners expressed an apparent willingness to cooperate with researchers provided the government or accredited agency affords recognition, but never been tested in practice.[[72]](#footnote-72)

Further the actual or potential beneficiaries of traditional medicines suggest the government to take measures of awareness campaign regarding the possibility and the methodology of applying for patent or utility model certificate.[[73]](#footnote-73) Both traditional medicine practitioners and the persons participated in Focus Group Discussion suggested the government to afford incentive measures to traditional doctors through provision of land for growing medicinal plants and grant or facilitated alignment of scientific researchers and laboratory. This, of course, requires government assurance for keeping the invention secret and non-piracy.

Despite the legal and attitudinal challenges for affording legal protection to traditional medicines in Ethiopia, the possibility of affording utility model protection to community held traditional medicines and scientifically proven traditional medicinal knowledge has been practically proven. The Research Directorate of Modern and Traditional Medicine of Ethiopian Public Health Institute has got utility certificates for clinical testing of medicinal values of for products already under community knowledge.[[74]](#footnote-74)

Further, the applicant for utility model certification shall show how the claimed medicine can cure a patient from a particular form of disease. This necessarily requires laboratory test, which calls for collaboration of traditional medicinal practitioners with researchers and laboratory operators. As pointed out above, this is unlikely in the current Ethiopian scenario. Traditional medicinal practitioners are largely suspicious any person in fear of piracy and some believe that the efficacy of medicine would be diluted if the secret of making the medicines is publicly disclosed. To get utility certificate of undisclosed TMs this attitudinal challenge shall be practically solved through awareness creation and assurance that may be given by appropriate government agencies.

No doubt attitudinal change cannot be resolved overnight, but now it is time to take positive action for awareness creation and provision of incentive to encourage traditional medicinal knowledge holder to seek legal protection. The government should offer an unequivocal assurance that a disclosed traditional medicinal knowledge to researchers and laboratories for possible testing of chemical elements for the purposes of comparing with prior art and industrial step consideration cannot be pirated by any means.

There shall be a clear government guarantee that a provisionally registered traditional medicinal knowledge cannot be sold or stolen. Pirates cannot benefit from a registered wisdom even the invention under examination is not yet approved for legal protection. A relevant government agency has duty for public awareness creation. In this regard it is suggested that the Research Directorate of Ethiopian Pubic Health Institute should be empowered to monitor, supervise, support, periodic follow up traditional medicinal practitioners. Awareness creation work can be conducted by lower level administration with the instruction given by the Research Directorate. Awareness creation would help coordination of traditional medicinal practitioners with universities and health researchers. Research work normally requires allocation of research fund and incentive. As the end result would benefit the nation, financial incentive mechanism should be arranged. Provision of financial incentive would attract all concerned to take part in researching traditional medicinal wisdom and TM practice.

**Conclusion and Suggestions**

The recognition, protection, and preservation of creativity and provision of reward to innovative talent plays a great role in the sustenance of progress. Reliance on law and regulating institutions encourages disclosure of privately held wisdom, which in turn ignites further innovation. A disclosed knowledge and invention enrich public domain. This serves *as a ladder* for the further research and better innovation.[[75]](#footnote-75) In this regard, it is rightly remarked that developing countries should maximize the effectiveness of intellectual property as a development tool and strategy.[[76]](#footnote-76) The patent system not only shields innovators, but also safeguards public interest by stirring the generation with old age knowhow.[[77]](#footnote-77) Innovators therefore should be encouraged to disclose their invention with a full confidence.[[78]](#footnote-78) The disclosure obviously makes privately held medicinal knowledge available to researchers and potential innovators that wish to stand on the shoulder of giants to see further.

The Ethiopian patent law is designed in consideration of international rules that work anywhere in the world. However, this international standardization can easily disqualify traditional medicinal knowledge. Consequently, a less stringent form of standardization that reflect local reality – a utility model is designed to protect minor inventions. A utility model that can be crafted in contemplation of local reality, can best safeguard the interest of traditional innovators. The utility model protection is a good beginning and has insisted some potential inventors to seek protection, but the Proclamation heavily influenced by the rules and principles “grown up” in advanced systems. In a situation where innovational acumen is at the threshold, strict application of rules constructed elsewhere in the world would not attract indigenous innovators. Therefore, with the goal of enriching public domain of innovational knowhow, Ethiopia should work aggressively on awareness creation, provision of incentives and revision of the proclamation on inventions, minor invention in a way it would accommodate the interest of traditional medicinal knowledge holders. Otherwise, the practitioners would continue to apply their self-regulation method that cannot save loss of privately held indigenous medicinal wisdom.

1. The data for this article is part of an extended study from which another article on a different issue is under published. [↑](#footnote-ref-1)
2. We have live testimony regarding early Ethiopia’s civilization. The engineering intellect of the crafters of Obelisks of Axum , the architecture of Lalibella and palace of Gondar, among others, confirm Ethiopia’s past technological and cultural progress. Given the standards of technology at the time, it may appear unbelievable to appreciate that the people who were not assisted by the modern technology and machinery had created such marvellous innovations, but it was the fruit of wisdom of the time. [↑](#footnote-ref-2)
3. The three cases that this author had experienced are more than pitfall. There was a popular traditional doctor in the village called Dangara. Dangara was popularly known by the local people because of Kute’s service. Kute, had curing medicine for almost all kinds of intestinal problems. Kute’s medicines categorically termed as “qachchaa Xalle” (ቃቻ ጣሌ). In Dangara, no one knew how to make “qachchaa Xalle” other than Kutee. As a traditional doctor, she served her people with curable herbal medicines but suddenly died. There is no service today, as no one is able to make medicines. A similar case happened in Ade Duguna. A traditional doctor had good curing medicine for asthma. The lady never disclosed the herb and the formula for mingling various herbs. She had also knowledge and experience for contraceptives but died without the knowledge being transferred to the public. Similarly, there was a traditional doctor (called Dargasso) who was known for curing domestic animals from deadly diseases like anthrax. He survived by no one and did not disclose the medicine and processes of making it. [↑](#footnote-ref-3)
4. About 80% of Ethiopians, and 90% livestock in Ethiopia still depend on traditional medicines. See Negero Gemeda et al (ed.) Ethiopian Traditional Medicine: Past, Current and Future, Workshop Proceedings, Ethiopian Public Health Institute, Adama, Ethiopia, December 14 – 16, 2015. [↑](#footnote-ref-4)
5. National Reference Centre for African Traditional Medicines, *A South Africa Perspective*. https://www.intechopen.com/books/traditional-and-complementary-medicine/african-traditional-medicine-south-african-perspective (Last visited 14/04/21). [↑](#footnote-ref-5)
6. WHO defines it in terms of health practice, approaches, knowledge, and beliefs, incorporating plants, animals and mineral based medicines, spiritual therapies, manual techniques, and exercises, applied singularly or in combination to treat, diagnose and prevent illness and mental wellbeing? [↑](#footnote-ref-6)
7. Id; The World Health Organization estimates 80% of Africans use traditional medicines.   In Ghana, over half of the children with malaria are first treated with herbs. <http://www1.voanews.com/english/news/africa/west/Ghana-traditional-health-care-part-two-voa-80335462.html>

   see also Fekadu Fulas , The Role of Indigenous Medicinal Plants in Ethiopian Health Care, http://www.hollerafrica.com/showArticle.php?artId=217&catId=1 (Last visited 11/29/20). [↑](#footnote-ref-7)
8. During field visit traditional doctors in Addis Ababa, Southern Nations and Nationalities Regional State and Amhara Regional Sates I observed patients waiting in line to see doctors. Especially, the clinic of Hakim Abraham Walelign around CMC, Addis Ababa is no different from clinics of modern medicine practitioners. Hakim Abraham’s clinic has waiting rooms with luxury furniture, computers, examination rooms with full facility, and a pharmacy. [↑](#footnote-ref-8)
9. For example, Mergeta Belay has a garden of traditional herbs in the city of Debre Markos. He also gathers some medicinal herbs from Abay Gorge (Interview with Firehiwot Teka, Director of Traditional and Modern Medicine Directorate of Ethiopian Public Health Institute, Gulele Addis Ababa February 2021; Another traditional medicine practitioner in Damot Gale, Wolaita Zone collects healer herb from uncultivated grazing area during wet season. (Interview with …. [↑](#footnote-ref-9)
10. Joana Mantey witnesses secretive holding of traditional medicinal plants of Ghana saying, “Knowledge of herbal medicine is a closely guarded secret…  Often it is shrouded in mystery and may be accompanied by the performance of certain rituals.” <http://www1.voanews.com/english/news/africa/west/Ghana-traditional-health-care-part-two-voa-80335462.html> (Last visited 11/29/20). Currently in Ethiopia, Mergeta Belay Adamu of Amhara Region has denied attempt to study the herb that he claims would stop the invasive weed – Emboch. Despite awareness of the legal protection available and application to the Ethiopian Intellectual Office, Mergeta Belay refused to disclose the herb allegedly kills the invasive weed. [↑](#footnote-ref-10)
11. They decorate the medicines with various colors with a view to keep monopoly of use. [↑](#footnote-ref-11)
12. This characteristic of traditional doctors is true in almost all over Africa. See BBC’s special reports about secrecy effort of traditional doctors of Ghana. <http://www1.voanews.com/english/news/africa/west/Ghana-traditional-health-care-part-two-voa-80335462.html>; see also Conserve Africa, Indigenous Knowledge and Environment, <http://www.conserveafrica.org.uk/sustainable-development-and-local-communities-in-africa/indigenous-knowledge-and-the-environment/> *(Last visited 11/29/20)* [↑](#footnote-ref-12)
13. According to Fekadu Fulas, “… during the era of the Axumite kingdom (7th-11th C), about 8,000 plants were used as medicinal agents. This period was followed by the Zagwe dynasty (11th-13th C), during which about 2,800 medicinal plants were recorded to have been used. Presently, there are anywhere between 650 and 1,000 medicinal plants in Ethiopia. ” This shows how public memory as to traditional medicines fading when time goes on and medicine holders or inventors die. <http://www.hollerafrica.com/showArticle.php?artId=217&catId=1> (Last visited 11/29/20). [↑](#footnote-ref-13)
14. The Ethiopian Patent Proclamation was promulgated in 1995 and fully effective after enactment of the regulation in 1997, but given poor publicity of laws in Ethiopia, presumably, the existence of this law and patent protection is still unknown to traditional inventors and need further publicity work. The legislation was designed in line with developed systems and its protective potential is doubtful in the case of traditional knowledge that remained secret for centuries. [↑](#footnote-ref-14)
15. Neighbor and former customer of regrettably witnessed this fact. (Interview with Ato Bikamo Ukumo, a former customer of Kute, Dangara Salata S/N/N/R/S March 2021). [↑](#footnote-ref-15)
16. In patent philosophy, United States patent system holds forefront. Though United States is not the first country that introduced patent system, the patent doctrines and principles are grown up by the United States legislature and the judiciary. The United States patent system is well developed and serves as exemplary in the global patent system. The United States from the very days of constitution has well understood the advantages of patent system and built up unshakable institutional and legal framework for encouraging innovative endeavors. [↑](#footnote-ref-16)
17. 67% of the respondents view that traditional medicinal practice immersed with spiritual belief of practitioners. Hakim Alemayehu Gebib expressly disclosed that some times he uses prayer to cure uncurable diseases. (interview conducted on ….. Almost the same information obtained from Research Director of Modern and Traditional Medicine Directorate of Ethiopian Public Health Institute ( Interview with Firehiwot Take on ….. [↑](#footnote-ref-17)
18. 45% of the respondents believe ownership of undisclosed traditions belong to the practitioners, 12% of the respondents believe traditional medicines belong to local community The latter appears applicable to traditional medicines known to the local people. 11% responded the owner of traditional medicines is the government, and 17% of the respondents believe traditional medicines are ownerless – belong to the whole mankind. This assertion may work only to traditional medicinal knowledge that is under public domain. [↑](#footnote-ref-18)
19. 37.5 % of the respondents suggest the government to afford legal protection to TM and the traditional practices. [↑](#footnote-ref-19)
20. In Ethiopia, a patent holder can exclusive use patented invention for 15 years with possibility of renewal for further 5 years. (See Proc. No. 123/1995, Proc. Concerning Inventions, Minor Inventions and Industrial Design, Neg. Gaz. of Transitional Gov. of Eth. 54TH Year - No. 25, A.A 10th May 1995, art. 16. [↑](#footnote-ref-20)
21. Fred Warshofsky, The Patent Wars (1994) p. 7. [↑](#footnote-ref-21)
22. This is the most important privilege of the patent holder. See Art. 22(2) Proc. No. 123/1995, Proc. supra note 19. [↑](#footnote-ref-22)
23. Sung and Schwartz, Patent Law Hand Book, (2000) P. 109. [↑](#footnote-ref-23)
24. Id. [↑](#footnote-ref-24)
25. United States Patent and Trademark Office, <http://www.uspto.gov/web/offices/pac/doc/general/whatis.htm> [↑](#footnote-ref-25)
26. Kieff F. Scott et al, Principles of Patent Law, cases and Materials, (14th ed. 2008) p. 1. [↑](#footnote-ref-26)
27. I Miller et al, Patent Law Fundaments, § 1:2 (2nd ed. 2009) p. 1 – 6. [↑](#footnote-ref-27)
28. Patent laws stimulate invention through incentive mechanisms and safeguard public interest through disclosure requirement. [↑](#footnote-ref-28)
29. Meges and Ginsburg, Foundations of Intellectual property, (2004) p.102. [↑](#footnote-ref-29)
30. Miller et al supra note 26. [↑](#footnote-ref-30)
31. 35 U.S.C. §112 (1994). [↑](#footnote-ref-31)
32. Maureen A. O’roarke, Toward a Doctrine of Fair use in Patent Law, 100 Columba law Rev. No. 5 (2000) p. 1183. Maureen argues that innovation is by nature cumulative building on prior work. … the patent statute therefore seek not only to reward the first comer who originates a particular creation but also to preserve sufficient information for the public. [↑](#footnote-ref-32)
33. Fusco Stefania, “Is the use of Patents Promoting the Creation of New Types of Securitas?” 25 Santa Clara Computer & High Tech. L. J. (2009) p.243. [↑](#footnote-ref-33)
34. Id. [↑](#footnote-ref-34)
35. Scot et al, supra note 25 at 155. [↑](#footnote-ref-35)
36. However, patentability requirements of most legal systems are by and large the same. Novelty, non-obviousness, usefulness, industrial application etc. are some of the most cited patentability requirements. The 17th century English patent law and the present United States Patent Act presumably influenced worlds patent law and as a result, requirements to grant patent are almost the same. [↑](#footnote-ref-36)
37. Proc. No. 123/1995, supra note 19, art. 3(5). [↑](#footnote-ref-37)
38. Based on Lockean labor theory, in United States initially the Act permitted patent license to “… anything under the sun that was made by man, but later this rule changed by judicial activism. The Lockean labor jurisprudence was substituted by the utilitarian doctrines. See Keiff et al supra note 25 at 539. Jefferson “rejected a natural rights theory in intellectual property rights and clearly recognized the social and economic rationale of the patent system. [↑](#footnote-ref-38)
39. 35 U.S.C. §102 (1994). Section 102 is regarded as a statutory land mine. See Kieff et al. supra note 251 at 323. [↑](#footnote-ref-39)
40. Rich Giles, The Laying Ghost of the “invention” Requirement, in Merges and Ginsburg, Foundations of Intellectual property (2004) p. 91 [↑](#footnote-ref-40)
41. Merges and Ginsburg, supra note 28 at 165 (Quoted from Suzanne Scotchmer, “Standing on the Shoulders of Giants: Cumulative Research and the Patent Law” 5 The Journal of Economic Perspectives, (1991) p.1. [↑](#footnote-ref-41)
42. In order to avoid litigation related to temporary interruption, the inventor may file continuation patent. [↑](#footnote-ref-42)
43. Graham v. John Deere Co, 383 U.S. (1996) p.1. ; Non-obviousness requirement is the most significant obstacle that a patent applicant faces. It has been called the “final gatekeeper of the patent system.” Keiff et al supra note 51 at 531. [↑](#footnote-ref-43)
44. Rich Giles, The Laying Ghost of the “invention” Requirement, Merges and Ginsburg, Foundations of Intellectual property (2004) p. 91 [↑](#footnote-ref-44)
45. Garder-Shafran Rachel, Intellectual Property Law Dictionary, Loose-leaf Series (2004). [↑](#footnote-ref-45)
46. The expression “Non-obviousness” appears equivalent to the phrases, “inventive step” as used by some jurisdictions, including Ethiopia. See Proc. No. 123 (1995) supra note 19, art. 3(4). [↑](#footnote-ref-46)
47. The Ethiopian law declares 15 years patent monopoly with possible extension of five additional years if the invention is practiced in Ethiopia. See art. 16 of Proc. No. 123, (1995). [↑](#footnote-ref-47)
48. For example, Honeywell Inc, the American makers of electronic control equipment, thermostats and sensors, took $96,000,000 in the form of damages and lost profit because of infringement of Japanese company, Minolta. This company was able to collect several millions of dollars from other infringers too. Warshofskyh Fred, The Patent Wars, The Battle to Own the World’s Technology, (1994) p.1. [↑](#footnote-ref-48)
49. Proclamation No 123, 1995 supra note 19 art, 40. [↑](#footnote-ref-49)
50. Id, Sub art. 2. The possibility of getting utility model certificate for traditional medicines is briefly discussed later. [↑](#footnote-ref-50)
51. Proclamation No 123, 1995 supra note 19. [↑](#footnote-ref-51)
52. Gladstone Mills et al, Patent Law Fundamentals, Lose leaf series, (2009) §4. [↑](#footnote-ref-52)
53. For example, the formula of Coca Cola is never disclosed, and the Company enjoys the invention for unlimited period of time . [↑](#footnote-ref-53)
54. Apart from patenting a novel idea, patentability requirements in Ethiopia and the United States patent law are almost identical: These are: novelty (newness (Art. 3), non-obviousness, publication in scientific journals, use for more than a year etc., are expressly mentioned.Though expressed in different terminology, the basic tenets of patentability in Ethiopia are almost similar to the patentability requirements of United States patent law that have celebrated more than two centuries. [↑](#footnote-ref-54)
55. Proc. No. 123 (199) supra note 19, art. 3(1). [↑](#footnote-ref-55)
56. Id, [↑](#footnote-ref-56)
57. The investor, therefore, should disclose how his/her invention is different from similar inventions in anywhere in the world. If a traditional inventor fails to see a prior art at any corner of the globe, he/she would lose intellectual property protection. This would discourage potential traditional inventor either not to disclose their intention or not to engage in inventive ventures. Some nations limit the contours of disclosure of prior art. In United States, for instance, if the thing is not known within the boundary of United States, it may be patented. The Ethiopian law prohibits issue of patent if similar invention is already known anywhere in the world. The contours of prior art in Ethiopia is worldwide, which appears to make the patentability procedures very complex. [↑](#footnote-ref-57)
58. Proc. No. 123 (1995), supra note 19, art. 3(1), art 3(2). [↑](#footnote-ref-58)
59. For instance, a doctor at Alpha Traditional Medicine Center informed that he learned the practice and curing herbs for his uncle long time ago. He never disclosed the curing herbs the methods of preparation of the medicines to anyone so for. He gathers medicinal herbs from Awash area and North Shao but has no garden of his own. He got a letter of cooperation from the head of medicinal plant section of the chairman of Ethiopian Traditional medicine Association. (Interview with Hakim Alemayehu Nebib – a traditional doctor at Alpha Traditional Medicine Center, March 13, 2021, A.A.) [↑](#footnote-ref-59)
60. Proc. No. 123 (1995), supra note 19, art. 3(1), art 4(2). [↑](#footnote-ref-60)
61. For example, Mergeta Belay Adamu who claims having traditional pesticide that can “kill” Emboch (invasive weed in Tana Lake and other lakes like Abaya worked for some time with a researcher at Bahibr Dar University refused to reveal the traditional herb and the formula he used to prepare the medicine. Mergeta Belay had been working with W/ro Fitfite – a PhD candidate at Bahir Dar University had test site at the out script of the city of Bahir Dar (Sebtamet) near Abay River. He attempted to convince the University researcher and Authorities by consuming the powder of the claimed “medicine” that apparently changed the color of the weed but could not absolutely kill it. After passages of weeks the weakened invasive weed grew up quickly in the test pond. When asked by the researcher to show the claimed herb for further laboratory test Mergeta Belay not only declined but stopped all forms of contact with the researcher and the University. (Interview with Dr. Ayalew Wondie, Director of Lake Tana and Water Resources Protection Agency of Amhara Regional State on Feberary 2021 Bahirdar, Ethiopia) Any attempt to reach Mergeta Belay by this researcher failed, as he virtually found unreachable. Mergeta Belay also had been working with the Ethiopian Public Health Institute, department of Modern and Traditional Medicine Research Directorate for about five years but allegedly disappears when the research center request disclosure of herbs for laboratory test. (Interview with Firehiwot Taka, Director of Department of Modern and Traditional Medicine Research Directorate of Ethiopian Public Health Institute, Gulele, Addis Ababa, Feb. 2021) [↑](#footnote-ref-61)
62. Interview with Hakim Alemayehu Gibeb,Alpha Traditional Medicine Centre, March 13, 2021, Addis Ababa. [↑](#footnote-ref-62)
63. Id; Interview with Firehiwot Take, Director of Research Directorate of Modern and Traditional Medicine Research of Ethiopian Public Health Institute, Gulele, Addis Ababa, Ethiopia) Hakim Alemeayehu claims that in absence of trustful legal system he fears that the modern researchers would steal his wisdom or sell it to abroad. He instead chose to keep his medicinal wisdom secret, and steadily teach his son to keep the medicine for the future generation. (interview conducted on March 13, 2021 at the Alpha Traditional Medicine clinic). Some traditional medicine practitioners, for instance, Hakim Abraham Walelign, practitioner, and owner of Ethio-mefthe Traditional Medicine Center assures he would work with research centers and even teach student who aspire to serve as traditional doctors, provided government assures protection formally. This promise, though apparently incurable, not practically tested by researchers or research centers. (Interview with Hakim Abraham Walelign on March 10, 2021, at Ethio-Mefthe Traditional Medicine Clinic Addis Ababa, Ethiopia). [↑](#footnote-ref-63)
64. In United States, legislative lacunae filled by courts; some of the rule of patent law are stipulated by the judiciary. [↑](#footnote-ref-64)
65. Proc No. 123(1995) supra note 19, art. 3(3). [↑](#footnote-ref-65)
66. For example, a traditional doctor in Boditi S/N/N/R/S informed that it took several years to practice medication. She new the medicine would work but afraid of intimating the same to the public. She consulted some of her friends who encourage her to operate the practice. This took several years from the moment of discovery of the medicine and the practice. (Interview with the traditional doctor at Bodit on Feb, 2021) [↑](#footnote-ref-66)
67. Proc. No. 123 (1995) supra note 19, arts, 38 – 45. [↑](#footnote-ref-67)
68. , Id, art. 38(1). [↑](#footnote-ref-68)
69. Interview with Hakim Alemayehu Gebib, Alpha Traditional Medicine Centre, Addis Ababa, March 13, 2021. [↑](#footnote-ref-69)
70. According to Firehiwot Take, director of the Modern and Traditional Medicine Research Directorate of Ethiopian Public Health Institute (EPHI) Megeta Belay had been working with the Research Center but disappears or turns of his phone when they reach to the level of disclosure of the herb for laboratory testing. [↑](#footnote-ref-70)
71. Interview with Hakim Alemahyehu Gebin, of Alpha Traditional Medicine Centre; interview with Firehiwot Take, Director of Modern and Traditional Medicine and Research Directorate also disclosed the same point. [↑](#footnote-ref-71)
72. For example, Abraham Walelign of Ethio-Mefthe Traditional Medicine Center, and President of the Utopia Traditional Medicine Practitioners Association informed that he would cooperate with researchers with a view to get legal protection either through patent or utility model system. Another traditional medicine practitioner expressed the contrary. Hakim Alemayehu of Alpha Traditional Medicinal Center expressed distrust to the current regulation and want to continue secretive holding of the traditional medicines. When asked how to save the traditional medicinal knowledge the practice for the future generation, his plan was to train his son from his young age. A traditional doctor in Damot Gale of Southern Nations and Nationality said that she is willing to teach anyone willing to get training and show the herb. When asked if she could show at the time of interview, she responded the herb does not grow in dry season and it takes three to four hours travel and search to get the medicinal herb. [↑](#footnote-ref-72)
73. 76% of the respondents to questionnaire view that the government should strengthen community awareness towards the importance of traditional medicines. [↑](#footnote-ref-73)
74. Interview with Firehiwot Take, the Director of the Directorate of Modern and Traditional Medicine Research Directorate of Ethiopian Public Health Institute (EPHI), Feb, 2021. The Directorate has got utility model certificate Damacase and Shiferaw (Mornga). It is publicly known for the medicinal value of these herbs, but the actual nutrients other chemical components were not scientifically proven by the community. The scientific proof and study of the chemical elements was taken as some think novel and protection was given. [↑](#footnote-ref-74)
75. See Sir Isaac Newton’s statement supra at note 40. [↑](#footnote-ref-75)
76. Derek H. C. Chen and Carl J. Dahlman, The Knowledge Economy, the KAM Methodology and World Bank Operations, (2005); see <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=841625> [↑](#footnote-ref-76)
77. Fusco Stefania, “Is the use of Patents Promoting the Creation of New Types of Securities?,” 25 Santa Clara Computer & High Tech Law Journal P.243 [↑](#footnote-ref-77)
78. The disclosure would help innovators to practice their creation openly employing unlimited number of employees or assistants without fear of piracy. The patent system would also protect parallel creation or reverse engineering. [↑](#footnote-ref-78)