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Challenges and Prospects of Vertical Farming for Sustainable Urban Development: The Case of Nifasilk-Lafto Sub-City of Addis Ababa

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Declaration

I, Yared Tilahun declare that this wor **Challenges and Prospects of Vertical Farming for Sustainable Urban Development** sources of materials used for the study have been duly acknowledged. I have produced it independently except for the guidance and suggestion of the Research Advisor. This study has not been submitted for any degree in this University or any other University.

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Confirmation

The thesis can be submitted for examination with my approval as an center`s advisor.

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Date_____

Dedication

This work is dedicated to my Grand Mother Tadelech Sima for her love, patience, wisdom and spirituality! I will always remain grateful for your kindness

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ACRONYMS

AACBPCD	Addis Ababa City Beautification, Park and Cemetery Development
ADLI	Agricultural Development Led-Industrialization
EPA.	Environmental Protection Authority
FAO.	Food and Agriculture Organization
GDP.	Gross Domestic Product
GIS.	Geographic Information System
GTP	Growth and Transformation plan
IDP	International Development Program
IDRC.	International Development Research Center
MSE.	Micro and Small Scale Enterprises
NGOs.	Non-Governmental Organizations
ORAAMP.	The Office for the Revision of the Addis Ababa Master Plan
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
RDPS	Research and development program system
RUAF.	Resource centers on Urban Agriculture and Food security
SDPRP	Sustainable Development Program to Reduce Poverty
UA.	Urban Agriculture
UPA.	Urban Peri Agriculture
USAID.	United State Agency for International Development

ABSTRACT

Urban community which community? enjoys food security when all people, at all times, have access to nutritious, safe, personally acceptable and culturally appropriate foods, produced in ways that are environmentally sound and socially just. One of the means for food security is urban agriculture. This research focuses on urban agriculture with a particular to Challenges and Prospects of Vertical Farming for Sustainable Urban Development: The Case of Nifasilk-Lafto Sub-City of selected areas of Addis Ababa. The general objective of the study is to explore the importance, challenge and prospects of vertical farming for sustainable urban agriculture development for food security. Data was gathered from both primary and secondary data gathered through qualitative and quantitative approaches. Representative sample household from a total of 414 urban farmers in the sub city 90 representative farmers were randomly selected. For the qualitative data nine key informant interviews were also conducted using a purposive sampling technique from the relevant government organizations. A semi-structured questionnaire, key informant interview ??? observation type of observation using photography, document analysis, and satellite images were the methods employed for data collection. The collected data was analyzed using a descriptive statistics for quantitative and qualitative data for narrative analysis for the quantitative and qualitative data respectively. The finding of the study indicated that urban agriculture activity has effect on the natural environment especially on soil erosion and water pollution as well as poses potential health risk due to contamination of vegetables with toxic substances. Informal settlers occupied reserved area for urban agriculture purpose by squatters. As well as urban agriculture activities in the protected area for green development and uses are the two major challenges identified in the study area. The study discusses the role of urban agriculture in connection with nutrition and food security, income generation and job opportunity, environmental improvement and sustainable urban development. Thus vertical farming as a new technological approach in urban agriculture activity should be promoted as it can solve technically and technologically the urban community problems.

Key words: Vertical farming, Challenges, prospect, sustainable, urban development

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The most popular type of unconventional urban farms are vertical gardens, which support growing of not only perennials and creepers but also bushes on the facades of buildings. They can be created on both outer and inner walls, in both public space and private houses. The main advantage of creating the green walls is the functional use of building facades, which brings benefits to ecology of urban, is as well as their inhabitants (Bribach, 2014).

An innovative method, commonly referred to as vertical farming (Despommier 2010) has emerged and has become an increasingly relevant part of the movement toward sustainable urban agriculture (Cobb, 2011; Nordahl, 2009). Vertical farming shows promise as an effective means to help increase food production, maintain food security and foster sustainable urban agriculture. The notion of vertical farms is not new. The idea of using large multistory buildings to cultivate agricultural products was first devised by American geologist, Gilbert Ellis Bailey, as described by his groundbreaking, but little known, book simply titled Vertical Farming (1915/2011). Bailey recognized, decades before the current environmental crisis and food security problem had become part of global discourse, that the only away to avert the inevitable future crisis of food scarcity was to create farming practices that went up rather than out the concept of vertical farming has been further developed. (Despommier 2010)

For every 1° rise in atmospheric temperature, it is estimated that 10 % of the land currently under crop cultivation will be lost. One answer to reversing this situation is controlled environment agriculture (Despommier 2011). Vertical farms have been proposed as a solution for future cities to grow most of the food inside city limits in ultra-efficient greenhouses (Vogel 2008) and, regardless of location, can be applied to every urban center (Despommier 2011). Despommier (2011) identifies the following rationale for creating vertical farms in urban centers over conventional agriculture: year-round produce; lack of crop loss due to weather events; no use of fossil fuels to harvest, transport, and refrigerate; no use of pesticides and herbicides; job creation in urban centers; lesser water use; and limited spoilage from excessive handling. This approach

to food production is largely environment independent and hence immune to climate change (Germer et al. 2011).

Agricultural activities take on many different forms in the urban areas of many of the world's countries. Urban farmers in Addis Ababa predominantly cultivate vegetables for personal consumption and profit. Urban farming production is not new to Addis Ababa; it has been a

animals. Well-to-do households raised cows for milk for home consumption. But there is no enough study in this area so that vertical farming seeks to ensure the sustainability of our cities r-increasing urban population.

1.2 Statement of the Problem

The construction sector has been booming massively, new residential areas have been built in different parts of Addis Ababa. When the government uproots people with their expansion, they are also destroying valuable farmland, decreasing the amount of land available for cultivation. Entire agricultural communities are moved and left with very little compensation for their land, with no other skills to rely upon in a city with already very few employment opportunities. This process of rapid urban development is working both to increase the populations of unemployed and homeless peoples, and to decrease the supply of fresh produce available, causing prices and food insecurity to increase. (Mara Gittleman 2009)

On the one hand, the water bodies might be polluted by either a point or nonpoint source of pollution. Point sources included municipal sewage treatment plant discharges, industrial plant discharges, factories power plants, underground coal mines, specific source such as drain pipes, ditches or sewer outfalls and oil wells and non-point source or diffuse in other hand have no specific location of sources. As stated by (UNEP, 2003), pollution started when humans began to farm the land and settle in town many years ago (Ara S, MA Khan, MY Zargar, et al 2003) there are numerous source of pollutants that could deteriorate the quality of water resource. (Tameru.et.al 2004) Stated that in developing countries source of pollution from domestic, Agricultural, Industrial activities are unregulated (Danquah L. 2010).

At the same time, urban environmental pollution and waste directly destroy crops growth, and make urban agriculture productivity decline.

Data shows that from the city administration trade & industry bureau Addis Ababa was dominated with agricultural land and activities. This changed with the urbanization of Addis. Only 5,640 hectares are allocated to 2,278 farmers. The core work process manager at the Addis Ababa City Administration Bureau of Trade and Industry Development and the Urban Agriculture Bureau, this land is diminishing from time to time, from 19,000 hectares a couple of years ago to the current 5,640. The government is pushing to expand urbanization in the mostly agrarian economy. In the meantime, there is a policy and strategy to improve urban farming. (AAEPA 2015)

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the study is to assess the Challenges of Surface farming and Prospects of Vertical Farming for sustainable urban agriculture development for food security attainment and urban poverty alleviation with special reference to the city of Addis Ababa.

1.3.2 The Specific Objectives

The following are the specific objectives of the study:

- To investigate the importance of vertical urban agriculture for urban food security and environment
- To identify the challenges encountered by households engaged in urban agriculture in the study area.
- To assess the prospects of vertical urban farming.

1.4 Research Questions

Based on the objectives of the study stated above, this research aims at addressing the following research questions:

1. What are the importance of vertical urban agriculture for urban food security and environment in sustainable urban agriculture?
2. What are the challenges of surface farming in the study area by households?
3. What are the potential and prospects of vertical farming for urban development?

1.5 Scope of the Study

Geographically, the study focuses in Nifasilk-Lafto Sub-cities of Addis Ababa City. Produces of Urban agriculture activities and vegetables produced in homestead (compound) and along the river buffer area by the urban farmers is the subject of the study.

The thematic scope of the study to assess the overall condition of Urban Agriculture types activity and vertical farming consider in center city of A/A Nifasilk-Lafto sub-city. Specifically, issues related with land use, socio-economic condition of households in the system of farming and the practice of Urban Agriculture with respect to environmental and health issues to the potential and prospects of vertical farming.

1.6 Limitation of the Study

To conduct the study, there is some problem related with gathering information from farmer on filed and even urban development office particularly Nifasilk Lafto sub-city so I was depending with on journals and articles like budget, crisis and conflict at study area but as I mention above secondary date there is no from study area even related res -Lafto sub-city and web-site.

another t give appropriate answer and enough information so it takes time because of this again and again go there to get owner of farmland.

1.7 Significance of the Study

In this research, nature and size of urban agricultural activity on urban farming are measured which will imply for issues of urban poverty alleviation and better use of urban natural resources. The study also helps to add value for the insights of understanding the role of vertical farming, especially for effective sustainable urban development reforms in the city of Addis Ababa. Agriculture which is vertical versa since urban agriculture is not a new phenomenon; instead, the extent of urban agriculture in Addis Ababa and its influen are examined. Different contextual factors that determine urban farming based livelihood activities are also addressed.

This research also helps for Government, decision makers, especially urban farmer and researchers can use this the result for possible solution for the issue under study and use as a spring board of future research undertaking. Policy makers, planners, environmentalists, agriculturists and other professionals are expected to take advantage of the findings of the study to improve strategies towards solving the existing challenges facing sustainability of urban

1.8. Organization of the Paper

The research is organized into five chapters. This first chapter dealt with introduction comprising the background, problem statement, research objectives, research questions and significance. The second chapter focuses on literature review on Vertical urban agriculture issue that enables to clarify the objectives of the study. The third chapters explains the research methodology i.e. types and sources of data, method of data collection, sampling method and data analysis method. The fourth chapter deals with situational analysis of the study area under investigation by identifying study area Vegetable Producer Cooperatives within Nifasilk-Lafto Sub-city. Identify, analyze and summarize the main issues investigated in this study. Finally, the last chapter draws conclusion and recommendations which are incorporated based on the finding of the study in chapter four as well as proposed solutions for each issue identified in the four chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 The Concept of Vertical Farming

is insufficient land and labor for traditional farming. According to the United Nations Population Fund (2007), the number of people living in towns and cities would surge beyond 5 billion by 2030. This is a vicious cycle. With growing number of people staying in cities, more agricultural land will be sacrificed to accommodate urbanization. With limited farmland and fewer farmers, the farming trade is not thriving. Very few people have the aspirations to be or stay on as farmers. Vertical farming is the solution for urban land-scarce cities, and countries like Singapore. But the concept of vertical farming is not new. Farmers in East Asia have been growing rice in vertical tiers (terraces) to conserve space and water. "Vertical Farming" was coined in 1915 by American geologist Gilbert Ellis Bailey. In 1950s, an attempt to integrate agriculture into the built-up environment was made in Denmark when a farmer grew cress in a factory on a mass scale. Since then, vertical farming has evolved into growing crops in a fully-controlled, indoor urban environment (Despommier, 2011)

In vertical farming, plants are cultivated in multi-stacks or vertically-inclined surfaces of buildings, warehouses, or greenhouses located in cities or urban areas. The plants could be cultivated in three ways a soil-based system in which plants are potted in trays of soil and sprayed periodically with a mist of nutrients, or an aeroponic system in which the roots of plants are sprayed periodically with a mist that provided the necessary nutrients, hydration, and oxygen for growth, ora hydroponic system in which plants were grown without soil by dipping the roots of plants in water containing nutrients (Despommier, 2011)

2.2 History of Vertical Farming in the World

The idea of vertical farming is not entirely new. Examples of it can be found dating back to the

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vertical environment would provide economic and environmental benefits. In the early 1930s,

William Frederick Gericke pioneered hydroponics at the University of California at Berkley. In the 1980s, Åke Olsson, a Swedish ecological farmer, also proposed vertical farming as a means for producing vegetables in cities. He is known for having invented a spiral-shaped rail system for growing plants. Around the turn of the century, Dickson Despommier, an American ecologist, and professor of public health, passionately revived the concept of vertical farming. He

purposes in skyscrapers. Using advanced greenhouse technology such as hydroponics and aeroponics, the vertical farm could theoretically produce fish, poultry, fruit, and vegetables. The vertical farm is considered to promote sustainable agricultural practices more than that by conventional farming, which refers to large scale, outdoor agriculture that embraces systems that engage heavy irrigation, intensive tillage and excessive use of fertilizers, pesticides, and herbicides.

Environmentalists, urban farmers, architects, agronomists, and public health experts, among others, have been joining this mini revolution as they partner to work out a way to salvage a food-scarce, ultra-urbanized future. A wide number of technology experts have converged on the concept of vertical farming, advancing the fields of robotics, aeroponics, aquaponics, and hydroponics. Nonprofits organizations (NGO) aiming to promote environmentalism and local economic prosperity, have been backing the vertical farm concept. Similarly, for-profit ventures that seek to meet the demand for local produce have supported this concept. Further, governments looking for ways to boost domestic food security have been funding these endeavors. Numerous countries including Korea, Japan, China, Germany, the United Arab Emirates, China, France, India, Sweden, Singapore, and the United States, have convened to discuss vertical farming. They have repeatedly endorsed the concept as integral to the long-term sustainability of their cities.

2.3 Forms of Urban Agriculture

Analysis of contemporary urban structures has laid the foundations for the development of various ideas of urban crop cultivation. My work presents the increasingly popular innovative forms of urban management, which support the cultivation of crops, i.e. green roofs, city farms, window farms (or window gardens) and vertical gardens.

Green roofs

ways of eco-compensation, i.e. investing in a given area in such a way that it increases its environmental value. It is important that green structures can be implemented not only in the new investments, but also in the those that already exist. The more popular the green roofs become, the more diversity in both the plant cover and its purpose can be observed. A widespread type of green roofs is dedicated to the restoration of a biologically active surface in towns and is usually not available for use. This is an environmentally useful space which provides a habitat for birds and other animals (Sznajda-Birnfeld et al., 2012).

Another type of green roofs are intensive green roofs, often referred to as roof gardens as this name reflects their nature. The roofs are usually flat and resemble standard gardens or farms t is important to build them properly so they can support an additional weight

(up to 1500 kg per m2), so as to be able to cultivate there a wide range of perennials, bushes and trees and to build additional elements, such as ponds, garden sculptures or garden houses. Introduction of the elements listed above will need to ensure a proper thickness of a vegetation layer, which can be up to 125 cm. Food produced on the roof of the workplace or dwelling houses will be fresher, healthier and cheaper because of, inter alia, the lack of transportation cost (Kania et al., 2013).

Vertical garden

Currently, the most popular type of unconventional urban farms are vertical gardens, which support growing of not only perennials and creepers but also bushes on the facades of buildings. They can be created on both outer and inner walls, in both public space and private houses. The main advantage of creating the green walls is the functional use of building facades, which brings benefits to ecology of urban areas as well as their inhabitants (Bribach, 2014). Vertical gardens are vertical constructions fixed to the wall, made of a lightweight frame which is mounted on a special fabric supporting plants and preventing the use of an automatic water spraying system. The purpose of the fabric is to support the roots as well as to maintain an appropriate amount of moisture and nutritive substances. The implemented watering system

distributes also a fertilizer which is necessary to nourish the plants. In case the daylight is not available, it is possible to use artificial light, which helps to locate the green wall inside or in a shady place (Kania et al., 2013).

City farms

City farms are environment- and agriculture-friendly projects which enable people at all age to visit a real farm located in the city centre. They promote the development of wastelands in an environmentally friendly way, while providing at the same time multiple benefits. Their activity aims at improving the lifestyle in terms of healthy nutrition, environmental protection and sustainable development, since the creation of a city farm ensures increased awareness of issues such as environmental degradation, the use of renewable resources of the Earth and the reduction of pollution resulting from the wasteful use of natural resources. The main purpose of building a city farm is to persuade people to live according to nature by practical activities as well as supporting the strategy of sustainable development and eco-development of urban areas. This can be achieved through the development of environmentally friendly areas, acceleration of organic waste recycling, improvement of water management, affecting the climate and biological diversity of urban wildlife (Palej, 2010).

2.4 Theoretical Framework/Perspectives

Vertical farming is a concept that involves cultivating plants with livestock on vertically inclined surfaces such as in skyscrapers in urban areas, where there is a lack of available land and space. It is an agricultural technique involving large-scale food production in high-rise buildings that enables fast growth and planned production by controlling environmental conditions and nutrient solutions to crops based on hydroponics using cutting-edge greenhouse methods and technologies.

2.4.1 Vertical Farming for Sustainable Development

Despommier recognized that current, industrial-based agriculture and land-utilization practices

ming does not rely upon more land and more water in order to be effective. Put simply, it involves the utilization of high-rise, multistoried buildings, coupled

with advanced greenhouse and emerging light-emitting diode (LED) ororganic light-emitting diode (OLED) technology to produce fruits and vegetables as well as fish, poultry, and small domesticated animals (Despommier, 2009; Max, 2011). Cultivating plants and raising fish and small animals in a controlled indoor environment ensures year-round productivity, thus making production independent of the vagaries of seasonal growing periods. Production would also be protected from adverse climatic events that normally reduce yields or completely eliminate productive capacity. Despommier (2007) suggested that with suitable technology and agro-management skill, a vertical farm acre can produce the equivalent of 4 to 6 soil-based acres. For some crops, especially those that grow in tight clusters such as strawberries, one vertical farm acre yields the same amount of produce as 30 outdoor acres. Vertical farms use less water, are less susceptible to diseases and pestilence, and would need much less agro-mechanization to sustain operation.

A vertical farm would also help alleviate chronic unemployment issues faced in many urban environments. Aside from offering jobs within the vertical farm infrastructure, additional ancillary jobs opportunities would result from the incorporation of the farm into the life of the community. First of all, the farm would need workers to construct and maintain the structure. The vertical farm would also include a system of grocery stores, organic food markets and eateries, and local distribution and transportation networks that would offer opportunities for a variety of other food-service related positions (Despommier, 2009; Hwang, 2010).

2.4.2 Sustainable Urban Agriculture

In the 19th century, British social activist E. Howard designed a new city mode utilizing broad farmlands to surround the beautiful living environment, putting all what is good offered by the positive city life together with all the beauty and welfare provided by countryside in order to deal

the big city. This should be the earliest urban agriculture theory.

Since the 20th century, along with the wide spread of urban agriculture in many developed countries, research in its theory has been furthering. This article explains the theoretical bases of urban agriculture mainly from the view of point of economics.

In some cases, it is true that the past is the future. Vertical farming is rooted in the agricultural practices of the nineteenth century. During World War I and later during World War II, people in communities were urged and supported by government officials to grow food in whatever spare land was available in the cities and towns of the nation, as a method of augmenting the scarce provisions available at that time. The future of sustainable urban agriculture has its roots in the past.

Figure 2.1: Vertical farming models aeroponic and hydroponic growing systems

Source: Sustainable Development and Biodiversity book (2017)

2.4.3 Urban Transformation

City transformation study from the industrial age to the global city requires vigorous examination. Transformation implies changes over time; the present urban fabric is resultant of successive generations of settlers who left their mark in physical structure as well as political, economic and social institutions. The city passed through a number of transformations since its inception in human history. The industrial revolution of nineteenth century after First World War due to technological revolution has created major transformation, the rapid shift in patterns of settlement from the country to the city. As industrialization changed the nature of urban life, globalization is doing the job since the latter part of the twentieth century - a further transformation process. Previously it was large-scale commodity production for a targeted mass market place, now it is a new system based around the generation of wealth from information services which are globally organized. For survival, cities have to compete in an international system having new hierarchies of power and opportunity from core global cities of New York,

London and Tokyo where the worlds information and financial super highway is centered, to regional and local centers. The transition to the urban industrial world and eighteenth and nineteenth centuries produced one of the great transformations in human history. Separation of work and residence took place. Factory based production started. Urban economy become capitalist based which bought labor power from the wage earning men and women. Single family housing came up. Clearer separation of gender roles came up. Women occupied role out of domestic sphere. This was about growth in terms of wealth and urban expansion. Now the transformation has shifted to the so-called knowledge and information industries.

Physical placement within particular region is not so important now. Ideas and knowledge are raw materials, industries being the research centers, flow of knowledge needs access. Flourishing sectors in present scenario are Information technologies, and World Wide Web.

2.4.4 Urban Ecology

, 2008a). Urban ecosystems integrate natural, built and socioeconomic systems. They represent both physical and conceptual spaces in which dynamic interactions between these three systems occur. Urban ecosystems are places where people live in high densities, or where built infrastructure covers much of the land (Pickett et al., 2001). A comprehensive understanding of urban ecosystems must include an understanding of how less densely populated areas also affect and influence reciprocal flows between densely and sparsely settled areas (Pickett et al., 2001).

Urban ecology is a multidisciplinary field that provides many tools for advancing the potential of sustainability and resilience in cities (McPhearson et al., 2016). Diverse conceptual approaches to urban ecology exist, reflecting the numerous and overlapping ways in which urban ecosystems are understood and studied (McPhearson et al., 2016). Although this gives urban ecology great depth and breadth, it also makes it difficult to define.

Urban ecology has been defined differently in different disciplines (Wu, 2014). In urban design and planning literature, for example, urban ecology has focused on the design of environmental amenities for people in cities and on reducing the environmental impacts of urban regions

(Pickett et al., 2011). The term urban ecology has been given a number of definitions, but these have largely failed to achieve a global consensus (Pickett et al., 2008; Wu, 2014; McPhearson et

of the processes determining the abundance and distribution of organisms, of the interactions between organisms, of the interactions between

Wu (2014) described how varying concepts and perspectives of urban ecology today fall into two

-human organisms in urban

em. Wu (2014) proposed that recent developments in urban studies warranted a third category:

Wu (2014) attempted to integrate the three perspectives into a broad definition

ecology may be defined as the study of spatiotemporal patterns, environmental impacts, and sustainability of urbanization with emphasis on biodiversity, ecosystem processes, and

logy studies the environmental state (i.e. biodiversity and ecosystem services and processes) and the impacts of urbanization on it, considering the relative sustainability of these patterns over different temporal and spatial scales.

For this report we define urban ecology as the study of the ecology of all living organisms (people, plants and animals) in urban environments (Parris, 2016). It includes the study of the distribution, abundance and behaviour of organisms and their interactions with their environment, and it encompasses the study of the spatiotemporal patterns, environmental impacts and sustainability of urbanisation, with an emphasis on biodiversity, ecosystem processes and ecosystem services (Wu 2014).

2.5. Potential and Prospect of Vertical Farming

Vertical Farming can be potentially beneficial in increasing food production, maintaining high quality and safety and contributing to sustainable urban farming. Well-known advantages of

growing food within the urban territory can be beneficial environmentally, socially and economically. Vertical farms can also provide solutions for increasing food security worldwide. Fatemeh Kalantari (2017)

2.5.1. Food Security

Food security has become an increasingly important issue. Demographers anticipate that urban population will dramatically increase in the coming decades. At the same time, land specialists (e.g., agronomists, ecologists, and geologists) warn of rising shortages of farmland (Despommier, D.2014). For these reasons, food demand could exponentially surpass supply,

increase by 40%, exceeding 9 billion people by the year 2050. The UN also projects that 80% of de in cities by this time. Further, it predicts that by 2050 we will need 70% more food to meet the demands of 3 billion more inhabitants worldwide united nation 2015). Food prices have already skyrocketed in the past decades, and farmers predict that prices will increase further as oil costs increase and water, energy, and agricultural resources diminish. The sprawling fringes of suburban development continue to eat up more and more farmland. On the other hand, urban agriculture has been facing problems due to land scarcity and high costs. We desperately need transformative solutions to combat this immense global challenge (Despommier, D.2014).

The logic of vertical farming is simple: produce more food on less land. The same rationale that we use to stack homes and offices in limited and expensive land, such as in Hong Kong or Manhattan, can apply to farming. Proponents of the vertical farm claim that it would create compact and self-sufficient ecosystems that cover multiple functions, from food production to waste management. Vertical farming could enable food production in an efficient and sustainable manner, save water and energy, enhance the economy, reduce pollution, provide new employment opportunities, restore ecosystems, and provide access to healthy food. In a controlled environment, crops will be less subject to the vagaries of climate, infestation, the nutrient cycle, crop rotation, polluted water runoff, pesticides, and dust (United Nation, 2015).

2.5.2. Climate Change

Climate change has contributed to the decrease of arable land. Through flooding, hurricane, storms, and drought, valuable agricultural land has been decreased drastically, thereby damaging the world economy (Kalantari, F.; Tahir, O.M.; Lahijani, A.; Kalantari, S2017). For example, due to an extended drought in 2011, the United States lost a grain crop assessed at $110 billion. Scientists predict that climate change and the adverse weather conditions it brings will continue to happen at an increasing rate. These events will lead to the despoliation of large tracts of arable land, rendering them useless for farming. It is common for governments to subsidize traditional farming heavily through mechanisms such as crop insurance from natural causes. Furthermore, traditional farming requires substantial quantities of fossil fuels to carry out agricultural activities (e.g., plowing, applying fertilizers, seeding, weeding, and harvesting), which amounts to over 20% of all gasoline and diesel fuel consumption in the United States.

This is especially important given the increasing distance between farms and cities from global urbanization. Sadly, the resulting greenhouse gas emissions from food transport and agricultural activities have contributed to climate change.

2.5.3. Urban Density

Vertic

incorporating more urban activities (i.e., housing more people, services, and amenities). Research has revealed that designating urban land to farming results in decreased population density, which leads to longer commutes. The increased gas consumption resulting from moving a relatively small percentage of farmland into cities would generate an extra 1.77 tons of carbon dioxide per household per year. Despommier details space efficiency of vertical farms. He suggested that a 30-story building (about 100 m high) with a basal area of 2.02 ha (5 ac) would be able to produce a crop yield equivalent to 971.2 ha (2400 ac) of conventional horizontal farming. This means that the production of one high-rise farm would be equivalent to 480 conventional horizontal farms.

2.5.4. Health and Social Benefits

Conventional farming practices often stress profit and commercial gain while paying inadequate attention to inflicted harm on the health of both human and the natural environment (Touliatos, D.; Dodd, I.C.; McAinsh2016). These practices repeatedly cause erosion, contaminate soil, and generate excessive water waste. Regarding human well-being, the World Health Organization has dete

may attract flies, and may contain weed seeds or disease that can be transmitted to plants. produce.

Further, growing crops in a controlled indoor environment would provide the benefit of reducing the excessive use of pesticide and herbicide, which create polluting agricultural runoff. According to Renee Cho, In a contained environment, pests, pathogens, and weeds have a much harder time infiltrating and destroying crops. When excess fertilizer washes into water bodies (e.g., rivers, streams, and oceans), a high concentration of nutrients is created (called eutrophication), which could disturb the ecological equilibrium.

2.5.5. Environment and Ecosystem Benefits

Traditional agriculture has been encroaching upon natural ecosystems for millennia. According to Dickson Despommier, Farming has upset more ecological processes than anything else it is the most destructive process on earth. In the past half century or so, the Brazilian rainforest has been severely impacted by agricultural encroachment, with some 1,812,992 km2 (700,000 mi2) of hardwood forest being cleared for farmland. Despommier suggested that encroachment on these ancient ecosystems is furthering climate change. In this way, indoor vertical farming can reduce the

the negative influences of climate change. If cities employed vertical farms to produce merely 10% of the ground area they consume, this might help to reduce CO2 emissions enough to develop better technological innovations for improving the condition of the biosphere long-term. By eliminating fertilizer runoff, coastal and river water could be restored, and fish stock of wild

converting most food production to vertical farming is the promise of restoring the services and functions of ecosystems.

2.5.6. Economics Benefits

Proponents of the vertical farm also argue that it will supply competitive food prices. The rising expense of traditional farming is quickly narrowing the cost gap. For example, when vertical farms are located strategically in urban areas, it would be possible to sell produce directly to the consumer, reducing transportation costs by removing the intermediary, which can constitute up to 60% of costs (Al-Kodmany, K. 2016). Vertical farms also utilize advanced technologies and intensive farming methods that can exponentially increase production. Researchers have been optimizing indoor farming by calibrating, tuning and adjusting a wide-range of variables including light intensity, light color, space temperature, crop and root, CO2 contents, soil, water, and air humidity (Al-Kodmany, K. 2016). In addition, vertical farming provides an opportunity to support the local economy. Abandoned urban buildings can be converted into vertical farms to provide healthy food in neighborhoods where fresh produce is scarce. Additionally, the high-tech environment of indoor farming can make it fun to farm. Hence, a technology-savvy younger generation has been enticed by the practice, grooming a new breed of farmers. Further, vertical farming provides impetus in the development of innovative agricultural technologies. Finally, it could reconnect city dwellers with nature through the activity of farming (Al-Kodmany, 2016).

2.6. Challenges of Urban Agriculture

Despite the potential of urban agriculture mentioned above, it has some problem worth noticing. Agriculture requires land. However, there is lack of space for growing crops in cities Knowing that growing food in cities requires land, it may not be prioritized in urban land uses since the demand for urban spaces to build houses is by far higher than using spaces for agricultural activities and also urban agriculture can be a health hazard. It uses resources of cities such as water and urban wastes for production.

2.6.1. Social Challenges and Health Risk of Urban Agriculture

Despite the advantages of urban agriculture mentioned above, it has some limitations worth noticing. In many cities, it is being practiced as an informal sector and has little support from local councils (Bryceson 2005, Bryld 2003, and Deelstra and Girardet 1999).

Space for cultivation;-Agriculture requires land. However, there is lack of space for growing crops in cities. As Bryld ities, there is an

land, it may not be prioritized in urban land uses since the demand for urban spaces to build houses is by far higher than using spaces for agricultural activities. Argenti (2000:1) further emphasized that agricultural productive lands are likely to be lost in this competition.

Health problems;-Urban agriculture can be a health hazard. It uses resources of cities such as water and urban wastes for production. Use of wastewater/polluted rivers and untreated compost may contaminate crops/livestock and become health hazards to human beings. There are a number of cases when urban farming brought health problems (UNDP 1996). Besides these, the major constraints of urban farming in Addis Ababa include lack of policy issues about urban agriculture which resulted in less attention to the sector, limited working capital for farming and over-use of resources (ORAAMP 2000).

2.6.2. Policy Gaps and the Neglect

The FDRE has developed a number of comprehensive policies, strategies and programs for accelerated and sustainable economic development since it assumed power in 1991. Such policies and strategies include the Agricultural Development Led-Industrialization (ADLI) Strategy, Rural Development Policy and Strategies (2003), the Sustainable Development Program to Reduce Poverty (SDPRP), the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), and the 2nd (GTP). By implementing these productive policies, strategies and programs, remarkable progresses have been made in various sectors in the last two decades. However, this has not been reflected in the area of UPA to any extent. The reasons were, among others, lack of attention and action by policymakers, urban executive bodies and planners, lack of appropriate extension packages and production technologies, inappropriate land use policies, and biased health and environment dimensions concerning this sector. Contrary to the appraised/assessed cases of different countries in the world, Ethiopia lacks policy frameworks for UPA despite the fact that the sector is a source of livelihoods and fresh food items for hundreds of thousands of urbanites in the country. It was not even addressed in the National Urban Development Policy of the Country (2005). Furthermore, no issues of UPA have

been mentioned in the subsequent urban-oriented development-spurring documents such as Urban Development and Construction Component of PASDEP (2006), Urban Industrial Development Package (2006) and Urban Lands Lease Holding Proclamation (2011). Many urban farmers in the country, therefore, operate without formal recognition of their main livelihood activity and they lack the structural support of proper

2.7 Addis Ababa Policy Frameworks on Urban and Peri-urban Agriculture

existing policy and legislative frameworks do not encourage it sufficiently. For example, UPA is not included in the 2010 2014 Growth and Transformation Plan (GTP), which is designed to

Indeed, the sector faces many problems that require policy support, including availability of land and security of tenure; access to clean water for irrigation; adequate supplies of inputs and credit services; weak farm organizations; low productivity, and long marketing chains.

In 2011, Ethiopia launched its five-year (2010/11 2014/15) national Growth and Climate Resilient Green Economy by 2025 plan that established the Addis Ababa green frame. This covers almost 41 percent (22 000 ha) of the land area of the city, and involves four different urban land-use categories green areas along riverbanks, forests and woodlands, urban agriculture, and recreational open spaces, botanical gardens, zoological parks, and natural and street parks. Built-up surface occupies about 37 per a and 22 percent is designated for urban expansion. Of this expansion area, 67 per cent is currently used for cultivation and a further 16 per cent as grazing land. Clearly, urban agriculture is an important part of green frame; however, enforcement of urban agricultural areas from encroachment and other uses remains a challenge.

Addis Ababa City Beautification, Park and Cemetery Development (AACBPCD) reported that it preserves the main features and beautiful sites of the city to provide a worthy setting for the capital and, above all, give inhabitants pleasant, convenient and healthy surroundings in which to live and work. The city government has traditionally focused much of its environmental enhancement efforts on establishing a few parks and roadside tree plantations (Eyob, 2010) and not on the multi-functionality of green spaces for reducing environmental risks to the city, such

as from flooding. For example, no serious effort has been made to expand the spatial extent of the city in a planned manner that would allow the city to acquire adequate green space along with growth. The availability of green space is rapidly diminishing because of poor management of existing spaces and weak governance (Alamerew, 2002).

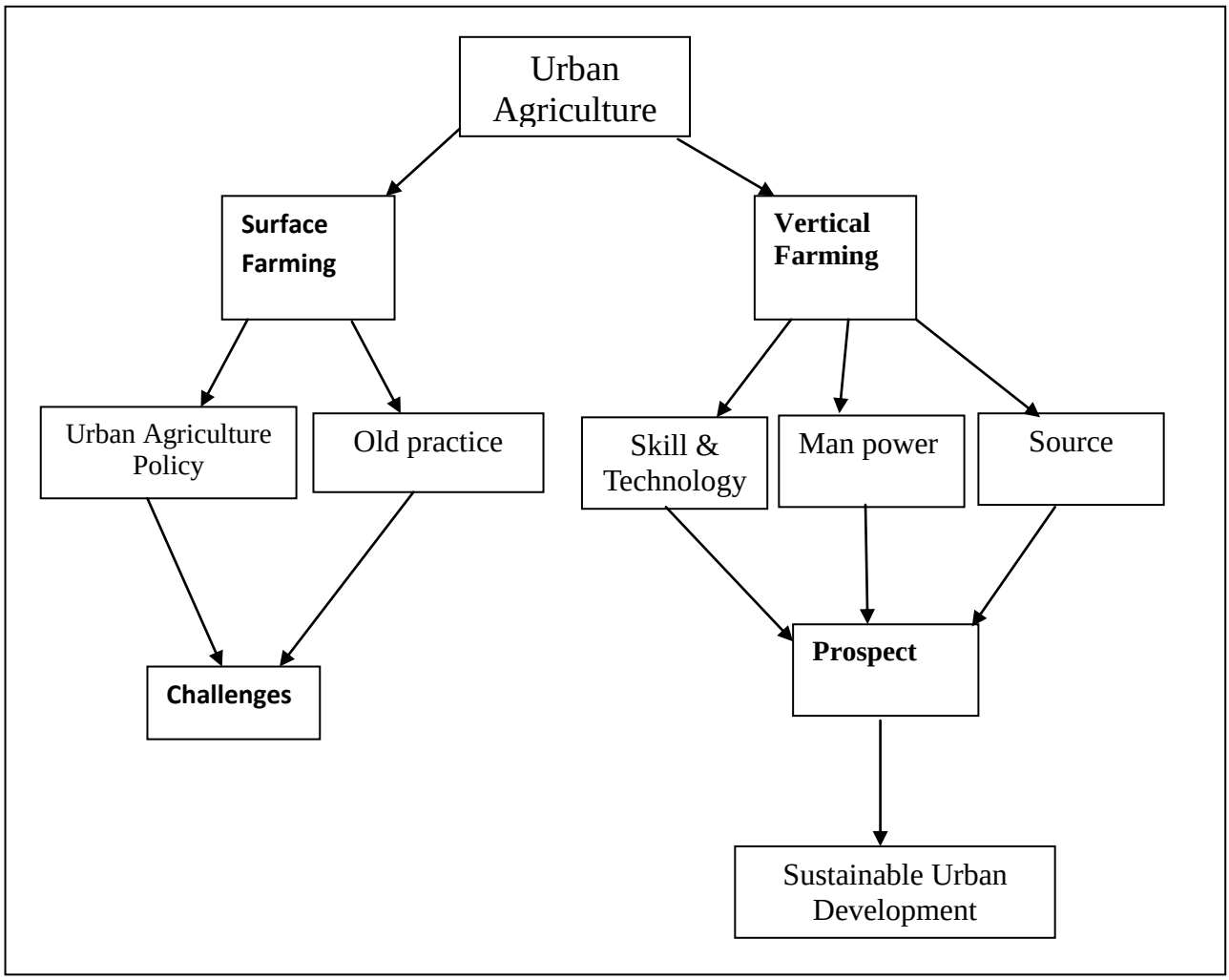
Encouraging urban and peri-urban agriculture

Urban agriculture policy framework currently being developed for the city of Addis Ababa provides a tangible measure for achieving greater visibility of urban agriculture within urban planning. The policy sets out a sound framework that promotes UPA in an effort to improve food security, income and employment in an environmentally friendly, socially inclusive and gender sensitive manner, while reducing environmental degradation and pollution through the sustainable utilization of natural resources and the environment. The policy framework, which the city government is in the process of developing, comprises five major elements access to land and water, health and environment, UPA services, gender and social issues, & institutional.

2.8 Conceptual Framework

To achieve the research objectives, the researcher developed a conceptual frame work. The concept of Urban Agriculture is very broad. However, the researcher tried to handle on, the prospect of Vertical Farming on cash crop and fresh food production on urban area. Hence, from the framework one can see the relationship between the impacts of new technology and skilled man power on crop and food production for sustainable development. If urban farmer coping and adapt this new technology secure food security and sustain urban development.

Linkage between the different determinants of urban farming activity



Source: developed by the author

Note: the factor at the head of the arrow is affected by the one at the tail of the arrow

CHAPTER THREE: RESEARCH MATERIALS AND METHODOLOGY

This chapter presents the research materials and methodology followed in an attempt to address the stated objectives of the study. It is sub-divided in to five sub-sections, namely, Description of the Study Area, research approach, sources of data, methods of data collection, and methods of data analysis

3.1 Description of the Study Area

The study was carried out in Nifas Silk sub-city of Addis Ababa Ethiopia. The city was selected for three main reasons. One, it is the largest city in Ethiopia harboring more than 30 % of the total urban population in the country; thus, it was assumed that it holds many of the urban farmers. Two, knowing that few researches are done so far in this issue, the study improves knowledge about the role that urban agriculture plays in the study area and can be one of the baseline references. And last but not least, it was assumed that research findings have good representing value for other cities in the country and similar urban areas elsewhere. Use of administrative units was found to be suitable to select representative study sites within the city. Each sub-city has independent administration council which represents directly the city administration council; thus, one sub-city was considered as one administrative unit. Different criteria were considered in selecting representative sub-city for the study. Major criteria were presence of urban agriculture office and location of sub-cities. This information was obtained after contacting with Addis Ababa urban agriculture office and Addis Ababa city administration. ORAAMP (2000).

Figure 3.1: Location of study area

Source: Addis Ababa city web site & google

3.2 Research Approach

Mixed approach, A triangulation of both quantitative and qualitative methods. Relevant information obtained from both primary and secondary sources. With the primary source of data, questionnaires and interviews are the main tools to obtain primary information. Majority of the primary data collect through household survey administered to urban farming households, field observations, and key informant interviews. Key informant interviews and target group discussions were carries out to substantiate the data obtain through the questionnaire survey.

3.3 Sources Data

There are two types of data that have been incorporated in this study. These are primary and secondary data. Primary data was collected from urban farmers who are organized in Nefasilk-Lafto Vegetable Producer Cooperative. Moreover, officials from Addis Ababa City Environmental Protection Bureau, Addis Ababa City Administration Office of Urban Planning, Addis Ababa City Urban Agriculture Department, and Nefasilk-Lafto Sub-city Urban Agriculture Department is other sources of primary data. On the other hand, secondary data is collect from different books, previously undertaken research papers, development agency

publications. In addition, draft and publicized government policy and strategy papers, satellite image, photographs, etc. other sources of secondary data.

The physical features of the study area explain based on secondary sources from Addis Ababa City Administration Urban Planning Department and Google Earth with the help of Geographic Information System (GIS) software. Socio-economic conditions of farmers in the cooperative base its information from primary sources via questionnaire and structured interview.

3.4 Sampling Frame

Sampling frame is a list or set of directions for identifying all elements in a study population. Therefore, the sampling frame for this study is the list of all local producer and stakeholder in Nefasilk-Lafto sub-city. The total size of sampling frame in the local producer and land owner are determined to be identifying sample size of household.

3.5 Sampling Design

A sample design is a definite plan for obtaining a sample from a given population before data is collected (Kothari, 2004). The study will use random sampling method. Random sampling technique was applied to collect data from the concerned government offices such as Addis Ababa City UA Department, Addis Ababa City Environmental Protection Bureau, Nefasilk-Lafto Sub-city Urban Agriculture Department, trade and industry bureau, Community and Addis Ababa. In addition to government officials, the site which produced vegetables will selected based on random sampling method. This is because the some vegetables producers are in their produce in their compound and provide for local market.

3.5.1 Population

The random sampling technique is used to collect data from urban farmers who produce and sold vegetables in the city. Specifically, urban farmers who produced and sold vegetable along middle and lower activity in Nefasilk-Lafto. The technique used identify sample respondents from the population is systematic random sampling. This is done using sample size.

3.5.2 Sampling Technique

selecting the strata and then a sample household from each stratified *weredas* has advantage of cost effectiveness; providing representative and reliable data; facilitating revisit or asking supplementary questions about urban agriculture activity and others relative question around there the progress of the work except its difficulty during analysis.

Finally, the researcher was deciding to use Stratified random sampling technique. The researcher was focused on proportionate stratified sampling. Urban farmer and knowledgeable people to acquire relevant information. While, stratified sampling helps the researcher to collect the information individual at first contact who again leads the researcher to still more information to be interviewed in the process up to the study is exhausted.

3.5.3 Sample Size

For the structured survey, four cooperatives were selected from the sample. The sampling frame was created based on the data obtained from the four cooperatives. First the study population was listed and then stratified based on participants' performance of productivity. A minimum of three types crops produce and current participation in the farmland were the two issues considered in selecting the participants in the study

To obtain reliable and manageable data, the researcher undertook the sample size from all target populations of urban vegetable farmers in Nefasilk lafto sub-city. The total size of members cooperatives Vegetable Producers are about 353 (previously they were 244) from these 90 respondents (35% of producer) was taken as sample and filled the questionnaire. Stakeholders, cooperatives leaders, urban agriculture officer, community, producer and other.

3.6 Methods of Data Collection

The primary data was obtained through a questionnaire, survey, Field observations. The secondary data was gathered from various sources including official documents, records and published and unpublished reports from various organizations and other related literature to achieve a comprehensive perspective of the issue under consideration.

3.6.1 Questionnaire

Both types of questioners are used and survey household to address the question so closed ended and open ended questionnaire the entire questionnaires are prepared in English and then translate thong language or they can speak and read without problem .

3.6.2 Interview (Key informant interview)

Unstructured interview material was prepared and administered. Unstructured questions raised due to some issues need further explanation or the interviewee initiates some relevant issues which are not prepared by the interviewer.

Interview with Addis Ababa Office of Agriculture development and privet farmers. interview were focused on the role of the government to enhance and promote urban agriculture, the extent of urban agriculture in Addis Ababa and their relation with market, policy issue and challenge and opportunity was the major issue.

Table 3.1: Key informant interview

Key informant interview	Position	city	Work experience	Kebele /woreda	Number Of people	Date of interview
Private urban farmer	farming	A/A	14	03,12 & 04	90	21/04/19
Expert	Nifasilk-lafto sub-city officers	A/A	5-9	Sub-city	2	02/05/19
Expert	Wereda officers	A/A	3-5	03,0,12 & 04	4	13/05/19
cooperatives	consulting	A/A	9-17	03,12 & 04	3	19/05/19

Source: Filed survey

3.6.3 Site Observation

This method is important to obtain information about what is happening in reality concerning the issue under study. Both primary and secondary data was employed in this study towards the achievement of intend objectives. Sources of several libraries written document and urban farmer

and urban development officers was consult in order to obtain the secondary data those are participant . Non participant of urban farming like libraries assistance and offices include AAU libraries, CSA, MoA, urban Agriculture Bureau, small and Micro Enterprises Development Agency, DDE and ILRI.

3.7 Method of Data Analysis

The data obtained during the survey and it was analyze using both qualitative and quantitative techniques. The methodologies employ to analyze the data for this research descriptive.

Quantitative Data Analysis: Data in Statistical tools such as percentage, frequency distribution and cross-tabulation used in the process of presenting and analyzing data from the field. *Qualitative Data Analysis*: Information was gather from the interviews and key informants was summarize into statements and The data is analyzed through systematic arrangement of the information and with given attention to local situation, opinion, perception and preference of households and institutions operating used clarify some of the results obtain in the study.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

The first sub-section of his chapter provides some facts on the demography and socio-economy of the study area. Following this, three important issues related to the characteristics of urban agriculture, institutional characteristics of urban agriculture and importance and challenge of urban agriculture

4.1 Demographic Characteristics of the Respondents

Urban farmers were requested to answer questions pertaining to their demographic and socio economic characteristics. The practice of urban farming is related to factors that include age and sex, educational, marital status, household size and composition, educational status and occupational characteristics of the households under consideration. The results are presented as follows.

Table 4.1: Characteristics of Nifasilk-Lafto Urban Agriculture

No.	Name of cooperative	No. of member	Farm land size	Recognition	Types of product
1	Kidus Mikael	16	0.2 Ha.	M.S.E certificate	Different type vegetables
2	Tagem vegetable	10	1 Ha	P.L.C certificate	Different type vegetables
3	Lafto vegetable	24	2.78 Ha	P.L.C certificate	Different type vegetables
4	Green development	40	1.706 Ha	P.L.C certificate	Different type vegetables
	Total	90	5.686 ha		

Source: Nifasilk-Lafto UA department office 2019 Use standard table to present your findings! Refer to the manual I prepared and sent to your email last year !!!! through out the paper

4.1.1 Age of the Respondents

The great majority of the urban farmers (70.4%) belong to the age group above 50 years. In fact, slightly more than one-third (35%) of the urban farmers are over 60 years of age. On the other

hand, the proportion of the urban farmers below the age of 40 and 30 years comprise only about (7.5%) and (2.1%) respectively. Hence, it is safe to say that most of the participants in the activity belong to the higher age groups.

Table 4.2: Ages of respondents

No.	Name of cooperative	No.	0-15	15-30	31-4	%	45-above	%
1	Kidus Mikael	16	0	0	3	20	13.	80
2	Tagem vegetable	10	0	0	2	20	8	80
3	Lafto vegetable	24	0	0	7	25	17	75
4	Green development	40	0	3	11	30	26	70
	Total	**90**		**3**	**23**		**64**	

Source: Nifasilk-Lafto UA department office 2019

This result shows us most of urban farmer categorized aged group so that they have no idea about new technology and searching to find new thing in the Agriculture area so their farming activity is backward or traditional system.

4.1.2 Sex of the Respondents

As regards the distribution of the Nefasilk-Lafto urban farming households by sex, males predominate in the activity (85.8%). The fact that there are more men than women in UA ventures doesn't confirm similar findings of other studies of UA where subsistence urban food production is found to be an activity usually practiced by females. Most of women are act as house keeper and rising children and also help their husband but products control, protect and provide farm land to plough by those women to managed their home.

Table 4.3: Sex of respondents

No.	Name of cooperative	No. of member	Sex			
			M	%	F	%
1	Kidus Mikael	16	5	30	11	70
2	Tagem vegetable	10	9	90	1	10
3	Lafto vegetable	24	16	70	8	30
4	Green development	40	37	90	3	10
	Total	**90**	**67**		**23**	

Source: Nifasilk-Lafto UA department office 2019

4.1.3 Household Size

The household size has different implication in one family. When the size of the household member increases the food and social service consumption necessarily increase. The income earning status of household can matter to meet basic necessities of family member. On the other hand, the increase in household size increases family labor for agriculture. Particularly, increased working age groups in the family have labor contribution significance.

Table 4.4: Household Size of the respondents

No.	Name of cooperative	No.	Small		Medium		Large	
			2-3	%	4-5	%	6-8	%
1	Kidus Mikael	16	2	12.5	8	50	7	37.5
2	Tagem vegetable	10	0	0	6	60	4	40
3	Lafto vegetable	24	4	16.6	11	45.5	9	37.5
4	Green development	40	6	15	18	45	16	40
	Total	**90**	**12**	**11%**	**43**	**45%**	**35**	**44%**

Source: Nifasilk-Lafto UA department office 2019

The study shows the average household size is 5.19 persons per household. The smallest and largest household size is 2 and 8 persons per households. The informant households data revealed; 11% (2-3 persons), 45 %(4-5 persons), 44 %(6-8 persons) per household size. This

study realized the fact that households need more labor participation because of irrigation intervention augmented production activities in the command area.

This result shows us household size and dependency aged group are higher than other result so urban agriculture productivity is very low. Most of products are used for only food consumption.

4.1.4 Marital Status of the Respondents

The marital status of informant household shows that finding further indicates the spatial variation in the involvement of females in urban farming whereby most of the female urban farmers are found in the location More than three - fourth (76.2%) of the urban farmers in the sample are married. The proportion of widowed household heads takes the second position (16.3%) followed by divorced /separated (4.2%) and single household heads (3.3%). It is also vital to note that single household heads predominate in the central location (62.5%).

Table 4.5: Characteristics of marital status

Marital status		**Married**	**Single**	**Divorced**	**Widowed**
Cooperatives	**No. member**	**HH %**	**HH %**	**HH %**	**HH %**
Tageme	10	4 40	2 20	3 30	1 10
LaftoFirut	24	19 79.5	3 12.5	2 8	0 0
KidusMicheal	16	9 56.5	3 18.5	4 25	0 0
Green development	40	35 87	1 2.3	2 5	2 5
total	**90**	**67 76%**	**9 3.3%**	**11 4.8%**	**3 16%**

Source: Nifasilk-lafto UA department office 2019

This result show us the marital status factor or matter on urban farming agricultural activity these is family in proper marriage more productivity in other way full marriage help each other wife

with partner so less productivity than in marriage.

4.2 Socio- Economy & Characteristics of Urban Farmers in the Study Area

The socio- economy status of the surveyed respondents for this research varies according to urban development office scale. Privet farmer who has large amount farm land property and high productivity in annual product rate that is good status and small and low product rate is lower status characteristics of urban farmer and also educational background matters in the economy of farmer

4.2.1 Educational Status and Occupational Characteristics

The educational level of the urban farmers is presented in table 4.6. As can be seen from the table, 21.1% % had not attended school and are illiterate while 43.3% of them can only read and write. Those who had attended post high school level of education are 35.6percent. Hence, it can be safe to conclude that people with low level of education predominate in the study area. Above all, the fact that UA benefits people with low level of education is apparent from the analysis. On the other hand, it is also important to note that urban farming is practiced by people with different educational levels ranging from the illiterate ones to those who attended university. That many people with higher levels of education are involved in UA implies that urban agriculture is not a marginal activity. Involvement of such highly educated people may also suggest that the practice of UA may continue to expand with increasing urban growth and ultimately be legitimized in the urban policy as more educated people tend to protect their investments by influencing policies and regulations in their favor.

Table 4.6: Educational status of the respondents

Education status		**Illiterate**	**Read & write**	**Primary (1-6)**	**Junior (7-8)**	**High school(9-12)**
cooperative	**No. member**	**No HH %**	**No. HH %**	**No. HH %**	**No. HH %**	**No. HH%**
Tageme	10	3 30	3 30	4 40	0 0	00
Lafto Firut & vegetables	24	2 8	12 50	9 37.5	1 4	00
Kidus Micheal	16	6 37.5	5 31	318.5	1 6.25	1 6.5
Green	40	8 20.5	19 47	922.5	3 7.5	1 2.5

development

Total HH	90	19 21%	39 43%	2527%	5 5.5%	2 2.5%

Source: Nifasilk-Lafto UA department office 2019

Education is one of the key factors influences farmer decision to apply intensive farming, diversification of agriculture, use of technology, adequate use of implements and conserve environment as well. Household education status and wise use of technological opportunity has impact on household livelihoods. The majority informant household education status is at low level.

The modern agriculture development needs highly skilled and knowledgeable man power capable enough to implement agriculture science with local knowledge. Today, agriculture production activities are shifting from the business as usual trend.

As result shows the data the majority urban farmer below junior class or they are low level educational status remains could read and write o this result show urban agriculture is practice traditional way they are background
is way less productivity in urban.

4.2.2. Occupation of the Respondents

The occupational status of respondents are different which are the majority farmer worked in factory and others respondents working in privet business so in urban agriculture participant in part time work or as additional work they rent or employ daily labor in the farm. As listed below table report few amount farmer engaged with urban farming its only occupation urban farming.

Table 4.7: Occupation of the respondents

No.	Occupation of the respondents	Frequency	Percent
1	Factory employee	33	36%
2	Privet business	31	34%
3	Urban agriculture	19	21%
4	others	7	8%
	Total	**90**	**100%**

Source: Interview producer 2019

The result show that occupational status of respondent urban farmer are working in part time b/c they are working in factory or others business and other farmer gives full time for urban agriculture those farmer more productivity than other part timer farmer because factory employee so busy to give urban farming and other result those part time farmer rent their farm land for other farmer or they gives for day labor so the productivity is less because the farmer p day to day so that decrease the product.

4.2.3 Farm land accessibility

Farmers acquired the land in different ways. A lot of farmer started as tenants working for urban landlords; others inherited the land from their parents, who were hired as farm workers during the Italian occupation in the mid-1930s. After their occupation of the country, the Italians built factories in the Mekanisa area of the city, as the nearby rivers and streams were favorable for industrial processing purposes. They also constructed several micro-dams to power processing factories, especially flour mills. In addition to processing activities, the Italians initiated vegetable production in the area and in the periphery of the city for the expatriate community. Some farmers obtained their farm by occupying vacant land by the river. In other way government provide river side farm land for young in MSE organization.

Table 4.8: Land accessibility

No.	land accessibility	Frequency	Percent
1	Inherited from their parents	21	23%
2	Obtained occupying vacant	13	14%
3	Government provide	29	32%
4	Young in MSE organization	27	31%
	Total	**90**	**100%**

Source: Interview producer 2019

4.3 Characteristics of Urban Agriculture Activity in the Study Area

Urban farming is not new to Addis Ababa; it has been a major part of the urban scene from the

residents cultivated crops, raised chickens, and kept dairy animals. Well-to-do households raised cows for milk for home consumption. Migrants to the city also cultivated crops to supplement their livelihoods. The city grew by annexing rural communities whose livelihoods depended on raising livestock and cultivating crops. Today, the practice of raising livestock for milk in the city is widespread. Eucalyptus trees are grown for the market inside the city and on high grounds around its fringes. Less visible but present in large numbers are gardens in which medicinal plants are grown by city herbalists.

Most of the Nefasilk-Lafto farmers are of Gurage descent. Of the 250 farmers, 88 percent are Gurage and over three-fifth of them migrated from different parts of the Gurage land several decades ago. The remaining farmers live in publicly-owned, dilapidated rental units. The ages of the farmers is widely distributed. Older farmers work less in the field but are quite active in their communities. They mediate family, intra-family, and community disputes, transfer farm knowledge to the young, supervise farm work done by hired workers, and keep an eye on the farms to prevent intruders.

4.3.1 Topographic Features of the Study Area

river line landscape for a long time. Many streams and rivers traverse the city, but most of their valleys are unsuitable for

construction uses and are thus better suited for urban farming. Most of this land belongs to the municipality, as all unoccupied land is within its jurisdictions. One of the most extensively used river valleys for irrigating urban farms in Addis Ababa is the Little Akaki. The Nefasilk-Lafto co-operative farm is located along this river, the oldest and largest irrigation farming cite in the city. The site stretches from Mekanisa in the north to the foot of the Lafto hill in the south, a three-to-five kilometer length. Most of the farm plots are located on gentle slopes while a few are on flat grounds near the river. The soil is mostly of a vertisol type but alluvial soils dominate close to the river.

4.3.2 Types of Urban Agriculture Production in the Study Area

The Nefasilk-Lafto farmers surveyed produce anywhere between 8 and 12 types of vegetables, the most common of which are Swiss chard, kale, cauliflower, lettuce, leek, cabbage, beans, carrot, cucumber, pepper, beetroot, and potatoes. Kale and Swiss chard are the most popular crops grown by all the farmers. On average, each farmer grows five different crops per year. Cultivation is done year-round, with a short respite during the heavily rained months of July and August. Farmers grow vegetables that mature early and can be harvested multiple times a year. The land is cropped continually for at least nine months of the year. Outside of the rainy season, no piece of land is left fallow. Most vegetable plots are left uncultivated during the rainy season but vegetables that withstand the heavy summer rain are picked for home consumption. Factors that limit year-round cultivation include water-logging, flooding, and weed infestation during the rainy season.

Cultivation practices are dependent on furrow irrigation; no other water-saving forms of irrigation are utilized. The frequency of irrigation depends on the type of crop. Root and tuber crops are irrigated once a day; while leafy vegetables are irrigated every two to three days. None of the farmers use fuel-fired pump to carry water to their field because it requires considerable investment, which most farmers cannot afford. Instead, basin irrigation systems are used to water farm plots. The system requires the building of a series of small dams along the Little Akaki River and constructing a parallel irrigation channel to carry water down to plots. Each farmer opens a hole through the channel to allow water to flow between vegetable plots and vegetable rows by way of gravity and close-off the hole after irrigating the field.

Irrigation water is not equitably distributed: up-river farmers utilized more water than down-river farmers. Farmers say they do not use potable water from the city water supply for irrigation because it is too expensive. In any case, the city does not have allowed farmers to use municipal water for irrigation while the need for clean drinking water for the city dwellers remains unmet, even if the farmers could afford it.

4.3.3 Types of Agricultural Production Systems and Urban Agriculture

The agricultural activities practiced in Addis Ababa are categorized in to three main groups: crop production, livestock rearing and mixed farming. In the present context, mixed farming means practicing both crop cultivation and livestock production together.

Table 4.9: Types of urban agriculture

	Types of urban agriculture	Frequency	Aware	Implement
1	Surface farming	90/90	Well known	90
2	Vertical farming	0/90	no	0
3	Rooftop farming	8/90	Yes known	2
4	Pot farming	27/90	Yes known	27
5	Vegetable & fishery	0/90	no	0
	total	**90**		

Source: Interview producer 2019

Crop production

A variety of crops are grown across the surveyed sub-cities in Addis Ababa, either for home consumption, for sale or both. Different types of crops and livestock that over 30 % of urban farmer households cultivate in a sub-city are marked with asterisk. Cultivating a variety of vegetables is found to be the most common practice in all of the sub-cities as compared to other kinds of crops. Carrot, different types of cabbage, cauliflower, lettuce, celery and/or potato are the most commonly cultivated vegetable crops, where over 75 % of urban crop producers in each sub-city cultivate most of the vegetables in a year (see Table 4.2 for list of names of the vegetables). All the vegetable producers reported that they cultivate vegetables mainly for selling

of the produces. And, they use the money for purchasing their foodstuffs and cover other household expenses. Cultivating field crops or tree planting are less common activities. It is only at Akaki-Qality that field crops like teff and wheat are found to be cultivated. Urban farmers who cultivate field crops usually use the produce for home consumption; only two households reported that they sell the surplus sometimes. Those who plant trees were found to supply to market tree seedlings or timbers depending on the types of the tree species.

Table 4.10: Types of urban agriculture products pls use this format to report your findings

Agricultural activities	Nefasilk- Lafto	percent
Crop production	Carrot	11
	Potato	7
	different cabbages	25
	lettuce	33
	zucchini,	6
others	Mushroom	15
		100%

Source: Nifasilk-Lafto UA office 2019

Average farmers produce twice in a year 12 (50%) and three times a year 12 (50%). The market

mainly, or face market shortage when oversupply of vegetable intensified in the city. In terms of income only 7 (29%) of the respondents believe they get enough income from their products, however, the rest 14 (71%) believe that they did not get enough income from their products. This is because farmers produce the same type of vegetable in a season which resulted inover-supply of the some vegetable in the market.

4.3.4 Reasons for Engaging in Urban Agriculture

Nefasilk-Lafto Vegetable Producer Cooperatives established in 1976 after the then military government (Derg) promulgation of land for tenants. Since then, for the last 37 years, the members grow and sold vegetables for Addis Ababa city market. Therefore, now vegetable

production in the study area can create employment for 431 people, from these 225 are male and 206 are female. Moreover, the beneficiary from this farming activity is not only the farmers alone but also 2,500 of their family which is 40% male and 60% female .A specific case on Ethiopian Collard Green has been made to indicate the level of income generate from vegetable production. Based on the information collected from individuals farmers in the study area shows that the net income earn from Ethiopian Collard Green is estimated to be 28838.46 Birr (in one season). The gross income in one season with 0.6heactare per household is 42,036.23Birr whereas the total cost of a household to produce vegetables (in this case Ethiopian Collard Green) is about13197.77Birr. The breakdown of each cost and income presented below:

Table 4.11: Push factor

No.	Push factors	Frequency	Percent
1	Generating Income	51	56
2	To Produce Fresh Product	14	15
3	Home Consumption	21	23
4	Other	4	4
	Total	90	67

Source: survey 2019

4.3.5 Initial Investment for Urban Farming

The initial source of capital to start urban farming, rent farm land or own land to start operation and the source of information and skills for conducting the urban farming activity were examined in the study. Accordingly, the largest proportion of the urban farming households (82.1%) used their own money to start the activity followed by borrowing from relatives and friends (11.3%), inheritance and gift (3.7%) and borrowing from banks (2.9%).As far as the rental farm land to start urban agriculture operation is concerned,80.8% of the urban farming households initially purchased vegetable seeds, while 12.1% inherited and 7.1% acquired them as gifts.

Table 4.12: Initial investment

No.	Initial investment	Frequency	percent

1	Own money	74	82.1%
2	borrowing Money from relatives & friends	10	11.3%
2	inheritance and gift	3	3.7%
4	borrowing from banks	3	2.9%
	Total	90	100%

Source: Filed survey 2019

4.3.6 Major Vegetables Grown and the Frequency of Production

According to the information collected from Nifasilk-Lafto Sub-city UA department, there have been 12 types of vegetable produced in the cooperative in 150ha of land. The dominant types of vegetable produced among the 12 vegetable types are Cauliflower, Spinach, Carrot, Lettuce, Onion and zucchini. However, the trend (from 2014 up to2018) shows that there had been a significant variation in terms of the type of vegetables produced and amount of land assigned.

For instance, in 2014 Cauliflower grown in 30haof land, but, it decline to 18ha and 8ha in the year 2017 and 2018 respectively. On the other hand, Lettuce was grown in 15ha of land in the year, but it increased in to 30haand 40ha in the year 2017 and 2018 respectively. In general, land in hectare assigned to vegetables like Spinach, Zucchini, Ethiopian Collard Green, Lettuce, and Potato increase in size while Cauliflower, Carrot, Onion, Cabbage and Beetroot decline from year 2014 to 2018. So this data shows that sustainable of urban agriculture is decreasing

Table 4.13: Productivity quintal per hectare in the year (2014 – 2018)

Vegetable Type	**Productivity (Quintal per Hectare) in a Year:**				
	2014	2015	2016	2017	2018
	Qt.	Qt.	Qt.	Qt.	Qt.
Habesha cabbage	12294	20062	19627	10786	10021
Gurage cabbage	2055	1291	1590	1867	1417
Carrot	725	4	504	306	306
Onion	728	300	1225	540	664
Zucchini	470	2022	1965		1125
costa	10815	11592	12256	6500	7750
tomato	804	1455	1015	725	797

Lettuce	9800	3934	4076	2600	2220
Lady finger		150	168	207	207
Cabbage	2473	740	1302	930	1428
Beetroot	216	20	20	405	585
Potato	2355	558.7	558	930	1192
Total	42735	42128	44306	26021	27712

Source: Nifasilk-Lafto urban Agriculture office 2019

The level of productivity (quintal per hectare) for the year 2014-2018 in 12 vegetable types indicates that there had been not significant variation from one year to the next; however, it seems to be increase as one can thoroughly examine and come up with the general trends of vegetable productivity in the cooperative. The reason behind increase in productivity may be related with the application of technology that vertical farming and increase in farming skill gained from experiences. Despite the increase in productivity, frequent flooding and the resultant effects of damaging vegetables makes farming activities difficult and season based.

4.3.7 Amount produced per year 2018

In the study area there are privet producer and cooperatives so Nifasilk Lafto sub-city urban agriculture development office reported in 2018 total vegetables product as listed below.

Table 4.14: Amount produced per year 2018

code	**1**	**2**	**3**	**4**	**5**	**7**	**8**
Vegetable	**Costa**	**tomato**	**potato**	**onion**	**cabbage**	**lettuce**	**carrot**
Production per quintal	7750	797	1192	664	1428	2220	306
Sold amount in Birr	542500	170000	240000	350000	590000	720000	158000

Source: Nifasilk-Lafto urban Agriculture office 2019

4.3.8 Type of Equipments and technology Used

Urban Farming practice farmer in the cooperative supported by various local instruments. All farmers use hand tools to dug and related activities with axes, shovel and similar equipment. However, all respondent indicates that flooding is the natural treat to their farming activities.

Table 4.15: Types of technology used

No.	Technology use	No.	Computerized farming	Vertical farming	hand tools	axes	shovel	Plough in line
1	Kidus Mikael	16	no	no	yes	yes	yes	yes
2	Tagem vegetable	10	no	no	yes	yes	yes	yes
3	Lafto vegetable	24	no	no	yes	yes	yes	yes
4	Green development	40	no	no	yes	yes	yes	no
	Total	**90**	**no**	**no**	**yes**	**yes**	**yes**	**yes**

Source: Interview producer 2019

In spite of poor safety method on farming practices and traditional method of production process, all respondents indicates that there have been no health problem recorded due to wastewater use for UA or other farming practices. This may be due to some disease emanated from wastewater utilization have not a direct and immediate impact on the patient and farmers hide the information since they are desperate to retain the land and the issue of wastewater impact on human health may resulted in expropriation of the land for public interests.

4.3.9 Input Use Household Expenditure for Inputs

The market supplies of farm implements such as land rent, labor, transport, machinery, improved seeds access are among the determinant factor in farm productivity. In addition, household profit returns depend on cost and quality of farm implement, transport, labor and marketing. Households have various types of expenditure for production purpose. Informants are asked about the major expenditure items until the product reach market place. The irrigation intervention has caused high expenditure in the production process.

The annual average expenditure of respondents is high. The average expenditure is 15,706.70 ETB up to 13,096 ETB. The huge investments in agriculture will increase costs of production items. The main informant expenditure item is 64.8% labor, 11.7% machinery and 7.02% transport cost. The minimum and maximum cost of labor is 11,059.12 ETB and 10,075.50 ETB per year.

Table 4.16: Household Expenditure

Farm implements	Costs in Birr	Percent
Fertilizer	1,075.50	6.2%
Improved seed	800	4.6%
Transport	1,200	7.02%
Machinery	2,000	11.7%
Labor	11,000	64%
total	**17.075.50**	**100%**

Source: Filed survey 2019

4.3.10 Water Sources for Urban Agriculture in the study area

The Awash Basin is situated in the east-central part of Ethiopia and constitutes the north-central part of the Ethiopian Rift Valley. Sandwiched between the northwestern and southeastern highlands, the basin is part of a predominantly hot and arid to semi-arid lowland region experiencing the effects of a rain shadow and documented water shortages (EDVSA and Halcrow, 1989). Over the last three decades there has been a dramatic increase in population density in this region. This, in conjunction with the widespread and accelerating activities in the fields of agriculture and industry, has brought about increased pollution of the Awash River and its tributaries. In turn the limited capacity to enforce regulations regarding the safety and protection of these rivers has aggravated the problem.

In particular the headwaters, which are situated in and around Addis Ababa, are extremely polluted from domestic, commercial and industrial sources. Among the important headwaters of the Awash is the Akaki River, which flows through the city of Addis Ababa. The river consists of two main branches, the confluence of which was the Aba-Samuel reservoir until recently. The western branch of the river, the Little Akaki, rises northwest of Addis Ababa on the slopes of Wechacha Mountain and flows for 40 km before it reaches the reservoir. Tributaries of the Little Akaki include Burayu, Gefersa, Leku, Qille, Gerbeja, Worenchiti, Melka Qorani, Kera and Jaja streams.

The eastern branch of the river, the Great Akaki, rises northeast of Addis Ababa and flows into Aba-Samuel Reservoir after 53 km. The important tributaries of the Great Akaki include Ginfile, Kebena, Kechene, Kurtume and Yeka. Both the Akaki Rivers are used for industrial,

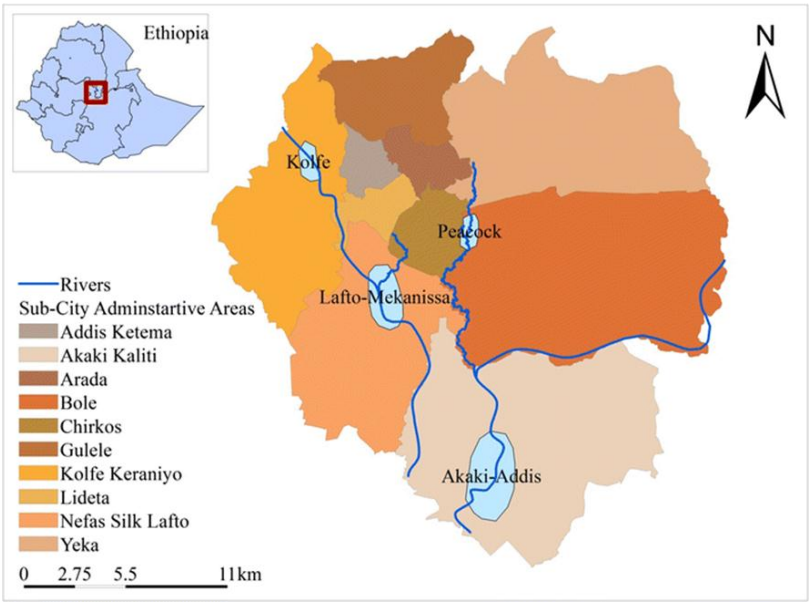
horticultural and domestic purposes. Unfortunately, these rivers are also used as disposal sites for the waste generated by industries and other sources from the city of Addis Ababa and its surrounding.

Currently, the pollution load on both Akaki Rivers has risen so high that the rivers, in particular the Little Akaki has deteriorated to the status of an open sewer. Populations utilizing these rivers for drinking and probably hygiene and horticultural purposes are affected by a variety of health complications. Chronic health risks exist in people consuming vegetables produced using these rivers for irrigation. Furthermore their ecology has been so disrupted that they have essentially

miru 2000).

As a result of a dramatic increase in population and the consequent demand for water, the government anticipates to utilize local groundwater sources (the Akaki well fields) situated in the vicinity. However, unless stringent measures are soon undertaken to improve surface water quality, seepage from the polluted rivers and runoff will ultimately affect the groundwater, which is an alternative potential for supplying clean water in the region. In fact currently the pollution of surface and groundwater is one of the most serious problems affecting the health of the population in and around Addis Ababa (Tamiru et al 2004).

Figure 4.2: Two major river of A/A



Source: Minster of health 2017

Sources of Water for urban farming most farmers used river water as main source of water for crop and livestock production. Nearly 90% of the respondents are entirely dependent on river water. Other 7% of the respondents used water from other sources in the form of irrigation from underground and artificial ponds and other 3% from rain water. One can easily understands that from this almost all the farmers dependent on river water for their agricultural activities even though very limited farmers used irrigation water from other sources underground and artificial ponds. To bring changes and sustainable development for the increasing population working with farmers at grass root at river water harvesting is vital.

Table 4.17: Water sources

No.	Source of water	Frequency	Percent
1	river	81	90%
2	pond	4	4%
3	rainfall	4	5%
4	Pipe line	1	1%
	Total	**90**	**100%**

Source: Interview producer 2019

Crop requires and transfer massive amounts of water for their entire development systems and activity. This makes water the major limiting facto r for agricultural production in tropical area. Depending on the crop, the location and efficiency level, producing one tone of cereal requires between 25 00 and 4000 tons of water (Webb, 1994). Since one tones of cereal covers the annual consumption of about eight persons on an average.

Different farmers have different perceptions regarding the amount of river water for their farm activities. Accordingly, from the sample respondents who were interviewed for about existence of enough river water for their farming purpose, nearly 91.1 of the respondents said that there is no enough river water at right time for their farming purposes because it is highly polluted. The rest 8.9% noticed that there are enough underground and artificial ponds for their farming purpose even though it varies from year to year.

4.3.11 Land Fertility

Most of urban farm land found near of riverside so rivers bring water by farce so urban farmland washed most of the time so fertility of the soil moderate so that urban farmer pushed to use fertilizer to treat their farm land

4.3.12 Flooding

Flooding in summer season happened repeatedly so urban farmer product in Ethiopia winter season washed the vegetables products so one of the biggest challenge of urban farmer in the

from flooding.

4.3.13 Land Use

In Addis Ababa, urban farming activities, especially vegetable growing, concentrated at spatially unwanted land along river banks. This is because land value in the city center not invited urban agriculture activities and farmers better access to water from Akaki River. Take into consideration the above issue, the Office for the Revision of Addis Ababa Master Plan (ORAAMP) proposed most of riverbank area as horticultural production site including 15meter distance in both sides of the river edge which is delineated for river buffer or the city administration considered the vegetable farm as a buffer zone of the river system.

The Office also delineate the western and northwester parts of the catchments for UA activities, however, the current practice in the study boundary shows that areas reserved for urban forestry and green along river encroached by informal urban farmers which they claim, during the interview made with them, the land they occupy before 37 years of the then proclamation of land for tenants.

The summarized challenges of UA in the city in general and in the study area in particular, which is related with land use, categorize in to two. The first one is, urban farming activities in part of the study area undertaken on restricted area for urban land proposed recreational area along the river which have an impact on the environment by decreasing the available vegetation cover, consequently, soil erosion and flash flooding will be some of the negative impact created by urban farming activities on reserved area for other activities.

The second one is informal occupation of proposed urban farming area by squatters and urban farmers themselves for land speculation and permanent housing This may resulted in reducing the proposed agricultural land in the city, consequently, the total area of land reserved for urban greenery become decline from time to time. To make things more worsen, the city administration provide legal title deed for those who informally occupied the land from farmers who owned legally.

4.4 Institutional Characteristics

Privet and cooperatives they have market accessibility and provide their product by different transport means and also product price determined by farmer himself no one entrap sometimes merchants takeoff their product from farmland.

4.4.1 Access to Market and Price

According to respondents market access problem is visible most of urban farmers have no market linkage and broker farced to take their products so farmer sale on street side and Some farmers provide for local market and near vegetables shops.

The price of vegetable deter

the products price value determine by farmer itself and current market decide the seals of product

4.4.2 Delivery Products from Farm Land to Market

The Nefasilk-Lafto farmers have convenient access to transportation to bring their produce to the Wholesale Vegetable Market in Mercato, known as the Atakilt Berenda, which is run by the Urban Producers Association. Produce is hauled to the market in rental pick-up trucks during early morning hours. Usually two to three farmers rent a car or pick-up truck to bring their produce to the market and divide up the cost of transportation. Small producers usually use hired labor to transport produces to the market. Most women farmers sell their produce directly to consumers at the nearest roadside market. Some women carry their produces and others use haulers to bring the produce to the market. In some cases, family members provide help. Farmers sell their crops in bulk instead of in portions, which has the advantage of reducing the cost of harvesting and transporting to market. The agriculture output markets are crucial to determine

farmers benefit. They need buyers in the market to sell their products with fair price. The poor market access can kill far

Table 4.18: Delivery products

No.	Delivery products	Frequency	percent
1	rent a car or pick-up truck	11	12%
2	hired labor to transport	19	22%
2	the nearest roadside market	39	43%
4	women carry their produces	21	23%
	Total	**90**	**100%**

Source: Field survey 2019

4.4.3 Support by Government

Urban farmer assists by government, Sub-city and wereda urban agriculture development office which are counseling service, short training, provide credit and linkage the market by different accessibility and others governments facilitate the NGO support.

Table 4.19: Assistance of institution

	Assistance of institution	Credit	Marketing`	Consulting
1	Government	yes	no	yes
2	Professional advice	no	no	yes
3	Extension training	no	no	yes
4	On farm demonstration	no	yes	no
5	Irrigation harvesting	yes	yes	yes
6	Drainage development	no	no	yes
	total			

Source: Field survey 2019

4.4.4 Types of Support

Government support in different ways for urban farmers who organize by SME young people. In the budget year there are a lot of plan prepared to support to farmers like consulting and

controlling system and provide fertilizers and short time training course and also market facilitation work.

4.5 Importance of Urban Farming and Potential Contribution

Urban agriculture plays an important role in enhancing urban food security since the costs of supplying and distributing food to urban areas based on rural production and imports continue to increase, and do not satisfy the demand, especially of the poorer segments of the population. Next to food security, urban agriculture contributes to local economic development, poverty alleviation and social inclusion of the urban poor and women in particular, as well as to the greening of the city and the productive reuse of urban wastes.

4.5.1 Economic Role of Urban Agriculture for Producer and Users

The urban farming household is a unit of mobilizing labor, managing productive resources and organizing consumption. The household produces part of its own subsistence and participates in the marketing of the vegetables product. Since urban farming is a labor intensive activity, it generates significant employment opportunities in production, processing and marketing both for the household heads and their dependents. The activity provides employment not only for the household heads and their spouses, but also for the children and other household members, and for other people like herders, sellers of fertilizer and seed and sellers of produce thereby reducing the level of unemployment within the urban farming household and the community in general.

Table 4.20: Role of urban agriculture

No.	Role of urban agriculture	No. of member	Percent
1	Food consumption	38	42%
2	Job opportunity	10	11%
3	Income generate	42	46%
	Total	**90**	**100%**

Source: Field survey 2019

4.5.2 Socio-economic Benefits of Urban Agriculture in the Study Area

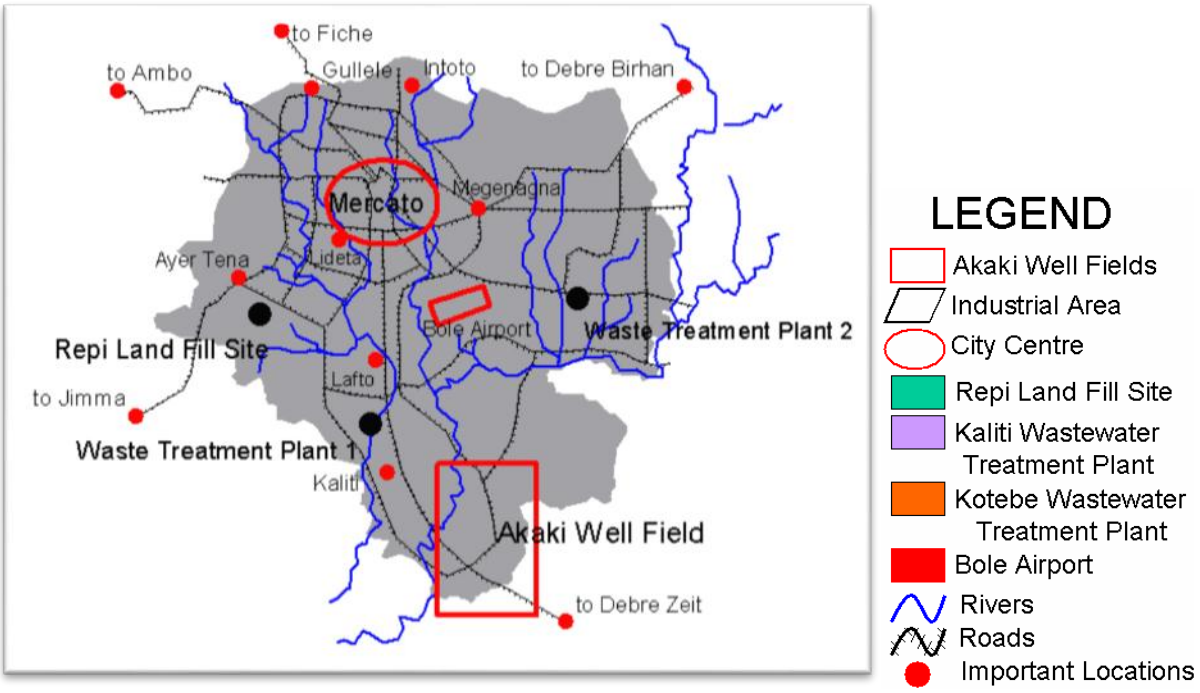
The labor demand types vary from household to house hold. Households who have enough family labor can cover their own farm labor. Those who have no enough family labor and produce more need labor for various activities such as field clearing, plough, planting, application of fertilizer, watering, harvesting. The respondents are asked whether they need labor for their farm activities. So in socio economic activity there are a lot of labor engaged the job from urban agriculture.

4.6 Challenges of Urban Agriculture

The health impact of heavy metal contamination and enter into the food web is paramount issue in the use of polluted wastewater for vegetable production along Akaki River. Accordingly, a number of authors and organizations such as Health Minster, 2017, undertaken studies on the issue. The result shows that heavy metal accumulation in water, soil and vegetable become increased through time. The summarized health related risk of vegetable production by using Little Akaki River presented below.

The problem of waste management in the city also further aggravated by the location of industries and garages which generate various toxic substances. Most of the industries as well as garages in Addis Ababa are planted very close to the riverbanks in the Southern and Western part of the city where the little Akaki River drains. Moreover, according to the interview made with Environmental Protection Bureau of Addis Ababa, the majority of the industries (90%) disposed of their wastes directly into Little and Great Akaki Rivers and its tributaries without any form of treatment. The volume of waste determined by the number of industries established along the river.

Figure 4.4: River pollutant



Source: Minster of health 2017

4.6.1 Soil Erosion in the Farmland

Soil stability in riverbank depends on the type of development undertaken within and around it. In addition, the type and level of vegetation planted and covered on the bank has its own role in the stability of soil along the river.

Table 4.21: Types and characteristics of soil

No.	Types of soil	Fertility status	Relatively relief
1	Black soil	fertile	moderate
2	Gray soil	fertile	Sloping
3	Brown	moderate	sloping
4	Red soil	poor	plain
	Average	fertile	sloping

Source: Own survey 2019

In the study area, due to farming activities on steep slope area (see picture 4.7. below) leads to erosion of soil and hence sedimentation of solid substances in the river. The problem is further exuberating by absence of or very scattered vegetation cover and the area is dominated by vegetable growing and human settlement with few vegetation cover

Figure 4.5: Little Akaki river wash vegetables product at study area

Source: Author own survey

The root cause associated with the problem is the farming practice performed on environmentally sensitive area (in this case on steep slope area/slope greater than 20%) which is unsuitable for any type of development except urban greenery. This makes conservation of soil resource in the site very difficult and erosion of soil resource as well as severe sedimentation marks the typical features of the site mentioned above.

Figure 4.6: Little Akaki river drainage

Source: Author own survey 2019

The study shows main factor affecting the urban farming that in the dominant land use of the study area is built-up area, which comprises industrial, residential, commercial & various public services and infrastructure. Specifically, the area surround the urban farming site intensively utilized for the fore mentioned development, consequently the level of risk associated with contamination of vegetables due to the close proximity of farming site with urban development is very high. This is because the river load pollutants from various sources and serve as the prime source of water for vegetable growing.

Figure 4.7: Dominant residential & industrial land use study area

Source: Google earth 2019

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

cooperative are male and married with large family size. The educational status of household head in the cooperative dominated by those who had not got secondary education, as a result they restricted in few income earning activities other than UA. With respect to farming practice in the cooperative, all members of the cooperative use surface irrigation to water their vegetable

by constructing small dam. Applying axe, shovel and other manual equipment in the field with poor safety method while they irrigate wastewater for their vegetable.

The health impact of heavy metal contamination and enter into the food web is paramount issue in the use of polluted wastewater for vegetable production along Akaki River. Study done by various researchers and organizations on heavy metal accumulation in water, soil and various vegetable due to wastewater used for watering vegetables depicts that heavy metal accumulation in water, soil and vegetables above the limit set by various multilateral international organizations.

I can conclude that even a little knowledge and awareness of VF can help food security and viability greatly. New technologies such as aeroponic systems, insulation methods and pest free plant growth has not only transformed the greenhouse industry but has also paved the way for new forms of farming such as rooftop farming.

However, the sustainability of development projects need close impact monitoring and evaluation. Building strong capacity in the society is important. The beneficiary households education and skill development are required informally or formally mainly for illiterate households capacity improvement. The modern mechanized agriculture practice transition demands skill developments.

5.2 Recommendations

Based on the finding of the study, the following recommendations were forwarded to improve the existing challenges created by UA activities as well as obstacles that hider the practice of UA in the city in general and in the study area in particular.

Practically it is difficult to evict farmers from the area and replaced by other uses. So, the better solution for the problem is recognizing the existing farmers as a user for the land, but they should change the traditional farming practice from surface farming to vertical farming or other technology such as hydropnic, aeroponic & aqoponic. In these methods, farmers will owned and growing fresh vegetables there, but they will be responsible for the whole management issues related with the vertical farming and hence they can sold the vegetables without significantly affected the density of the land. Such a solution could not be operational within few years, but

unless and otherwise farmers change the current practice of vegetable production, pressure from residents of the city and government bodies may leads to a loss of their jobs.

Vertical farms come in different shapes and sizes, from simple two-level or wall-mounted systems to large warehouses several stories tall. But all vertical farms use one of three soil-free systems for providing nutrients to plants hydroponic, aeroponic, or aquaponic. The following recommendations are given based on the study results for intervention of stakeholders to maximize socio-economic benefits of Nefasilk-lafto urban agriculture producer and for user households, to local area, regional and national levels.

Hydroponics: The predominant growing system used in vertical farms, hydroponics involves growing plants in nutrient solutions that are free of soil. The plant roots are submerged in the nutrient solution, which is frequently monitored and circulated to ensure that the correct chemical composition is maintained.

Aeroponics: Aeroponics systems are still an anomaly in the vertical farming world, but they are attracting significant interest. An aeroponic system is by far the most efficient plant-growing system for vertical farms, using up to 90% less water than even the most efficient hydroponic systems. Plants grown in these aeroponic systems have also been shown to uptake more minerals and vitamins, making the plants healthier and potentially more nutritious.

Aquaponics: An aquaponic system takes the hydroponic system one step further, combining plants and fish in the same ecosystem. Fish are grown in indoor ponds, producing nutrient-rich waste that is used as a feed source for the plants in the vertical farm. The plants, in turn, filter and purify the wastewater, which is recycled to the fish ponds. Although aquaponics is used in smaller-scale vertical farming systems, most commercial vertical farm systems focus on producing only a few fast- omponent.
This simplifies the economics and production issues and maximizes efficiency.

Vertical farming is growing rapidly, and this research barely scratches the surface of long and complex endeavor. Future research may examine specialized technologies and methods for various indoor farming systems.

- Strengthen irrigation user cooperatives and unions bring in to this technology to easily produce much amount products.
- Improving to access vertical farm implements at district, sub-city and Keble/wereda level.
- Build modern building to use only vertical farming activity.
- Encouraging cluster based command area production.
- Closely working with implement supplier cooperatives and providing fair price market opportunities for vertical farm implements.
- Creating market linkage to increase on farm buyers of vegetables by introducing areas potential to attract market.

Researchers should invent, advance, and further develop local farming techniques to make vertical farm projects feasible in these countries. For example, they may invent recycling methods that reduce reliance on water, design local systems by capturing rainwater, and may capitalize on local solar power for providing natural light and energy.

REFERENCES

Addis Ababa City Administration Trade and Industrial Development Bureau AACATIDB/. 2009.

Addis-Ababa Urban Agriculture Department (2006), Annual Performance Report, Addis-Ababa, Ethiopia.

Anna Lewandowska-Czarnecka on 19 December (2017). The potential of urban agriculture for sustainability of cities. Ara S, MA Khan, MY Zargar, et al Physico-chemical characteristics of Dal Lake water Aqua enviro toxicol. 2003

Axumite G. Egizabher. (1994). Urban Farming, Cooperatives, and the Urban Poor in Addis Ababa. Cities feeding people: an examination of urban agriculture in East Africa PP 79-98.Ottawa, IDRC.

Bayer, A.W. (1995). Living With Livestock in Town: Urban Animal Husbandry. Berlin, ETC International.

BoFED (2007). Urban Development Indicators of Addis- Ababa, Addis-Ababa.

Bribach Ch., (2014). FLORAFELT Vertical Garden Guide, Norcross, Georgia.

Central Statistical Authority (Ethiopia) (2005). Statistical Abstract of Ethiopia.CSA, Addis Ababa, Ethiopia.

Community and the celebration of local food. Int J Agric Sustain 8(1&2):54 61.

Danquah L. the couses and health effects of river pollution. A case study of the Aboabo river , Kumasi 2010 Deelstra, T. &

l-Koschella and H. de Zeeuw

Agriculture on the Policy Agenda, Resource Centre on Urban Agriculture and Forestry: Leusden.

Degefa, A., Mekonnon, Y. and Demissie, T. (2006). Assessment of dietary intakes of essential nutrients and nutritional status of PLWHA in Yeka, Lideta and Akaki Sub Cities of Addis Ababa, Ethiopia.

Despommier, D. Farming up the city: The rise of urban vertical farms. Trends Biotechnology. 2013, 31, 388 389.

Endamana D., Kengne I.M., Gockowski1 J., Nya J., Wandji1 D., Nyemeck J., Soua1 N. N. and Bakwowi J. N. (2003).

FAO (1998).Feeding the Cities: The State of Food and Agriculture, Rome, FAO.

FAO (1994). Special programme for food security IDRC/ UN-HABITAT. Guidelines for Municipal Policymaking on Urban Agriculture.

FAO 2001.the special program for food security.

FAO (1998). Ethiopia: National Livestock Development Programme Preparation Report (Volume 3 of 5 volumes).

FAO (1999). Urban Food Security and Food Marketing: A Challenge to City and Local Authorities, Rome, FAO.

FAO (2008). Profitability and sustainability of urban and peri-urban agriculture.

FAO. 2001a. A briefing guide for the successful implementation of urban and peri-urban agriculture in developing countries and countries of transition. Revision 2, Handbook Series. Volume III. Rome.

FAO. (2011). Ethiopia Country Programming Framework 2012-2015.

Federal Democratic Republic of Ethiopia /FDRE/ 2011.Federal Negarit Gazeta Urban Lands Lease Holding Proclamation No. 721/2011. Addis Ababa.

Foeken D., Michael S. and Malongo M. (2004). Urban agriculture in Tanzania: Issues of sustainability.

Freeman D. (1991). A city of farmers: informal urban agriculture in the open Spaces of Nairobi, Kenya. Montreal: McGill-

Gebre Egziabher, A. (1994). Urban farming, cooperatives, and the urban poor in Addis Ababa.

Girma Kebbede, Farmers in the City: The Case of Addis Ababa, Ethiopia Mount Holyoke College, South Hadley, MA, USA.

Gittleman. J. (2009). The role of urban agriculture in environmental and social sustainability: a case study on Boston.

Gittleman. M. (2009). Urban Expansion in Addis Ababa: Effects of the Decline of Urban Agriculture on Livelihood and Food Security Tufts University.

Kalantari, F.; Tahir, O.M.; Lahijani, A.; Kalantari, S. A Review of Vertical Farming Technology: A Guide for Implementation of Building Integrated Agriculture in Cities. Adv. Eng. Forum 2017, 24, 76 91. ISSN 2234-991X.

Kheir Al-Kodmany February (2018). The Vertical Farm: A Review of Developments and Implications for the Vertical City.

Lovell ST (2010). Multifunctional urban agriculture for sustainable land use planning in the United States. Sustainability 2:2499 2522.

Mattered E. F. SCHUMACHER (1973). SMALL IS BEAUTIFUL Economics as If People.

Ministry of Finance and Economic Development (Ethiopia) (2006). Ethiopia: Building on Progress: A plan for Accelerated and Sustained Development to End Poverty (2005-10). Vol. I. Main Text. Addis Ababa.

Mireri C., A. Kyessi, N. Mushi and P. Atekyereza (2006). Urban Agriculture in East Africa: Agriculture

Mougeot, L. (2006). Growing Better Cities: Urban Agriculture for Sustainable Development. International Development Research Centre: Ottawa.

Mougeot, L.J.A. (2000). Urban agriculture: definition, presence, potentials and risks. In N. Bakker, M. Dubbeling, S. Guendel, U. Sabel Koschella & H. de Zeeuw, eds. 2000. Growing cities, growing food, urban agriculture on the policy agenda, pp 1-42. DSE, Feldafing.

Nigussie, M. (2010). Urban agriculture situation analysis report for Addis Ababa City Administration. USAID Urban Garden Program. Addis Ababa, Ethiopia.

ORAAMP (1999). Land use and city structure studies of Addis Ababa and the Metropolitan area: Executive summary report. Addis Ababa city Council. Addis Ababa, Ethiopia.

ORAAMP (2000). Urban agriculture in Addis Ababa. Addis Ababa city Council, Addis Ababa, Ethiopia.

Redwood, M., (2009). Agriculture in urban planning: Generating livelihoods and food security. London: earth scan.

Smith, D.L (1994). Urban Agriculture in Kenya. In Cities Feeding People, Ottawa, IDRC.

Sumner J, Mair H, Nelson E (2010). Putting the culture back into agriculture: civic engagement,

Tamiru A (2001). The Impact of Uncontrolled Waste Disposal of Surface Water Quality in Addis Ababa. SINET: Ethiopian Journal of Science 24(1):93-104. Addis Ababa.

Tegegne, A., Tadesse, M., Mekasha, Y. & Yami, A. (2000). Market-oriented urban and peri-urban dairy systems. Urban Agriculture Magazine, no 2, Urban Livestock, Leusden, RUAF.

Tewodros Ferdissa. (2007). Livelihood Dependence on Urban Agriculture in Addis Ababa, Ethiopia, Master thesis, Norwegian University.

The United Nations. World Population Prospects: The 2017 Revision; United Nations: New York, NY, USA, 2017.

Thomas P. Z. Mpofu. February, (2013) Research Journal of Agricultural and Environmental Management Vol. 2(2), pp. 051-057, February, 2013.

Tinker, I (1994). Urban Agriculture is Already Feeding Cities. In Cities Feeding People, Ottawa, IDRC.

Todaro M.P. (2000). Economic Development, 7th ed. Addison-Wesley Longman, Inc. England.

Touliatos, D.; Dodd, I.C.; McAinsh, M. Vertical farming increases lettuce yield per unit area compared to conventional horizontal hydroponics. Food Energy Secur. 2016.

UNDP (1996). Urban Agriculture: Food, Jobs, and Sustainable Cities. United Nations Development Program, Volume One, UNDP New York.

United Nations Environment Programme (UNEP), November 2014.

Mara Gittleman 2009 Urban Expansion in Addis Ababa: Effects of the Decline of Urban Agriculture on Livelihood and Food Security Tufts University,

WB. (2004). The World Bank group countries; Ethiopia Washington D.

koncepcjeteoretyczne i instytucjonalnewarunkirealizacji [Food security theoretical concepts and institutional conditions for implementation], UniwersytetWarszawski, Warszawa.

Yitaye Alemayehu. (1999). A study on livestock production systems, feed resources and feed allocation practices in three peasant associations of the Awassa woreda, southern Ethiopia. M.Sc. Thesis, Alemaya University of Agriculture, Alemaya, Ethiopia.

Zenebe Woldu. (2010). Urbanization: Market Opportunities Ethiopia: Country Position Paper, Ethiopian Horticulture Producer Expol1ers Association (EHPEA) Addis Ababa, Ethiopia.

COLLEGE OF DEVELOPMENTAL STUDIES

CENTER FOR REGIONAL & LOCAL DEVELOPMENT STUDIES

(RLDS)

Questionnaire

Potential and prospect of vertical farming for sustainable urban development: the case of Nifasilk-Laftosub-city of Addis Ababa

The general objective of the study is potential and prospect of vertical farming for sustainable urban development in food security attainment and urban poverty alleviation with special reference to the city of Addis Ababa.

The specific objectives are to:In order to address the general objective, the following specific objectives are answered by the study:

- To investigate the importance of vertical urban agriculture for urban food security and environment in sustainable agriculture.
- To identify factors for urban farming in the study area.
- To examine the challenges and prospects of vertical urban agriculture in the study area..

By: Yared Tilahun

Questionnaire to be answered by urban farmer in the cooperative

Dear Respondents

The aim of this questionnaire is to find out potential and prospect of vertical farming for sustainable urban Development in Addis Ababa and surrounding kebeles and to suggest possible recommendation Please, your information will be kept certainly confidential and hence expect you to complete the information honestly. Therefore, your genuine cooperation in answering the questions listed below will be of a great importance to the study.

Thank You!

choice.

1. Identification Information

1.1 Code----------

1.2 Wereda/ Kebela-------

1.3 Producer Cooperative------

1.4 Category of the Household; Farmer ☐ drivers ☐

2. Demographic Characteristics of Household Information

2.1. Association of Name/ Private----------

2.2. Sex of Household Head

Male ☐ Female ☐

2.3. Marital Status

Married ☐ Single ☐ Divorced ☐ Widowed ☐

2.4. Total family size ☐

2.5. Age of The household Head ☐

2.6. Educational Level

Illiterate ☐ Only Read and Write ☐ Elementary ☐

H/School Completed ☐ College or University Graduate ☐ others ☐

2.7. Do You Have Any Other Occupation?

Yes ☐ No ☐

3. URBAN FARMING ACTIVITY ISSUES

3.1. How Many Times You Grow Vegetables Within A Year?

One ☐ Two ☐ Three ☐ Four ☐

3.2. What Are The Major Vegetable Types Growing In The Farm? Please List the Vegetable Types?

No	Type of Vegetable
1	
2	
3	
4	
5	
6	

3.3. Do You Know About Urban Vertical Farming Activity? _____

3.4. What Was The Pushing Factor To Start Urban Agriculture? _____

3.5. Why Do You Engaged In Urban Agriculture?

Rank	Reason	Code
	Generating Income	1
	To Produce Fresh Product	2
	Home Consumption	3
	Other	4

3. 6. In What Urban Agriculture Activity Are You Engaged?

Rank		Code
	Vegetable Production	1
	Sheep Rearing And Fatting	2
	Poultry Production	3
	Fishery	4
	Other	5

3.7. How Did You Access The Land?

I. Provided By Government/ Kebele 2. Provided By NGO 3. Rented 4. Other (Specify) ____ _

3.8. What Is A Plot Size Currently Used For Urban Agriculture? Is It Enough?

3.9. If Q 3.8. No, How Do You Overcome The Problem? _____

3.10. What agricultural equipment you use during Vertical farming Activity? (You can select more than one choice)

Small ☐ pond Water pumping machine ☐ Different hand tools ☐

Other Please specify_____

3.11. Have you ever encounter flooding on your vegetable and other property?

Yes ☐ No ☐

3.12. If yes, mention the amount and severity of flooding. _____

3.13. What type of urban farming method use?

Surface farming ☐ vertical farming ☐ rooftop farming ☐

3.14. Do you have an Idea about fishery in vertical farming Activity? ------

3.15 Would you tell me about your farm land soi l type?

Type	**Fertility status**	**Relative ly relief**
Black	Poor	Plain
Red	moderate	Moderate
Brown	Fertile	Sloping

3.16. What additional input used to grow vegetables? (You can choice more than one)

Pesticide Herbicide Natural fertilizer Artificial fertilizer

Other, Please specify _____

3.17. Where do you get water resource to use Urban agriculture?

☐ ☐ ☐ ☐

3.18.Do you face any health problem related with wastewater use for vegetable growing?

Yes ☐ No ☐

3.19. If yes what types of disease you faced so far?_____

3.20. Do you assisted by development agents?

Yes ☐ No ☐

1) Professional advice 2) extension training 3) On farm demonstration 4) Irrigation water usage 5) drainage development 6) effective use of farm implements 7) specify----------

3.21. Do you access farm implements such as fertilizer, pesticides, and improved seed on time?

Yes ☐ No ☐

3.22 How many times do you produce within a year? _____

3.23 How do you perceive the condition of your land fertility?

1. Excellent 2) very well 3) well 4) low

3.24 How much farmland do you have? _____

3.25 Is that enough farmland what you have to produce all types of crop production? --------

3.26 How many floor layers need to produce all types product in once?----------

4. MARKETING ISSUES

4.1. How long it takes to the nearest market in ----------minutes/hours?

4.2. Did you get enough money from the sale of vegetable in the market?

Yes ☐ Sometimes there are marketing problem No ☐

4.3. Did you get enough market for your product?

Yes ☐ Sometimes there are marketing problem No ☐

4.4. Do you produce surplus for market? Yes ☐ No ☐

1) shortage of water 2) lack of land 3) No market demand or low price 4)No transport access 6) Loss of soil fertility 7) low quality production 8) lack of finance

4.6. Where do you sell your farm products?

1) On farm 2) to service union/ cooperatives 3) taking to the local market

4) Nearby town 5) other specify

4.7. Do you get reasonable price for your produce?

Yes ☐ No ☐

4.8 What does distribution system you use?

1. Take up 2. Value chain system 3. Direct supply 4. Other system

5. ECONOMICALLY ISSUES

5.1 How much money do you earn during one farming season from vegetable? _____

5.2What are initial investments for urban farming activity?

Types of contribution	Deposit money	Providing land	Sharing knowledge	Labor force	others
Measured					
Amount of investment					

5.3 Do you get credit access from Urban Agriculture office and others?

5.4 Have you ever got government support for your Urban Agriculture activity?

Yes ☐ No ☐

5.5 Who are give you support for your activities? How?

Supporter	Technical	Credit	Market	Counseling
NGO				
Government				
Privet				
others				

5.6 Average annual crop production produce of every year?

Type of crops	**vegetables quintal /basket**	**2014**	**2015**	**2016**	**2017**	**2018**
tomato						
cabbage						
spinach						
carrot						
onion						
potato						
pepper						
lettuce						
Costa						

5.7 What is your perception of production vegetable?

1) Very high 2) medium 3) good 4) low

Seri. No.	Crop items	2014	2015	2016	2017	2018
1	tomato					
2	cabbage					
3	spinach					
4	carrot					
5	onion					
6	potato					
7	pepper					
8	lettuce					
9	Costa					

5.8 The Average annual Price of Major Agriculture Products in Nefasilk-lafto-City 2014/2017

The Annual Average Price of Crops

5.9 Average Annual Sales Crop Production (From April 2017- March 2018)

code	1	2	3	4	5	6	7	8
Vegetable	Costa	tomato	potato	onion	cabbage	pepper	lettuce	carrot
Production per quintal (kg, basket)								
Sold amount in Birr								

Type of crops	September	October	November	December	January	February	march	April	may	June	July	august
tomato												
cabbage												
spinach												
carrot												
onion												
potato												
pepper												
lettuce												
Costa												

5.11 What is the balance did you get? _____

5.12 How much do you spent until the product reach market?

Farm implements	**Costs in Birr**
Fertilizer	
Improved seed	
Pesticides	
Insecticides	
Transport	
Marketing	
Machinery	
Labor	
Total	

Annex 2. Interview Questions to Nifasilk--Lafto Vegetable Producer & Cooperative Officials

1. What is the background of the cooperative? (It includes naming, establishment, number of cooperative, etc)
2. How many do you have total size of farm land?
3. How many members have in the accession?
4. Why the problems come frequently happen in the cooperative in relation to farming activities? What measure you took to overcome such challenges?
5. What is the main production out puts in the area?
6. Do farmers have adequate access to farm implements?
7. Who supply the farm implements to farmers?
8. What is the initial investment of urban farming?
9. Do farmers have market demand and linkage; transport access for farm products?
10. Do you have permission to use pipe water from government?
11. How do you work cooperation with Nifasilk-lafto sub- city urban Agriculture office?
12. Do you think irrigation use changed farmer livelihood?
13. What are the major challenges of agricultural productivity?
14. How the marketing access and other related situation of your products?
15. What is the push factor to enjoy in the urban farming?
16. How about the amount of vegetables in quintal per hectare?
17. Who is main user the product?
18. How about the price did you sold your vegetable product for consumers?
19. Who are the main customers of the vegetable product?
20. What is the rule & regulation of government that based on urban farming?
21. How the major of challenges of farm implement supply?

Annex 3. Interview Questions to Nifasilk-Lafto Sub City UA Department officer

1. How do get the cooperative recognition by the government and have title deed for the land farmers produced vegetables?
2. What type of support the offices provide to urban farmers in the cooperative?
   - ✓ Assigning to support them in farming practices
   - ✓ Facilitating access to credit
   - ✓ Training delivery on farming and other related issues
   - ✓ Awareness rising on UA related risks and protective measures
   - ✓ Environmentally friendly UA practices
3. How do the Government office facilitate in the supply of additional inputs that are help to increase in vegetable productivity?
4. What technical support the office provided to the farmers so as to determine what vegetable type they should produce to alleviate market related and other challenges?
5. How many alternative agricultural products farmers produce to minimize health risk associated with vegetable products based on technical support from the office?
6. Who is major role play to increasing urban farming in the site?
7. How many product of vegetable type in quintal per hectare?
8. Why did Differ the productivity of different vegetables per hectare?
9. Do you give training about fishery activity in urban agriculture?
10. Do you make aware for producer about vertical farming new technology?
11. Who are dominant the market provides the urban farming?
12. Who is the gives significance to change marketing?
13. What is your contribution to aware introduce new technology in urban farming?
14. Do you provide farming land to increasing urban farming?
15. Is there permission to use pipe line for urban farming?
16. who is highly practice in social class in the urban farming?

በማበራት እና በከተማ ግብርና የተሰማሩ ገበሬዎች የሚሆን መጠየቅ

1. በመጀመሪያ እራሶንና ስለ ማህበሮዎቹ መች እንደተመሰረተ ያስተዋውቁን?
2. በማህበር ውስጥ ታቅፈው ያሉ ገበሬዎች ብዛት?
3. ምን ያህል የከተማ ግብርና የሚያከናውኑበት መሬት ነው? በቂ ነው?
4. በማህበር ሆነ በግል በከተማ ግብርና እንቅስቃሴ ውስጥ ገጥሞ የነበረ ችግር ካለ?
5. ምን አይነት ችግር ነው እና ችግሩን ለመቆጣጠር የተወሰደ መፍትሄ?
6. ዋና ዋና በከተማ ግብርና ተሰማርተው የሚያመርቱት የግብርና ውጤት ምን ድነው?
7. ለከተማ ግብርና እንቅስቃሴ ግባቶች ሙሉ በሙሉ ተግልተል ይላሉ?
8. ከመንግስት ሆነ ከሌላ አካል የሚደረግ ድጋፍ ካለ?
9. ለከተማ ግብርና እንቅስቃሴ ለችግር መፍትሄ እገዛ አለብኝ የሚሉት ካለ?
10. የገበያ ትስስር ምን ይመስላል በቀላሉ ገቢ ያማግኘት ትችላላቹ?
11. ምርት ለማከፋፈል የትራንስፖርት አቅርቦት እንዴት ነው?
12. የመንግስት ባለሙያ በምን መልኩ ክትትል እና ድጋፍ ያደርሉ?
13. ለከተማ ግብርና የሚሆን የውሃ አቅርቦት ከወንዝ መስኖ ሌላ አለ በመስኖ መጠቀማቹሁ ውጤታማ አድርገል?
14. የመስመር ውሃ ለከተማ ግብርና ከመንግስት የመጠቀም ፍቃድ አላቹ?
15. ከግባት እና ምርጥ ዘር አቅርቦት ጋር ተያይዞ የሚነሱ ችግሮች ካሉ?
16. ምን ያህል የግብርና ውጤት በምን ያህል የግብርና ቦታ ላይ ታመርታላቹሁ?
17. የግብርና ቦታ አሁን ያላቹ በቂ ነው ብላቹ ታምናላቹ? በቂ ቦታ ቢኖር በምርት ላይ ውጤት ይኖራል?
18. የግብርና ውጤት የምትሸጡበት ዋጋ ተመጣጣኝ ነው?
19. የምርቶቹ ዋጋ የሚተምነው ማነው ተጠቃሚን የማይጎዳ ነው ተመራጭነት አለሁ?
20. በዋናነት የግብርና ውጤት ተጠቃሚው የሆነው ማነው?

21. የተሻለ ምርት እንዲመጣበት ቦታ ላይ ጥሩ ውጤት እንዲገኝ አዳዲስ የቴክኖሎጂዎች ለመተግበር ሞክራችዋል?
22. በከትማ ግብርና ውስጥ የዓሳ ማምረት ዘዴ ታውቃላቹ ሞክረቹስ ያውቃል?
23. ጸረ ተባይ እና አረም ትጠቀማላቹ ምን ያህል ትጠቀማላቹ?
24. የከተማ ግብርና ወደ ላይ ማምርት እንደሚቻል ግንዛቤ አላቹ?
25. በቀላሉ በተደጋጋሚ የሚያመርቱት የምርት አይነት ምንድነው ገቢያስ ተቀባይ አለው?

ለክፍለ ከተማ እና ለወረዳ የከተማ ግብርና ጽ/ቤት የሚሆን መጠየቅ

1. የከተማ ግብርና ህብረት በመንግስት እውቅና እንዴት እና መቼ አገኘ?
2. በክ/ከ እና በወረዳ በከተማ ግብርና ህብረት ድርጅት ታቅፈው ያሉ ማበራት ብዛት ተደራጅተው በስራ ላይ አሉ ስንት ናቸው?
3. መንግስት ለማህበራቱና በውስጡ ላሉ በከተማ ግብርና ዘርፍ ተሰማርተው ላሉ ገበሬዎች ምርቶቹ ላይ እድገት እንዲያመጡ እገዛ ያደርጋል?
4. ለማህበረቱ ሆነ ለገበሬው ምን ምን ድጋፍ ይደረግላቸዋል ግንዛቤ ከማስጨበጥ ሌላ?
5. በከተማ ግብርና እንቅስቃሴ ውስጥ ገበሬዎች ምን አይነት ችግር ይገጥማቸዋል?
6. በመንግስት በኩል ለገበሬው ችግሩን ለመፍታት የምታደርጉት እገዛ ካለ?
7. በመንግስትና በማህበራት መካክል የሚነሱ ችግሮች ካሉ?
8. ከመንግስት ግንዛቤ ለማስጨበጠት የሚመደቡ ባለሙያዎች ለመርዳት ብቁ ናቸው?
9. ገቢያ ከማስተሳሰርና የትራንስፖርት አቅርቦት የሚደረግ ድጋፍ ካለ?
10. አዳዲስ ቴክኖሎጂዎች ከማስተዋወቅ አካያ ተግባራዊ ተደርገዋል?
11. ጽ/ቤቱ በከተማ ግብርና ውስጥ ስለ vertical farming ግንዛቤ አለ?
12. ግንዛቤ ካለ ወደ ወረዳ እና ገበሬዎች ለማውረድ የተደረገ እንቅስቃሴ አለ?
13. በከተማ ግብርና እንቅስቃሴ ውስጥ የምርት ውጤቶች የተሻለ እና ውጤት የሚየስገኝ የገቢያ ምርት እነዲያመርቱ ድጋፍ ይደርጋል?

14. ለገበሬው በግብርና ምርት ውጤት ላይ ተጠቃሚ እንዲሆን ዋጋ ተመን ታስተካክላላቹ?
15. ከግባት እና ምርጥ ዘር አቅርቦት ጋር ተያይዞ የሚነሱ ችግሮች ካሉ?
16. ምን ያህል የግብርና ውጤት በምን ያህል የግብርና ቦታ ላይ ታመርታላቹሁ?
17. የግብርና ቦታ አሁን ያላቹ በቂነው ታምናላቹ በቂ ቦታ ቢኖር በምርት ላይ ውጤት ይኖራል?
18. የብድርና ቴክኒካል ድጋፍ እንዲያገኝ ገበሬው የተለየ ድጋፍ የሚደረግበት ሁኔታ አለ?
19. በምርጥ ተመክሮ ማህበራት እርስ በእርስ አቀራርቦ ለማሰራት የሚደረግ ድጋፍ አለ?
20. ተጨማሪ ለከተማ ግብርና የሚሆን መሬት በመንግስት ተዘጋጅቶ የሚቀርበት ስርዓት አለ?
21. በውሃ አጠቃቀም ላይ ከወንዝ ወይም የዝናብ ውሃ አቁሮ ከመጠቀም ሌላ የመስመር ውሃ እነዲጠቀም ድጋፍ ይደረጋል?
22. ገበሬው የቁጠባ ባህል እንዲኖረው ዘመናዊ የእርሻ ውጤት እንዲጠቀም ግንዛቤ ይሰጣል?
23. ጸረ ተባይ እና አረም እነዲጠቀም ታበረታላቹ ታቀርባላቹላቹ?
24. ግብርና ወደ ላይ ማምርት እንደሚቻል ግንዛቤ ትሰጣላቹ ለገብሬው?

Appendixes

Vegetable Type	Productivity (Quintal per Hectare) in a Year:									
	2014		2015		2016		2017		2018	
	Ha.	Qt.	Ha.	Qt.	Ha.	Qt.	Ha.	Qt.	Ha	
Habesha cabbage	33.0	12294	54.84	20062	52.34	19627	42.3	10786	39.3	10021
Gurage cabbage	4.63	2055	4.3	1291	5.3	1590	8.3	1867	6.3	1417
Carrot	1. 68	725	0.005	4	1.2	504	1.7	306	1.7	306
Onion	2.10	728	0.8	300	3	1225	3	540	3.02	664
Zucchini	1. 68	470	7.02	2022	7.02	1965	6.02	Qt.	5	1125
costa	26.2	10815	30. 64	11592	30. 61	12256	26	6500	31	7750
tomato	2. 68	804	2.91	1455	2.9	1015	2.9	725	2.9	797
Lettuce	23.5	9800	14.56	3934	14.56	4076	13	2600	14.8	2220
Lady finger			0. 6	150	0.8	168	1.38	207	1.38	207
Cabbage	5.89	2473	1.85	740	3.1	1302	3.1	930	5.1	1428
Beetroot	0.54	216	0.043	20	0.05	20	2.25	405	3.25	585
Potato	6.73	2355	1.51	558.7	1.51	558	3.01	930	4.26	1192
Total	108.6	42735	119.0	42128	122.4	44306	112.9	26021	118	27712

Key Informant interview

Key informant interview	Position	city	Work experience	Kebele /woreda	Number Of people	Date of interview
Cooperatives head	Chairman	A/A	14	03,0,12 & 04	4	21/04/19
Expert	Nifasilk-lafto sub-city officers	A/A	5-9	Sub-city	7	02/05/19
Expert	Wereda officers	A/A	3-5	03,0,12 & 04	4	13/05/19
producer	farmers	A/A	9-17	03,0,12 & 04	75	19/05/19

በን/ላ/ክ/ከተማ በአትክልትና ፍራፍሬ ልማት የተደራጁ ማህበራት

የመሸጫ ቦታ ፍላጎት መጠየቂያ

10/09/2010

ተ.ቁ	የማህበሩ ስም	የሚገኝበት ወረዳ	የአባላት ብዛት			ህጋዊ ሰውነት	የማህበሩ ሰብሳቢ	ስልክ ቁጥር	አስተያየት
			ወንድ	ሴት	ድምር				
1	መካኒሳ ጎፋ ሳሪስ አት/አምራች	3.4.5.6.11.12	105	139	244	በሀ/ስ/ማ/ሰርፊትኬት ያለው	አቶ ሀይሉ ወ/ዩሀንስ	0911145751	✓
2	አርጋው ሉላና ጓደኞቹ አት/አ	11	6	4	10	በጥቃቅን ተደራጅተው ንግድ ፍቃድ ያወጡ	አርጋው ተስፋዬ	0922848915	✓
3	ሀመፋ አት/አም/አት/አምራች	12	11	10	21	በሀ/ስ/ማ/ሰርፊትኬት ያለው	ተሰማ ደርጋ	0913191466	✓
4	ገ/ሀዋርያ፣ ሰለሞንና ጓደኞቻቸው	ጀሞ01	8	11	19	በጥቃ/ ተደራጅተው ንግድ ፍቃድ ያወጡ	ሰለሞን ክፍሌ	0911017853	✓
5	ላፍቶ አት/አም/ሀ/ስ/ማህበር	12	16	8	24	በሀ/ስ/ማ/ሰርፊትኬት ያለው	ማንደፍሮ ማሞ	0911355137	✓
6	አረንጓዴ ልማት አት/ማ	06	37	3	40	በጥቃቅን ተደራጅተው ንግድ ፍቃድ ያወጡ	ወንድሙ ተገኝ	0910725050	[illegible]
7	ቴገም አት/አምራች	12	9	1	10	በሀ/ስ/ማ/ሰርፊትኬት ያለው	ተስፋው አትርፍ	0911543420	✓
8	ጎ/ ቤዛ ኪዳ/ ምረት አት/አ/ማሀ	05	12	8	20	[illegible]	[illegible]	0911356759	✓
9	ወረዳ 09 ወጣቶች አት/አም/ማሀ	09	14	3	17			0913249057	[illegible]
10	ወገን ቆሻሻ/አን/ማህበር	11	2	8	10				
11	ቅዱስ/ሚ/አት/አም	12	5	11	16	[illegible]	[illegible]	0911783059	✓