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Challenges and Prospects of Riverbank Urban Agriculture: The Case of Mekanisa, Gofa and Saris Vegetable Producer Cooperative

MSc Thesis in Environmental Planning and Landscape Design

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This thesis is submitted to the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), the School of Graduate Studies of Addis Ababae University in fulfillment of all requirements for the degree of Masters in Environmental Planning and Landscape Design.

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Declaration and Confirmation

I, the undersigned, declare that this thesis is my own and original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged, following the scientific guidelines of the Institute.

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Confirmation

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

Advisor`s Name: **Hailu Worku (PhD)**

Signature:

Acronyms

^0C	Degree centigrade
^0F	Degree
AA	Addis Ababa
AU	Africa Union
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CRDI	Center de recherché pour be developpement international
DAP	Diammonium Phosphate
eg	example
EPA	Environmental Protection Authority
FAO	Food and Agriculture Organization
G.C.	Gregorian Calendar
GDP	Gross Domestic Product
GIS	Geographic Information System
ha	hectare
HIV AIDS	Human Immune Virus Acquired Immune Deficiency Syndrome
IDRC	International Development Research Center
km^2	kilometer squire
m	meter
m.a.s.l.	meter above sea level
m^3	meter cube
mg/l	milligram per litter
MSSEs	Micro and Small Scale Enterprises
NGOs	Non Governmental Organizations
ORAAMP	the Office for the Revision of the Addis Ababa Master Plan
RUAF	Resource centers on Urban Agriculture and Food security
SS	Suspended Solid
TMDI	(theoretical maximum daily intake)
UA	Urban Agriculture
USAID	United State Agency for International Development
VIP	Ventilated Improved Pit

Abstract

This thesis sought to assess and analyze challenges and prospects of riverbank urban agriculture in one cooperative vegetable producer along Little Akaki River of Addis Ababa city. The study was basically an assessment that used both qualitative and quantitative approaches. Sample household from a total of 241 urban farmers randomly selected and nine key interview persons were selected by using purposive sampling from relevant government organizations. A structured questionnaire, interview guiding questions, photography, document analysis, and satellite images were methods and tools of data collection. The finding of the study indicates that urban agriculture activity in the study area has an impact on the natural environment especially;on soil erosion and water pollution as well as pose health risk due to contamination of vegetables with toxic substances.. Informal occupation of reserved area for urban agriculture by squatters as well as urban agriculture activities in protected area for other green development and uses are the two major challenges observed in the study area. The contribution of urban agriculture in the city includes employment creation for more than 3807 household heads and benefits more than 14,544 family members. It also serves as poverty reduction strategy for the disadvantage group of the society such as women, elder and youths who do not have job at the moment. The benefits of urban agriculture in the selected cooperative shows that it is the survival livelihood for 241 household heads and 2,500 family members. Vegetable growing along river both in the city and the cooperative more challengeable as domestic and industrial waste management are very poor and the spatial location of industries and garage close to the river. Recognizing and providing tenure security of the existing urban farmers is the primary solution for the challenges in the study area. However, in order to enforce the city structure plan, commercial forests and fruit trees should substitute the existing vegetable farms. Moreover, capacitating urban agriculture units in the city can solve technical and other problems which urban farmers face in the study area.

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Chapter One Introduction

1.1. Background of the Study

In 2008, for the first time ever, more than 50% of the world's population living in urban settings. The highest rates of urbanization currently occur in poor areas of Africa and Asia. The scale of this process of urbanization is difficult to comprehend in respect of the numbers of houses, water connections, schools, clinics, hospital beds and jobs that will be required over the coming decades in the more impoverished countries of the world (Potter & Evans, 1998).

Many of the countries in which fast urban growths are least-developed nations. These countries are not capable enough to provide sufficient food demanded by the expanding urban population via imports from rural areas (Tewodros, 2007). Mougeot (2006) states that for the urban poor, food have become what can only be termed a "basic luxury." Households from Calcutta to Kinshasa, from Lima to Lagos, spend as much as 80% of their income on food. In many African cities, it is common for families to eat just one meal a day. Malnutrition and related health issues are commonplace. Little wonder, then, that increasing numbers of people look for ways to supplement the meager amounts of food that they can afford to buy. Accordingly, many inhabitants especially the urban poor participate in urban farming activities in cities and towns of the developing world.

The effect of Urban Agriculture (UA) on community especially the producer is multi facet i.e. it poses different types and magnitudes of health risks and benefits to farmers compared with rural agriculture (Boischio et al, 2006). According to FAO (2001) UA contributes to urban food security through increased food availability, stability and, to some extent, accessibility. Moreover, as it explained by Catherine (2000), the social and environmental benefits of UA are desperately needed by cities as the world faces an unprecedented process of urbanization--the largest migration in human history.

It also increases food diversity, improves the quality of urban diets through diversification, by adding horticultural and animal products to the basis of staple food. UA contributes to poverty alleviation both through a reduction of expenditures and through an increase of income, and most importantly by creating employment. For instance, UA employs 800 million urban residents worldwide. Furthermore, UA creates green zone with in and around the city and modify local micro climate, and recycle solid

and liquid wastes. Other benefits of UA includes access to consumer markets, reduction in post-harvest losses, less need for packaging, storage and transportation of food, proximity to services, including waste water treatment facility, etc.(FAO, 2001).
The disposal of waste has become a serious problem in many cities. Urban agriculture can contribute to solving this problem by turning urban wastes into a productive resource through compost production, and irrigation with wastewater. Urban agriculture and forestry can also have a positive impact upon the greening of the city, the improvement of the urban micro-climate (wind breaks, dust reduction, shade) and the maintenance of biodiversity as well as the reduction of the ecological foot print of the city by producing fresh foods close to the consumers and thereby reducing energy use for transporting, packaging, cooling, etc. (Veenhuizen and Danso, 2007).

The health and environmental effects of wastewater use for agriculture were well explained in Volume II of World Health Organization (WHO) Guidelines for the Safe Use of Wastewater, Excreta and Grey-water which published in 2006. The most common problem that wastewater use can cause in soils is salinization which causes soil structure collapse, losing pores and interconnections that allow water and air passage. Ground water contamination due to excess use of wastewater and surface water pollution with the application of pesticide and artificial fertilizer are some of the environmental effects of wastewater use for agriculture. The primary health hazards associated with the use of wastewater, excreta and grey-water in agriculture and aquaculture, as indicated by Volume I of WHO Guidelines for the safe use of wastewater for agriculture, are excreta-related pathogens, some vector-borne diseases and certain chemicals.

As indicated by Veenhuizen, (2010), UA, in most cases, ignored by the existing land use planning of municipalities. Moreover, land use, housing, transportation, the environment, the urban economy and recreation, amongst others, are issues that planners are heavily involved in. The food system, however, is notable by its absence from the writing of planning scholars, from the plans prepared by planners and from the lecture rooms in which planning students are taught. As opposed to other commercial or private activities in cities, urban food production has never been addressed properly by legal regulation and planning.

1.2. Statement of the Problem

Urban agriculture is a traditional practice in Ethiopia, and the urban-based population is used to keeping cattle, sheep, and chickens, or growing rain-fed crops and vegetables, on the plots adjacent to their houses (Gittleman, 2009). In addition to its benefits for the production of foods from vegetables, crops and rearing animals, urban agriculture has socio-economic and environmental benefits. For instance, UA in Addis Ababa create large number of employment and source of income for the city residents.

In spite of its benefits, urban agriculture in the study area has a lot of challenges with associated effects and root causes. Urban farmers on the river bank mainly dependent on irrigated water from Akaki River. The quality of water that used to produce vegetable is highly polluted, since the river serve as a natural drainage for domestic as well as industrial wastes generated in the city. In addition, the vegetables could be contaminated as farmers `wash them with wastewater before bringing them to market. There is no legislation that prohibits or permits the use of stream water for crop production in the study area, although campaigns try to alert people to the related risks. However, these vegetables have been covered more than 40% of the city vegetable consumption.

Formal acceptance of urban agriculture as an urban land use and integration into urban development and land use plans is a crucial step towards effective regulation and facilitation of the development of urban agriculture (Veenhuizen and Danso, 2007). Accordingly, the Office for the Revised Addis Ababa Master Plan (ORAAMP) recognized UA as a formal land use within the city with 15% of the city land secured for UA land use. Despite government recognition of UA as a formal land use in the city, the existing situation shows that informal settlements encroach the proposed land and at the same time some of ongoing UA practice undertaken on reserved area for other land use such as river buffer and protected area like steep slope (slope greater than 20%).

In Ethiopian urban centers in general and Addis Ababa city in particular almost all buffer zone of the river banks are violated and the vegetation in the area have been deforested. For example, according to Assefa (2009), any local development initiative such as urban renewal along Riverbank should 100m away from it i.e. 50 meter measured from the tip of each sides of the riverbank. Out of the 50 meter protection distance 5 meter will be allocated for walkway and drainage maintenance space and the rest 45 meter on each side will be protected as green. On upgraded site the buffer zone

will be 60 meter, as there will not be big physical change in the area. The existing practice shows that urban agriculture encroach the buffer zone set by the government body and government recognized as a buffer zone without specified what type of urban agriculture allowed and prohibited.

As explained above, UA in the city has a number of challenges and opportunities, however, strategically and comprehensively analyze its benefits and problems have not been made since then. Study made on the risk associated with the consumption of vegetables growing along Akaki River irrigated with untreated wastewater (For instance, Fisseha, 2007 and Prabu, 2009) focus on the level of heavy metal accumulated in water, soil and vegetables, however, they failed to incorporate planning solution in their studies.

Therefore, this study thoroughly analyzes the existing land use of UA along the River bank and proposes appropriate methods to minimize health risk pose by irrigation of vegetables with untreated wastewater. In addition, the socio-economic and environmental challenges and opportunities of urban farming activities for urban farmers and the city residents have been addressed.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study is to identify and assess the existing socio-economic and environmental challenges and opportunities of Mekanisa, Gofa and Saris vegetable producer association.

1.3.2. Specific Objectives

The specific objectives of the study are:

1 To assess the current and proposed land use of catchment that used as vegetable growing for the Mekanisa, Gofa and Saris vegetable producer association.
2 To assess the socio-economic benefits and challenges of urban agriculture for cooperative farmers who are grown vegetable in the area.
3 To examine benefits and challenges of river bank urban agriculture on the environment and health risk posed by the farming activity in the study area.
4 To suggest some possible recommendation and propose applicable planning solution that help to solve the current challenges of urban agriculture practice along Little Akaki River.

1.4. Research Questions

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

1. How is the existing land use looks like with respect to the proposed land use along riverside of the cooperative farm and the catchment?
2. What are the socio-economic challenges and opportunities of UA in the study area?
3. What are the benefits and challenges of riverbank UA on the natural environment and human health in the study area?
4. What are the possible proposed solutions and recommendations to minimize the existing socio-economic and environmental challenges and maximize the opportunities created by UA in the study area?

1.5. Scope and Limitation of the Study

Geographically, the study concentrated in Nifasilk-Lafto Sub-city of Addis Ababa City Administration. In this research, vegetables that are produced along the river by urban farmers were the subject of the study. The thematic scope of the study try to assess the overall condition of UA practice in Mekanisa, Gofa and Saris Vegetable Producer Assocation, specifically, issues related with land use, socio-economic condition of households in the cooperative farms and the practice of UA with respect to environmental and health related challenges and opportunities was assessed. Finally, land use and other mitigation measures and recommendations were forwarded.

The major limitation of the study was the inability of using primary data on issues related with human health implication of vegetable production in the study area. This was due to the need for biology and chemistry background as well as laboratory skill. Collecting information from various departments in the city was a challenging task. First of all, information was not organized as needed. Second, as the research touch several organizations and individual so that access to them was time consuming and less accessibility due to various reasons. Getting recent maps was a problem and too costly.

1.6. Significance of the Study

UA in the city in general and in the study area in particular create opportunities as well as challenges, accordingly, different scholars studied the issue repeatedly. Their research works have been helpful for the producer (urban farmers), consumers as well

as the government for the smooth functioning of the sector. The significance of this study is provide a different insight into managing UA by using urban land use planning which is easy to implement and helpful for alleviating the problem sustainably. Therefore, decision makers, especially Addis Ababa city Administration, and other researchers can use the research as a possible solution for the issue under study and use as a spring board of future research undertaking.

1.7. Organization of the Paper

The research was organized into six chapters. The first chapter deals with introduction, which comprises background of the study, problem statement, research objectives, significance and research questions. The second chapter focuses on related literature review on riverside 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 catchment area of Mekanisa, Gofa and Saris Vegetable Producer Cooperatives within Nifasilk Lafto Sub-city. The fifth chapter tries to identify, analyze and summarize the main issues investigated in this study. Finally, the last chapter focus on conclusion and recommendation which is incorporated based on the finding of the study in chapter five as well as proposed solutions for each issue identified in the fifth chapter.

Chapter Two: Review of Related Literature

2.1. Definition and Rational of Urban Agriculture

Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products (Veenhuizen, 2010).

Veenhuizen definition is more focus on the major activities of UA, however, Mougeot, (2000) define UA more broadly i.e. 'Urban agriculture is located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, and grows or raises, processes and distributes a diversity of food and non-food products, (re-uses) largely human and material resources, products and services found in and around that urban area, and in turn supplies human and material resources, products and services largely to that urban area.'

Urban agriculture may seem an odd topic for a planning study. According to Holland Barrs Planning Group (2002), UA certainly is a little different from the traditional topics of planning which has ignored the community food system in urban areas until relatively recently. However, our relationship with food is an important part of our relationship with the environment and has important implications for social and economic well-being.

When thinking about food at the scale of an urban community, it may be helpful to think of food as flowing from the productive hinterland (the environment) through the community (where activity takes place) back to the environment in the form of wastes (see figure2.1. below).

Fig.2.1. Flow Diagram of Resources and Waste Generated from Resources Utilization by Community

Food should be seen in the context of sustainable development as a “flow” similar to the flow of energy, water, and waste where how we address this flow affects the relative sustainability of our community.

The argument in favor of the rational of UA further strengthening by its contribution to the city planning objectives. For instance, UA offers many opportunities to support the development of more sustainable high-density neighborhoods. It can not only help neighborhoods to respond to the new objectives of sustainability, but also support other more traditional objectives promoted in the city, such as enhanced livability, local social networks, leisure and recreation opportunities, and cultural and demographic diversity. As such, urban agriculture systems can be seen as another instrument in the city’s planning toolbox (Redwood, 2009).

2.2. Benefits of Urban Agriculture

The benefits of UA have been widely described by various scholars and literatures both in developing and developed world. Based on the theory described and the practical experience observed, the benefits of UA can be grouped into three broader categories. These are:

2.2.1. Health and social benefits

In this sub category, as indicated by Holland Barrs Planning Group (2002), UA has a benefits of improved nutrition, food security, community building, greater local control and understanding of food system, reduced reliance on food charity, therapeutic/recreational opportunities are among others.

Moreover, as Veenhuizen (2010) described, UA can function as an important strategy for poverty alleviation and social integration of disadvantaged groups (such as immigrants, HIV-AIDS affected households, disabled people, female-headed households with children, elderly people without pension, youngsters without a job) by integrating them more strongly into the urban network, providing them with a decent livelihood and preventing social problems

The contribution of UA in a community food security summarized by Bellows, et al (2005). For instance, during the time of war and conflict, it tenuous the dependence on distant food source. A local agri-food system provides a relatively secure and more

locally controlled source of food. Better interaction between local consumers and farmers increases awareness of local food options. Enhanced community also augments knowledge and commitment to healthy sustainable and secure food products and practices.

2.2.2. Economic Benefits

Economically UA create the benefit of increase in household income and employment opportunity. As indicated by Holland Barrs Planning Group (2002), the markets for food products and the prices paid in these markets influence the size and nature of food growing and food processing operation that can be economically viable. Local UA has the potential to generate primary local economic activity and spin-off industries and if managed properly to attract investment.

According to Redwood (2009), UA comes from existing data on the proportion of income that city dwellers spend on food. Table2.1. illustrates the need to find more reasonable sources of food and provides a strong argument for UA as a household supplement that can counteract the worst effects of poverty. Its effectiveness is not limited to poverty reduction at the household level: it also creates economic spin-off industries & employment, plus it improves the urban biophysical environment.

Table2.1. *Percentage of income spent on food by low-income residents in selected cities*

City	Income spent on food (%)
Bangkok (Thailand)	60
La Florida (Chile)	50
Nairobi (Kenya)	40-60
Dar es Salaam (Tanzania)	85
`Kinshasa (Congo)	60
Bamako (Mali)	32-64
Urban USA	9-15

Source: Mark Redwood, 2009

The situation of the urban poor is precarious in the present context of volatile food prices and the financial, fuel and economic crises. Urban consumers are almost exclusively dependent on food purchases and the urban poor are the most affected the first to lose their jobs; 60-80% of their household expenditure is on food, hence these households are highly affected by decreasing purchasing power and rising food prices (Zeeuw and Dubbeling, 2009).

Redwood (2004) also describes the socio-economic role of UA as it is a pragmatic and useful activity. The growing population in urban areas creates a huge demand for agricultural produce. Instead of importing food in from rural hinterlands, urban agriculture is close to urban markets and thus transportation costs are lower. In addition, UA improves household nutrition through food self-reliance, reduces the amount of money spent on food while also providing extra income if it is sold in the market.

2.2.3. Environmental Benefit

One of the issues frequently cited in many literatures is the challenge of managing waste both in developed and developing nations. UA can contribute to solving this problem by turning urban wastes into productive resources through compost production, vermiculture and irrigation with wastewater. According to Veenhuizen (2010) UA and forestry can also have a positive impact upon the greening of the city, the improvement of the urban micro-climate (wind breaks, dust reduction, shade) and the maintenance of biodiversity as well as the reduction of the ecological foot print of the city by producing fresh foods close to the consumers and thereby reducing energy use for transport, packaging, cooling, etc.

Deelstra and Girardet (2000) in their book identified that if appropriately planned and integrated into urban design, urban agriculture can contribute to the comfort of citizens. Green spaces around apartment blocks and houses, as well as neglected spaces in the city, help to improve the physical climate because vegetation can: help increase humidity, lower temperatures and introduce more pleasant odors to the city; capture dust and gases from polluted air through deposition and capture by the foliage of plants and trees, and soils; and help break wind and intercept solar radiation, creating shadow and protected places.

Moreover, Bellows et al (2005) describe the environmental benefits of UA as urban area gardens and farms improve air quality. On the local level, plant foliage reduces carbon dioxide, ozone concentrations (heavy, low-lying gas), and lowers urban mass temperatures. On a more macro scale, locally grown food reduces the present average of 1300 miles that our food travels from “field to plate.” Growing (and buying) locally is fuel efficient, less polluting, and has a relevant and substantial impact on our health.

Urban gardens and farms increase urban bio-diversity. They attract beneficial soil microorganisms, insects, birds, reptiles, and animals. Gardens play a role in species preservation for birds and butterflies by providing food, resting spaces, and protection along migratory flight paths. Urban food production improves urban and urban fringe soils. Rooted plants stabilize the ground and reduce soil erosion. Cared-for soils absorb rainfall that then does not run over exposed, compacted dirt and pavement absorbing toxic debris and dumping it into storm drains. Urban compost systems can transform significant amounts of a city's waste (organic waste from yards, parks, food establishments, etc.) for beneficial re-use.

2.3. Challenges of UA

2.3.1. Health Risk and Social Challenges of Urban Agriculture

Health risks associated with UA cited as the critical challenges in most literatures that deals with UA. As indicated by Boischio et al (2006) examples of risks include hazardous biological and chemical exposures among farmers and consumers as a result of wastewater use on vegetable crops; transmission of zoonotic diseases in the context of (usually confined) livestock activities; and malaria transmission possibly increased due to irrigation and drainage schedules.

According to Veenhuizen and Danso (2007), the main health risks associated with urban agriculture can be grouped into the following categories:

- Contamination of crops with pathogenic organisms as a result of irrigation with water from polluted streams and insufficiently treated wastewater or the unhygienic handling of the products during transport, processing and marketing of fresh products;
- Spread of certain human diseases by mosquitoes and scavenging animals attracted by agricultural activities;
- Contamination of crops due to prolonged intensive use of agrochemicals;
- Certain diseases transmitted to humans by keeping livestock in close proximity without proper precautions being taken.
- Contamination of crops by uptake of heavy metals from contaminated soils, air and water.

Crop, soil, and water pollution from industrial and chemical by-products can pose serious health risks within the urban food system. These risks to men, women, and especially

children, range from occupational hazards from exposure to toxic elements while farming, handling and distributing food (and non-food) crops, to the short and long-term effects of consuming foods contaminated by heavy metals. The sources of heavy metal pollution in soils are plentiful and include: irrigation especially with sewage; solid waste disposal (sludge and compost refuse); fertilizer and pesticide application; and atmospheric deposition. Chemical pollution is one of the four most pressing urban environmental concerns as industrial and chemical pollutants are often disposed in local bodies of water or vacant land without adequate measures to protect human health (Kathleen, 1999). In general Veenhuizen, 2006 summarizes the impacts of heavy metal on human health as follows in the following table:

Table 2.2. Selected chemicals of health concern identified in untreated municipal wastewater

Heavy Metals	Potential Health Effects
Arsenic	Gastrointestinal, skin, and nerve damage, cancer
Cadmium	Gastrointestinal, kidney and lung damage
Chromium	Lung and skin damage, cancer
Lead	Nervous and immune system and kidney damage embryo/feto toxic
Mercury	Brain and kidney damage, embryo/feto toxic
Nickel	Lung, brain, kidney, liver, spleen and skin damage, cancer

Source: Veenhuizen, 2006

Health risks from chemicals are caused by heavy metals (for example, cadmium, lead, and mercury) and many organic compounds (for example, pesticides). These mostly derive from industrial wastewaters and, if these are discharged to public sewers, they are present in municipal wastewaters. The health effects of prolonged exposure to many of these chemicals are well known for example, cancers (Scheierling et al, 2010).

2.3.2. Environmental Challenge

The environmental challenge associated with UA along riverbank is highly related with its spatial location and additional inputs applied to improve productivity of agricultural products. A study made by Veenhuizen and Danso (2007) indicates that urban agriculture could contaminate local water sources if overly high inputs of chemical fertilizers and pesticides are used. The wastewater discharge from intensive poultry farms for instance can be high in micro-organisms and could contaminate drinking water supplies. Inappropriate farming practices may - under certain situations - lead to

reduction of vegetation or siltation of water bodies. Because of the under-valuation of urban agriculture and the stiff competition for land, urban agriculture is often pushed back to the marginal areas within a city such as wetlands and hill-slopes, where it may harm the fragile ecosystems if not properly guided.

Despite official restrictions & potential health implications, Pay, et.al. (2010) summarizes why farmers use untreated wastewater in many developing countries as:

- Wastewater is a reliable or often the only water source available for irrigation throughout the year.
- Wastewater irrigation often reduces the need for fertilizer application as it is a source of nutrients.
- Wastewater use involves less energy even when pumping, if the alternative clean water source is from deep groundwater, which reduces costs.
- Wastewater generates additional benefits including greater income from cultivation & marketing of high-value crops such as vegetables, which create year-round employment opportunities

The root causes associated with accumulation of heavy metal in the environment by applying wastewater for agriculture in developing countries currently includes rapid industrialization and increased exploration of natural resources, and indiscriminate use of raw city effluent for irrigation accelerated the addition of heavy metals onto soils. For instance, Lead (Pb) is one of the most widespread and persistent metal pollutants in soils (Qadir, 2007).

At toxic levels, Pb may reduce plant growth by disturbing chlorophyll formation, decreasing photosynthetic activity and eliminating enzymatic activity. Moreover, its entry into the food chain from contaminated soils and waters results in severe toxicity to animals and humans. An increasing demand for uncontaminated agricultural land has emphasized the need to remediate contaminated soils. These soils must comply with legislation to limit the transfer of heavy metals form soil into potential food crops (Qadir, 2007).

2.4. Urban Agriculture Land use and Government Policy

According to Veenhuizen (2006) planners are often accused of posing the greatest challenge to urban agriculture as they have not integrated it into urban areas as a land

use nor designed residential estates to allow the activity to be carried out on-plot. Despite the enormous benefits for individuals and communities, urban agriculture is largely ignored in urban and regional planning. Instead of considering opportunities to preserve farmland or to integrate new production functions into urban environments, agricultural landscapes are often considered by land use planners as areas for future development. Because planners and policymakers are not typically engaged in the production activities of agriculture, they often overlook problems and opportunities within the entire food system. As a result, we see a growing disconnect between urban residents and the agricultural landscapes that sustain them.

By neglecting activities related to food systems, planners are missing a great opportunity to use something as essential and enjoyable as food, in their efforts to develop healthy communities that support a good quality of life. Food, as one of the basic essentials of life, has been almost completely avoided as an organizing strategy for improving communities. For example, rarely are urban agriculture features such as community gardens given the same level of importance as other open green space, and the result has been a lack of inclusion in the city planning process or zoning to protect them (Redwood, 2009).

To curb the problem many cities try to incorporate UA as one land use feature in their Master Plan like industry, residence, or service. A policy framework for urban agriculture would encompass planning policies, legislation and regulations that guide or regulate land use planning and management. However, in most cities, urban agriculture is ignored, not addressed in national and municipal policies or is not acknowledged as a valid urban land use. And when regulations or by-laws on or related to, urban agriculture exist, this is often not under an overall and clear policy, and the law may be interpreted differently by different actors (Veenhuizen, 2006).

The policy instrument that can be used to achieve the objective of integrating urban agriculture into urban land use planning is urban land use zoning. Layout plans could indicate the areas within the city in which urban agriculture is allowed, including guidelines from planners on types of urban agriculture. In Botswana, the City of Gaborone has set up poultry zones on land considered of low potential for development of other land uses (Veenhuizen, 2006).

To stimulate UA, enhance its potential and facilitate its integration into urban development, municipal land use regulations that accompany the produced plans should clearly spell out urban agriculture as a legitimate land use. Standards for layout planning need to be developed on land size that considers agricultural production around the house. For example, standards already exist for the size of schools, open spaces, and roads per thousand inhabitants. Improved standards for community or neighborhood gardens in dense areas and community or neighborhood gardens together with private gardens in less dense gardens should be part of the plan formulation process. Further, specifications should be made for the types of activities that are permissible in given areas (Veenhuizen, 2006).

Chapter Three: Research Methodology

3.1. Type and Sources of Data

There were 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 cooperatives namely Mekanisa, Gofa, and Saris 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 Nifassilk Lafto Sub-city Urban Agriculture Department were other sources of primary data. On the other hand, secondary data were collected from different books, previously undertaken research papers, development agency publications. In addition, draft and publicized government policy and strategy papers, satellite image, photographs, etc were other sources of secondary data.

The physical features of the study area explained 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. Environmental challenges such as water pollution, erosion of soil and health impacts of UA activities dependent on primary and secondary sources data from Sub-city Urban Agriculture Department and various private and Non Governmental Organizations (NGOs) research results. With respect to land use related challenges, the primary data sources were Addis Ababa City Administration Office of Urban Planning Department, photographs and Google Earth Images were among others. Finally, a model of household income from vegetables was conducted after thorough interview made with members of the cooperative farmer.

3.2. Method of Data Collection

The data were collected through:

i) Questionnaire

Questionnaire was help to collect primary data from households who participate in urban agriculture activity. Two sets of questionnaire were used i.e. closed ended and open ended questionnaire. The entire questionnaires were prepared in English and then translate into Amharic, because Amharic is either the respondent's mother thong

language or they can speak and read without problem, as the respondents lived in the city more than four decades.

ii) Interview

In this method, both structured and an unstructured interview material were prepared and administered. The former method enables to extract predetermined data that the researcher believed to relevant the study, however, the later method enables to get depth and detail information which is collected during the interview was in progress. Unstructured questions raised due to some issues need further explanation or the interviewee initiates some relevant issues which were not prepared by the interviewer. Basically, the interview materials were prepared for five different organization experts and cooperative secretary and vice chair man. The following table shows the detail of interviewees position in the organization their position and number.

No.	Name of the Institution	Number	Position
1	Nifasilk-Lafto Sub-city UA department	1	Head
2	Addis Ababa City UA Office	2	Experts in Vegetable
3	Addis Ababa City EPA	2	Experts in River Pollution Protection
4	Addis Ababa City Administration Urban Planning Institute	2	Expert
5	Mekanisa, Gofa and Saris Vegetable Producer Association	2	Secretary and Vice Head

Table3.1. Name of the institution (officials and experts) with their position

iii) Site Observation

This method is important to obtain information about what is happening in reality concerning the issue under study. It is also suitable in dealing with subjects where respondents are not capable of giving verbal report of their feelings for one reason or the other (Kothari, 2004). Accordingly, the researcher gets a chance to observe the potential challenges and opportunities of UA along the river especially the environmental challenges of riverside UA due to its spatial location and some pictures captured during the field visit of the site and incorporated in the analysis part of the study.

3.3. Sample Design

A sample design is a definite plan for obtaining a sample from a given population before data is collected (Kothari, 2004). The study used both random and non-random sampling method. Non 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, Mekanisa, Gofa and Saris Vegetable Producer Association, and Addis Ababa City Administration Urban Planning Department.

In addition to government officials, the site which produced vegetables was selected based on non-random sampling method. This is because the Mekanisa, Gofa and Saris Vegetable Producer Cooperatives are the largest cooperatives farming operated in the city for more than 37 years and it contain 150ha of farm land from 270ha of land that have been developed by the traditional cooperative farmers.

The random sampling technique was 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 catchment of Little Akaki River were selected randomly. They organized in cooperative namely Mekanisa, Gofa and Saris Vegetable Producer Cooperative. The technique used to identify sample respondents from the population was systematic random sampling. This was done using sample size interval that helps to take the n^{th} of household from the cooperative list. This was possible by dividing the total number of households for sample size.

However, due to spatially scattered nature of farmer production site, it was a difficult task to access to each of the 24 sample households. With the help of the cooperative secretary, about 19 sample households reached and filled the questionnaire, but the rest 5 sample replaced by using availability sampling technique.

3.3.1. Population

The total population of urban vegetable farmers in the city, according to Addis Ababa City Urban Agriculture Department, is 1574 of which 977 are organized into 12 cooperative and 597 are small holder vegetable farmers. These cooperative farmers occupied 270 hectare of land and other small holder farmers cultivated vegetable in 119.5 hectare of land irrigated with river in the city. It was impossible for the researcher

to include all elements of the population in the study due to scarcity of resource and time. Taking into in consideration a sample from the cooperative was taken to collect valuable data that could represent the target population. So the target population for this study was the cooperative members of urban farmers in the city which has 1,799 households with 9,293 beneficiaries.

3.3.2. 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 was the list of all cooperative members organized in Mekanisa, Gofa and Saris Vegetable Producer Association. The total size of sampling frame in the cooperative is determined to be 241 household.

3.3.3. Sample Size

To obtain reliable and manageable data, the researcher undertook the sample size from all target populations of urban vegetable farmers in the city. The total size of members organized in Mekanisa, Gofa and Saris Vegetable Producer Association is about 241 (previously they were 244) from these 24 respondents (10% of farmers) was taken as a sample and filled the questionnaire.

3.3.4 Data Analysis Interpretation and Presentation

For the purpose of accomplishing the objectives of the study and to answer the research questions, the researcher edited, coded, classified and tabulated the collected raw data in order to make it ready for analysis. Information from primary and secondary sources was analyzed by using qualitative and quantitative methods. Data that have quantitative nature such as average, percentage and alike were compute with Microsoft Excel software. On the other hand, qualitative data such as information related with overview of urban agriculture activity in the city, situational analysis of solid waste management in Addis Ababa, etc. were analyzed through interpretations of organized data, discussion of the finding in the form of text, and qualitative description of advanced software like Geographic Information System (GIS).

To summarize the data, to enhance textual description and to make comparison easy, the researcher use different data presentation tools such as tables, charts, verbal or text description, GIS data explanation, visual photography, etc. The summarized form of data source, collection and analysis presented in next page.

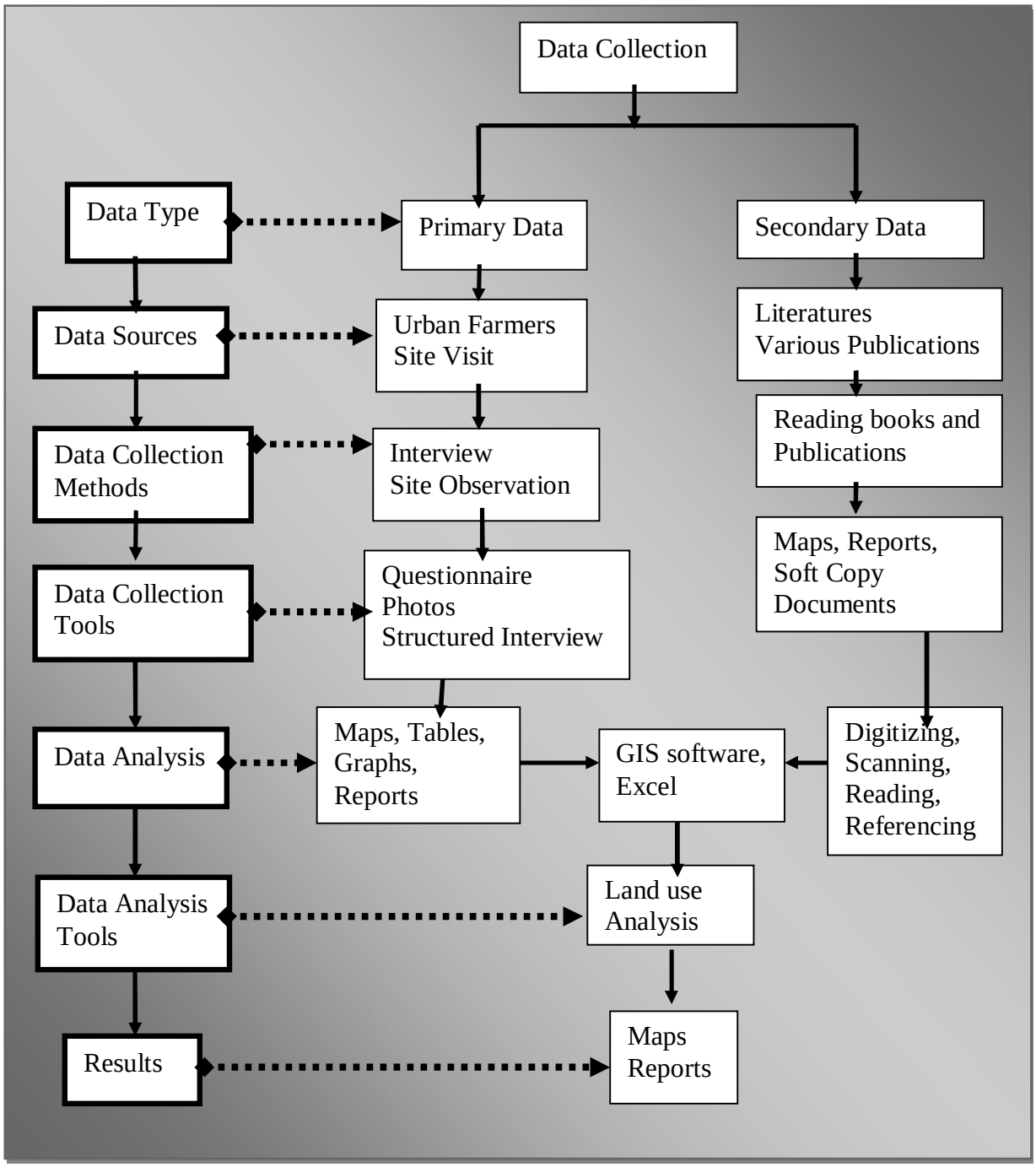


Fig.3.1. Data Collection and Analysis Method

Chapter Four: Description of the Study Area

4.1. Location of Study Area in Addis Ababa

Addis Ababa is the capital city of Ethiopia. It is a seat of the African Union (AU) and the United Nations Economic Commissions for Africa and gateway for diplomats and tourists. The total population of the city, according to the 2007 Housing and Population Census, is about 2,739,551 million and the total area of the city is 540square kilometer (54,000 hectare). Out of it, 22,000 hectares land designed for green frame, but currently it is estimated that 7,900 hectares of land is allocated for green frame. The average elevation of the city is around 2,500 meter above sea level (m.a.s.l). which is the highest when one can compared with many cities of our world. In terms of governance there are three level of government: City Government at the top, 10 sub-city administrations in the middle and 116 Woredas which is the smallest unit of government in the hierarchy.

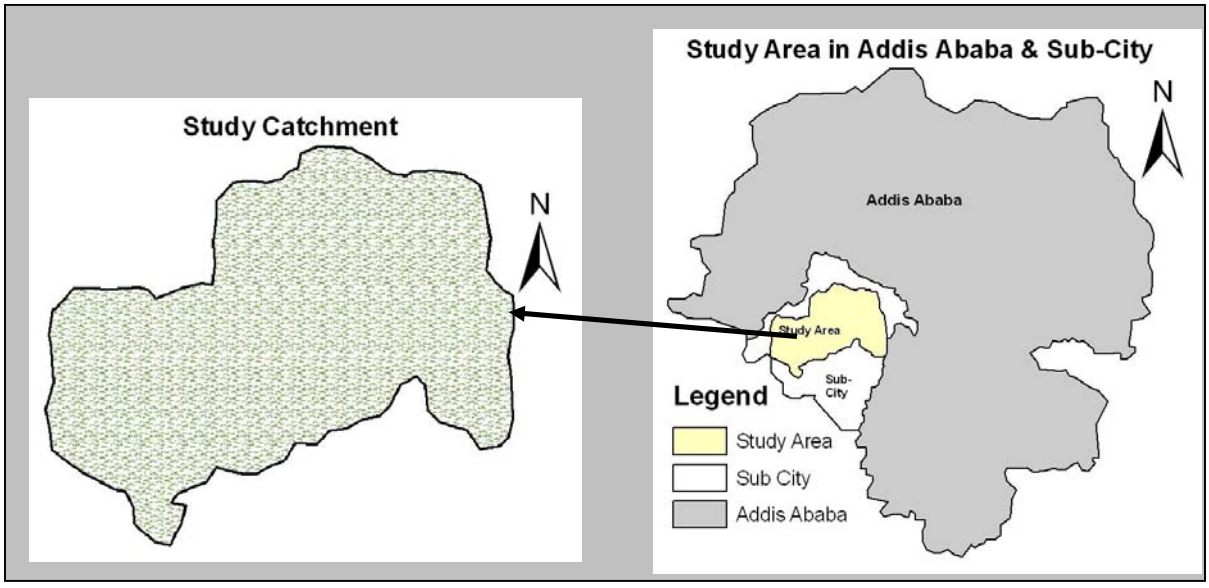


Fig.4.1. Location of the Study Area in Addis Ababa

4.2. Little Akaki River in Addis Ababa

The Little Akaki River is mainly found in Addis Ababa region and the catchment area of about 540 km^2.The catchment area is bound within Addis Ababa city that geographically lies between the range of $38^0$40'37''E -$38^0$45'40''E longitude and $8^0$55'20''N-$8^0$59'40N'' latitude. It is located at the south western part of the city. Out of the 10 sub-cities Kolfe-Keraniyo, Lideta, Gulele, Nifasilk-Lafto, Addis-Ketema, Akaki-Kality and Kirkos sub city contain Little Akaki River.

As indicated in the Review of the Status of Akaki River Water Pollution Strategic Implementation Plan for 2005-2015 (2005) Little Akaki River basin starts from Gullele (North Addis Ababa). Most streams that flow from north western sides meet together at Gullele area. The stream flows from north western sides meet at Gullele Soap, Shirt and Marble Industries are located, from the main upper stream of the Little Akaki River. This flows down to the most densely populated areas of the city in which many residents and commercial centers are found in Messalemia area. At this point the river serves as the most domestic and commercial waste dumping sites. Then it flows down to the center of the city and pass through Lideta area, where the Awash Winery is planted.

On the other side some streams start at around Keraneo, Netherlands embassy and then flow downwards to Alert Hospital and Mekanissa Alcohol and Liquor Factory. This great stream is the major tributary of little Akaki, which flows through Tobacco Corporation and Addis Ababa Abattoir. The lower stream of Little Akaki River flows through the south west side of the region and continues to flow the rural area of Akaki in which most horticultural activities are using it and continues to flow into Aba Samuel dam and then the Awash River (figure 4.2. shows location of Little Akaki in Addis Ababa in below).

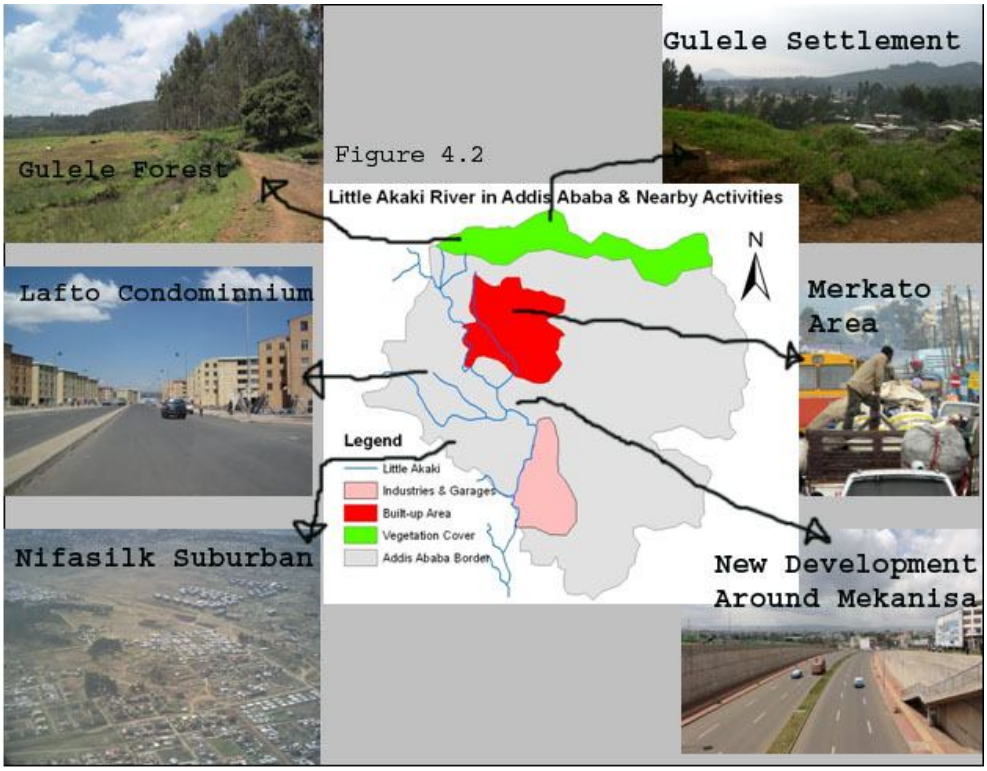


Fig.4.2. Location of Little Akaki River in Addis Ababa

4.3. Vegetable Production Site in the Catchment

The specific area of this research is delineated in Nifasilk-Lafto sub city. This is because Nifasilk Lafto sub city contain the majority of this sub-catchment of Little Akaki River. The catchment has a total of 41.15 square km which exclude catchments contained in other sub-cities. The reason behind not including all catchments in this study is that, it is difficult to analyze and manage within this timeframe and resources.

There are 7 major and 6 medium rivers which are fed by 75 small river tributaries in Addis Ababa. The rivers start from the northwest and northeast part of the city and flow south wards & converge at Beseka & create Lake Aba Samuel (Hayal et al., 2009). From these Rivers, Little Akaki and its tributaries contained in the catchment that extend from the North (around Alert Hospital) to the center of the catchment and join the Kera River which come from the north eastern part of the catchment (around Kera) and flows Southern direction. During its course to the lower catchment of the River, many cooperatives and small holder vegetable producers grow various kinds of vegetable to the city market

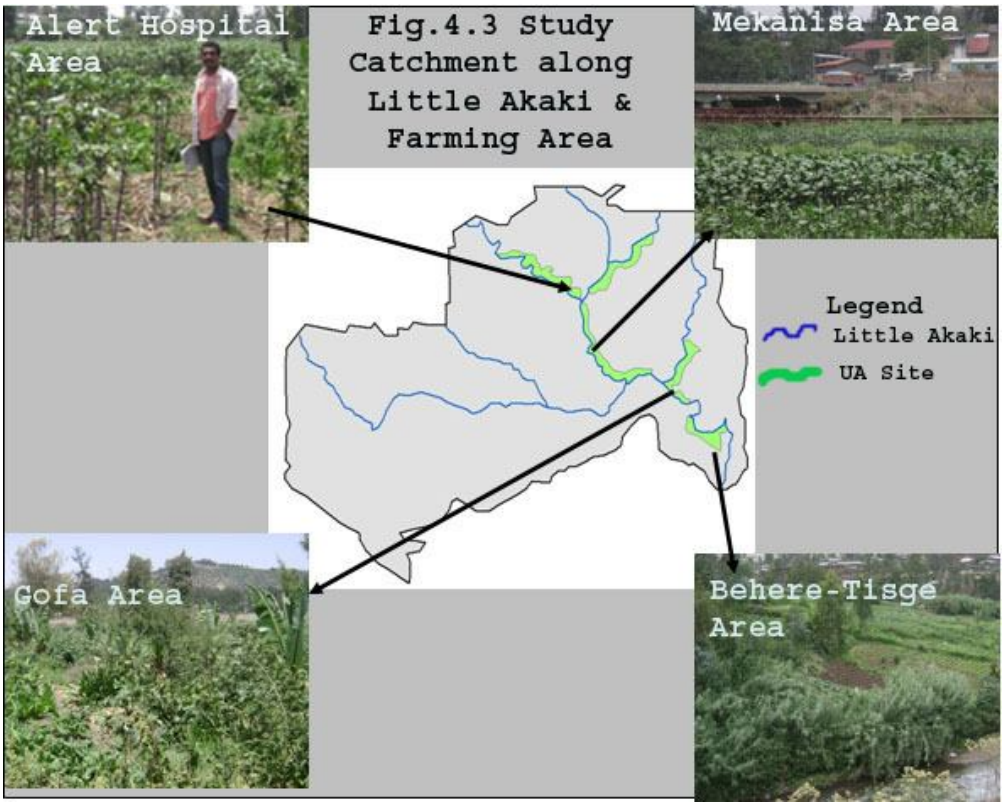
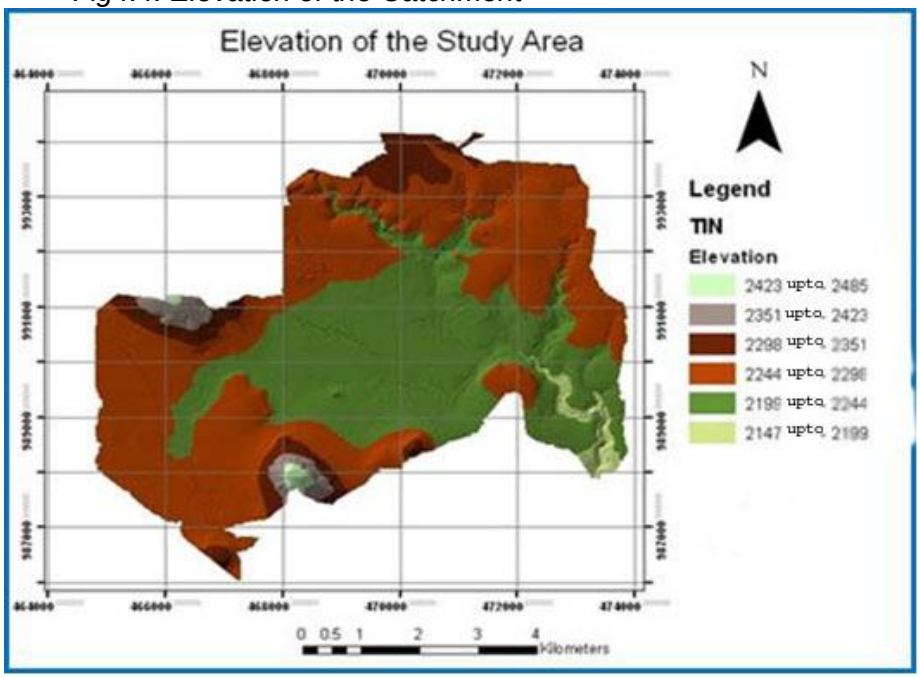


Figure 4.3. shows the cooperative farm in the catchment

4.4. Topographic Feature of the Catchment

The catchment area has an elevation between 2147 m.a.s.l. to 2485 m.a.s.l (see figure 4.4. in the next page), and the dominant elevation of the catchment is between 2200 m.a.s.l. to 2300 m.a.s.l. which is below the average elevation of the city i.e. 2500 m.a.s.l. This make the catchment have warmer temperature than the city which contribute to better temperature for growing vegetable in the area. Elevation greater than 2300 m.a.s.l. marked on the two mountain tip at the west and south west area of the catchment.

Fig4.4. Elevation of the Catchment

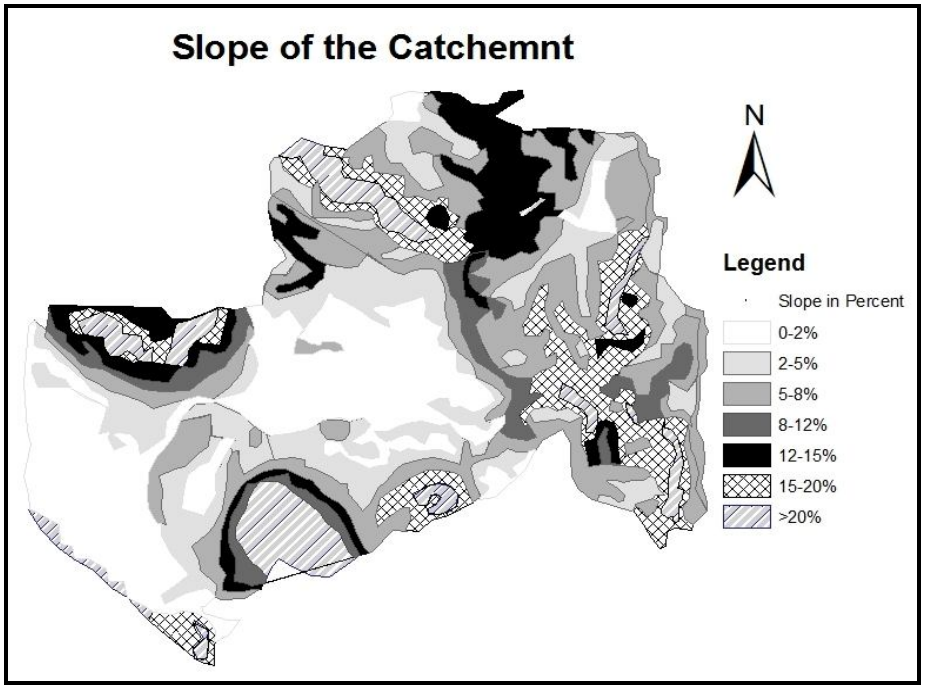


Source: ORAMP, 2002

The slope of the catchment varies significantly from one area to another (see figure 4.5. in the next page), but it dominated by flat area which is suitable for farming activities. The western parts of the catchment has slope greater than 20% at the top of mountain and flat at the bottom. In addition, parts of riverbank area especially in the north covered by steep slope which is not suitable to farming and other development initiative. Taking in to consideration, the environmental plan of the city proposed those areas with slope of greater than 20% reserved for forest and restricted any types of development other than urban greenery.

The northern part of the catchment especially along the river that extends from Alert Hospital to Mekanisa Ring Road dominated by slope greater than 20%, however, the revised master plan proposed the area for urban farming activity. Almost all urban farming activities along river bank in Addis Ababa in general and in the study area in particular dominated by vegetable growing which is not permanent plantation and the capacity to hold soil and infiltrate water are minimal, so proposed the area for urban farming have environmental impacts and the revised master plan should either specify what type of UA activity performed or reserved the area for urban forestry.

Fig.4.5. Slope of the Catchment



Source: ORAMP, 2002

4.5. Climate

Addis Ababa enjoys a mild, Afro-Alpine temperate climate. The city possesses complex mix of highland climate zones, with temperature differences of up to 10^{o}C, depending on elevation and prevailing wind patterns. According to the data obtained from National Meteorological Services Agency, the mean annual temperature, the mean annual maximum and mean annual minimum temperatures of the town are reckoned to be about 17.22ºC, 23.76ºC & 10.67ºC, respectively, which is the characteristic of a modest temperate climate.

Table4.1. Weather Average for Addis Ababa in the Year 2010

Month	Ja	Fe	Mar	Ap	Ma	Ju	Jul	Au	Se	Oc	No	De
Average High ^{o}C	20	21	21	22	22	19	17	18	19	19	19	19
(^{o}F)	68	70	70	72	71	67	63	64	66	67	67	67
Average Low ^{o}C	12	12	14	14	14	13	13	12	13	12	11	11
(^{o}F)	53	54	57	58	58	56	55	54	55	54	52	51

Source: National Meteorological Service Agency of Ethiopia

4.6. Soil

Study done by Girma et al, (undated) the major soil types of the study area are Pellic Vertisols and Nitosols. Pellic Vertisols are found at Akaki, just south of Addis Ababa with too shallow soil depth at 3% slope with surface cracking features. Nitosols are found in the high land of Addis Northwest and Northeast of the catchments. Nitosols have very good potential for agriculture and have high water storage capacity.

4.7. Land use Land Cover of the Catchment

According to the Office for the Revision of the Addis Ababa Master Plan (ORAMP, 2002) it is estimated that the total area of the city covers 54,000 hectares, of which about 22,000hectars of land is designed for green frame. The remaining land allocated for industry, social service, housing and transport.

Table4.2. Land use Land cover Share of the Catchment

Land cover	**Land use (ha)**	**Percentage**
Infrastructure & River	391	9.18
Built up Area	1570	36.86
Bare land	945.80	22.19
Vegetation in Built up Area	170.82	4
Forest	69.37	1.62
Scattered Vegetation	178.55	4.18
Riverside Urban Agriculture	102.91	2.42
Agriculture	611.78	14.37
Grassland	220	5.17
Total	**4259.61**	**100**

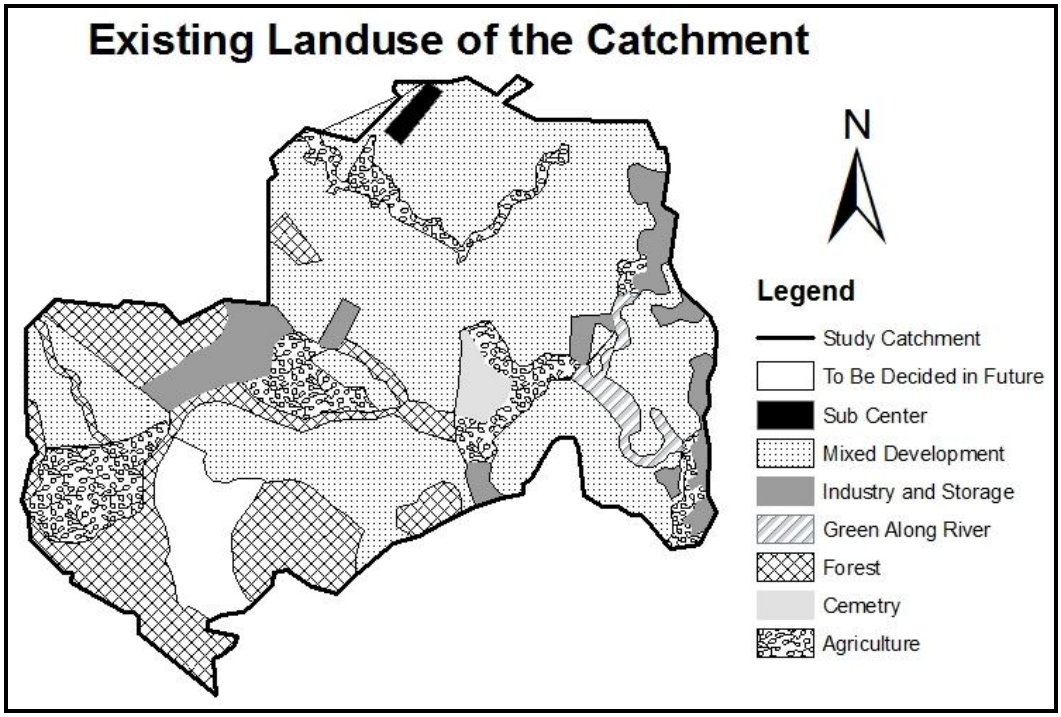
The study area/catchment covers an area of 4259.61 hectares (see table 4.2. above and figure 4.6. in the next page) which comprise built-up area 1570 ha (36.86%), bare land 945.8 ha (22.19%), vegetation in built up area 170.82 ha (4%), forest 69.37 ha (1.62%), scattered vegetation 178.55 ha (4.18%), riverside urban agriculture 102.91 ha (2.42%), agriculture 611.78 (14.37%) and grassland 220 ha (5.17%) of the total land cover.

Figure 4.6. above clearly shows that the dominant land use of the catchment 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 sources of water for vegetable growing. The issue clearly calls for urgent measure in the management of both solid and liquid wastes.

4.8. Existing Land Use of the Catchment

The existing land use of the catchment (see figure 4.7. in the next page) mainly dominated by mixed use development which is about 2229ha (52.33%), followed by forest and agriculture 762.23ha (17.9%) and 495.86ha (11.64%) respectively. The remaining area assigned for industry and storage 271.23 (6.36%), undecided land 204.26ha (4.79%), Green along river 95.46ha (2.23%), cemetery 51.20ha (1.2%), sub-center 26.8ha (0.63%), and 123.63 (2.9%) is plan to occupied by several infrastructure such as roads and government utilities. Based on this information and the information obtained from the land use and land cover of the catchment, agriculture give due emphasis in both cases i.e. from the total area 17.9% and 16.79% respectively.

Fig.4.6. Existing Land use of the Catchment

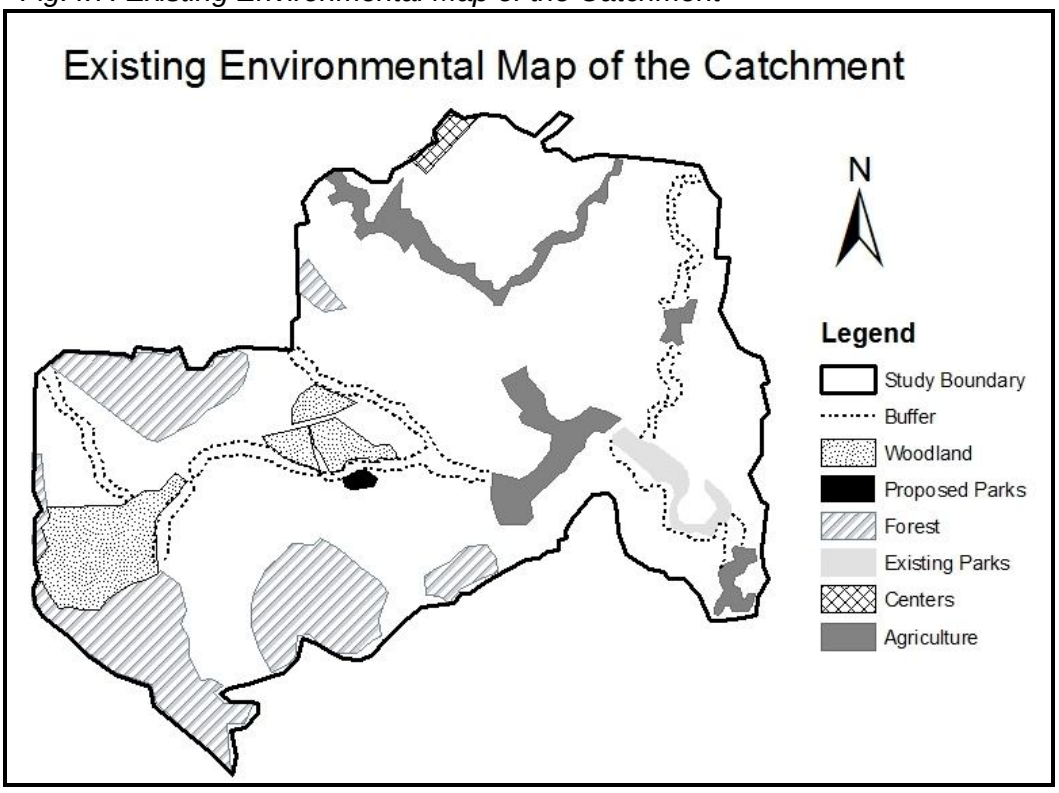


Source: ORAMP, 2002

4.9. Existing Environmental Map of the Catchment

The existing environmental map of the city shows that 97.9 ha of land occupied by 15 parks, 7, 175ha agriculture, and 12,176ha forest land. Moreover, 1403ha have been planned for riverbank parks, 341.63ha for proposed parks and the remaining area reserved for wood land, and protected lands. With respect to the study area, forest plan to cover 650.81ha, but it only 10% of the plan i.e. 69.37ha, next to forest woodland planned to cover 255.59ha, agriculture 224ha, river buffer 116 ha which expect to serve as riverbank recreation area, existing parks 16.53ha, and proposed parks 8.2ha of the environmental map of the study area.

Fig.4.7. Existing Environmental Map of the Catchment



Source: ORAMP, 2002

Chapter Five: Socio-Economic & Environmental Condition of Urban Agriculture in the Study Area

5.1. Introduction

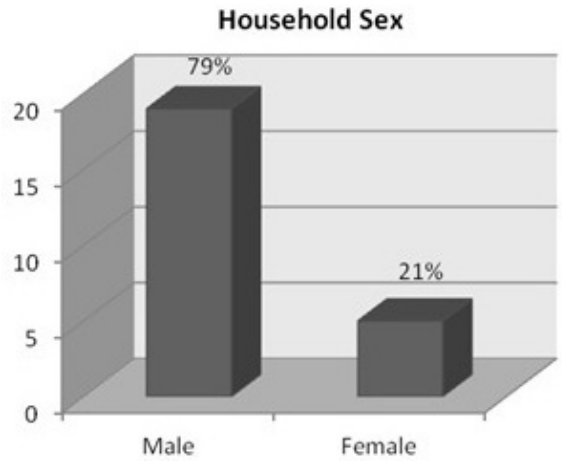
Akaki River basin covers western part and drain the city from north to south. Big Akaki (900 km^2) and little Akaki basin has catchment area of about 540 km^2 (Prabu, 2009). This sub-catchment of Little Akaki covers only 42.60 square km and located mainly at Nifasilk Lafto sub-city. Urban farming activity in this sub-catchment undertaken by one traditional cooperative namely, Mekanisa, Gofa and Saris Vegetable Producer Cooperative which established in the year 1975 following the then promulgation of land for tenants by the Derg regime.

Since then, urban farming activity in this cooperative contribute a lot for the city economy by supporting the producer's income and employment creation, provide alternative source of food for farmers and their family, protect the natural environment by greening the area, minimizing wastes by using wastewater for vegetable production, supplying fresh vegetable to the city market etc. On the other hand, urban farming activities face various challenges such as tenure insecurity, flooding (as they reside on flood plain area), access to clean water for irrigation, etc. In addition, farming activities along river bank crests a lot of challenges such as contamination of soil, soil erosion, human health risk due to contamination of vegetable, etc. Therefore, this chapter thoroughly identifies, analyze and interpret each of the above issues by the support of data from different sources collected during the data collection period.

5.2. Characteristics of Urban Farmers in the Study Area

As indicated in figure 5.1, 19 out of 24 sample households or (79%), were male while small numbers of respondents were female, which shows male dominated occupation. Marital status of households in the study area dominated by those who have married which is constitute 20 (83%), followed by widowed and divorced that account for 3 (13%) and 1 (4%) respectively. Family size of urban farmers, as indicated in figure 5.3, in the cooperative shows that 23 out of 24 respondents (96%) of respondents have five and above family size and the rest 4% have family size of four. In terms of educational status of respondents, almost half of them 11 (46%) are illiterate, followed by those who can read and right, primary education and secondary and above 8 (33%), 4 (17%), and 1

(4%) respectively. Job status in addition to urban farming activity shows that 20 (83%) of respondents don't have other job, but 4 (17%) of respondents have job other than urban farming dominated by self employed.



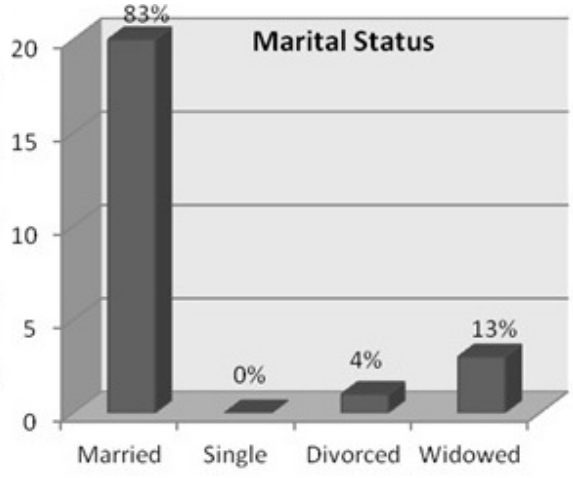
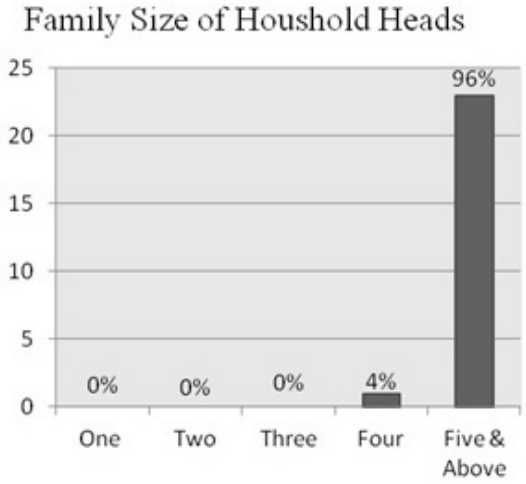


Fig.5.1. Household Head Sex *Fig.521. Marital Status of Household Head*

The above figure indicates that urban farming activity is mostly dominated by male household head, this may be male, in most cases, is the bread winner of the family. Other elements of the questionnaire (marital status, family size, educational status and additional income earning in addition to urban agriculture) responses were highly related with the background of household heads. They were tenants on the occupied land, they did not have the opportunity to learn, as a result they remain in this activity, and unable to successfully adopt family planning.



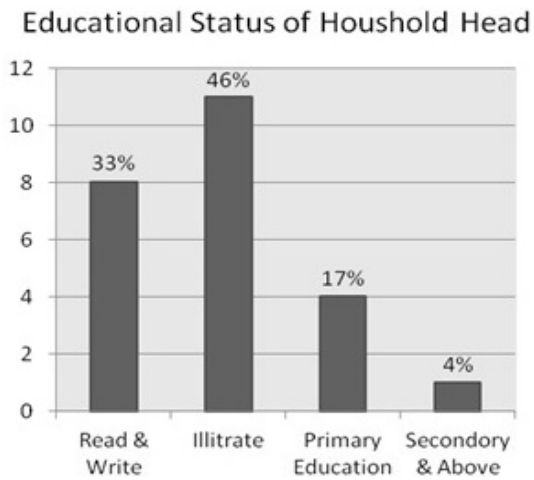


Fig.5.3. Family Size of Household Heads Heads *Fig.5.4. Educational Status of Household*

Farming practice in the cooperative supported by various local instruments. Figure 5.5. in the next page shows that all cooperatives use surface irrigation taking the advantage of gravity, and small dam to divert the flow of water into their farm. All farmers use hand tools to dug and related activities with axes, shovel and similar equipments. However, all respondent indicates that flooding is the natural treat to their farming activities; as a result farmers during summer time become jobless and waiting to end summer rain. In terms of safety method, farmer used 16 (67%) wash the vegetable before they actually sale in the market, 15 (62%) and 12 (50%) putting plastic shoe and hand glove respectively, but none of them are treat the wastewater before watering the vegetables.

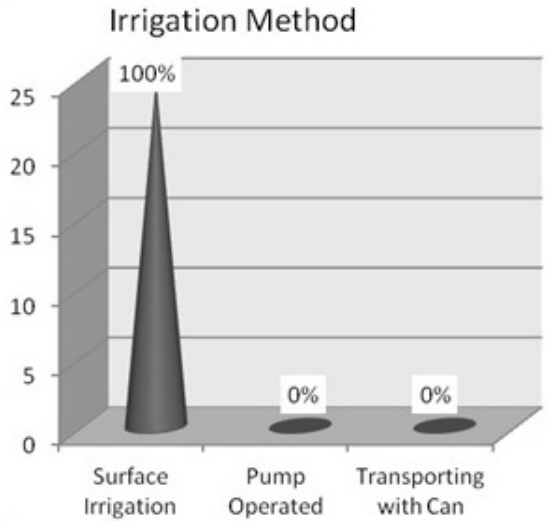


Fig. 5.5. Irrigation Type in the Cooperative

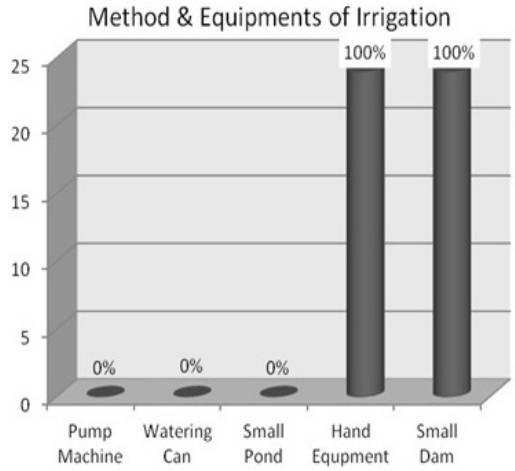
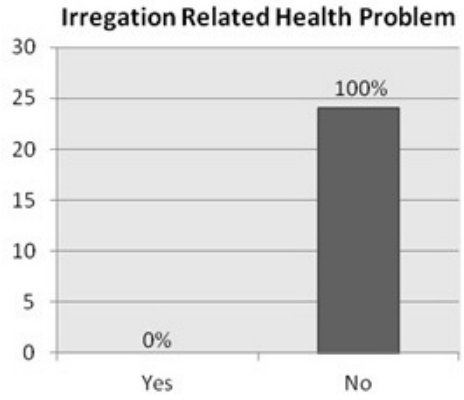


Fig.5.6. Irrigation Method & Equipment

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.



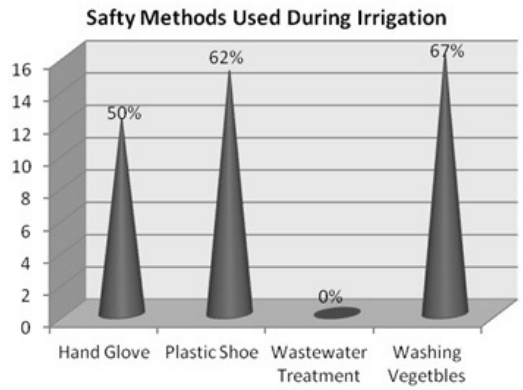
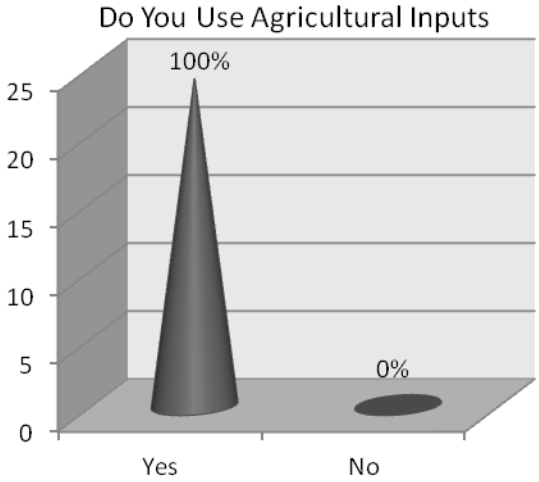


Fig.5.7. Irrigation Related Health Problems *Fig.5.8. Safety Method Used During Irrigation*

Increase in productivity requires intensive utilization of agricultural inputs such as fertilizers, selected seeds, herbicide, pesticides and a like. In the cooperative all farmers applied natural and artificial fertilizers, and selected seeds, however, few of them 4 (17%) respond that they apply pesticide when pests have been intensified in their farms, but none of them use herbicide and manual weeding is the common method of avoiding weed. But, according to the information collected from Nifasilk Lafto Sub-city Urban Agriculture Department, all farmers use pesticides when pest has been infested in the farm. This implies that farmers use inputs that increase productivity for their vegetable production, with the cost of health impact and environmental pollution.



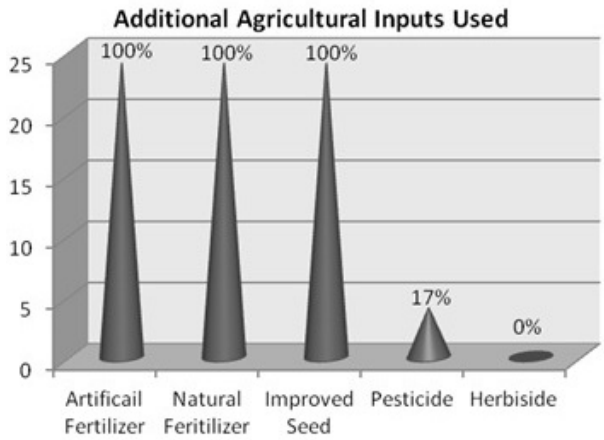
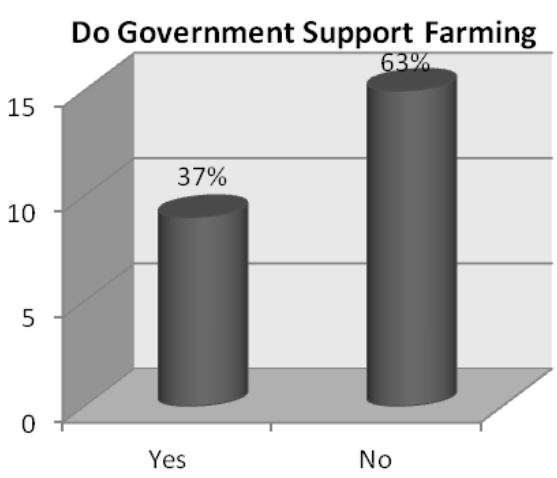


Fig.5.9.Farmers Agricultural Inputs Used *5.10.Types of Agricultural Input Used*

Technical, financial and in-kind supports of urban farmers improve the overall performance of farming practices. In Mekanisa, Gofa and Saris Vegetable Producer

Associations there has not been significant support from government organizations and NGOs who operate in the sub-city. Some of the support provided by government organization includes recognizing their organization responded by 19 (79%) followed by training delivery 50%, and in kind support such as selected seeds and fertilizer 4 (17%). But there is no loan provision and security of tenure for the land they grow vegetables. Moreover, the support of NGOs in any aspects of vegetable production not recorded or absent at all.



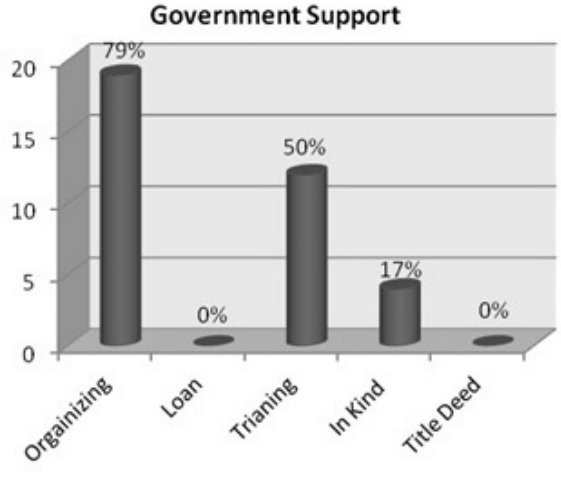


Fig5.11. Government Support the Cooperative *Fig.5.12. Types of Government Support*

As shown in figure 5.13 below, on average farmers produce twice in a year 12 (50%) and three times a year 12 (50%). The market condition of farmer's product shows that 92% of respondent encountered, either sometimes or mainly, or face market shortage when oversupply of vegetable intensified in the city. Only 2 (8%) of respondents have not marketing problem for the vegetables they produced. 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 in over-supply of the some vegetable in the market.

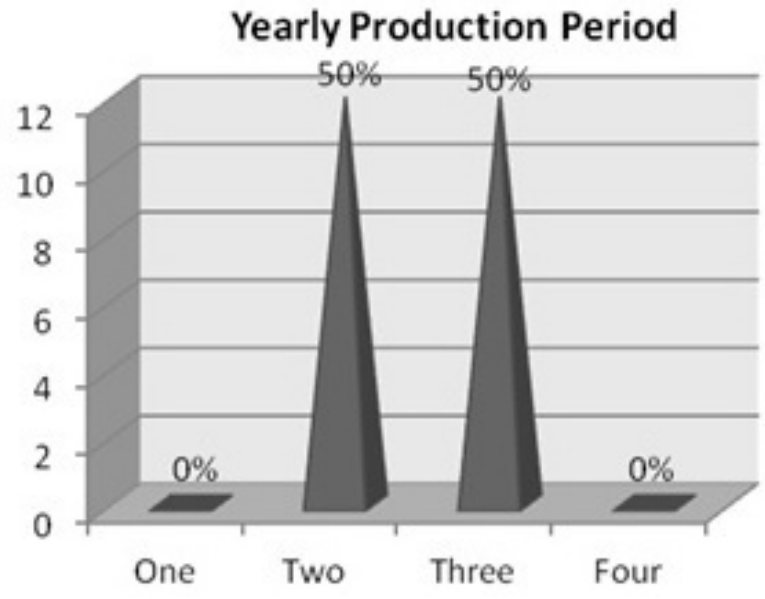


Fig.5.13. Yearly Production Period in the Cooperative

5.3. Challenges of Urban Agriculture

5.3.1. Environmental Challenges

The environmental challenge associated with UA in the study area includes pollution of soil during the use of Little Akaki River for irrigation purpose, water pollution due to fertilizer and pesticide application, and soil erosion due to growing of vegetable on steep slope and river bank area.

i. **Water pollution due to fertilizer and pesticide application:** According to the information collected from Nifasilk Lafto sub-city UA head, all members of the cooperative in the study area use fertilizer before they actually planting vegetables. Uria and DAP are the primary fertilizer applied in the area. Uria mostly apply to leafy vegetable such as cabbage, cauliflower, lettuce and Ethiopian kale, however, DAP on the other hand appropriate to use root vegetables such as beetroot, potato, carrot and alike.

In order to know the extent of the problem created by commercial fertilizer used by urban farmers in the cooperative, determining the volume of fertilizers actually used in the cooperative is indispensable. Accordingly, the yearly total application of fertilizer estimated to be about 2083.33quintal. This can be calculated as follows:

1”Massa” approximately equal to 360m^2 needs half a quintal/year

The estimated farmland in the study area is about 150ha (1,500,000m^2)

1,500,000m^2/360m^2 = 4166.67 “Massa” * half a quintal = **2083.33 quintal**

However, the yearly pesticide use in the area is not constant as the farmers use it when pest has infested in their farmland. But the main pesticide used by the farmer in the study area includes Malataine, dimethoate and alike. Thus there is high probability of leaching of pesticides and fertilizers residues into the Akaki River there by making the rivers more polluted, consequently, the existence of weed and algae over the water body of Aba Samuel rivers are the indicators of fertilizer access to the water (APAP, 2006). This makes threat to wildlife and other biological creature in and along the river as well as the downstream area of all the way to Aba Samuel artificial reservoir.

The other effect observed due to fertilizer application on irrigated agricultural land is Eutrophication. The basic cause of eutriphication is the accumulation of nutrients in a body of water. Fertilizers contain nitrogen and phosphorus, which are essential nutrients for enriching the soil with the goal of increased agricultural production. Eutrophication of lakes and other bodies of water causes shifts in the types of aquatic life that survive. Many fish species disappear due to insufficient oxygen supplies. Akaki river experience the depletion of fishes due to both eutriphication and pollution effects of the river. Another effect of eutrophication's is algal blooms that result from excessive deposits of nutrients.

ii. Erosion of Soil due to farming on riverbank and steep slope area

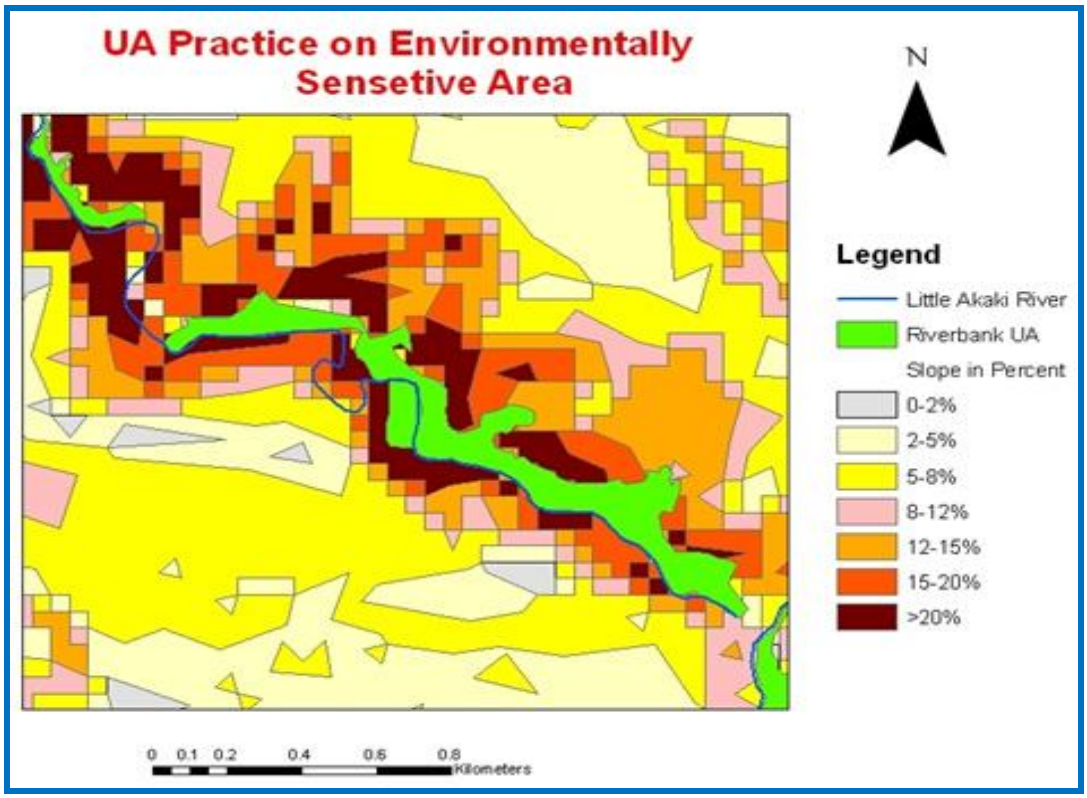
Soil stability in riverbank depends on the type of development undertaken within and around it. In addition, the type and level of vegetation planted and covered on the bank has its own role in the stability of soil along the river. In the study area, due to farming activities on steep slope area (see picture 5.2. below) as well as in the river bank (see picture 5.1. below) leads to erosion of soil and hence sedimentation of solid substances in the river.

Picture 5.1&5.2 Photograph Showing Urban Agriculture on Environmentally Sensitive Area

Source: Author's Own Survey

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.

Figure5.14. Urban Farming Land use on Environmentally Sensitive Area



Source: Google Earth, 2011

The severity of the problem visible in the site around Alert Hospital, Kera, and Mekanisa area (see fig 5.1. in the next page). 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. The farming practice obviously contradict with the principle set by ORAAMP which says forest, woodland, buffer, and conservation areas located along rivers and streams; on flood prone, swampy, and steep areas of slope greater than 15% and around large scale industries, cemeteries, ground-water resources; landslide prone and eroded areas should be protected and conserved to add the city green framework. 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.

5.3.2. Health Related Risks

Chemicals of health significance in water used for drinking and other domestic purposes include inorganic constituents, organic compounds, chlorinated hydrocarbons, disinfectants and their by products and other organic constituents like chlorinated hydrocarbon and disinfectants and disinfectant by products are shown to induce cancer in human beings as well as in livestock. Inorganic constituents (As, Ba, B, Cd, Cr, Cu, Cn, F, Pb, Mn, Hg, No_3, No_2, Se) can also jeopardize human health whenever they are injected in amount exceeding a certain threshold level (APAP, 2006).

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 APAP, 2006, 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.

According to Walta Information (2004) based its information from Hygiene and Environmental Health Protection Department Head with the Bureau reported that vegetables including Cabbages, Salad, Carrot, Tomato, Green Paper and Onion produced through irrigations from river waters polluted by toxic and waste material from factories and households was posing serious endanger to the health of the resident of the City. Vegetables grown at environmentally contaminated sites in Addis Ababa could

uptake and accumulate metals at concentrations that are toxic to human health. Cabbage was in general the least accumulator of metals/metalloids. Lettuce and Swiss In a few cases, As, Cr, Fe and Pb in these vegetables have surpassed maximum permitted concentrations. The intake of most of the metals constitutes less than 10% of the TMDI (theoretical maximum daily intake) at present, and hence health risk is minimal. But with increase in vegetable consumption by the community the situation could worsen in the future. (Fisseha Itanna 2002).

As the study made by Prabu in 2009, the extent of heavy metal concentration on water, soil, and different vegetables grown using Akaki River water have been analyzed for seven heavy metals Cd, Cr, Cu, Zn, Mn, Fe and Ni. The results show that the heavy metal content in Akaki water was higher than the natural element levels in freshwater. Except for Fe and Mn, all other metals were present above the maximum allowable limits in soil samples. The concentration of Cr in all vegetables was more than the maximum limit. The Cd accumulation was more in leafy vegetables than other vegetables under study. Metal transfer factors from soil to vegetables were significant for Zn, Mn, Cu, Fe and Cd & accumulation of Cr and Ni was comparatively less while that of Zn, Fe, Cu & Mn is more in vegetable plants.

The study made of the Akaki River, in 2010 by Addis Ababa City Environmental Protection Authority taking as a fundamental and up to date information source. Five of the sample farms were located along Akaki River and one control farm from pollution free area. The sample includes water, soil and vegetables irrigated with polluted Akaki River. Water analysis result shows that, Pb, Fe, BOD, and COD concentrations exceed the standards. Fe and Ni concentration in soil exceeds the recommended maximum level set for soils. Cr, Fe and Pb level in Cabbage and Lettuce is found to be higher than the recommended maximum level.

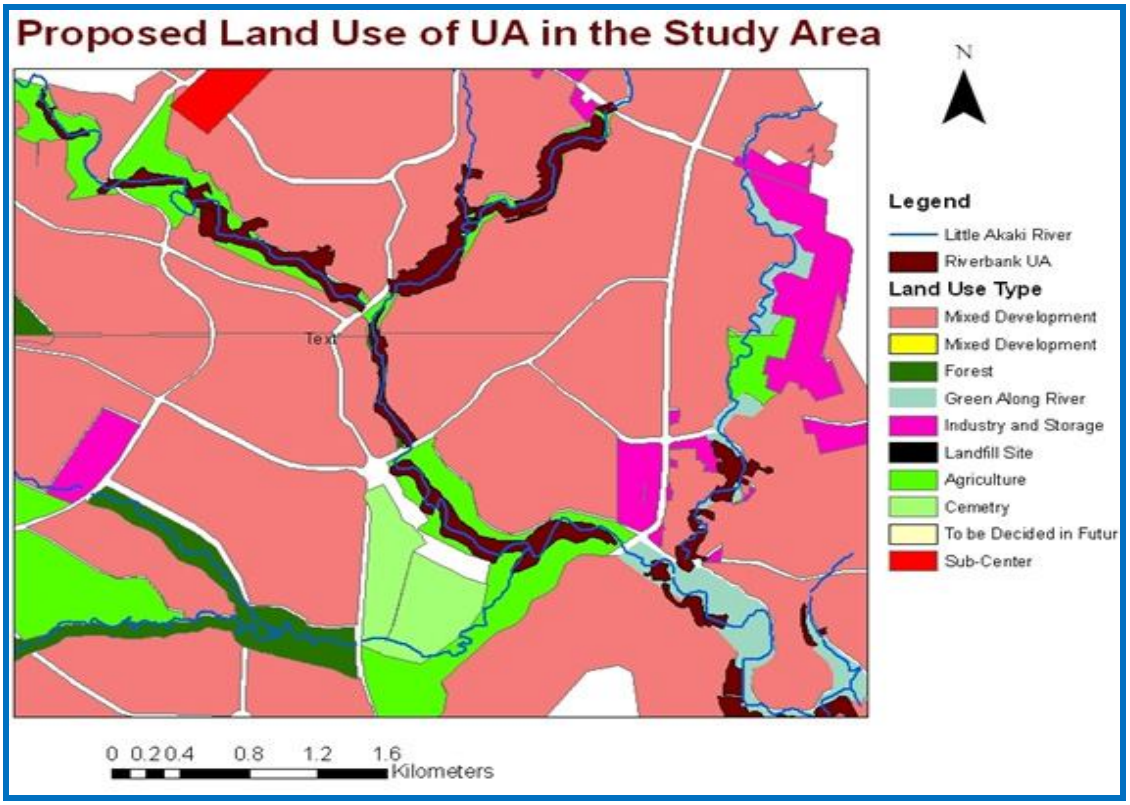
5.3.3. Land Use Related Challenges

5.3.3.1. Spatial Location of Urban Agriculture in the Study Area and its Challenges

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.

Fig.5.15. Proposed and Current Land use of Urban Agriculture in the Study Area



Source: Google Earth, 2011

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.

Image5.1. & 5.2. Urban Agriculture on Reserved Area for Green Along River and Forest

Source: Google Earth, 2011

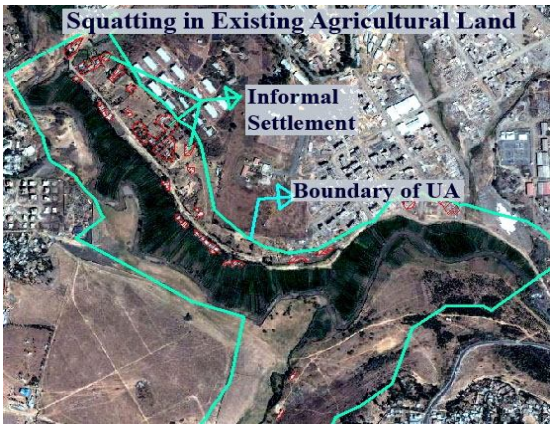
On the other hand, interview made with an expert from Addis Ababa city urban planning institute explain that, area extended from Gofa condominium site to Behere Tsige public Park reserved for green along river so as to intensifying riverside recreation area around the park, and strengthening the existing forests around "Gofa Sefer". However, the existing situation in the study area shows that vegetable producers occupied the land for more than three decades, except the park itself (see image 5.1. above).

On the contrary, ORAAMP Proposed part of the western side of the city as well as the study area for urban agriculture, however, as indicated in image 5.3, 5.4, and 5.5, there are three sites which informally occupied by squatters. The first site is located at the western border of both the city and the study area. The dominant activity in the area is farming and the city is not currently well developed there, but administratively it contained within the city as a result farmers informally sold the land for residents as well as they build their house in the farm they occupied. The organic form of development, which is clearly shown below in image 5.3. below evident for informal settlement in the specified area.

Image 5.3. Informal Settlement on Reserved Area for Urban Agriculture

Source: Google Earth, 2011

Image 5.4. Informal Settlement on Proposed Area for Urban Agriculture



Source: Google Earth, 2011

The second site is located at the center of the study area or at the edge of the developed land of the city. The site, like other urban fringes of the city, occupied by informal settlers who purchased the land from formal owners of the land. According to Addis Ababa City Urban Planning Institute, previously the land was informal but know it become formalized and residents have formal title deed from the respective government organization. The third site is located between “Behere Tisge” Public Park in the south and near to “Mekanisa” vegetable producing site in the north or close to “Gofa” condominium house. As indicated above in image 5.5 the area is sparsely occupied by informal settlers who have owned and operated vegetable in the area.

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 forestry and 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.

5.3.3. 2. Luck of Enforcement on River Buffer in Addis Ababa

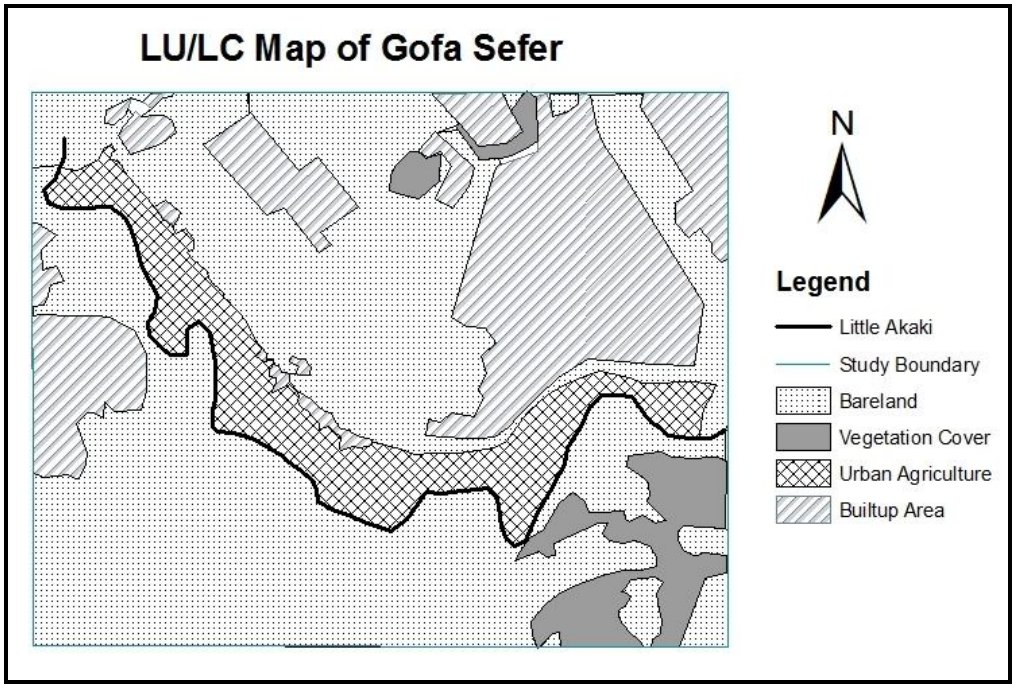
The Office for the Revision of Addis Ababa Master Plan (ORAAMP, 2002) proposed to develop buffer zone along stream and river in the city with a standardize minimum distance that prohibit development that have a potential harmful effect on the river. It is a standard size of Greenery River and streams at least with a 10m. width from the riverbank on both sides and in addition 5m. width of walk-way were plan to develop. It is the minimum distance i.e. if the topography of the river too deep and sloppy, in order to protect the soil from erosion, the width of buffer zone will be increase. The plan also set the minimum width of buffer zone 50m. width in both sides of the river edge in newly developed neighborhood and redeveloped areas of the city.

The revised master plan also set that 30 m-100 m on each sides of the river has been left for river buffer. This buffer zone could be used for fruit tree cultivation, water protection, recreation, wildlife corridor, nursery and others to improve the living conditions of the people around and ensure the sustainability of biological creature lived there or used as corridor to move one place to the other (FEPA, 2005 in Dejytnu, 2007).

Despite the proposed master plan set the minimum buffer zone along riversides, the current practices of UA in the city in general and the study area in particular contradicts with what the plan is actually said. For instance, Buffer zone around urban farming area

of “Gofa Sefer” near to “Gofa” condominium site, totally violate the specified width set by the aforementioned authority. As it can be seen below on the picture and satellite image, the practice of urban farming activity in the study area is very close to Little Akaki River without letting any space for vegetation cover.

Fig. 5.16.LU/LC Map of “Gofa Sefer” Shows UA Activities on River Banks



Source: Google Earth, 2011

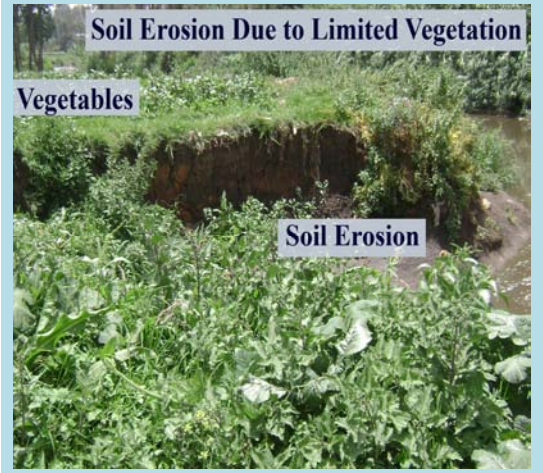
The effect of such improper practice of urban farming activities includes:

- Erosion of soil in the area (see picture 5.3 in the next page)
- Due to soil erosion, sever sedimentation of soil on the river bed is apparent (see picture 5.4 in the next page)
- Overflow of river water on the vegetable farm, consequently, damaging the growing vegetables and it make farmers jobless during the rainy season and they become wait and see when the rain is stop and back to work.

The three issues listed above are serious in the middle of vegetable growing site that extend from “Mekanisa” taxi fermata vegetable production site to “Gofa” condominium site. The reason is that the slope of the area near to the river is between 0%-5% and the existing vegetable production have been performed without letting buffer for the river banks. According to Lowrance et al (1995 in Dejytnu, 2007), in area where slope is minimal and surface water flows are slow and uniform, riparian areas can be highly effective in slowing the force of materials that reach streams. Therefore, if the buffer

zone in the area has been enforced, there will be a high probability of minimizing sedimentation, flooding and erosion of soil in and near to the riverbank.

Picture 5.3.Soil Erosion Due to Limited Vegetation Cover



Picture 5.4.Severe Sedimentation of the River in the Study Area

Source: Author's Own Survey

Booth and Reinelt (1994 Dejytnu, 2007) indicates that, the increases in sediment entering the stream also result in changes in the stream feature, including a widening and shallowing of the streambed, a loss of aquatic habitat, and a decrease in the streambed "roughness" as pools become filled and the stream bank is covered with fine soils (Booth and Reinelt, 1994 in Dejytnu, 2007). In addition, interview made with urban farmers in the study area shows that, due to the river filled with various materials, the volume of water reached in the farm and the extent of flood become increase from time to time; as a result the loss of vegetable due to flooding and the frequent maintenance of small dam become increase.

5.3.4. Inappropriate Waste management in the city

According to the Evaluation of the 2003-2010 Development Plan of Addis Ababa City (2009), in Addis Ababa about 1,003,815m^3 solid waste ware generated, from this 669,645 m^3 (66.71%) were collected and disposed off into the city landfill site. The rest 334,170m^3 (33.29%) were not collected and disposed off elsewhere in the city open space such as open land, forests, and mostly into the nearby river system. Moreover, as indicated by Central Statistics Agency (CSA, 2007), solid waste coverage in the city shows that there were 628,986 housing units available in the city, from this 213,925

housing units (34.01%) relied solid waste collection service from the municipality, 223,723 (35.57%) collected by individuals, 77,531 (12.33%) burn or burry and the rest dump into river 11.57% and behind their house 5.81%.

The high amount of solid waste generated combined with the inefficient means of collection can also be an important source of pollution of the rivers since leachates transported by run-off during the rainy season ultimately end up in the rivers. Further more, as solid waste is not segregated in to appropriate fractions during disposal (i.e. organic, chemical and other categories) there is a possibility for toxic compounds from household and other sources especially industrial wastes.

Due to unregulated urban growth and a high fraction of informal settlements, it is difficult to quantify the sanitary conditions for the entire city, however, the 2007 population and housing cense reveled that from the total population of the city 85.66% had toilet access in the form of flash toilet private or shared, VIP latrine shared or private and pit latrine private or shared. The rest the residents (14.34%) do not have any toilet access and they defecate on open spaces such as along river or river bed, in forests and any vacant land in the city that have not appropriate owner of the land. In addition, wastewater generated in the city treated at Kality Waste Water Treatment Plant. The treatment plant designed to treat 7600m^3/day but, according to Hayal et.al. 2009, its daily flow rate has reached to 7,500m^3 wastewater per day. In terms of housing units, it gives less than 10% of the population lived in the city. The rest, disposed into drainage ditch, open space around their compounds and the nearby river.

Table5.1. Liquid Waste Management in Addis Ababa

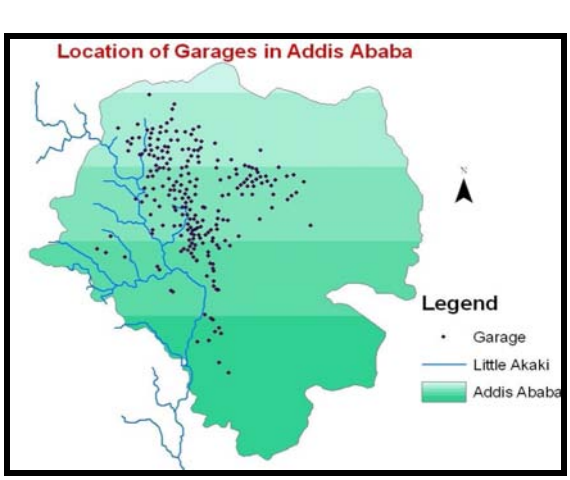
Solid Waste	**All housing units**	**Collected by municipality**	**Collected by individual**	**Dump Behind House**	**Dump into River**	**Burn or Burry**	**Other**
	628,986	213,925	223,723	36,512	72,789	77,531	4,506
Percent	100	34.01	35.57	5.81	11.57	12.33	0.72
Toilet	All housing units	No toilet facility	Flush toilet private	Flash toilet shared	VIP latrine shared & private	Pit latrine private	Pit latrine, shared
	628,986	90,206	58,123	35,684	124,423	62,009	258,541
Percent	100	14.34	9.24	5.67	19.78	9.86	41.11

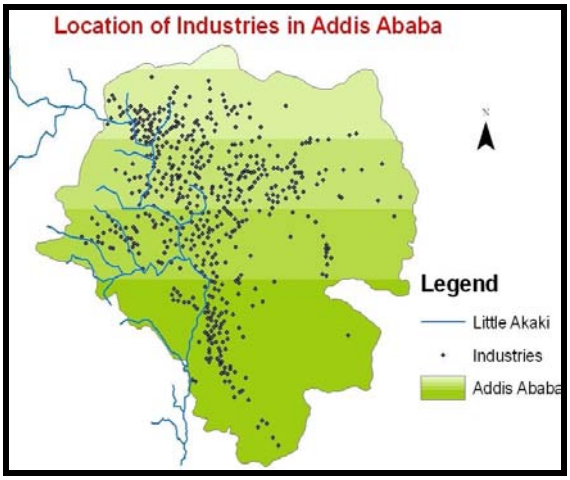
Source: The 2007 Population and Housing Census

The problem of waste management in the city also further aggravated by the location of industries and garages which generate various toxic substances. As indicated in figure 5.5 and 5.6 below, 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. The study made by Federal Environmental Protection of Addis Ababa (1999, in APAP, 2006), out of 741 industries found in the country, 484 (65.3%) were in Addis Ababa. Currently it is estimated that some 2,000 industries established in the city which is a 4 fold growth within 13 years.

The waste treatment status of the city of Addis Ababa, especially industrial wastes, indicates that more than 90% of the industries discharge their waste without any treatment into near by water bodies and open spaces (EPA, 2003, in APAP, 2006). A study made by Girmay (2000) out of 25 industries surveyed 10 industries directly dispose their untreated waste water to the Little Akaki and its tributaries while the rest dispose their liquid waste into open drainage system in the city.

Figure5.17. & 5.18. Spatial Location of Garages and in Addis Ababa





Source: ORAMP, 2002

The cumulative effects of inappropriate solid and liquid waste management by municipal and industrial sources causes deterioration of river water which is the only source of water for urban farmers in the study area. As a result marketing vegetables grown from

surch area is challenged by the infromation disseminated from various organization and individuals who are working on the issue.

As indicated by the study made by Addis Ababa City Environmental Protection Bureau in 2008 on three selected industries namely tannery, beverage and paint factory on the level of effluents disposed into the river by comparing the standard with the actual level of Temperature, ph, Suspended Solid (SS), Total Nitrogen, Phosphorus, Ammonia, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Coliform, Fecal Coliform, Heavy Metal, and Chloride. The result shows that (see annex 7, 8, and 9) the majority mean value of the parameter studied were significantly above the minimum standard set by the bureau. For example standard for suspended solid mg/l in paint factory is 250 but the result was 6286.3 which are far reaching the minimum standard set by the bureau.

5.4. Benefits of Urban Agriculture in the City and the Study Area

5.4.1. Economic Role of UA in Addis Ababa

Urban agriculture has been long history in and around of the city of Addis Ababa. It is estimated to about 50-60years long that produce and supply fresh products to the residents. According to Addis Ababa City Urban Agriculture Office, urban agriculture create employment for 3807 vegetable producers, and it benefits more than 14,544 farmers and their family members through cooperative producers, Micro and Small Scale Enterprises (MSSEs), backyard garden and supplementary products in regular crop producer (for the detail please refer on annex 11).

The United States Agency for International Development (USAID) Urban Garden Program, (2010) estimate the contribution of UA production to gross domestic product (based on the information collected from the city bureau of finance and economic development). Accordingly, it was 0.63% in 1988, 0.47% in 2004, 0.37% in 2005 and 0.3% in 2006. Similarly, the contribution of UA to employment was 3.02% of the male and 2.27% of female in 2005 while the share in 2006 was reduced to 0.74% for males and increased to 0.33% for female. In the year 2009 and 2010, the contribution of UA in terms of employment increased significantly where 461 UA based MSSEs were involved employing about 4870 youth , women, youth, the elder and other segments of the city residents in poultry, diary, vegetable, silk, mushroom, fruit, etc production.

Table5.2. Major Commodities Developed by Micro and Small Scale Enterprises

No	Commodity Type	Number of MSSE
1	Poultry	76
2	Diary	112
3	Vegetable	64
4	Fruit	80
5	Flower and fruit Seedling Production	8
6	Park Administration	1
7	Silk	6
8	Mushroom	4
9	Integrated	46
	Total	461

Source: USAID Urban Garden Program (2010)

Urban agriculture in the city support large number of disadvantage groups such as women, the elderly, people living with HIV AIDS through creating employment and sources of income. For instance, People Living with HIV AIDS Vegetable Gardening Association (PLWHAVGA), which has been supported by USAID, established to give an opportunity for those who do not equally compete with others. This association has organized more than 250 members each producing $30m^2$ that contributed in household food security and income of these disadvantaged groups (USAID, 2010). Moreover, almost all traditional cooperatives that grow vegetables along the river bank of Akaki owned and operated by retired people and their family who do not have any means except the farming activity for their income and employment.

5.4.2. Socio-economic Benefits of Vegetable Production in the Study Area

Mekanisa, Gofa and Saris 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. The total numbers of cooperative members, currently, are about 241 households which dependent on income and employment from this activity. Therefore, vegetable production in the study area can create employment for 241 people, from these 201 are male and 40 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 about **13197.77Birr**. The breakdown of each cost and income presented below:

i. Income: The average household income in one season for Ethiopian Collard Green is estimated to be 42,036.23Birr, it is calculated as follows:

- The average production in one season for a hectare is 363.95 quintal
- Each household owned an average 0.6 hectare of land
- So 363.95quintal*0.6hectare = 218.37 quintal of Ethiopian Collard Green
- The selling price for a quintal of Ethiopian Collard Green is estimated to be 192.50Birr (when the market has shortage in Vegetable it costs 250.00Birr and if there is surplus of vegetable production it reduced into 120.00-150.00Birr the estimation is based on interview made with urban farmers in the study area)
- 218.37quintal*192.50birr = **42,036.23Birr**

ii. Expenditure: The estimated total expenditure on producing Ethiopian Collard Green in one season per household is about **13197.77Birr**. The detail breakdown of each expenditure presented below in table5.3.

No	Types of Expenditure	Measurement	Quantity	Unit Price	Total Price
1	Improved seed	Tassa1	9.6	112.00	1,075.20
2	Fertilizer (Uria)	Quintal	2.4	1,000.00	2,400.00
3	Daily laborers	Number	872	40.00	3,456.00
4	Pesticide	Hectare	0.63	2,200.00	1,320.00
5	Transportation	Quintal	218.37	430.53	2,666.67
6	Warehouse renting	Quintal	218.37	510.00	2,183.70
7	Salary for Guard & secretary	In number	3	3*2000Birr /241 households	24.90
8	Maintaining small irrigation dam	Maintaining twice a year		11,000.00/241 households	45.65
9	Tax on land	Paying once a year		12,361.00/2seasons /241 households	25.65
Total					13197.77

Table5.3. Summary of Major Expenditure for Selected Vegetable (in One Season)

Note:
1. a can that have a capacity of 1 litter for liquid substances
2. 29 daily laborers required for 3 days
3. in one hectare an estimated 2,200.00 Birr is required
4. 12.21 Birr for each quintal includes all transport related costs in the whole process of vegetable growing
5. Before the actual selling of vegetables, on average, each quintal of vegetable stored For 2 days

iii. Net Income: The net income generated from Ethiopian Collard Green in one season is calculated as follows:

Total Gross Income (**42,036.23Birr)** – Total Expenditure (**13197.77Birr)** = **28838.46 Birr**

Some of the assumption during the analysis of expenditure includes;

- In each year there are 2 vegetable growing seasons
- Each household have 0.6 hectare of land (the information is collected from Addis Ababa City Urban Agriculture Office i.e. the cooperative have 150 hectare minus 5.4 hectare for utility right of way, expropriation of land by government for public investment, walkway, and a like gives as 144.6 hectare which divided by 241 members)
- The average production of Ethiopian Collard Green in one production season per hectare is estimated to be about 363.95 quintal (this information is collected from Nifasilk Lafto Sub City Urban Agriculture Department) and converted to 0.6 hectare equals to 218.37quintal
- In this analysis family member that contribute as a daily laborer for vegetable production process is not included

5.4.3. Vegetable Type, Amount and Productivity in the Cooperative

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, Baro Onion and Fosoliya. However, the trend (from 2002 up to 2008) shows that there had been a significant variation in terms of the type of vegetable produced and amount of land assigned. For instance, in 2002 Cauliflower grown in 30ha of land, but, it decline to 18ha and 8ha in the year 2007 and 2008 respectively. On the other hand, Lettuce was grown in 15ha of land in the year, but it increased in to 30ha and 40ha in the year 2007 and 2008 respectively. In general, land in hectare assigned to

vegetables like Spinach, Zucchini, Ethiopian Collard Green, Lettuce, and Potato increase in size while Cauliflower, Carrot, Baro Onion, Fosoliya, Sedino, Cabbage and Beetroot decline from year 2002 to 2008.

Tabl 5.4. Vegetable Productivity (Quintal per Hectare) from 2002-2008G.C. for Mekanis, Gofa and Saris Vegetable Producer Cooperative

Vegetable Type	Productivity (Quintal per Hectare) in a Year:							
	2002	2003	2004	2005	2006	2007	2008	Average
Cauliflower	270	276.6	280	275	277	265	265	272.66
Spinach	420	416	420	425	416	420	450	423.86
Carrot	400	397.5	400	380	416	400	400	399.07
Baro Onion	325	320	340	350	333	330	330	332.57
Zucchini	225	230	225	235	222.2	225	225	226.74
Ethiopian Collard Green	350	370	360	365	361	366.6	375	363.95
Fosoliya	160	162.5	165	155	166	170	170	164.07
Lettuce	250	256.67	260	270	277	285	600	314.1
Sedino	220	212.5	225	230	333	225	225	238.64
Cabbage	300	273.33	250	-	-	-	-	274.44
Beetroot	350	300	250	300	-	300	300	300
Potato	-	-	-	350	222	36	250	214.5

Source: Nifasilk Lafto Urban Agriculture Department

The level of productivity (quintal per hectare) for the year 2002-2008 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 improved seeds, inorganic fertilizers, pesticides, 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.

5.4.4. Environmental Benefits of Urban Agriculture

The study conducted in the cooperative indicates that all respondents watering their vegetable with polluted Akaki River and adding natural fertilizer (compost) in addition to artificial fertilizer such as Uria and DAP. These practices contribute a lot in converting urban wastes into productive uses, as a result it reduce the volume of waste generated

in the city. The greening of the city is another contribution of urban agriculture in the city in general and the study area in particular. The city of Addis Ababa is well known in the proliferation of informal settlement in spatially unwanted lands such as steep slope, river buffer and other public open space. But urban agriculture in the study area creates attractive urban greenery by protecting the area with illegal occupation by squatters and open dumping site for solid wastes and open air defecation.

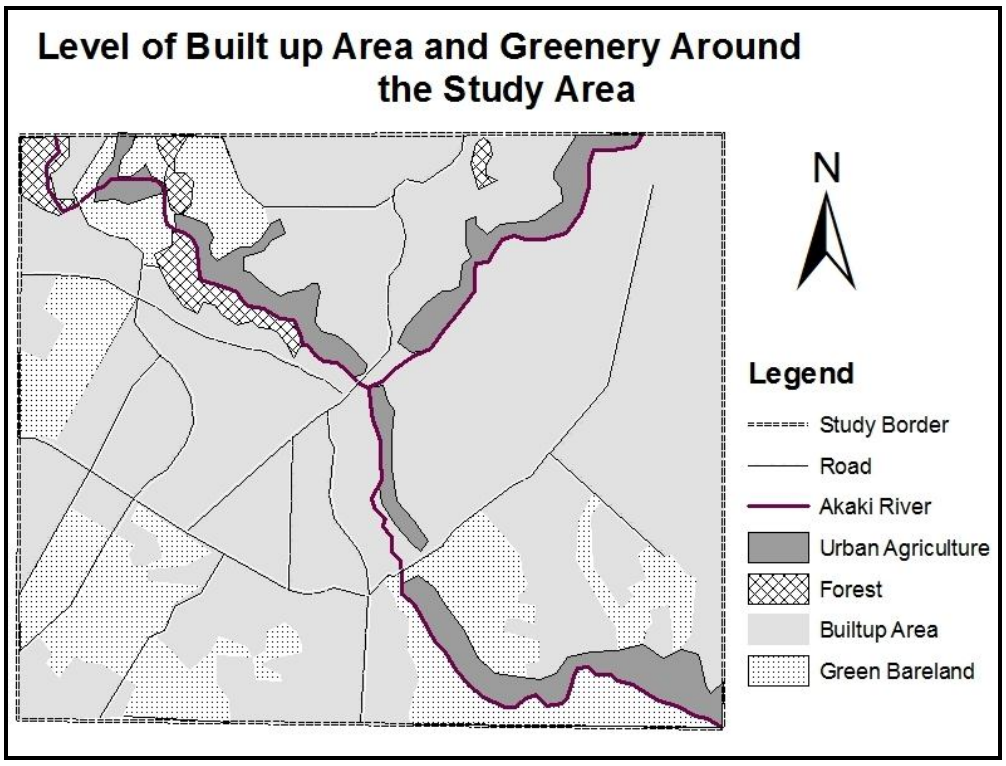


Fig.5.19 Level of Built-up Area and Greenery around the Study Area

According to Veenhuizen (2010) urban agriculture and forestry can also have a positive impact upon the greening of the city, the improvement of the urban micro-climate, the maintenance of biodiversity as well as the reduction of the ecological foot print of the city by producing fresh foods close to the consumers and thereby reducing energy use for transport, packaging, and cooling. Accordingly, UA create an opportunity to home for various specious of plant and animal including birds, eucalypts tree, and shrubs.

Chapter Six: Conclusion and Recommendation

6.1. Conclusion

The result of the study indicates that the majority of urban farmers household heads in the 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.

Additional inputs such as fertilizer, pesticides and improved seeds are crucial to improve the volume of production or increase productivity. Accordingly, all members of the cooperative use natural and artificial fertilizers, improved seeds, and to some extent pesticides. To be effective in increase in productivity, government and NGOs support are critical, however, the support of government organization such as the City and Nifasilk-Lafto Sub-city Urban Agriculture Department are very low. Above all, after all management issues are sort out, marketing of the final product for the farmers will be an issue. The study in the cooperative shows that there have been marketing problem when there is surplus of a particular product in the city, consequently, the revenue generate from vegetable production become decline.

The environmental cost of riverside urban agriculture in the study area associated with river pollution due to fertilizer and pesticide use and erosion of soil due to farming on riverbank and steep slope area are among other. The spatial location of urban farming activities in the study area as well as in the catchment faces various challenges. Informal settlement in reserved area for UA and urban agriculture in proposed area for other uses are the two major problem in the catchment, as a result environmental resources such as forests, soil and the river are endanger.

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 meltilateral international organizations.

A study made by Prabu in 2009 on the level of heavy metal in soil, water and various vegetable shows that the heavy metal content in Akaki water was higher than the natural element levels in freshwater. . Except for Fe and Mn, all other metals (Cd, Cr, Cu, Zn, and Ni) were present above the maximum allowable limits in soil samples. The concentration of Cr in all vegetables was more than the maximum limit. On the other hand information from Addis Ababa City Environmental Protection Authority, in 2010 depicts that level of heavy metal accumulation in water, soil and various vegetables passed the standard set by international development agecny limits.For instance, Water analysis result shows that, Pb, and Fe concentrations exceed the standards. Fe and Ni concentration in soil exceeds the recommended maximum level set for soils. Cr, Fe and Pb level in Cabbage and Lettuce is found to be higher than the recommended maximum level.

.

Although informal occupation of urban farming activities in restricted area has its own impacts, enforcing laws and regulation set by the government can be considered as the root cause of the problem concluded above. For instance, the existing urban farming activities on river buffer area (15m on both sides of river edge) restricted by law, however, farmers britches the law and practically use the area for UA purpose. Moreover, the overall waste management situation makes riverside UA activities in the city more risky. This is because the majority of industries located their plant near to the river and they dispose-off their liquid and solid wastes directly or with drainage into the river without any form of prior treatment, consequently, farmers irrigate vegetables with wastewater which contaminate the product.

There are different types of benefits being generated from the city UA activities. The contribution of urban farming activities in terms of employment creation and income generation are the basic ones. Moreover, the contribution of UA for the city economy and poverty reduction also indispensable. It is also support large number of disadvantage group of the city residents such as women, the elderly and people living with HIV AIDA are among the major ones.

The socio-economic benefits of UA in the study area are not different from what it has in the city. It creates 241 employments for household heads and benefits 2,500 members of their family. The specific case study in one vegetable type namely Ethiopian Collard Green states that the monthly average income generated from UA activities is more than 2,500.00 Birr excluding farmers and their family contribution during the production process. The trend in vegetable productivity in the last ten years indicates that there has been no significant variation in terms of vegetable production in quintal per hectare.

6.2. Recommendation

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.

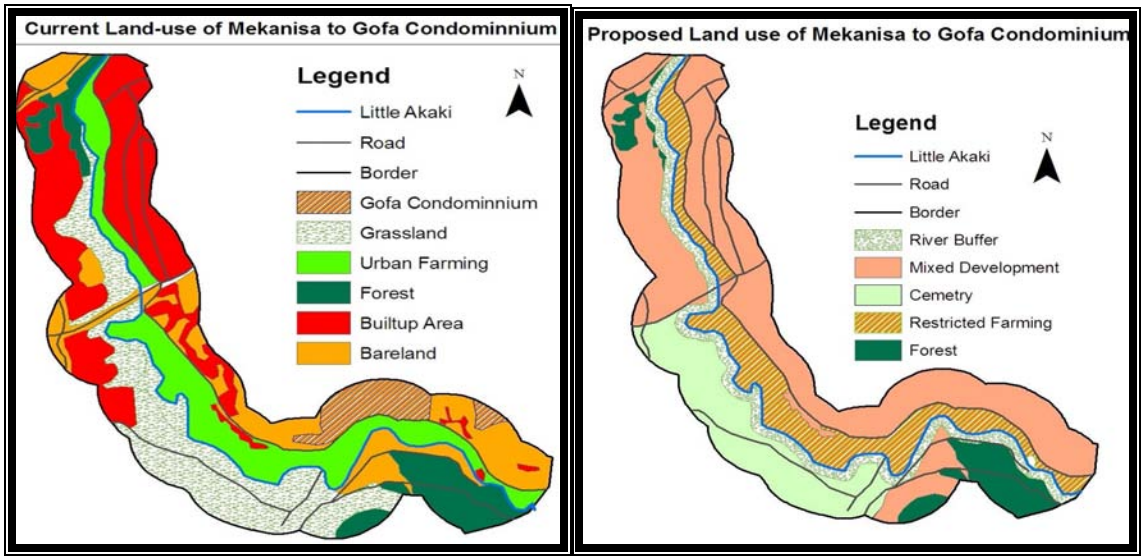
1. The municipality should enforce the proposed land use which set by ORAAMP in 2002 and amened its decision on some sites proposed for UA. This may affect informal urban farming activities undertook in an area proposed to other uses such as riverside buffer zone, area reserved for forests and restricted area for green along river. Squatters will be affected by the aforementioned decision. This is because, they informally occupied land reserved for UA uses. However, to minimize severe social crisis due to forced eviction and resettlement as well as to make socio-economic and environmentally sustainable decision the following solutions were forwarded in the selected sites:

   Site One: From Mekanisa Taxi fermata to Gofa condominium. This area, according to ORAAMP, 2002, reserved for urban forestry, and urban agriculture, however, farmers currently occupied area restricted for urban forestry and growing various types of vegetables. Moreover, the existing land use of the city around Gofa condominium reserved for urban agriculture, but it fail to put in place what type of urban agriculture allowed and prohibited. Both conditions aggravate the state of micro environmental condition of the area.

   Solution: 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 land use from vegetable growing to commercial forestry or other permanent vegetation such as Ensete Ventricosum. In

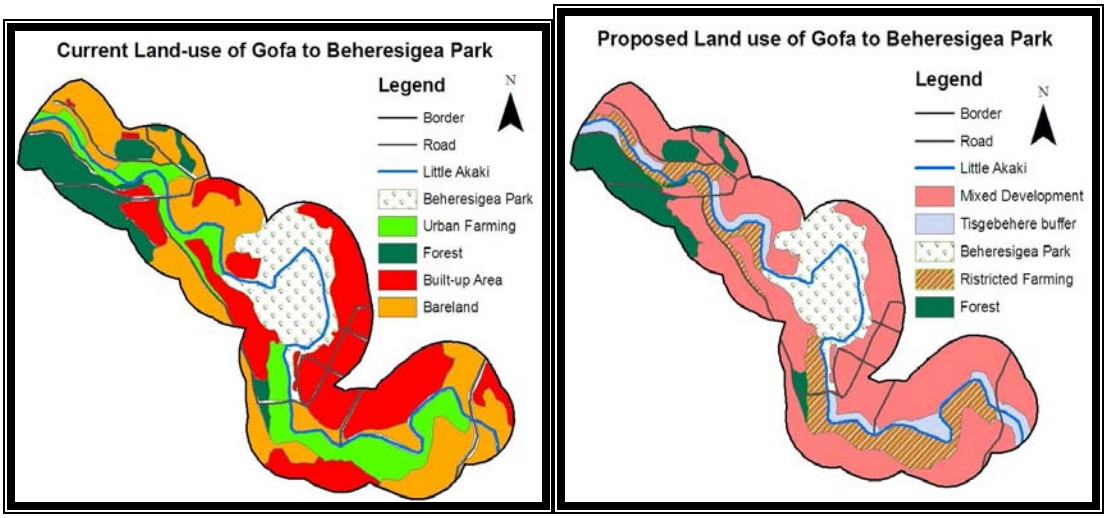
this methods, farmers will owned and growing trees there, but they will be responsible for the whole management issues related with the forest and hence they can sold the tree without significantly affected the density of the forest. Such a solution could not be operational within few years,but unless 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.

Fig.6.1. and 6.2. Proposed and current land use of Mekanisa to Gofa condominium



Site Two: From Gofa condominium to Behere Tsige Public Park and extended to Hana Mariam church. The existing land use proposed the site for riverside recreational area. But the current land use dominated by vegetable growing and to some extent public park and the rest encroched by squatters.

Fig. 6.3. and 6.4. Planned and Current Land use of Gofa to Beheresigea Park



The proposed solution for the above problem is security of tenure transfer to urban farmers, who currently occupied the land, which is taking as the primary solution for the problem. Then after, encouraging farmers to shift other agricultural activities which combining different forms of land use (multifunctional land use) for instance, by combining agricultural land use (in this case different perennial trees) with riverside recreational activities gives a win-win solutions for parties concerned.

Site Three: Located at the central and southwestern part of the catchment. The site, according to ORAAMP, 2002, proposed to UA, however, squatters occupied the southwestern sites and government construct condominium houses at the central parts. The condition in the southwestern parts is not so severe, as the city is not developed there and farmers informally sold the land for squatters.

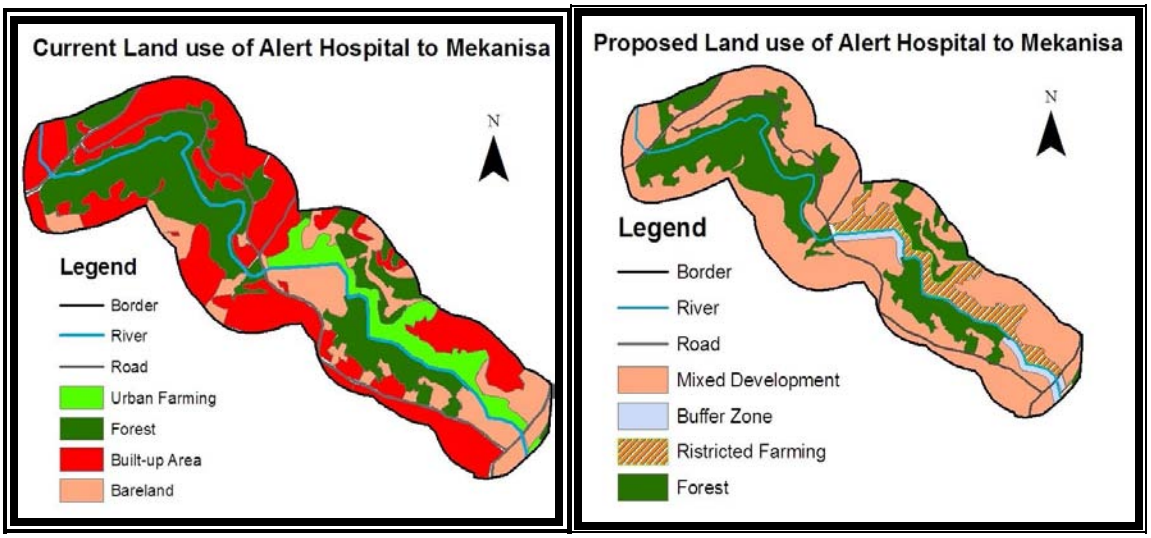
The proposed solution for the problem is, it is not possible to comment on government decision, especially higher level political decision on low cost housing for middle and lower income residents. Informal market on government land requires immediate intervention by the city administration, since, as indicated by many literature and expert from Addis Ababa City Institute of Urban Planning, they are land speculators and the prime motive of squatters in Addis Ababa is profit rather than access to housing units.

Site Four: From Alert Hospital to Mekanisa Taxi fermata. Actually the area is proposed for urban farming activities and the current land use in the area shows that UA and relatively dense forest cover the majority of riverside areas. The biggest challenge in

this specific site is topography which dominated by slope greater than 20%. Proposing the site for UA by the municipality may contradict with ORAAMP standard which set slope greater than 20% protected from development and allowed to use urban forestry.

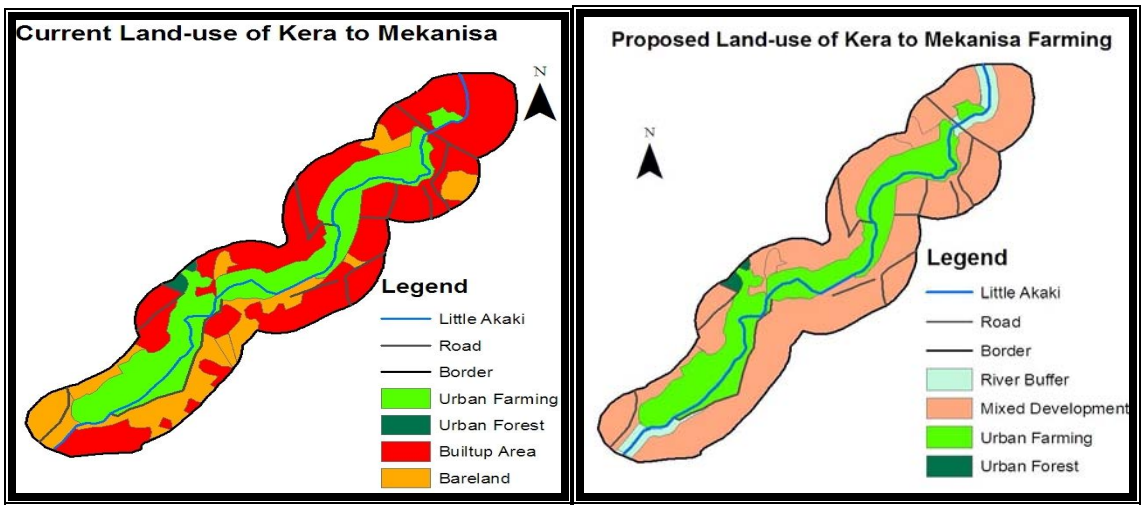
Solution: The potential of the area i.e. availability of forests can be a starting point to change the type of existing agricultural activities undertaken in the area. Accordingly, urban farmers should supported by the city administration and other government and NGOs to change the current vegetable growing (since it exposed the area for soil erosion and sedimentation of river as well as health related risks) into urban forestry with appropriate tenure security and the right to maximize economic benefits from the selling of trees in the area.

Fig. 6.5. and 6.6. Planned and Current Land use of Alert Hospital to Mekanisa `



Site Five: From Kera Slaughter House to Mekanisa Taxi fermata. The existing land use of the city proposed the area for UA. However, the problem is violating the proposed 15m distance buffer zone in the two sides of the river edge and use the area for vegetable production. Moreover, the slope of part of the area is greater than 20% which is not suitable for any uses except reserved for green development. These situations have a potential environmental impact, especially soil erosion, sedimentation of solid substances into the river and river pollution due to fertilizer uses.

Fig.6.7 and 6.8 Planned and Current Land use of Kera to Mekanisa Farming



Solution: Recognizing urban farmers as a user of the area should a better solution for the existing challenges. In addition, encouraging farmers shift from vegetable production into planting commercial trees, and perennial fruits which are permanent and help to minimize environmental problems mentioned above. In terms of income source, they have a huge potential with minimum labor and other input requirementes, since vegetable growing demand day to day management with human and material resource requirments.

2. Addis Ababa City Administration should further clarify what type of UA activities are suitable in what area in addition to recognizing UA as a land use in the city. The structure plan specified 15% of the city land delineated for UA activities, however, it failed to specify in which area what type of UA activities allowed and what type of UA activities prohibited. For instance, there will be health and environmental impacts when leafy vegetable growing allowed near to asphalt road, cattle fattening, rearing, piggery, near to central business district as they have offensive odor, waste management and traffic problems, intensive horticulture and poultry near in an area sources of drinking water (due to the risk of water contamination from use of chemical fertilizers or pesticides).

3. Challenges related with application of artificial fertilizers and pesticides which has negative impacts on water and soil, marketing problems when supply is greater than demand of vegetables in the city, other technical and training gap can be managed through strengthening the capacity and mandates of Addis Ababa UA Extension

Service Core Process. For instance, by cooperating with governmental and NGOs, professional extension expert can make research on consumer preference on vegetables type in different seasons to avoid marketing problem of vegetable products, they also provide professional expertise on fertilizer and pesticide uses without significantly affect the natural environment, and they can also bridge technical gap and training requirements of vegetable producers in the study area.

4. Analysis of the existing waste management practice in Addis Ababa indicates that, there have been serious problem in both domestic and industrial waste management. Moreover, the spatial location of industries and garage exacerbate waste management of the city, as they don't have treatment plant for their wastes and disposed-off directly into the river, consequently, use of the river water for irrigating vegetables has an impact on the natural environment and human health.

   With the aforementioned information, the long term solution for the problem should be rest on the city waste management department. Accordingly, the department should improving its efficiency in collection and disposal especially in liquid wastes with innovative and sustainable method like they did in solid waste collection where payment on solid waste collection is based on the amount of water consumption per month. This method could be better to applied in liquid waste management, as amount of water consumption more explained and relevant with the amount of liquid waste generated in the city.

5. Crop restriction is an option to avoid or minimize the health risk associated with wastewater use for vegetable production. Even if it requires extensive research, negotiation with the existing farmers, commitment from higher level government decision, by restricted irrigation, it is possible to produce many useful and profitable crops, food crops that are processed before consumptions, food crops that have to be cooked before consumption such as potatoes, cabbage, and the like.

   However, this restricted irrigation method is feasible when the following possible measures should be adopted. These are:

   a. A law abiding society and strong law enforcement exist, so it is expected a lot from those who promulgate law and enforcing it.

b. A strong central management unit that control irrigation project especially at the sub-city level, with full of institutional arrangement in the hierarchy.
c. Planners and designers of restricted irrigation schemes engage with local farmers early in the planning process to consult them and determine what restricted crops can be grown at a reasonable profit.

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Annex 1. Questionnaire to be Answered by Urban Farmers in the Cooperative

Dear respondents,

This questionnaire is designed to make a study on Challenges and Prospects of Riverbank UA (The Case of Mekanisa, Gofa and Saris Vegetable Producer Cooperative). Therefore, your genuine cooperation in answering the questions listed below will be of a great importance to the study.

Thank You!

Answer the following questions in the box provided on each options by putting "X" sign in your choice.

1. Sex of household heads
   ☐ Male ☐ Female
2. Marital status
   ☐ Married ☐ Single ☐ Divorced ☐ Widowed
3. Family size
   ☐ One ☐ Two ☐ Three ☐ Four ☐ Five and above
4. Educational level
   ☐ Illiterate ☐ Only read and write ☐ Elementary
   ☐ High school completed ☐ College or university graduate
5. Do you have any other job other than farming activity in the city?
   ☐ Yes ☐ No
   5.1. If your answer is yes what is your occupation?
   ☐ Public employed ☐ Self employed ☐ Private formal employment
   ☐ Unemployed ☐ Retired
6. How many times you grow vegetables within a year?
   ☐ One ☐ Two ☐ Th ☐ Four
7. What are the major vegetable types growing in the farm? Please list at least four vegetable types

   _____ _____

   _____ _____
8. How much money do you earn during one farming season from vegetable?
9. Did you get enough money from the sale of vegetable in the market?
   ☐ Yes ☐ Sometimes there are marketing proble ☐ No

10. Did you get enough market for your product?

☐ Yes ☐ Sometimes there are marketing proble☐ No

11. What agricultural equipment you use during irrigating vegetables? (you can select more than one choice)

☐ Small pond ☐ Water pumping machine☐ Different hand tools

Other Please specify_____

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

☐ Yes ☐ No

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

13. What type of irrigation method use?

☐ Surface irrigation☐ By using can ☐ Water pumping machine

14. What additional input used to grow vegetables? (You can choice more than

☐ ☐ ☐ ☐

Pesticide Natural fertilizer Artificial fertilizer Herbicide

Other, Please specify _____

15. What security method you use while irrigating vegetable with wastewater?

☐ Hand glove ☐ Plastic shoe ☐ Treating wastewater before using ☐ Washing with clean water after harvesting

Other, please specify

_____

16. Do you face any health problem related with wastewater use for vegetable ☐ing? ☐

Yes No

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

_____

_____

_____

17. Have you ever got government support for your vegetable growing activity?

☐ Yes ☐ No

18. Did NGOs give you support for your activities?

☐ Yes ☐ No

Annex 2. Interview Questions to Mekanisa, Gofa and Saris Vegetable Producer Cooperative Officials

1. What is the background of the cooperative? (it includes naming, establishment, number of cooperative, etc)
2. What is the total size of cooperative land in hectare?
3. What are the main challenges frequently happen in the cooperative in relation to farming activities? What measure you took to overcome such challenges?
4. What protective measure use while you use wastewater for watering vegetable? How was it is effective?
5. How frequent flooding was happened in your farm? What is the extent of damage?

   What protective method you use to alleviate the challenge?
6. What are the marketing access and other related situation of your products?
7. What is the cost of:
   - ❖ Improved seed in a hectare for different vegetables?
   - ❖ Constructing, maintaining and operating small diversion dam in a year?
   - ❖ Artificial fertilizer and pesticide in a hectare?
   - ❖ Daily laborer for a hectare per day for an individual
   - ❖ Transporting the vegetable and fertilizer in one season?
   - ❖ Renting warehouse to store vegetable per day per quintal?
   - ❖ Monthly salary for permanent employees?
   - ❖ Yearly tax on land?
8. What is the amount of vegetables in quintal per hectare?

9. At what price did you sold your vegetable product for consumers?
10. What amount land in hectare expropriated by government for development uses? How do you explain the processes and the compensation?

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

1. Is the cooperative recognized 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 DA 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. Did the 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. What alternative agricultural products urban farmers produce to minimize health risk associated with vegetable products based on technical support from the office?
6. Did the office support urban farmers in the construction, operation and maintenance of small dam to divert the river water into their farms?
7. What technical support the office delivered to minimize environmental impacts and health risk due to the use of pesticide and artificial fertilizers?
8. What is the yearly product of vegetable type in quintal per hectare?
9. What is the productivity of different vegetables per hectare?

Annex 4. Interview for Addis Ababa City Environmental Protection Authority

1. How many manufacturing industries are available in the city?
   1.1. From these how many of them are established alongside of river?
   1.2. From these factories how many of them are treat their wastes before disposal?
   1.3. What are the biological and chemical pollutants that have been disposed off directly into the river by the factories?
2. Did the authority study or applied any agricultural products other than vegetables to protect the public and job security for urban farmers?
3. How the authority administer buffer zones which legally assigned to administer by the city administration?
4. What technical support provide the authority to urban farmers growing vegetable along Little Akaki River?
5. What is the authority role/contribution to minimize health and environmental impacts of vegetable production by using untreated wastewater?
6. What is the role of the authority to make environmentally friendly vegetable production along river buffer and steep slope area?
7. Is there policy or guideline that prohibit or allow to use wastewater for irrigation purpose
8. Is there a guideline that prohibit development along riverside to protect river pollution
9. Is there a guideline that enforces industries to treat their wastes before they discharge into the natural environment?
10. Is there any awareness or training program that give to farmers who produce vegetables along Akaki river
11. What is the proportion of leaded gasoline that used by vehicle in the city?
12. How is your organization collaborate with other respective institution which directly or indirectly influence the healthy functioning of the natural environment and human health due to UA activity

Annex 5. Interview for Addis Ababa City Urban Agriculture Department

1. How many urban farmers are available in the city?
   1.1. From these how many of them are organized through the office?
   1.2. From these how many of them are growing vegetable along Little Akaki River?
   1.3. Do you have list of names of urban farmers operated in Mekanisa, Gofa and Saris Vegetable Producer Cooperative?
2. What is the share of vegetable production which produced by urban farmers that supply to the city?
3. Which vegetable is most common that have been grown in the city?
4. What is the contribution of UA for the GDP?
5. What proportion of the city residents engaged in UA activity?
6. Did the organization studied whether wastewater use for UA increase or decrease vegetable productivity
7. How is your organization collaborating with other respective institutions which directly or indirectly influence the healthy functioning of the natural environment and human health due to UA activity?
8. In what area your institution support urban farmers that are operated in the city? How?
   8.1. Organizing them
   8.2. Providing training on improving farming practice as well as financial management
   8.3. Facilitating access to credit facility
   8.4. Better market access
   8.5. Aid in kind
   8.6. Other (please specify)_____

Annex 6. Interview with Addis Ababa City Administration Urban Planning Institute

1. What is the minimum width of buffer zone for water bodies in the city? Is it applicable and enforced in the city?
2. What measure did the organization to take to enforce buffer zone in the city?
3. What type of development are allowed/prohibited along river? At what distance? Why?
4. Is there zoning regulation that certain types of urban agriculture are allowed and other types are excluding in order to reduce health and environmental risk?
5. Is the institute take proactive measure to protect the environment especially the river system in the city?
6. Is zoning regulation of the city help to protect environmental resources especially river?
7. Is the current urban planning practice of the city compatible to protect the river with other uses/development?

Annex 7 Effluent from Tannery Industry Disposed off Little Akaki River

Parameter Analyzed	**Measurement**	**Mean Value**	**Standard**	**Deviation**
Temperature	$_0$C	19.4	40	<20.6
pH		7.75	6-9	Within the limit
Suspended Solid	mg/l	6286.3	250	>6036.3

SS)				
COD	mg/l	66.7	80	<13.7
BOD	mg/l	3135.8	100	>3035.8
Cadmium	mg/l	0.0031	1	<0.9969
Lead	mg/l	15.4	0.5	>14.9
Zinc	mg/l	0.9	5	<4.1
Chromium	mg/l	0.9	2	<1.1

Annex 8 Effluent from Beverage Factory Disposed off Directly to Little Akaki River

Parameter Analyzed	Measurement	Mean Value	Standard	Deviation
Temperature		28.5	40	<11.5
pH		6.9	6-9	Within the limit
Suspended Solid SS)	mg/l	431.8	50	>381.8
Total Nitrogen (as N)	mg/l	74.3	40	>14.3
Total Phosphorus (as P)	mg/l	18.3	5	>8.3
Total Ammonia	mg/l	2.9	20	<17.1
COD	mg/l	10913.25	250	>10663.25
BOD	mg/l	1260.5	60	1200.5
Total Coliform	CFU/100ml	$504.9*10_9$	400	
Fecal Coliform	CFU/100ml	$630.2*10_2$	400	

Annex 9. Effluent from Paint Factory Disposed off Little Akaki River

Parameter Analyzed	Measurement	Mean Value	Standard	Deviation
Temperature		25.2	40	<14.8
pH		7.2	6-9	Within the limit
Sulfide	Mg/l	78.9	1	>77.9
Total NH3 (as N)	Mg/l	34.8	30	>4.8
Suspended Solid SS)	Mg/l	851.6	50	>801.6
Total Nitrogen (as N)	Mg/l	268.5	60	>208.5
Total Phosphorus (as P)	Mg/l	44.9	10	>34.9
Chloride	Mg/l	3261.8	1000	>2261.8
Chromium	Mg/l	268.9	2	>266.9
COD	Mg/l	1930.7	500	>1430.7
BOD	Mg/l	661.2	200	>461.2

Annex 10. UA along Riverbank in Addis Ababa with Irrigated area in Hectare

Name of the Scheme	River Name	Districts	Irrigated Area (ha.)	Beneficiaries (hhs.)			Irrigation System
				Women	Men	Total	
Shankla Ena Kacha Fabrica	Shankla	Cola Cola Fabrica	8.5	11	41	52	Surface
Tinishu Akaki & Keranio	Tinishu Akaki	Keranyo	7.5	3	23	26	Surface
Mekanisa, Gofa and Saris	Tinishu Akaki	Goffa Seffer	150	40	204	244	Surface
Kebena Ena Bulbula	Kebena & Bulbula	Peackock Park	7.5	6	25	31	Pump
Kolfae Ena Lideta	Tinishu Akaki	Kolfae	51	17	92	109	Surface
Fanta	Akaki	Akaki	10	-	28	28	Surface
Mekane Brhan Tesfa	Akaki	Akaki	12	45	20	65	Pump
Mekana Yersha Limat Abat Turetengoch	Akaki	Akaki	5	5	17	22	Surface
Fnote Selam	Akaki	Akaki	5	5	60	65	Surface
Abat Enat Turetngoch	Akaki	Akaki	5.5	99	126	225	Pump
Chello	Akaki	Akaki	4	90	-	90	Pump
Bole Lemi	Akaki	Bole	4	20	-	20	Pump
Other Small Hollders	Especially Tinishu & Tilku Akaki	In all Sub-cities	119.5	100	497	597	Surface
Total			**389.5**	**441**	**1133**	**1574**	

Number of Producers Households | Types of Production | Number of Beneficiaries | Farmin g Size | Remark

Annex11. Types and Number of Vegetable Producers in Addis Ababa

	Male	Female	Total	Male	Female	Total		
1. Cooperative Association 1.1. Traditional Cooperative 1.2. Cooperatives Established after 2003	1007 589 418	792 368 424	1799 957 842	4593 1887 1761	5820 2630 2199	9293 4517 3960	277.68 262.00 15.68	Organized through MSSE
2. Vegetable Producer Association	70	101	171	340	259	599	1.53	Not Organized MSSE
3. Vegetable producer on their crop farm	264	270	534	840	938	2078	47.12	
4. Vegetable Producer on their compound	326	977	1303	1282	1242	2574	5.66	
Total	**1677**	**2140**	**3807**	**7055**	**8259**	**14544**	**331.99**	

Vegetable	2002	2003	2004	2005	2006	2007	2008

	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal	Land (hec.)	Product Quintal
Cauliflower	30	8100	30	8300	25	7000	28	7700	25	6925	18	4770	8	2120
Kosta	25	10500	25	10400	30	126000	32	13600	30	12480	30	12600	30	13500
Carrot	20	8000	20	7950	15	6000	10	3800	12	4992	10	4000	3	1200
Baro Onion	15	4875	15	4800	10	3400	8	2800	10	3330	8	2640	8	2640
Zikuni	10	2250	10	2300	12	2700	12	2820	15	3330	12	2700	12	2700
Ethiopian Collard Green	10	3500	10	3700	20	7200	22	8030	12	4332	24	8800	35	13125
Fosoliya	12	1920	12	1950	8	1320	8	1240	8	1328	8	1360	8	1360
Lettuce	15	3750	15	3850	20	5200	20	5400	30	8310	30	8550	40	24000
Sedino	8	1760	8	1700	6	1350	6	1380	4	1332	4	900	2	450
Cabbage	3	900	3	820	3	750	-	-	-	-	-	-	-	-
Beetroot	2	700	2	600	1	250	-	300	-	-	1	300	1	300
Potato	-	-	-	-	-	-	3	1050	4	888	5	180	3	1050
Total	**150**	**46255**	**150**	**46440**	**150**	**47770**	**150**	**48120**	**150**	**47247**	**150**	**48500**	**150**	**62445**

Annex 12. Vegetable Types & Amount of Production in Hectare in the Cooperative