Impact of Urban Agriculture on Poverty Reduction among Households in Hossana Town of Hadiya zone, Southern Ethiopia

A Thesis Submitted to the School of Graduate Studies of Jimma University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Economics (MSc)

By:

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JIMMA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

JUNE, 2017

JIMMA, ETHIOPIA

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As member of the Examining Board of the Final M.Sc. Open Defense, we certify that we have read and evaluated the thesis prepared by: Abraham Tessema entitled*: Impact of Urban Agriculture on Poverty Reduction in Hossana Town of Hadiya Zone, Southern Ethiopia* and recommended that it be accepted as fulfilling the thesis requirement for the degree of Master of Science in Economics (Economic Policy Analysis)

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the Council of Graduate Studies (CGS) through the Departmental Graduate Committee (DGC) of the candidate's major department. I hereby certify that I have read this thesis prepared under my direction and recommended that it be accepted as fulfilling the thesis requirement.

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Biography Sketch

The author was born on February6, 1984 in Kufana rural kebele of Duna Woreda in Hadiya zone, Southern Ethiopia. He attended his elementary junior and senior secondary education at Amacho Wato elementary junior and secondary school and Wachemo Comprehensive Senior Secondary School respectively. After successful completion of his high school education, he joined Jimma University, Ambo College of Agriculture for his Diploma and graduated in June, 2003.After graduation, he served as an agricultural supervisor and coordinator at Gumer woreda Agriculture and Development office, Gombora Woreda Agriculture and Development from year 2005 to 2015.Indeed; he attended his BSc degree in Agro-economics at Haramaya University from year 2007 to 2011 in summer program. By the year 2016, he joined Jimma University, school of graduate studies to pursue his M.Sc. degree in Economics (Economic policy Analysis).

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ACRONYMS and ABBREVIATIONS

AIDS	Acquired Immune Deficiency syndrome
ATT	Average Treatment effect on the Treated
CM	Caliper Matching
CSA	Central Statistical Agency
GDP	Gross Domestic Product
HICE	Household Income, Consumption and Expenditure
HIV	Human Immune Deficiency Virus
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
KM	Kernel Matching
NGOs	Non-Governmental Organizations
NNM	Nearest Neighborhood Matching
PPS	Probability Proportional Sampling
PSM	Propensity Matching Score
RUAF	Resource Centers on Urban Agriculture and Food security
SDGs	Sustainable Development Goals
SNNPR	Southern Nations, Nationalities and peoples' Region
UA	Urban Agriculture
UPA	Urban and Peri-Urban Agriculture
UN	United Nations
US	United State
WFP	World Food Program
WM	Welfare Monitoring

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Abstract

Urban agriculture is the production of food and non-food items within the urban area and its periphery, for home consumption and/or for the urban market. Although urban agriculture has a significant impact in fulfilling the basic demand of low-income households, it still lacks proper consideration and the right full place for policy-makers, urban planners, and authorities. This study tried to evaluate the impact of urban agriculture on poverty reduction at household level in Hossana Town using cross-sectional data obtained from 176 urban households selected from three kebeles. Factors affecting households' participation in urban agriculture were identified using binary logit model while propensity score matching was used to evaluate the impact of urban agriculture on poverty reduction (by using proxy consumption expenditure and asset building). Furthermore, this study also examined the extent of participation of urban households in urban agriculture with the help of secondary data. The binary logistic result revealed that variables such as household size, income from other sources, access to credit, access to water, access to extension services and access to the improved inputs significantly enhanced participation of urban agriculture practice except for income from other sources. The results from the propensity score matching showed the participation of urban agriculture practice has a robust and positive effect on urban households' consumption expenditure per adult equivalent per month and asset building per capita. The average treatment effect on the treated (ATT) was 432 and 1.1; Ethiopian Birr and unit respectively for consumption expenditure per adult equivalent and assets building per capita, increase for participants as compared to non-participants, indicating that efforts to promote existing urban agriculture practice will contribute to poverty reduction among urban households. According to the findings of this study, major determinants are very important in determining households to participate in urban agriculture or not and urban agriculture has a significant positive impact on poverty reduction. Therefore, urban agriculture practice should be encouraged by Government and Non-government organizations through provision of credit, farm inputs, and extension services in order to increase its production thereby reducing poverty among urban households so that it can be taken as an alternative poverty reduction policy strategy.

***Keywords**: binary logit model, Ethiopia, Hossana Town, propensity score matching, urban agriculture, urban poverty*

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Urban agriculture has been experienced in the world for thousands of years and the majority of poor urban households in developing and developed countries have been engaged in urban agriculture to escape from poverty and generate income for their livelihoods. It is estimated that 200 million urban inhabitants produce food for the urban market, and urban agriculture contributes 15 to 20 percent of the world's food (Armar-Klemesu, 2000; De Zeeuw & Marellie, 2009).

The mismatch between the increasing urban populations and the availability of employment opportunity in industrial or manufacturing sectors, and in the lack of formal jobs in many African cities; urban agriculture considerably served as an important source of employment for the urban poor and urban agriculture created vital employment opportunity for urban people (Zezza & Tasciotti, 2010; Arku, Mkandawire, Aguda, & Kuuire, 2012).

According to Lamba(1993), urban agriculture is the final sequence of survival strategies exhibited by households in Ethiopia. Households in the urban areas react to the extreme threat from poverty by moving out urban farming on any vacant space available. Urban agriculture is also practiced because of lack of income and being without a job of the urban centers. Besides, urban agriculture has also been considered as a contributor to improved nutritional levels among the urban poor in Ethiopia. The majority of the urban population of Ethiopia comprises of the poor who cannot afford to buy high-valued food stuff.

Nevertheless, the ability of urban agriculture to endlessly supply food for the urban poor depends on better planning based on accurate geospatial information to enable sustainable management of the practice (Addo, 2010).

Urban agriculture's ability to do so in general and its sustainability in particular; however, is being threatened by the population rises due to natural and rural-urban migration, coupled with an urban sprawling and infrastructure developments that are competing with urban farming for available space and scarce resources such as water for irrigation(Gittleman, 2009).

Poverty in Ethiopia manifests in a number of ways and this, in fact, is attributed to a multitude of interrelated factors. Getahun(2002), for example, has identified these factors as the insufficient source of income, lack of asset/skill, poor health status, poor educational level and backward attitude of people towards work. These factors in one or another way have a direct or indirect effect on the life standard of the people. For example, lack of income results in the reduction of expenditure pattern, poor health leads to being unproductive, absence from work, less energetic, lack of education results in a lack of skill, helplessness and so on.

According to the results obtained from the 1999/2000 Household Income, Consumption and Expenditure (HICE) and Welfare Monitoring (WM) Surveys of the Central Statistical Agency (CSA), about 44 percent of the total population (45% in rural and 37% in urban areas) were found to be below poverty line, while the results of the 2004/05 surveys revealed that about 39 percent of the total population (39.3% in rural and 35.1% in urban areas) were found to be under the poverty line(CSA, 2012).For example, consumption/ expenditure on food and non- food essentials was lowest among households living in SNNPR and Amhara. In SNNPR more than a quarter of households (26%) fell into the lowest consumption/expenditure quintiles while in Amhara, 22% were in the lowest quintiles (WFP, 2014)

According to CSA (1994), migration is the movement of people, which necessarily involves along lasting change of residence. In Hossana town, about 38.8 percent of the total populations were in–migrants of which 46.5 percent were from under areas and 53.5

percent are from rural areas. Moreover, Hossana town has relatively high population density i.e. about 2484persons per square kilometers (Ashenafi, 2015). Therefore; rural-urban migration is one of the most important factors, which contribute to the most population increase so that urban-rural migration jointly with population density aggravates poverty and unemployment.

Recently; however, there are encouraging urban agricultural practices. Ethiopia is one of the developing countries which have set the implementation of urban agriculture for the city/ town dwellers to escape from urban poverty (Dereje, 2011).

Lastly but not least poverty is one of key problem of many households in Hossana town. The livelihoods of them mainly depend on food from the rural farmers. The existence of more than 5530 participant households is engaged in urban agriculture which is one of survival strategy, as a source of employment and away to reduce poverty in town (Hossana Town Agriculture Development Office, 2016).

Cognizant of this fact, this research has intended to study the impact of urban agriculture on poverty reduction. In particular, it is focused on the extent of participation, determinants of participation in urban agriculture and impact of urban agriculture on poverty reduction among households in Hossana of Hadiya zone.

1.2. Statement of the Problem

About one-quarter of the developing world's poor live in urban areas, but also that poverty is becoming urbaner and that the poor are urbanizing faster than the population as a whole(Ravallion, Chen, & Sangraula, 2007).

Poverty is the general feature for the nation and causing much sufferings and anguish to the largest proportion of the population in Ethiopia. It is high agenda of the government, donor agencies, NGOs and other actors that have the inspiration to reduce the level and mitigate the effect and it associated impacts on the wellbeing of the people. The Ethiopian government has been formulating and implementing various policy interventions and programs that are in one way or another related to poverty reduction. Yet most efforts are biased towards rural areas (Esubalewu, 2006).

Though in absolute terms poverty is still a rural phenomenon, there is currently a diffusion and growth of urban poverty. The number of urban poor is increasing at an unprecedented level that might be fueled by the highest rural-urban exodus and alarming internal population growth. In the meantime, the urban economy has limited capacity to accommodate the unprecedented population explosion (Ibid).

Hosanna is the political, economic and socio-cultural center of Hadiya zone administration following this, the proportion of migrants from rural to urban and other urban centers were high and increased from time to time. Furthermore, many of the dwellers have low income in Hosanna (Solomon, 2014).

Urban home gardening, as unlike to other larger forms of agricultural production in the city or to home gardening in rural areas, is a particularly undocumented phenomenon and its impacts remain understudied (Henn & Henning, 2002; Redwood, 2009). Urban agriculture is a direct action against hunger which contributes to poverty reduction. It should strongly be promoted to address the sensitive foodscarcity problems of urban communities of Ethiopia (Dereje, 2011). In this regard, there are households who practice urban agriculture within Hosanna town and around it. These families have been using urban agriculture produces to lead their livelihood and sometimes to make some extra profit from the market (Hossana Town Agriculture Development Office, 2016).

There have been some previous related studies on urban agriculture and poverty reduction. These studies include the linkage between poverty and urban agriculture (Drakakis-Smith, Bowyer-Bower, & Tevera, 1995; Egziabher, 1994), the contribution of urban agriculture to urbanhouseholds or household poverty reduction(Simeon, 2008;Belete, 2015)and food security contributions of urban agriculture (Endale, 2011). Most of them have used only descriptive analysis to assess the contribution of urban agriculture to poverty reduction so that it is not adequate. Moreover, their findings showed that urban agriculture is a source of income, food supply (for self-sufficiency), employment creation and environmental protection; however, they didn’t reveal

explicitly the impact of urban agriculture on poverty reduction. Thus, little is known about its impact on poverty reduction in urban households.

However, particularly the impact of urban agriculture on poverty reductionhas not yet studied by any researcher in the study area. Therefore, this study tries to fill the research gap by evaluating the impact of urban agriculture on poverty reduction among households. Moreover, it also in depth identifies the factors affecting the participation of urban households and examines the extent of participation of urban households in urban agriculture in Hossana town of Hadiya zone.

1.3. Research Questions

What is the extent of participation of urban households in urban agriculture?

What are factors affecting the participation of urban households in urban agriculture?

What is the impact of urban agriculture on poverty reduction?

1.4. Objectives of the Study

1.4.1. General Objective

The general objective of the study is to evaluate the impact of urban agriculture on poverty reduction among households in the study area.

1.4. 2.Specific Objectives

- To examine the extent of participation of urban households in urban agriculture
- To identify factors affecting the participation of urban households in urban agriculture
- To evaluate the impact of urban agriculture on poverty reduction

1.5. Significance of the Study

Urban agriculture has the potential to be the country's main means of achieving food security and economic wellbeing, and it deserves the attention of policy-makers. The outcomes of the study can be used as input for policy makers and urban planners to consider urban agriculture as an option for livelihood as well as an employment opportunity for urban communities. The results of this study also contribute to the

qualitative and quantitative knowledge base to farmers, individuals and associations who wants to invest in urban agriculture, and field workers. This research is expected to have an important role in filling the knowledge gap in this area and motivate future researcher.

It is believedfurther evidence and literature for those researchers who have the interest to conduct a study related to this topic. It also extends to set urban agriculture policy intervention and strategy to employment opportunities, income generation, and poverty reduction. Urban agriculture is the source of income and food for many urban communities particularly for those who have low earnings. This sector contributes to employment, access to nutrition, food subsistence, and poverty reduction.

1.6. Scope and Limitation of the Study

Geographically, this study concentrated in Hadiya zone, particularly in Hossana town. Its scope delimited to the urban households and the environs in *kebeles* of Hossana town. It is difficult to capture household consumption expenditure change and assets building change over time since it is cross-sectional study.

Also, this study does not show the linkage between urban agriculture and rural agriculture on poverty reduction as it is highly concentrated on urban agriculture and its impact on poverty reduction. Moreover, the study of this research, the researcher has encountered number of limitations. Some of the challenges lack relevant and related data; some of the respondents have not interested in answering the questions at the time of interview and shortage of time and financial constraints.

1.7. Organization of the Thesis

The thesis is composed of five chapters which are systematically constructed and put in such a way that the information is flown coherently.

The first chapter is the introduction which includes the background of the study, statement of the problem, research questions, the objectives of the study, the significance of the study, scope and limitations of the study, and organization of the thesis. The second chapter is literature review that describes the conceptual framework for urban agriculture and poverty and related literature review. The third chapter deals with the

methodology of the study including the description of the study area, the population of the study, research design, data and data Sources, sampling techniques and procedure, and sample size determination, a method of data collection, data analysis methods and techniques, and model specification. The fourth chapter explains results and discussions. The fifth chapter describes conclusions and recommendations. The remaining parts of this thesis are references and appendices.

CHAPTER TWO

LITERATURE REVIEW

2.1. Related Literature Review

2.1.1. Concepts of Urban Agriculture and Poverty

2.1.1.1. Urban Agriculture

Urban agriculture can be expressed as growing of plants and the raising of animals for food and other uses within urban and peri-urban areas, and related activities such as production and delivery of inputs and the processing and marketing of products (DeZeeuw, 2004).

Urban agriculture is remained one under-appreciated avenue to get better urban food security. Most of the municipal authorities in several cities still do not recognize how to include support for urban agriculture into planning or remain concerned about environmental effects. Municipal governments should expand an appropriate legal and regulatory framework that facilitates urban agricultural activities moves them into the proper economy and addresses food safety and health concerns raised by unclean production practices in urban and peri-urban areas. Authorities should formulate policy through a review process that engages all stakeholders, including urban farmers, consumers, and marketing agents (Cohen & Garret, 2009).

Urban Agriculture (UA) comprehends production, processing, and distribution activities within, around cities and towns, whose core motivation is personal consumption and/or income generation. Also, urban agriculture competes in order to get scarce urban resources of land, water, energy, and labor that are in demand for other urban activities. Urban Agriculture is located within or on the fringe of a city or peri-urban and comprises of a diversity of production systems, ranging from subsistence production and processing at the household level to fully commercialized agriculture (Veenhuizen, 2006).

Urban agriculture contributes to local economic development through boosting urban poor asset base, increasing income, reducing poverty, and including the urban poor and

women into mainstream economic activities (Jongwe, 2013). In Ethiopia; however, the urban poor accomplish urban agriculture on land in transitional use and where usufruct rights are at issue. Thus, this problem leads to low investment in urban agriculture then poor productivity (Lamba, 1993).

2.1.1.2. Defining and Measuring Poverty

A. Concept of Poverty and Operational Terms

Poverty is a multidimensional concept that can be defined as a pronounced deprivation in well-being. However, its operational terms in this study are a lack of consumption and lack of assets (durable assets).

The World Bank states poverty as a 'pronounced deprivation in well-being' (World Bank, 2000). Such a definition, however, raises the vital question of what 'well-being' is and also how it should be measured. There is an arrangement of approaches that address this issue exists, with a significant conceptual distinction being that between the 'welfarist' and 'non-welfarist' approaches (Ravallion & Biden, 1994).The 'welfarist' approach measures well-being solely on utility information, resulting from the preferences of individuals. The non-welfarist approach, on the other hand, bases the evaluation of well-being (welfare) on the attainment of certain basic achievements, such as food, clothing, and shelter.

The distinction between the two methods can be explained by considering the case of two individuals, in which the first is much poorer (among other things) in food, clothing, shelter and medical attention than the second, but is nevertheless happier (Sen, 1985). The welfaristmethod, noting that the first individual is happier than the second, will consider the first to be better off. But according to the non-welfarist method, it is the second individual who is enjoying a higher well-being.

Sen(1979) claims that the neglect of non-utility information makes welfare too restrictive (Ng, 1981).The non-welfarist approach tries to answer this criticism by concentrating on the satisfaction of basic needs deemed necessary for a good standard of living. Therefore, the identification of specific forms of commodity deprivation (both absolute and relative)

becomes crucial, and the well-being of individuals is evaluated by such measures as income, nutrition, and health. Ravallion, however, says that '... (A) nagging worry about these approaches has been arbitrariness in deciding what commodities matter and (when necessary) how one should value one against another…' (Ravallion,1994).

Another conceptual definition of poverty and well-being, which does not accept both utility and commodity based measures, is found in the seminal works of Sen(1985, 1990). Sen(1985) says that well-being depends on what kind of life a person is living, and what he/she is succeeding in 'doing' or 'being'. Accordingly, well-being is seen from the perspectives of 'functioning' and 'capabilities'. 'Functioning' is an achievement and 'capability' is the ability to achieve. 'Functioning' is linked to the state of existence of a person such as whether a person is well nourished, clothed, educated or participates in society without shame. On the other hand, Capability has to do with an individual's freedom in the choice of their life and 'functioning'. It suggests that a poor person may be considered as one with low capabilities.

Regardless of the different conceptions of poverty and well-being highlighted above, most empirical studies solely consider the satisfaction of material needs by defining a basket of goods necessary to sustain a minimum standard of living. Thus, income and consumption expenditure have been the preferred and most widely used measures of well-being (Ravallion & Huppi, 1991; Ravallion & Biden, 1994; Sahn & Nino, 1994).Such an approach has the benefit of empirical tractability; however, it ignores the multi-dimensional nature of poverty.

In countries where a reliable income data can be found, income has frequently been used to conduct poverty and welfare analysis. However, the generally preferred indicator of welfare has been consumption expenditure, in part because of the unpredictability of income. Income may fluctuate in an unpredictable manner, making it a 'noisy' indicator of welfare. Consumption tends to be not as much of volatile as income because consumption smoothing opportunities such as saving, borrowing, and community-based risk sharing are available to the poor. This proposes that current consumption, relative to current income, is a better indicator of both current and long-term standard of living (Ravallion, 1994; Lipton & Ravallion, 1995; Deaton, 1997).

Another consideration in poverty analysis relates to the fact that measures of consumption are commonly available at the household level. To have a clear picture of the degree of deprivation wants those appropriate corrections to be made to total household consumption or income to take account of the differing needs of households. Needs may vary because of difference in the size and/or composition of households. A common approach is to divide aggregate household consumption by household size to get consumption per capita. However, using consumption per capita as a measure of well-being has a serious drawback because it is based on the assumption that each household member has the same consumption needs. A better measure of welfare can be obtained by changing aggregate household consumption into 'consumption per adult equivalent' using an appropriate equivalence scale. The equivalence scale will differ across sex and age taking into account the different consumption requirements of household members (Deaton & Muellbauer, 1986; Deaton, 1997).

B. Identifying Poverty Lines

Given a right measure of welfare, the identification of the poor necessitates that a poverty line used to determine below which individuals or households are considered poor. There are a number of means that such a poverty line may be identified. The most common method is to estimate the cost of a consumption bundle for which basic consumption needs will be met. This is known as the cost of basic needs approach. It proceeds by first estimating the food expenditure necessary to attain some recommended food energy intake. This expenditure level can be measured as the food poverty line. Next, an allowance is made for non-food goods to arrive at the total poverty line (Ravallion,1994; Lipton & Ravallion, 1995).

Constructing the poverty line using the cost of basic needs approach, however, presents some difficulties. For instance, setting the food energy requirement may be problematic as there are significant variations among people in physical features and work habits. This provides the task of setting a minimum energy requirement, even for a specific group in a specific region, daunting. Even after a minimum requirement is set, there still leftovers the problem of choosing a food bundle that meets it (Sen, 1999). A bundle that meets the requirement at minimum cost (given prevailing prices) could be chosen, but

such a bundle is no relevance if it is not in tune with the eating habit of the poor. As Sen (1999) points out, '… the actual incomes at which specified nutritional requirements are met will rely greatly on the consumption habits of the people in question'. The second difficulty linked with deriving the basic needs poverty line is in making an allowance for non-food goods. This stems from the fact that there is nothing that can serve the same role as food energy requirements in fixing the non-food component of the poverty line (Ravallion,1994).

In practice, two approaches have been commonly used to derive the poverty line; the 'food energy intake' and 'food share' methods (Ibid). Both approaches are founded on the assumption that there is a minimum energy requirement for a typical person to keep up normal activities, such as the 2,200 Kcal per day threshold stipulated by the World Health Organization. Therefore, the 'food energy intake' method attempts to identify the total consumption expenditure at which a person is expected to attain the minimum food energy requirement. It is accomplished by regressing calorie intake on consumption expenditure or income. The poverty line, then, becomes that level of total expenditure at which the minimum energy requirement is achieved (Greer & Thorbecke, 1986; Ravallion, 1994).

The advantage of this method is that it automatically comprises an allowance for non-food goods, circumventing one of the difficulties mentioned above. Nevertheless, it may lead to an 'inconsistent poverty comparison across sub-groups or overtime since people with the same command over basic consumption needs will not, in general, be treated the same way' (Lipton & Ravallion, 1995).

In the case of 'food share' method, the cost of the food bundle that meets the minimum energy requirement is assessed for each population subgroup. The food poverty lines are then divided by the share of food in total expenditure of the poorest households, such as the poorest decile, in each sub-group to get the total poverty line. This method may also lead to inconsistencies in poverty comparison as the share of food in total expenditure does not remain constant across sub-groups (Ravallion,1994).

An alternative method of constructing the poverty line, which is a version of the cost of basic needs approach (Ravallion& Biden, 1994). In this method, a basket of goods for which basic food requirements will be met is well-defined. The cost of this basket at market prices becomes the food poverty line. An allowance for non-food goods is then added on the food poverty line to obtain the total poverty line. This is done by guessing a food Engle curve and determining the food share of the representative household whose total consumption is precisely equal to the food poverty line (Ravallion, 1994; Ravallion & Biden, 1994).

2.1.2. Review of Global and African Urban Agriculture

Urban dwellers may engage themselves in growing crops and more habitually raise limited animals to produce their own food. The urban poor households are also benefited by urban agriculture to fulfill their needs. Research has shown that the majority of the urban farmers are women. 40 %and 42% of their populations in some African countries and in some American cities is engaged in urban or peri-urban agriculture respectively (IFPRI, 2002).

Even in well established, highly developed cities that are Taipei, Taiwan, urban agricultural activities can be readily observed, particularly on the city's edge. In Hanoi, Vietnam, 18 percent of the land is given to agriculture. In Quito, Ecuador, 35 percent of the land is unoccupied and regularly used for farming (Redwood, 2008). In Rosario, Argentina's third-largest city, 80 percent of the land is unoccupied and10, 000 city inhabitants earn their living from agriculture (IDRC, 2008;Redwood, 2008).

According to one guess, around 200 million city dwellers generate food for the urban market, which is 15–20 percent of entire global food production (Veenhuizen, 2006). In West Africa, almost 20 million households (20 percent of the urban population) put into practice urban agriculture and they contribute 60–100 per cent of the fresh vegetable market in those cities(Baker, 2008).The merits of urban and peri-urban agriculture are a lot of contributing to the food supply chain. Since the most of the sales are near the production centers the cost of transportation is low. Producers can towards fulfilling market demands (Redwood, 2008).

Urban farming systems contribute their part in gets rid of waste streams and recycling nutrients which would otherwise be lost through reuse of liquid and solid wastes. Some cities have enacted urban agriculture policies in current years, including Accra, Beijing, Brasilia, Bulawayo (Zimbabwe), Havana (Cuba), Hyderabad (India), Rosario (Argentina) and Nairobi (Kenya) (Ibid).

In the findings of Jezra Thompson, the following are benefits of urban agriculture, these are:

- Decreasing excessive supply of vacant and unproductive lands through the management of local managements.
- Establishing green spaces within urban centers.
- Providing poor people with quality and more nutritious food.
- Developing self-sufficiency among inner-city residents through growing food for themselves as well as for others.
- Employment chance for the poorest urban residents, thus bringing more income to residents.
- Reuse of waste products of supermarkets into compost and fertilizer.
- Reducing food transportation cost through the greater availability of local produce.

In Kampala, urban agriculture uses most of the land in Uganda's capital, and roughly half of the city's households produce some of their own food. The city council has enacted ordinances, following broad stakeholder consultation that engaged urban farmers, to assist and control urban agriculture, while protecting public health(Cole, Lee-Smith, & Nasinyama, 2008).

In most African cities, assisting low-income households with urban agriculture might be an effective means of improving urban food security. More generally, urban food security relies upon wages, employment, and informal sector opportunities, and the significance of a health perspective is less evident here. It is, nevertheless, vital to keep in mind that measures designed to improve urban food security which weakens the economic

opportunities of the more vulnerable urban residents are likely to be counterproductive (Boon Emmanuel.K, 2003).

2.1.3. The General Importance of Urban Agriculture

Urban agriculture has the indispensable potential to tackle some of the key challenges that cities in developing countries faced from achieving sustainability such as urban poverty, food insecurity, and unemployment, environmental problems of the cities (RUAF, 2014).

In recognition of the Sustainable Development Goals (SDGs), urban agriculture can assist in potentially decreasing hunger and poverty creating sustainable food production patterns and promoting the integration of environmental values in development. In terms of decreasing poverty and hunger, urban agriculture provides a mechanism for improving urban food security and providing entrepreneurship opportunities for low-income individuals. In creating sustainable food patterns, urban agriculture is projected to reduce climate change-related greenhouse gas emissions through reducing food production and distribution inputs. Furthermore, by incorporating waste management, nutrient recycling and energy recycling urban agriculture utilize environmentally sustainable practices in meeting the necessities of urban regions(Game & Primus, 2015).

According toAdejumo(2003), commercial horticulture provides an appealing view for the environment by greening the environment, and encourages the development of thehealthy community; social values of the communities and help economic development. Therefore, there are practices of horticulture in three main ways. First, vegetation enhances the economic and social values or developments of the community. Second, horticulture activities promote the development of the healthy community by utilizing carbon gasses (gases that are generated in the cities) during plants' photosynthesis and after that oxygen is released as a byproduct which is very important air for human beings. Third, itimproves environmental management and it provides an appealing outlook for the environment (Albert, 2012, pp. 134-135).

Urban agriculture contributes to urban food security, local economic development, poverty reduction and social inclusion of the urban poor in particular, and to

environmental sustainability by greening and by productive use again of the urban wastes (Marielle *et al.*, 2013).

2.1.4. Urban Agriculture in Ethiopia

In line with the increment of the urban population, urban centers face economic shocks and food insecurity. Kedir & Mackay(2003) showed that in urban areas 26percent people are challenged by chronic poverty and 23percent of households experienced transitory poverty. In urban centers poverty is caused by unemployment, underemployment, lack of sanitation, rising cost of living, reduced inter-dependency among urban households, household composition, low asset ownership, low level of education, high dependency on the informal sector, HIV/AIDS and increased population pressure as a result of natural growth and rural-urban migration(WFP- Ethiopia, 2009).

According to Sabine Gündel (2006), over the last decade, there has been a growing recognition of the meaning of urban and peri-urban agriculture (UPA) for poor people's livelihoods. Although a great deal attention has been given by governments and donors to urban job creation and employment sources, health and infrastructure, IFPRI's Global Vision 2020 emphasizes that efforts to improve urban livelihoods must go further than a focus on urban jobs. Urban and rural livelihoods are frequently intertwined through goods, services, and people.

2.1.5. Urban Agriculture Policy in Ethiopia

The urban agriculture policy in Ethiopia was not supportive of urban agriculture progress so far. The planner should give much attention to the urban agriculture benefits. The lack of proper attention from policy-makers, urban planners, and local authorities, stemmed from the shortage of information that substantiates urban agriculture's importance in the city sustainability is also causing aproblem for urban farming in the city. Add to this the lack of reliable data on the extent of urban areas being used for farming has also affected developing sustainable policies to manage urban farming in the city (Dawit, 2010).

2.1.6. The Economic Impacts of Urban Agriculture

Urban agriculture creates employment opportunities for 800 million urban dwellers in the world and decreases the high rate of urban unemployment, and contributed to local economic development by creating significant employment for the urban residents and enhanced the living standards of the urban resident (Axel & Wilfried, 2008).

Urban agriculture is one of the particularly vital sources of employment for people who may not successfully compete for formal sector jobs, for peoples with low skill and for vulnerable urban peoples. It is estimated that 40 percent of urban dwellers in Africa are vigorously engaged in urban agriculture in one way or other related sectors (Arku *et al*., 2012).

Urban food production, processing, and marketing encourage local economic development by creating income and employment. Chance for many poor urban households and urban agriculture policies is part of a local economic development policy that focuses on income generation and employment creation for a whole range of producers from home-based to community-based. Next to growing crops or rearing animals, urban agriculture provides other employment opportunities, for example: agricultural input production and delivery activities; the collection of urban organic wastes and the production of compost or animal feed from collected organic wastes, sale of agricultural inputs and the development of related micro-enterprises: productions and sale of processed products for instance meals, jams, and other food products(Moustier & Danso, 2006) .

Urban Agriculture contributes to the urban economy development by generating employment for a number of poor urban households by generating incomes equivalent or greater than the official minimum wage rate (Ibid).

As argued by Weinberger & Lumpkin(2007), urban horticultural products are contributing to the increasing domestic and international food demand, urban agriculture expanding market access for urban poor in lagging regions of the world and serving residents in lagging regions to escape poverty through the production of staple crops (Albert, 2012).

According to Smith, Ratta, & Nasr (1996),urban agriculture has created employment opportunity for 80% of the families in Libreville (Gabon), 68%of urban dwellers in six Tanzanian cities, 45% in Lusaka (Zambia), 37% in Maputo (Mozambique36% in Ouagadougou (Burkina Faso) and 35% in Yaoundé (Cameroon) . The urban farming's uses family labor in order to produce crops(De Zeeuw & Marellie, 2009).

Since the late 1980s, employment in Lomé's market vegetable-growing business multiplied the number of times (from 620 in 1987 to 3000 in 1994), vegetable-growing business contributed to decreasing food imports and rising local unemployment in Lome(Mougeot L., 2005).

Vegetable urban farming provides the livelihood strategies of the urban community and it can also contribute to household food and nutritional security, create informal employment, contributes to income diversification of the urban farmers by selling surplus produce or savings on food expenditures, and generally promotes urban food supply systems and promote environmental sustainability by making use of the disposal urban waste (Marielle *etal*., 2013).

Vegetable urban farming in Ghana generated monthly net income range from US$30 to $US70 per small holding vegetable producing households and the income can amount to US$ 200 or more. These amounts normally go beyond official annual minimum salaries, and sometimes the income the farmers earn from vegetable urban farming is corresponding to the official minimum wage in the formal sector or to a basic government workers salary and vegetable urban farming helped the households to escape poverty (Drechsel et al., 2008).

As Lustig & McLeod(1997) argued vegetable urban farming in Lagos, Nigeria helped the urban farmers to escape poverty and urban agriculture notably contributed to the economic development of Nigeria (Albert, 2012).

Ezedinma & Chukuezi(1999) argued that ornamental plant and flower production is profitable urban agricultural activity and the producer households got annual benefits from US$ 400 up to US$ 4700 (Nigeria) or US$ 5000 (Lomé). Besides to these, the urban farmers obtained benefits from the processing and marketing activities (e.g. ghee making,

preparation of street foods, and cleaning/packaging food for sales to small local shop, and supermarkets)(De Zeeuw & Marellie, 2009, p. 14).

The data from the Kumasi study suggested that the urban farmers with 0.05 and 0.2 ha by year-round irrigations earn annual income ranges from 400 to 800 US$ an income twice greater than the rural farmers and Irrigated vegetable production has enabled the urban farmers to leap forward over the poverty line and provides significant high profits for the vegetable producing households (Drechsel *et al*., 2008).

In Dar esSalaam full-time production of certain vegetables or garden farming created an income of $US 60/month 30% more than the average salary. This is also true for Nairobi families in slum areas; the urban farmers sold relatively modest of their productions and consumed their own output. These families' standard of living is greater than that of neighboring non-farming families (Nugent, 2000).

In Shanghai, China, about 60percent of vegetables are produced in the urban and peri-urban areas of the City. In fact that, terms of the Gross Domestic Product (GDP), urban agriculture contributed 2% in Shanghai (China) (De Zeeuw & Marellie, 2009).

2.1.7. Urban Agriculture and Poverty Reduction

Urban agriculture contributes to food security and poverty reduction in developing countries. For the urban poor who have low or uneven income from other sources, raising livestock and growing cash and food crops provide income (Belevi & Baumgartner, 2003). A cow, for instance, is able to lower poverty levels in a number of ways. Milk consumption increases the health of the family while the surplus is sold in local markets to enhance family incomes. A cow can also able to provide farmyard manure which improves soil fertility and increase crop production and thereby enhancing food security (Mumero, 2005).

Another benefit of urban agriculture not commonly recorded is the fungible income. 'Fungibility' is the capacity to provide for extra income that can be spent on essentials similar to health care and education (Mlozi, 1995).

Studies so far have shown that urban agriculture provides household food and nutritional security, the creation of informal employment, income diversification through sales of surplus produce or savings on food expenditures, and more generally promotes urban food supply systems and, at smallest amount in potential, environmental sustainability (Mougeot.L,2000; Foeken, Soffer, & Mlozi, 2004, p. 195). It is widely recognized that the urban poor could gain from farming in town owing to the relatively low investments needed to start the activity. There are also indications that in nutritional terms, the poor people who practice urban farming are better off than the poor who do not (Mwangi, 1995; Mwangi & Foeken, 2006).

By growing vegetables in the backyard and maize on the open land in and around the city, residents save much money meant to buy the grown products and redirect the saved money to buy other household commodities which they could not afford if they were not practicing urban farming (Bower & Tengbeh, 1997).

However, as indicated in some studies done in Kenya and Tanzania have shown, it is exactly the poor who are under-represented among the urban farmers; no access to land is the key obstacle. And if they do have access to land, they face other constraints (lack of capital being the main one), which causes them to act upon worse than the non-poor urban farmers (Flynn, 2005).

2.1.8. Constraints of Urban Agriculture

According to Mougeot (2000), lack of positive government policy on and recognition of urban agriculture as a feasible sector are prevalent in most developing countries. Most policies on agriculture, food, health, nutrition and environmental policies are silent on urban agriculture. Lack of official recognition of urban agriculture often leads to a feeling of insecurity among urban farmers, thereby limiting their commitment to investment in this sector. Many of the urban studies in developing countries concentrate on housing, urban services, and non-agricultural informal activities and exclude or give modest attention to urban agriculture. Regardless of its existence and its ability to provide maintenance to the urban poor, urban agriculture has been underestimated and treated as a barely visible temporary phenomenon.

Urban agriculture is being endangered by urban sprawling and infrastructure developments that are competing with urban farming for available space and scarce resources. For instance, water for irrigation, similarly, some credit agencies, researchers, development agencies and market agents generally do not consider urban agriculture as a significant industry (Marielle *etal*., 2013). As a consequence, the sector' benefits are not being fully recognized by those urban development planners or agency. According to (Mougeot,2000), lack of access to farming land, shortage of clean and adequate water supply as well as the lack of access to farming inputs that is seeds, fertilizer, and pesticides are the most critical constraints to urban agriculture.

2.2. Empirical Literature Review

Gamhewage, Sivashankar, Mahaliyanaarachchi, Wijeratne, & Hettiarachch(2015) studied that women participation in urban agriculture and its influence on family economy in the capital city of Srilankan by using logit model, they got that the most influential socio-economic factors affecting the women participation in urban agriculture are; age, education level, number of members in the family and total cultivable area. For instance, Chagwiza, Zivenge, Chivuraise, & Munyati(2012) conducted the study on factors affecting urban vegetable production in Harare, Zimbabwe by using multiple linear regression model and they suggested that income, home ownership, sex, age, and the market as a primary source of vegetables significantly affect residents' likelihood to participate in the urban vegetable production.

Jongwe(2013) studied synergies between urban agriculture and urban household food security in Gweru City, Zimbabwe by applying logit regression model; he showed as household size, household head age and educational status are significant factors that affect participation in urban agriculture. Furthermore, G.Rezai, N.Shamsudin, Z.Mohamed, & S.Juwaidah(2014) conducted research on factor influencing public participation in urban agriculture in Malaysia with the use of exploratory factor analysis and their result revealed that society recognition, attitude and the social impact of urban agriculture are the top three considerations for individuals participating in urban agricultural activities.

According to Mesay(2010), he studied food security achievement role of urban agriculture in Adama city, Ethiopia by applying multiple linear regression models and his research suggested that the amount of commercial fertilizer applied per unit hectare, number of oxen (availability of traction power), dung input and sex of household head are the major determinants of food availability.

Daniel & Getaneh(2016), they studied factors that affect employment generation through urban agriculture in Bishoftu area of Oromia Region, Ethiopia by using multiple linear regression model so that their study revealed that perception of a better credit, access to inputs, access to land, land ownership, educational status, better farm income, engagement in poultry and dairy farms are significantly affected employment contribution of urban agriculture. Furthermore, its role to urban farmers', urban agriculture has played a massive role in supplying; fresh products to the city dwellers, raw materials to agro-processing industries and market to their products.

Although agriculture is generally perceived as only a rural activity, it can also be an element in urban livelihoods, used as a source of food and employment for poor households and for whole cities. The extent of urban agriculture is broadly varied depending on land availability and legal restrictions. The study reveals that as much as 40 percent of the population in African cities and up to 50 percent in Latin American cities are engaged in urban or peri-urban agriculture. In the 1980s urban and peri-urban agriculture in China's largest cities met greater than 90 percent of vegetable demand and greater than half of meat and poultry demand (IFPRI, 2002).

In light of the livelihood security, the study conducted in the city of Lima, the capital of Peru located inthe western of Latin America showed that urban producers use a variety of assets, which theycombine to deal with risks and vulnerabilities. They are divided into fivecategories: natural, physical, human, financial and social. At this juncture, one of the primary threats tourban producers is rampant urban sprawl. Moreover, urban households engaged in agriculturecontend with a lack of recognition and understanding from policy makers (Villavicencio, 2008).

The study undertaken in the capital of Zambia, Lusaka indicated that the baseline for urban agricultureis the availability of resources. Also, the same study revealed urban agriculture can use as analternative income-generating activity and as a buffer for household food security (Drescher, 2000).

The study carried out in five East African cities: Addis Ababa; Dar es Salaam; Kampala; Kisumu and Nairobi revealed that urban livestock keeping, the one segment of urban agriculture, benefits the poor and provides a means of diversifying livelihood activities that are accessible to vulnerable groups such as female-headed households, children, retired people, the sick and widows, on top of this, providing a source of locally produced food projects for people living near the livestock keepers. Besides, this study also showed that Livestock is kept as social safety nets, retirement policies, deposits for funerals, sources of food and income. Urban livestock keeping is of great importance to those in need of a social security strategy (Richards & Godfrey, 2003).

The case study research conducted in the city of Nairobi revealed that several land holdings potentially boost the diversification and intensification of foodproduction systems. Thus, diversification of crops and livestock-rearing, household income amplified in several ways. First, if they were sold, the surplus food crops and livestock with their products fetched extra income. Second, the better availability of food crops relieved the households' incomefrom food purchases. As a result, households' food security was improved by increased availability and access to diversified diets (Njogu, 2008).

Urban agriculture can be viewed as a survival strategy for the urban poor during crisis periods and contributes to household food security especially for women and elderly. The study carried out in the city of Hanoi, the capital of Vietnam revealed that urban agriculture provides about one-half of the food demand, and involves 10 percent of the urban labor force in processing and marketing, retailing, input supply, seed and seedling production (World Bank, 2005).

An empirical study carried out by Tewodros(2007) showed that urban agriculture playsrole in the livelihoods of urban farmer households in Addis Ababa city. The role of

urban agriculture in household income and urban poverty reduction, and socio-economic challenges in relation to urban farming were investigated by the researcher. Further, he clearly showed that Urban farming was found to contribute considerably (65 %) to livelihoods of urban farmers at both sectoral and household levels, for which livestock and crop production accounted for 40 % and 45 %, respectively in Addis Ababa.

The urban farmers supply a variety of crops and livestock for home use and/or market. In fact that mixed farming is the most familiar activity by many urban farmers in the city indicates farmers' options for diversification. The most common practice for crop producers is cultivating vegetable crops, and it may be associated with the size of landholdings (being small), and suitability of vegetables for cultivation, piece by piece harvesting and their liquidity. Regardless of its substantial sectoral contribution, livestock production, mostly raising of milk cattle, is practiced by few urban farmers, and this may be because of capital (credit) constraints as the sub-sector requires high initial investment (Ibid).

Most of the urban studies which are done in developing countries mainly concentrate on housing, urban services, and non-agricultural informal activities (Mougeot, 2006). However, they mainly exclude or give modest attention to urban agriculture; even those studies that were conducted in the area of urban agriculture, they paid attention to the environmental concerns and a little concern to Poverty reduction dimensions so that the researcher built a heartfelt aspiration to show the impact of urban agriculture in addressing Poverty reduction and its converging impact to the achievement of the poverty reduction goal at household and community level.

2.3. Conceptual Framework

Based on literature review, conceptual framework outlines various factors which can be taken into consideration in this study, with an emphasis on factors affecting participation in urban agriculture and its impact on poverty reduction (by considering two proxy variables such as asset building and consumption expenditure) (Forexample,Figure.1).

Personal and Demographic factors such as age, sex, household size and education level are important factors in urban agriculture participation. Economic factors similar to the

land size and other income can also affect participation in urban agriculture. On other hands, institutional factors like access to water, access to credit, access to extension services and access to improved inputs can strongly affect participation in it.

Urban agriculture provides to households own consumption, households may sell agricultural products and they can earn income. Income earned from the selling of agriculture products can use to fulfill households' basic needs and it is also used to build durable assets to households. On another hand, income earned from urban agriculture can save for future use and households invest in other economic activities and it also uses hire laborers and people in other economic sectors (employment). Therefore, as households directly or indirectly get consumption, build assets, and as a source of job opportunity to individuals as well as households can invest in future in other economic activities so that it leads to poverty reduction (Simeon, 2008).

The conceptual framework can be diagrammatically summarized as follow

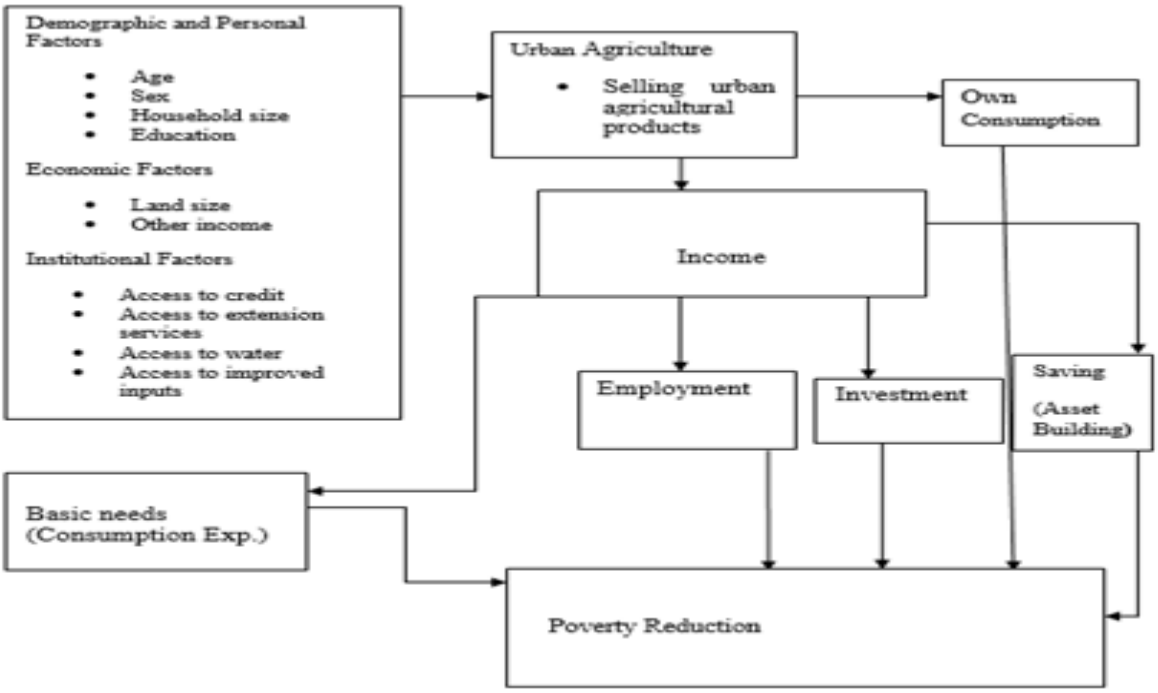

Figure 1: Conceptual Framework for Impact of Urban Agriculture on Poverty Reduction (Micro Level)

Source: modified (Simeon, 2008)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Description of the Study Area

3.1.1. Location of the Study Area

Hossana town is the administrative and commercial center of the Hadiya zone. It has been declared a model town by the regional state government. The town has got its new administration structure in 2004 consisting of three sub-towns and eight kebeles. Hossana town is located southwest of Addis Ababa at a distance of 232 km via Alemgena-Butajira route, 280 km from via Wolkite route, and 305 km via Ziway. Hossana is located in the southeast of Hawassa (the capital of SNNPR) at approximately 168 km via Halaba-Angeca and 203 km via Halaba. The absolute geographic location of Hossana is from 70 30′ 00′ to 70 35′ 00″ North latitude and from 370 491′ 00″ to 370 53′ 00″ East longitudes. The administrative area of Hossana town is 10,414.3 hectares, out of this 4,585.48 hectares of the town has been master planned (Hossana Town Finance and Economic Development Office, 2014).

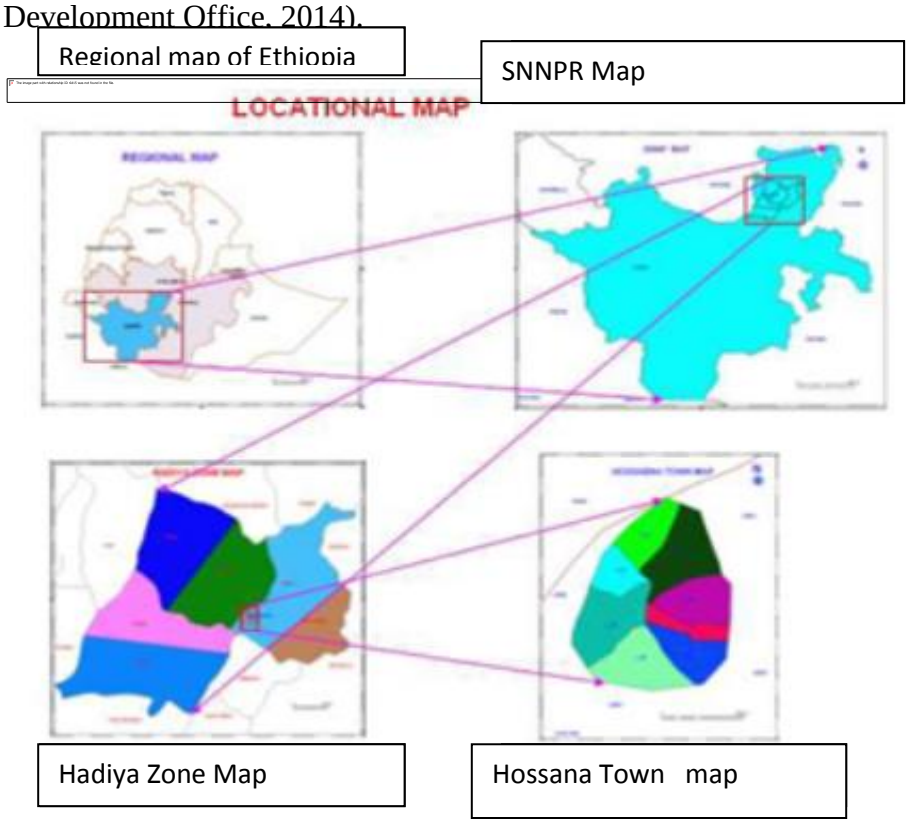

Figure 2: Location Map of Study Area Source: Abinet (2011)

3.1.2. Topography of the Study Area

Physically, the town of Hosanna covers an area of 40.7 km2 of land with alternatively changing horizontal or vertical landscape orientation. It includes several ups and downs, hills and plains. It can commonly be said that the town is inclined generally from west to east. The drainage pattern of the town is from west to east. Approximately 25% of the land is within the slope classification range of 4–7%. The present day landscape of Hosanna owes its actual surface from the past volcano-tectonic activities with the slight modification by local thick soil formation, soil erosion and to some extent by valley formation. Hosanna town is at the southern edge of the western plateau of the physiographic region. Its location on a topographically high place makes the town serve as a divide for the Gibe Omo and Rift Valley Lakes drainage basins. The elevation within the town ranges from 2,400 m near Hossana Hospital, currently called Queen Eleni Hospital, and 2,200 m at *Tekle-Haymanot* Church above the sea level. The average elevation is 2,300 m from the mean sea level. Hossana town is prone to flooding and soil erosion due to a high gradient from its peak from the site of the hospital to the lowland of the open market area during the rainy seasons (Hossana Town Finance and Economic Development Office, 2014).

3.1.3. Climate of the Study Area

The altitude of the town ranges from 2140 m to 2380 m above sea level. This shows that the town is mainly characterized by highland *'Weynadega*' climatic conditions. There is a meteorological sub- station in Hosanna at a specific location of 37049′00″ E, 70 30′ 00″ N. The methodological data for the town is available for five years, from 2009 to 2013. The average annual temperature of the town is 18.50 C (based on methodological recordings of five years). The mean monthly temperature varies from maximum of 200 C for the months of April to June and to minimum of 170 C for the months of December and January. The average annual rainfall in the town is approximately 1121.3 mm. There are three distinct seasons of rainfall in the town i.e. „the '*Bega'* (Dec, Jan, Feb) provide rainfall for limited parts of the town, '*Belg*' (March, April, and May) of the little rainfall seasons. The amount of the rainfall received is relatively lower than the kiremt rainfall

that occurred in June, July, and August. On this basis, there is mainly two seasons –rainy and dry season (Ibid).

3.1.4. Farming Systems

The farming system in the town is mixed type involving crop and livestock production where crops contribute a larger share to household's income. Crops such as maize, banana, wheat, avocado, *Teff*, barely, *enset*, coffee, haricot bean, potato and other crops are mainly grown in the area. Animals such as sheep, goats, cows, oxen, donkeys, poultry, are reared. The urban agriculture may take place on on-farm (on-plot) such backyards and around the kitchen, and it can be performed also on land away from residence (off plot). There are two main cropping seasons in the Hossana town: spring *(belg* in Amharic) and summer (*meher* in Amharic). The *belg* season begins from late February to late April/early May where maize, barely, haricot bean, and potato are planted. The *meher* cropping season begins early June and continues up to the end of August. Crops like *teff*, wheat, maize, haricot bean, and potato are planted in the meher season (Hossana Town Agriculture Development Office, 2016).

3.1.5. Demographic Characteristics, Ethnic Group and Religion

The total population of Hosanna was 13,467 and 31,701 in 1984 and 1994 respectively (CSA,1994). Within ten years, the town's population reached 69,995 (more than double) (CSA, 2007). Based on CSA 2007 the population census result, the current population of the town is projected to 97,184 at the end of 2013 out of which 49,322 (50.8%) and 47,863 (49.2%) are estimated to be male and female respectively (CSA, 2014). Between 1986 and 1996 the population size of the town was growing on the average by 8.15 percent per population growth while during 1996- 2007 the growth rate has increased to 13.31 percent population growth rate. This rate further increased to 9.7 percent growth rate during 2007-2014 (CSA, 2014). The rapid population growth and town expansion were rural to urban migration as result of remittance sent from South Africa in the town.

The residents of Hossana has been different religious followers among them Protestant, Orthodox and Muslim were found and with regard to ethnic groups Hadiya, Amhara,

Gurage, Silte and Kambata, and others have been living in the town and the Hadiya ethnic group maintain the almost all numbers.

3.2. Research Design

The convenient methodology was applied for data collection and employing it in the field for both qualitative and quantitative methodologies within a framework of a case study approach. Review of secondary data and schedule interviews with urban households in order to get necessary data for this study was done accordingly. The study used both quantitative and qualitative methods in research and it was also cross-sectional

3.3. Data and Data Sources

Both quantitative and qualitative data were collected in this study. The primary data sources were obviously the sample respondent households' heads, which were selected randomly and stratified random sampling techniques from selected sub-town of Hossana town. On the other hands, the secondary data sources were those data, which were collected from Hadiya Zone Agriculture Department and Hossana Agriculture Development Office. In addition, it was collected from published and unpublished documents, internet which is related to the subject.

The qualitative data that was collected in this study for the variables such as access to water, access to extension services, access to improved inputs and access to credit whereas the quantitative data that was collected in this study for variables were consumption expenditure, total monthly income, income from other sources (other income), educational status, land size and asset building by the households. Furthermore, data on the household demographic characteristics was collected in this study.

3.4. Sampling Technique and Procedure

For this research, a multi-stage sampling technique was employed to draw sample households in this study since it helps to reduce heterogeneity within households through sampling processes. In the first stage, one sub Town was randomly selected from Hossana town. In the second stage, selected sub town comprises three Kebeles then all of them were selected purposively due to high potential urban agriculture practice. In the third stage, a total of 176(83 participants and 93 non- participants) household heads (HHS) were selected based on probability proportional sampling (PPS) technique from selected *kebeles* by using simple random sampling for non-participants whereas stratified random sampling for participants in urban agriculture.

3.5. Sample Size Determination

A Simplified Formula for Proportions

Yamane(1967) provides a simplified formula to calculate sample sizes. This formula was used to calculate the sample sizes. The sample size was determined using the formula given by Yamane(1967) in drawing an adequate sample size from a given population at 95% confidence level, 0.5 degrees of variability and 7% level of precision.

$$n = \frac{N}{1 + e2(N)}$$

Where

n = the sample size

N =the total household heads

e = the level of precision.

Based on the above formula 176 household heads were selected by the researcher.

Therefore:

$$n = \frac{N}{1 + e2(N)}$$

$$n = \frac{1321}{1 + .07^2(1321)} = 176$$

Table 1: Distribution of Sample Size

Kebele's Name	Number of Households	Proportionally determined Sample Size			Sampling Techniques
		Participants	Non-participants	Total	
J-Naramo	665	27	62	89	Stratified Random and Random
Heto	326	20	23	43	» »
Bobicho	330	36	8	44	» »
Total	1321	83	93	176	

3.6. Method of Data Collection

Primary data collection was gathered using structured questionnaire and semi-structured questionnaire. Four enumerators who have adequate knowledge about the area and well acquainted with the culture and language were recruited. They were trained on the methods of data collection and contents of the questionnaire. Secondary data was collected from relevant literature, reports of Agricultural and Development Department

and office and other publications. After, this both quantitative and qualitative information was collected to respond to raised questions around studying area.

3.7. Method of Data Analysis

After all necessary data were collected; it was analyzed through descriptive and econometric models by the researcher. Econometric models were developed in order to identify factors affecting the participation of urban household in urban agriculture and also to evaluate the impact of urban agriculture on poverty reduction. Logit model was employed to analyze factors affecting participation in urban agriculture (urban agriculture takes a dummy variable 1 if the participant, 0 otherwise) by using data that was collected through structured and semi-structured questionnaire from households. Propensity score matching method was applied for investigating the impact of urban agriculture on poverty reduction. STATA Software version (13) was employed for the analysis of the data.

3.8. Model Specification

3.8.1. Binary Logistic Model

One of the purposes of this study is to identify factors affecting participation in urban agriculture. The dependent variable, in this case, is dichotomous variable, which takes a value of zero for non-participant households and one for the participant ones

When one or more of the independent variables in a regression model are binary, we can represent them as dummy variables and proceed to analyze. Binary models assume that households belong to either of two alternatives and that depends on their characteristics. Thus, one purpose of a qualitative choice model is to determine the probability that a household who fall in one of either alternatives (in this study the alternatives are either participant or non-participant in urban agriculture).

The Probit and Logit models are commonly used, models. The Probit model is associated with the cumulative normal probability function. On another hand, the logit model

assumes cumulative logistic probability distribution. The advantage of these models over the linear probability model is that the probabilities are bound between 0 and 1. Moreover, they best fit to the non-linear relationship between the probabilities and the independent variables; that is one which approaches zero at slower and slower rates as an independent variable (Xi) gets smaller and approaches one at slower and slower rates as Xi gets large(Train, 1986).

Usually, a choice has to be made between Logit and Probit models, but the statistical similarities between the two models make such a choice difficult. For this study, the Logit model is selected, though both Logit and Probit models may give the same result. The logistic function is used because it represents a close approximation to the cumulative normal distribution and is simpler to work with. Moreover, as Train(1986)pointed out a logistic distribution (Logit) has got advantage over the others in the analysis of dichotomous outcome variable in that it is extremely flexible and easily used function (model) from the mathematical point of view and lends itself to a meaningful interpretation and relatively inexpensive to estimate. So that to address the second objectives of the study logit model was employed.

Following Pindyck& Rubinfeld(1981) the cumulative logistic probability function is specified as:

$$Pi = F(Zi) = F[\alpha + \sum(BiXi)] = \left[\frac{1}{1+e^{-[\alpha+\sum(BiXi)]}}\right] \quad \text{---------- (1)}$$

Where:

e represents the base of natural logarithms

Xi represents the ithexplanatory variable

Pi is the probability that a household is being participated in urban agriculture given xi,

α and βi are regression parameters to be estimated

The odds ratio is the probability that a household is participated in urban agriculture (Pi) to the probability that it isnot participated in urban agriculture (1 - Pi).

$$(1-p) = \frac{1}{1+e^{-zi}}$$

And putting using natural logarithms

$Zi = Ln\left(\frac{pi}{1-pi}\right) =$ α + β1x1 + β2x2 + − − ∓βnxn---------- (2)

If we consider a disturbance term, ui, the logit model becomes

$$\text{Zi} = \alpha + \sum_{t=1}^{n} (BtXti) + \text{Ui}$$

So the binary logit becomes:

Pr (PUA) = f(X)

Where *PUA is* participation in urban agriculture, *f(X)* is the dependent variable participation in urban agriculture and *X* is a vector of observable covariates of the households;

X = [AGE, SEX, LS, HZ, AW, AC, IOS, EDUC, AES, AII].

Where:

AGE- the age of household head in years

SEX- the sex of household head can be identified as male or female (a dummy variable)

LS-the size land that can be used to conduct urban agriculture in hectares

HZ-household size in number

IOS- other income (Income from other sources) in birr

AW-access to water, it is a dummy variable (yes or no)

AC-access to credit, it is a dummy variable (yes or no)

EDUC- the education level of household head (categorical)

AES- access to extension services, it is a dummy variable (yes or no)

AII- access to improved inputs, it is a dummy variable (yes or no)

3.8.2. Propensity Score Matching

In this study, PSM is employed in order to evaluate the impact of urban agriculture on Poverty reduction by using two proxy households' consumption expenditure and their durable asset building. The matching technique is widely used in impact evaluation in the absence of baseline data and when randomization is very unlikely. According to Ravallion (2005), impacts estimated with parametric models are more biased and less robust to miss specification of regression functions than those based on matched samples

After obtaining the predicted probability values conditional on the observable covariates (the propensity scores) from the binary estimation, matching was done using a matching algorithm that was selected based on the data at hand. According to Rosembaum& Rubin(1983), propensity matching score can be expressed as the conditional probability of getting a treatment given pretreatment features. Hence, assume $Yi^{T}$and$Yi^{C}$is the outcome variable for participant and non-participant in urban agriculture, correspondingly.

The change or difference in outcome between treated and control groups can be calculated from the following mathematical equation: $\Delta i=Yi^{T}-Yi^{C}$(1)

Yi^T: Outcome of treatment (asset building per capita or consumption expenditure per adult equivalent of the ith household, when he/she is participant), Yi^C: Outcome of the non-participant individuals (i.e. asset building per capita or consumption expenditure per adult equivalent of the ith household when he/she is non-participant in urban agriculture), ΔI is change in the outcome as a result of participation in urban agriculture for the ith household.

Let the above equation be defined in causal effect notational form, by conveying Di=1 as a treatment variable conveying the value 1 if the individual received the treatment, and 0 otherwise. So, the Average Treatment Effect of an individual i can be written as:

$$ATE=E(Yi^T \mid Di=1)-E(Yi^C \mid Di=0) \quad (2)$$

Where ATE, Average Treatment Effect, which is the effect of treatment on the outcome variable: $E(Yi^T \mid Di=1)$: Average outcomes for individual, with treatment, if he/she would participant (Di=1). $E(Yi^c \mid Di=0)$: Average outcome of untreated, when he/she would non-participant, or absence of treatment (Di=0). The Average Effect of Treatment on the Treated (ATT) for the sample households is given by:

$$ATT=E(Yi^T-Yi^C \mid Di=1) =E(Yi^T \mid Di=1)-E(Yi^C \mid Di=1) \quad (3)$$

According to Rosenbaum and Rubin (1983), the success of matching estimators as a feasible estimator for impact evaluation depends on two fundamental assumptions:

Conditional Independence Assumption (CIA) 1: This assumption states that treatment assignment (Di) conditional on attributes; X is independent of the post program outcome (Yi^T, Yi^C). In formal notation, this assumption corresponds to:

$$(Yi^T-Yi^C) \perp (D \mid Xi) \quad (4)$$

This assumption levies a restriction that choosing to participate in an urban agriculture is purely random for similar individuals. As significance, this assumption eliminates the familiar dependence between outcomes and participation that might lead to a self-selection problem (Heckman, Ichimura, Smith, & Todd, 1998).

The conditional average effect of treatment on the treated has a challenging, if the number of the set of conditioning variables (X's) is high, and thus the degree of complexity for finding alike households both from participants and non-participants becomes problematic.

To reduce the dimensionality problem in calculating the conditional expectation, Rosenbaum and Rubin (1983) revealed that instead of matching on the base of X's one can equivalently match treated and control units based on "propensity score" expressed as the conditional probability of getting the treatment given the values of X's, notational expressed as P (Xi) =Pr (Di=1 ⎪ Xi) Where Pr is the probability or the logistic cumulative distribution, Di = 1 if the subject was treated, Xi is a vector of pre-treatment features. In assessing the propensity scores, all variables at the same time affect participation in the program and outcome variables were included. Therefore, the average treatment effect on the treated conditional on propensity score P(X) can then be derived as:

$$ATT=E\left(Yi^{T} \mid P(X), Di=1\right) =E\left(Yi^{C} \mid P(x), Di=1\right) \quad (5)$$

Assumption 2: Assumption of Common Support: $0<P(X)<1$ (6)

The assumption is that P(x) lies between 0 and 1. This restriction implies that the test of the balancing property is performed only on the observations whose propensity score belongs to the common support region of the propensity score of treated and control groups (Becker & Ichino, 2002). Individuals that drop outside the common support area or region would be excluded in the treatment effect estimation. It is an important condition to guarantee enhancing the quality of the matching served to estimate the ATT.

Choosing a Matching Algorithm

The three commonly used matching algorithms, namely nearest neighbor matching, caliper matching, and kernel-based matching was employed to evaluate the impact of urban agriculture on poverty reduction. The nearest neighbor matching (NNM) method matches each household from the participant group with the household from the non-participant group having the closest propensity score. The matching can be done with or without replacement of observations. NNM faces the risk of bad matches if the closest

neighbor is far away. This risk can be reduced by using a caliper matching (CM) method, which imposes a maximum tolerance on the difference in propensity scores. However, some treated units may not be matched if the dimension of the neighborhood is too small to contain control units. The kernel-based matching (KM) method uses a weighted average of all household in the participant group to construct a counterfactual. The major advantage of the KM method is that it produces ATT estimates with lower variance since it utilizes greater information; its limitation is that some of the observations used may be poor matches.

3.9. Variable Definition and Measurement

1. Dependent Variable: Participation in urban agriculture where takes 1 if it is a participant and 0 for non-participant of urban household in kebele.

2. Outcome Variables:

i. **Consumption Expenditure per Adult Equivalent (CEAE):** It is a continuous variable and measured in birr per adult equivalent which can be estimated by adding consumption expenditure(i.e., both goods and services that are purchased, it is also provided from one's own production which is consumed in a given household) then it is divided by adult equivalent(it can be calculated by adding values obtained through converting members of household with respect to their sex and age by multiplying adult equivalent conversion unit.

ii. Asset Building per Capita (ABC): A continuous variable and measured in number per capita which can be estimated by adding total durable assets then it is divided by household size.

3. Independent Variables

1. **Age of Household Head (AGE):** Age is a continuous variable and measured in years. Older people tend to participate in urban agriculture because of family responsibilities and need to improve their living standard (Onyango, 2011).Itis not expected positive or negative relationship between age and participation in urban agriculture. There is no prior expectation.

2. Sex of the Household Head (SEX): Sex of the household is a dummy variable. In this, study expected that male headed household takes 1 whereas female headed household takes 0. Jongwe(2013) suggested that the sex of household head is positively related to participation in urban agriculture. Male headed households are expected to be related positively to participation in urban agriculture whereas female headed households are negatively related to participation in urban agriculture.

$$\text{SEX}=\begin{cases} 1 = male \\ 0 = female \end{cases}$$

SEX is expected to correlate with urban agriculture participation positively.

3. Educational Level of Household Head (EDUC): Education is a categorical variable. According to Jongwe(2013), educational level is negatively related to participation in urban agriculture. It expected that there is directly or indirectly related to participation in urban agriculture in this study.

$$\text{EDUC}=.\begin{cases} 0 = illiterate \\ 1 = primary \\ 2 = secondary \\ 3 = abovegrade12 \end{cases}$$

There is no prior expectation

4. Household Size (HZ): The size of the household is a continuous variable. The researcher expected that household size is positively related to participation in urban agriculture. Gamhewage *etal*(2015) suggested that household size has direct relationship to participation in urban agriculture. The expected effect of HZ on urban agriculture participation is positive.

5. Land Size of Household (LS): Land size is a plot of land that is used to employ different urban agriculture activities by the household measured in hectares. For instance, Gamhewage *etal*(2015), total cultivated land is an important factor that affects participation in urban agriculture. It is expected to have positive relation to participation in urban agriculture. The expected effect of LS on urban agriculture participation is positive.

6. Other Income (Income from Other Sources (IOS) is measured in birr. The household head can diversify income in participating on other activities such as running petty or small trade, daily laborer and hiring in government organization and non-government organization so on. If household head gets a better income from other activities then there is less probability to be venture in urban agriculture. Moreover, income earned off the farm might not be used for agricultural production, but rather, to increase consumption, finance investments in non-agricultural production or education (Pfeiffera, Feldmanb, & Taylorc, 2009). It is expected to have negative relationship with participation in urban agriculture.

7. Access to Credit (AC): It is a dummy variable and it takes 1 if there is access to credit, otherwise 0. In this study, it is expected that there is access to credit household head by using this option he or she can easily buy very important inputs which are used to participant in urban agriculture. For instance, the non-availability of adequate credit when needed negatively impacts the farm output (Guirkinger & Boucher, 2008). Therefore, access to credit is positively related to participation in urban agriculture. AC= $\begin{cases} 1 = got\ credit \\ 0 = did\ not\ get \end{cases}$

8. Access to Water (AW): It is dummy variable which takes1 if there is access to water, otherwise 0. Jacobi, Amend, & Kiango(1999) suggested that access to resources, above all water, is the major constraint for urban agriculture. For example, Tap water is available to a number of households and used for productive purposes. Thus, it expected to have a direct relation to participation in urban agriculture. AW=$\begin{cases} 1 = had\ water \\ 0 = did\ not\ have \end{cases}$

9. Access to Extension Services (AES): It is a dummy variable which takes 1 if there is access to extension service, otherwise 0.As local authorities are being accommodative to urban agriculture some residents are receiving extension services on various aspects of agricultural production (Mougeot L. , 2000). In this study, it is expected that it is positively related to participation in urban agriculture.

AES=$\begin{cases} 1 = got\ extension\ services \\ 0 = did\ not\ get \end{cases}$

10. Access to Improved Inputs (AII): It is a dummy variable which can take 1 if there is access to improved inputs, otherwise 0. According to Smith *etal*.(2001), lack of access to farming inputs such as seeds, fertilizers, pesticides, chicks & heifers, feed and medicine is a major constraint facing urban farmers. Inputs are not readily available in cities because the markets and sale channels are not either not developed and organized or are oriented toward rural farmers. So, it expected that it is positively related to participation in urban agriculture.

$$\begin{cases} 1 = obtained\ improved\ inputs \\ 0 = did\ \ not\ obtain \end{cases}$$

Table 2: Summary of Variable Definition and Measurement

No	Variables	Symbol(Abbreviation)	Type	Measurement
1	Explanatory Variables			
1.1	Age of Household Head	AGE	Continuous	In years
1.2	Sex of Household Head	SEX	Dummy	Takes 1 for male, otherwise 0
1.3	Education Level of Household Head	EDU	Categorical	0=illiterate 1=primary education,2=secondary 3=above grade 12
1.4	Household Size	HZ	Continuous	Number of members in household
1.5	Land Size of Household	LS	Continuous	In hectare
1.6	Income from Other Sources	OIS	Continuous	In Birr
1.7	Access to Credit	AC	Dummy	Takes 1forgot credit, otherwise 0
1.8	Access to Water	AW	Dummy	Takes 1 for had water, otherwise 0
1.9	Access to Extension Services	AES	Dummy	Takes 1 for obtained extension, otherwise 0
1.10	Access to Improved Inputs	AII	Dummy	Takes 1 for got improved inputs, otherwise 0
2	Dependent Variable			
2.1	Participation in Urban Agriculture	AU	Dummy	Takes 1 for participants, otherwise 0
3	Outcome Variables			
3.1	Consumption Expenditure per Adult Equivalent	CEAE	Continuous	In Birr per AE
3.2	Asset Building per Capita	ABC	Continuous	In unit per capita

CHAPTER FOUR

RESULTS AND DISCUSSIONS

In this study, both primary and secondary data were collected. Primary data was from 176 sampled households who have been lived in study area three *kebeles* on demographic characteristics, sex, age, education, access to extension services, access to credit, family size, access to water, land size (unoccupied space), income from other sources(other income), access to improved inputs, household consumption expenditure, durable asset building and secondary data was from Hossana Town Agriculture and Development Office, Hadiya Zone Agriculture and Natural Resource Development Department. In this part, the descriptive and econometric analysis was undertaken by the researcher using STATA software version 13. Under descriptive statistics, some important characteristics of households, institutional factors, extent of participation in urban agriculture and contribution of urban agriculture to households were displayed with appropriate statistical tools like tables, mean, maximum, minimum, bar chart and percentages. Econometric models such as binary logit model and propensity matching score were used to identify factors affecting urban households' participation in urban agriculture and to evaluate the impact of urban agriculture on poverty reduction respectively.

4.1. Descriptive Results

4.1.1. Descriptive Statistics Summary

Table 3: Difference in Sex of households and Institutional Factors by Participation status in Urban Agriculture (percentage)

Description	Participants		Non-participants		Sig.
	Yes	No	Yes	No	
Sex (male=yes, female=no)	60.2	39.8	44.1	55.9	0.032**
Access to credit	39.8	60.2	20.4	79.6	0.005***
Access to extension services	38.6	61.4	16.1	83.9	0.003***
Access to improved inputs	41	59	15	85	0.000***
Access to water	41	59	17.2	82.8	0.003***

&* *are* statistically significant p<5% and 1% based on chi squared test

for dummy variables, respectively

Source: Own Computation based on data, 2017

Table 4: Difference in mean against in Urban Agriculture Participation

Description	participants	Non-participants	Sig.
Average Age	45.07	45.68	0.000***
Average Household size	5.04	4.74	0.000***
Average Land size	0.03	0.02	0.000***
Average Income from other sources	2216.40	2590.10	0.000***

*** *are* statistically significant p< 1% based on paired t-test

Source: Own Computation based on data, 2017

4.1.2. Socio-economic Characteristics of Households

4.1.2.1. Sex of the Household Head

Table 5: Sex of Sample Respondents

Description	Female	%	Male	%	Total sample size	%
Participants	33	39.8	50	60.2	83	100
Non-participants	52	55.9	41	44.1	93	100
Total	85	48.3	91	51.7	176	100

Pearson chi2 (1) = 4.5838 Pr = 0.032

Source: Own computation based on data, 2017

The socio-economic/demographic characteristics of the urban households by participation status were presented in (Table 5). According to data, the result showed that the majority (51.7%) of the respondents was males and 48.2 % was females. When we see the comparison by participation in urban agriculture, out of 100 %participant sample households, 60.2% are males whereas out of 100% non-participant of sample households, the corresponding figure is about 44.1%. It is statistically significant at 5%.

4.1.2.2. Age of the Household Head

Table 6: Age of Sample Respondents

Description	Total sample Size	Participants	Non- participant
Mean	45.39	45.07	45.68
Minimum	30	30	30
Maximum	75	60	75
Total	176	83	93

Source: Own computation based on data, 2017

The average age of the sample household head was found to be 45.39 years where the minimum is 30 and the maximum is75 (Table 6). The average household age of participants in urban agriculture is 45.07 and the corresponding figure for non-participants is 45.68. From the statistical analysis performed, it is found out that the mean age difference between participants and non- participants is much and statistically significant at 1%

4.1.2.3. Family Size of Household

Table 7: Family Size of Sample Household Heads

Description	Total sample Size	Participants	Non- participant
Mean	4.89	5.04	4.74
Minimum	2	2	2
Maximum	8	8	8
Total	176	83	93

Source: Own computation based on data, 2017

Table 7, it was indicated that in the study area the average family size is 5 persons per household, when the minimum is 2 and maximum is 8. When we compare the average household size between participants and non-participants of urban agriculture is related but there is difference. From the statistical analysis performed, it is found out to be statistically significant at 1%. Family size in a household influences the amount of labor the household can spend on urban agriculture and the amount of food consumed.

4.1.2.4. Level of Education of the Household Head

Table 8: Education Level of Sample Household Head

Description	Participants		Non-participants		Total sample Households	
	Frequency	%	Frequency	%	Frequency	%
Illiterate	7	8.43	5	5.37	12	6.82
Primary education	15	18.07	26	27.96	41	23.30
Secondary education	31	37.34	41	44.09	72	40.90
Above grade 12	30	36.16	21	22.58	51	28.98
	83	100	93	100	176	100

Pearson chi2 (3) = 5.7119 Pr = 0.126

Source: Own computation based on data, 2017

As tabulated (Table 8), from total sample household heads,40.9 % of households have attained secondary education. The comparisons by the participation in urban agriculture revealed that 37.34% participants have attained secondary education whereas 44.09% of non-participants have completed secondary education. Thus, it shows that more than half respondents have completed primary and secondary education. Education helps households to increase productivity through promoting awareness on possible advantages of modernizing agriculture. Thus, there is no significant difference between participants and non- participants households in terms of education. Above all, it is important to note that urban agriculture is practiced by people with different education levels.

4.1.2.5. Land Size

Table 9: Land Size (Unoccupied Space) of Household Head

Description	Total Sample Size	Participants	Non- participant
Mean	0.03	0.03	0.02
Minimum	0.001	0.002	0.001

Maximum	0.25	0.25	0.05
Total	176	83	93

Source: Own computation based on data, 2017

As (Table 9) stated the land holding of the sample household varies from 0.001 hectare to 0.25 hectare. The average land holding is 0.03 hectare. The mean land holding for participants is 0.03 and the corresponding figure for non-participants is 0.02 hectare. When we compare the average land size between participants and non-participants of urban agriculture is related but there is difference. Therefore, the average land size for both participants and non-participants is statistically significant at 1%

4.1.2.6. Income from Other Sources (Other Income)

Table 10: Income from Other Sources of Sample Respondents

Description	Total Sample Size	Participants	Non- participant
Mean	2413.86	2216.40	2590.10
Minimum	300	300	900
Maximum	7000	6000	7000
Total	176	83	93

Source: Own computation based on data, 2017

The average other income of the sample household head was found to be 2413.86birr per month where the minimum is 300 birr per month and the maximum is 7000 birr per month (Table 10). The average other income of participants of urban agriculture is 2216.40 birr per month and the corresponding figure for non- participants is 2590.10 birr per month. From the statistical analysis performed, it is found out that there is significant difference between participants and non-participants in other income. It is statistically significant at 1%.

4.1.3. Institutional Factors

4.1.3. 1.Access to Credit Services

Table 11: Credit User of Sample Household Heads

Description	Participants	%	Non-participants	%	Total sample size	%
Yes	33	39.8	19	20.4	52	29.5
No	50	60.2	74	79.6	124	70.5
Total	83	100	93	100	176	100

Pearson chi2 (1) = 7.8716 Pr = 0.005

Source: Own computation based on data, 2017

The main source of credit in the study area is cooperatives, Omo microfinance, and relatives. Table 11 showed that from the sample households 29.5% have got credit while 70.5 % did not take credit. There are various factors which hinder households not to take credit. In fact, some of them are food consumptions rather than farm inputs consumption and unexpected expenditure, existing of high- interest rate and by having enough money to buy agricultural inputs. When we compare to participants with non-participants is 39.8% and 20.4% got credit respectively. On other hands, 60.2% of the participant and79.6%non-participant households did not take credit. Thus, this shows there is a relatively high difference between participants and non-participants in terms using credit access. It is also statistically significant at 1%

4.1.3.2. Access to Extension Service

Table 12: Extension Services User Sample Household Heads

Description	Participants	%	Non-participants	%	Total sample size	%
Yes	32	38.6	15	16.1	47	26.7
No	51	61.4	78	83.9	129	73.3
Total	83	100	93	100	176	100

Pearson chi2 (1) = 8.8722 Pr = 0.003

Source: Own computation based on data, 2017

As result of (Table 12), about 73.3 % of the sample households do not get extension service. When we compare to participants with non- participants, the majority of the participants (38.6%) households get support from extension agents. Extension service here refers to advice, technical training, and sharing experience. About 38.6% treated group and 16.1% control groups consult extension agents whenever they need technically related with urban agriculture. From the respondents, about 61.4% of the participants and 83.9 % non- participants reply they do not get extension service. It is statistically significant at 1%.

4.1.3.3. Access to Improved Agricultural Inputs

Table 13: Improved Agricultural Inputs User Sample Household Heads

Description	Participants	%	Non-participants	%	Total sample size	%
Yes	34	41	14	15	48	27.3
No	49	59	79	85	128	72.7
Total	83	100	93	100	176	100

Pearson chi2 (1) = 14.8443 Pr = 0.000

Source: Own computation based on data, 2017

According to (Table 13), about 72.7% of the sample households did not use improved agricultural inputs, 27.3% of sample households' user of as improved agricultural inputs. When we compare to participants with non- participants' households, the majority of the participants' households used as improved agricultural inputs to improve agricultural products. According to, the survey about 41% of participants and 15% non-participants used as improved agricultural inputs. Agriculturally improved technologies are recommended inputs, varieties of improved seeds, improved diseases and pest management which are used to improve agricultural products. About 59% treated group and 85% control groups did not use improved agricultural inputs which mean they use as their own desires. It is also statistically significant at 1%

4.1.3.4. Access to Water

Table 14: Availability of Water to Sample Household Heads

Description	Participants	%	Non-participants	%	Total sample size	%
Yes	34	41	16	17.2	50	28.4
No	49	59	77	82.8	126	71.6
Total	83	100	93	100	176	100

Pearson chi2 (1) = 8.8722 Pr = 0.003

Source: Own computation based on data, 2017

According to (Table 14), about 71.6% of the sample households did not have water access, 28.4% of sample households' had water access. When we compare to participants with non- participants' households, the majority of the participants' households had water access to participate in urban agriculture. According to, the survey about 41% of participants and 17.2 % non- participants had as water access. Water access includes having pipe water, wheel water, spring water and river in his/her residential compound or near there in order to participate in urban agriculture. About 59% treated group and 82.8% control groups did not have any access to water. It is also statistically significant at 1%

4.1.4. The Extent of Participation of Urban Households in Urban Agriculture

As it is shown in Figure 3, we can understand among livestock production, in diary production, there is the highest percentage of participant households while it stands at the first stage and then it is followed by poultry. Further, in the former one it is characterized by increasing trend and in the latter one it is illustrated by constant trend from the year 2012 up to 2016. Figure 4revealed that the percentage of participants in crop production is shown by decreasing trend as urbanization is highly competed for land that construction houses, planting manufacturing industries and other non-agricultural activities but the percentage of participants in vegetables and fruits production is characterized by increasing trend since they require relatively less land size.

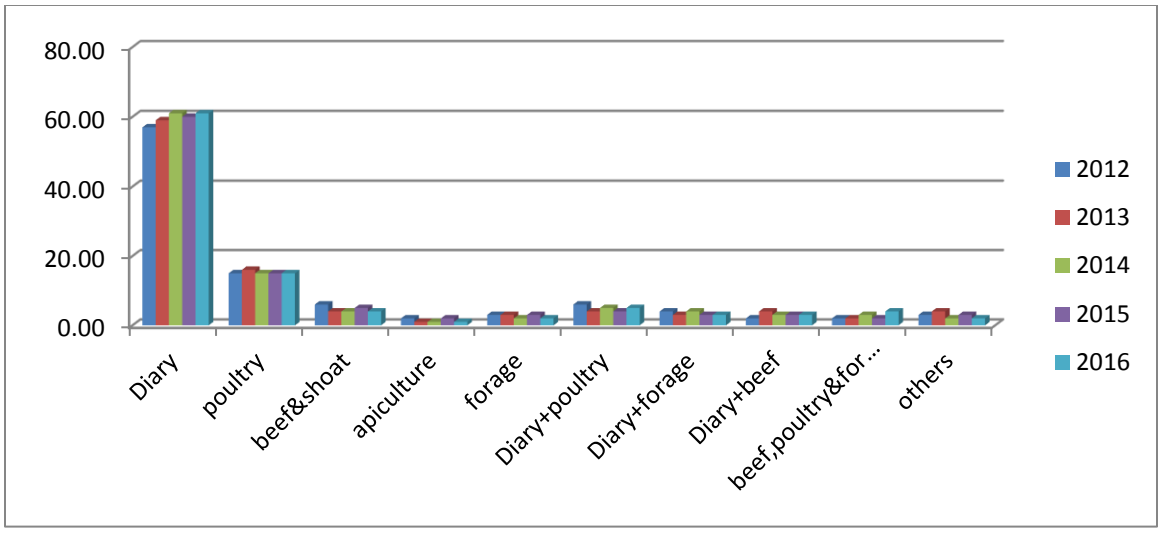

Figure 3: Trend Analysis of Participant Households in Livestock Production and Forage Development (percentage)

Source: Hossana town agricultural development office report, 2016

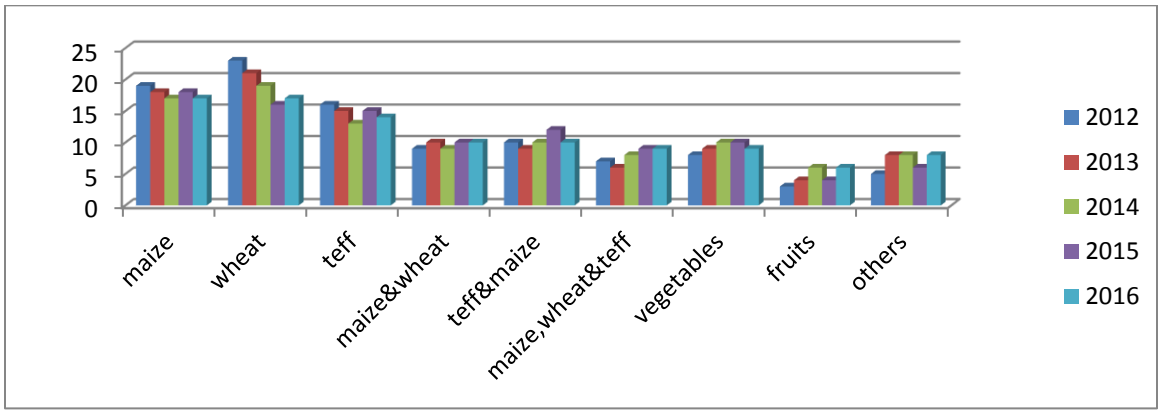

Figure 4: Trend Analysis of Participant Households in Crops Production, Vegetables and Fruits

Source: Hossana town agricultural development office report, 2016

Generally, it is indicated in Figure5revealedthat percentage of participation of households in urban agriculture is characterized by different trends such increasing, decreasing and constant. We can realize that the percentage of participants in livestock production has an increasing trend especially dairy and poultry whereas in crop production has a decreasing

trend but not vegetables and fruits from the year 2012 up to 2016. Thus, this result shows that livestock production highly substitutes crop production in urban areas.

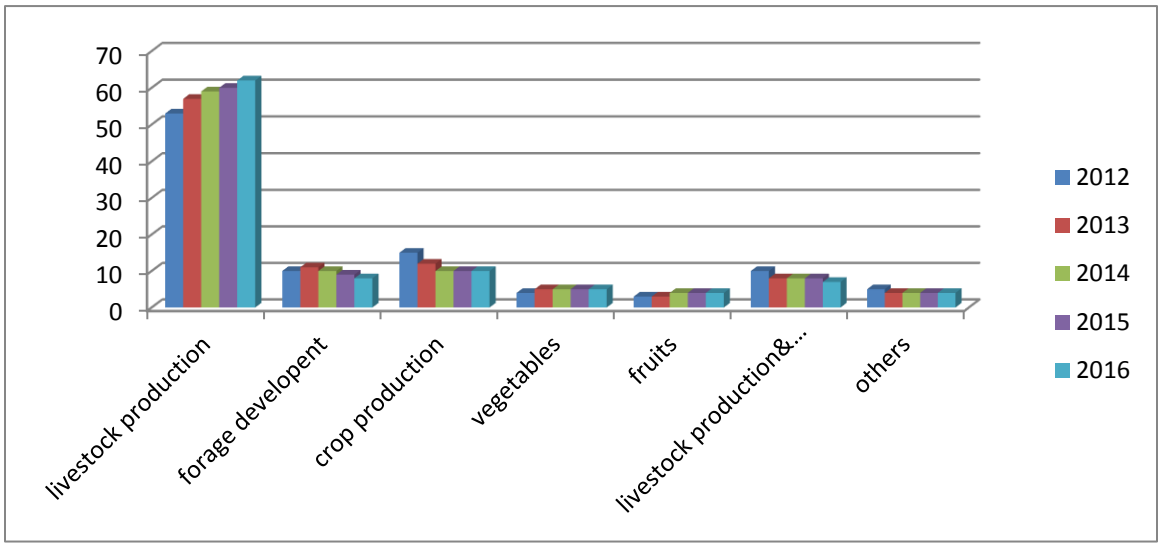

Figure 5: Trend Analysis of Participant Households in Livestock Production, Forage Development, Crop Production, Fruits & Vegetables (percentage distribution)

Source: Hossana town agricultural development office report, 2016

4.1.5. Contribution of Urban Agriculture to Households

4.1.5.1. Reasons of Practicing Urban Agriculture

Table 15: Objectives of Households to Engage in Urban Agriculture

	Frequency		
Description	Yes	No	Total
To generate additional income	75(43%)	101(57%)	176(100%)
Major source of livelihood	83(47.2%)	93(52.8%)	176(100%)
For survival strategy	36(20.4%)	140(79.6%)	176(100%)

Source: Own computation based on data, 2017

In Table 15, people are engaged in urban agriculture for three reasons: a major source of livelihood (47.2%), an additional source of livelihood or part-time job (43%), and survival or adaptive strategy (20.4%). This implies that urban people of Hossana town consider urban agriculture as an important activity for their living. Urban dwellers carry

out production for personal consumption of products, income augmentation, and income or asset diversification and to counter the effects of economic crises and food inflation. Urban Agriculture yields both direct income through sales and indirect income through reduction of expenditures on food. Urban agriculture offers direct and indirect employment opportunities.

4.2. Econometric Models Results

4.2.1. Multicollinearity Test

Prior to running the logistic regression model to estimate propensity scores, the explanatory variables were checked for the existence of severing multicollinearity problem. A technique of Variance Inflation Factor (VIF) was calculated to detect the problem of Multicollinearity among continuous explanatory variables. Accordingly, the VIF (X_i) result shows that the data had no serious problem of multicollinearity. This is because, for all continuous explanatory variables, the values of VIF were by far less than 10. Furthermore; correlation matrix shows that there is no high correlation between all explanatory variables and less than 0.8. This also detects that there is no a serious multicollinearity problem so that all the explanatory variables were included in the model. Heteroskedasticity test was done using Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and the P-value was 0.516 which is insignificant implying the absence of the problem of heteroskedasticity (refer Appendix II).

4.2.2. Binary Logistic Model Results

A binary logistic regression model was used to estimate and identify determinants of participation in urban agriculture and propensity score matching model was used to analyze the impact of urban agriculture on poverty reduction. Before fitting both models, it is essential to check whether there is or not a high degree of association among and between both discrete and continuous explanatory variables. In logistic regression contained a binary outcome and discreet or continuous explanatory variables. For each explanatory variable in the model, there would be an associated parameter. The Wald test by Angrist & Imbens(1995) is used to test whether the parameter associated with an explanatory variable is zero or not. If the parameter of the explanatory variable

significantly differs from zero then associated variable should be included in the model. Therefore, all explanatory coefficients were greater than zero.

The goodness fit of the model for the binary logistic regression model, an intuitively appealing way to summarize the result of the fitted logistic model is via a classification table. This cross-classification is the result of cross-classification of the outcome variable 'y" with a dichotomous variable whose values are derived from the estimated logistic probabilities. With regard to the predictive efficiency of the models out of 176 sample household include in the model, 128 (73%) were correctly predicted. The sensitivity and specificity indicate that 71% of a participant of urban agriculture and 75% of non-participant of urban agriculture households were correctly predicted in their categories respectively.

With regard to the error rates committed in the classification table, the false positive rate (number error where the household is predicted to be participant, but it is, in fact, non -participant) is 28.05% while the false negative rate (the number of error where the false household is predicted to be non -participant, but it is, in fact, participant) is 25.53%. This result is thought to provide evidence that the model fits (see Appendix III).

4.2.2 .1.Main Factors that Affecting Participation in Urban Agriculture

In this subsection, we treat results concerning participation household level as well as the socio-economic, demographic and other factors that affect the participation behavior of households. The main purpose of this section is to specify a logistic regression model fitted to identify the potential factors affecting participation in urban agriculture in the study area. The variables such as age, sex, household size, land size, educational status, other income, access to credit, access to water, access to extension services, and access to improved inputs are used to estimate the logistic regression model. Using participation in urban agriculture as a dependent variable whereby a value of 1 is given to households belonging to participant urban households and 0 for the non-participant urban households. Accordingly, the model uses 10 explanatory variables and the model was estimated by the following likelihood estimation procedure. The results of the logistic regression model estimates indicate that out of the 10 factors included, 6variables were

found to have a significant influence on the probability of participating in urban agriculture at less than 10% probability level. The variables considered were household size, income from other sources, access to credit, access to extension services, access to water and access to improved inputs. The remaining four of the 10 explanatory variables were found to have no significant influence on the probability of participating in urban agriculture. The significant explanatory variables which have an effect on participation in urban agriculture are discussed below.

Table 16: Summary of Results for Binary Logit Model Estimates Factor Affecting Participation in Urban Agriculture

Variables		Robust Coefficient	Odds Ratio	Z-value	P>|z|	Marginal effect(dy/dx)
Constant		-1.88962	0.1511292	-1.05	0.295	
SEX		0.534432	1.706479	1.46	0.144	0.1320743
AGE		-0 .0026498	0.9894035	-0.39	0.698	-0.0026498
Education	Edu (1)	-0.3865054	0.679427	-0.51	0.607	-0.0949036
	Edu (2)	-0.3252433	0.7223516	-0.46	0.648	-0.0805403
	Edu (3)	0.7046345	2.023107	0.93	0.352	0.1743573
Household size(HZ)		0.3248332**	1.3838	2..32	0.020	0.080799
Land size(LS)		3.563548	35.28819	1.03	0.305	0.8863968
Income from other sources (IOS)		-0.000282**	0.9997181	-1.98	0.048	-0.0000701
Access to credit(AC)		0 .6904981*	1.994709	1.71	0.087	0.17093
Access to water(AW)		0.9892982**	2.689239	2.35	0.019	0.2421024
Access to extension services(AES)		0.9379242**	2.554673	2.40	0.017	0.2301116
Access to improved inputs(AII)		0.8003671*	2.226358	1.82	0.069	0.1973889
					Number of obs =	176
					Waldchi2(12) =	40.55
Log likelihood = -97.47786						

***&* are Statistical significant at p<5% and p<10% respectively*

Family Size: Among the important demographic variables, family size is to be highly significant in determining the probability of urban households' participation in urban

agriculture in the study area. This variable is positively associated with the participation in urban agriculture and significant at the probability level of 5%. Marginal effect is 0.08(Table 16), that implies the being other things constant, as family size increased by one person, the probability of household participating in urban agriculture increased by 8percent. This result matches with the finding of Jongwe (2013) that states increase in household size increases vulnerability and leads to households venturing into urban agriculture as a coping mechanism.

Other Income: It represents the amount of income earned from other activities rather than agriculture in cash or in kind within the year. In the study area, the household head gets a better income from other activities then there is less probability of being a venture in urban agriculture. Accordingly, in the study area, the participation of urban households and their family members in urban agriculture is highly determined by their ability to not get access to other job opportunities. The result suggests that households engaged in other activities are endowed with higher income and less likely to participate in urban agriculture. Consistent with the expectation, income from other sources (other income) is negatively and significantly associated with urban households at a probability level of 5%. The probabilities of urban households to be participating in urban agriculture decreases by a factor of 1.00 as the urban households obtain more unit of other income.

Access to Credit: credit is an important source of investment on activities that generate income for urban households. The households can purchase agricultural inputs like improved seeds, fertilizer, and livestock for resale after fattening. Households who have access to credit could increase their production to escape poverty. The logit model analysis revealed that credit has a significant positive association with participation in urban agriculture at a probability level of 10%. This result agreed with the prior expectation about access to credit service. This is because urban households who have the opportunity of accessing farm credit would build their capacity to produce more through purchasing of agricultural inputs. The households with more access to farm credits have the possibility to participate in urban agriculture than those who have no access to credit. The odds ratio in favor of participation in urban agriculture increases; other things remain constant, by a factor of 2.0as far households get access to farm credit.

Access to Water: it is positively related to the participation of urban agriculture practice. This variable is significant at 5% probability level. The Odds ratio is 2.7 (Table 16), this is that household heads who had water access are approximately three times more likely to participate in urban agriculture as compared to household heads who did not have it. Jacobi, Amend, & Kiango(1999) suggested that access to resources, above all water, is the major constraint for urban agriculture.

Access to Improved Inputs: it is significant at the 10% level of significance. Improved agricultural inputs refer to household heads get recommended inputs, improved seeds and improved diseases and pests management practices. The odds ratio is 2.2(Table 16), this is that households who got improved inputs are about two times more likely to participate in urban agriculture as compared to households who did not get.

Access to Extension Services: it is positively related to participation in urban agriculture practice. This variable is significant at 5% probability level. The odds ratio is 2.6 (Table 16), this is that household heads who are involved in extension services are nearly three times more likely to participate in urban agriculture as compared to household heads who are not involved in extension services. The main reasons for possible factor in urban households' decision to participate in urban agriculture and their level of production since urban households receive a number of services from extension services, including technical services on its production.

4.2.3. Impact Analysis of Propensity Score Matching

Some importance of estimation of the propensity score are: to estimate the ATT and to obtain matched treated and non-treated observations. Thus, propensity score methods allow the researcher to directly address the question of what can be earned from participants and the loss of being non-participants. According to Grilli & Rampichini (2011), the necessary steps when implementing propensity score matching are: Propensity score estimation, Choose matching algorithm, Check overlap/common support. Thus, to analyze the impact of participation in urban agriculture practice on urban households' consumption expenditure and their durable asset building (poverty reduction), propensity score matching with different matching algorithms namely: nearest neighborhood,

caliper, and kernel matching were employed. Matching of the participant and non-participant households were carried out to find out the common support region. The basic principle for determining the common support region is to be deleting all observations whose propensity score is smaller than the minimum propensity scores of participants and larger than the maximum in the control group (Caliendo & Kopeinig, 2008).That is, deleting all observations out of the overlapping region.

Table 17: Predict Propensity Score Common Support Region

Observations	Mean	Std. Dev.	Min	Max
Non-participant	0.3729129	0.2006117	0.1175179	0.866362
Participant	0.5813284	0.2052649	0.117418	0.87881154
Total	0.4711469	0.22755166	0.117418	0.8781154

Source: Own computation based data, 2017

The summary statistics of propensity scores of urban households (Table 17), the predicted propensity scores range from 0.117418 to 0.87881154 with a mean value of 0.5813284 and standard deviation0.2052649 for the participant households, while it ranges from 0.1175179 to 0.866362 with a mean value of 0.3729129 and standard deviation 0.2006117 for those non- participant households. Accordingly, the common support region was satisfied in the range of 0.117418 to 0.866362by dumping 23observations (13 from those participants and 10 from those non-participant households) (see Appendix V& VII).

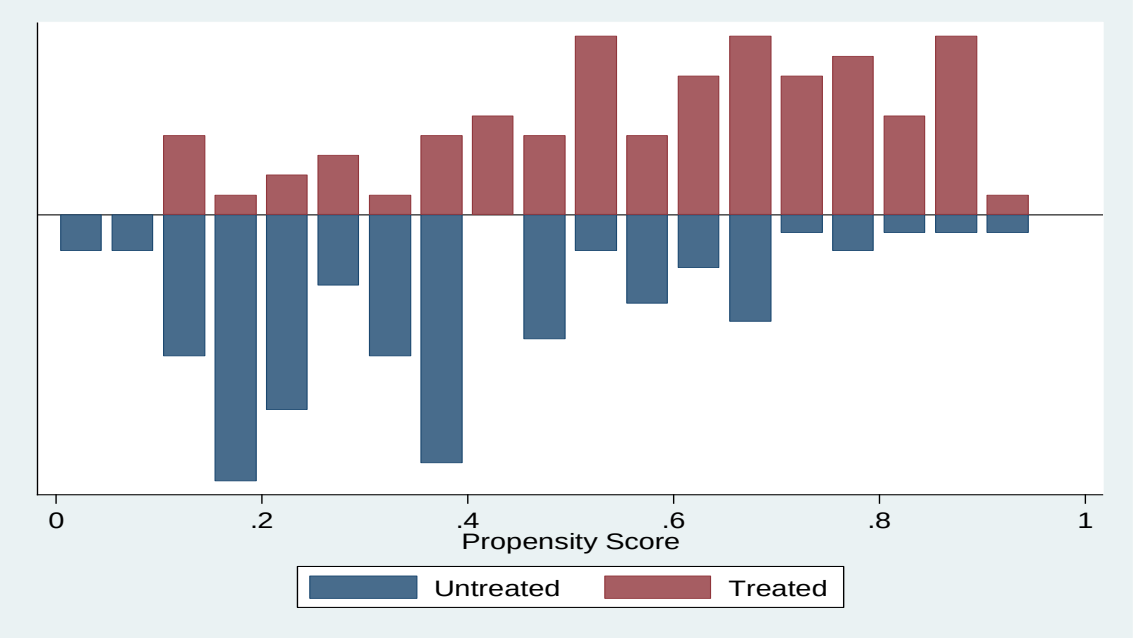

Figure 6: Propensity Score Distribution of Sample Households before Matching

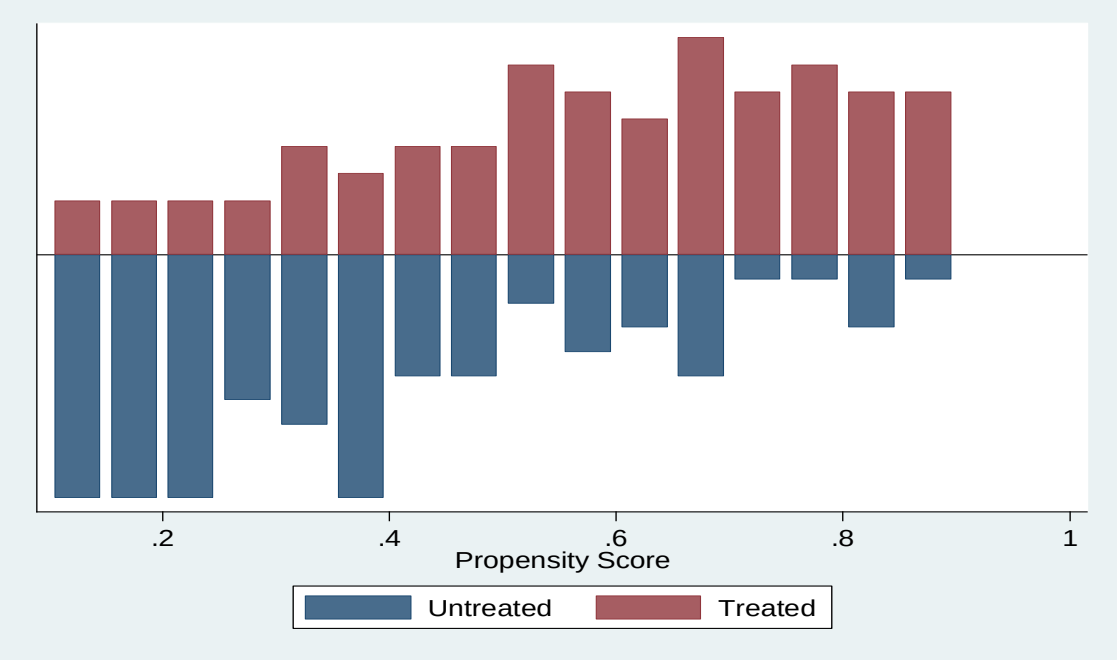

Figure 7: Propensity Score Distribution of Matched Sample Households

Source: Own computation based data, 2017

4.2.3.1. Matching Algorithms of Participant and Non-Participant Households

It is known that choice of matching estimator is decided based on the balancing qualities of the estimators. According to Dehja & Wehba (1999), the final choice of a matching estimator was guided by different criteria such as equal means test referred to as the balancing test, pseudo-R^2 and matched sample size. The balancing test is a test conducted to know whether there is a statistically significant difference in the mean value of per-treatment characteristics of the two groups of the respondents and preferred when there is no significant difference.

Accordingly, matching estimators were evaluated via matching the participant and non-participant households in common support region. Therefore, a matching estimator having balanced (insignificant mean differences in all explanatory variables) mean, bears a low pseudo R^2 value and the one that results in large matched sample size is preferred.

Table 18: Performance of Matching Estimators for Sample Households

Performance Criteria						
Outcome variables	Matching algorithms	Balancing Test	Pseudo-R2	Matched sample size		
				Participants	Non-participants	Total
Consumption expenditure Per adult equivalent	NNM (1)	9	0.049	70	83	153
	NNM (4)	10	0.021	70	83	153
	NNM (5)	10	0.021	70	83	153
	CM (0.01)	10	0.047	57	62	119
	CM (0.25)	9	0.049	70	83	153
	CM (0.5)	9	0.049	70	83	153
	KM (0.01)	10	0.015	57	62	119
	KM (0.1)	**10**	**0.006**	**70**	**83**	**153**

	KM (0.5)	7	0.061	70	83	153
Durable asset building Per capita	NNM (3)	9	0.049	70	83	153
	NNM (4)	10	0.021	70	83	153
	NNM (5)	10	0.021	70	83	153
	CM (0.01)	10	0.047	57	62	119
	CM (0.25)	9	0.049	70	83	153
	CM (0.5)	9	0.049	70	83	153
	KM (0.01)	10	0.015	57	62	119
	KM (0.1)	**10**	**0.006**	**70**	**83**	**153**
	KM (0.25)	7	0.061	70	83	153

Source: Own computation, 2017

4.2.3.2. Estimation of Treatment Effect

Choice of the matching algorithm was carried out from the nearest neighbor, caliper, and kernel methods. The choice of the estimator based on three criteria; namely, balancing test, Pseudo R-square and matched sample size. The matching estimator which balances more independent variables has low pseudo- R^2value and a result in large matched sample was chosen as being the best estimator of the data. Accordingly, kernel matching method with of (0.1) was found to be the best estimator of the data of consumption expenditure and asset building of urban agriculture practice (Table 18). As depicted in the table, relatively, this estimator resulted in the least pseudo- R^2 value (0.006), a large number of matched sample size and having balanced (insignificant mean differences in all explanatory variables).

Table 19: Average Treatment Effect on the Treated

Variable sample		Treated	Controls	Difference	S. E	T-stat
Ceae	Unmatched	1504.85135	1111.31325	393.538098	45.3319816	8.68
	ATT	1515.52857	1083.10162	432.426948	54.9171077	7.87*
Abc	Unmatched	3.93243243	2.79518072	1.13725171	0.175224815	6.49
	ATT	3.94285714	2.8416805	1.10117664	0.211180233	5.21*

Source: Own computation, 2017

As showed (Table 19), the Average Treatment effect on the Treated (ATT) was computed based on kernel (0.1) matching method. Outcome variables are consumption expenditure per adult equivalent and asset building per capita which are measured in Ethiopia Birr and in unit respectively. The impact of urban agriculture on poverty reduction (by using household consumption expenditure) was based on a sample of matched treated and control groups, the estimated average treatment effect (ATT) significant effect on expenditure of participant households with significant t - statistic (7.87) at 1 percent significance level ($p< 0.001$). The average consumption expenditure of participant households in urban agriculture practice was higher by 432birr per adult equivalent in given monthly expenditure when compared with the average consumption expenditure of non-participant households, which was similar result with Belete(2015) finding that stated the urban agriculture yields both direct income through sales and indirect income through reduction of expenditures on food to participants.

The kernel (0.1) matching method result revealed that the durable asset building of the urban households who were the participant of urban agriculture practice was much greater with one unit per person than non-participants in given period. From the Table19, it is clear that the average treatment effect on the treated (ATT) of average consumption expenditure with t-value 7.87 and asset building with t-value 5.21, indicating the effective level of significance. So it is concluded in this analysis that the participation in urban agriculture practice has positive consumption expenditure and asset building effect on the participant households in the study area. Therefore, participation in urban agriculture has a positive impact on the life of the participants indicating positive welfare effect or reducing poverty on the side of participants (see Appendix VII).

4.2.3.3. Sensitivity Test for Average Treatment Effect on the Treated

Sensitivity analysis is a strong identifying assumption and must be justified. According to Grilli & Rampichini (2011), sensitivity analysis is the final diagnostic that must be performed to check the sensitivity of the estimated treatment effect to small changes in the specification of the propensity score. In Appendix-VIII (A), the result was reported, based on this concept of the sensitivity analysis shows that the effect of treatment at Γ = 1; it has similar value in Qmh+ bound and Qmh- bound (Γ = 1=no hidden bias) andso it is significant treatment. The treatment effect in Qmh+ is significant at 10% starting fromΓ value 1.3 up to 2. This shows that average treatment effect on treated is insensitive to external change. Hence, there are no external variables which affect the result above calculated for ATT (asset building per capita) in this range.

Moreover, in Appendix VIII (B), the Q_mh+ statistic adjusts the MH (Mantel-Haenszel) statistic downward for the case of positive (unobserved) selection while Q_mh- statistic adjusts the MH statistic downward for the case of negative (unobserved) selection. From the table result, under the assumption of no hidden bias (Γ = 1), the Q_mh+ and Q_mh- test-statistic gives a similar result, indicating a significant treatment effect. This is also the case for the different bound of odds of differential assignment due to unobserved factors. The negative values of Q_mh+, therefore indicate negative selection bias where the most likely participants of urban agriculture production tend to have lower income even in the absence of participation. This, therefore, can be interpreted as downward bias in estimated treatment effects. This bias is however not significant at different bound levels both for likely underestimation of the treatment effects and overestimation of the treatment effects as indicated by Pmh + and P_mh - values. It also shows that the study was insensitive to a bias that will double or triple the odds of a change in consumption expenditure per adult equivalent as a result of the urban agriculture practice. We can, therefore, conclude that the results are insensitive to possible deviations emanating from the identified unconfoundedness assumption and therefore it holds shown to have a positive significant impact on consumption expenditure per adult equivalent it should be promoted among urban households as a way of improving their livelihoods or reducing poverty (see Appendix VIII).

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This study compared the participants and non-participants differences achieved from urban agriculture practice or production. And it also identified factors that affected the urban households' participation in urban agriculture practice (production). Therefore, in this section summarizes the major findings of the study and proposes recommendations for Planning and policy purpose. Policy- makers and planners of the program who want to plan as well as policy make they can use urban agriculture practice how it brings better change on poverty reduction which means in this research it was found that households who participate in urban agriculture practice are better off in consumption expenditure(income) and their durable asset building.

5.1. Conclusions

Around 200 million city dwellers produce food for the urban market, which is 15–20 percent of total global food production. Urban and Peri-urban agricultural productions contribute to the economic development through income and employment generation, food security, asset accumulation, poverty reduction and improving human nutrition and health. In this research, we evaluated the impact of urban agriculture on urban households' poverty. The results revealed that urban agriculture increases income for low-income groups by providing an important share of households' consumption, i.e., reducing their expenses in food, by selling the products they produce to generate income which may be used to build durable assets, or to the purchase of food.

Both descriptive and econometric methods were employed for data analysis. A propensity score matching approach was used to compare participant households with non- participants in terms of two key measures of household wellbeing; consumption expenditure as measured in Ethiopia Birr per adult equivalent and asset building as a unit per capita as a proxy for household level poverty status. The matching techniques were employed such as the nearest neighborhoods matching, caliper matching and kernel matching.

Among the algorithms used, kernel (0.1) matching was to be the best estimator of data based on balancing test, pseudo $R^2$and sample size. The results showed that urban agricultural practice had significantly positive impact on households' consumption and asset building. Furthermore, factors such as income from other sources (other income), household size, access to extension services, access to water, access to improved inputs and access to credit were found to be important variables to determine urban households to participate. The sensitivity analysis also showed that the estimates are almost free from unobserved covariates in gamma range 1.3 to 2 and completely insensitive on ATT of asset building per person and consumption expenditure per adult equivalent respectively.

The implication of the findings is straightforward; even if the participation of urban agriculture practice is quite low in Hossana town, those households who could use practice could improve their consumption expenditure and asset building through urban agriculture production. Hence, scaling up the best practices of the participants to other urban households can be considered as one option to enhance poverty reduction in the area.

5.2. Recommendations

Understanding the factors that influence or hinder urban agriculture practice participation is essential in planning and executing related programs for meeting the challenges of urban agricultural production in our country. Therefore, to enhance urban agriculture practice participation by urban households, it's important for policy- makers and planners of practice to understand households need as well as their ability to participate practice in order to come up with a practice that will suit them. It is better to encourage urban agriculture practice because the results of this study signified that the production from urban agriculture practice increases substantially both the consumption expenditure (income) and asset building of participants.

Based on the results of this research, the following core points are presented as recommendations to improve production from urban agriculture practice.

The agricultural research and extension activities need to consider improved agronomic practices along with urban agriculture in order to increase its production, and for the successful promotion, improvement and scaling up of good agronomic practices and extension should contact households individually as well as in group to be awarded in terms of urban agriculture is suitable to improve households' income and their asset building.

To attain poverty reduction of the nation, policy-makers should devise more effective urban households' training mechanisms and provide more applicable urban agriculture practice mechanization effective on the process of its production.

Frequent and continuous training, technical advice and material support should be provided by the government to urban households to enhance the productivity and economic viability of urban agriculture.

Urban households should emphasize on the specific types of crops and animals which are more profitable and most important to urban agriculture. For example, it should be given more emphasis for dairy farming, poultry, and tree which bear fruits.

Urban households should be advised on good agricultural practices, suitable sites for farming, suitable crops, methods of cultivation, soil conservation techniques and improved live stocks managements by experts and agricultural extension services should be provided to the urban households.

Households in urban areas should be taught by concerned bodies about the importance of urban agriculture as a source of food supply, urban job creation, and income generation. Moreover, the issue of urban agriculture should not be only the scientific and research concern but also it should be urban poverty reduction and policy agenda.

Government and NGOs could enhance the productivity of urban agriculture through creating awareness to urban households by providing appropriate improved farm inputs which are recommended fertilizer use, improved seeds, improved diseases and pesticides management practices that would help to address poverty.

Promoting use of credit and finance to urban households, the researcher recommends that the land use and administration of job process to formulate policy or strategy that tend to favor individual's land rights because this property rights structure is presumed to lead to more efficient forms of land use, as well as provide the property owners the ability to use the land as collateral for credit and they can be used the land as collateral for getting a loan. They can use money that is obtained from borrowing in order to participate in urban agriculture and it also uses to increase agricultural production.

Water was found as one of important constraint that hinders urban households to not participate in urban agriculture practice in the study area. Hence, alternative water sources should be strengthened through digging wheel water and use low-cost water for urban agriculture production.

The introduction of the above measures into the picture of urban agriculture practice which it could enhance the number of participants and the productivity under urban agriculture practice. Thus, expansion in the level of urban agriculture practice would consequently result in increased substantial urban agriculture production and income on a sustainable basis.

5.3. Future Research Directions

The researcher has used not only the cross-sectional data but also consecutive five years data to attain the objectives in the study. The latter is used to show the extent of participation of households in urban agriculture, however, the researcher didn’t see the extent of production of households in urban agriculture since it is difficult to get data. Moreover, this study considered only a single town so that it may not fully represent the impact of urban agriculture in different towns or different cities of Ethiopia. Hence, any researcher who is interested in investing related topic or similar topic should use panel data from different cities or towns, at least sufficient time series data in city or town in order to evaluate the impact of urban on urban poverty reduction thoroughly. Lastly but not least, this study also does not show the linkage between urban and rural agriculture on poverty reduction so that it may be considered for future research direction

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APPENDICES

Title: Impact of Urban Agriculture on Poverty Reduction among Households in Hossana Town of Hadiya Zone, Southern Ethiopia

JIMMA UNIVERSITY

DEPARTMENT OF ECONOMICS

ECONOMIC POLICY ANALYSIS (MSc)

Appendix I: Questionnaire (Interview Schedule)

Date of interview: ----------

1. Name of the Interviewer: ----------Sign: ----------

2. Name of the respondent: ---------- HH ID ----------

3. Name of kebele----------Code----------

I. Household Characteristics

S.No			Remarks
1.	Sex of household head	1.male 2.female	
2.	Age of household head	----------years.	
3.	Religion of household head	1.Christian (Orthodox) 2. Christian (Protestant) 3. Christian (Catholic) 4. Muslim 5. Others (specify)	
4.	Ethnicity of household head	----------	
5.	Marital status of household head	1. Single 2. Married 3. Divorced 4. Widowed	
6.	Family size(The number of household members including household head)	1.Total males--------	Age 1.Under 10 years:---------- 2.B/n 10 and 13: --

			3.B/n 14 and 16: ---- 4.B/n17 and 50: -- 5.Above 50: ----------
		2. Total females----------	Age 1.Under 10 years: ------ 2.B/n 10 and 13:---- 3.Between 14 and 16:-- 4.Between 17 and 50: -- 5.Above 50: ----------
		Ground Total----------	
7.	Education status attained by household head	1.Illiterate 2.Grade1 to 8(primary) 3.Grade 9 to 12(Secondary) 4.Above grade12	

II. General information on urban agriculture

8	Have you ever participated in urban agriculture?	1.Yes 2. No	
9	If your answer in Q.9 is yes then what type of activity of urban agriculture practiced by the family	1.poultry 2.beekeeping 3. Dairy 4. Fattening 5.wheat 6. Teff 7.Maize 8.bean 9. sorghum 10. Banana 11. Avocado 12. cabbage 13. carrot 14. onion	
10.	When did you start to engage in urban agriculture?	1. About----------month/s 2. About----------year/s 3. I don't remember	
11	Who did initiate you to engage in urban agriculture?	1. Own interest; 2. Government support 3.awareness and training from non- governmental organizations	

		4. Others specify_____	
12	What is the reason for you to start urban agriculture?	1. Low food supply for HH; 2. Unemployment; 3.Low income 4. Others specify	
13	What is the main objective of the HH to engage in Urban Agriculture?	1. Major Source of livelihood 2. Additional source of livelihood/part time job 3. Survival/adaptive strategy 4.Others specify_____	
14	What is the ultimate use of urban agriculture products?	1.HH food supply/own consumption 2. Market sale 3. Both 1 and 2 4. Leisure	
15	What are the products of the urban agriculture undergone by Your household?	1.---------- 2.---------- 3.----------	
16	Who did contribute labor for the farm undergone?	1. Family labor; 2. Hired labor	
17	To whom do you sell your product?	1. Consumers; 2. Wholesalers; 3. Retailers	
18	Where is the market place for sell of urban agriculture products in the area	1.'Melibera 'market 2. Small market with in town 3. informal market based on negotiation 4.others (specify)	

III. Poverty Indicators

1. Assets building (human capital, physical capital, productive capital)

19. Is the household income changed/improved due to your engagement in urban agriculture? 1. Yes 2. No

20. If yes to Q19 above, can you give information of your yearly/monthly income that did you obtain fromthe urban agriculture activities? _____Birr per month

21. Did you participate in other activities (apart from urban agriculture)?

1. Yes 2. No

22. If yes for Q 21 above, what are the other sources of income for your family?

1. Employee government/private firm

2. Remittance

3. Petty trading

4. Others specify _____

23. How much income is earned from other activities)? ----------Birr per month

24. Did you use other income sources to enhance urban agriculture? 1. Yes 2. No

25. If yes toQ24, what purposes do you use? ----------

26. How much is your farm land size or land size (Vacant space) to be used for urban agriculture? ---------- (per hectare)

27. How much is total income earning ----------birr per month?

28. How many of the following assets are owned by your household? If "Yes" use "1" or "No" use "2"

1.Table and chair		7.Large electric stove(mitad)		13. Bicycle	
2.Sofa set		8. Small gas stove		14.Compute r	
3.Radio only (working		9. Refrigerator/freeze r		15. Motorcycle	
4.Televisoi n		10. Jeweler		16.. Car	
5.Stallite Dish		11. Sewing/ Knitting Machine		17. Cell phone	
6. Radio with		12. Cart		18. Beds	

CD/DVD Player					
19.No primary school completed persons	Quantity----------	No secondary school completed persons	Quantity----------	No persons above secondary school attainment	Quantity----------
20. Grain storage		21. Hoe and Digger		22 Plough	
23. Ox-Yoke		24. Axe		25. Sickle	
26. Spade		27. Modem beehive		28. Water pump	
29. cow		30. chick		31.ox	
32. Heifer		33.Goat		34.sheep	

35. Type of dwelling house 1. Muddy wall and corrugated roof 2. Bricks wall and corrugated roof 3. Others (specify)

1. *Expenses category*

A. Food consumption expenditure per month

Items	1=Yes 2=No	How much in total did your household eat per month?			How much came from purchases?			How much came			Other sources		
Cereals, Grains and		Quantity per (kg,litre,No)	unit price	Expense(birr)	Quantity per (kg,litre,No)	U.p	Expenses(birr)	Quantity per (kg,litre,No)	U.p	Expenses(birr)	Quantity per (kg,litre,No)	u.p	Expenses
Teff													
Wheat													
Barley													
Maize													

Sorghum													
Millet													
Vegetable													
Onion													
Garlic													
Potato													
Tomato													
Cabbage													
Carrot													
Selata													
Fruit													
Banana													
Mango													
Orange													
Avocado													

Guava													
Animal product													
Eggs													
Milk													
Beef													
Chicken													
Butter													
Honey													
Other													
Sugar													
Cooking oil													
Local areki													
Salt													
Coffee													
Local beer													

Beer													
'Coc ho'													
'Bull a'													

B.Non-food consumption expenditure (per month)

Did your household buy or pay any (Items)?	1=yes 2=no	How much did	Remark
Matches			
Batteries			
Candles, incense			
Laundry soap/Omo			
Hand soap			
Charcoal			
Firewood			
Cigarettes, tobacco,			
Transport			
House rent			
Water fee			
Electricity			
Hear dressing			
Hair food			
Other, specify			

C. Non-food expenditures per year

Did your household buy or pay any (Items)?	1=yes 2=no	How much did	Remark
Clothes/shoes/fabric for MEN			
Clothes/shoes/fabric for WOMEN			
Clothes/shoes/fabric for BOYS			
Clothes/shoes/fabric for GIRLS			
Kitchen equipment (cooking pots, etc.)			
Lamp/torch			
Contributions to IDDIR			
Donations to the church/mosque			
Blanket/bed sheet			
Umbrella			
School fee			
Stationary Materials (exercise books, pen and books)			
School Uniform			
Land tax and other levies			
Funeral expense			
Health expense			
Marriage ceremony- gift			
House maintenance			

IV. Institutional factors

29. Have you received any support from Development agents (experts)? 1. Yes 2. No

30. If yes, what are the supports given? 1. Advice 2. Experience sharing 3. Training (technical) 4. Other Specify…….

31. Do you have access to credit to be engaged in agricultural activities? 1. Yes 2. No

32. If yes to Q31, what are the sources? 1. Cooperatives 2. Local leaders 3. Microfinance institute 4. Neighbors and relatives 5. Other specify……

33. For what purpose you have used the credit money? 1. Purchase of inputs (seeds, livestock breeds, fertilizer, chemicals, drugs) 2. Renting of land 3. Consumption expenditure 4. other specify

34. If No, why not? 1. No collateral 2. No access to credit supply 3. High cost of access to credit 4. No need 5. Others specify ……

35. Do you have access to improved inputs to be participated in urban agriculture? 1. Yes 2. No

36. If Yes for Q 35 above, what are the sources of your access in order to get improved inputs?1. Government organizations (Hadiya zone Agriculture Development Department, Hossana Town Agriculture Development Office)2. NGOS 3. Othersspecify

37. Do you have access to water to be engaged in urban agriculture? 1. Yes 2. No

38. If your answer is yes in Q39 what are them? 1. Spring water 2. River water 3. Wheel water 4. Tape water 5. Other specify

39. What purpose do you use water 1. For domestic consumption 2. For production of vegetables and fruits 3.For feeding livestock 4 . Other specify

Appendix II: Correlation, Multicollinearity and Hetroscedasticity

. corr sex age edu hz ls ios ac aw aes aii

(obs=176)

	sex	age	edu	hz	ls	ios	ac	aw	aes	aii
sex	1.0000									
age	-0.1145	1.0000								
edu	0.0927	-0.2204	1.0000							
hz	-0.0166	0.0381	0.0810	1.0000						
ls	-0.1219	0.1546	-0.1885	-0.0065	1.0000					
ios	-0.0599	-0.0054	0.0492	-0.1252	0.0730	1.0000				
ac	0.0278	0.0443	-0.0962	0.0209	0.0493	0.0604	1.0000			
aw	-0.0215	-0.0066	-0.0571	-0.0589	0.0599	-0.0602	0.0615	1.0000		
aes	0.1662	-0.0742	-0.0979	-0.1013	-0.0832	0.0431	0.1628	0.2086	1.0000	
aii	0.1068	-0.0328	-0.0170	0.0051	0.1965	-0.0225	0.2466	0.2932	0.0869	1.0000

- **Continuous variables**

```
. vif
```

Variable	VIF	1/VIF
edu	1.09	0.914240
age	1.07	0.935097
ls	1.06	0.944186
hz	1.03	0.973153
ios	1.03	0.973541
Mean VIF	1.06	

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ua

         chi2(1)      =     0.42
         Prob > chi2  =   0.5163

. ovtest


Ramsey RESET test using powers of the fitted values of ua
      Ho:  model has no omitted variables
                F(3, 162) =      1.30
                Prob > F =      0.2755
```

Appendix- III: Logistic Model, Marginal Result and Model fitness

```
. xi:logit ua i.edu sex aes aii aw ac (age ls hz ios),r
i.edu             _Iedu_0-3           (naturally coded; _Iedu_0 omitted)

Iteration 0:   log pseudolikelihood = -121.70966
Iteration 1:   log pseudolikelihood = -97.683379
Iteration 2:   log pseudolikelihood =  -97.47852
Iteration 3:   log pseudolikelihood =  -97.47786
Iteration 4:   log pseudolikelihood =  -97.47786

Logistic regression                               Number of obs   =        176
                                                  Wald chi2(12)   =      40.55
                                                  Prob > chi2     =     0.0001
Log pseudolikelihood =  -97.47786                 Pseudo R2       =     0.1991
```

ua	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Iedu_1	-.3865054	.7514203	-0.51	0.607	-1.859262	1.086251
_Iedu_2	-.3252433	.7127151	-0.46	0.648	-1.722139	1.071653
_Iedu_3	.7046345	.7570179	0.93	0.352	-.7790934	2.188362
sex	.534432	.3661163	1.46	0.144	-.1831428	1.252007
aes	.9379242	.3912241	2.40	0.017	.1711391	1.704709
aii	.8003671	.4400022	1.82	0.069	-.0620214	1.662756
aw	.9892582	.4215303	2.35	0.019	.1630741	1.815442
ac	.6904981	.403389	1.71	0.087	-.1001297	1.481126
age	-.010653	.02742	-0.39	0.698	-.0643952	.0430892
ls	3.563548	3.470636	1.03	0.305	-3.238774	10.36587
hz	.3248332	.1400098	2.32	0.020	.050419	.5992474
ios	-.000282	.0001423	-1.98	0.048	-.0005609	-3.08e-06
_cons	-1.88962	1.803071	-1.05	0.295	-5.423575	1.644334

```
. mfx

Marginal effects after logit
      y  = Pr(ua) (predict)
         =  .46450296
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
_Iedu_1*	-.0949036	.18094	-0.52	0.600	-.449548	.259741	.232955
_Iedu_2*	-.0805403	.17526	-0.46	0.646	-.424035	.262954	.409091
_Iedu_3*	.1743573	.18341	0.95	0.342	-.185129	.533843	.289773
sex*	.1320743	.08932	1.48	0.139	-.042999	.307147	.517045
aes*	.2301116	.09216	2.50	0.013	.049484	.41074	.289773
aii*	.1973889	.10527	1.88	0.061	-.008929	.403707	.272727
aw*	.2421024	.09831	2.46	0.014	.049423	.434782	.284091
ac*	.17093	.09792	1.75	0.081	-.020985	.362845	.295455
age	-.0026498	.00682	-0.39	0.698	-.016017	.010717	45.392
ls	.8863968	.86336	1.03	0.305	-.805755	2.57855	.025767
hz	.080799	.03479	2.32	0.020	.012615	.148983	4.88636
ios	-.0000701	.00004	-1.98	0.047	-.000139	-8.4e-07	2413.86

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. xi:logistic ua i.edu sex aes ac aw aii(age hz ls ios),r
i.edu              _Iedu_0-3           (naturally coded; _Iedu_0 omitted)

Logistic regression                               Number of obs   =        176
                                                  Wald chi2(12)   =      40.55
                                                  Prob > chi2     =     0.0001
Log pseudolikelihood =  -97.47786                 Pseudo R2       =     0.1991
```

ua	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Iedu_1	.679427	.5105352	-0.51	0.607	.1557875	2.963145
_Iedu_2	.7223516	.5148309	-0.46	0.648	.1786835	2.920201
_Iedu_3	2.023107	1.531528	0.93	0.352	.4588218	8.920593
sex	1.706479	.6247697	1.46	0.144	.8326493	3.497354
aes	2.554673	.9994496	2.40	0.017	1.186656	5.499787
ac	1.994709	.8046436	1.71	0.087	.9047201	4.397895
aw	2.689239	1.133596	2.35	0.019	1.177124	6.143793
aii	2.226358	.9796025	1.82	0.069	.9398628	5.273824
age	.9894035	.0271294	-0.39	0.698	.9376344	1.044031
hz	1.3838	.1937455	2.32	0.020	1.051712	1.820748
ls	35.28819	122.4725	1.03	0.305	.0392119	31757.07
ios	.9997181	.0001423	-1.98	0.048	.9994393	.9999969
_cons	.1511292	.2724967	-1.05	0.295	.0044113	5.177562

n

. estat gof, group(10)

Logistic model for ua, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

number of observations = 176
number of groups = 10
Hosmer-Lemeshow chi2(8) = 5.86
Prob > chi2 = 0.6632

. estat classification

Logistic model for ua

Classified	True D	True ~D	Total
+	59	23	82
-	24	70	94
Total	83	93	176

Classified + if predicted Pr(D) >= .5
True D defined as ua != 0

Sensitivity	Pr(+| D)	71.08%
Specificity	Pr(-|~D)	75.27%
Positive predictive value	Pr(D| +)	71.95%
Negative predictive value	Pr(~D| -)	74.47%
False + rate for true ~D	Pr(+|~D)	24.73%
False - rate for true D	Pr(-| D)	28.92%
False + rate for classified +	Pr(~D| +)	28.05%
False - rate for classified -	Pr(D| -)	25.53%
Correctly classified		73.30%

Appendix –IV: Summary Participation in Urban Agriculture of Consumption Expenditure and Asset Building

. tab ua, sum(ceae)

UA	Summary of CEAE		
	Mean	Std. Dev.	Freq.
0	1106.5376	228.70375	93
1	1492.5783	323.58699	83
Total	1288.5909	337.50542	176

. tab ua,sum(abc)

UA	Summary of ABC		
	Mean	Std. Dev.	Freq.
0	2.7849462	.93074844	93
1	3.9638554	1.2634234	83
Total	3.3409091	1.2456678	176

Appendix - V: Summary of Propensity Score of Participation

```
. *summary of ps
.
. sum  _pscore
```

Variable	Obs	Mean	Std. Dev.	Min	Max
_pscore	157	.4711469	.2275166	.117418	.8781154

```
. sum  _pscore if  ua==1
```

Variable	Obs	Mean	Std. Dev.	Min	Max
_pscore	74	.5813284	.2052649	.117418	.8781154

```
. sum  _pscore if  ua==0
```

Variable	Obs	Mean	Std. Dev.	Min	Max
_pscore	83	.3729129	.2006117	.1175179	.866362

```
.
. sum  _pscore ,detail
```

psmatch2: Propensity Score

Percentiles		Smallest		
1%	.1175179	.117418		
5%	.1346233	.1175179		
10%	.1603826	.1186031	Obs	157
25%	.2778275	.1197871	Sum of Wgt.	157
50%	.4690002		Mean	.4711469
		Largest	Std. Dev.	.2275166
75%	.6640725	.866362		
90%	.8024654	.8709535	Variance	.0517638
95%	.8359635	.8767176	Skewness	.1072953
99%	.8767176	.8781154	Kurtosis	1.802916

Appendix -VI: Propensity Score Matching Test

```
. pstest $xlist ,sum both
```

Variable	Unmatched / Matched	Mean Treated	Mean Control	%bias	%reduct |bias|	t-test t	t-test p>|t|	V(T)/ V(C)
sex	U	.59459	.48193	22.6		1.41	0.160	.
	M	.59459	.51351	16.3	28.0	0.99	0.324	.
age	U	44.811	45.578	-11.3		-0.71	0.481	0.73
	M	44.811	44.243	8.4	26.1	0.59	0.556	1.31
edu	U	2.027	1.8916	15.6		0.98	0.329	1.20
	M	2.027	2.1892	-18.7	-19.7	-1.22	0.224	1.70*
ac	U	.37838	.24096	29.9		1.87	0.063	.
	M	.37838	.47297	-20.6	31.2	-1.16	0.247	.
aes	U	.39189	.20482	41.5		2.61	0.010	.
	M	.39189	.33784	12.0	71.1	0.68	0.498	.
aii	U	.36486	.15663	48.5		3.06	0.003	.
	M	.36486	.31081	12.6	74.0	0.69	0.490	.
hz	U	5.0946	4.8675	20.2		1.26	0.208	0.96
	M	5.0946	5.1216	-2.4	88.1	-0.15	0.881	1.05
ls	U	.0238	.02345	0.8		0.05	0.960	0.29*
	M	.0238	.02159	5.1	-526.6	0.61	0.543	6.27*
ios	U	2227.8	2540.1	-24.1		-1.51	0.133	1.07
	M	2227.8	2383.8	-12.0	50.1	-0.71	0.476	0.96
aw	U	.39189	.18072	47.7		3.01	0.003	.
	M	.39189	.45946	-15.3	68.0	-0.83	0.409	.

* if variance ratio outside [0.63; 1.59] for U and [0.63; 1.59] for M

Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
Unmatched	0.161	35.06	0.000	26.2	23.4	101.8*	1.03	20
Matched	0.040	8.22	0.607	12.3	12.3	47.2*	1.54	40

* if B>25%, R outside [0.5; 2]

Appendix- VII: Result of ATT Using Propensity Score Matching

```
. psmatch2 ($ylist $xlist), kernel outcome(abc)bwidth(0.1)common  logit ate
```

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
abc	Unmatched	3.93243243	2.79518072	1.13725171	.175224915	6.49
	ATT	3.94285714	2.8416805	1.10117664	.211180233	5.21
	ATU	2.79518072	3.88178798	1.08660726	.	.
	ATE			1.09327299	.	.

Note: S.E. does not take into account that the propensity score is estimated.

psmatch2: Treatment assignment	psmatch2: Common support		Total
	Off suppo	On suppor	
Untreated	0	83	83
Treated	4	70	74
Total	4	153	157

```
. psmatch2 ($ylist $xlist), kernel outcome(ceae)bwidth(0.1)common logit ate
```

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
ceae	Unmatched	1504.85135	1111.31325	393.538098	45.3319816	8.68
	ATT	1515.52857	1083.10162	432.426948	54.9171077	7.87
	ATU	1111.31325	1425.51671	314.203462	.	.
	ATE			368.292638	.	.

Note: S.E. does not take into account that the propensity score is estimated.

psmatch2: Treatment assignment	psmatch2: Common support		Total
	Off suppo	On suppor	
Untreated	0	83	83
Treated	4	70	74
Total	4	153	157

Appendix-VIII: Sensitivity Analysis Tests on Treated (ATT)

Table A

```
. mhbounds abc,gamma(1(0.05)2)

Mantel-Haenszel (1959) bounds for variable abc

Gamma          Q_mh+     Q_mh-     p_mh+     p_mh-
-------------------------------------------------
    1          1.0641    1.0641   .143643   .143643
 1.05         1.10783   1.02703   .133967   .152202
  1.1         1.14722   .989343   .125645   .161248
 1.15         1.18541   .953804   .117927   .170091
  1.2          1.2225   .920198    .11076   .178735
 1.25         1.25856   .888336   .104095    .18718
  1.3         1.29368   .858057   .097888   .195431
 1.35         1.32792   .829217   .092103   .203491
  1.4         1.36134   .801693   .086704   .211365
 1.45         1.39399   .775374   .081661   .219059
  1.5         1.42592   .750165   .076946   .226578
 1.55         1.45717   .725978   .072534   .233926
  1.6         1.48779   .702737   .068403    .24111
 1.65         1.51781   .680373   .064531   .248134
  1.7         1.54726   .658824   .060901   .255004
 1.75         1.57617   .638034   .057494   .261726
  1.8         1.60456   .617954   .054295   .268303
 1.85         1.63247   .598536    .05129   .274741
  1.9         1.65992   .579741   .048465   .281045
 1.95         1.68692   .561528   .045809   .287219
    2         1.71351   .543865    .04331   .293267

Gamma : odds of differential assignment due to unobserved factors
Q_mh+ : Mantel-Haenszel statistic (assumption: overestimation of treatment effect)
Q_mh- : Mantel-Haenszel statistic (assumption: underestimation of treatment effect)
p_mh+ : significance level (assumption: overestimation of treatment effect)
p_mh- : significance level (assumption: underestimation of treatment effect)

.
```

Table B

Mantel-Haenszel (1959) bounds for variable ceae

Gamma	Q_mh+	Q_mh-	p_mh+	p_mh-
1	.	.	.	.
1.05	-.081139	.	.532334	.
1.1	-.081139	-.081139	.532334	.532334
1.15	.	-.081139	.	.532334
1.2	-.081139	-.081139	.532334	.532334
1.25	.	-.081139	.	.532334
1.3	.	-.081139	.	.532334
1.35	.	.	.	.
1.4	-.081139	.	.532334	.
1.45	-.081139	-.081139	.532334	.532334
1.5	.	-.081139	.	.532334
1.55	-.081139	-.081139	.532334	.532334
1.6	.	-.081139	.	.532334
1.65	-.081139	-.081139	.532334	.532334
1.7	-.081139	-.081139	.532334	.532334
1.75	-.081139	-.081139	.532334	.532334
1.8	-.081139	.	.532334	.
1.85	-.081139	-.081139	.532334	.532334
1.9	-.081139	-.081139	.532334	.532334
1.95	.	-.081139	.	.532334
2	-.081139	-.081139	.532334	.532334

Gamma : odds of differential assignment due to unobserved factors

Q_mh+ : Mantel-Haenszel statistic (assumption: overestimation of treatment effect)

Q_mh- : Mantel-Haenszel statistic (assumption: underestimation of treatment effect)

p_mh+ : significance level (assumption: overestimation of treatment effect)

p_mh- : significance level (assumption: underestimation of treatment effect)

Appendix IX: Conversion Factors Used to Estimate Adult Equivalent

Age	Male	Female
<10	0.6	0.6
10 to 13	0.9	0.8
14 to 16	1	0.75
17 to 50	1	0.75
> 50	1	0.75

Source: Storck, et al., 1991.