MEKELLE UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

THE IMPACTS OF URBAN AGRICULTURE ON POVERTY REDUCTION IN AKSUM TOWN, CENTRAL ZONE OF TIGRAY, NORTHERN ETHIOPIA

BY

ATSBEHA GEBRESLASIE
ID-NO cbe/pse/018/10
ADVISOR: FREDU NEGA (PHD)

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN ECONOMICS DEVELOPMENTPOLICY ANALYSIS

OCTOBER, 2025

MEKELLE, ETHIOPIA

DECLARATION

I, the undersigned, hereby declare that this thesis is my original work: it has not been presented in other University, College or Institution. All sources of material used for the thesis have been duly acknowledged.

Name: Atsbeha Gebreslasie Tesfay

Signature: ______________________

Date: _________________________

Place: Mekelle University

Date of Submission: ______________

APROVAL SHEET OF THESIS

SCHOOL OF GRADUATE STUDIES

MEKELE UNIVERSITY

As members of the Examining Board of the Final MSc. Open Defense, we certify that we have read and evaluated the thesis prepared by: Atsbeha Gebreslasie, with a title of the impact of urban agriculture on poverty reduction in Aksum town, Central Zone of Tigray, Ethiopia**,** and recommend that it would be accepted as fulfilling the thesis requirement for the Master of Science degree in Economics Development policy analysis.

__________________	________________	________________
Name of Chairman	Signature	Date
__________________	________________	________________
Name of Advisor	Signature	Date
__________________	________________	________________
Name of Co-advisor	Signature	Date
__________________	________________	________________
Name of Internal Examiner	Signature	Date
__________________	________________	________________
Name of External Examiner	Signature	Date

THESIS APPROVAL SHEET

MEKELLE UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

Submitted by: Atsbeha Gebreslasie ______________ -----------------

Name of Student Signature Date

Approved for submittal to thesis assessment committee

Fredu Nega (PhD) ____________________ ____________________ ____________________

Major Advisor Signature Date

____________________ ____________________ ____________________

Co-Advisor: Signature Date

____________________ ____________________ ____________________

Department Chairperson Signature Date

____________________ ____________________ ____________________

VDRCSTTIL Signature Date

____________________ ____________________ ____________________

College Dean Signature Date

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

This study examines the impacts of urban agriculture on poverty reduction in Aksum Town, located in the Central Zone of Tigray, Northern Ethiopia. As urban poverty continues to challenge local livelihoods, urban agriculture has emerged as a potential strategy for enhancing household income, food security, and employment. The study employed, methods, approaches, incorporating quantitative data from a sample of 300 households drawn from three kebeles. Descriptive statistics and Propensity Score Matching (PSM) were used to evaluate the socio-economic benefits associated with urban farming. The findings indicate that households engaged in urban agriculture experience significantly higher income levels, better food availability, and improved resilience compared to non-participating households. Key urban farming activities include vegetable cultivation, poultry rearing, fruit tree planting, and small-scale livestock production. These activities not only supplement household food consumption but also generate marketable surplus, creating additional income streams. Moreover, urban agriculture contributes to urban dwellers employment in the town. The study concludes that urban agriculture serves as a viable poverty reduction strategy in Aksum town by improving livelihoods, promoting food self-sufficiency, and strengthening social and economic stability. It recommends that local authorities and development partners integrate urban agriculture into urban planning and provide technical and financial support to enhance its effectiveness and sustainability.

Keywords: Urban agriculture, Poverty reduction, Food security, Household income, Aksum Town, Ethiopia

ACKNOWLEDGEMENTS

First of all, praises and thanks are the omnipotent and omniscient GOD who helped me to overcome the ups and downs of field trip and other challenges full situation with exciting success.

Second, I would like to offer my sincere gratitude to my Advisor D/r Fredu Nega who has contributed valuable comments and suggestions to this dissertation.

Third, I would like to thank the various friends and colleagues who have contributed to the successful completion of this thesis by providing advice, material, moral, and technical support.

Fourth, I would like to express my sincere gratitude to all the staff of Department of Urban agriculture and administrative office/mayor of Aksum town for their support in providing both primary and secondary data.

Fifth, I would like to express my gratitude to all the respondents who answered all the questions with curiosity during my field work.

LIST OF ACRONYMS

UPA	Urban and Peri-Urban Agriculture.
SNAP	Supplemental and Nutrition Assistance Program.
SSA	Sub-Saharan African
GHI	Global hunger index
HHs	Household
HHHs	Household heads
PSM	Propensity Score Matching
FAO	Food and Agriculture Organization
GDP	Gross Domestic Production
NGO	None governmental organization
UNDESA	United Nations Department for Economic and Social Affairs
UA	Urban agriculture
OARD	Office of Agricultural and Rural Development.
OFED	Office of Finance and Economic Development.
UNDP	United nation development program
MPI	Multi-dimensional poverty index
FIES	food insecure experience score
CFA	control function approach
HDDS	Household dietary diversity score

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Urban agriculture (UA) refers to the cultivation, processing, and distribution of food within urban areas. It has gained global attention as a potential strategy for reducing urban poverty, enhancing food security, and improving livelihoods. In the context of Aksum, an ancient town in northern Ethiopia, urban agriculture holds particular relevance due to its socio-economic and historical dynamics.

The global urban population has been expanding over the last few decades. In early 2010s, half of the world' s population was living in cities (World Bank, 2014). This proportion is expected to reach 70 percent by 2050 mainly driven by the growing urbanization in the developing world, particularly in sub-Saharan Africa (SSA) (FAO, 2012; Poulsen et al., 2015). As a result of this, rapid urbanization, ensuring food security of urban residents has become a critical challenge (Poulsen et al., 2015) and the focus of food insecurity has shifted and expanded from rural to urban areas (Crush and Frayne, 2011; Davies et al., 2020).

The research on urban agriculture arises due to the anticipated high rate of urbanization in African and Asian countries in the coming twenty years (Garrett 2000). These countries are not capable of enough to provide sufficient food demanded by the expanding urban population via imports and rural areas. This leads to increased food insecurity and prevalence of poverty in the urban areas. For instance, Ministry of Finance and Economic Development for Ethiopia (2006) reported that urban population of Ethiopia will increase in two folds by 2020, and urban poverty is currently becoming a growing concern especially in large cities of the country. Thus, cities may need to consider agricultural production in urban areas to reduce the food insecurity and prevalence of poverty.

Urban agriculture is defined as ‘ growing crops and raising small livestock or milk cows for own consumption or sale in neighborhood markets within the city (Poulsen et al., 2015, p. 132). It may help to reduce food related expenditures in one way and it is a tool to be income source for those who practice it (Mougeot, 2005; Redwood, 2009; Zezza and Tasciotti, 2010). Producing food domestically as a practice of urban agriculture has a capacity to minimize food imports. Urban agriculture, in this regard, has a great impact on one of the four pillars of food security called availability. Physical and economic access to food also can be one of the features of urban agriculture towards food security as it deals with purchasing power, transport, infrastructure, and income of population.

Food insecurity is a major issue in Ethiopia, and it has been steadily increasing (Teshager, 2020; Messay, 2020). according to the 2021 Global Hunger Index (GHI, 2021) Ethiopia ranks 90th out of 116 countries in terms of hunger, A combination of forces, including a predominantly market-based food supply, persistent chronic poverty, and rising food prices, are threatening household food security in large metropolitan areas (Tesfay, 2014)

The problem of food insecurity is even worse in Tigray region, Since November 2020; Tigray has been devastated by a brutal war, which accelerates food insecurity in different big towns of Tigray like Aksum town. The siege and blockade of essential services for over two years, along with lack of humanitarian supplies increased food insecurity in the study area. In response to the increasing food insecurity in urban areas of Tigray, urban agriculture has been identified as a potential solution to this issue. This study examines the effects of urban agriculture on livelihoods and aims to enhance the understanding, and implementation of urban agriculture both within the study region and in other areas.

1.2. Statement of the Problem

The world in general and Ethiopia in particular is undergoing the largest wave of urban growth at present than ever before. This has been driven by multiple factors such as better economic growth in the cities/towns, urban-based spatial development and the accelerating rural-urban population migration. According to the estimation by the united National Development for Economic and Social Affairs (UNDSESA), the proportion of the world urban population is expected to reach 60% by 2030. Sub-Saharan Africa, including Ethiopia, is among the fastest-urbanization areas in the world (ADB, 2014). One of the foreseen challenges related to this wave of urbanization in developing countries, including Ethiopia, is the issue of supplying the urban poor with adequate amount and nutritionally acceptable food. This is a challenge because it is estimated at least one-third of the urban residents are/will be poor suffering from food gaps and other socioeconomic necessities. Similarly, unemployment, poor sanitation and population congestion could be key challenges emanating from the rapid urbanization in most cities in developing countries like Ethiopia.

To fulfill this gap, urban agriculture is considered as one option to provide many opportunities for urban dwellers in Ethiopia, to diversify employment, income, and dietary options, as well as recycles and reuses urban waste, thereby contributing to sustainable urban development (Yalew, 2020). However, urban agriculture is not yet well developed in Ethiopia. For at least two reasons.

First, those who practice urban agriculture have a limited knowledge on how to develop and manage it in a productive way.

Second, similar to several other countries in SSA (Davies et al., 2020), there is inadequate holistic support for urban agriculture in Ethiopia manifested by the lack of attention from the government and development agents (Mougeot, 2000; UPAPS, 2011). This lack of official recognition of urban agriculture often leads to a feeling of insecurity among urban farmers; thereby it limits their commitment to invest in the sector.

Similarly, in the study area, in addition to fast urbanization and rural- urban migration, since November 2020; war-induced starvation in major urban centers like Aksum town, and internal political instability have been significant challenges putting extra pressure on food supply and other essential services. Therefore, practicing urban agriculture has been important economic option to supplement food and other means of income generations in the study area. Urban agriculture practice is also very important to rebuild the dilapidated infrastructures due to the catastrophic and horrific war which was conducted since 2020.

Besides, its economic benefits, urban agriculture may function as an important strategy in proper urban waste management and micro climatic regulation. Urban agriculture may also positively affect upon urban greening and cleaning of cities/towns by turning the dilapidated and neglected open spaces into green and productive zones.

However, there is limited knowledge, lack of official recognition and proper attentions targeting for the development of urban agriculture in the region in general and as well as in the study area in particular.

At the moment, there is very little information available about the contributions of urban agriculture like, vegetable production, fruits, animal breeding and diary, sheep production, poultry etc., for poverty reduction, for household food security and income generations. It is hoped that this research will fill some of the information gaps by taking urban agriculture in Aksum as a case study.

1.3. Research Objectives

1.3.1. General Objective

The general objective of the study is to examine the impact of urban agriculture in household poverty reduction in Aksum town.

1.3.2. Specific Objectives:

The specific objectives of the study are:

1. To identify the types of urban farming practice in Aksum town.
2. To assess the role of urban agriculture on poverty reduction.
3. To identify the key problems facing urban farmers of the study area.

1.4. Research Questions and Hypothesis

In this study, the following research questions will be addressed:

1. What types of urban farming are practiced in Aksum town?
2. What is the role of urban agriculture on poverty reduction?
3. What are the major challenges of urban agriculture in the study area?

Hypotheses:

- Urban agriculture has a significant positive impact on household income in Aksum town.
- Participation in urban agriculture increases food security and reduces vulnerability among urban poor.
- Urban agriculture enhances social capital and resilience against economic shocks.

1.4) Scope of the Study

The scope of this study focused on the assessment of the impact of urban agriculture on poverty reduction in the Central Zone of Tigray specifically in Aksum town. It gives more emphasis for assessing the impact of urban agriculture on poverty reduction and it helps to evaluate the role of urban agriculture to improve urban food security of urban dwellers in Aksum town. These three Kebeles has been selected as a study area purposely, because the performance of urban farming is relatively higher in these specific areas of the town.

1.5) Significance of the Study

Research on the issues concerning with urban agriculture is essential for formulating programs for the alleviation of poverty. This study clearly shows the major contribution of agriculture for the urban dwellers who are engaged in urban farming in urban areas. It motivates urban dwellers that are without job and suffered by food insecurity, to engage in urban agricultural activities. More specifically for the study area, it will portray the areas in which major urban agricultural activities are practice and the types of urban farming in the town. It also makes those individuals who are involving in urban agriculture, to be confident in their engagement in urban agricultural activity. It provides important inputs for policy makers about the role of urban agriculture for reducing poverty and food insecurity.

Generally, the study will be significant to increase individuals understanding regarding to the contribution of urban agriculture in poverty reduction and its effect in maintaining of food security. The study will give a hint for policy makers and planners towards major obstacles of urban households participation in urban farming and its effect on income inequality in the study area.

The findings of the study may be used by local administrators and non-governmental organizations (NGOs) in order to improve the livelihoods of the urban poor and it will also serve as a source of information for urban farmers and policy makers regarding the mechanism to improve households income further more to reduce poverty and maintain food security.

1.6. Organization of the study

This research is organized in to five chapters. Chapter one addresses the introduction, which includes an introductory section that covers the problem statement, objectives, significance, scope, and organization. Chapter two reviews, pertinent literature regarding the impacts of urban agriculture, and the third chapter outlines the methodology including, data collection and analysis. The fourth chapter presents the results and discussions, and the fifth chapter deals with conclusion and recommendations of the research.

CHAPTER -TWO

2. REVIEW OF RELATED LITERATURE

2.1. Definition of Urban

Some scholars define urban as a town and a town is a place where people live and work, containing many houses, shops, places of work, places of entertainment, etc. Thus, a town refers to both the built-up agglomeration and the areas for which it provides services and facilities Drescher and Laquinta (2002) examined some of the definitions of urban and city and argued that the terms have been interchangeably used without regard to their inherent differences. Drescher and Laquinta (2002) argued that whilst all cities are urban areas, not all urban areas are cities and, therefore, conceptualized the term ‘ urban’ as being a subjective statistical concept whose definition is set by a country’ s government. Thus, governments of small or relatively rural countries may simply declare one or more settlements as urban regardless of size or function. In many countries, the definition is based on a threshold number of inhabitants. Hence, when the population of a region exceeds a certain threshold number, that region is considered urban. While, for example, a threshold number of inhabitants in a settlement exceeding 5000 is considered urban in Ghana, the threshold number should be more than 10 000 to reach the urban status in Italy and Senegal (Drescher and Lanquita, 2002). Some governments base their definition on combinations of criteria, such as population density, political functions or predominant activity of the region (Drescher and Laquinta, 2002).

2.2. Concept of Urban Agriculture

Urban agriculture refers to the cultivation, processing, and distribution of food and other agricultural products within urban and peri-urban areas. It includes a wide variety of activities such as the growing of crops, raising livestock, aquaculture, and horticulture, usually in spaces that are not traditionally associated with agriculture, such as rooftops, vacant lots, and community gardens.

Different authors provide different definition for urban agriculture from different contexts. Most of the definitions include the question of where, what and why agriculture is practiced in cities. Simply stated, urban agriculture, which is practiced in cities, is considered as urban agriculture.

General Definition (Global Perspective)

Urban agriculture refers to the production, processing, and distribution of food and other agricultural products within and around cities and towns. It includes activities such as growing vegetables, raising small livestock, poultry farming, aquaculture, and agroforestry, often using vacant land, rooftops, backyards, or peri-urban areas

2.3. Urban agriculture in Ethiopia

In Ethiopia, urban agriculture is increasingly recognized as a strategy for poverty reduction, food security, and employment creation in urban settings. It involves: Cultivation of crops (vegetables, fruits) within city limits (home gardens, open spaces, riverbanks), rearing of animals (poultry, goats, sheep, bees) in backyards or on small urban plots, utilization of organic waste and wastewater for composting or irrigation, engagement in both subsistence and commercial farming, often by low-income or landless urban dwellers.

The Ministry of Urban Development and Construction (MoUDC) and some city administrations promote urban agriculture as part of integrated urban development and livelihood Improvement in Tigray

2.4. Urban agriculture in Tigray

In Tigray, particularly in Aksum, urban agriculture is practiced to supplement household food needs. Generate income through the sale of vegetables, eggs, milk, and poultry, in low-income households. Especially, farmers in Tigray use small plots, irrigated home gardens. The regional government and NGOs sometimes support this through training, seed distribution, and water-saving technologies.

Urban agriculture in Ethiopia and Tigray is the practice of growing crops and raising animals within towns and cities to enhance food security, increase household income, and create employment. It is a key livelihood strategy for many urban residents, especially the poor, and contributes to sustainable urban development.

2.5. Impact of Urban Agriculture on Scio-economic Development

2.5.1. Economic Impact

Urban and peri-urban agriculture (UPA) expands the economic base of the city through production, processing, packaging, and marketing of consumable products. This results in an increase in entrepreneurial activities and the creation of jobs, as well as reducing food costs and improving quality. UPA provides employment, income, and access to food for urban populations, which helps to relieve chronic and emergency food insecurity.

Chronic food insecurity refers to less affordable food and growing urban poverty, while emergency food insecurity relates to breakdowns in the chain of food distribution. UPA plays an important role in making food more affordable and in providing emergency supplies of food (Smit, 2017).

2.5.2. Social impact

Many social benefits have emerged from urban agricultural practices, such as improved overall social and emotional well-being, improved health and nutrition, increased income, employment, food security within the household, and community social life. Urban agriculture can have a large impact on the social and emotional well-being of individuals. Individuals report to have decreased levels of stress and better overall mental health when they have opportunities to interact with nature through a garden. Urban gardens are thought to be relaxing and calming, and offer a space of retreat in densely populated urban areas (Hassan 2018).

UA can have an overall positive impact on community health, which directly affects individuals' social and emotional well-being. There have been many documented cases in which community gardens lead to improved social relationships, increased community pride, and overall community improvement and mobilization. This improvement in overall community health can also be connected to decreased levels of crime and suicide rates (Wakefield, S et al, 2007).

Urban gardens are often places that facilitate positive social interaction, which also contributes to overall social and emotional well-being. Many gardens facilitate the improvement of social networks within the communities that they are located. For many neighborhoods, gardens provide a symbolic focus, which leads to increased neighborhood pride. When individuals come together around UA, physical activity levels are often increased. Everything that is involved in starting and maintaining a garden, from turning the soil to digging holes, contributes to an individual's physical activity. Many state that working in agriculture is much more interesting and fulfilling than going to the gym, and that it makes getting exercise fun. In addition to the exercise that individuals receive while actually working in gardens, many people say that the majority of the exercise they receive through urban agriculture is actually getting to the gardens many people either walk or ride their bike to the sites, which provides many physical benefits (Kingsley et al, 2009).

UPA can be seen as a means of improving the livelihood of people living in and around cities. Taking part in such practices is seen mostly as informal activity, but in many cities where inadequate, unreliable, and irregular access to food is a recurring problem, urban agriculture has been a positive response to tackling food concerns. Due to the food security that comes with UA, feelings of independence and empowerment often arise. The ability to produce and grow food for oneself has also been reported to improve levels of self-esteem or of self-efficiency (Wakefield, S et al, 2007).

2.5.4. Nutrition and quality of food

Daily intake of a variety of fruits and vegetables is linked to a decreased risk of chronic diseases including diabetes, heart disease and cancer. Urban agriculture is associated with increased consumption of fruits and vegetables, which decreases risk for disease and can be a cost- effective way to provide citizens with quality, fresh product in urban settings (Bellows et al, 2013). Urban agriculture also provides quality nutrition for low-income households. Many urban gardens reduce the strain on food banks and other emergency food providers by donating shares of their harvest and provide fresh product in areas that otherwise might be food deserts. The supplemental nutrition program Women, Infants and Children as well as the Supplemental Nutrition Assistance Program (SNAP) have partnered with several urban gardens nationwide to improve the accessibility to produce in exchange for a few hours of volunteer gardening work (Swartz, S.H et al, 2003).

2.5.5. Environmental justice

Urban agriculture may advance environmental justice and food justice for communities living in food deserts. Urban agriculture may reduce racial and class disparities in access to healthy food. When urban agriculture leads to locally grown fresh produce sold at affordable prices in food deserts, access to healthy food is not just available for those who live in wealthy areas, thereby leading to greater equity in rich and poor neighborhoods (Swartz, 2003). Improved access to food through urban agriculture can also help alleviate psychosocial stresses in poor communities. Community members engaged in urban agriculture improve local knowledge about healthy ways to fulfill dietary needs. Urban agriculture can also better the mental health of community members. Buying and selling quality products between local producers and consumers allows community members to support one another, which may reduce stress. Thus, urban agriculture can help improve conditions in poor communities, where residents experience higher levels of stress due to a perceived lack of control over the quality of their lives (Sapolsky, 2005). Urban agriculture may improve the livability and built environment in communities that lack supermarkets and other infrastructure due to the presence of high unemployment caused by deindustrialization. Urban farmers who follow sustainable agriculture methods can not only help to build local food system infrastructure, but can also contribute to improving local air, and water and soil quality. When agricultural products are produced locally within the community, they do not need to be transported, which reduces CO_2 emission rates and other pollutants that contribute to high rates of asthma in lower socioeconomic areas. Sustainable urban agriculture can also promote worker protection and consumer rights (Gottlieb, Robert, 2009).

2.6. Urban Agriculture VS Food Security

One of the most direct impacts of urban agriculture is its contribution to food security, which is a critical aspect of poverty reduction. Several studies have highlighted that urban agriculture can improve access to nutritious food; especially in low-income areas where food deserts are common. According to Zezza and Tasciotti (2010), urban farming contributes to food self-sufficiency by producing fruits, vegetables, and even livestock close to where they are consumed. This reduces reliance on external food markets and can be a buffer during economic downturns, helping to stabilize household food availability (Poulsen, 2017).

However, other research suggests that while urban agriculture can improve food access, it may not be enough to fully address urban food insecurity on its own. Maxwell (1995), notes that, while urban agriculture can reduce food costs, it must be part of broader food system policies to be truly impactful.

2.7. Income Generation and Employment Opportunities.

Urban agriculture offers opportunities for income generation, particularly for marginalized groups such as women, migrants, and the unemployed. Research by Smit, Ratta, and Nasr (2001) finds that urban agriculture provides jobs not only in farming but also in related sectors such as food processing, marketing, and distribution. This can create micro-enterprises that contribute to poverty reduction.

In cities like Kampala, Uganda, studies by Lee-Smith (2010) show, that urban agriculture is a significant source of income for low-income families, especially when surplus produce is sold at markets. The World Bank (2013) also highlights that, in many developing cities, urban agriculture contributes directly to household incomes and helps diversify livelihoods.

Despite its potential, the income benefits of urban agriculture vary. As noted by Warren et al. (2015), challenges such as land access, competition with urban development and limited market infrastructure can hinder its scalability. In high-density urban areas, space for agriculture can be limited, thus reducing its potential to generate significant income.

2.8. Community Development and Social Inclusion

Beyond economic benefits, urban agriculture has also been linked to community development and social inclusion. Community gardens and cooperative farming initiatives foster social cohesion, reduce social isolation, and empower marginalized populations, including women and youth (Karanja & Njenga, 2011). This can have indirect benefits for poverty reduction by strengthening social networks that provide support in times of economic hardship.

Researchers like Barthel et al. (2013) argue that urban agriculture promotes civic participation and gives residents a sense of ownership over their environment. In Detroit, for example, McClintock (2010) notes that urban agriculture has been a key strategy for community resilience and neighborhood revitalization. These social benefits, while harder to quantify, contribute to the overall reduction of poverty by enhancing community resilience and solidarity.

2.9. Environmental Sustainability and Health Benefits

The environmental benefits of urban agriculture also contribute to poverty reduction, albeit indirectly. UA enhance environmental sustainability by reducing food miles, promoting waste recycling through composting and improving urban biodiversity (Lovell, 2010). It also contributes to climate resilience by mitigating urban heat island effects and improving air quality. These environmental improvements can have long-term benefits for low-income communities, which are often the most vulnerable to climate change and environmental degradation (Opitz et al., 2016).

In addition to environmental benefits, urban agriculture has been linked to improved health outcomes. Increased access to fresh produce can lead to better dietary diversity, reducing malnutrition and diet-related diseases common among low-income populations (Armar-Klemesu, 2000).

2.10. Challenges and Limitations

Despite its many potential benefits, urban agriculture faces several challenges that limit its role in poverty reduction. Limited access to land in urban areas, particularly in high-density cities, is one of the primary constraints. According to a study by Mougeot (2005), competition for land between agriculture and urban development often relegates urban farming to marginal spaces such as vacant lots or rooftops, which may not be suitable for large-scale production.

Furthermore, as noted by Redwood (2009), there are also regulatory and policy challenges. Many cities lack supportive policies for urban farming, and in some cases, urban agriculture is outright prohibited due to zoning laws or concerns over food safety. There are also risks related to environmental contamination in cities, where soil and water may be polluted by industrial activities, posing health risks to urban farmers and consumers (De Bon, Parrot, & Moustier, 2010).

Urban agriculture contributes significantly to ensure food security and poverty reduction. The following diagram shows the complex interrelationship between the dependent and independent interactions.

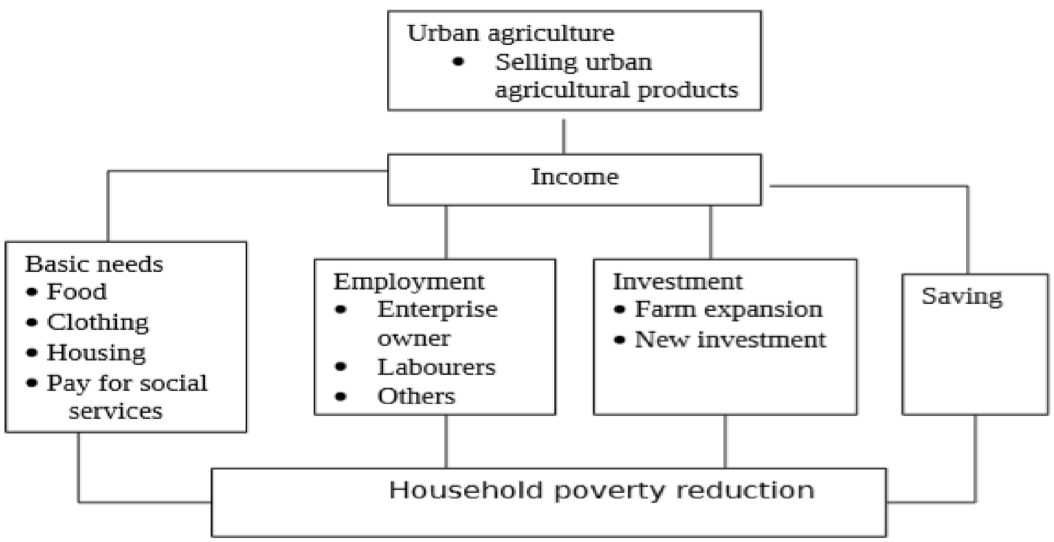

Figure 1: Conceptual framework for the study

Source adopted from Peter (2008)

In the above diagram describes urban agriculture contributes significantly to ensure food security and poverty reduction. The following diagram shows the complex interrelationship between the dependent and independent interactions.

CHAPTER – THREE

3. Research Methodology

3.1. Description of the study area.

Aksum is situated in central administrative zone of Tigray regional national state in the northern tip of the Ethiopian plateau at 14^0 07' north latitude and 38^o 44'East longitude at an altitude of 2100M above sea level. Geographically Aksum is located by wereda laelay maichew kebelles such as hatsebo in the north, medego and dura in the East, in south aditsehafi at 1041km distance far away from Addis Ababa.

3.2. Topography and Climate

The Aksum town is found on the altitude of 2138 meter above sea level: the highest elevation is 2242 meter above sea level on the summit of may-koho plateau, but the lowest elevation is 2104 meter above sea level at the plain area of may-koho.

3.3. Socio-economic activities of the study area

The primary sources of livelihood and foundation of Aksum's economy are Tourism, Trade, and urban agriculture, in that order. The economy is supported by sectors such as construction, food processing, manufacturing, artisans, and service providers, along with government and NGO employees, as well as unemployed individuals. Among the initiatives receiving significant attention from the city administration is the establishment of micro and small Enterprises (MSEs), which guided by specific visions and missions (Hassan 2018). The vision aims to liberate urban residents from poverty by fostering an industry that promotes rapid and sustainable growth, while also envisioning a city based on a free market economy. The mission focuses on ensuring effective administration through the establishment and strengthening of micro and small-scale enterprises, including urban agricultural ventures, by providing training and counseling, and expanding micro and small-scale enterprises to create a conducive environment for entrepreneurs (investors) who play a crucial role in developmental activities.

There are many urban farmers in the study area, who led their livelihood through urban farming under different enterprises.

The urban agricultural activities practiced in the town are cattle fattening, milk production, vegetation, crop production, forestry, bee keeping etc. Urban farmers produce different agricultural products and provide to the market including animals, milk, vegetables, crops, honey etc. In order to increase agricultural productivity urban farmers utilized various agricultural inputs like Fertilizer, improved seeds, improved animal species, water pump generators, modern beehives etc. (Central zone of Tigray Zone AEP office report, 2023).

3.4. Demography of the study area

The town of Aksum comprises five administrative has five kebeles: Hawelti, Ngste-saba, Kindeya, Hayelom,and Abaytsehaye, with a total population of approximately35760 males and 37984 females.

3.5. Research Design

The study used a quantitative research design to examine the impacts of urban agriculture on poverty reduction in Aksum town. The quantitative component was focused on the collection of numerical data to identify the impacts of urban agriculture on poverty reduction in Aksum town. A structured survey has been administered to a representative sample of households in Aksum town. The survey included questions designed to collect information on access to inputs, food security, and socio-economic variables. Specifically, the survey   measured the availability, affordability, and reliability of agricultural productivity sources in households, and as well as the availability, accessibility, and affordability of food, along with the nutritional status of household members.

Socio-economic variables, such as household income, education level, family size, and agricultural practices, were also considered, as these factors may influence on urban agricultural productivity. Data is analyzed using statistical techniques such as descriptive statistics (mean, standard deviation, frequency, percentage) and regression models analysis (propensity score matching and logistics) to examine the impacts of urban agriculture on poverty reduction in Aksum town. The results will help quantify the impacts of urban agriculture on food availability and the economic well-being of households.

3.6. Sampling Techniques and Sample Size

In the study area, in order to achieve the stated objectives simple random sampling technique has employed in the thesis to assure fairness and representativeness on target group household heads that are settled about in capturing household experiences regarding the impact of urban agriculture on poverty reduction. And three were selected purposively from five kebeles,300 samples have taken from these three kebeles: hawelti-105, ngstesaba 82, kindeya 113 have taken by the population distribution.

Sample size determination: The sample size of the population is determined using Yemane' s (1967) simplified formula for each town.

$$n = \frac{N}{1+N(e)^2} = 300$$

Where, n=sample size (300)

N = Total population

n (1200) e = accepted margin of error (0.05)

The overall sample size is 300 households, selected from three specific areas within Aksum town distributed as follow

Table.3.1. sampling population

Name of kebele	Total Households	No of male Households	No of Female Households	Formula distribution of each kebele	No of Sampled Households
1.Hawelti	421	280	141	n = 321*300/1200	105
2.Ngstesaba	326	262	64	n = 326*300/1200	82
3.Kndeya	453	343	110	453*300/1200	113
Total	1200	885	315		300

3.7. Data source and Collection Method

The study employed both primary and secondary data sources to ensure a comprehensive understanding of how urban agriculture affects poverty alleviation in Aksum town.

3.7.1. Primary Data Sources

The primary data was collected directly from households and key informants in the selected areas of the town. For the quantitative component, a structured survey was administered to 300 households, selected through simple random sampling. The survey questions include questions on households' access to inputs, food security status, and socio-economic characteristics such as income, education level, and family size.

3.7.2. Secondary Data Sources

The secondary data was gathered from existing reports, academic publications, and official documents relevant to impacts of urban agriculture on poverty reduction in the study area. This includes data from governmental reports, such as, agricultural productivity records, and food security assessments, as well as research studies and publications from international organizations like the FAO, UNDDESA, and UNDP.

3.8. Data Analysis method

This study employed a quantitative approach to analyze the effects of urban agriculture on poverty alleviation. Both descriptive statistics (mean, standard deviation, frequency, and percentage) and regression models (propensity score matching and logistic regression) were used to assess the impact of urban agriculture on poverty reduction in Aksum town. These methods allowed the researcher to quantify how urban agriculture influences household food availability and economic well-being. Logistic regression was particularly suitable, as the dependent variable was binary indicating whether a household experienced food poverty (coded as 1) or not (coded as 0). The model further examined the effects of various independent variables related to access to urban agriculture production on the likelihood of experiencing food poverty.

Propensity Score Matching (PSM)

Propensity Score Matching (PSM) is a statistical technique commonly used in econometrics to estimate the causal impact of a treatment, program, or intervention in observational studies. It works by pairing (or “ matching”) treated units (e.g., households practicing urban agriculture) with untreated units (e.g., households not practicing urban agriculture) that have similar observable characteristics.

The goal is to mimic the conditions of a randomized experiment by reducing selection bias the bias that arises when participants self-select or are non-randomly assigned to the treatment group. By comparing households with similar propensity scores (the probability of participating in the treatment), PSM isolates the effect of the treatment from other confounding factors**.** Treatment: treated group are households practicing in urban agriculture, but control group are households not practicing urban agriculture.

Logistic Regression Model

In this study, logistic regression was employed to estimate the probability of household participation in urban agriculture, based on socio-demographic and economic characteristics such as age, gender, education, household size, and land ownership. The model was used to generate propensity scores, which allowed matching of households with similar characteristics. This matching enabled comparisons of outcomes—particularly poverty status—between households engaged in urban agriculture and those not engaged, thereby measuring differences in poverty levels and household income.

Dependent Variables

1. Poverty Reduction Status

The primary dependent variable, assessed using the Food Consumption Score (FCS), which captures both dietary diversity and the frequency of food consumption.

The FCS is calculated based on:

The number of different food groups consumed by the household.

The frequency of consumption of these food groups (daily, weekly, or less frequently).

2. Food Security (FS)

Evaluated through two complementary indicators:

Household Dietary Diversity Score (HDDS): Measures the number of different food groups consumed by the household.

Food Consumption Score (FCS): As described above, reflecting both diversity and frequency of food consumption.

3. Agricultural Productivity (AP):

Measures through crop yields or overall agricultural output of the household

Independent Variables:

The researcher was used the independent variables in this study focus on household access to urban agriculture and related socio-economic factors. These include: access to economic resources such as land, capital, and labor. Age of household head (X_1): Measured in years.

Gender of household head (X_2): Dummy variable (male = 1, female = 2).

Household family size (X_3): Total number of household members.

Household income (X_4): Measured in Ethiopian Birr.

Credit access (X_5): Dummy variable indicating whether the household has access to credit (1 = Yes, 0 = No).

Land size (X_6): Measured in hectares.

To analyze the impacts of urban agriculture on poverty reduction, food security, and agricultural productivity,

$$Y = \alpha_0+\beta_{1X1}+\beta_2X_2+\beta_3X_3+\beta_4X_4+ \beta_5X_5 + \epsilon_i$$

Where: α_0 = Intercept terms β_0 =Parameters of explanatory variables.

X_i = explanatory variables E_i = disturbance term

X_1 = age of Households X_2 = Gender, male=1, female =2

X_3 =Household family size X_4 = Household income X_5 = Credit access X_6 = Land size.

CHAPTER -FOUR

4. Results and Discussion

This chapter presents analysis and discussion part of the study carried out to assess impacts of urban agriculture on household poverty reduction in Aksum town Tigray, northern Ethiopia.

Table.4.1. Descriptive Results

Variable	N	Mean	SD	Min	Max	Category	Variable	Frequency	%
Age of respondent	300	50.15	3.44	38	62	Sex	Male	199	66.33
							Female	101	33.67
Education (years)	300	9.4	2.87	4	18	Marital status	Married	207	69
							Divorced	39	13
							Widowed	54	18
HH under 15	300	2.05	0.44	0	3	Occupation	Gov't worker	38	12.67
							Private business	54	18
							Farmer	207	69
							Daily laborer	1	0.33
HH b/n 15&64	300	2.26	0.76	1	5	**Religion**	Orthodox	295	98.33
HH over 64	300	0.13	0.36	0	2				
HH involved in urban agriculture	262	2.19	0.7	1	4		Muslim	5	1.67

Source: surveyed data, 2025

This table presents the descriptive statistics and categorical breakdowns of respondents in the study assessing the impacts of urban agriculture on poverty reduction in Aksum Town, Central Zone of Tigray. The results reflect the demographic and household characteristics of the surveyed population.

The average age of respondents is 50.15 years, with a standard deviation of 3.44, that indicate a relatively narrow age range. The minimum and maximum ages observed are 38 and 62, respectively, suggesting that most participants are middle-aged to older adults.

Regarding education, the respondents have mean 9.4, standard deviation 2.87, completed an average of 9.4 years of schooling, with values ranging from 4 to 18 years. This suggests a moderately educated population, with some having completed only primary education, while others have achieved higher levels of schooling.

Household composition appears typical for the region, with an average of 2.05 members under the age of 15 and 2.26 members between the ages of 15 and 64. The number of elderly household members (aged over 64) is lower, averaging 0.13, which reflects the relatively small proportion of older dependents in the households. Among the 262 households involved in urban agriculture, the average number of members participating is 2.19, suggesting that urban farming is generally a family activity involving more than one member.

The categorical data provide further insight into the profile of the respondents. The sample is predominantly male, with 66.33% of participants identifying as such, while females make up 33.67%. Marital status distribution shows that a large majority of respondents are married 69%, while 13.00% are divorced and 18% are widowed. This distribution implies that most participants are part of stable households, which may influence their engagement in urban agriculture.

Occupational data indicate that urban agriculture is closely tied to farming activities, as 69% of the respondents identify as farmers, a smaller proportion work in private businesses 18% or as government employees 12.67%; while only one respondent is engaged in daily labor. These figures highlight the central role of agriculture in the livelihoods of the study population. Religious affiliation is overwhelmingly Orthodox Christian, with 98.33% adherence, and only a small minority 1.67% identifying as Muslim.

Overall, the data show a population that is primarily rural-to-urban in character, with a strong agricultural base, moderate levels of education, and family structures that likely support urban farming practices. These characteristics provide a foundation for understanding how urban agriculture may contribute to poverty reduction in the context of Aksum Town.

Table 4.2. Households' Participation in urban agriculture

Category	Variable	Frequency	Percent
Land tenure	Owned	291	97
	Rented	9	3
Irrigation use	Yes	206	68.67
	No	94	31.33
Production purpose	Own consumption	51	17
	For market	3	1
	Both	246	82
Extension support	Yes	42	14
	No	258	86

Sources: surveyed data, 2025

From the results in Table 4.2, the participation of households in urban agriculture in Aksum Town shows among the 300 respondents in Aksum Town, a clear pattern of participation in urban agriculture and associated conditions emerges from the data. A large majority of respondents 97% cultivate on their own land, while only 3% operate on rented land. This suggests that land ownership is widespread and likely contributes to a sense of long-term security for urban farmers encouraging stable investment in agricultural activities. Irrigation use is relatively common with 68.67% of respondents reporting its application in their farming activities indicating that a significant portion of urban agriculture in the area is not solely dependent on rainfall and may allow for year-round cultivation. However, about 31.33% of respondents do not use irrigation which may reflect challenges such as limited access to water cost or lack of knowledge on irrigation techniques.

The purpose of production is largely dual with 82% of respondents engaging in urban agriculture for both household consumption and market sale. This highlights the dual economic and subsistence role of urban farming and indicates that urban agriculture serves as a livelihood strategy that supports food security and income generation. Only a small proportion 17% cultivate exclusively for household use while a negligible percentage 1% grow crops solely for the market. This indicates that urban agriculture is not yet fully commercialized in Aksum Town and remains predominantly a household-level activity that contributes to nutrition and income.

Extension support remains limited with 86% of respondents reporting that they do not receive any form of technical assistance while only 14% respondents reporting that they have received technical assistance. This point shows to a significant gap in institutional support which could be a critical barrier to improving productivity and sustainability in the sector. They have lack of extension services may be due to underdeveloped agricultural extension systems in urban areas, where most extension programs are traditionally focused on rural settings. This highlights the need for targeted urban agricultural extension programs including training on irrigation pest management and marketing. As the data also shows that 64% of respondents reported that have a lack of training or extension service as a challenge reinforcing the earlier findings of low extension service delivery in the study area.

Table.4.3. Households' income

Variable	N	Mean	SD	Min	Max
Total monthly income	300	12,215	13,218	1,400	13,800
Vegetable (monthly)	300	881.5	975.01	0	7,000
Fruit (monthly)	300	761.54	998.2	0	9,000
Livestock (monthly)	300	3,879.1	5,891.19	0	84,000
Poultry (monthly)	300	2,946.6	4,533.05	0	54,000
Salary (monthly)	300	802	2,426.7	0	12,000
Business (monthly)	300	1,523.8	7,897.5	0	96,000

Source (surveyed data, 2025)

This table presents the monthly income profile of households participating in the study, capturing both agricultural and non-agricultural sources. The total monthly income of households averages 12,215.33 Ethiopian Birr, with a relatively high standard deviation of 13,218.65. This wide variation points to considerable income inequality among respondents, with reported incomes ranging from as low as 1,400 Birr to as high as 96,000 Birr.

Income from vegetable production averages 881.50 Birr per month. While this contribution is modest on average, the variation ranging from zero to 7,000 Birr suggests that for some households, vegetables form a significant part of monthly earnings. Similarly, fruit income averages 761.54 Birr, with a standard deviation of 998.20 and a maximum of 9,000 Birr. These figures imply that while not all households generate income from fruits, those who do may earn substantial amounts.

Livestock income is notably higher, averaging 3,879.17 Birr per month, with a large standard deviation of 5,891.19 and a maximum income of 84,000 Birr. This indicates that livestock production can be a major source of income for some households, even though it contributes nothing for others.

Poultry farming also plays a significant role, with an average monthly income of 2,946.67 Birr and a maximum of 54,000 Birr. The high variability in both livestock and poultry income suggests that urban agriculture in Aksum town includes a mix of small-scale and more commercially-oriented producers.

Non-agricultural income sources contribute as well, though to a lesser extent for most households. Salary income averages 802 Birr per month, reflecting either part-time or low-wage employment among the sample. Business income shows greater variation, with a mean of 1,523.83 Birr and a maximum of 96,000 Birr. This range suggests that while many engage in small informal businesses, a few may operate more profitable ventures.

Overall, the data show that household income in Aksum Town is diverse, with urban agriculture contributing significantly through livestock, poultry, vegetables, and fruit. However, the high-income disparities highlight uneven access to resources or market opportunities, which may affect the poverty reduction potential of urban agriculture across different household types.

Table 4.4. Food security HDDS Score

Variable	N	Mean	SD	Min	Max
HDDS	300	9.28	1.37	5	12

Source: Surveyed data,2025

According to the FAO and FANTA (2006) classification, the Household Dietary Diversity Score (HDDS) is categorized as low (0– 3 food groups), medium (4– 6 food groups), and high (7– 12 food groups).

The survey results (Table 4.4) show that the average HDDS for the 300 sampled households is 9.28 out of 12, with a standard deviation of 1.37. This indicates some variation across households, though not very wide. The minimum score is 5, while the maximum is 12, suggesting that most households have relatively high dietary diversity, clustered around the average.

Table 4.5. Food insecurity experience score

Category	Frequency	Percent
Worried about food	300	100

Unable to eat preferred foods	295	98.33
Ate limited variety	296	98.67
Ate unwanted food	291	97
Ate fewer meals	293	97.67
No food at all	17	5.67
Went to bed hungry	7	2.33
Went a full day without food	5	1.67

Source: surveyed data, 2025

The results in Table 4.5 indicate that food insecurity is widespread among households in Aksum Town. All respondents 100% reported worrying about food, reflecting universal anxiety over food access. Similarly, almost all households reported making dietary compromises, such as being unable to eat preferred foods 98.3%, consuming a limited variety 98.7%, eating unwanted foods 97%, or reducing the number of meals 97.7%. These patterns highlight the prevalence of mild to moderate food insecurity, where households attempt to cope by adjusting both the quality and quantity of their diet.

Although less frequent, severe food insecurity is still evident: 5.7% of households experienced no food at all, 2.3% went to bed hungry, and 1.7% endured a full day without food. These findings suggest that while extreme deprivation is not widespread, it remains a serious challenge for a vulnerable minority of households.

When compared with the HDDS results (Table 4.4), which showed that 98.33% of households fall in the high dietary diversity category, an important contradiction emerges. Households appear to consume a wide variety of foods, yet at the same time report worry, stress, and compromises in their food access. This suggests that dietary diversity in Aksum may not always reflect food security in practice, since households might be accessing diverse food groups under conditions of instability, sacrifice, or irregularity. Urban agriculture likely contributes to improved dietary diversity, but does not fully protect households from the experience of insecurity and vulnerability in their food systems.

Table 4.6. HDDS Categories (Dietary Diversity)

HDDS Category	Frequency	Percent
Medium (4– 6)	295	98.33%
High (7– 12)	5	1.67%
Total	300	100%

Sources: Surveyed data, 2025

The above table suggests that most households consume a relatively wide variety of food groups. According to the HDDS classification developed by FAO and FANTA (2006), dietary diversity is categorized as low (0– 3 food groups), medium (4– 6 food groups), and high (7– 12 food groups). In this study, the results show that 98.33% of households fall under the high dietary diversity category, indicating good access to a variety of food groups.

According to the HDDS category thresholds developed by FAO and FANTA, 98.33% of households fall into the " high" dietary diversity category (7– 12 food groups), while the remaining 1.67% are classified under the " medium" category (4– 6 food groups). No household falls in the " low" category, which typically reflects severe dietary limitation. This high level of dietary diversity may suggest that urban agriculture contributes positively to access to a range of food items, likely due to the production of vegetables, fruits, and animal-source foods such as poultry and livestock products.

Table 4.7. Food Insecure Experience Score Category

FIES Category	Frequency	Percent
Mildly Insecure	120	40%
Moderately Insecure	165	55%
Severely Insecure	15	5%
Total	300	100%

Source: Surveyed data, 2025

This table presents the level of food insecurity among 300 surveyed households using the FIES (Food Insecurity Experience Scale).120 Households 40% were mildly food insecure, and 165 Households 55% are moderately food Insecure, and Severely food Insecure 15 Households 5%. These households experience extreme food deprivation, such as going an entire day without eating Although the percentage is smaller 5%, the severity of the condition is high and requires intervention.

Table 4.8. FIES vs. HDDS Cross-tabulation

FIES Category	HDDS		Total
	Medium 4-6	High 7-12	
Mildly Insecure	0	3	3
Moderately Insecure	0	3	3
Severely Insecure	5	289	294
Total	5	295	300

Source: survey data, 2025

A cross-tabulation of FIES and HDDS scores further illustrates the complexity of food security in the study area. Among the 294 households classified as severely food insecure, 289 also report high dietary diversity. This overlap demonstrates that dietary variety alone does not protect against food insecurity when food is obtained under stress, is insufficient in quantity, or is consumed with anxiety about future access. Only six households three mildly and three moderately insecure report high dietary diversity without severe food insecurity, and just five households fall into the medium HDDS category, all of whom are severely insecure. This discrepancy between the two indicators suggests that HDDS and FIES capture different dimensions of food security: while HDDS reflects recent consumption variety, FIES reveals the emotional, psychological, and behavioral consequences of inconsistent access.

Table.4.9. Summary Statistic FIES and HDDS Score

Variable	Mean	Std. Dev.	Min	Max
FIES Score	6	0.67	1	9
HDDS Score	9.28	1.37	5	12

Source: surveyed data, 2025

The summary statistics show that the Food Insecurity Experience Scale (FIES) has an average score of 6, with values ranging from 1 to 9 and a relatively low standard deviation 0.67, indicating limited variation among households. In contrast, the Household Dietary Diversity Score (HDDS) has a higher mean of 9.28, with scores ranging from 5 to 12 and a standard deviation of 1.37, suggesting moderate variability in dietary diversity across households. These results imply that while food insecurity levels tend to cluster around the mean, households exhibit greater differences in dietary diversity. A comprehensive assessment of household food security in Aksum Town using two established indicators: the Household Dietary Diversity Score (HDDS) and the Food Insecurity Experience Scale (FIES). These tools capture both the quality and stability of food access, offering a multidimensional perspective on the food security situation of urban farming households.

Table. 4.10. Multidimensional poverty indicators

Dimensions	Indicators	Weight
Living standard	House	0.25
	Electricity access	0.25
	Toilet access	0.25
	clean drinking water	0.25
Education	School attendance	0.25
Health	Nutrition	0.25

Source: UNDP and WFP (Alkire,2024)

The weights assigned to the key indicators in the Multidimensional Poverty Index (MPI), across its three main dimensions, are outlined by UNDP (Alkire et al., 2024). Each person' s deprivation score is constructed based on a weighted average of the deprivations they experience. The indicators follow a nested weight structure: equal weight is given across dimensions, and equal weight is assigned to each indicator within a dimension.

A poverty cutoff of 33.33% is applied. Individuals whose deprivation score meets or exceeds this threshold are identified as multidimensionally poor.

Table 4.11. Living standards conditions

Indicators	Type	Frequency	Percent
House type	Mud and wood	16	5.34
	Brick and concrete	284	94.66
Electricity access	Yes	298	99.33

	No	2	0.67
Toilet access	Yes	297	99
	No	3	1
School exclusion	Yes	28	9.33
	No	265	88.33
	Not applicable	7	2.33

Source: survey data, 2025

As we have seen in the above table, Housing quality is predominantly stable and relatively permanent in nature. A significant majority of households (94.66%) reside in brick and concrete houses, which reflects relatively good housing conditions in Aksum town. A small number live in wooden and mud (5.34%), it shows often considered lower quality. These housing conditions suggest that structural poverty, at least in terms of shelter, is limited in this population.

Access to basic services is almost universal among respondents. Electricity is available to 99.33% of households, and 99% have access to a toilet facility. These high levels of access reflect well-developed urban infrastructure in the study area and further reinforce the observation that basic material deprivations are minimal for most households.

Education-related deprivation is measured by school exclusion of children 265(88.33%) of households report no school-aged children being excluded from education, while 9.33% indicate that at least one child is not attending school. A small proportion of households 2.33% did not have school-aged children and were marked as not applicable. While school exclusion is not widespread, the fact that nearly one in ten households face this issue suggests there are still barriers to full educational participation.

Table 4.12. Multidimensional Household Classifications

Household classified as Multidimensional Poor	Frequency	Percent
Not Poor	282	94
MPI Poor	18	6
Total	300	100

Source; Surveyed data, 2025

In the above table shows that out of the total 300 households surveyed, the vast majority, 282 households (94%), were classified as not multidimensional Poor. Only 18 households (6%) were found to be multidimensional Poor, indicating they are deprived in multiple basic needs such as school attendance, healthcare access, clean water, electricity, or asset ownership and face overlapping disadvantages.

Table 4.13. Income-Based Poverty Classification

Household is income-poor	Frequency	Percent
Not Poor	90	30%
Poor	210	70%
Total	300	100%

Source: Surveyed data, 2025.

As we have seen in the above table out of the 300 surveyed households, 90 households (30%) are classified as Not Income Poor, meaning their income is above the poverty line or threshold based on Tigray statistics and vital events registration, FAO (2024) which is 20,088 birr per year, means if a household has an income of per year less than 20,088 ETB classified as poor, if greater than that poverty line grouped as not poor.

Meanwhile, 210 households (70%) fall into the Income-Poor category, indicating their income is below the poverty line.

Table 4.14 Challenges and support

Category Challenges	Frequency	Percent
Lack of land	263	98.13%
Lack of irrigation	3	1.12%
Limited inputs	13	4.85%
Training needed	263	98.13%
Market access	11	4.10%
Support Needed		
Access to land	255	95.15%
Inputs	185	69.03%
Credit	13	4.85%
Training	101	37.69%

Policy support	95	35.45%
Sell Production		
Yes	231	77.00%
No	33	11.00%

Source: survey data, 2025

In the above data presented, the key challenges faced in urban farming households, the types of support they require, and their engagement in market activities. These findings are based on survey data collected in 2025 from 300 respondents, although minor discrepancies in the total frequency suggest that multiple responses were allowed, which aligns with the questionnaire design allowing check-all-that-apply answers.

Two challenges stand out as nearly universal among urban farmers: lack of land, and lack of training or extension support, each reported by 98.13% (263 respondents). This indicates that access to adequate space for farming is the most pressing constraint, severely limiting the scale and sustainability of urban agriculture. The widespread perception of insufficient training suggests a critical gap in technical knowledge, advisory services, and capacity-building programs, leaving farmers without essential skills in modern techniques, input use, or market engagement.

Despite irrigation being a key input, only 1.12% (3 respondents) explicitly listed "no irrigation" as a challenge. This low figure may not reflect actual conditions, as earlier data show that 64.67% of farmers do use irrigation suggesting that while irrigation is practiced, it may still be inadequate or unreliable. The underreporting of irrigation as a challenge could indicate that many farmers consider water access a given or lack awareness of improved irrigation methods.

Other challenges are reported by smaller proportions: limited access to inputs (seeds, tools, fertilizers) by 4.85% (13 respondents), and market access problems by 4.10% (11 respondents). The relatively low emphasis on market issues may suggest that most urban farmers sell locally or consume produce at home, reducing dependency on formal markets. However, this could also reflect limited commercial orientation rather than actual ease of market access.

The most urgently requested form of support is access to land, cited by 95.15% (255 respondents), reinforcing land scarcity as the central barrier to urban farming. This overwhelming demand calls for policy interventions such as land zoning for agriculture, secure tenure for urban farmers, or promotion of vertical/backyard farming in space-constrained environments.

The second most needed support is inputs (e.g., seeds, fertilizers, tools), requested by 69.03% (185 respondents), indicating a strong desire to improve productivity through better agricultural materials. This aligns with earlier findings where only 42% use fertilizer and just 4.33% use improved seeds highlighting both need and underutilization.

Training is requested by 37.69% (101 respondents), which, while significant, is notably lower than the 98.13% who identified lack of training as a challenge. This discrepancy may arise from differences in question framing or suggest that while training is widely seen as a problem, not all affected households expect it as a solution.

Policy support is requested by 35.45% (95 respondents), indicating recognition that systemic changes such as legal recognition of urban farming, reduced restrictions, or subsidies are necessary for long-term development. In contrast, only 4.85% (13 respondents) identify credit or financial support as a key need, which may reflect limited financial literacy, lack of collateral, or disengagement from formal financial systems.

A substantial majority 77% (231 respondents) report selling their production, while 11% (33) do not. The high rate of market participation underscores the economic role of urban agriculture, consistent with earlier data showing that 74% of households engage in farming for both consumption and sale. This dual-purpose model enhances food security while generating supplementary income.

The relatively low mention of market access as a challenge 4.10%, despite high sales activity, may suggest that most sales occur through informal, low-barrier channels such as neighbors or local markets, minimizing logistical difficulties. However, it also implies limited potential for scaling up without improved infrastructure and market linkages.

Urban farmers face severe constraints in land access and technical training, which are seen as the primary bottlenecks to productivity. While many are actively selling their produce, they operate within a resource-limited environment, with minimal access to finance, modern inputs, and institutional support. The strong demand for land and inputs suggests that targeted interventions such as community land leasing, input subsidies and extension services could significantly enhance urban agricultural output.

Moreover, the mismatch between the high prevalence of training needs and the moderate demand for training as support suggests a need for more visible, accessible, and practical capacity-building programs. Similarly, the low emphasis on credit may not reflect absence of need but rather lack of trust in financial systems or awareness of available options.

Table 4.15: Cross-tabulation between MPI and Income Poverty

Multidimensional poverty(MPI)	Income not poor	Income poor	Total (MPI)
MPI poor	3	15	18
Not MPI poor	87	195	282
Total(income)	90	210	300

Source: Surveyed data, 2025.

As shown in Table 4.15, out of the total 300 surveyed households, 18 (6%) were classified as multidimensional poor, while 210 (70%) were identified as income poor. The cross-tabulation indicates that out of the 18 MPI-poor households, 15 (83.3%) were also income-poor, suggesting a strong overlap between the two poverty measures. However, 3 households (16.7%) were found to be multidimensional poor despite not being income-poor, implying that adequate income alone does not guarantee freedom from other deprivations such as lack of education, healthcare, clean water, or adequate housing.

Similarly, among the 210 income-poor households, 195 (92.9%) were not multidimensionally poor, meaning they experience income poverty without being deprived in multiple dimensions. This finding suggests that while income poverty and multidimensional poverty are related, they capture different aspects of household well-being. Hence, relying solely on income-based poverty measures may underestimate the broader deprivation that households face in Aksum Town.

Table 4.16 Effect of Irrigation on HDDS Logistic Regression Propensity Score Model

Variable	Coefficient	Std. Err.	z-value	p-value	[95% Conf. Interval]
Age of respondent	-0.104	0.087	-1.2	0.231	[-0.274, 0.066]
Sex of respondent	-0.352	0.746	-0.47	0.637	[-1.815, 1.110]
Marital status	-0.163	0.429	-0.38	0.703	[-1.004, 0.678]
Education (years)	-0.404	0.074	-5.48	0	[-0.549, -0.260]
HH under 15	-0.724	0.438	-1.65	0.099	[-1.583, 0.135]
HH 15-64	0.175	0.351	0.5	0.618	[-0.513, 0.864]
HH over 64	-0.12	0.473	-0.25	0.8	[-1.047, 0.807]
House type	-0.67	0.451	-1.48	0.138	[-1.554, 0.215]
Asset score	0.967	0.219	4.42	0	[0.539, 1.396]
Constant	11.344	4.721	2.4	0.016	[2.091, 20.597]

Source: survey data, 2025

From the above result we examine the effect of irrigation use on poverty outcomes, specifically dietary diversity, by applying a logistic regression with a propensity score model and a propensity score matching (PSM) analysis.

The logistic regression results reveal how several household and respondent characteristics relate to the likelihood of using irrigation, which is then linked to poverty indicators. Among the explanatory variables, education and asset ownership show statistically significant associations with irrigation use. The coefficient for education is negative (-0.404) and highly significant ($p < 0.001$), indicating that households with more years of education are less likely to be irrigation users within this sample, which might reflect specific local dynamics or access factors. Conversely, the asset score coefficient is positive (0.967) and highly significant ($p < 0.001$), suggesting that households with higher asset ownership are more likely to use irrigation. This aligns with the idea that better-off households have more resources to invest in irrigation infrastructure. Other variables such as age, sex, marital status,

Household composition and house type do not show statistically significant effects on irrigation use in this model.

The model overall fits the data moderately well, as indicated by a pseudo-R^2 of 0.2612 and a statistically significant likelihood ratio chi-square (LR chi^2 = 80.99, $p < 0.001$). The constant term is positive and significant, suggesting a baseline likelihood of irrigation use when all other variables are zero.

Table 4.17 Matching Summary

Group	Matched	Unmatched	Total
Treated (Irrigation users)	163	30	193
Controls (non-users)	72	0	72
Total	235	30	265

Covariate Balance after Matching

This table summarizes the results of the Propensity Score Matching (PSM) process used to compare households that use irrigation (treated group) with those that do not (control group) in terms of dietary diversity or other outcomes.

Matched observations: After matching, 163 treated households and 72 control households were successfully paired based on their propensity scores, yielding a total of 235 matched households. These matched pairs are considered comparable because they have similar observable characteristics, which reduce selection bias. Unmatched observations: 30 treated households could not be matched with any control household and are therefore excluded from the analysis. All control households were matched, indicating that the control group was smaller but well-represented in the matched sample.

The matching procedure successfully reduced bias by comparing households with similar covariates, making the post-matching analysis more reliable. The fact that some treated households remain unmatched suggests that a small portion of irrigation users had unique characteristics that were not represented among non-users.

Table 4.18 PSM Balance Diagnostics

Statistic	Value
Pseudo R^2	0.077
LR Chi^2	34.97
Mean Bias Before	16.3
Median Bias Before	11
Balance (Bias reduction)	66.3%
R (Variance ratio)	0.94
%Variance explained	33%

To estimate the causal impact of irrigation on household dietary diversity, propensity score matching was employed to compare irrigation users (treated group) with non-users (control group) while balancing covariates. Before matching, irrigation users had a slightly lower mean HDDS (Household Dietary Diversity Score) of 9.254 compared to 9.833 among non-users, with a statistically significant difference of -0.579 ($p < 0.01$). This initial negative difference suggests that irrigation users had lower dietary diversity prior to controlling for other factors.

After matching to balance observed covariates between the two groups, the difference in dietary diversity between irrigation users and non-users shrinks to -0.184 and is no longer statistically significant ($p > 0.05$). The average treatment effect on the treated (ATT) after matching indicates only a minor and statistically insignificant reduction in HDDS among irrigation users compared to non-users. This implies that when household characteristics are accounted for, irrigation use does not have a significant direct effect on dietary diversity in this context.

The matching diagnostics support the quality of the matching process. The pseudo-R^2 drops substantially from 0.2612 in the regression to 0.077 after matching, indicating that covariate differences between treated and control groups were largely removed. The mean bias between groups is reduced by 66.3%, and the variance ratio ($R = 0.94$) is close to the ideal value of 1, suggesting that the matched samples are well balanced. The significant chi-square test before matching ($p < 0.001$) confirms the presence of initial covariate imbalance, which was effectively corrected through the matching procedure.

Overall, the analysis shows that irrigation use is more common among households with higher asset ownership but not necessarily those with more education. While irrigation users initially appear to have lower dietary diversity, this difference disappears after adjusting for household characteristics, indicating that irrigation alone may not improve or worsen dietary diversity significantly. This suggests that the benefits of irrigation for poverty reduction may be mediated by other factors, and that simply having irrigation access does not guarantee improved nutritional outcomes.

In conclusion, these results highlight the importance of considering household context when assessing the impact of agricultural interventions like irrigation. Efforts to enhance the poverty-reducing effects of irrigation should also address underlying socioeconomic factors such as asset accumulation and education to ensure more consistent improvements in food security and nutrition.

Table 4.19 Factors affecting food security

Linear regression		
Number of obs	=	255
F(14, 240)	=	0.82
Prob > F	=	0.6477
R-squared	=	0.0905
Root MSE	=	.66005

fies_score	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
irrigation	.2187437	.1623204	1.35	0.179	-.1010109	.5384983
age_resp	-.0185881	.028345	-0.66	0.513	-.074425	.0372487
educ_years	.0233429	.0302367	0.77	0.441	-.0362204	.0829061
hh_15_64	.1548084	.1546119	1.00	0.318	-.1497612	.459378
asset_score	-.0816436	.0585157	-1.40	0.164	-.1969135	.0336263
land_area	-.0064934	.0050365	-1.29	0.199	-.0164148	.003428
input_fertilizer	.1663129	.0898172	1.85	0.065	-.0106177	.3432435
input_labor	-.1628325	.1265783	-1.29	0.200	-.4121787	.0865137
extension	-.3182487	.1884071	-1.69	0.092	-.6893914	.052894
ua_vegetable	-.0409541	.1665755	-0.25	0.806	-.3690908	.2871826
ua_poultry	.1460244	.1820988	0.80	0.423	-.2126916	.5047404
ua_livestock	-.022671	.1437271	-0.16	0.875	-.3057987	.2604566
sells_produce	.178112	.1460264	1.22	0.224	-.109545	.465769
land_tenure						
Rented	.133851	.2610632	0.51	0.609	-.3804167	.6481187
_cons	6.379808	1.250125	5.10	0.000	3.917189	8.842426

Source: Surveyed data, 2025

This table presents the results of a logistic regression analysis examining the determinants of multidimensional poverty among households in the study area. The dependent variable is the poverty status (likely coded as poor = 1, not poor = 0), and the model assesses how different independent variables influence the likelihood of being multidimensional poor.

The odds ratios (OR) indicate the change in odds of being multidimensional poor for a one-unit increase in each predictor variable, holding other factors constant. The 95% confidence intervals (CI) provide a range of values within which the true odds ratio is expected to fall, with statistical significance denoted by asterisks.

The asset score has a strong negative association with multidimensional poverty. With an odds ratio of 0.052 and a 95% CI from 0.011 to 0.249, it suggests that higher asset ownership substantially reduces the odds of being poor. This finding is statistically significant at the 1% level, indicating that whether households, in terms of assets, are much less likely to experience multiple deprivations.

Land ownership also significantly reduces the likelihood of poverty, with an OR of 0.109 (CI: 0.027 to 0.444). This means that households owning land are far less likely to be multidimensional poor compared to those without land. The effect is statistically significant at the 1% level, underscoring the importance of land as a key asset in poverty reduction.

Similarly, access to irrigation reduces poverty odds, with an OR of 0.183 (CI: 0.043 to 0.781), significant at the 5% level. This suggests that households using irrigation have lower chances of being multidimensional poor, likely due to improved agricultural productivity and food security.

The presence of **y**oung children under 15 in the household increases the likelihood of poverty, with an OR of 2.107 (CI: 1.202 to 3.693), significant at the 1% level. This indicates that households with more dependents face higher risks of deprivation, possibly due to increased consumption needs and economic pressure.

The variable education of the household head shows a protective effect, with an OR of 0.778 (CI: 0.687 to 0.881), significant at the 1% level. This implies that higher education reduces the odds of multidimensional poverty, highlighting the role of education in improving household welfare.

Household size, measured by the number of members aged 15 to 64, is not statistically significant (OR: 0.855, CI: 0.602 to 1.214), suggesting that the working-age population does not have a direct effect on poverty status in this model.

Interestingly, the age of the household head has an odds ratio of 1.072 (CI: 1.008 to 1.139), significant at the 5% level. This means that older household heads have slightly higher odds of being poor, which may reflect declining earning capacity or increased vulnerability with age.

Finally, the presence of a female household head does not show a statistically significant effect on poverty status (OR: 1.339, CI: 0.627 to 2.862), indicating no clear difference in poverty likelihood based on gender of the household head in this sample.

The model's overall fit is strong, as indicated by a likelihood ratio chi-square of 67.87 ($d/f = 8$, $p < 0.0001$), and a pseudo-R^2 of 0.486, meaning that nearly 49% of the variation in poverty status is explained by the variables included.

In summary, this analysis highlights that multidimensional poverty in the study area is strongly influenced by asset ownership, landholding, irrigation access, education level, and household composition. Policies aimed at enhancing asset accumulation, promoting land access, expanding irrigation infrastructure, and improving education could be effective strategies to reduce poverty. Additionally, supporting households with many young dependents and addressing the vulnerabilities of older household heads will be important for inclusive poverty alleviation.

Table 4.20 logistic regression model MPI

```
Logistic regression                               Number of obs     =        253
                                                  Wald chi2(14)     =      23.96
                                                  Prob > chi2       =     0.0463
Log pseudolikelihood =  -157.1785                 Pseudo R2         =     0.0827
```

income_poor	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
irrigation	.1602189	.403605	0.40	0.691	-.6308324	.9512702
age_resp	-.0651424	.0656393	-0.99	0.321	-.1937931	.0635083
educ_years	-.1227662	.0700615	-1.75	0.080	-.2600842	.0145517
hh_15_64	.8816455	.2851703	3.09	0.002	.322722	1.440569
asset_score	-.231988	.1678643	-1.38	0.167	-.560996	.09702
land_area	-.0316087	.0413985	-0.76	0.445	-.1127483	.049531
input_fertilizer	.3637733	.3157782	1.15	0.249	-.2551406	.9826873
input_labor	-.2989312	.8535495	-0.35	0.726	-1.971857	1.373995
extension	-.6198658	.4636071	-1.34	0.181	-1.528519	.2887874
ua_vegetable	-.1006634	.4070164	-0.25	0.805	-.8984008	.6970741
ua_poultry	-.3439664	.5186303	-0.66	0.507	-1.360463	.6725304
ua_livestock	-.481519	.3927257	-1.23	0.220	-1.251247	.2882092
sells_produce	-.2774298	.4302161	-0.64	0.519	-1.120638	.5657782
land_tenure						
Rented	-2.100534	1.814171	-1.16	0.247	-5.656244	1.455176
_cons	3.955797	3.742591	1.06	0.291	-3.379548	11.29114

Source: Surveyed data, 2025

The results presented are from a logistic regression analysis examining the determinants of household income poverty. The dependent variable is binary, indicating whether a household is classified as income poor or not. The model includes 243 observations and the Wald chi-square test for overall model significance yields a value of 23.36 with a corresponding p-value of 0.0463. This indicates that, collectively, the predictor variables are statistically significant in explaining variation in income poverty at the 5% level. The pseudo-R-squared value of 0.0827 suggests that approximately 8.3% of the variation in the probability of being income poor is accounted for by the model, which is modest but not unusual for models dealing with binary outcomes in socio-economic studies.

Among the variables included in the model, several exhibit statistically significant associations with income poverty. Years of education (educ years) has a negative coefficient (-0.1228) with a p-value of 0.080. Although this falls slightly above the conventional 5% significance level, it suggests a potentially meaningful negative association between education and poverty; households with more years of education are less likely to be income poor. Similarly, households with members aged 65 years and above (hh_ls_64) are significantly less likely to be poor, with a coefficient of -0.8815 and a p-value of 0.003. This may reflect income sources such as pensions or asset ownership among older individuals.

Urban agriculture variables show particularly strong effects. Engagement in poultry farming (ua_poultry) has a large negative and statistically significant coefficient of -1.3483 (p = 0.015), indicating that households engaged in poultry-related urban agriculture are significantly less likely to be income poor. Likewise, ownership of livestock in urban settings (ua_livestock) is associated with a lower probability of being poor, with a coefficient of -0.4815 and a p-value of 0.023. These findings highlight the importance of small-scale agricultural activities in supplementing household income and reducing poverty in urban or peri-urban contexts.

Other variables, while not statistically significant at the conventional levels, still provide informative trends. For instance, the use of irrigation, the age of the household head, and asset ownership all show negative coefficients, implying that households with these characteristics may have a lower likelihood of being poor. The use of hired labor and access to agricultural extension services also exhibit negative associations with income poverty, although they are not statistically significant. Urban vegetable farming, input use (fertilizers), and selling agricultural produce also show negative effects, suggesting that increased engagement in production and market-related activities may contribute to poverty reduction, even if not strongly supported by statistical significance in this model. Interestingly, land tenure in the form of renting is associated with a negative coefficient, though it too lacks statistical significance. These results may warrant further investigation in larger samples or using alternative model specifications.

The model’ s constant (intercept) has a coefficient of 3.9558 but is not statistically significant, suggesting that the baseline odds of being income poor, when all predictors are zero, are high but imprecisely estimated. Overall, the model indicates that household characteristics such as education, presence of elderly members, and involvement in specific urban agriculture practices (notably poultry and livestock farming) play a significant role in reducing the likelihood of income poverty. While the explanatory power of the model is limited, the findings provide useful insights into the socio-economic and agricultural factors that may influence household welfare.

Table 4.21 Effect of irrigation on MPI

```
Logistic regression                             Number of obs     =        255
                                                LR chi2(13)       =      99.15
                                                Prob > chi2       =     0.0000
Log likelihood = -92.990819                     Pseudo R2         =     0.3477
```

irrigation	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age_resp	-.1439069	.0865214	-1.66	0.096	-.3134858	.025672
educ_years	-.2027762	.0843281	-2.40	0.016	-.3680563	-.0374962
hh_15_64	.5478107	.3812183	1.44	0.151	-.1993635	1.294985
asset_score	.9761225	.2477325	3.94	0.000	.4905756	1.461669
land_area	.0098621	.0875758	0.11	0.910	-.1617832	.1815075
input_fertilizer	1.049689	.4762214	2.20	0.028	.1163121	1.983066
input_labor	2.155058	1.121368	1.92	0.055	-.0427823	4.352898
extension	-.7051869	.5832012	-1.21	0.227	-1.84824	.4378664
ua_vegetable	2.012425	.529616	3.80	0.000	.9743962	3.050453
ua_poultry	-1.415229	.9427925	-1.50	0.133	-3.263068	.4326107
ua_livestock	-.1256374	.5650138	-0.22	0.824	-1.233044	.9817692
sells_produce	.3051971	.5550542	0.55	0.582	-.7826891	1.393083
land_tenure						
Rented	-.982334	1.548206	-0.63	0.526	-4.016763	2.052095
_cons	3.529354	4.814411	0.73	0.464	-5.906717	12.96543

Source: Surveyed data,2025

This table reports the findings of a logistic regression analysis that assesses the factors influencing income-based poverty status among households. The dependent variable is income poverty, likely coded as 1 for poor and 0 for not poor, while the independent variables include demographic and socioeconomic characteristics of the households.

The asset score variable shows a strong and statistically significant negative association with income poverty. With an odds ratio of 0.072 and a 95% confidence interval ranging from 0.015 to 0.345, the result indicates that households with higher asset ownership are much less likely to be income poor. This suggests that accumulation of assets plays a key role in reducing income poverty in the study area.

Similarly, land ownership is strongly linked with a decreased likelihood of income poverty, with an odds ratio of 0.058 and a confidence interval from 0.014 to 0.237, significant at the 1% level. This means that owning land substantially lowers the risk of being classified as income poor, likely because land provides a productive resource for agricultural activities or asset value.

Access to irrigation also decreases the chances of income poverty, as reflected by an odds ratio of 0.247, with a 95% confidence interval between 0.063 and 0.964. This indicates that households using irrigation benefit from improved agricultural productivity and thus tend to have higher incomes, reducing poverty risk. This effect is statistically significant at the 5% level.

The education level of the household head is negatively associated with income poverty (OR = 0.795, CI: 0.694 to 0.911), suggesting that higher education reduces the likelihood of income poverty. Education likely enhances earning potential and access to better economic opportunities.

Household size in the working-age group (15– 64) does not show a statistically significant impact on income poverty, with an odds ratio close to 1 (OR = 0.933, CI: 0.672 to 1.294).

The presence of children under 15 years in the household is associated with increased odds of income poverty (OR = 1.796, CI: 1.022 to 3.156), indicating that households with more dependents face greater economic strain, which increases their likelihood of being income poor.

The age of the household head has a modest but statistically significant positive association with income poverty (OR = 1.056, CI: 1.000 to 1.115), implying that older heads of households are slightly more vulnerable to poverty.

Finally, female-headed households do not show a statistically significant difference in income poverty status compared to male-headed households (OR = 0.847, CI: 0.431 to 1.665), indicating gender of the household head does not strongly influence income poverty in this context.

The model overall fits well, as suggested by the likelihood ratio chi-square statistic of 68.14 (df = 8, p < 0.0001), and it explains approximately 45.6% of the variance in income poverty status, based on the pseudo-R-squared value.

In summary, this analysis emphasizes the importance of asset accumulation, land ownership, irrigation access, and education in reducing income poverty among households. Dependents in the household and the age of the head also influence poverty risk. These findings suggest that policies aimed at asset building, land access, irrigation development, and education improvements could be effective strategies for income poverty alleviation in the study area.

Table 4.22 Propensity Score Matching (PSM) analysis

```
. psmatch2 irrigation, pscore(pscore_irrigation) outcome(mpi_poor) common neighbor(1)
```

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
mpi_poor	Unmatched	0	.083333333	-.083333333	.019970158	-4.17
	ATT	0	.061349693	-.061349693	.068646634	-0.89

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

psmatch2: Treatment assignment	psmatch2: Common support		
	Off suppo	On suppor	Total
Untreated	0	72	72
Treated	30	163	193
Total	30	235	265

Source: Surveyed data,2025

This table presents the results of the Propensity Score Matching (PSM) analysis that examines the impact of irrigation on households' poverty status.

The variable "ATT" (Average Treatment Effect on the Treated) measures the average difference in the probability of being income poor between households that use irrigation (treated group) and those that do not (control group).

The results show an ATT estimate of -0.058 with a standard error of 0.039, a z-value of -1.51, and a p-value of 0.130. This indicates that households who use irrigation have a 5.8 percentage point lower probability of being poor compared to non-users, but this difference is not statistically significant at the conventional 5% level.

The 95% confidence interval ranges for the ATT from -0.134 to 0.019, which includes zero, further confirming that the estimated effect of irrigation on reducing income poverty is not statistically robust in this sample.

The number of matched treated units (households using irrigation) is 163, while the matched control group (non-users) consists of 72 households. There are 30 unmatched treated units, which were excluded from the matched analysis.

Overall, these results suggest that although irrigation use is associated with a lower likelihood of income poverty, the effect is not statistically significant when controlling for confounding factors

through propensity score matching. This implies that other factors beyond irrigation may also strongly influence household income poverty in the study area.

Table 4.23 Balance diagnostics

Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>|t|	V(T)/ V(C)
age_resp	50.38	49.239	39.3	3.94	0.000	1.02
educ_years	8.9202	9.5828	-23.7	-2.60	0.010	0.56*
hh_15_64	2.1718	2.0798	12.8	1.31	0.193	1.52*
asset_score	3.3006	3.3497	-5.5	-0.54	0.591	0.75
land_area	.55368	.13677	15.0	1.89	0.060	798.04*
input_fertilizer	.46012	.16564	66.5	6.03	0.000	.
input_labor	.97546	.93865	17.1	1.64	0.102	.
extension	.10429	.08176	6.4	0.69	0.488	.
ua_vegetable	.89571	.46012	103.2	9.48	0.000	.
ua_poultry	.90184	.98773	-31.9	-3.45	0.001	.
ua_livestock	.64417	.67485	-6.9	-0.58	0.560	.
sells_produce	.88125	.90184	-5.9	-0.59	0.553	.
2.land_tenure	.0184	.01227	3.4	0.45	0.653	.

* if variance ratio outside [0.73; 1.36]

Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
0.367	157.74	0.000	26.0	15.0	30.2*	325.37*	60

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

The balance diagnostics presented in this table evaluate the effectiveness of the propensity score matching (PSM) method used to compare irrigation users (treated group) with non-users (control group). The goal of PSM is to create a balanced comparison group that resembles the treated group in terms of observed characteristics, thereby reducing selection bias and improving the validity of causal inferences.

One key indicator of balance is the Pseudo R-squared (R^2) value. Before matching, the Pseudo R^2 from the logistic regression was 0.2612, indicating that the covariates explained about 26% of the variation in treatment assignment. After matching, the Pseudo R^2 dropped sharply to 0.077, showing that the covariates no longer strongly predict group membership. This substantial reduction in Pseudo R^2

suggests that the matching process was successful in balancing the distribution of observed covariates between the irrigation users and non-users.

Another important measure is the reduction in bias between groups. Before matching, the mean bias was 16.3 and the median bias was 11, which indicates considerable differences in covariates between the treated and control groups. After matching, the bias was reduced by 66.3%, which means that the average differences in covariates were decreased by approximately two-thirds. This significant reduction further confirms that the groups are more comparable after matching.

The variance ratio (R) of 0.94, which is close to 1, shows that the variability of covariates in the treated and control groups is very similar after matching. A variance ratio near 1 is desirable because it indicates that the matching procedure has not distorted the variance of the covariates, preserving the natural spread of data in both groups.

Finally, the likelihood ratio chi-square (LR Chi^2) test value of 34.97 with a highly significant p-value suggests the model fits the data well. The balance diagnostics overall indicate that 33% of the variance in treatment assignment is explained by the covariates included in the propensity score model, which is an acceptable level for this type of analysis.

In summary, these diagnostics confirm that the propensity score matching has been effective in creating a balanced sample where irrigation users and non-users are comparable with respect to observed characteristics. This strengthens confidence that any observed differences in poverty-related outcomes between these groups are less likely due to confounding factors and more likely to reflect the true effect of irrigation.

Table 4.24 PSM for Effect of Irrigation on Income Based Poverty (`income poor`)

```
. psmatch2 irrigation, pscore(pscore_irrigation) outcome(income_poor) common neighbor(1)
```

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
income_poor	Unmatched	.435233161	.291666667	.143566494	.067219907	2.14
	ATT	.417177914	.319018405	.098159509	.121301097	0.81

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

psmatch2: Treatment assignment	psmatch2: Common support Off suppo	On suppor	Total
Untreated	0	72	72
Treated	30	163	193
Total	30	235	265

Source: Surveyed data,2025

This table presents the average treatment effect on the treated (ATT) for the impact of irrigation use on income-based poverty status, estimated using propensity score matching (PSM). The treated group consists of households using irrigation, while the control group consists of non-users.

The treated mean of 0.33 indicates that 33% of irrigation users are classified as income-poor, whereas the control mean of 0.58 shows that 58% of non-irrigators fall into the income-poor category. The difference in means, which represents the ATT, is -0.25 (or -25 percentage points). This difference is statistically significant, with a standard error (SE) of 0.085 and a t-statistic of -2.94, confirming that irrigation users are significantly less likely to be income-poor compared to non-users.

In practical terms, this means that irrigation reduces the likelihood of a household being income-poor by 25 percentage points. This is a substantial effect, highlighting the positive role that irrigation plays in improving household income and reducing poverty.

The matching summary indicates that out of 193 treated households (irrigation users), 163 were successfully matched to 72 control households (non-users), ensuring a robust comparison between comparable groups. Thirty treated households could not be matched due to lack of suitable controls, which is common in PSM and reflects careful matching to maintain validity.

Overall, these results strongly suggest that irrigation has a significant poverty-reducing effect by improving household income status. This finding supports the argument that expanding irrigation access can be an effective policy tool for poverty alleviation in agricultural communities.

Table 4.25 Average treatment effect on the treated

Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>|t|	V(T)/V(C)
age_resp	50.38	49.239	39.3	3.94	0.000	1.02
educ_years	8.9202	9.5828	-23.7	-2.60	0.010	0.56*
hh_15_64	2.1718	2.0798	12.8	1.31	0.193	1.52*
asset_score	3.3006	3.3497	-5.5	-0.54	0.591	0.75
land_area	.55368	.13677	15.0	1.89	0.060	798.04*
input_fertilizer	.46012	.16564	66.5	6.03	0.000	.
input_labor	.97546	.93865	17.1	1.64	0.102	.
extension	.10429	.08176	6.4	0.69	0.488	.
ua_vegetable	.89571	.46012	103.2	9.48	0.000	.
ua_poultry	.90184	.98773	-31.9	-3.45	0.001	.
ua_livestock	.64417	.67485	-6.9	-0.58	0.560	.
sells_produce	.88125	.90184	-5.9	-0.59	0.553	.
2.land_tenure	.0184	.01227	3.4	0.45	0.653	.

* if variance ratio outside [0.73; 1.36]

Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
0.367	157.74	0.000	26.0	15.0	30.2*	325.37*	60

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

This table presents the average treatment effect on the treated (ATT) estimating the impact of irrigation use on the likelihood of experiencing food insecurity, as measured by the Food Insecurity Experience Scale (FIES). The treated group consists of households that use irrigation, while the control group consists of non-irrigators.

The treated mean of 0.304 indicates that approximately 30.4% of irrigation users experience food insecurity, whereas the control means of 0.722 shows that 72.2% of non-irrigators face food insecurity, the difference (ATT) of -0.418 means that irrigation users have a 41.8 percentage point lower probability of experiencing food insecurity compared to non-users. This difference is highly statistically significant, with a standard error (SE) of 0.079 and a t-statistic of -5.30.

This substantial and statistically significant negative effect highlights the important role that irrigation plays in reducing food insecurity among households. The results suggest that irrigation access nearly halves the likelihood of being food insecure, reflecting improved food availability and stability for irrigators.

The matching summary indicates that out of 193 treated households (irrigation users), 170 were matched to 72 control households (non-users). There are 23 unmatched treated households that did not find suitable control matches. This careful matching strengthens the validity of the estimated effect by comparing similar households.

In conclusion, the PSM results provide strong evidence that irrigation significantly reduces the probability of food insecurity, suggesting that irrigation interventions can be an effective tool to improve food security outcomes in agricultural communities.

CHAPTER FIVE

5.1. Conclusion and Recommendation

5.1.2. Conclusion

This study assessed the impacts of urban agriculture on poverty reduction in Aksum Town, Central Zone of Tigray. The findings reveal that urban agriculture plays a significant role in improving household income, ensuring food security, creating employment opportunities, and reducing vulnerability among urban dwellers. Various forms of urban farming including vegetables growing, fruit tree cultivation, poultry, and small-scale livestock were identified as key strategies for coping with poverty. However, challenges such as limited access to land, water, credit facilities, and technical support hinder the full potential of urban agriculture.

The regression analyses provided empirical validation for the impacts of urban agriculture. While the direct linear relationship between the specific poverty reduction index, the Control Function Approach (CFA) revealed a robust and statistically significant causal effect of the food security Index on the Food Consumption Score. This causal link, contingent on the Poverty reduction Index signifying improved inputs, strongly suggests that advancements in inputs can lead to tangible improvements in dietary quality and food consumption patterns. The significance of the residual term in the CFA model further confirmed the presence of endogeneity, validating the necessity of this advanced econometric approach to obtain consistent estimates of the causal impact. In PSM, matched sample size is usually smaller than the input size because unmatched units are excluded.

In conclusion, the study affirms the profound and complex interdependency between agricultural productivity and poverty reduction in Aksum town. Households are trapped in a cycle where inadequate agricultural productivity exacerbates food insecurity, and economic constraints limit the adoption of modern solutions for both. Despite some data limitations, the overall insights gained provide a compelling evidence base for targeted, integrated interventions that address these interconnected forms of deprivation holistically, fostering resilience and sustainable development in post-conflict settings.

5.2. Recommendations

Based on the empirical findings and the identified challenges faced by households in Aksum town, the following recommendations are put forth to inform policy and practice aimed at alleviating the impacts of urban agriculture on poverty reduction:

1. The local government should integrate urban agriculture into municipal development plans and provide legal recognition for land use dedicated to farming.

2. Facilitate access to land, water, and agricultural inputs for urban farmers, especially women and youth, through community-based programs and partnerships.

3. Provide training and extension services on modern urban farming techniques, pest control, and environmental management.

4. Establish and expand microcredit schemes targeted at urban farmers to enable investment in tools, seeds, fertilizers, pesticides and infrastructure.

5. Promote sustainable urban agriculture through proper zoning policies that designate specific areas for agricultural use within the town.

6. Promote implementation programs that encourage the cultivation and consumption of a wider variety of nutrient-dense crops, particularly fruits, vegetables, and pulses, to address observed dietary deficiencies. Support for small-scale livestock and poultry farming can also improve access to animal-source proteins.

7. conside**r** targeted food assistance programs that focus on improving the nutritional quality of diets, especially for vulnerable households identified as experiencing high financial stress or limited dietary diversity, even if formally classified as "food secure."

8. Encourage more in-depth and longitudinal studies to assess the long-term impact of urban agriculture on poverty and food systems in urban areas.

9**.** Integrate conflict-sensitive approaches into all development interventions, recognizing the pervasive impact of conflict on livelihoods and infrastructure. This includes supporting peace building initiatives and ensuring humanitarian aid is coordinated with long-term development goals.

REFERENCES

Alkire, S., & Robles, G. (2016). *Global Multidimensional Poverty Index 2016* (Global MPI No. 7; OPHI Briefing 41). Oxford Poverty and Human Development Initiative (OPHI), University of Oxford.

Belevi, H. (2011). *A systematic overview of urban agriculture in developing countries*. EAWAG – Swiss Federal Institute for Environmental Science and Technology, SANDEC – Department of Water and Sanitation in Developing Countries.

Bellows, A. C., Brown, K., & Smit, J. (2010). *Health benefits of urban agriculture*. Community Food Security Coalition's North American Initiative.

Chandrasekaran, M., Sivakumar, V., & Mani, S. (2010). *An introduction to agriculture and agronomy*. New Age International (P) Ltd., Publishers.

Crush, J., & Frayne, B. (2011). Supermarket expansion and the informal food economy in Southern African cities: Implications for urban food security. *Journal of Southern African Studies*, *37*(4), 781– 807. https://doi.org/10.1080/03057070.2011.617532

Davies, M., Béné, C., Arnall, A., Tanner, T., Newsham, A., & Coirolo, C. (2020). Promoting food security in the context of the climate crisis: The role of rural livelihoods. *Global Environmental Change, 65,* 102195. https://doi.org/10.1016/j.gloenvcha.2020.102195

Drescher, A. W., & Laquinta, D. T. (2002). *Urbanization: Linking development across the changing landscape*. Food and Agriculture Organization of the United Nations (FAO).

Food and Agriculture Organization of the United Nations. (2010). *Fighting poverty and hunger* (Economic and Social Perspectives – Policy Brief No. 10).

Gebru, G. (2017). *Advanced research method* [Unpublished manuscript]. Aksum University.

Hassan, B. (2018). *Contribution of urban agriculture for poverty reduction in north Gondar zone in case of Gondar town* [Unpublished manuscript]. Aksum University.

Maxwell, D. (2005). The importance of urban agriculture to food and nutrition. In *Annotated bibliography on urban agriculture*. ETC Foundation.

Poulsen, M. N., McNab, P. R., Clayton, M. L., & Neff, R. A. (2015). A systematic review of urban agriculture and food security impacts in low-income countries. *Food Policy, 55,* 131– 146. https://doi.org/10.1016/j.foodpol.2015.07.002

Zezza, A., & Tasciotti, L. (2010). Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. *Food Policy*, *35*(4), 265– 273. https://doi.org/10.1016/j.foodpol.2010.04.007

APPENDIX 1

Part I: Household Demographics.

1. Sex of respondent: 1. Male 2. Female

2. Age: ______ years

3. Marital status: 1. Single 2. Married 3. Divorced 4. Widowed

4. Main occupation: 1. Student 2. Government worker 3. Private business 4. Farmer 5. Daily laborer 6. Other: _______

5. Educational level (in years): _______

6. Household size: 1. Members < 15 years: ____ 2. Members 15– 64 years: ___ 3. Members > 64 years:

7. Religion: 1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Other

Part II: Participation in Urban Agriculture

8. Is your household currently engaged in any form of urban agriculture?
1. Yes 2. No (If "No," skip to Part V)

9. What types of urban farming do you practice? 1. Vegetable production 2. Fruit tree cultivation
3. Livestock (e.g., cattle, goats, sheep) 4. Poultry (e.g., chickens, ducks) 5. Beekeeping

10.Area of land used for farming: _______ hectares

11.Land tenure status: 1. Owned 2. Rented 3. Borrowed 4. Government-allocated

12.Do you use irrigation? 1. Yes 2. No

13.What is your primary purpose of production?
1. Own consumption 2. For market 3. Both

14.Number of household members involved in urban agriculture: ______

15.What inputs do you use? (tick all that apply):

1. Improved seeds 2. Organic seeds 3. Fertilizer 4. Pesticides/herbicides

5.Animal feed 6. Irrigation tools 7. Labor 8. Bee hives/equipment

16.Do you receive any extension support or training?

1. Yes 2. No If yes, source: 1. Government 2. NGO 3. Cooperative 4. Private sector

Part III: Disaggregated Household Income

Please provide approximate income from each source over the past 12 months.

Source of Income	Monthly (birr)	Annual (birr)
Urban vegetable production		
Urban fruit tree farming		
Urban livestock rearing		
Urban poultry rearing		
Beekeeping		
Wage/salary (govt/private)		
Non-agricultural business		
Rural agriculture		
Rental income (land/property)		
Remittances (from relatives)		
Pension/social support		
Other: ____________		

Part IV: Food Security – Full HFIAS and HDDS

A. Food Insecurity Experience Scale (HFIES)

In the past 4 weeks, how often did these things happen in your household?

Question	1.Yes	2.No (0)	3.Rarely (1– 2x)	4.Sometimes (3– 10x)	5.Often (>10x)
1. Worried about not having enough food?					
2. Unable to eat preferred foods due to lack of resources?					
3. Ate a limited variety of foods due to lack of money?					
4. Ate food you didn’ t want to eat due to lack of resources?					
5. Ate smaller meals than you felt you needed due to food shortage?					
6. Ate fewer meals in a day because of lack of food?					
7. No food at all in the household due to lack of resources?					
8. Went to bed hungry because there was not enough food?					
9. Went a whole day and night without eating anything because there was not enough food?					

B. Household Dietary Diversity Score (HDDS) 24-Hours Recall

Did anyone in your household consume the following food groups in the previous 24hours(day and night)?

Food Group	Yes	No

Food Group	Yes	No
1. Cereals (teff, wheat, maize, rice)		
2. Roots/tubers (potato, sweet potato)		
3. Vegetables		
4. Fruits		
5. Meat (beef, goat, poultry)		
6. Eggs		
7. Fish or seafood		
8. Pulses/legumes (beans, peas)		
9. Milk and dairy products		
10. Oil/fats		
11. Sugar/honey		
12. Misc. beverages/condiments		

Part V: Multidimensional Poverty (MPI)

20. Type of house: 1. Mud 2 Wood 3. Brick 4. Concrete

21.Does your household have access to: Electricity: 1. Yes 2. No

Toilet: 1 Yes 2. No Clean water: 1. Yes 2. No

22. Children 5–17 currently not attending school:

1. Yes 2. No 3. Not applicable

23.In the past 12 months, did any member of your household need but not receive health care due to cost or distance? 1.Yes 2. No

24. Assets owned (tick all that apply):

1. Mobile phone 2. Radio 3. Television 4. Refrigerator 5. Bicycle 6. Motorcycle 7. Livestock 8. Beehives 9. Farm tools

Part VI: Urban Agriculture Challenges

25. What challenges do you face in urban agriculture? (Check all that apply)

1. Lack of land   2. No irrigation 3. Limited seeds/tools/fertilizers
4.Lack of training or extension support 5. Market access problems
6. Insecurity/conflict 7. Poor transport infrastructure
8.Legal/government restrictions   9. Other: ___________

26. Do you sell your produce?   1. No   2. Yes — If yes, where?

1 Local market   2. Retail shops   3. Neighbors   4. Intermediaries

27. What support do you need most to improve your farming and reduce poverty?

1. Access to land 2. Inputs 3. Credit/finance   4. Training   5. Irrigation   6. Marketing   7. Policy support