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Impacts Of Urban Expansion On Croplands And Peri-Urban Communities In Case Of Adet Town, North West Ethiopi

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November 2024

Bahir Dar, Ethiopia

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A Thesis Submitted to the Department of Geography and Environmental Studies in Partial Fulfillment of the Requirements of the Degree of Master of Arts in Geography and Environmental Studies

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Advisor

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November 2024

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Declaration

I, Wondwesen Shitahun undersigned, hereby declare that this MA thesis report is my original work and all reference materials used in the thesis have fully acknowledged. I certify that this thesis has not previously been presented to any other universities for the requirements of any academic awards or degrees.

Declared by:

Wondwesen Shitahun _____ _____

Name Signature Date

APPROVAL SHEET

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As an advisor, I have read and critically evaluated this thesis prepared under my guidance by Wondwesen Shitahun entitled as "*Impacts of Urban Expansion on Croplands and Peri-Urban Communities in case of Adet Town, North West Ethiopia."* I recommend that it is eligible to fulfill the requirements for the award of Master of Arts in Geography and Environmental Studies.

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Examiners' Approval Sheet

As examiners, we have read and evaluated the thesis prepared by Wondwesen Shitahun and examined the candidate. We recommend that the thesis is eligible to fulfill the requirements for the award of Master of Arts in Geography and Environmental Studies.

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Acronyms

°C	Degree Celsius
AARCMS	Adet Agricultural Research Center Meteorological Stations
ATAMS	Adet Town Administration Municipal Service
GCP	Ground Control Point
GIS	Geographic Information System
GPS	Global Positioning System
Ha:	Hectare
MUDHCo	Ministry of Urban Development and Housing Construction
ESS	Ethiopian Statistical Service
SPSS	Statistical Package for Social Science
UN:	United Nations
UNDESA	United Nations Department of Economic & Social Affairs
UNECA	United Nations Economic Commission on Africa
UN-Habitat	United Nations Human Settlements Program
WGAZPC	West Gojjam Zone Administrative Zone Plan Commission
YDDPCO	Yilmana Densa District Plan Commission Office
YDDAO	Yilmana Densa District Agriculture Office
YDDLAO	Yilmana Densa District Land Administration Office

Abstract

Urbanization is recently rising all over the world, particularly at an alarming rate in developing countries. Likewise, most towns in Ethiopia recently are expanding towards the peri-urban areas. The expansion of these towns result the conversion of cropland to urban land uses. This study aimed to assess the impact of urban expansion on croplands in Adet town and its effects on peri-urban households' in terms of loss of cropland and income change. The study used descriptive survey research design. Firstly, the researchers used open-source remote sensing satellite imagery data of three different periods of 2005, 2014, and 2023 to assess the extent of urban expansion into rural cropland. Then, the researchers used household surveys data, where data collection tools such as questionnaires and interviews utilized. A combination of purposive and snowball sampling techniques was employed to ensure the representativeness of sample kebeles and households respectively. The survey data were analyzed using percentages, frequencies, and paired sample t-test. In addition, the LULC changes happened in the study area for every 9 years of the last 18 years area was analyzed using ERDAS IMAGINE 2015 and Arc Map 10.3. The LULC change analysis showed that cropland and grazing land decreased from 3633.3 to 3158.6 ha and 689.13ha to 533.3ha respectively between 2005 and 2023. Whereas built-up and forest area increased from 108.81ha to 692.06h and 1035.63 to 1082.92 respectively in the period between 2005 and 2023. The expansion of built-up area leads for the shrinking of cropland that result a decrease in households income. The mean household income before cropland loss was 2.66, while the mean income after the loss dropped to 2.56. These problems have managed by addressing rural-urban migration, training on income generation, and the government should involve in the construction of condominiums on small plot area size.

Key words**: **Built-up area, cropland, land use land covers, peri-urban, urban expansion

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Urbanization has defined as an increase in the proportion of the population living in urban areas and the physical expansion of existing urban centers. Urban expansion is a universal phenomenon occurring globally due to better job opportunities and a more comfortable lifestyle, which lead people to migrate from rural to urban areas (Weber & Puissant, 2003). Urbanization, the process of urban expansion, may involve both horizontal and vertical growth of the physical structure of urban areas (UNECA, 2016).

According to a report by the United Nations (UN, 2019), the global population increased from 2.54 billion in 1950 to 7.63 billion in 2018, and it is projected to exceed 9.77 billion by 2050. Along with population growth, more people are choosing to live in urban areas. Likewise, the percentage of the world's population residing in urban areas increased from 35.5 percent in 1950 to 55.3 percent in 2018, and this number expected to reach 68.4 percent by 2050.

Urban expansion occurs both vertically and horizontally, often leading to significant encroachment on surrounding agricultural land. This results in the loss of arable land, natural landscapes, and rangelands. A study by (Gardi et al., 2021) projected that by 2030, urban areas will expand by 590,000 square miles to accommodate the needs of more than 1.47 billion people living in urban centers worldwide. An assessment of global land area indicated that over 145,000 square kilometers converted to urban or artificial land uses, representing a 23 percent increase in just five years from a baseline of 630,000 square kilometers. This phenomenon is particularly pronounced in countries experiencing rapid economic growth or demographic pressure, with the fastest urban land expansion occurring in Africa and Asia (Gao & O'Neill, 2013).

Despite Ethiopia's rapidly growing urban population, it remains one of the least urbanized countries in Africa, with only 21.2 percent of its population living in urban centers as of 2019. This figure is expected to rise to 40 percent by 2050 (UN, 2019). According to the Ethiopian Central Statistics Agency (CSA, 2013), the urban population is projected to nearly triple from 15.2 million in 2012 to 42.3 million by 2037, with an annual growth rate of 3.8 percent. Analysis suggests the rate of urbanization may be even faster, at approximately 5.4 percent per year, potentially resulting in a tripling of the urban population by 2034, with 30 percent of the population residing in urban areas by 2028.

Urban growth in Ethiopia is generally characterized by inadequate planning or a lack of implementation of plans, resulting in cities that often lack necessary infrastructure and services (Haregeweyn et al., 2012; MUDHCo, 2014; Zewdie et al., 2018). Peri-urban areas surrounding cities are particularly vulnerable to the rapid conversion of prime agricultural land into urban settlements, which threatens the livelihoods of farmers (Belay, 2014; Wegedie, 2018). Local peri-urban farmers are at risk of displacement when their land has needed for urban development. Furthermore, as urban settlements expand, various groups with diverse interests may be attracted to peri-urban agricultural areas, often forcing local landholders who depend on agriculture to relinquish their land rights (Adam, 2014).

The Amhara region is one area experiencing rapid urbanization in Ethiopia. From 1994 to 2007, the region's urban population grew at a rate of 3.94 percent, surpassing the national rate of 3.77 percent (CSA, 2013). Between 2001 and 2005, the urban population growth rate was even higher, at 4.4 percent. In 2007, the region boasted 208 cities and towns, contributing to 11.7 percent of the urban population, up from 8.5 percent in 1994. According to the Ethiopian Statistical Service (ESS, 2022) population projection indicated that North Gonder zone had the highest urban proportion (21.4%), followed by South Wollo (14.3%), North Shoa (10.2%), and East Gojjam (10.1%). %). South Gondar and West Gojjam had urban population proportions of 9.3% and 8.8 %, respectively, followed by the Bahir Dar special zone, which had 8.5 %.

Adet town, located in the Amhara region's North Gojjam administrative zone, is one of the fastest-growing urban centers in the region, with an estimated population of 43,200 (ESS, 2022). Upgraded to a town administration in 2010, Adet serves as the administrative seat of Yilmana Deensa district. Situated 42 kilometers from Bahir Dar, the town has attracted many residents and investors due to its proximity to the city. Access to infrastructure, such as roads and electricity, has further facilitated private investment in and around Adet. Since 2014, the town has increasing rapidly in area and population, expanding in all directions and encroaching upon fertile croplands (ATAMS, 2023). Therefore, this study intends to examine the impact of urban expansion on croplands in peri-urban areas.

1.2. Statement of the Problem

Urban expansion is currently increasing at an alarming rate in developing countries, driven by rapid population growth and high rates of rural-to-urban migration. This process typically manifests as the physical or horizontal expansion of urban areas into peripheral agricultural lands, significantly affecting farmers in peri-urban regions, particularly in agrarian economies like Ethiopia. The implications of such urbanization are profound, as the encroachment on agricultural land not only displaces farmers but also threatens food security and livelihoods in these regions (Terfa et al., 2019).

One of the most significant negative impacts of urban expansion in developing countries is the loss of cropland (Deng et al., 2015). Research indicates that rapid urban expansion consumes available land in peri-urban and rural areas, forcing farmers living on the urban fringes to seek new farming spaces, which ultimately results in a decrease in cropland area (Abass et al., 2018). As cities expand, the availability of land for agricultural use diminishes, often leading to conflicts over land rights and usage. This urbanization process presents a fundamental challenge to living standards and food security in many agrarian economies. The conversion of agricultural land to urban uses leads to the loss of farmland, grazing land, and natural areas, consequently reducing crop yields and overall food productivity. The resulting decrease in available agricultural land directly threatens the ability of local farmers to sustain their livelihoods, making the study of urban expansion and its effects on cropland an urgent area of research (Aragaie, et al., 2022).

While a number of studies have investigated the effects of urbanization in Ethiopian towns such as; Belay (2014), Bergude (2021), Firew (2010), Goshime (2020), Inki (2018), Wegedie (2018), and Yimam (2017), most of these have primarily focused on the impacts of urbanization on the livelihoods of peri-urban households without adequately examining its effects on cropland specifically. Additionally, some studies had conducted in the Yilmana Densa District on land use and land cover changes. For instance, (Fisseha et al., 2011) analyzed land use and land cover changes in the Debe-Mewi watershed over 51 years (1957-2008), and (Demelash, 2022) examined land use conflicts and their impacts. Although these studies confirmed significant changes in land use due to population increases, they did not address how urban expansion specifically contributes to the reduction of cropland in the region.

Despite the concentration of new urban developments in peri-urban areas, there remains a notable gap in research focusing on the impact of urbanization on agricultural (Adam, 2014). According to recent data from the Adet town administrative municipal office and the Yilmana Densa district agricultural office (2023), as well as surveys conducted by the researcher, the administrative boundary of Adet town is expanding outward, encroaching upon peripheral lands at the expense of cropland. This trend results in the conversion of substantial amounts of agricultural land into urban uses, adversely affecting the income of dispossessed households and threatening their livelihoods.

Although various studies on urban expansion had conducted in Ethiopian towns, none have specifically focused on Adet town in the North Gojjam zone. Furthermore, the extent and potential impacts of the horizontal expansion of Adet town had not systematically investigated. This gap in the literature underscores the need for targeted research that examines how urban expansion affects cropland and the income of communities dispossessed by this growth.

This study aims to fill this research gap by analyzing the urban expansion of Adet town and its impact on surrounding croplands and community income. By employing remote sensing and GIS techniques to study changes from 2005 to 2023, the research will provide a comprehensive understanding of the dynamics at play in Adet town. Through this investigation, the study seeks to illuminate the consequences of urban expansion on cropland and highlight strategies to mitigate adverse impacts on affected communities.

1.3. Objective of the Study

1.3.1. General objective

The general objective of this study is to assess the impacts of urban expansion on croplands and peri-urban communities in the case of Adet town.

1.3.2. Specific Objectives

The specific objectives of the study are:

- To examine the causes of Adet town's expansion.
- To investigate the extent of Adet town's expansion using satellite imagery from 2005 –2023
- To investigate the impacts of urban expansion on cropland in the study area.
- To assess changes in the income of peripheral households related to urban expansion in the study area.

1.4. Research Questions

To address the defined objectives, the following research questions have identified:

- What are the causes of Adet town's expansion?
- What is the extent of Adet town's expansion from 2005 – 2023?
- What are the impacts of urban expansion on cropland in the study area?
- What income changes have peri-urban households experienced because of urban expansion?

1.5. Significance of the Study

The findings of this study offer valuable insights into the impacts of urban expansion on cropland resources, quantified through the integrated application of GIS and Remote Sensing. The results can serve as crucial input for planners and decision-makers in developing and refining urban expansion strategies and policies. Additionally, the study provides an opportunity to understand trends in the growth of built-up areas and the underlying driving forces behind this expansion.

Moreover, the research expected to highlight potential areas for intervention, offering recommendations for government and non-governmental institutions to address the challenges posed by urban expansion. By identifying key issues and trends, the study can help in designing more effective land management and urban planning strategies. Furthermore, the findings will contribute to the broader body of knowledge on urban expansion and its socio-economic impacts, supporting future research and policy development in similar contexts.

1.6. Scope of the Study

The scope of this study has defined by its geographic focus on Adet town. The town has been experiencing significant horizontal expansion in all directions, making it a key area of interest for examining the implications of urban growth. The surrounding rural kebeles, which encompass agricultural lands and peri-urban communities, are also central to this research. The scope of the study includes an investigation of the various causes driving urban expansion in the study area. Understanding these causes is crucial for contextualizing the subsequent impacts on cropland and rural livelihoods. Additionally, the research focused to analyze how urbanization affects the availability of cropland, as well as the income changes experienced by households who have been dispossessed their land holdings due to this expansion.

1.7. Limitation of the Study

The researcher encountered several constraints while conducting this research. One challenge was obtaining previously recorded secondary data from the land administration office, particularly data related to land use and land cover. Additionally, the researcher faced difficulties in locating dispossessed households, as they had dispersed across a wide area, making the data collection process time-consuming and labor-intensive.

Despite these challenges, the researcher persevered and successfully completed the research by employing snowball sampling to address the sample households and converting LULC soft copy data in to hard copy from Yilmana Densa District Land Administration Office. In summary, while the study faced several limitations related to data accessibility and participant engagement, the researcher adapted to these challenges through strategic sampling methods and data conversion techniques. These efforts contributed to the successful completion of the research.

1.8. Organization of the Thesis

The thesis organized into five chapters. The first chapter introduces the research, including the background of the study, statement of the problem, research objectives, research questions, significance of the study, scope of the study, limitations of the study, and the organization of the thesis.

The second chapter presents a literature review, summarizing related works pertinent to the research. The third chapter describes the study area and outlines the research methodology, including research design, sampling methods, and methods of data collection and analysis.

The fourth chapter focuses on the results of the study, with detailed discussions and interpretations. The final chapter, chapter five, presents the conclusions drawn from the results and offers recommendations based on the findings.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1. Conceptual Definition of Terms

Cropland: Refers to land primarily used for growing crops, whether through irrigation or rain-fed methods (Agidew & Singh, 2017).

Geographic Information System (GIS): A computer system designed to manage geospatial data. It encompasses a range of tasks, including data input, storage, retrieval, and output, as well as various descriptive and analytical functions (Weng, 2004).

Land Use/Land Cover: These related terms have distinct meanings. "Land use" refers to how people utilize the landscape, whether for development or other purposes. "Land cover" describes the physical characteristics of a region, such as forests, wetlands, agriculture, and other types of land and water (William & L.Turner, 1992).

Peri-urban: As the spatial extent it can refers to rural agricultural areas located between urban built-up areas in cities and predominantly rural agricultural areas (Adam, 2014).

Peri-urban communities: Refers to those households who dwell at the outskirt of cities and depends as farming their main livelihood strategy (Adam, 2014).

Remote Sensing: Generally refers to the activities of recording/observing/ perceiving (sensing) objects or events without being in direct contact with the objects or events being observed (Weng, 2004).

2.2. Theories of Urbanization

There are been several explanations on what drives urbanization and how cities had emerged. Some of the available literatures on the theories of urbanization have ideas that intersect with others; while some came up as a build up from other theories. Some of these theories are highlighted below to further buttress the understanding of why and how urbanization takes place (Bodo, 2019).

2.2.1. The Theory of Self-Generated Urbanization

This theory suggest that urbanization occurrence requires two separate conditions, which are the generation of surplus products that sustain people in non-agricultural activities and the achievement of a level of social development that allows large communities to be capable

of working successfully alone (Bodo, 2015). It is believed that this type of changes that result in urbanization took place simultaneously in the Neolithic period when the first cities emerged in the Middle East (Wheatley, 1971). This theory also holds that rural-urban migration was the source of this form of urbanization, as people began to move to the cities for factory jobs. Thus, industrialization was identified as the driver behind the exodus movement of people from the rural settlements to urban areas. Before the industrial revolution in Great Britain in the twentieth century, historical evidence showed that no society had described as urbanized. It was after this period that the West began to industrialize rapidly and soon after the accelerated industrialization and then urbanization in the rest of the world through the last century to the present. This theory concludes that industrialization produces urbanization. This theory has also been queried for focusing on rural-urban shift within counties as the source of the urbanization, considering that there are other cities that are urbanized based on other factors, and not necessarily through rural-urban migration (Pred, 1977).

2.2.2. Modernization Theory

This theory was prevalent and influential from the 1950s the 1970s. The theory asserts that urbanization results from the introduction of new things and innovations within the society through industrialization, technological application, information penetration and cultural diffusion (Smith, 1996). Considering urbanization through the lens of modernization, it is common to see elements of modernization (new things) in every society that has moved from the primitive era (Stone Age) to a new or modern pattern of doing things. The importance of technology in social organization and shaping of the society is very obvious; as urbanization usually results afterwards. The present state of urbanization and development in the world today cannot be separated from its initial state at the onset of modernization (Kasarda and Crenshaw, 1991). Most developments are products of technologically driven societies, which could boost or increase economic capabilities, provide surplus food through improve agricultural system and the use of mechanical and electronic tools or machines to reduce workload on citizen; yet increasing speed and efficiency of work done (Lenski and Nolan, 1984).

2.2.3. Dependency/World-System Theory

The theorists in this tradition believe that, this kind of system is introduce through either intentional coercion or through the inherent logic of capitalism in certain areas; and also the presence of under development among the population (Wallerstein, 1979). Amore critical analysis of dependency world-system theory had been reviewed at a more basic level, whose views were rested on three assumptions. Firstly, these critical theorists believed that a unique form of capitalist development pattern exist in societies, attributing it to a form of social organization. Secondly, for capitalism to be in place, certain social structure will manifest in the form of unequal exchange, uneven development, individual social inequality, core periphery hierarchies and dominance structures. Perhaps, these features of underdevelopment were not available in such societies; the dependency/world-system theorists asserted that a capitalistic development will necessitate such scenario or create them into the system (Kasarda and Crenshaw, 1991).

The views of these theorists were clear, that the social changes in the third world were because of structures and processes of the capitalist world system. Thus, this system thrive through the unequal structure and disproportionate development in the society; as the world cities of the developed world are using primate capitals of the third world as accumulators and transmitters of wealth (Bornschier, 1981; London, 1987; Portes and Benton, 1984).

2.2.4. Theory of Urban Bias

Michael Lipton, a development economist, who is a leading proponent of the urban bias theory. He argued that the rural people were described as being parasitized by urban populations, who benefits massively from the consumption of cheap good from the rural settlements and beautiful urban structures from the tax incomes from these rural areas (Dixon and McMichael, 2016). This bias in favor of the urban settlements has created disparity between the rural and urban areas; as regard to consumption, wage and productivity levels; necessitating mass exodus of the rural dwellers to cities for greener pastures and an improved standard of living (Corbridge and Jones, 2005).

The sufferings and abject poverty among the people in the rural areas is attributed to urban bias (Lipton, 1997). This results from the uneven distribution of available resources among the populace; a situation that concentrate developmental projects like agricultural and industrial reforms in the urban centers, making the impoverish rural dwellers to move to the cities where they can access quality education, health care service, basic social amenities, security, essential goods and services (Bates, 1981; Lipton, 2005). The urban bias theorists believed that there are groups that hinder the economical development of the rural areas by pressuring the government to protect their interest by their location in urban areas at the expense of the rural areas (Ades and Glaeser, 1994). And this development process in the poor countries that is economically bias to the rural areas has been embedded in the political structure by the urban groups. Therefore, the people in these rural areas continue to suffer from stunted growth, reduced investments, lower public goods provision and political repression due to the lack of political will or power to aid their development (Lipton, 1997).

2.3. Concept of Urban Expansion

According to Mcgranahan et al., (2004), there are no universally accepted criteria for distinguishing urban areas from rural areas. National definitions vary widely, as summarized in United Nations publications. Some researchers prefer to define urban areas based on standardized criteria such as population size and density, while others consider additional factors like commuters living beyond dense settlements. Generally, urban areas defined as settlements with significant administrative functions and a substantial proportion of the population engaged in diverse economic activities.

The term "urbanization" specifically refers to an increase in the proportion of a country or region’s population residing in urban settlements, while "urban growth" denotes an increase in the absolute size of a country or region’s urban population (Bloch et al., 2015). Urbanization encompasses a rural-to-urban transition that involves changes in population, land use, economic activity, and culture, or any combination of these factors.

Urbanization is a complex socio-economic process that transforms the built environment, converting formerly rural areas into urban settlements while shifting the spatial distribution of the population. This process includes changes in dominant occupations, lifestyles, culture, and

behavior, thereby altering the demographic and social structures of both urban and rural areas (UN, 2019).

2.3.1. Urbanization in Africa

Since the 1950s, Africa's urban populations have been growing steadily; reaching 40 percent of the continent's total in 2014 and projected to hit 56 percent by 2050. Urbanization accelerated in the post-independence period, slowed in the 1990s, and gained momentum again in the 2000's. Africa's urban population is expected to triple by 2050, with Africa and Asia together accounting for nearly 90 percent of the world's urban population growth (UNDESA, 2015).

Excluding North Africa, urbanization in Africa increased from 15 percent in 1960 comparable to Europe in the 17th century to 38 percent today, surpassing South Asia. The number of urban residents in Africa nearly doubled between 1995 and 2015 and is projected to almost double again by 2035 (UNECA, 2016).

Urbanization rates vary across African sub-regions and countries. East Africa, while the least urbanized, is urbanizing the fastest, whereas Southern Africa, the most urbanized, is progressing more slowly. For instance, trends in Mozambique and Rwanda reflect their unique economic dynamics, policies, and conflicts (Terfa. et al., 2019).

Urbanization is driven by four main factors: net rural-to-urban migration within a country, international migration, natural population growth (influenced by mortality and fertility rates), and the reclassification of rural towns as urban areas. Early theories of Africa's urbanization emphasized migration, suggesting that high wage differentials between urban and rural areas drove migration despite high urban unemployment, as the urban wage was attractive even if the likelihood of securing an urban formal sector job was low (Harris and Michael, 1970). However, there is now broad agreement that the role of migration in Africa's ongoing urbanization has diminished, with natural demographic growth becoming a more significant factor (Jedwab et al., 2014). Reclassification also plays a role in some countries. For example, Uganda, which had 33 districts in 1986, now has 111 districts, each with administrative and commercial towns (World Bank, 2015).

2.3.2. Urbanization in Ethiopia

The history of urbanization in Ethiopia goes back to the Axumite. During this time, there were many towns where commerce had flourished with buildings and constructions of high standard. Centuries later, these urban centers began to shift to Lalibela and Gondar. Much of the

urban history to Ethiopia following the Axumite period had characterized by the absence of fixed urban centers. This trend continues up to the end of the 19thC. In fact it continues until Addis Ababa was selected as a fixed political and commercial center by Minelik II. Like most African countries on Ethiopia large-scale urbanization is a fairly a recent phenomenon. However, the history of towns developing in the country extends back to the Axumite Kingdoms of 14thc, when Axum, the first political and religious center in the north of the country, was established. Despite this long urban history however, Ethiopia remains one of the least urbanized countries in sub-Saharan Africa (Terfa et al., 2019).

Prior to 20thc, the establishment, and growth of the Ethiopian cities has said to be in response to indigenous political, religious, economic as well military strategic, requirements. Despite its failure to build a well organized and large size urban settlement, the constant shift of the location capital cities of the empire during this period had accounted for the establishment and growth of a number of towns, particularly in north Ethiopia. For instance, Axum, Lalibela, and Gondar found in the 4thC, 11thC and 17thC, respectively are some of the urban centers that served as capitals of nations. The factors that contribute to the growth of urbanization in Ethiopia include the establishment of central government, the introduction of modern means of transport and communication, schools, hospitals and modern business, Ethiopia's contact with the outside world and the establishment of large number of industries and organized farms as intensified process of urbanization in Ethiopia (Belay, 2014).

Despite Ethiopia's urbanization level was only 21.2% in 2019, the annual urban growth rate of 4.5% surpasses the Sub-Saharan Africa average of 4% and is expected to increase to 5.4% (World Bank, 2015).

Urbanization in Ethiopia is uneven, with a few urban centers accounting for a significant proportion of the total urban population. A settlement qualifies as urban if its population exceeds 2,000. According to this criterion, there are 971 urban settlements with an estimated total population in millions (MUDHCo, 2014).

Table 2.1: Classification of urban centers (MUDHCo, 2014)

Population size	1984		1994		2007	
	Number	%	Number	%	Number	%
Below 5000	511	78.9	683	74.0	394	40.6
5000 – 19999	111	17.1	187	19.9	457	47.0
20000 – 99999	24	3.7	48	5.3	104	10.7
100000 – 249999	1	0.2	3	0.3	12	1.2
Above 249999	1	0.1	1	0.1	4	0.4
Total	648	100	922	100	971	100

Projections in the MUDHCo, (2014) indicate that Addis Ababa will maintain its primacy with over 6 million inhabitants, and the number of urban centers will reach around 2,500 by 2035. The urban system in Ethiopia is unbalanced, with Addis Ababa serving as the primate city. This imbalance has economic consequences, as most investments are concentrated in Addis Ababa, leading to stagnation in secondary cities and prompting further migration to the capital.

Standard growth models suggest that urbanization is associated with a shift from agriculture to more productive service and manufacturing sectors. Urbanization is positively linked to income, and the world is becoming increasingly urbanized (Glaeser, 2014; Henderson, 2010). Historically, developed countries have seen labor move from agriculture to more productive non-farm sectors as economic growth progresses. This trend may also apply to many Asian countries in their early urbanization stages. However, urbanization in Africa, the second-fastest urbanizing continent has occurred without substantial economic growth complicating the quantification of this relationship (Henderson, 2010; UN, 2019).

2.4. Drivers of Urban Expansion in Ethiopia

Urban expansion in Ethiopia has driven by several factors: migration from villages to towns, expansion into peri-urban areas, and the natural growth of urban populations.

2.4.1. Migration

Migration is a major factor influencing urban growth dynamics in Ethiopia and has significantly contributed to the country's urban population (Bezu & Holden, 2014). Migration in Ethiopia includes both rural-to-urban and urban-to-urban movements. Studies by (Eshetu & Beshir, 2017), revealed that the proportion of migrants in urban centers has drastically increased. In 2005,

migration from rural to urban areas accounted for 24 percent of all migration flows, decreasing by seven percentage points by 2013. Conversely, migration within rural areas accounted for 46 percent of total migration flows, representing a decrease of more than ten percentage points in the same period (CSA, 2013). According to the World Bank's Ethiopia Urbanization Review (World Bank, 2015), migration contributed 30 – 37 percent of urban growth between 2007 and 2017 and is expected to contribute 38 – 48 percent by 2037.

2.4.2. Expansion of Physical Infrastructure

Urban expansion includes the upgrading of villages to urban centers and the physical growth of urban areas into surrounding rural regions due to urban sprawl. As the demand for land has increased, urban centers have expanded their boundaries into surrounding rural and peri-urban areas, often incorporating land previously used for agriculture (Vandercasteelen et al., 2017). Urban expansion can occur both in planned and unplanned manners. Commercial and manufacturing expansions have generally been guided by urban planning, while many residential settlements arise from urban sprawl and informal settlements on the outskirts (Tesema et al., 2020). The development of commercial activities, infrastructure, and services in these areas attracts individuals from agrarian backgrounds, leading to lifestyle transformations and contributing to spatial expansion and overall urban population growth (Ermias et al., 2019).

2.4.3. Natural Growth

According to World Population Prospects (UN, 2019), Ethiopia is one of the fastest-growing countries in the world, with a growth rate of 3.02% per year. At this rate, Ethiopia's population has expected to double in the next 30 years, reaching 210 million by 2060. The majority of the world’s population growth in the next 40 – 50 years has anticipated coming from Africa, with Ethiopia playing a significant role. In 2016, the infant mortality rates were 59 deaths per 1,000 live births in urban areas and 76 deaths per 1,000 live births in rural areas. These figures represent a decline from 97 deaths in urban areas and 115 deaths in rural areas per 1,000 live births in 2000. This decline is primarily due to improvements in health services. The availability of better health services in urban centers thus contributes to natural population growth by reducing child and infant mortality rates (CSA, 2017).

2.5. Impacts of Urban Expansion

Urbanization can have both positive and negative impacts, as explained by (Bah et al., 2003). However, negative impacts are often emphasized because urban growth is frequently uncontrolled or uncoordinated, overshadowing positive aspects.

The positive implications of urban expansion include increased economic production and more employment opportunities. Additionally, urbanization can lead to an improved quality of life due to better opportunities, enhanced services, and elevated lifestyles. Urban expansion can extend basic services, such as transportation and water, as well as specialist services, including better educational and health care facilities, to a larger population. Despite these benefits, rural farming communities surrounding expanding towns often face several challenges. These include socio-cultural problems, economic difficulties, environmental deterioration, and land tenure insecurity (Ayele & Tarekegn, 2020). This study will examine the impacts of urbanization from the perspectives of changes in cropland and the effects on the income of dispossessed households.

2.5.1. Impacts of Urban Expansion on Croplands

Urbanization negatively affects peri-urban areas in several ways. Uneven urban expansion occupies valuable farmland around urban centers, leading to conflicts with farmers dispossessed from their land. As urban centers expand, they encroach on fertile agricultural and forest lands, which are crucial for their ecological functions. The expansion results in a reduction in agricultural production and the number of family farmers, who often migrate to nearby urban centers. Rapid urbanization also leads to the over-exploitation of both renewable and non-renewable resources in peri-urban areas, especially land. Urban residents have different consumption patterns compared to those in peri-urban areas, and the demands of urban centers frequently exceed the carrying capacity of their own territory (Mcgranahan et al., 2004).

According to Adugna (2016), urban expansion causes significant loss of farmland and displaces households involved in farming. This loss of natural assets, primarily agricultural land, leads to inadequate food, poor nutrition, and deteriorating health.

2.5.2. Impacts of Urban Expansion on Households' Income

In Ethiopia, the rapid expansion of cities and towns driven by urbanization has led to increasing expropriation of agricultural land by regional and federal governments for public purposes. Federal and regional laws on rural land expropriation and compensation are perceived as unfavorable to those losing their land (Kasa et al., 2009).

Farmers with large families are particularly vulnerable to unemployment and poverty, as they often lack the education and skills necessary for alternative employment. Individuals without basic qualifications or skills struggle to compete in the labor market (Goshime, 2020).

The expanding urban areas in developing countries like Ethiopia present multifaceted challenges, particularly affecting the income of farming communities in peri-urban areas. The transformation of agricultural fields into urban functions displaces farmers, either by forcing them to relocate or by rendering their farming income obsolete. Those who lose their farmland due to conversion to residential and other land uses often experience a permanent loss of income derived from farming and must seek alternative livelihoods (Talema & Nigusie, 2023).

2.6. Conceptual Framework

The conceptual framework presented below illustrates that rapid urban expansion driven by population growth, rural-to-urban migration, and urban development programs. These factors can produce both positive and negative impacts for farming communities in peri-urban areas. The independent variables include driving forces such as the rate of natural increase, rural-to-urban migration, and reclassification of areas. The dependent variables encompass the consequences such as loss of cropland and changes in household income.

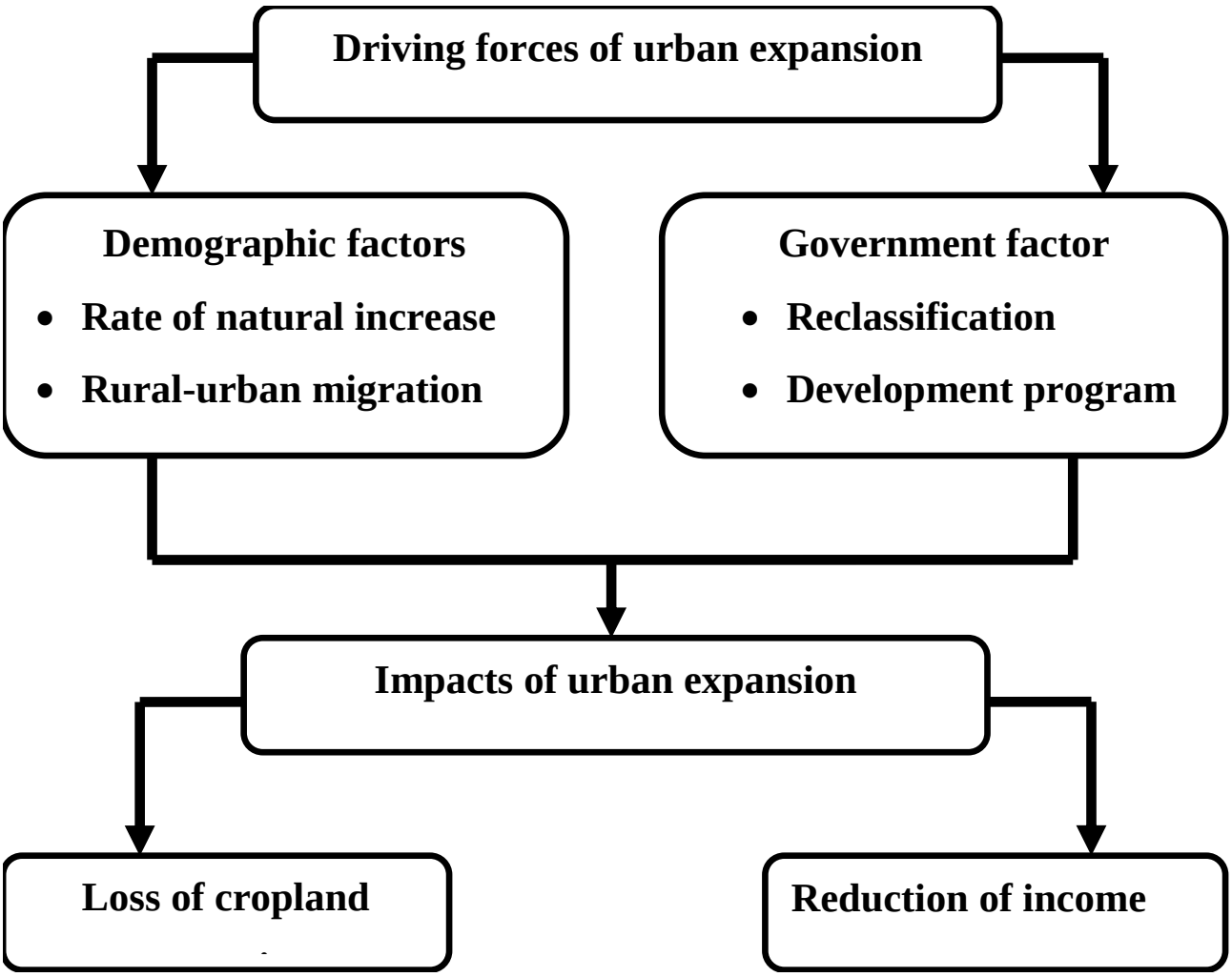


Figure 2.1: Conceptual framework of the study

UNIT THREE

3. RESEARCH METHODS AND MATERIALS

3.1. Description of the Study Area

3.1.1. Historical Background of Adet Town

Adet derives its name from an old woman named "*Ady*," who lived in a place called Adet Hana, approximately five kilometers east of the town. The name "*Adet*" has originated from *Ady*: with the local community modifying her name by replacing "-y" with "-et." In Tigregna, "Ady" means "*my mother*" or "*my homeland*." Oral traditions suggest that Adet town had established around 1599 by *Woizero Ady* and *Ras Bitwaddad Woldegiyorgis*. They owned a large area of land, and many people from different regions settled in the area (YDDCTO, 2023).

Adet town began to govern by a master plan in 1981. In 2010, the town administration whad formed, consisting of five rural and three urban kebeles, making it an independent administrative unit. However, in 2013, the five rural kebeles had removed and incorporated into Yilmana Densa district. As of November 2018, Adet town has organized into three urban kebeles. Due to an increase in its population, two additional urban kebeles has added, bringing the total to five urban kebeles. At its establishment, Adet town had a population of 16,366, which has now grown to 61,255 residents. The town has organized into a town council, an administrative council, and 13 sector offices (ATAPC, 2023).

3.1.2. Location

Adet town has situated in the Amhara Regional State, within the North Gojjam administrative zone of Yilmana Densa district. The town bordered by two rivers: the Shigez River to the west and the Shina River to the east. Geographically the area located at 11°15' 16" north to 11°16'59" north latitude and 37°28'38" east to 37°29'50" east longitudes. Relative to its surroundings, Adet has encircled by Yilmana Densa district on all four sides. Specifically, it lies between Senkegna kebele to the north, Adet Zurya to the south and east, and Mosbo kebele to the west. The town has organized into five kebeles. Adet serves as the administrative center of the Yilmana Densa district and is located 42 kilometers southeast of Bahir Dar, the regional capital, and 440 kilometers northwest of Addis Ababa (YDDPCO, 2023).

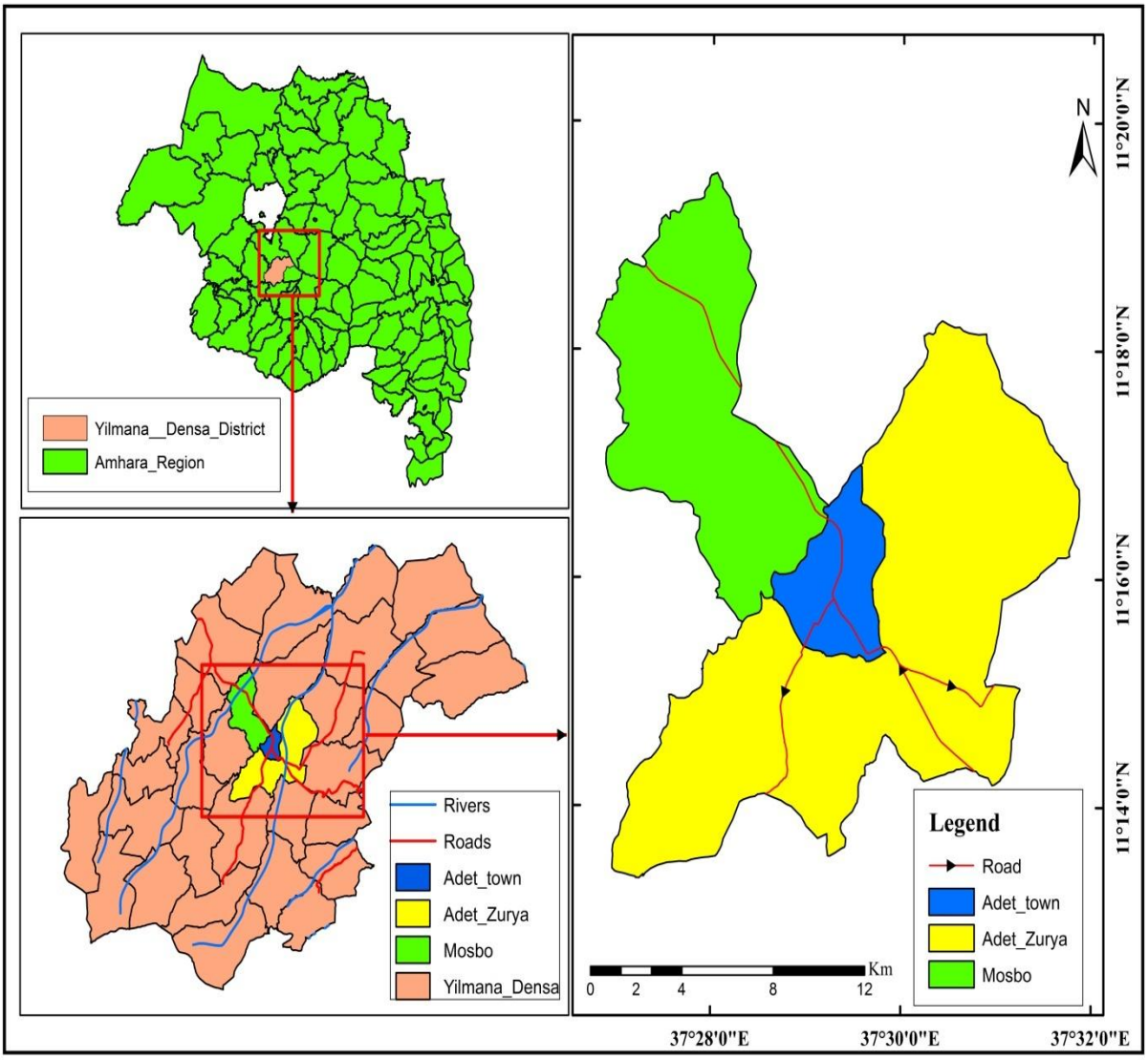


Figure 3.1: Location map of the study area

3.1.3. Population

Adet town has a total population of approximately 43,200, comprising 22,360 males and 20,840 females. This marks a significant increase from the 1984 population and housing census, which recorded a population of 6,501. The town has grown at an average annual rate of 5.53%. Adet is one of the most populous district towns in the Amhara region, with its current population accounting for 15.7 percent of the total population of Yilmana Densa district (ESS, 2022).

3.1.4. Topography, Drainage, and Soil

The landforms of Adet town and the surrounding rural kebeles is categorized into plain, mountainous, valley, and undulating terrains, covering approximately 16%, 20%, and 60% of the land area, respectively. About 54 percent of the land has slopes greater than 15 percent (YDDAO, 2023).

The Abay River drains the entire Yilmana Densa district's catchment area, with several permanent tributaries flowing into the Abay basin. These tributaries originate from the Amedamit-Birr Adama mountain ranges and include Shina, Shigez, Tule, Yezat, Kotet, Dinje, Genet, and Andasa streams (Mehari, 2021).

The major soil types of the area are Nitisols covering 45% of the soil landscape followed by Vertisols (30%), and Luvisols (25%). Geologically, basaltic basement complex that overflowed by lava in the Tertiary-Quaternary volcanic rocks, resulted in young soils that are developed over pre-weathered materials (Ejigu et al., 2021).

3.1.5. Climate

The Adet town and the surrounding rural kebeles receive an average annual rainfall of 1,238 mm, with a maximum-recorded rainfall of 1,695 mm in 1996 and a minimum of 956 mm in 2022. The majority of rainfall occurs between June and mid-September, with approximately 72% of the annual rainfall concentrated during these four months. This pattern places the area in the summer rainfall zone. The dry months extend from November to March, during which less than 6% of the annual rainfall recorded (AARCMS, 2023).

The annual potential evapo-transpiration ranges from 110 to 125 mm. The length of the growing period varies from 120 to 180 days, classifying the area as a moist zone. Wind speeds range from 0.68 m/s in November to 1.14 m/s in May. Maximum annual temperatures occur between March and April, ranging from 22°C to 29.4°C, while minimum temperatures occur between November and December, ranging from 5.4°C to 12.1°C, over a span of 20 years (AARCMS, 2023).

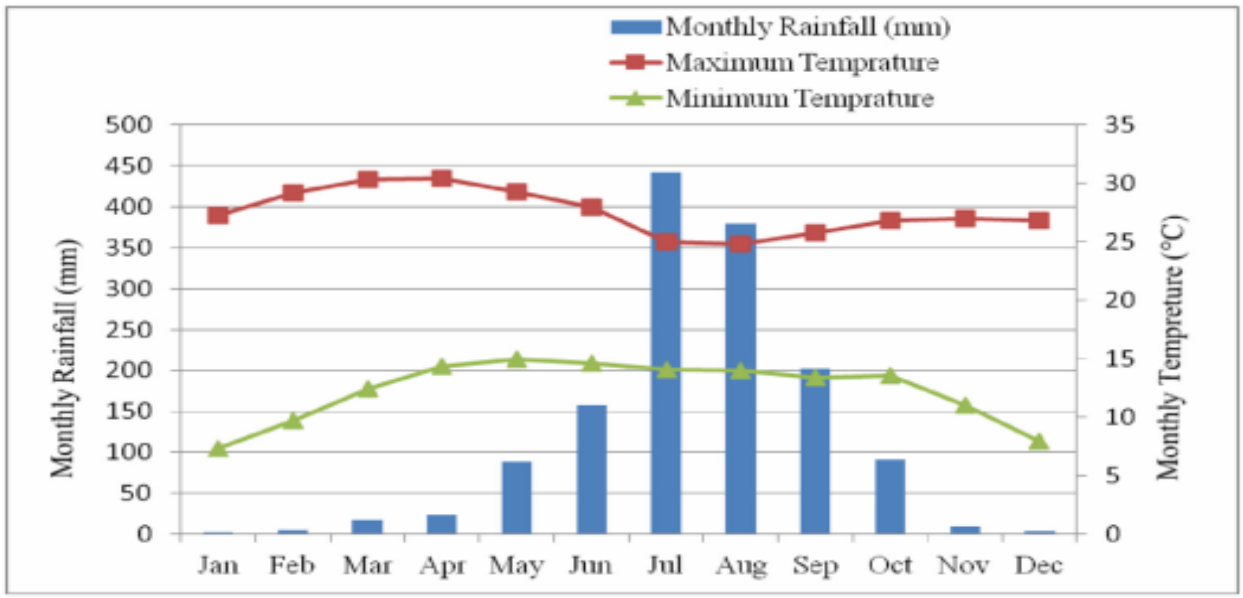


Figure 3.2: Rainfall and temperature distributions of the study area (2004–2017) (Ejigu et al., 2021).

3.1.6. Land Use and Farming System

The total land area of Adet town, Adet Zurya and Mosbo kebeles is estimated to be 5177 hectares be 99,180 hectares. According to the report (unpublished) of Yilmana Densa District Office of Agriculture, the major land use patterns of the Yilmana Densa comprise cultivated land (57%), forest and bushes (2%), grazing land (33%) and others (8%).

The area falls within the highland mixed crop-livestock system with cereals and pulses forming the bulk of the staples. Maize is the dominant cereal along with teff, wheat, and barley while potato and field pea are rotational crops. The area falls within the high potential maize-producing belt of the Ethiopian highlands (YDDAO, 2023).

3.2. Research Design

This study employs descriptive survey research design, focusing on assessing the impacts of urban expansion on the cropland and income of peri-urban communities. The objective is to identify the conditions of urban expansion both prior to and during the study period.

The research employs a mixed research approach. The qualitative method employed to describe the current conditions and processes related to urban expansion in the periphery of Adet town, providing context and deeper insights. The quantitative approach generates numerical data that allows for precise statistical analysis, enabling comparisons and generalizations.

3.3. Sources of Data

The study utilizes both primary and secondary data sources. Primary data collected from sample households, local administrative experts, satellite imagery, and geophysical surveys, ensuring firsthand insights and perspectives. Secondary data gathered from Google Earth, and reports from government agencies, research journals, and reputable websites. Specifically, data from government offices included demographic and urban planning information from the planning commission, details on displaced farmers and land use from the land administration office, and geographical and economic data from the agriculture office. This combination of data sources enriches the analysis by providing both empirical evidence and contextual background.

3.4. Data Collection Tools

To obtain relevant information for the study, various data collection tools employed were questionnaires, in-depth interviews with key informants, field observations, and satellite imagery.

3.4.1. Questionnaire

Structured questionnaires featuring both closed and open-ended questions used to gather household-level information. The focus included the socio-economic and demographic characteristics of respondents, the causes and extent of urban expansion, and its impacts on changes in cropland and income. This method allows for the collection of diverse data points, facilitating a comprehensive understanding of the issue.

3.4.2. Key Informant Interview Guide

An interview guide with pre-designed questions facilitated face-to-face interviews with individuals possessing extensive knowledge about the area. Interviews conducted with ten individuals, including two experts from the Adet town municipal administration, two from the Yilmana Densa District Land Administration Office, one from the kebele administration office, one kebele Development Agent, and four community elders. The researcher conducting the interviews using a checklist ensured thorough documentation of responses. The information gathered from key informants was crucial for triangulating and enhancing the reliability of data collected through other methods, providing multiple perspectives on the impacts of urban expansion.

3.4.3. Field Observation Guide

Field observations had conducted to collect firsthand data on urban expansion. This involved direct observation to assess the physical manifestations of urban expansion. Data collection had performed randomly to verify classified satellite images, gather land use, and land cover data for accuracy assessment. Ground control points had recorded using a Garmin GPS device, and visual data on the extent of urban expansion captured with a camera. Observations had systematically conducted using a checklist to ensure comprehensive data collection, allowing for a richer understanding of the land use/ land cover changes occurring due to urban expansion.

3.4.4. Satellite Imagery

To investigate the extent of urban expansion in the study area, the researcher had employed satellite imagery from three distinct periods: 2005, 2014, and 2023. This selection is pivotal for understanding the changes in land use and urban development over time.

The year 2014 serves as a critical benchmark, as it represents a significant period of rapid growth in Adet town. During this time, over sixty-six cooperative housing associations began construction, indicating a notable increase in residential development and urbanization. By analyzing the satellite images from these three years, the researcher can explore urban expansion trends across two intervals: from 2005 to 2014 and from 2014 to 2023. Each of these intervals spans nine years, allowing for a comprehensive examination of growth patterns.

The satellite images have sourced from the United States Geological Survey (USGS) Earth Explorer website, which recognized for its extensive repository of satellite data. The researcher ensured that the images spatially referenced in the Universal Transverse Mercator (UTM) projection, specifically utilizing the World Geodetic System (WGS) 1984 UTM Zone 37 North datum. This standardized spatial referencing is crucial for accurate geographic analysis, facilitating the comparison of land cover changes over time.

Table 3.1: Properties of Landsat satellite image data

Landsat	Date of Acquisition	Orbit	Sensor	Altitude	Resolution	Path and Row
Landsat-7	2005-02-14	WRS-2 S-S	ETM+	705 km	30 m x 30 m	p170 r052
Landsat-8	2014-01-16	WRS-2 S-S	OLI, TIRS	705 km	30 m x 30 m	p170 r052
Landsat-8	2023-01-25	WRS-2 S-S	OLI, TIRS	705 km	30 m x 30 m	p170 r052

3.5. Sampling

For the study, a combination of purposive and snowball sampling techniques was employed. Adet town had selected purposively due to its rapid urban expansion, making it a relevant case for examining the impacts of urban growth. The district consists of 35 rural kebeles and 5 urban kebeles, totaling 40 kebeles. Given constraints related to finance, time, and expertise, studying the entire population of all kebeles was not feasible. Therefore, the selection of sample kebeles was necessary. Consequently, four kebeles had chosen: Mosebo and Adet Zurya from the rural areas, and Adet Kebele-04 and Adet Kebele-05 from the urban areas.

Adet Zurya and Mosebo had selected from the rural kebeles because they are located in proximity to Adet town and directly impacted by urbanization. Their selection allows for an examination of how urban expansion affects surrounding rural communities. In contrast, Adet Kebele-04 and Adet Kebele-05 chosen from the urban kebeles because they had predominantly built on land that originally belonged to Adet Zurya. These urban kebeles exhibit a higher rate of expansion compared to other urban areas, making them critical for assessing the dynamics of urban growth.

Sample households have identified by using snowball-sampling techniques. Initially, data on the number of households that had lost their land holdings due to the expansion of Adet town obtained from the Yilmana Densa District Land Administration Office. This data provided a foundation for understanding the extent of land loss in the area. Following this, the number of sample households proportionally distributed across the selected kebeles to ensure representation from both rural and urban contexts.

The sample size was determined using a formula provided by (Singh & Masuku, 2014), which is designed to ensure statistical validity in survey research. The formula used to calculate the sample size is:

$$S = \frac{Z^2 \times P\ (1 - P)}{C^2}$$

Where;

S= sample size

Z^2 = value of Z score square at 95% confidence interval (1.96)

P= sample proportion (percentage picking choice expressed as a decimal (0.1%) of the.

C^2= confidence interval expressed as a decimal square (0.052)

$$S = \frac{1.96^2 \times 0.1\ (1 - 0.1)}{0.052^2}$$

$$S =. \frac{3.8416 \text{ x } 0.09}{0.0025} = 138.2976 \approx 138$$

In addition to the household surveys, key informant interviews have conducted to gather qualitative insights. Ten key informants had selected purposively. This included two representatives from the land administration office, two from the town mayor's office, one from the rural kebele administration, one developmental agriculture agent, and four community elders. These participants had chosen because they possess comprehensive knowledge about the impacts of urban expansion in the area and can provide valuable perspectives on the issue. This combination of quantitative and qualitative sampling methods enhances the study's overall robustness and depth of understanding regarding urbanization in Adet town.

Table 3.2: Sample size of the study area

No	Sample Kebeles	Number of Dispossessed Households	Total Sample Size
1	Adet Zurya	231	44
2	Mosebo	98	19
3	Adet Kebele-04	243	46
4	Adet Kebele-05	150	29
Total		722	138

Source: Yilmana Densa District Land Administration Office (2023)

3.6. Data Analysis

3.6.1. Survey Data Analysis

The analysis of survey and key informant interviews data involves both qualitative and quantitative methods to provide a comprehensive understanding of the factors influencing the expansion of Adet town and its effects on peri-urban households.

The primary qualitative data had collected through structured interviews with government officials and community elders. This qualitative approach allowed for an in-depth exploration of local perspectives on the causes of town expansion and its impact on cropland and income. The interviews transcribed and analyzed thematically, which involved identifying recurring themes and patterns in the responses.

In addition to qualitative insights, quantitative data gathered through household surveys, which provided demographic and socio-economic information about the sample population. This data processed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics employed to summarize key characteristics of the households surveyed. Percentages and frequencies have calculated to present a clear overview of these demographic characteristics, allowing for comparisons across different socio-economic groups. The survey also included questions regarding the causes of Adet town's expansion and its impacts on cropland and household income.

Responses analyzed using a combination of descriptive and inferential statistics:

Descriptive Statistics: Percentages and frequencies had used to summarize how many respondents attributed town expansion to specific factors, such as economic development, migration, or urbanization. Means had calculated to quantify the average income changes and land loss experienced by households.

Inferential Statistics: The paired sample t-test was particularly valuable in this context, as it allowed for comparison of income levels and land holdings before and after the onset of town expansion. This statistical method provided insights into the significance of changes, indicating whether the observed impacts were statistically meaningful.

The results of this detailed analysis are presented in a variety of formats, including tables, figures, and charts.

3.6.2. Spatial Data Analysis

The spatial data analysis conducted through a systematic approach involving several key steps: image pre-processing, image classification, field data analysis, accuracy assessment, and land use/land cover detection. This methodology allowed for a comprehensive evaluation of urban expansion in the study area, specifically in Adet town.

Image Acquisition

To assess urban expansion, Landsat-7 and Landsat-8 satellite images had utilized. Landsat-7 images from the year 2005 provided a baseline for comparison, while Landsat-8 images had used for the years 2014 and 2023. All images of Adet town had acquired from the same path and row (p170 r052), ensuring consistency in the data, and minimizing discrepancies related to atmospheric conditions or sensor variations.

Pre-processing Activities

The pre-processing of Landsat images involved several crucial activities:

- **Layer Stacking**: This process combines multiple spectral bands from the satellite images, enhancing the ability to distinguish between different land cover types based on their spectral signatures.
- **Resolution Merging**: By integrating images with different spatial resolutions, finer details captured, making it easier to analyze smaller land cover features.
- **Sub-setting**: This step involved cropping the images to focus on Adet town specifically, reducing the amount of data processed and allowing for a more targeted analysis.

Image Classification

After pre-processing, supervised image, classification had performed using ERDAS IMAGINE 2015 software. This technique involves training the classification algorithm with known land cover types, resulting in distinct categories such as: cropland**,** built-up areas**,** forest and shrub land **and** grazing land.

The classified images had then imported into ArcGIS 10.5 software to quantify and generate detailed land use and land cover maps.

Table 3.3: Types of LULC classes in the study area

Land Use/Land Cover	Description
Cropland	Land used for growing crops, including areas allotted to rain-fed and/ or irrigated cultivation.
Built-up area	All types of artificial surfaces, including residential, commercial, industrial land uses, and transportation infrastructures.
Forest and shrub land	Areas covered by trees, natural vegetation, and bush land.
Grazing land	Areas used for communal grazing, as well as a bare land that has very little grass cover.

Source: Own classification, 2023

Field Data Analysis and Accuracy Assessment

To ensure the accuracy of the classification results, training areas selected using a handheld GPS device, which facilitated precise location tracking for the different land cover types. Ground control points collected to validate and compare the classified images against actual geographical

features. For the study 120 GPS points uses, 40samples were collected from field, whereas the remaining 80 points taken from Google earth map.

The accuracy assessment involved comparing field data collected via GPS with the classified images. This had done using ERDAS IMAGINE 2015 software, allowing for the identification of classification errors and the calculation of accuracy metrics, such as overall accuracy, user's accuracy, and producer's accuracy for each land cover class.

Therefore, an accuracy classification assessment was performed through the standard method (Congalton, 1991). Thus, accuracy assessment, and Kappa statistics computed as follows.

$$\text{Users Accuracy} = \frac{\text{Number of corre ctly classified pixels in each category}}{\text{Total number of classified pixels in that category (the row total)}} \times 100$$

$$\text{Producers Accuracy} = \frac{\text{Number of correctly classified pixels in each category}}{\text{Total number of classified pixels in that category (the column total)}} \times 100$$

$$\text{Overall Accuracy} = \frac{\text{Number of correctly classified pixels in each category (diagonal)}}{\text{Total number of referenced pixels}} \times 100$$

$$\text{Kappa Coefficient} = \frac{(TS \times TCS) - \sum(\text{column total} \times \text{row total})}{TS^2 - \sum(\text{column total} - \text{row total})} \times 100$$

Where: Where TS = total sample and TCS = total correctly classified samples

Land Use/Land Cover Detection

Finally, the land cover maps for the three periods (2005, 2014, and 2023) analyzed to compare the types and extent of land use and land cover changes over the 18-year period. The changes evaluated to determine the trends in urban expansion, particularly the conversion of cropland to built-up areas.

The rate of change for each land use/land cover type had computed, providing valuable insights into the dynamics of urbanization and its impacts on the socio-economic and environmental landscape of Adet town. This comprehensive analysis is crucial for understanding the implications of urban growth and informing future planning and policy-making efforts.

Figure 3.3: Google Earth image of Adet town

Source: Google Earth (2023)

3.7. Material and Software

The materials and software used in the study include ERDAS IMAGINE 2015, Arc GIS 10.3, Google Earth, SPSS-Version26, Microsoft Word, and Microsoft Excel.

Table 3.4: Materials and soft wares

Materials and soft wares	Function
ERDAS IMAGINE 2015	Used for classifying land use and land cover in the study area.
Arc GIS 10.3	Employed to prepare maps of the study area and to visualize land use/land cover classifications
Google Earth	Provided high-resolution images to assist in identifying land use and land cover types.
SPSS Version 26	Utilized for processing and analyzing households' data
Microsoft Excel	Used to the input of GPS points and organization of data
Mendeley	Utilized for managing citations and creating the bibliography

These tools collectively supported a comprehensive analysis of urban expansion and its impacts in the study area, ensuring accurate data processing, effective visualization, and thorough documentation. By leveraging this suite of software and materials, the study was able to produce reliable results and insights into the socio-economic and Land use/Land cover dynamics associated with urban growth.

3.8. Methodological flow of the Study

The following figure illustrates the methodological flow chart of the study.

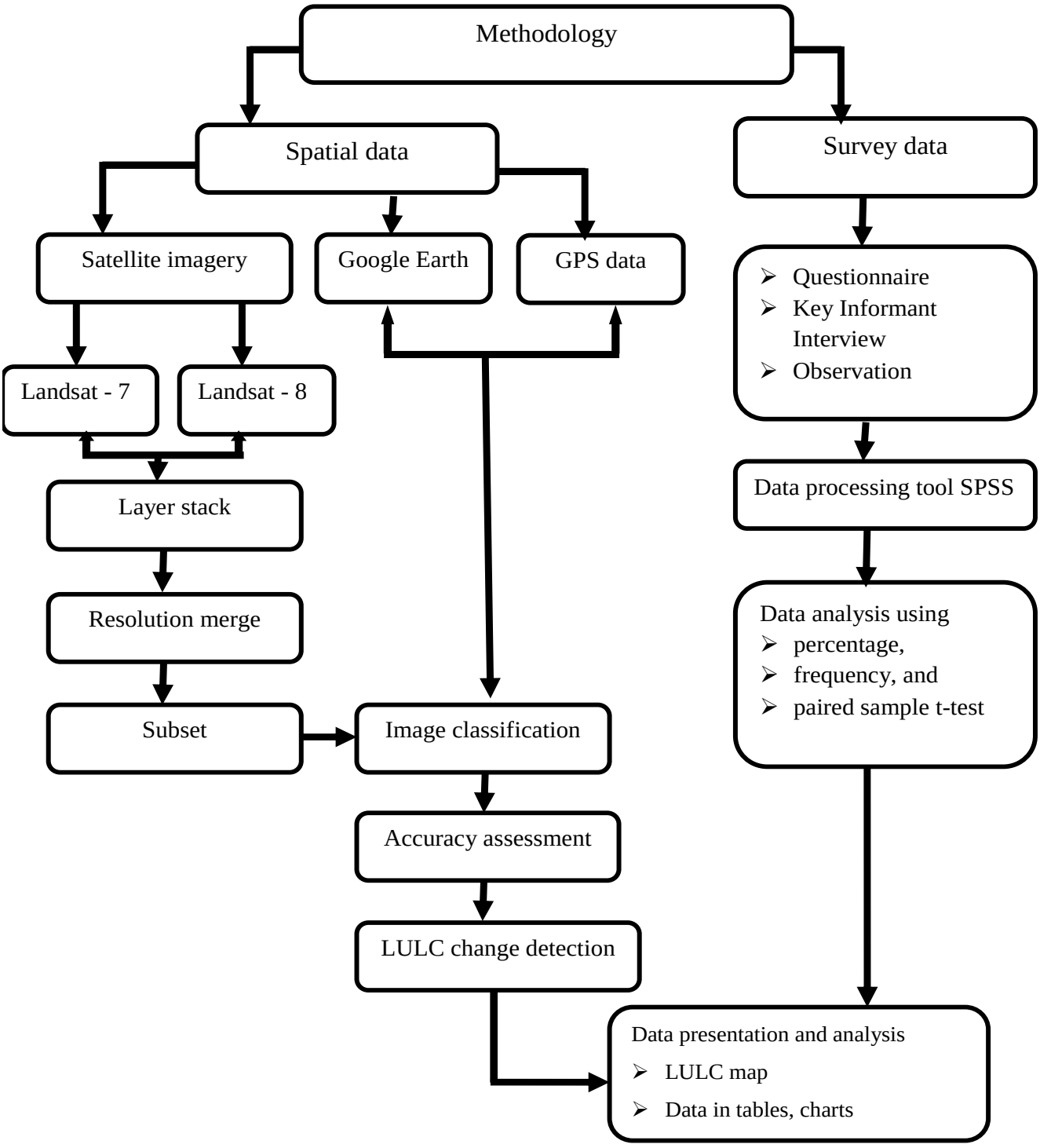


Figure 3.4: Methodological workflow of the study

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter presents the main findings of the study on urban expansion and its impact on croplands in the peri-urban community. It covers the demographic and socio-economic data of respondents, the responses from sample households and key informants, and the trends in land use and land cover changes in the study area.

4.1. Response Rate

The response rate determines the adequacy of the data for statistical analysis. A total of 138 questionnaires were distributed to sample households. Of these, 133 (96.4%) were completed and returned, which is considered representative of the population under study.

4.2. Background Information of the Households'

This section presents the background information of the respondents, including their sex, age, level of education, family size, marital status, occupation, and land holding size.

4.2.1. Sex of the Households'

As shown in Table 4.1, out of the 133 respondents, 85% (113) were male and 15% (20) were female. The predominance of male respondents reflects traditional gender roles in rural settings, where men have more commonly recognized as household heads. This dynamic influences family leadership and decision-making processes. The presence of female respondents, though smaller, indicates that women also play a crucial role in household management.

4.2.2. Age of the Households'

As presented in Table 4.1, the age distribution of respondents is as follows: 19.5% are aged 20-29, 30.4% are aged 30-39, 25.4% are aged 40-49, 13.8% are aged 50-59, and 10.9% are aged 60 and above. The ages of the respondents range from a minimum of 21 to a maximum of 89. The majority of respondents being in their economically productive years suggest they have relevant experience and are actively engaged in dealing with urban expansion's effects on their land and income.

Table 4.1: Demographic information of households'

Demographic information of households'	Frequency	Percent
Sex		
Male	113	85%
Female	20	15%
Total	133	100%
Age		
20 – 29	27	20.3%
30 – 39	40	30.1%
40 – 49	34	25.6%
50 – 59	17	12.8%
Above 60	15	10.9%
Total	133	100
Family size		
1 – 3	46	34.6%
4– 6	61	45.9%
7 – 9	23	17.3%
Above 10	3	2.2%
Total	133	100%
Marital status		
Married	81	60.9 %
Unmarried	12	9 %
Divorced	37	27.8%
Widowed	3	2.3%
Total	133	100%

Source: Own survey (2023)

4.2.3. Family Size of the Households'

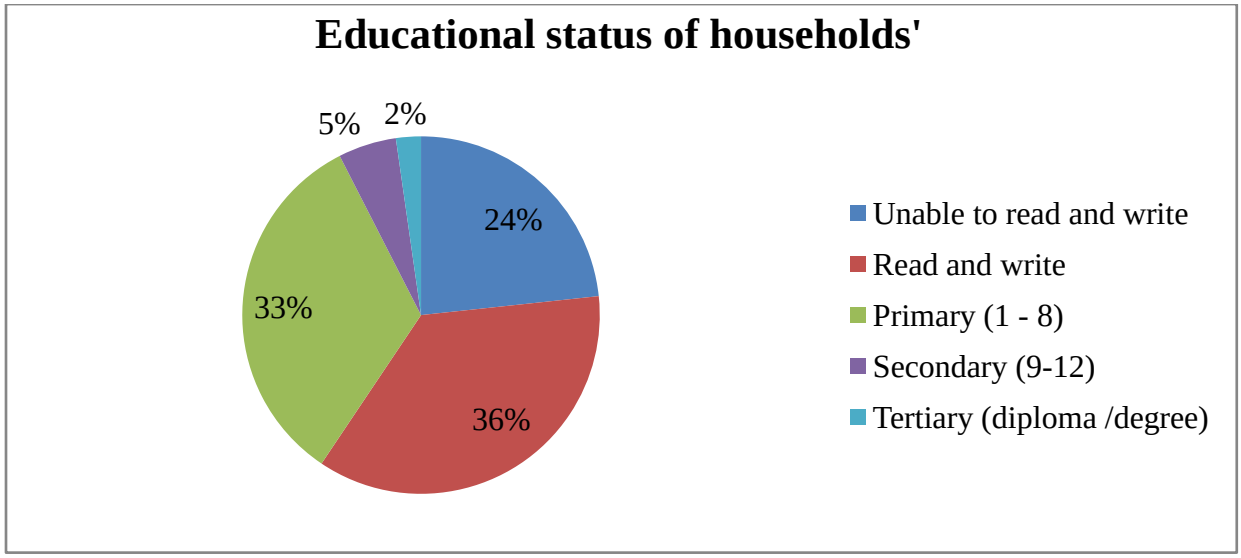
As presented in Table 4.1, the majority of households (45.7%) have a family size of 4 to 6 members. Households follow this with 1 to 3 members (35.5%), 7 to 9 members (17.4%), and those with 10 or more members (1.4%). Households with larger family sizes that have lost their landholdings are more likely to experience significant changes in their income levels due to the increased financial demands of supporting more family members.

4.2.4. Marital Status of the Households'

As shown in Table 4.1, the majority of respondents (60.9 %) are married. This is followed by divorced individuals (27.8%), unmarried individuals (9 %), and widowed individuals (2.3%). The marital status of respondents influences their experiences and perspectives, particularly in terms of family management and care giving responsibilities.

4.2.5. Educational Status of the Households'

Among the respondents, 22.5% are unable to read and write, while 34.8% can read and write. The remaining respondents distributed across various education levels: 31.9% have attended primary education, 6.5% have completed secondary education, and 4.3% have achieved tertiary education. Educational status plays a critical role in economic opportunities and adaptability. Households with lower levels of education may face challenges in finding employment and improving their economic conditions.



Source: Own survey (2023)

Figure 4.1: Education level of households'

4.2.6. Occupation of the Households'

As indicated in Table 4.2, the majority of households (40.6%) are engaged in farming, followed by mixed occupations (29.3%), daily labor (11.3%), handicrafts (9.8%), and trading (9%). The dominant occupation in the study area is farming, reflecting the agricultural nature of the community. The significant percentage of households involved in mixed occupations suggests that many individuals diversify their activities to stabilize income. The relatively lower percentages in handicrafts, trading, and daily labor indicate that these are less common but still important sources of income. Urbanization, which often leads to the conversion of agricultural land into developed areas, can disrupt traditional farming practices and reduce agricultural productivity, thereby affecting household income.

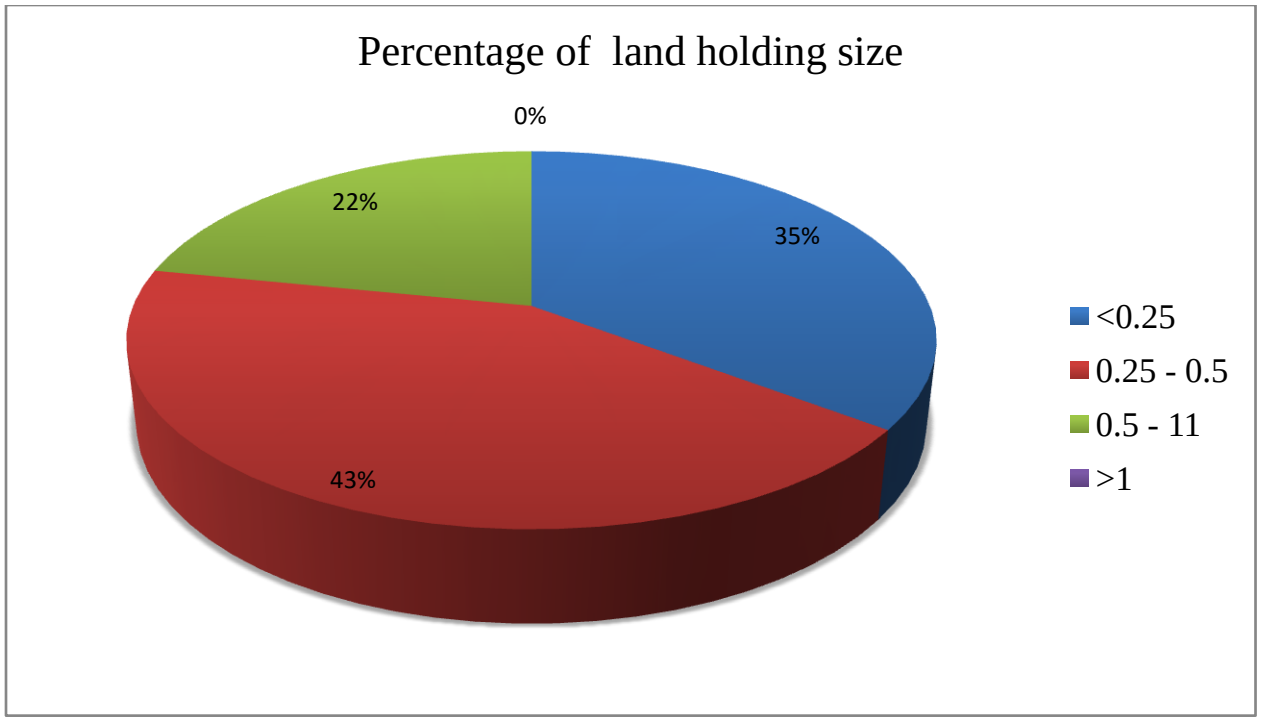
Table 4.2: Occupation of households'

Type of occupation	Frequency	Percent
Farmer	54	40.6 %
Merchant	12	9 %
Handicraft	13	9.8%
Daily labor	15	11.3%
Mixed (more than one)	39	29.3%
Total	133	100%

Source: Own survey (2023)

4.2.7. Land Holding Size of the Households'

As presented in Figure 4.2, the distribution of land holdings among households was as follows: 42.9% have land holdings between 0.25 and 0.5 hectares, 35.3% have holdings less than 0.25 hectares, and 21.8% have holdings greater than 0.5 hectares. No households have land holdings exceeding 1 hectare. This expansion has led to the loss of land, either partially or entirely, causing a decrease in the average land size per household. The absence of holdings greater than 1 hectare suggests that urban encroachment has substantially diminished the available land for agricultural use, which can negatively affect agricultural productivity and the income of affected households.



Source: Own survey (2023)

Figure 4.2: Percentage of land holding size of households'

4.3. Causes of Urban Expansion in Adet Town

This research sought to understand the primary cause of Adet town horizontal expansion through the perspectives of the interviewed people. According to the survey of households, all of respondents agreed that the town had rapidly expanded into the surrounding rural kebeles.

Table 4.3: Household responses regarding urban expansion to their vicinity

Existence of urban expansion to their locality	Frequency	Percentage
Yes	133	100%
No	-	-
Total	133	100%

Source: Own survey (2023)

Several factors contribute to the horizontal urban expansion of Adet town. All survey respondents agreed that the increase in urban built-up area has come at the expense of cropland.

Table 4.4: Households' multiple responses to the causes of Adet town expansion

Cause for Expansion	Responses	
	Frequency	Percent
Natural population growth of the town	46	22.1%
Migration from rural area	35	16.8%
Access to infrastructure	44	21.2%
Urban expansion program	31	14.9%
Suitable climate and topography	52	25.0%
Total	208	100.0%

Source: Own survey (2023)

The data presents households' multiple response results about the causes of Adet town expansion among samples of 133 respondents. A significant majority, 25% of the respondents alluded that urban expansion was due to the town's suitable climate and topography for settlement as significant contributors to its rapid growth. 22.1% respondents cited natural population growth within the town as another key factor. Additionally, 21.2% pointed to improved access to infrastructure, 16.8% respondents attributed the expansion to migration from rural areas, and 14.9% respondents identified urban expansion programs as responsible for the town's horizontal growth (Table 4.4).

The data obtained from the West Gojjam Zone Plan Commission (2023) indicate that Adet is the most populous and fastest-growing town in the administrative zone. The town's rapid expansion attributed to several factors, including a high rate of rural-to-urban migration, an increase in natural population growth in urban areas, and a rising influx of investment. According to data from key informants, the migration of rural residents seeking better living conditions and opportunities in Adet, coupled with the town's growing urban population, has significantly driven its expansion. Since 2014, the local government has been transferring large tracts of land to housing cooperatives. This program has facilitated rural-to-urban migration by providing more housing options, allowing many migrants to secure urban housing plots. As a result, Adet's population has increased substantially.

Furthermore, the town has seen a significant increase in investment, with investors acquiring extensive areas of land (over 890 hectares) for various projects. This influx of investment has further contributed to the town's expansion. As the population grows, there is also a heightened

demand for space to accommodate the construction of essential institutions and market places, which has driven the town's continued growth.

The rapid urban expansion of Adet can be had better understand through several key factors. Rural-to-urban migration refers to the movement of people from rural areas to cities like Adet, often driven by the search for improved living conditions and opportunities. Natural population growth involves an increase in the population due to the difference between the birth rate and the death rate within the town. Investment influx often results in infrastructure development, which supports further population growth and urban expansion. Government policies, such as transferring land to housing cooperatives, aimed at supporting urban development and facilitating migration to urban areas. Finally, as the town's population increases, there is a growing need for additional facilities like schools, hospitals, and marketplaces, necessitating further expansion of the urban area to meet these demands. This finding supports the research of Mamuye and Ebabu (2021), who identified that the major causes of urban expansion of Werabe town was rural-urban migration, infrastructure accessibility and demographic dynamics (high birth & low death rate).

4.4. Land Use/Land Cover Analysis

4.4.1. Land Use/Land Cover of the study area for 2005, 2014, and 2023

Land use and land cover are related but distinct concepts. Land use refers to how humans utilize the land for various purposes, such as economic activities and development. It focuses on the functional role of the land. Land cover, on the other hand, describes the physical characteristics of the Earth's surface, including vegetation, water, soil, and man-made features such as settlements (William & L.Turner, 1992).

Land use and land cover changes involve detecting and quantifying alterations in the land surface. To analyze these changes, land cover maps from different years are required. Therefore, the land use and land cover types of Adet town for the years 2005, 2014, and 2023 discussed in the following sections.

Table 4.5: LULC of the study area for the periods of 2005, 2014, and 2023

LULC Type	Area Coverage		
	2005	2014	2023
	Hectare	Hectare	Hectare
Built-up area	108.81	153.67	692.06
Forest area	1035.63	1001.88	1082.92
Cropland	3633.3	3759.12	3158.59
Grazing land	689.13	552.2	533.3
Total	5466.87	5466.87	5466.87

***Source**: Analysis of Landsat imagery data for 2005, 2014, and 2023*

Table 4.5 shows the area coverage of land use and land covers in the study area across three times: 2005, 2014, and 2023.

In 2005**,** cropland was the predominant land use, covering 3,633.3 ha of the area, followed by forest at 1,035.63 ha, grazing land at 689.13 ha, and built-up area at 108.81 ha. This data indicates that built-up areas were minimal compared to other land cover types, providing a baseline for measuring urban expansion over time.

By 2014**,** after nine years, cropland had increased slightly to 3,759.12 ha. Forest cover decreased marginally to 1,001.88 ha, grazing land reduced to 552.2 ha, and built-up areas grew to 153.67 ha. This shows a modest increase in both cropland and built-up areas, while forest and grazing lands declined.

In 2023**,** cropland remained the largest land cover type at 3,158.59 ha, but had decreased significantly from previous years. Forest area increased to 1,082.92 ha, and built-up areas expanded notably to 692.06 ha. Grazing land decreased further to 533.25 ha. The decrease in cropland is substantial, while increases in both forest and built-up areas reflect ongoing urban expansion and changing land use patterns.

The data shows a significant transformation in land use over the study period. Cropland has decreased notably, while built-up areas have expanded significantly. Forest cover has increased slightly, and grazing land has diminished. This indicates substantial urban expansion and a reduction in crop and grazing lands.

4.4.2. Land Use/Land Cover Change Detection

Change detection involves identifying differences in the state of an object or phenomenon by observing it at different times. This process quantifies temporal changes using multi-temporal data sets. One of the most commonly used techniques for change detection is post-classification. Post classification change detection had selected as it reduces the possible effects of spectral resolution and sensor differences between the multi-temporal images. This method enables to assess the temporal changes of the LULC types and to compute the extent of LULC conversion induced by the urban expansion (Singh, 1989).The change statistics for LULC maps of two time periods was calculated as:

Change in percent = $(\frac{X-Y}{Y}) \times 100$

Rate of change (hectare/year) = $(\frac{X-Y}{T})$

Where;

X = the area of LULC (ha) in the final year,

Y = is the area of LULC (ha) in initial year, and

T = the time interval between X and Y in a year.

Positive percentage values suggest an increase whereas negative values imply a decrease in area coverage (Adigeh & Abebe, 2023).

4.4.3. Land use/land cover change from 2005 to 2014

This matrix shows the changes in LULC from 2005 to 2014. Built-up areas increased by 44.86 hectares, while forest areas decreased by 33.75 hectares. Cropland expanded by 125.82 hectares, and grazing land decreased by 136.93 hectares. The percentages indicate the proportion of each LULC type within the total area for each year, highlighting the significant shifts in land use over the period.

Table 4.6: LULC conversion matrix of 2005 – 2014

Year	2014							Change 2005-2014
2005	LULC	Unit	Built up	Forest	Cropland	Graze	Total	
	Built-up	Hectare	103.23	0	5.58	0	108.81	44.86
		%	94.9	–	5.1	–	100	41.2
	Forest	Hectare	12.82	751.95	211.59	59.27	1035.63	-33.75
		%	1.2	72.6	20.4	5.8	100	-3.3
	Cropland	Hectare	35.19	56.52	3536.55	5.04	3633.3	125.82
		%	1	1.6	97.3	0.1	100	3.5
	Grazing	Hectare	2.43	193.41	5.4	487.89	689.13	-136.93
		%	0.3	28.1	0.8	70.8	100	-19.9
	Total	Hectare	153.67	1001.88	3759.12	552.2	5466.87	
		%	2.8	18.3	68.8	10.1	100	

Source: Analysis of Landsat imagery for 2005 and 2014

Note: *In the LULC change matrix, the "grand total" column reflects the initial state, while the "grand total" row shows the final state. The diagonal (green) cells represent unchanged LULC classes, while the white cells indicate areas converted to different LULC classes.*

From 2005 to 2014, significant changes in land use and land cover (LULC) observed, marked by an increase in built-up areas by 44.86 hectares, raising their proportion to 41.2% of the total area and indicating urban expansion (Table 4.6). In contrast, forest cover decreased by 33.75 hectares, leading to a decline to 18.3%, which raises concerns about biodiversity loss due to deforestation and land conversion for agriculture or urban use. Cropland saw a substantial increase of 125.82 hectares, now comprising 68.8% of the total area, reflecting intensified agricultural practices and increased food production demands. Meanwhile, grazing land decreased dramatically by 136.93 hectares, now representing only 10.1% of the total area, highlighting concerns about livestock sustainability amid agricultural encroachment.

4.4.4. Land Use/Land Cover Change from 2014 to 2023

In the period from 2014 to 2023, the LULC conversion matrix reveals significant changes in the extent of different LULC classes. As shown in Table 4.7, there was a notable increase in both built-up areas and forest areas, while cropland and grazing land decreased.

Table 4.7: LULC conversion matrix of 2014 – 2023

Year	2023							Change 2014-2023
2014	LULC	Unit	Built up	Forest	Cropland	Graze	Total	
	Built-up area	Hectare	143.73	9.94	0	0	153.67	+538.39
		%	93.5	6.5	–	–	100	350.4
	Forest area	Hectare	14.49	823.86	10.08	153.45	1001.88	81.04
		%	1.4	82.3	1	15.3	100	+8.1
	Cropland	Hectare	518.36	92.25	3148.51	0	3759.12	-600.53
		%	13.8	2.4	83.8	–	100	-15.9
	Grazing land	Hectare	15.48	156.87	0	379.85	552.2	-18.9
		%	2.8	28.4	–	68.8	100	-3.4
	Total	Hectare	692.06	1082.92	3158.59	533.3	5466.87	
		%	12.7	19.8	57.8	9.7	100	

Source: Analysis of Landsat imagery of 2014 and 2023

The analysis of the land use and land cover data from 2014 to 2023 reveals notable transformations in land utilization. Built-up areas saw a dramatic increase of 538.39 hectares, accounting for 93.5% of the total area in 2023, indicating a significant trend towards urbanization and development (Table 4.7). Similar trends were observed in Bahir Dar city, where built-up areas increased by 2,522 hectares from 1986 to 2016 (Wondyfraw et al., 2019). In contrast, forest areas increased by 81.04 hectares, elevating their share to 19.8%. This suggests a positive shift towards potential reforestation, which attributed to the expansion of eucalyptus plantations in the area. Similar result was identified in Jimma city, where forest cover increased from 1606ha in 2013 to2606ha in 2021 (Aboye et al., 2023). However, cropland experienced a considerable decline of 600.53 hectares, which now represents 57.8% of the total area, highlighting concerns regarding agricultural sustainability and land degradation. The reduction in cropland had attributed to pressures from urban expansion, as well as changes in agricultural practices. Grazing land also saw a slight decrease of 18.9 hectares, now making up 9.7% of the total area, reflecting ongoing challenges in livestock management.

4.4.5. Land Use/Land Cover Change from 2005 to 2023

The land use and land cover (LULC) data from 2005 to 2023 reveals significant shifts in land utilization patterns. As shown in Table 4.8, from 2005 to 2023, built-up and forest areas increased significantly. Whereas cropland and grazing land shown decrement.

Table 4.8: LULC conversion matrix of 2005 – 2023

Year	2023							Change 2005-2023
2005	LULC	Unit	Built up	Forest	Cultivated	Graze	Total	
	Built-up area	Hectare	101.52	7.29	0	0	108.81	583.2
		%	93.3	6.7	–	–	100	536
	Forest area	Hectare	27.9	738.81	205.74	63.18	1035.63	47. 29
		%	2.7	71.3	19.9	6.1	100	4.6
	Cropland	Hectare	540.05	132.34	2952.85	8.06	3633.3	-474.71
		%	14.9	3.6	81.3	0.2	100	-13.1
	Grazing land	Hectare	22.59	204.48	0	462.06	689.13	-155.83
		%	3.3	29.7	–	67	100	-22.6
	Total	Hectare	692.06	1082.92	3158.59	533.3	5466.87	
		%	12.7	19.8	57.8	9.7	100	

Source: *Analysis of Landsat imagery of 2005 and 2023*

The land use and land cover (LULC) data from 2005 to 2023 reveals significant shifts in land utilization patterns (Table 4. 8). Built-up areas increased substantially by 583.2 hectares, making up 93.3% of the total area in 2023, indicating a strong trend toward urbanization and infrastructure development. This expansion is linked to rapid population growth in Adet town, which rose from 19,169 in 2007 to an estimated 43,200 in 2022 (ESS, 2022).

Forest areas also saw a modest increase of 47.29 hectares, bringing their proportion to 19.8%, suggesting some degree of reforestation or improved forest management practices, although their overall share remains relatively low.

In contrast, cropland experienced a notable decline of 474.71 hectares, now constituting 57.8% of the total area. This decline may indicate challenges in agricultural sustainability, possibly due to urban encroachment.

Grazing land similarly decreased by 155.83 hectares, now representing 9.7% of the total area, highlighting ongoing pressures on livestock management, and grazing practices.

These findings are consistent with broader trends observed in Ethiopia. In comparison, (Kebebew et al., 2019) reported a substantial increase in built-up areas in *Laga Tafo-Laga Dadi Town*, from 813.87 hectares in 1996 to 4,409.82 hectares in 2016, alongside a decrease in agricultural lands and forest area. Conversely, (Adugna, 2016) observed an increase in both crop and forest areas in *Sebeta town*, with cropland rising from 1,014.2 hectares in 1986 to 8,847.81 hectares in 2016, and forest area increasing from 560.9 hectares to 1,292.9 hectares.

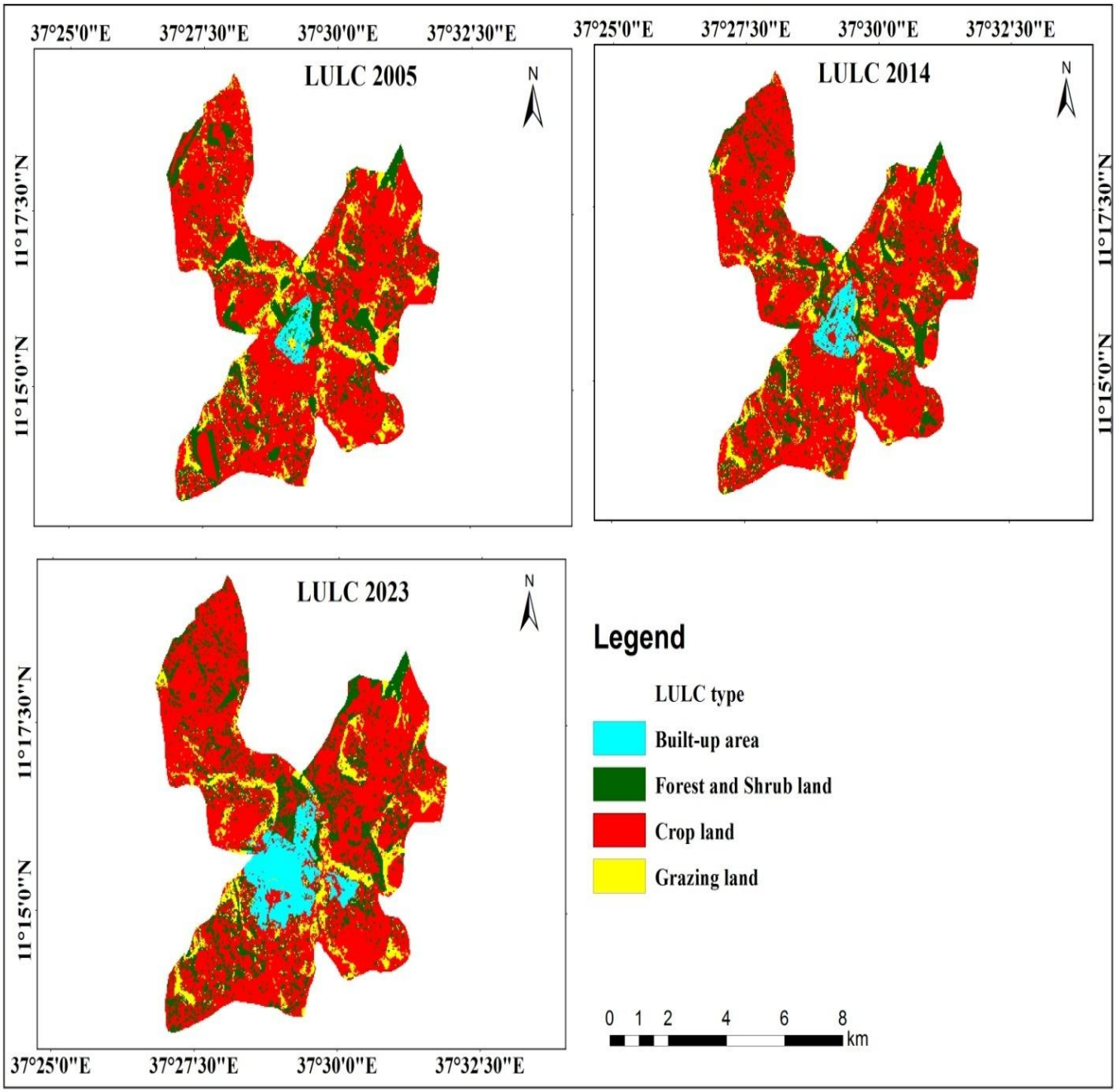


Figure 4.3: LULC map of the study area for the study periods of 2005, 2014, and 2023

4.4.6. Trend analysis of land use and land cover from 2005 – 2023

Adet town and the surrounding two rural kebeles have experienced various land use and land cover changes between 2005 and 2023. Table 4.9 illustrates the trends in land use and land cover for 2005, 2014, and 2023.

Table 4.9: Trends of LULC change of the study area from 2005 to 2023

LULC	Area coverage in year						Rate of Change in 2005-2023	
	2005		2014		2023			
	Hectare	Percent	Hectare	Percent	Hectare	Percent	Hectare	Percent
Built-up area	108.81	2%	153.67	2.8%	692.06	12.6%	583.25	536%
Forest area	1035.63	18.9%	1001.88	18.3%	1082.92	19.8%	47.29	4.6%
Cropland	3633.3	66.5%	3759.12	68.8%	3158.59	57.8%	-474.71	-13.1%
Grazing land	689.13	12.6%	552.2	10.1%	533.3	9.8%	-155.83	-22.6%
Total	5466.87	100%	5466.87	100%	5466.87	100%		

***Source**: Analysis of satellite imagery 2005, 2014, and 2023*

Built-up area

The built-up area in the study area increased significantly over the study period. It expanded from 108.81 hectares (2.0% of the total area) in 2005 to 692.06 hectares (12.6%) in 2023. This represents a substantial increase of 583.25 hectares, or 536%, indicating rapid urbanization. This growth highlights the shift towards more built-up areas, likely driven by increasing population. Mamuye & Ebabu (2021) reported similar results that built-up area in Worabe town increased from1963.98 ha in 2009 to 5251.95 ha in 2019.

Forest area

The forest area showed a moderate increase from 1035.63 hectares (18.9%) in 2005 to 1082.92 hectares (19.8%) in 2023. The net gain of 47.29 hectares represents a 4.6% increase. The expansion of forest area could attributed to increased eucalyptus tree plantations, which have become a significant land use practice in the study area due to their economic benefits and lower costs compared to other crops. A similar result was reported by (Molla et al., 2023), who found that, between 1991 and 2021, the area of eucalyptus tree plantations in Mecha district increased from 908.87 hectares to 26,261.9 hectares, representing a growth of 17.6% approximately twenty-nine times the initial area.

Cropland

Cropland experienced a notable decrease from 3633.30 hectares (66.5%) in 2005 to 3158.59 hectares (57.8%) in 2023. This represents a reduction of 474.71 hectares, or 13.1%. The decline in cropland area, despite an initial increase between 2005 and 2014, reflects a shift in land use priorities, with more land could being converted to built-up areas and forest. Similarly, (Chandel, 2023) reported that cropland decreased by 22hectares between 2002 and 2022 in Jajura town.

Grazing land

Grazing land decreased from 689.13 hectares (12.6%) in 2005 to 533.30 hectares (9.8%) in 2023. This reduction of 155.83 hectares, or 22.6%, indicates a loss of grazing land, which is due to conversions to other land uses such as built-up areas and forest. Data obtained from key informant interviews confirmed that most of the grazing land has held communally. Farmers bordering these grazing lands are expanding their cropland and planting on communal grazing land. In addition, the government is transferring communal grazing lands to housing cooperatives, as the compensation payment for communal grazing land is lower than for other land use and land cover types (LULCs). This has resulted in the continuous shrinking of grazing land.

Overall, these trends highlight the dynamic nature of land use in the study area, with substantial urban expansion at the expense of crop and grazing lands. The increase in built-up areas combined with the decline in cropland and grazing land suggests the need for effective land management strategies to balance development and environmental sustainability in Adet town and its surroundings.

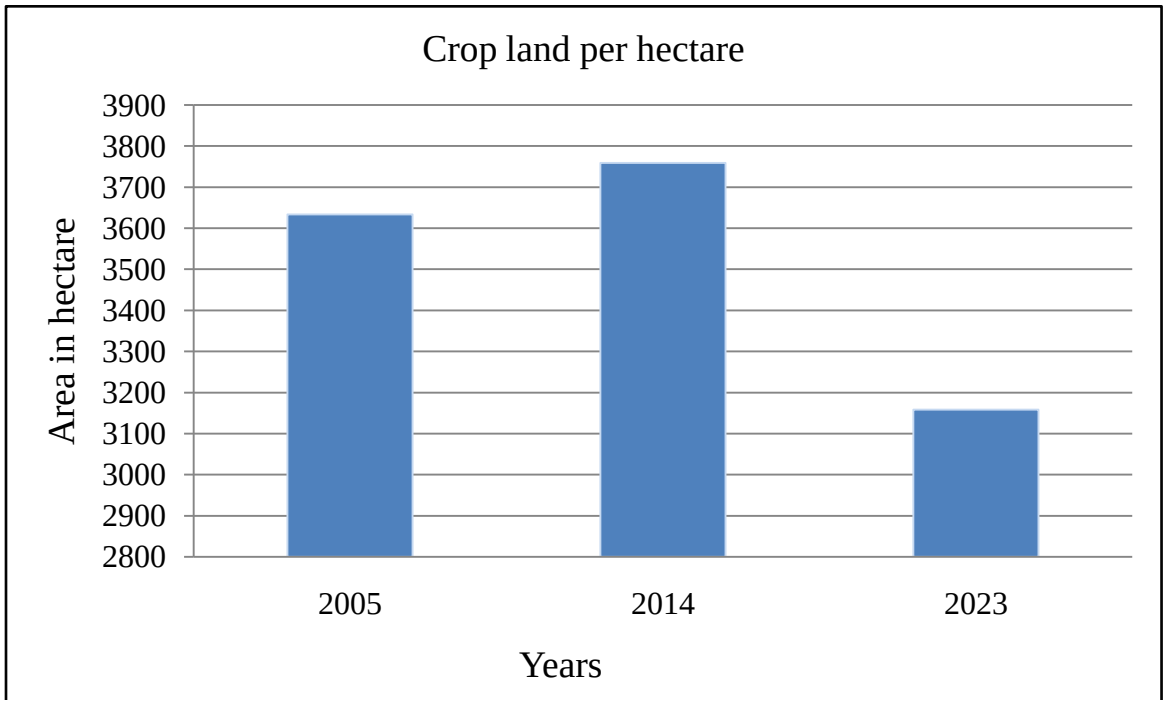


Figure 4.4: Cropland use land cover of the study area in 2005, 2014, and 2023

Figure 4.4 illustrate a significant transformation in cropland use with a notable decrease in recent years following a period of growth. This shift underscores the need to assess the implications of land use changes on cropland and to develop strategies for sustainable land management.

The data presented in Table 4.10 show a significant transformation in cropland use over the study periods.

Table 4.10: Average rates of cropland LULC change

Year	Cropland (ha)	Total change			Average cropland change per year	
		Year	Area (ha)	Percentage	Area (ha)	Percentage
2005	3633.3	2005-2014	125.82	3.5	13.98	0.38
2014	3759.12	2014-2023	-600.53	-15.9	-66.72	-1.77
2023	3158.59	2005-2023	-474.71	-13.1	-26.37	-0.72

As shown in Table 4.10, between 2005 and 2014, cropland in the study area increased by 125.82 hectares. This represents an average annual increase of 13.98 hectares, or a 3.5% increase per

year. This positive change suggests that crop cultivation was expanding, likely due to the significant conversion of forest areas to cropland and minimal expansion of built-up areas.

However, from 2014 to 2023, the cropland area decreased significantly by 600.53 hectares. This equates to an average annual decrease of 66.72 hectares, or a 15.9% reduction per year. The sharp decline indicates a major shift in land use, with substantial amounts of cropland had converted to other uses such as built-up and forest areas.

Overall, from 2005 to 2023, cropland decreased by a total of 474.71 hectares. The average annual decrease during this period was 26.37 hectares, reflecting a 13.1% reduction per year. This long-term decline highlights a trend of decreasing cropland, which could attributed to the impact of urban expansion on agricultural areas.

The findings revealed that built-up areas are expanding at the expense of crop and forestlands. Yimam (2017) reported that farmland decreased by 14.627km^{2}from 1986 to 2016 in Kutaber town, Amhara region. Similarly, Shafi (2021) showed that cropland was decreased by 2166ha from 1996 to 2014 in Harar city. To the contrary, (Bergude, 2021) revealed that agricultural land was increased by 848.43ha from 1999 to 2019 in Sodo town.

Overall, these trends highlight the dynamic nature of land use in the study area, with substantial urban expansion at the expense of agricultural and grazing lands. The increase in built-up areas combined with the decline in cropland and grazing land suggests the need for effective land management strategies to balance development and environmental sustainability in Adet town and its surroundings.

4.4.7. Accuracy Assessment

The classified land use and land cover maps may contain some sort of errors because of several factors, from classification technique to the methods of satellite data capture. In order to use the classified maps, the errors must be quantitatively evaluated through classification accuracy assessment and intended to produce information that describes reality (Congalton, 1991).

Therefore the results of the overall accuracy assessment for the years 2005, 2014, and 2023 were 88.8%, 89.2%%, and 91.4%%, respectively (***See Appendix-I***). According to (Congalton, 1991), the baseline requirement for overall accuracy is 80% or higher. Therefore, the accuracy results for 2005, 2014, and 2023 all meet or exceed this requirement, indicating that the classified land cover maps are reliable for the study.

4.5. Impacts of Urban Expansion on Croplands

The analysis of cropland holding size before and after urban expansion among households' presented and discussed as follows.

Table 4.11: Paired samples statistics of households' cropland holding before and after urban expansion

	Mean	N	Std. Deviation
Crop land holding size before displacement	2.65	133	.946
Crop land holding size after displacement	1.22	133	.414

The paired samples statistics reveal a significant reduction in cropland holding size following displacement. The mean cropland holding size before displacement was 2.65 hectares (SD = 0.946), while after displacement, it dropped dramatically to 1.22 hectares (SD = 0.414). This complete decrease of 1.436 hectares underscores the severe impact of displacement on agricultural capacity, reflecting findings by Zewdie and Abate (2019), who noted that land dispossession in Ethiopia often leads to substantial reductions in land available for farming, thereby jeopardizing food security for affected households.

Table 4.12: Paired samples correlations of households' cropland holding before and after urban expansion

	N	Correlation	Sig.
Crop land holding size before displacement & Crop land holding size after displacement	133	.600	.000

The paired samples correlation indicates a moderate positive relationship between cropland holding sizes before and after displacement, with a correlation coefficient of .600 ($p < .001$). This suggests that households with larger land holdings prior to displacement generally maintain some proportion of their land, although significantly less. This finding supports the research of Mersha (2020), who found that larger initial land holdings can provide a buffer against the total loss of agricultural capacity, albeit not completely preventing it.

Table 4.13: Paired samples test of households' cropland holding before and after urban expansion.

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Crop land holding size before urban expansion – Crop land holding size after urban expansion	1.436	.772	1.304	1.569	21.448	132	.000

The paired samples test reveals a statistically significant mean difference of 1.436 hectares ($t = 21.448$, $p < .001$), indicating that the loss of cropland due to urban expansion was substantial and significantly affects households' agricultural livelihoods. The 95% confidence interval for this difference ranges from 1.304 to 1.569 hectares, confirming the robustness of this finding. These results are consistent with the work of Gebre and Getahun (2021), who emphasized that the reduction in land holding sizes directly correlates with increased poverty and vulnerability among displaced agricultural households.

Overall, the data demonstrates a significant decline in cropland holding sizes following urban expansion, underscoring the economic implications for dispossessed households. This aligns with existing literature that emphasizes the vulnerability of rural communities in Ethiopia to land loss and its cascading effects on food security and livelihoods. The findings highlight the urgent need for policies that support displaced farmers in reclaiming or securing sustainable land access to enhance their resilience.

4.6. Impacts of Urban Expansion on Households' Income

This section discusses how the loss of cropland due to urban expansion affects farmers' incomes. With decreased agricultural production, farmers must find new ways to generate income to make up for their losses.

4.6.1. Households' previous and current income earning occupations

It is obvious that when farmers lose their farmland, their production and, consequently, their income from farming expected to decrease. As a result, farmers are compelled to seek alternative

income-generating activities to compensate for the loss of income from the reduced land. Table 4.14 confirms the extent to which dispossessed farmers in the study area had forced to find additional sources of income.

Table 4.14: Households who changed previous occupation due to urban expansion

Have you changed your occupation due to urban expansion?	Frequency	Percent
Yes	76	57.1%
No	57	42.9%
Total	133	100%

Source: Own survey (2023)

As presented in Table 4.14, the majority of households 57.1% reported that they have changed their previous occupation, while 42.9% of respondents indicated that they have not completely changed their occupation.

Additionally, data obtained from key informant interviews with local community elders confirm that those households who changed their occupation lost all their cropland and only have residential land left. Conversely, those who did not change their occupation still have some cropland remaining and continue their agricultural activities on it.

The analysis of household income-earning occupations before and after dispossession in the study area reveals significant shifts.

Table 4.15: Paired samples statistics of households' previous and current occupations

	Mean	N	Std. Deviation
Households previous income earning occupation	1.44	133	1.144
Households current income earning occupation	2.80	133	1.812

The mean for households' previous income-earning occupation is 1.44 (SD = 1.144), while the mean for current income-earning occupation is significantly higher at 2.80 (SD = 1.812). This increase of 1.361 underscores a transition to potentially more diversified income sources following dispossession, which is consistent with findings by Abate and Zewdie (2020), who

noted that displaced households often seek alternative occupations that can mitigate economic vulnerability.

Table 4.16: Paired samples correlations of households' previous and current occupations

	N	Correlation	Sig.
Households previous income earning occupation & Households current income earning occupation	133	.675	.000

The paired samples correlation shows a moderate positive relationship ($r = .675$, $p < .001$) between previous and current income-earning occupations, suggesting that while there is a transition in the types of income-generating activities, households that had more stable previous occupations tend to maintain some economic continuity in their new roles. This is in line with research by Mersha (2020), which found that households with prior experience in diverse economic activities are better equipped to adapt to changes post-dispossession.

Table 4.17: Paired samples test of households' previous and current occupations

	Paired Differences				T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Households previous occupation- Households current occupation	-1.361	1.339	-1.591	-1.131	-11.721	132	.000

The paired samples test indicates a statistically significant mean difference of -1.361 ($t = -11.721$, $p < .001$), confirming that the shift in income-earning occupations is substantial and meaningful. The 95% confidence interval for the difference ranges from -1.591 to -1.131, indicating a robust finding that displaced households have significantly altered their income-generating activities. This aligns with Gebre and Getahun (2021), findings that emphasize the

necessity for adaptive strategies as displaced households navigate new economic landscapes, often resulting in a diversification of income sources.

Overall, the data indicates a significant transition in income-earning occupations for households following dispossession, reflecting a shift towards potentially more sustainable or varied economic activities. These findings corroborate existing literature on the resilience and adaptability of rural households in Ethiopia, highlighting the importance of policies that support economic diversification and access to new opportunities for displaced populations.

4.6.2. Households' Income Before and After Dispossession

The dispossession of households from their cropland significantly affects their agricultural production, leading to a reduction in income generated from these activities. Table 4.18 illustrates the variance in households' income before and after dispossession from their cropland.

Table 4.18: Paired samples statistics of households' income before and after cropland lose

	Mean	N	Std. Deviation
Households income after cropland lose	2.56	133	1.257
Households income before cropland lose	2.66	133	1.319

Descriptive statistics show that the mean household income before cropland loss was 2.66 (SD = 1.319), while the mean income after the loss dropped to 2.56 (SD = 1.257). The relatively small decrease in income, despite being statistically significant, highlights the potential for coping mechanisms among households. This observation is consistent with findings from Mekonnen and Teshome (2021), who argue that households often diversify their income sources in response to agricultural shocks, which can help cushion the financial blow.

Table 4.19: Paired samples correlations of households' income before and after cropland lose

	N	Correlation	Sig.
Households income after cropland lose & Households income before cropland lose	133	.965	.000

The paired samples correlation demonstrates a strong positive relationship between household income before and after cropland loss, with a correlation coefficient of .965 ($p < .001$). This

suggests that households with higher income prior to losing cropland generally report higher income levels after the loss, indicating some level of resilience or resourcefulness among these households. This finding resonates with research by Abate et al. (2019), which highlights that households with diverse income sources tend to manage shocks better, thereby mitigating the negative effects of cropland losses.

Table 4.20: Paired samples test of households' income before and after cropland lose

	Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Households income after cropland lose - Households income before cropland lose	-.098	.345	-.157	-.039	-3.265	132	.001

The paired samples test reveals a significant decrease in household income after cropland loss, with a mean difference of -0.098 (p = .001). This indicates that, on average, households experienced a reduction in income following the loss of cropland. At 95% confidence interval, the difference ranges from -0.157 to -0.039, confirming that the reduction in income is statistically significant and not due to random chance. These findings align with those of Barlow et al. (2020), who found that agricultural households in Ethiopia often face financial instability following land loss, which can lead to increased poverty levels and reduced quality of life.

Besides, the data obtained from key informants, including community elders, confirmed that households' incomes were heavily dependent on their land. Income generated through crop production, selling grassland and trees, and renting of land for crop cultivation. The loss of landholding has led to a substantial decrease in income, as households can no longer generate money from these sources.

Overall, the data indicates a significant reduction in household income following cropland loss, underscored by a strong correlation between pre- and post-loss income levels, highlighting the severe economic impact of urban expansion on their financial stability.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The study on the expansion of Adet town in Ethiopia provides significant insights into the multifaceted causes and impacts of urban growth, particularly its effects on cropland and household income change.

A key finding of this analysis is that urban expansion is driven by a complex interplay of factors, including population growth, rural-to-urban migration, enhanced infrastructure, government initiatives, and favorable geographical conditions. Respondents identified population growth as a primary driver, aligning with existing literature that emphasizes the role of high fertility rates and healthcare improvements in urbanization. Additionally, migration patterns reveal that economic opportunities in urban areas attract rural populations, supporting the notion of a push-pull model where individuals leave rural settings for better livelihoods. The role of infrastructure, as emphasized by the study, had not overstated, as improved transportation and utility access create favorable conditions for urban growth, making cities more attractive to residents.

The impact of Adet's urban expansion has particularly pronounced in the agricultural sector. The analysis shows a dramatic reduction in average cropland holdings among dispossessed households, decreasing from 2.65 hectares to 1.22 hectares. This significant loss of land not only affects agricultural productivity but also jeopardizes food security, revealing the vulnerability of these households to urban encroachment. The correlation between pre- and post-displacement land holdings indicates that those with larger initial land holdings are better able to retain some land post-displacement, though the overall loss remains substantial. This underscores the need for policies that assist dispossessed farmers in securing sustainable land access to bolster their resilience against economic impacts.

In terms of household income, the study highlights notable transitions in income-earning activities post-displacement. Households reported an increase in the diversity and potential lcurativeness of their occupations, moving from an average of 1.44 previous occupations to 2.80 current ones. This shift suggests an adaptive response to the loss of cropland, with many households seeking alternative livelihoods to mitigate economic vulnerability. However, despite these adaptations, the study found a significant average decrease in household income, indicating that urban expansion's economic impacts are profound and multifaceted. The strong positive

correlation between pre-loss and post-loss incomes illustrates the resilience of households with higher initial incomes, yet the overall decline emphasizes the financial instability brought about by land loss.

The land use and land cover change detection results reveal significant conversions among land cover types. The built-up area in Adet increased dramatically from 108.81 hectares to 692.06 hectares, reflecting a 536% growth driven by urbanization. In contrast, cropland and grazing land experienced significant reductions, highlighting a shift in land use priorities that favors urban development over crop production. The reduction of grazing land, exacerbated by government policies transferring communal lands to housing cooperatives, indicates a troubling trend that threatens traditional farming practices and community cohesion. The increase in forest area, primarily due to eucalyptus plantations, offers a nuanced view of land use changes. While this expansion may provide some economic benefits, it does not compensate for the losses in crop and grazing lands, emphasizing the need for a balanced approach to land management that considers both economic and ecological sustainability.

In conclusion, the findings of this study underscore the urgent need for integrated urban planning strategies that can effectively address the challenges posed by rapid urban expansion in Adet.

5.2. Recommendation

The findings of the study on the expansion of Adet town highlight the urgent need for comprehensive strategies to manage urban growth while safeguarding cropland and the income of affected households. Here are some recommendations aimed at addressing these challenges effectively:

- **Address rural-urban migration**: To mitigate the high rate of rural-urban migration contributing to Adet town's expansion, the town administration should enhance infrastructural development in nearby rural satellite towns. This approach could reduce the migration pressure on Adet town.
- **Integrated urban planning**: Policymakers should develop and implement integrated urban planning strategies that prioritize sustainable growth. This involves creating zoning regulations that balance urban development with the protection of crop and communal lands. Future development plans should include assessments of environmental impacts and ensure that croplands have preserved for food security.

- **Support for dispossessed households**: Establish support programs for farmers who have lost their land due to urban expansion. This can include financial assistance, access to alternative land, or resources to transition into new livelihoods. Providing training in diversified agricultural practices and income-generating activities will enhance their resilience against economic shocks.
- **Enhance income opportunities**: The district agriculture office should create an action plan that includes development packages such as urban agriculture initiatives, including animal fattening, dairy farming, beekeeping, and backyard vegetable gardening, to increase household income.
- **Promotion of economic diversification**: Encourage economic diversification by supporting small and medium enterprises within the urban area. This has achieved through microfinance programs, training, and infrastructure that enable entrepreneurship. Providing skills development opportunities will help dispossessed households adapt to new economic realities.
- **Promote vertical development**: To minimize the impact of urban expansion on cropland, the town's municipal services should encourage vertical development and promote condominium-housing programs.

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Appendix-I: Accuracy assessment of the study area for 2005, 2014, and 2023

2005							
LULC Type	Built-up	Forest	Cropland	Grazing	Classified totals	Number correct	Users accuracy
Built-up	7	1	0	1	9	7	77.8%
Forest	1	16	0	1	18	16	88.9%
Cropland	0	1	40	2	43	40	93.0%
Grazing	0	1	1	8	10	8	80.0%
Total	8	19	41	12	80	71	88.8%
Producer accuracy	87.5%	84.2%	97.6%	66.7%			
Overall Accuracy 88.8%							
Kappa coefficient 0.8152							
2014							
LULC Type	Built-up	Forest	Cropland	Grazing	Classified totals	Number correct	Users accuracy
Built-up	8	1	0	1	10	8	80.0%
Forest	2	17	0	0	19	17	89.5%
Cropland	0	2	40	2	44	40	90.9%
Grazing	0	0	1	9	10	9	90.0%
Total	10	20	41	12	83	74	89.2%
Producer accuracy	80.0%	85.0%	97.6%	75.0%			
Overall Accuracy 89.2%							
Kappa coefficient 0.8352							
2023							
LULC Type	Built-up	Forest	Cropland	Grazing	Classified totals	Number correct	Users accuracy
Built-up	5	1	0	0	6	5	83.3%
Forest	0	15	0	1	16	15	93.8%
Cropland	0	2	46	1	49	46	93.9%
Grazing	0	2	0	6	8	6	75.0%
Total	5	20	46	8	79	72	91.14%
Producer accuracy	100.0%	75.0%	100%	75.0%			
Overall Accuracy 91.14							
Kappa coefficient 0.8452							

Appendix-II: Household Survey Questionnaire

BAHIR DAR UNIVERSITY

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Questionnaire for Sample Household

Dear Respondents,

The main purpose of this questionnaire is to collect firsthand data about the ***"Impacts of urban expansion on croplands and peri-urban communities in case of Adet town."*** This study aims to fulfill the requirements for awarding a Master of Arts degree at Bahir Dar University. Your genuine and accurate information regarding urban expansion and its effects on croplands is crucial for the success of this research. Therefore, the researcher greatly appreciates your willingness to contribute. Please be assured that all information gathered will kept confidential and used solely for research purposes.

Thank you for your cooperation!

Questionnaire code_____

Date_____

I. Personal information of the respondents

Note: Circle the answer that meets your choice and fill on the blank space for additional answers.

1. Sex
   a. Male
   b. Female
2. Age
   a. 20 – 30
   b. 31 – 40
   c. 41 – 50
   d. 51 – 60
   e. +60
3. Level of education
   a. Unable to read and write
   b. Read and write
   c. Primary education (1 – 8)
   d. Secondary education (9 – 12)
   e. Tertiary (college and university)

4. Marital status
   a. Single
   b. Married
   c. Divorced
   d. Widowed
5. Kebele
   a. Adet zurya
   b. Mosbo
   c. Adet– 04
   d. Adet – 05
6. Family size
   a. 1 – 3
   b. 4 – 6
   c. 7 – 9
   d. > 10

II. Socio- Economic Profile

7. Occupation
   a. Farmer
   b. Merchant
   c. Daily labor
   d. handicraft
   e. If any mention____
8. Do you have your own land?
   a. Yes
   b. No
9. If your answer to question number 8 is yes, how many hectares of land do you have? _____
10. For what purposes have you been using your land?
    a. Cropland
    b. Grazing land
    c. Garden
    d. If any other please mention_____

III. Causes of the expansion of Adet town

11. Is their spatial urban expansion in your locality?
    a. Yes
    b. No
12. If your answer to question number 11 is yes, what are the factors for the expansion (multiple responses are possible)?
    a. Natural population growth of the town
    b. Rural urban migration
    c. Accessibility to infrastructure
    d. Urban expansion program
    e. Suitable climate and topography for settlement
    f. If any other mention please_____

IV. Impacts of urban the expansion on landholding of households

13. Did you lose your land due to urban expansion?
    a. Yes
    b. No
14. If your answer for question number 13 is yes, how many hectares did you lose?
    a. < 0.25
    b. 0.25 – 0.5
    c. 0.5 – 1
    d. > 1
15. What type of land did you lose due to urban expansion?
    a. Crop land
    b. Grazing land
    c. Garden
    d. Residence
    e. If any other mention _____

V. Urban expansion and income of households'

16. Did you modify your income earning activities due to urban expansion?
    a. Yes
    b. No
17. What were your income earning activities before dispossession (multiple responses are possible)?
    a. Mixed farming
    b. Dairy farming
    c. Handicraft
    d. Small trade
    e. Daily laborer
    f. Contractual employee
    g. Permanent employee
    h. If any mention_____
18. What is your income earning activity after dispossession (multiple responses are possible)?
    a. Mixed farming
    b. Dairy farming
    c. Handicraft
    d. Small trade
    e. Daily laborer
    f. Contractual employee
    g. Permanent employee
    h. If any mention_____
19. Is there a variation in your income before and after dispossession from your landholding?
    a. Yes
    b. No

20. If your answer to question number 19 is yes, what was your net income (in birr per annum) before dispossession?
    a. < 15000
    b. 15000 – 30000
    c. 30000 – 45000
    d. 45000 –60000
    e. > 60000
21. What is your net income (in birr per annum) after dispossession?
    a. < 15000
    b. 15000 – 30000
    c. 30000 –45000
    d. 45000 –60000
    e. > 60000

Appendix-III: Interview Questions for Key Informants

BAHIR DAR UNIVERSITY

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Dear Respondents, the main purpose of this questionnaire is to collect firsthand data about the "***Impacts of urban expansion on croplands and peri-urban communities in case of Adet town.***" This study aims to fulfill the requirements for awarding a Master of Arts degree at Bahir Dar University. Your genuine and accurate information regarding urban expansion and its effects on croplands is crucial for the success of this research. Therefore, the researcher greatly appreciates your willingness to contribute. Please be assured that all information gathered will kept confidential and used solely for research purposes.

Thank you for your cooperation!

I. Personal Information of the Respondents

1. Address: _____
2. Kebele: _____
3. Sex: _____
4. Age: _____
5. Level of Education: _____
6. Position in the Office: _____
7. Occupation: _____
8. Years of Service in the Office: _____

II. Interview about the condition of expansion of Adet town

9. How would you describe the trends of Adet town's expansion in relation to the surrounding peri-urban area?
10. In your opinion, what factors have contributed to the spatial urban expansion of Adet town?
11. What are your views on the negative impacts of urban expansion on the social and economic conditions of households?

12. Could you explain the current living conditions of farmers and their families who have lost their assets and have dispossessed from farming?
    a. Source of income:
    b. Types of occupations they are engaged in:
13. What solutions do you propose for the challenges faced by the dispossessed farming community because of the town's expansion?
14. What role could your office play in improving the lives of the peri-urban farming community affected by urban expansion?