# Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City Soloke kebele

Teshale Mezgebe Tesfaye

A ThesisSubmitted to the Department of Architecture

School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Masters of science in Urban Planning and Design

Office of Graduate Studies

Adama Science and Technology University

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Adama, Ethiopia

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Advisor Yared Girma (Ph.D.)

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# DECLARATION

I declare that this thesis entitled “Land Use Land, Cover Changes Dynamic and resultingsocio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City” is my own work and has not been submitted to any university for similar purpose. The references used in this thesis are duly recognized by proper citations.

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# RECOMMENDATION

I, the major advisor of this a thesis, hereby certify that I have closely advised the student while developing this thesis and read the draft thesisentitled'' Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City" prepared under my guidance by Teshale Mezgebe Tesfaye. Therefore, I recommend the submission of the thesis to the department for further review and evaluation.

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# APPROVAL SHEET

We, the advisors of the thesis entitled "Land use land cover changes dynamic and its impact on the resident Adama city,in the case of Dabe sub-city" by Teshale Mezgebe Tesfaye, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporate to the final version of the thesis.

Major Advisor Signature Date

Co-advisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis by Teshale Mezgebe Tesfaye have read and evaluated the thesis entitled "Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City" and examined the candidate during the open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban Planning and Design.

Chairperson Signature Date

Internal Examiner Signature Date

Sitotaw Haile Erena (PhD) 26 July,2022

External examiner Signature Date

Finally, approval and acceptance of the thesis is contingent upon the submission of its final copy to the office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

Department Head Signature Date

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Office of Postgraduate Studies, Dean Signature Date

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| | |
|---|---|
| GISs | Geographic Information Systems |
| LULC | Land use land cover |
| RS | Remote sensing |
| UNFPA | United Nations Population Fund |
| DEM | Digital Elevation Model |
| EMA | Ethiopian Mapping Agency |
| UTM | Universal Transverse Mercator |
| WGS | World Geodetic System |
| CSA | Central Statistical Agency |
| OIES | Institute of the Office of Interdisciplinary Earth Studies |
| IGBP | International Geosphere and Biosphere Programme |
| IHDP | International Human Dimensions Programme |
| SSA | Sub-Saharan African |
| TVET | Technical Vocational Education Training |
| OBN | Oromia Broadcasting Network |
| CAD | Computer Aided Design |
| GPS | Global Positioning System |
| INSA | Information Network System Agency |
| PCC | Post-Classification Comparison |
| NASA | National Aeronautics and Space Administration |
| RGB | Red Green Blue |
| ERDAS | Earth Resources Data Analysis System |

| | |
|---|---|
| ETM | Enhanced Thematic Mapper |
| OLI | Operational Land Imager |
| ASTER | Advanced Spaceborne Thermal Emission and Reflection Radiometer |
| NASA | National Aeronautics and Space Administration |
| TM | Thematic Mapper |
| ETM+ | Enhanced Thematic Mapper Plus |

# ABSTRACT

*Adama city is suited in Rift Valley, on flat terrain characteristics and surrounded by mountains and ridged topography. The objective of this study was to analyze how Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City, has changed over the last three decades. Demand for urban land is rising due to urbanization; this demand is triggered by rural to urban migration & growth of urban population. Access to urban land is uneasy for residents.*

*To achieve the intended objective, the study uses the Land sat image of 1990, 2008, and 2021 and identifies, quantifies, and maps the land use land cover of the study area. Both qualitative and quantitative data were used and evaluated in a systematic way using Geographic information service and remote sensing techniques as analysis tools respectively. For this investigation, the studyused both primary and secondary data.The study used to analyze the Land sat images of settlers for three consecutive decades,questionnaire and focal discussion with the settlers for a long period of time in the study area. The characteristics were confirmed using observed Land use land cover by using kappa parameters; the overall kappa index of 0.801, 0.806% and 0.814%. The result shows that the proportion of built-up area was 12.4 % in 1990, in the table 9: rose to just over 26.21% in 2021, with annual growth rates of 9.5%, 4.32%, and 13.82% in the three study phases, indicating an expansion in the built-up area was 8.34km$^2$, resulting in agriculture, barren land and forest losing 3.91km$^2$, 3.22km$^2$, and 1.21km$^2$ respectively from 1990 to 2021. From the group discussion with the elders of the selected area and the experts from municipality offices, the main causes of land use land cover change were the expansion of the city towardsthe study area and the implementation of an industrial park in the study area, and the informal settlers migrated from different areas of the country to that place for different reasons. The output of the study provides useful information for land- planners and decision-makers to make better decisions to improve future land use policies and formulate management strategies within the framework of sustainable land use planning.The planner and policy makers to develop urbanization not only in the horizontal dimension but in vertical dimension as well. Furthermore, implementation of building bylaws and land use plans is highly recommended.*

**Key words**: - Dabe, Geographic information service,Land use/cover, Residents,Remote sensing.

# CHAPTER ONE

# 1. INTRODUCTION

Nowadays, most of the world population lives in cities and metropolises. However, it is often the case that settlements grow irregularly under the pressure of masses coming to cities and these do not develop according to well-defined plans. Hence, it is necessary to monitor urban areas with frequent update (Said, 2007). Generally, there is a rapid urbanization in the world. This rapid urbanization is usually carried out in all over the world cities and city's with the growth of the population until today, the population living in urban areas has increased by 3 times.

This increase was doubled in developed countries and 4 times in developing countries. The urban population in Ethiopia is increasing rapidly, if not managed proactively, rapid urban population growth may challenge and struggle the city is to provide basic facilities infrastructures. Urbanization is failing to meet the demands of growing numbers of urban residents and basic service delivery infrastructure are already undermined in many cities by growing urban extents and by lack of improper urban planning implementation, and a lot of agricultural land change in to urban settlements (Yeung, 2000). Urbanization is creating continuing urban sprawl and associated problems in cities of developing countries. African cities are experiencing rapid urbanization which leads to unsustainable development.

Land is the major natural resource on which economic, social, infrastructure and other human activities are undertaken. It is also the source of materials needed for these activities. Changes in land use have occurred at all times in the past, present, and are likely to continue in the future (Lambin, 2003 & SC, 1996). Land-use/Land cover and its impacts on terrestrial resident, ecosystems, including forestry, agriculture and biodiversity have been identified as high priority issues at global, national, and regional levels (Fu, 2000). Land-use/land-cover (LU/LC) changes caused by natural and human processes have played a major role in global as well as regional scale patterns of the climate and other aspect of the earth (Ramachandra,2012).

LU/LC dynamics are a result of complex interactions between several biophysical and socio-economic conditions, which may occur at various temporal and spatial scales (Reid,

2000). This kind of information is required in many aspects of land use planning and policy development, as a prerequisite for monitoring, modeling and resident change and as a basis for land use statistics at all levels. The massive LU/LC change is a result of the rising human population's need for land for settlement and agriculture, which is posing a challenge to land management objectives. Land usage should be proportional to land capacity, while also taking into account the overall climate and environment (FAO/UNEP, 1999). Human population is increasing and causes transformation of the natural setting/environment into human landscapes. Therefore, it is critical to study to have detailed information, spatial and temporal LU/LC dynamics and the rate of changes.

The main resident problems in both rural and urban areas are due to change of vegetated surfaces into a settlement, bare land and agricultural land. Land use/Land-cover dynamic is one of the main variables measured using Remote Sensing technology with different sensors such as, Landsat-5 TM, Landsat-7 ETM+ and Landsat-8 TIRS (Gebrekidan, 2016).

A land cover change further disturbs the biogeochemical driving that induces global warming, erosion of soil and land-use patterns. Population growth is commonly blamed for widespread land-use change and resident degradation (Cleaver, 1994). Its land use/land-cover patterns are changing as a result of population growth, industrialization, and other natural and human activities (overgrazing, deforestation, unplanned land-use for habitation and other activities).

This indicate that change in LU/LC resulted in negative impacts on livelihood of farmers activities and leads resident problems, thereby, challenging land management system and tenure security Land management is a system of planning and management methods and techniques that aims to integrate ecological with social, economic and legal principles in the management of land for urban and rural development purposes to meet changing human needs, while simultaneously ensuring the long-term productive potential of natural resources and the maintenance of their resident and cultural functions.

In recent years, worldwide cities are experiencing rapid growth because of the rapid increase in world population and the irreversible flow of people from rural to urban areas. Specifically, in the larger city and cities in developing countries, the rate of population growth has remained consistent, and many of them are now confronting with spontaneous and

unplanned settlements. At the densely populating sites or periphery to prevent such problems from happening, urban planners need detail updating maps for thorough effective, and efficient planning and management. However, most city planners lack such maps, and often they possess old data which is not relevant for current decision-making. Even if they fail to do so hold a detailed updated map of the city area, a regularly updated map with an acceptable resolution can at least give them an impression about the changes in the city area (Amarsaikhan, et al. 2000).

Changes in urban land will take place due to the implementation of new urban plans. Such plans may be prepared either to accommodate urban expansion, or to create new city s in accordance with the resettlement scheme, or to improve the existing resident infrastructure (Alain, 1996). As knowledge has progressing and as science and technology was developing, society will achieve both an improve insight into the processes and consequences of resident change and the means of altering the environment significantly.

Population growth is one of the most important factors causing the observed land-use changes because of the increase of demand for shelter. Urban spread out has been blamed for inefficient use of land resources and large-scale interference on agricultural lands. As cities expand, agricultural land and habitats like forests are transformed into land for housing, roads, and industry. Thus, the problem of expanding city centers is complex and complicated land-use change is the end result of numerous interacting factors arising from different levels of associations of human-environment systems, which differs in time and space.

The studychooses this area because it was the main gate from Djibouti, Harar and Arsi Arba Gugu, so, the community selected this area because trade activity was active, and also the expansion of the city along this area was fast when compared with the other sub-cities in the city.

## 1.2 Statement of the Problem

Demand for urban land is rising due to urbanization;this demand is triggered by rural to urban migration & growth of urban population. Access to urban land is uneasy for residents.The city capacity to deliver land for residents is low.

Due to the constraints of urban land at an affordable price for the lower and middle class, many of the peripheries of Adama city were occupied by informal settlers. Adama's master plan proposed compact of urban growth in the three major directions: East (Dabe sub-city), North (Bole sub-city), and West (Dembla sub-city). The same plan had put general development guidelines for the proposed expansion areas. In this regard, the strategy was designed to develop land for housing in the expansion areas with the parallel provision of services and infrastructure. The growth and current settlement patterns in Adama are likely to continue.

Even though the city hosts several mid-rise hotels and commercial buildings in the inner city and commercial districts, the future growth of Adama is predicted to be largely horizontal. This is mainly due to the incapability of the urban residents to afford high-rise buildings. Spatial activities such as building houses, infrastructure, and industry may cause negative environmental impacts such as pollution, noise, loss of nature vegetation, changing of groundwater bench, hazards, etc. (Miller,2000). As a result, the objective of this research was to determine Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City.

Based on government policy practice, industrial park development has been done in other countries. Adama city was one of the selected ones for the development. Due to this, the study area was selected, and the informal settlers accompanying the project created great land changes in the area. This was the motive of the researcher, how the change occurred, and how the change affected the environment and the society of the study area.

Adama city is perceived as a place where one could have a better life, because of better work opportunities, better services, and better lifestyles. It is also considered one of the most beautiful, relatively well-planned, and safest cities by many standards. As a result, the coming of people from rural to urban areas was the main Cause for LULCC. Due to land use and land cover changes, the farmland of the farmers was changed to an urban area and deforestation occurred severely in the study area. Because of this, the farmers and their families practicing on farms have become jobless and their animals were lost due to absences of grazing land and erosion was severe. This would have a significant impact on the surrounding ecosystem,

lossof agricultural land, destruction of forest cover, water depletion, and the benefits generated from the land.

Because of this rapid growth in the urban-rural periphery, planners and policymakers lack of accurate planning, timely implementationand cost-effective urban land use data, which is essential to making the decision concerning land resource management? Quantifying changes in land use and land cover for the future is, therefore, important in Adama city Dabe sub-city, Ethiopia for monitoring and resolving the negative consequences. This could be useful for better land use management and environmental development in the study area.

## 1.3 Objectives of the Study

### 1.3.1 The general objective

The general objective of this study wasto analyze the Land use land cover, changes dynamic between 1990-2021 and its driving forces and impacts in case of the Dabe sub-city of Adama using GIS and RS techniques.

### 1.3.2. Specific Objectives

**This study specifically aimed to:**

I. Identify the major driving forces for LULC change in the local context
II. Quantify land use land cover changes pattern from 1990-2021 in Dabe sub-city of Adama city
III. Identify the major impact reviled on residents due to urban growth.

## 1.4 Research Questions

- ✓ What was the land use land cover pattern of changes from 1990 to 2021 in Dabe sub-city of Adama?
- ✓ What were the major driving forces for LULC change in the study area?
- ✓ What were the major resident problems that reviled due to urban growth?

## 1.5 Significance of the Study

Analyzing Land use land cover changes dynamic and its impact on resident of Adama city, in Dabe sub-cityprovide greater importance to the research community, urban planners, stake holders as well as decision making groups in terms of understanding the impacts of land use

land cover changes in the study area. The results of this study could provide better information about the changes in urban land use quantified through integrated application of GIS and Remote sensing. In addition, it also provides the opportunity to understand the trends of changes in built up areas as a result of driving variables. Moreover, the findings of this study were an initial input for future research direction for interested groups in the area.

## 1.6 The Scope of the Study

Geographically, the intended study was restricted to the Adama city administration. Conceptually, the research had three important scopes. These are spatial scope, thematic scope, and temporal scope. Thematically, the scope of this research was supposed to be based on the theoretical principles of urban planning, theory, and principles to assess the dynamic of land use and its impact on residents of Adama city, in the Dabe sub-city. In addition, the spatial scope of this research was limited within the administration boundary of Adama city Dabe sub-city.

## 1.7 Limitations of the study

The high spatial resolution of remote sensing data interpretation was required to obtain better simulation results was the main challenge the researcher. In this study, 30-meter Land sat satellite images obtained from USGS earth explorer website (https://earthexplorer.usgs.gov/) has been used. Generating accurate land use the land cover map was a challenge from such images due to a coarse resolution. It was difficult to make a clear distinction between different land use features classes. The present study was attempted with all possible efforts in acquiring required inputs in the form of primary and additional data collection, interpretation and analysis. However, the study has come across certain limitations. One of the limitations was boring process to get data from different organizations.

## 1.8. Organization of the study

The whole thesis is divided into five chapters. The first chapter lays the background of the study providing general introduction about the research work including the problem statement, questions and research objectives, the scope and limitations of the study were also highlighted. The second chapter deals with literature survey in which the related works as have been performed by various other studies are presented. In the third chapter, information about the chosen study area is given and how the several data layer maps are generated, also outlining the methodology of carrying out the task and the data sources utilized. Chapter 4 presents the findings of this research work and a detailed discussion on the results obtained. Finally, in the fifth chapter, a conclusion is drawn based on the results obtained along with future research possible and recommendation.

# CHAPTER TWO

# 2. LITERATURE REVIEW

## 2.1 The Concept of Land Use Change

Land use refers to the ways in which, and the purpose for which, human beings employ land and its resources (Briassoulis, 2000). Land use can be broadly defined as the level of spatial accumulation of activities such as production, transaction, administration, and residence with highly dynamic relationships between them. Urban land use reflects the nature of social and economic activities in an area, as well as interactions with other areas. It results from the complicated interactions between the land system and the social-economic systems (Jian Quan, 2003).

Economists, geographers, anthropologists, planners, and other social scientists have been concerned about land use. The term refers to the use of land by humans. Conversion of grazing to cropping, change in fertilizer use, drainage improvements, irrigation installation, and use, plantations, the building of farm dams, pollution and land degradation, vegetation removal, changed fire regime, the spread of weeds and exotic species, and conversion to non-agricultural uses are all examples of land-use change attributable to management(Quentin et. al., 2006).

The realms of LULC are connected, in the terminology we adopt, by the neighboring sources of change: those human actions that directly alter the physical environment. The realms of LULC are connected, in the terminology we adopt, by the neighboring sources of change those human actions that directly alter the physical environment. Through proximate sources, human intentions for land use were translated into changed physical conditions of land cover. The point of contact between the basic requirements of the natural and social sciences, between physical processes and human behavior is shown by the example of proximate sources (Lee. 2018).

On the one hand, these local sources cause land cover changes or changes in the properties of the ground surface. They may take the form of either conversion or modification, and they may lead as well to secondary environmental impacts trace gas emissions, biodiversity loss,

soil erosion, and degradation and microclimatic change, and water flow and water quality changes are an example. On the human side of the chain, the proximate sources reflect human goals mirrored in land uses (Turner & Meyer, 1994).

## 2.2 Land use and Land cover Changes

The definition of land use and land cover has been used interchangeably in the land use research community because of the availability of many existing information systems. However, these two terms explain two different issues and meanings. Land cover refers to the observed biophysical cover on the earth's surface including vegetation, bare soil, hard surfaces and water bodies. Whereas land use is the utilization of land cover type by human activities for the purpose of agriculture, forestry, settlement and pasture by altering land surface processes including biogeochemistry, hydrology and biodiversity (Di Gregorio & Jansen, 2000).

Land use and land cover changes became prominent as a research topic on the global environmental change several decades ago with the idea of processes in the earth's surface influence climate. In early 1980's the significance impact of land use and land cover change on the global climate via carbon cycle was understood where terrestrial ecosystems acted as a source and sinks due to the changes. Following this, the forthcoming volume of the 1991 Global Change Institute of the Office of Interdisciplinary Earth Studies (OIES) dedicated to land use and land cover changes at global level by explaining the major recent trends of changes, their consequences in environment, and human causes on it (Meyer &Turner, 1992).

Latter under the support of land use and land cover change project of the International Geo-sphere and Biosphere Programme (IGBP) and International Human Dimensions Programme on Global environmental Change (IHDP), the research community has identified three basic issues. These understood the causes of land use and land cover changes, how to quantify it (Lambin et al, 2003). Conversion and modification are the two forms of land cover changes where the former is a change from one class of land cover to another (e.g. from grassland to crop land) (Meyer & turner, 1992). The latter is, however, a change within a land cover category.

Land cover changes due to human activities drive land use and hence a single class of cover could support multiple uses. On the other hand, a single system of land use can maintain several covers (as certain farming systems combine cultivated land, improved pasture and settlements). Changes in land use and land cover caused through direct and indirect consequences of human activities on the environment for the purpose of having better life. One of the direct impacts of humans is population growth where its increase and decrease have effects on land use especially in developing world at longer time scales. The mutual interactions between environment and social factors at different spatial and temporal scales as land use and land cover change is a complex process (Lambin et al,.2003). Causes of land use and land cover change can be categorized as direct (proximate) or indirect (underlying) (Ver burg et al, .2002).

The direct causes comprise human activities that could arise from the continuous use of land and directly alter land cover which reflect that human are driving forces. They are generally operated at local levels and explain how and why local land cover and ecosystem processes are modified directly by humans. On the other hand, indirect causes are fundamental forces that strengthen the more direct causes of land cover changes. These causes are resulted due to the complex interaction of social, political, economic, technological and biophysical variables. Land use and land cover changes have significant consequences on climate change, hydrology, air pollution and biodiversity. Study that it caused a various microclimatic change (Meyer &Turner, 1992). The rise in global surface temperature is associated with deforestation through changes in land use.

This in turn caused a strong warming in urban environment called urban heat island. Their study also showed water pollution occurred due to land cover changes from cultivation to settlement (urban areas). It has been reported also that loss of forest species has wide range of effects on biodiversity. Identifying the causes and impacts of land use and land cover change require understanding both how people make land-use decisions and how specific environment and social factors interact to influence these decisions (Lambin et al, 2001).

## 2.3. Urban Land use Changes

From a broader point of view urbanization is one of the ways in which human activities altering global land cover. Although urbanization trend is global, according to the reports of

the United Nations Centre for Human Settlements (Habitat, 2001), it has showed most remarked changes in developing countries associated with the migration of rural people to cities for better opportunities. Following this there had been estimated a rapid growth of population in urban areas at an average rate of 2.3% per year between 2000 to 2030 (Nations, 2001). Urban growth, particularly the movement of residential and commercial land use to rural areas at the periphery of metropolitan areas, has long been considered as a sign of regional economic vitality (Yuan et al, 2005).

However, its importance become unbalanced with impacts on ecosystem, greater economic differences and social fragmentation. It can be defined as the rate of increase in urban population. Dynamic processes due to urban change, especially the tremendous worldwide expansion of urban population and urbanized area, affect both human and natural systems at all geographic scales (Brinkerhoff. 2000).

Urban growth in Adama city, was towards the periphery of urban areas due to the grouping of a number of smaller settlements as well as through the consumption of agricultural land. The growth was predicted to continue in the future and would have wide range of consequences on natural resources. Their study also noted that population growth was one of the major driving factors for such rapid growth in the study area. Traditionally demographic data has been used to asses' urban sprawl (Carlson & Traci, 2000).

Meanwhile the use of aerial photography become important to update land covers maps. Since land cover changes at regional level occurred increasingly due to human activity, the changes couldn't be realized in the community. Therefore, accurate and updated information is required to design strategies for sustainable development and to improve the livelihood of cities. The ability to monitor urban land cover and land use changes is highly desirable by local communities and policy decision makers.

Due to the increased availability and improved quality of multi spatial-temporal data and new analytical techniques, nowadays it is possible to monitor urban land cover and land use changes and urban sprawl in a timely and cost-effective way (Yang et al, 2003). Therefore, the use of satellite image provides for regional planning and urban ecology.

## 2.4 Urban population and land use land cover change trends

The Magnitude of Urbanization in the Developing World population of developing-country cities is expected to grow from around 2 billion in 2000 to nearly 4 billion in 2030 over the next three decades. In the year 2000, the built-up areas of developing countries' cities were predicted to reach 200,000 $km^2$. The built-up area of developing country cities will exceed 600,000 $km^2$ by 2030. In other words, by 2030, these cities can be expected to triple their land area, with every new resident converting, on average, some 160 $m^2$ of non-urban land to urban land during the coming years (UNCHS, 2004).

The term land cover originally referred to the type of vegetation that covered the land surface, but has broadened subsequently to include other aspects of the physical environment also, such as soils, biodiversity and surfaces and ground water (Moser, 1996). In the disaster-prone areas of landslides, the destruction of forests and the vegetative cover that binds the top soil at an increasing pace and the conversion of forest land into agricultural and horticultural holdings (Khan et al., 2017). Brings changes in land use and land cover on the other hand, there were those who welcomed it and actively laid the foundation for cities to take in the incoming waves of new migrants (Tseng yu.1988). Historically, humans have been modifying land to obtain the essentials for their survival, but the rate of exploitation was not the same as it is today.

Recent rapid rate of exploitation has brought unprecedented changes in ecosystems and environment processes at local, regional and global scales. Presently, land use/land cover changes encompass the environment concerns of human population including climate change, biodiversity depletion and pollution of water, soil and air. Today, the monitoring and mediating the adverse consequences of land use/land cover change while sustaining the production of essential resources has become a major priority of study and policy makers around the world (Erle & Pontius, 2007).

Human activities which are mainly driven by socio-economic factors bring out changes in non-built-up and built-up land despite restrictions by physical conditions (Long et al. 2007). Land use change, including land transformation from one type to another and land cover

modification through land use management, has altered a large proportion of the earth's land surface.

### 2.4.1 Forces Shaping Urban Expansion

What are the existing forces influencing urban expansion? The interaction of the following broad types of processes determines the expansion of urban areas. These include the physical or geographic variables that influence land use and spatial interaction in the city, as well as the demand for land by the city's households or businesses and the governmental limitations that govern land use and spatial interactions (Seto et al, 2003). Climate, slope, mountain barriers, and the presence of drillable water aquifers are only a few examples of natural factors that may influence urban expansion (Terfa. 2019)

Rural migration and natural population increase in the city, as well as the level of urbanization and the city's position in the country's urban hierarchy can all have demographic effects. The level of economic development, differences in household incomes, exposure to globalization, the level of foreign direct investment, the degree of employment decentralization, the level of real estate finance markets, the level and effectiveness of assets taxation, and the presence of high inflation and acute housing problems are all factors which influence urban expansion (Angel et al 2005).

Urbanization, rapid population increase, and changing socioeconomic pattern are deriving forces that influenced spatial change in peri-urban areas (Jongkroy,2009). In 1900, worldwide, there were rural dwellers to each urban dweller; now there is less than one and projections suggest close to three urban dwellers to two rural dwellers by 2025. UN's projections suggest that the world's urban population will grow by more than a billion people between 2010 and 2025 (United Nations 2008).

This, in turn, necessitates space, which necessitates the expansion of urban communities into rural areas (Cernea.1995). Natural population growth is a major factor in urban growth for all countries, although rural-urban migration plays a larger role in many developing countries (Gugler.1996). Migration contributes fast growth of the urban population due to the relative economic development that attracts people to urban centers for commerce, employment, and education.

Many believe that cities are expanding very rapidly and are growing for non-productive reasons specifically; some scholars believe that new policies and regulations on land acquisitions and illegal land markets might have encouraged the extensive shifts of cultivated areas into built-up areas (Yeh et al 2003). A number of observers also suggest that housing prices have risen unreasonably high in many cities of the developing countries and are inducing developers and investors to invest in more housing stock than would be rational in a purely market-driven economy (Wu, F.2000). In short, scholars believe that there are economic and non-economic factors that are encouraging the expansion of urban to non-urban areas.

### 2.4.2 Urban expansion in a variety of forms

Is urbanization essentially the same everywhere, or does it take on significantly various forms? Different modes of urban expansion exist. New urban expansion in any city can occur at the same densities (people per square kilometer) as existing built-up regions, at higher densities, or at lower densities. It can happen through high-density redevelopment, infilling existing open spaces in densely populated places, or new "undeveloped" development in mostly undeveloped areas. New green field development can either be created in direct range to existing built-up areas or can leapfrog away from them, leaving swaths of undeveloped space between them. It has the potential to expand on sensitive habitats such as wetlands, watersheds, forests, and other green spaces (Angel et al, 2005).

Urban expansion modelsthat seek to explain variations in the rate of expansion of cities typically focus on population, income, and transport cost effects, but rarely incorporate the weaker policy and regulatory effects and are therefore have limited utility in guiding policy. In parallel, the effects of “business as usual” urban expansion on desirable socio-economic outcomes (Ahfeldt &Pietro Stefani, 2018). The use of material resources and climate change have also been the subject of econometric modeling, with improving, but still weak results (Hodson et al, 2012 & Lee, 2014). A scientific consensus appears quite far away.

Their argument promotes urban regulation strategies and new intra-urban resident initiatives and it goes in line with the compact city argument that favors controlled direction of

inevitable expansion to the periphery to support a full range of facilities and to the sites that causes the least resident damage (Isaac et al, 2000).

### 2.4.3 Consequences of urban expansion

While the literature identifies various social and economic consequences associated with urban sprawl, this article focuses on environment problems. These negative impacts include, among others, air pollution resulting from automobile dependency, water pollution caused in part by increases in impervious surfaces, the loss or disruption of environmentally sensitive areas, such as critical natural habitats (e.g., wetlands, wildlife corridors), reductions in open space, increased flood risks, and overall reductions in quality of life (Kenworthy, et al, 1999).

Subdividing large natural areas into smaller spatial units can inhibit wildlife movement across the land scape (Peck 1998 & Cieslewicz, 2002). Leapfrog development patterns further fragment natural landscapes by leaving patches of open land intermingled with built-up areas. Roadways, fences, and other abrupt, human-defined edges can act as barriers to wide-ranging species (Brody, 2008). More specifically, the reliance on automobiles has contributed to reductions in air and water quality as well as the accelerated depletion of fossil fuels (Nechyba & Walsh, 2004)

These negative consequences of sprawl must be counter balanced with the widely-held notion that this type of development pattern provides relatively affordable housing opportunities and a seemingly higher quality of life. It also diverts construction away from the central parts of the cities that need to be redeveloped. As a result of urban expansion social interaction between people reduces and urban lifestyle becomes less exciting resulting in alienation, social fragmentation, and both economic and social segregation and unplanned changes of farming land into urban land (Durlauf, et al, 1995).

## 2.5 Land Use Policy

The land policy of the country states both rural and urban lands to be the property of the state and ensures the use right by renting urban land for a definite period of time. The policy allows that the government can retain land needed for public interest and use individual holdings for better development activities by paying compensation to the owners for the properties stationed on such lands.

The policy also helps to stabilize the price of land and houses and equitably distribute land to both the rich and poor. The leasing of urban land to users at a reasonable rate through long-time installment saves the beneficiaries from expending large sums on the purchase of land at once and the use of money for other development activities (Urban Development 2005). Since the nationalization of extra houses and land in 1975 land is public property and it is in the hands of the government and again, in the constitution, it is clearly stated that land is public property and owned by the Ethiopian people and government.

The right to use land is given to individuals in lease terms. In December 1994, the constitution approved land under the control of the people and government of Ethiopia thus prohibiting land selling (EPA, 1997). Lease law was enacted in 1994 and revised in 2002. The main goals of lease are

- Remote lease system; collect lease payments so as to address infrastructure demands of the city dwellers
- Address housing problems of the city by providing lease holding to capable private dwelling houses
- Encourage investment so as to alleviate economic and social problems of the city
- Ensure fairness (justice) in administrating urban

## 2.6. The Informal Settlements

### 2.6.1. Informal Settlements in Urban Expansion

The informal settlements are considered as one of the causes for the land use land cover changes dynamic and its impact in the study area and the expansion areas of the eastern and southern part of Adama. Informal, or unplanned, settlements occur when an individual, known as squatters, establishes land rights to or occupies for exploitation land that is not registered in their names, government land, or land legally owned by others (Kibwana,.2000). People who occupy land or structures without the owner's permission are known as squatters (Habitat, 2003). In many developing-world cities, 40-50 % of the population lives in slums and informal settlements.

Building elements are assembled appropriately, with public spaces structured by groups of residential blocks, emphasizing the neighborhood scale and collective

nature of public spaces. This design option facilitates social control of public spaces, reducing the incidence of street violence and vandalism (Rau. 2007)

In most developing countries, poor economic performance caused by both internal and external factors has led to the growth of informal settlements in the outskirt of urban areas parallel to the formal ones. Informal settlements provide cheap accommodation and economic opportunities for a large part of the population meaning that these settlements respond both to housing needs and to the search for economic activities. People living in informal settlements seem to be more innovative than the planners and managers of a large city in most cities and city s of the developing nations (Freihage. 1987).

## 2.7 Trends of Urban Growth

The world is undergoing the largest wave of urban growth in history. According to the United Nations Population Fund (UNFPA, 2013), rapid population growth has been concentrated in city s and cities of the world. The report also projected that by the year 2030 the vast majority of this growth was observed in the developing world of Africa and Asia where urban growth is highly concentrated. Because cities offer a lot of opportunities such as jobs and sources of income than the corresponding rural areas, they attracted a lot of people. Following the rapid increase of population in urban areas, the growth of the world's rural population has shown a slowly decreasing pattern as indicated in figure 2.1 below.

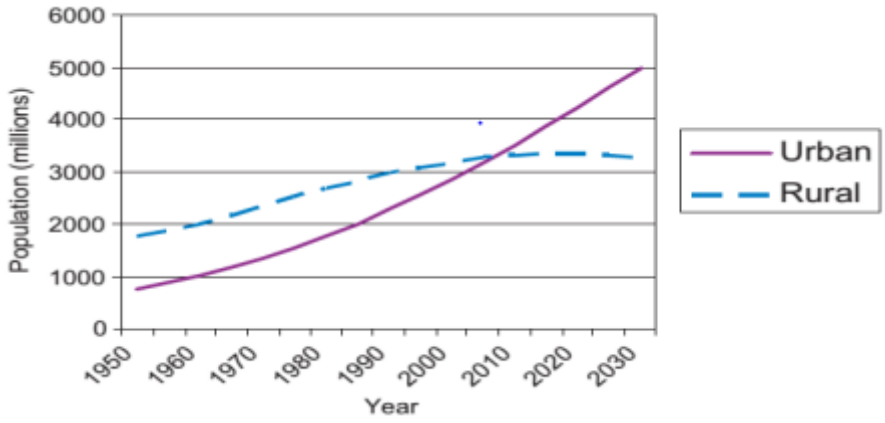



Figure 1. Trend of urban growth

World's urban and rural population size estimated and projected, 1950–2030, (Cohen, 2006).

It is clearly shown in figure 1 that when the world's urban population increased four-fold between 1950 and 2003, the world's rural population less than doubled going from 1.8 billion in 1950 to 3.2 billion in 2000 (Cohen, 2006). Regarding to projection of population growth, the world's urban population is expected to increase by almost 2 billion over the next 30 years, whereas the world's rural population is actually expected to decline slightly falling from 3.3 billion in 2003 to 3.2 billion in 2030. Ethiopia is one of the second largest populated countries in Africa with a total population of over 100 million and having an annual growth rate of 3.02%. The country is experiencing an average annual urban growth rate of 4.6%, which is a high rate by world standard (Cohen, 2004). Even though urbanization rates differ depending on the methodologies applied, Ethiopia's urbanization is low relative to other Sub-Saharan African (SSA) countries. Since the majority of the population (85%) is living in the rural areas, where agriculture is the backbone of the country's economy, it is evident that urban growth to below.

The self-sufficiency of agriculture also contributed to reinforcing of the rural peasant life from their territory. It is only 16% of the population lived in urban areas Central Statistical Agency of Ethiopia (CSA), Among these are in small cities and city s (Schmidt & Kedir, 2011). The city of Adama, where this study is conducted, is located in the East Shewa part of Ethiopia. It is one of the fastest growing cities in the country. The urban area is believed to be in a dynamic state of expansion following the nomination of the city as the capital of Oromia region of Ethiopia from 2003 to 2006 E.C.

## 2.8. Application of Remote Sensing & GIS on Urban Land Use Change

### 2.8.1 Urban Expansion and the Urban Land Use Change

In order to fully comprehend the phenomenon of urban land use change, simply observing it and measuring it even using sophisticated methods of geo informatics and statistics is not sufficient. What is also needed is an account of its driving factors. This helps to explain, for instance, why urban land use change occurs at a given rate and in a given pattern, and why these significantly differ among countries and even regions (Kolankiewicz & Beck 2001).

An aerial view of most major cities is no longer one of concentrated urban centers surrounded by country side but of complex spatial patterns of urbanized and non-urbanized

areas with urbanized areas often stretching along major transport corridors for long distances beyond the city boundaries. In addition, it is common for residential communities and industrial and commercial concentrations to develop close to major cities but separated from the built-up area (WHO, 2001).

### 2.8.2. Some Experience about Urban Land Use Change Detection Studies

The development of RS and GIS eased the process of LULC change detection of both urban and rural land uses. RS as a monitoring technique and urban planning requires data on changing LU, urban sprawl, and the environment. In this study, LULC change analysis using remotely sensed data has been applied to discover the trend of development of the rural-urban border of Enscheda city, Netherland. The city of Enscheda is experiencing physical expansion along with its horizontal intensification.

Change detection can be defined as the process of identifying differences in the state of object or phenomena by observing them at different times by using remote sensing techniques (Singh, 1989). Essentially, it also involves the ability to quantify temporal effects using multi-temporal data sets. Because of repetitive spatial coverage at short time intervals and consistent image quality, change detection is considered as one of the major applications of remotely-sensed data obtained from Earth-orbiting satellites (Singh, 1989). Change detection has a wide range of applications in different disciplines such as land use change analysis, forest management, vegetation phenology, seasonal changes in pasture production, risk assessment and other environment changes (Singh, 1989).

The main objective of change detection is to compare spatial representation of two points in time frame by controlling all the variances due to differences in non-target variables and to quantify the changes due to differences in the variables of interest (Lu et al, 2004). A change detection research to be good, it should provide the following vital information: area change and rate of changes, spatial distribution of changed types, change trajectories of land-cover types and accuracy assessment of change detection results.

### 2.8.3 Land use land cover change and its impact on the residence in both developed and developing countries

Human populations and their use of land have transformed most of the terrestrial biosphere into human caused biomes. Such transformation has caused a variety of new ecological patterns and processes to emerge and has been significant for more than 8000 years (Ellis, 2011). Recently, issues related to LULC change have gained interest among a wide variety of study, ranging from those who favor modeling spatial-temporal patterns of land conversion to those who try to understand the causes, impacts and consequences (Ver burg et al. 1999; Brown et al. 2000; Theobald, 2001).

Land use affects land cover and changes in land cover affect land use. A change in either however is not necessarily the result of the other. Changes in land cover by land use do not necessarily suggest degradation of the land. However, many shifting lands use patterns driven by a variety of social causes, result in land cover changes. These changes affect biodiversity, water, settler and radiation budgets and other processes that come together to affect climate and biosphere (Riebsame et al. 1994). Human activities which are mainly driven by socio-economic factors bring out changes in non-built-up and built-up land despite restrictions by physical conditions (Long et al. 2007).

Land use change, including land transformation from one type to another and land cover modification through land use management, has altered a large proportion of the earth's land surface. The worldwide changes to forests, farmlands, waterways and air are being driven by the need to provide food, fiber, water, and shelter to more than six billion people. Global croplands, pastures, plantations and urban areas have expanded in recent decades. This expansion is accompanied by large increases in energy, water, and fertilizer consumption, along with considerable losses of biodiversity (Foley et al. 2005). Land cover can be altered by forces other than anthropogenic. For instance, Natural events such as weather, flooding, fire, climate fluctuations and ecosystem changes may also initiate modifications upon land cover. There are also incidental impacts on land cover from other human activities such as forest and lakes damaged by acid rain from fossil fuel combustion and crops near cities damaged by tropospheric ozone resulting from automobile exhaust (Meyer, 1995).

Land-use and land-cover (LULC) change has become a fundamental and essential component in current strategies for monitoring environmental changes and managing natural resources (Rawart,J.S et al,.2013). Increasing anthropogenic activities around the biosphere are causing large-scale alterations of the Earth's land surface, which affect the effectiveness of global systems (Lambin,E.et al,2001).

LU/LC and its resources have been used for the social, material, cultural, and spiritual needs of humans, while, in the process, humans have caused significant changes. The rapid changes of LU/LC, particularly in developing countries have resulted in the reduction of different vital resources including water, soil, and vegetation (Chomitz & Kamari, K,.1998). Furthermore, the actions leading to LU/LC changes have a local cause. However, because of their speed, extension, and intensity, they have numerous and critical global implications particularly on natural resources.

The increasing change is alarming and can significantly impact the local, regional, national, and worldwide environment (Minale,AS & Meshesha,TW,.2013). Study, policymakers, and planners utilize LULC information to determine changes in natural resources, including evaluating growth patterns. A better understanding of land dynamics requires the detection of LULC change. Empirical studies by study from diverse disciplines proved that changes in LULC are key to various applications such as hydrology, agriculture, forest, environment, geology, and ecology (Weng, Q.A,.2014).

Studies on LULC change detection have always attracted the attention of scientists. Many studies argue that LULC change could result in ecosystem imbalance and impacts on the environment caused by humans and their role in climate change. Furthermore, their findings yield arguments that focus on interventions, which require evidence on the impacts and rates of LULC change and the distribution of these changes in time and space as a fundamental factor in present strategies for environmental monitoring of changes and managing natural resources. Several studies have proven the effectiveness of space-borne imagery to monitor LULC changes, specifically in Africa (Thakkar, A.M,.2017).

# CHAPTER THREE

# 3. RESEARCH METHODOLOGY

## 3.1. Description of the study area

Geographically, Adama city is spatially positioned at crossroads in southeast of Addis Ababa at a distance of 99 km and 84.7 kilometers via old & express road respectively along all-weather road that leads from Addis Ababa to the sea port of Djibouti. It takes only one hour journey on well-constructed asphalt road to reach a national capital/ primate city of the country that serving as a nerve-center of the country. It is situated in Rift valley within Awash River Watershed in Oromia Regional State of Ethiopia & north of Asella town at 75 kilometers distance. Astronomically, it is located at 8° 33′ N latitude and 39° 16′ E longitude.

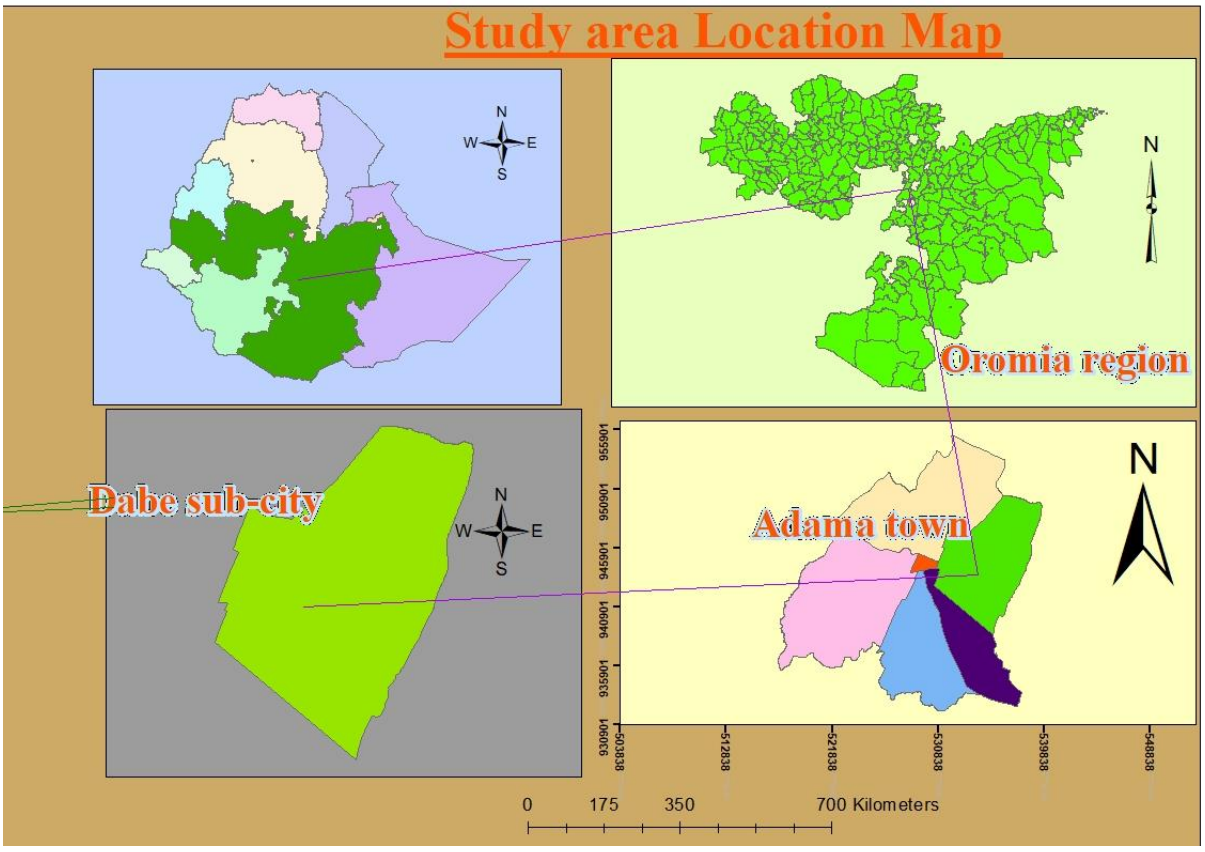



Figure 2. Map of study area

### 3.1.1 Topography of Adama city

Varies from ground elevations of 1,595masl to 1, 740msl.The southern central part of the city constitutes the lowest areas with ground elevation ranges from 1595masl to 1630masl. Areas with higher altitudes are found from the central to the northern and on the southern verges of the city. The altitude of these areas varies from 1630masl to 1740msl.

### 3.1.2 Climate of Adama city

Climate located in the Grit Rift Valley of tropical climatic zone. There are four climatic seasons, Gena/Kremt, (rainy period) Bona/Bega, (dry period) Belg (small rains) and Meher (a spell between the long and small rains). The daily temperature varies between $5.5^0$C during November/December and $35^0$C during March to May. The mean annual ambient temperature is between 19 $^0$C and 22 $^0$C. Maximum temperatures usually occur in March to May. The mean monthly maximum exceeds 30 $^0$C. Minimum temperatures are at their lowest in November. The mean annual rainfall for the years 1995-1998 is 822.5 mm. The wettest months are July and August. The average amount of rainfall in July is 230 mm and in August 200 mm. The proportion of the precipitation in these two months is about 55% of the annual total.

Adama city has been continuously growing in both social and economic aspects due to the following major factors. The restructuring of the city by regional government to the higher level of special zonal administrations improved the lifestyle of its population availability of city infrastructures and its close proximity to Addis Ababa. Strategic location of the city on the highways connecting the eastern and southern part of the country; and the port of Djibouti with Addis Ababa has greatly contributed to its development. The Addis Ababa-Djibouti railway passing through the city also enhances the growth. The Wonji and Metehara sugar state farms and factories, the Sodere resort area.

### 3.1.3 Socio-economy

Favorable Resident Conditions for living and investment Adama city population growth has been progressively increasing from time to time. The total population estimate of the city at present is around 310,600 and expected to reach 730,000by year 2035. Moreover, peri urban dwellers around the four corners of the city have been merged to Adama city since it

has been already restructured and established by the Regional Government to higher level of special zonal administration University, colleges, TVET and other lower educational institutes have been flourished. The number of health service institutions has been increasing over the past years

There were 59,431 housing units in the city, according to population census of year 2007 (CSA, 2007). Trade plays a significant role in the economy of Adama city. There are 11,160 legal traders though the existences of considerable illegal traders are inevitable. Industrial activities have been increased. Around 542 industrial establishments are found in the city. Around 685 ha of land or 15% of the Master Plan have been reserved for industries. Urban farms have started to be expanded in a large scale. Cattle fattening is a major practice in Adama city.

The recently built historical buildings, specifically, Gelma Aba Geda and Memorial Monument are prospects for contributed a lot in attracting tourists and also a master plan which is fundamental for the present and future socio-economic development the same. In general, the city has all infrastructures such as modern communication network, Road Network, Electric power supply, Fuel supply and Water supply systems. It has also the latest and unique television broadcasting station, “Oromia broadcasting network (OBN)”, which in the country.

## 3.2 Research design

The design of this research was mixed design followed by convergent parallel mixed design due to the fact that the data collection for both quantitative instrument and qualitative method and analysis were done simultaneously.

## 3.3. Materials

### 3.3.1. Software’s

It is Arc GIS and Erdas imagine software and its extensions were used mainly in addition to some others that were used rarely for minor purposes, such as Auto CAD for reading the structural plan of the city, Map Source Garmin for uploading the collected positional coordinates of the study area using handheld GPS and for conversion purposes, various

programs of Microsoft office for further viewing, editing and arranging the spatial data of GPS and the whole documents of this paper.

### 3.3.2. Equipment's and Tools

Laptop and Desktop computers were the main equipment that was most commonly used, from the scratch of data collection to the end output of the findings for data processing, editing, and analysis, and the final output preparation helps handheld GPS for collecting the spatial information that helps determine the location of the study area. It was more comfortable, portable, and accessible for use and thus was preferred to be used by the researcher.

## 3.4. Sources of data

The studyused both primary and secondary data to get adequate information.

## 3.4.1. Primary sources

The primary data has been collected from settlers of the study area.Primary source was first-hand data that has been collected through different primary data collection methods that help the studyto undergo the research, like observation, Questionnaire, and interview. The primary data concerning the land-use dynamic change and its impact on the local population was collected from different sources questionnaires, interviews with different officials, elders, and case study families from locals and settlers.

### 3.4.2 Secondary sources

The secondary data used for this research was satellite image and a Google Earth of 2022 image from kh. Google com. 2022, Aerial photographof the 1990, 2008 and 2021 from land sat image, Auto CAD format of the study area data from Dabe sub-city land administration office and statistical data from Central Statistical Agency (CSA), Dabe sub-city and Adama city Administration. Datawhich indicates about expansion of the city took from Adama city Administrationoffice, published and unpublished documents, thesis and browsing of the internet.

## 3.5. Sample Design.

### 3.5. 1. Population, Sample unit, Sampling Technique and Sample size

### 3.5. 2 Population

Change in population growth accelerates the demand for land and the dynamics in land-use/land cover changes. The results of the 1984 census revealed by CSA that the population of Adama city reached to 77, 237, while the 1994 census counted a total population of 127,842. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this city has a total population of 220,212, an increase of 72.25% over the population recorded in the 1994 census, of whom 108,872 are men and 111,340 women. According to 2007 census population projection for 2009 the total projected population size of a bustling city of Adama is currently estimated at 373, 661(table 1). This factor triggers the ever-growing demands for urban services such as land for residence, economic and industrial activities and public services.

Table 1.The projected population size of Adama city year 2007-2011 EC

| City | Year | Male | Female | Total |
|---|---|---|---|---|
| Adama city | 2007 | 176,487 | 179,857 | 356,344 |
| | 2008 | 185,107 | 188,554 | 373,661 |
| | 2009 | 193,992 | 197,605 | 391,597 |
| | 2010 | 206,153 | 207,083 | 413,236 |
| | 2011 | 216,046 | 217,0003 | 433,046 |

Source and projected population

In this time Adama city have been six sub-cities, from the above data, Dabe sub-city accounts for about 18% of the 2009 accounted population (67259) of the population. This factor triggers the ever-growing demands for urban services such as land for residence, economic and industrial activities, and public demand.

### 3.5.3. Sampling Unit

The objective of this study was Identify the major driving forces for LULC change in the local context, identify land use land cover change pattern from 1990-2021 in Dabe sub-city of

Adama city andidentify the major impact reviled on residents due to urban growth Therefore, the sampling units were officials and questionnaire, experts working in the land management sector, and communities in the sub-city suburbs, kebeles, and municipalities.

### 3.5.4. Sampling Technique

To achieve the study objective, the study used a purposive sampling method and systematic sampling method. Because the systematic sampling technique enables us to choose elements from the target population and purposive sampling the studyused for elder's household and experts who work around the research area.Six Focus Group Discussions with an average of 10 participants were conducted with elder settlers for the basis of impact of land use land cover and the driving force of land use land cover.

### 3.5.5. Sample size

There are guidelines that should be observed in determining the size of a sample according to Kothari (Gosaye. 2007) when the target study population (N) is less than 10,000; the sample size is calculated by using the following formula.

$nf = n/1+n/N$, and $n = (Z^2 * p*q)/d^2$

Where: nf = the desired sample size (when the population is less than 10,000)

n= desired sample size (when the population is greater than 10,000)

N= Estimated population size

z= standard normal variable at the required confidence level 90% (z=1.96)

p= estimated characteristics of the target population that is 0.50, q= 1-p

d= level of statistical significance (i.e.,10%)

To be economical and finish the research within the given time, the studyselected the reasonable household that represents the population. The sub city contains three kebeles with 4216 households in the research area. From these households the studyselected the Dabe solloke kebele the one which is highly affected by the land use land cover change in the last three decades and containing about 1206 households (CSA, 2009). Since the land use land cover change, the driving force and its impacts occurs through long period of time the

studyused purposive sampling technique from the community which have been lived in the area for more than two decades. The sample size was taken based on Kothari formula was 163.

| S. N | Kebele | **Number of participants** | | | | | |
|---|---|---|---|---|---|---|---|
| | | In sample size | | Returned questionnaire | | Not returned questionnaire | |
| | | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
| 1 | Dabe solloke | 163 | 100 | 120 | 74 | 43 | 26 |

Among one hundred sixty-three participants of the study, 74 percent of respondents have returned the questionnaire and forty-three /26 percent of respondents have not returned the questionnaire. Therefore, the analysis has been presented based on participants who have been returned the questionnaire.

## 3.6. Data collecting Instruments

In order to collect relevant data, the studyused interview, questionnaire and observation as the main data collecting tools. Questions were prepared in English Afan Oromo and Amharic language.

### 3.6.1 Interview

Interview is one of the main data collecting instruments that used for this research. In order to getinformation regarding to impact of urbanization in the selected area the study interviewed the local communities. For this purpose, both structured and unstructured interview types were employed. The process of interview was conducted in Afan Oromo in order to avoid language problem that might face respondents to reply what they wanted to say.

This data collecting tools was mainly used for an illiterate respondent elder’s settler. The main issues raised on the interview were. the major land use land cove changes on the area, the driving forces and the major impacts due to these changes on the environments and the communities.

### 3.6.2 Questionnaire

The other data collecting method that used for this study was questionnaire. Since most of the respondents were educated (can read and write) the questionnaire that has both open ended and close ended questions was distributed by the researcher. The questionnaire contains major parts such as socio economic of the population, the driving forces and impacts of the land use land cover changes. Questions were prepared in English, Afan Oromo and Amharic language because all of the respondents not educated (the respondents were not well educated in English language).

### 3.6.3 Observation

The third data collecting tool that used for this research was observation. observation specifically used in this research to compare the actual land use land cover with the previous prepared maps and land sat image in different periods on the research area.

## 3.7. Data acquisition and image processing

Different types of satellite imagery are available for LULC analysis. However, when carrying out studies to monitor LULC changes, Land sat imagery is preferred due to temporal resolution coupled with near and mid-infrared bands which allow close examination of vegetation and landscape features (Zeledon & Kelly, 2009). Three cloud-free Land sat4-5 (TM), Land sat 7 (ETM+), and Land sat 8 (OLI) satellite data were used in this study and the images were selected based on their availability and quality. The images were acquired within the same yearly season to help reduce seasonal and varying sun positions effects and spatially referencing in the Universal Transverse Mercator zone 37N. Table 2 presents the detailed characteristics of the data used in this study.

Based on the political economy change occurred in the of 1990 and 2008 the new millennium of the country was in this year the migration of the society within the country and to the country from different country were occur with this decades. This is the motive of the studyto select this time boundary for the intervals.

Table 2 Characteristics of the Land sat images used for the study

| Satellite | Sensor | Path/Row | Spatial resolution (m) | Date of acquisition | Source |
|---|---|---|---|---|---|
| **Land sat 4-5** | TM | 168/070 | 30 | 1990 -01-19 | USGS |
| **Land sat 7** | ETM+ | 168/070 | 30 | 2008 -01-19 | USGS |
| **Land sat 8** | OLI | 168/070 | 30 | 2021-01-19 | USGS |

The standard image preprocessing techniques was performed on the three satellite images using QGIS 2.16.2 and ArcGIS 10.8 both Land sat image was included; extraction, color composite, geometric correction or dereferencing, atmospheric correction, topographic correction, layer stacking (band selection and combination), image enhancement and sub-setting (clipping). The three images were registered to a common UTM Zone 37N with WGS 84 projection parameters.

Satellite bands were composed in different ways in order to identify surface features in the study area. True color composite is usually known by RGB 321 combination where band 3 reflects red color, band 2 reflects green and band 1 reflects blue color. Another composite is called "false-color composite" which uses RGB combination of 432. In this band combination band, 4 represents the NIR infrared, band 3 belongs to red, and band 2 to green. This combination gives better visualization in identifying vegetation that looks red in 432 combinations.

### 3.7.1. Image classification

Image classification is the process of categorizing an image into a smaller number of individual classes based on the reflectance values (Jensen,2005). The images were classified based on physiographical knowledge of the study area, additional information, thelocal knowledge, and visual interpretation of each LULC class supported by the use of the historical function of Google Earth image. The four (4) classes with their associated descriptions as shown in table 3. The unsupervised classification algorithm was first performed on each image because the supervised classification was not able to separate barren land and built-up areas from agricultural areas due to spectral reflectance error. Then, the supervised

classification was performed. For the purpose of high precision and accuracy, the studytook 285 stratified points for each land use category.

Table3LU/LC classification scheme used in the study area

| LU/LC CLASS | DESCRIPTION |
|---|---|
| WATER BODIES | permanent open water, ponds, reservoirs |
| AGRICULTURAL LAND | All cultivated and uncultivated agricultural lands areas such as farmlands, crop fields including fallow lands/plots and Horticultural lands. |
| FOREST | Plantations, mixed forest lands and forest on customary land. |
| BUILT-UP AREA | Residential, commercial and services, industrial, socio-economic infrastructure and mixed urban and other urban, transportation, and roads and. |
| BARREN LAND | Areas around and within forest protected areas with no or very little vegetation cover including exposed soils, stock quarry, rocks, landfill sites, and areas of active excavation. |

### 3.7.2. Accuracy assessment of the images

Accuracy assessment of a classified image is an important step in LULC change analysis. Google Earth images were used to extract reference data. The accuracy assessment was performed on 2008 and 2021 satellite images only. Accuracy assessment was not performed on 1990 images due to the unavailability of ground validation data in the form of aerial photographs and archived Google earth images. The same image classification method used for the 2008 classified map was, however, adopted for both 1990 and 2021 images. The accuracy assessment was determined using Kappa coefficient, overall accuracy, producers and user's accuracies derived from the confusion (error) matrix (Congalton & Green 2009; Liu et al. 2007).

The Kappa coefficient reports the relationship between the classified map and reference data (Lille sand&Kiefer., 2000). The error matrix computed the overall accuracy of four (4)

land use classes individually and collectively. The Kappa coefficient was computed using the equation proposed by Jensen and Cowen (1999).

$$K = \frac{N\sum_{i=1}^{r} -xii - \sum_{i=1(xi+x\,x1)}^{r}}{N2 - \sum_{i=1(xi+x\,x1)}^{r}} \quad \ldots\ldots 3.1$$

Where: K = Kappa coefficient of agreement; N = Total number of observations (sample points); Xi = Observation in the line i and column I; Xi+ = Total marginal of the line I; X+1 = Total marginal of the column i.

### 3.7.3. Change detection analysis

Land use and land cover change transition matrix Change detection quantifies the changes that are associated with LULC changes in the landscape using geo-referenced multi-temporal remote sensing images acquired on the same geographical area between the considered acquisition dates (Ramachandra & Kumar 2004). The study employed a post-classification comparison (PCC) change detection method to detect the LULC changes of two independently classified maps that occurred between two different dates of the study period (Jensen 2005). Post-classification comparison is the most common technique used to compare maps of different sources despite having a few limitations.

The approach provides comprehensive and detailed "from-to" LULC change information as it does not require data normalization between the two dates (Coppin et al. 2004; Jensen 2005; Teferi et al. 2013; Aldwaik and Pontius 2013). The use of the PCC technique resulted in a cross-tabulation matrix (LULC change transition matrix) which was computed using overlay functions in ArcGIS. Gross gains and losses were also calculated for three periods: 1990-2008, 2008-2021 and 1990-2021.

## 3.8 Data Analysis Methods and Procedures

The completion of data collection and data analysis was done. The data manipulated from hand-digitized, ortho-rectified satellite images in Geographic Information Systems (GISs) was used to compare the type and distribution of land uses in Adama city, Ethiopia, in three

decades. Generally, both quantitative and qualitative data analysis was used for objectives two and three. Finally, GIS & remote sensing method was used to achieve objective one.

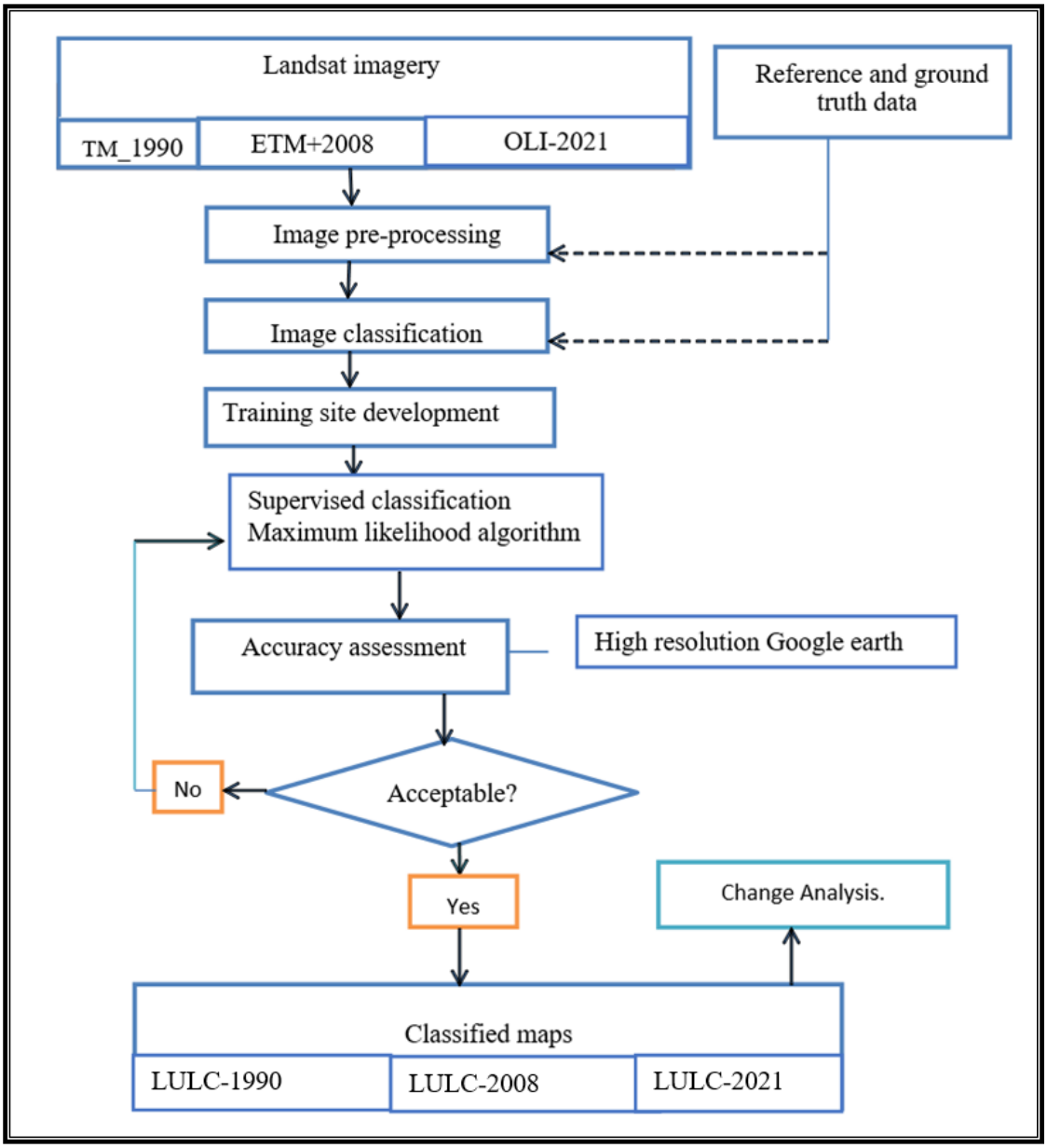



Figure 3.Flow chart of the methodology for objective one

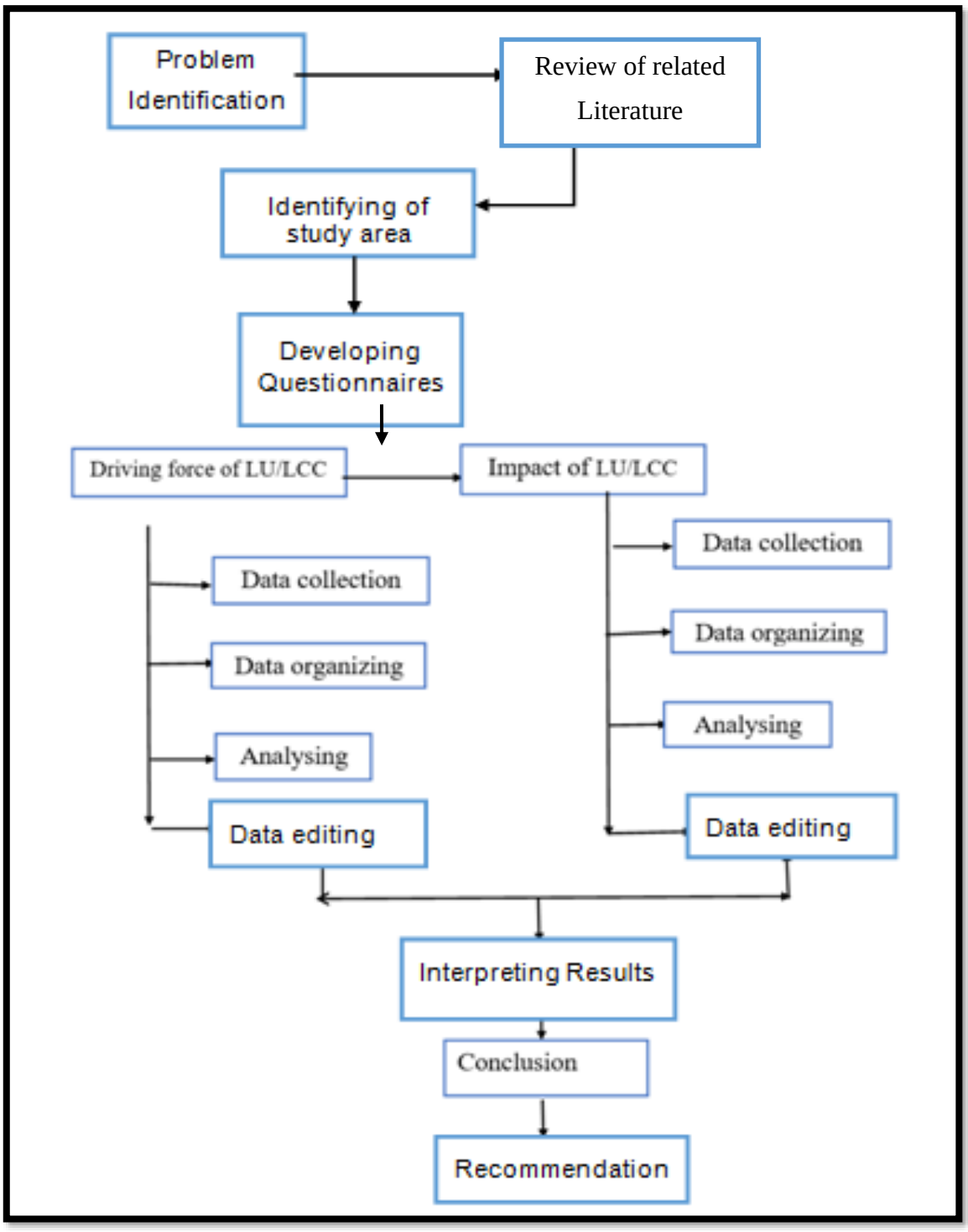



Figure 4Flow chart of the methodology for objective two and three

# CHAPTER FOUR

# 4. RESULTS AND DISCUSSION

In this chapter, the results obtained from data analysis as per the study objectives, and discussion on result are presented and described in detail.

## 4.1. Background of the respondent

This section describes the background of the respondents, which includes: sex composition of the respondents, age category of the respondents, educational level, marital status of household, occupation status of the respondents, and family size of the respondents.

### 4.1.1. Sex composition and age category of the respondents

Below (table 4) depicts the sex composition of respondents. 36.7 % of respondents were females while 63.3 % of them were males. According to the findings indicated in the below figure (5), respondents' ages ranged from 17 to above 50 years old. Respondents who were the ages <17-30 years old comprise 3% of the surveyed population. About 35% of the participants were within the age range of 18-30 years of age. While 47% and 15% of the respondents were withinthe ageranges of 31-50 and greater than 50 respectively. In relation to their age, the majority of respondents were between the ages of 31-50 years of age at the time of the interview. This indicates that the majority of respondents are found to be in the range of productive age.

Table 4Sex of respondents

| S. N | Sex of respondents | Frequency | Percent |
|---|---|---|---|
| **1** | Male | 76 | 63.3 |
| **2** | Female | 44 | 36.7 |
| | Total | 120 | 100.0 |

Source: Field Survey 2021

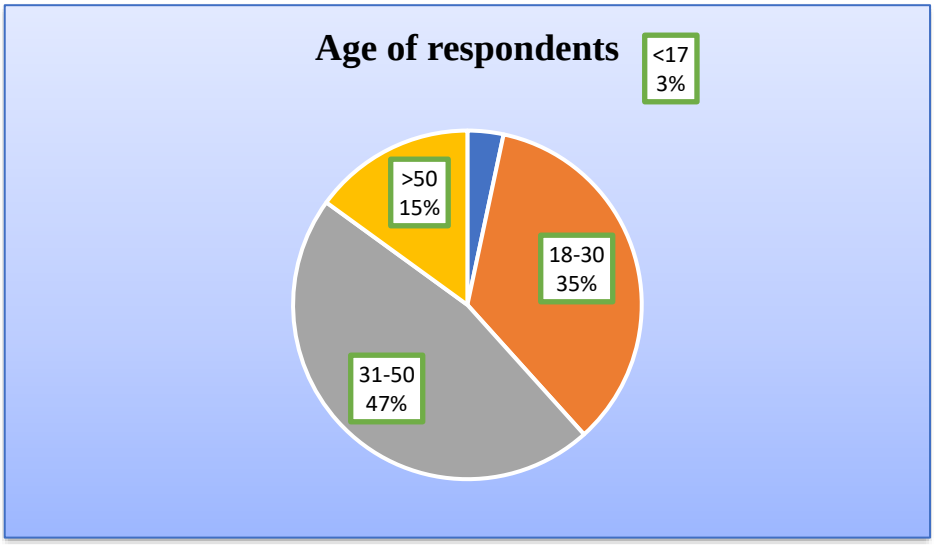



Figure 5Age of respondents

### 4.1.2 Marital status

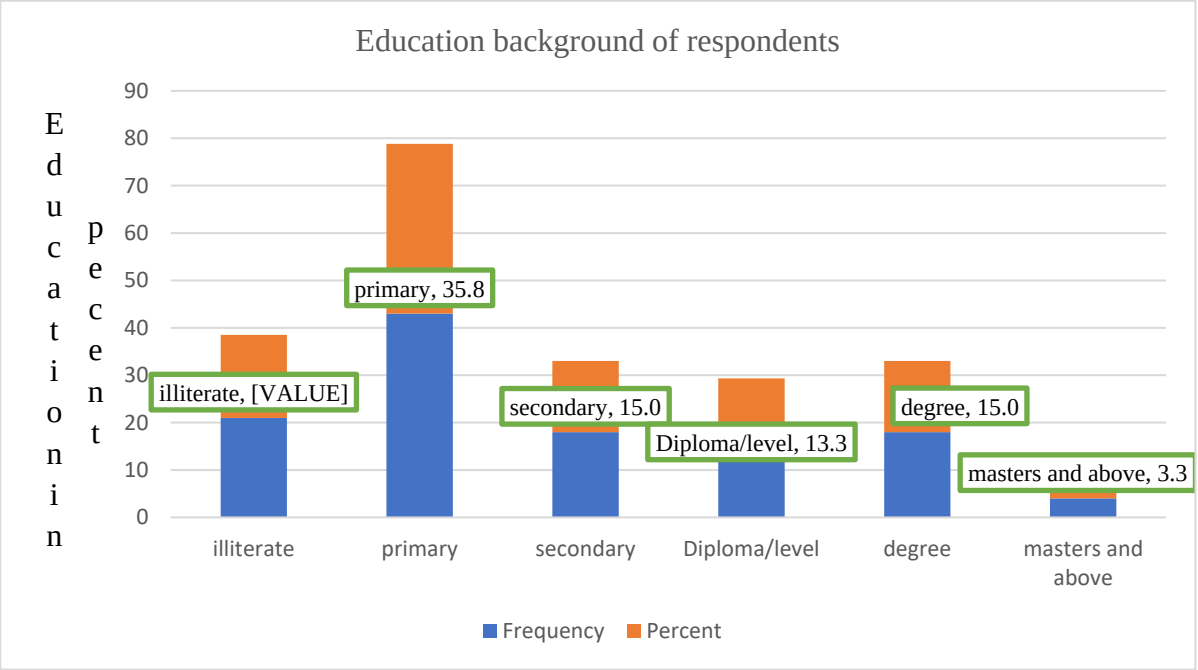
Analysis of the data indicated that 57.5 % of the respondents were currently married; while single, divorced, widowed and refuse to answer constitute 21.7, 5.0, 6.7 and 9.2 percent respectively. Table 5 present data on the marital status of the respondents

Table 5Status of respondents

| S/N | Marital status of respondents | Frequency | Percent |
|---|---|---|---|
| **1** | Single | 26 | 21.7 |
| **2** | Married | 69 | 57.5 |
| **3** | Divorce | 6 | 5.0 |
| **4** | Widowed | 8 | 6.7 |
| **5** | Refuse to answer | 11 | 9.2 |
| | Total | 120 | 100.0 |

### 4.1.3 Educational background of respondents

The educational characteristics of respondents from illiterate to higher education level as the data indicates. The below Figure manipulates the distribution of the respondents by level of education. Based on the below Figure 6: 17.5 percent of the respondents were illiterate or cannot read and write, 35.8% respondents' primary, 15.0% secondary, 13.3% diploma/levels. 15 % and 3.3% degree, masters and above respectively. As the Figure shows, the majority of the respondents' educational level found to be primary and illiterate. This indicates that they mainly depend on business and self-employed activities. This situation can lead expansion of the built, as a consequence, causes for LU/LCC.



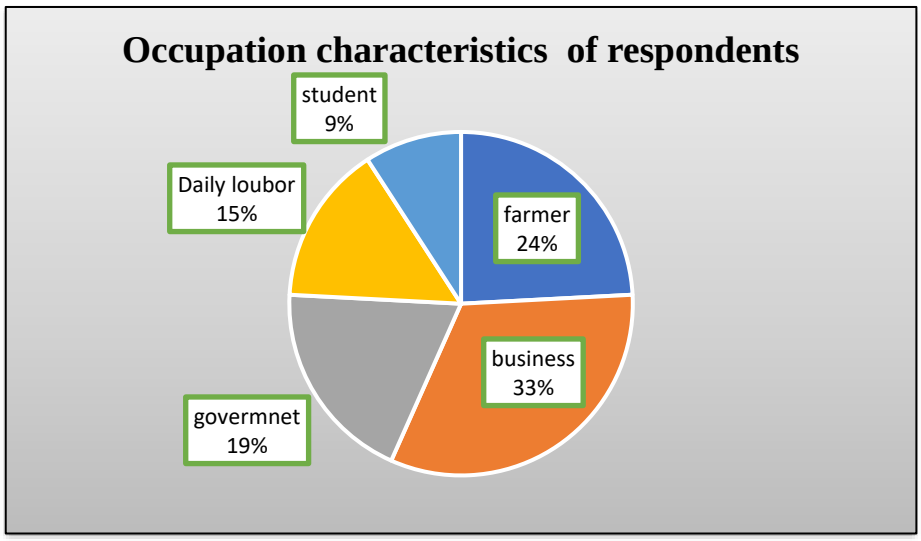

Source: Field Survey 2021

Figure 6 Distribution of respondents by the level of education the survey revealed

### 4.1.4 Occupation characteristic of respondents

An analysis of the figure below reveals the occupational status of respondents. Accordingly, 24% of the respondents responded that they were engaged in agriculture, 19% of the participants of the study agreed that they were engaged with a government employee, 33% were businessmen, and 9% were a student (Figure 7). While the remaining 15% were engaged in other activities, daily labor (self-employed) such as woodwork, metalwork, construction,

and shopkeepers. Therefore, the occupational activities in the study area were a factor in land use/ land cover change. For instance, 33% of the respondents were businessmen. Most of them come from rural areas for business work; this indicates a high number of businessmen buy farmland for the purpose of their business and for living in areas. So, this indicates the cause of the change in land use land cover was immigration from rural to urban areas.




Source: Field Survey 2021

Figure 7Occupation of respondents

### 4.1.5 Family size of the respondents

Based on the findings of the study, the family size of respondents was specified. Accordingly, 37.5% (n=45) were within the family members of the 1-4 category, 18% (n=21) of the respondent's family members were in a house within the range of 5-7 family members, while 18% (n=21) and 45% (n=54) of the respondent's and the family size were labeled in the range of 8-10 respectively (Table 6). One can conclude from this that as the number of people/family size increased in a given place within the scarce land resource, people were forced to change land use land cover to another type. So, due to population pressure (high number of family size), land use /land cover in the study area changed from time to time. For instance, bare land, forest, and agricultural land changed into settlements.

Table 6Family size respondents

| S, N | Family size of respondents | Frequency | Percent |
|---|---|---|---|
| **1** | 1-4 | 45 | 37.5 |
| **2** | 5-7 | 21 | 17.5 |
| **3** | 8-10 | 54 | 45.0 |
| | Total | 120 | 100.0 |

Source: Field Survey 2021

### 4.1.6 Land acquisition

Another question that the study

raised during the data collection was ‘what is your means of land acquisition?’; As indicated in table 7, of the sample households, 56.7% of landowners were through buying and 14.2% were inheritance, while the remaining 11.7, 10.0, and 7.5 percent of the respondents were through the gift, renting, and government respectively. The table shows that, after LULC changes due to selling their farmland, the next coming generation will be landless due to scarcity of the land resource.

Table 7Land acquisition of the respondents

| S. N | Land acquisition | Frequency | Percent |
|---|---|---|---|
| **1** | Inherited | 17 | 14.2 |
| **2** | Buy | 68 | 56.7 |
| **3** | Gift | 14 | 11.7 |
| **4** | Government | 9 | 7.5 |
| **5** | Renting | 12 | 10.0 |
| | Total | 120 | 100.0 |

Source: Field Survey 20214

## 4.2. Accuracy assessment

Classification accuracy was assessed quantitatively using an error matrix, which is the commonly used method in LULC classification accuracy assessment (Bulti, 2019). In this regard, sample pixels were selected from each classified image through a stratified sampling scheme in ArcGIS software. The samples were overlaid with Google earth (for 1990, 2008, and 2021). Through the error matrix generated for every classified map, overall accuracy, user accuracy, producer's accuracy, and overall kappa were calculated. The accuracy requirements for change detection analysis were determined by the suggestion of Congalton and Green (2009). The values of the overall accuracy and kappa coefficients for all the classified LULC maps of 1990, 2008, and 2021 were found to be above 80%, as shown in Table 8.

Table 8. Accuracy assessment

| S. N | Class _name | 1990 | | 2008 | | 2021 | |
|---|---|---|---|---|---|---|---|
| | | User's Accuracy | Producer's Accuracy | User's Accuracy | Producer's Accuracy | User's Accuracy | Producer's Accuracy |
| 1 | Built-up | 84.21 | 77.42 | 67.31 | 83.33 | 67.86 | 90.48 |
| 2 | bare land | 74.07 | 70.18 | 81.52 | 92.59 | 71.43 | 62.50 |
| 3 | Forest | 60.98 | 47.17 | 72.09 | 92.54 | 65.79 | 69.44 |
| 4 | Agriculture | 78.95 | 92.92 | 100.00 | 57.89 | 89.74 | 83.83 |
| 5 | Over accuracy | 0.87 | | 0.908 | | 0.912 | |
| 6 | Observed Accuracy | 0.53 | | 0.526 | | 0.526 | |
| 7 | Kappa(K) | 0.801 | | 0.806 | | 0.814 | |

## 4.3. Land-use/land-cover in 1990, 2008 and 2021

Land-use/land-cover classification results of 1990 showed that the dominant LU/LC classes were agriculture and bare land (soil). These classes accounted for 60.33 $km^2$ of the overall area coverage. From the total area, agriculture accounted for 36.08 $km^2$ (59.80%) and bare land accounted for 9.91 $km^2$ (16.43%). The other LU/LC, the forest, and settlement (built-up) together accounted for 6.86 $km^2$ (11.37 %) and 7.48 $km^2$ (12.40%) of the total area. Analysis of Land sat images also showed that agriculture constitutes the largest proportion of land in

the study area with a value of 33.7 $km^2$ (55.84%), surveyed by bare soil, which accounted for 7.14$km^2$ (11.85%). Other LU/LC classes such as forest and settlement (Built-up) together accounted for 19.49$km^2$ (32.31%) of the total area. In 2008, bare soil covered the smallest area of all other classes.

Theland-use/land-cover classification results of the 2021 Land sat image revealed that the dominant LU/LC categories were agriculture and settlement (built-up) accounting for 47.99$km^2$ (79.10%), and forest accounted for 5.65$km^2$ (9.36) and bare land accounted for 6.69 $km^2$(11.53%). However, built-up area in 2021 increased by 8.34$km^2$ from 1990 to 2021. Generally, agriculture is the major LU/LC of the area in relation to area coverage, followed by forest land. Bare soil was seriously changed area because of the community contract different infrastructures by treating the land were changed the area in to agriculture and built-up.Consequently, the bare land was the reason to decrease of LU/LC from 1990-2021. Around the study area the forest is exit on the mountain and surrounding so it was not significantly changed to built-up or agriculture this was the main reason to some change. The agriculture also not significantly changed because the farmer farms the bare land gully buy treating the soil then they changed the land in to farm.Detailed statistical data for each of these classes and the LU/LC map of the study period were shown in Table 9. Table

Table 9.LU/LC _classes

| **LULCClasses** | **1990** | | **2008** | | **2021** | |
|---|---|---|---|---|---|---|
| | **Area in $km^2$** | **Area in %** | **Area in $km^2$** | **Area in %** | **Area in $km^2$** | **Area in %** |
| **Built-up** | 7.48 | 12.40 | 13.21 | 21.90 | 15.82 | 26.21 |
| **Bare land** | 9.91 | 16.43 | 7.14 | 11.85 | 6.69 | 11.53 |
| **Forest** | 6.86 | 11.37 | 6.28 | 10.41 | 5.65 | 9.36 |
| **Agriculture** | 36.08 | 59.80 | 33.7 | 55.84 | 32.17 | 52.89 |
| **Sum** | **60.33** | **100.00** | **60.33** | **100.00** | **60.33** | **100.00** |

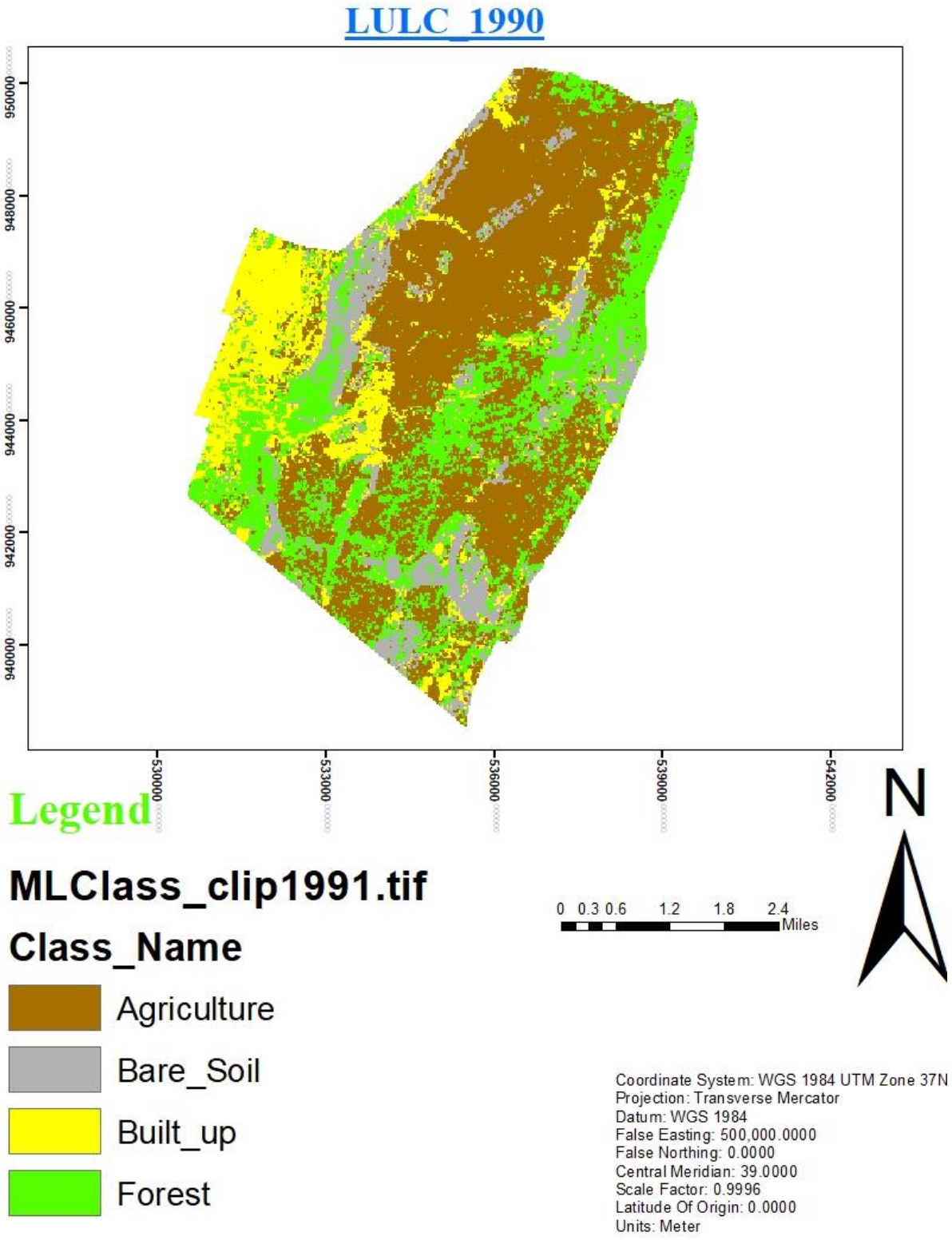



Figure 8. LU/LC in the study area during 1990.

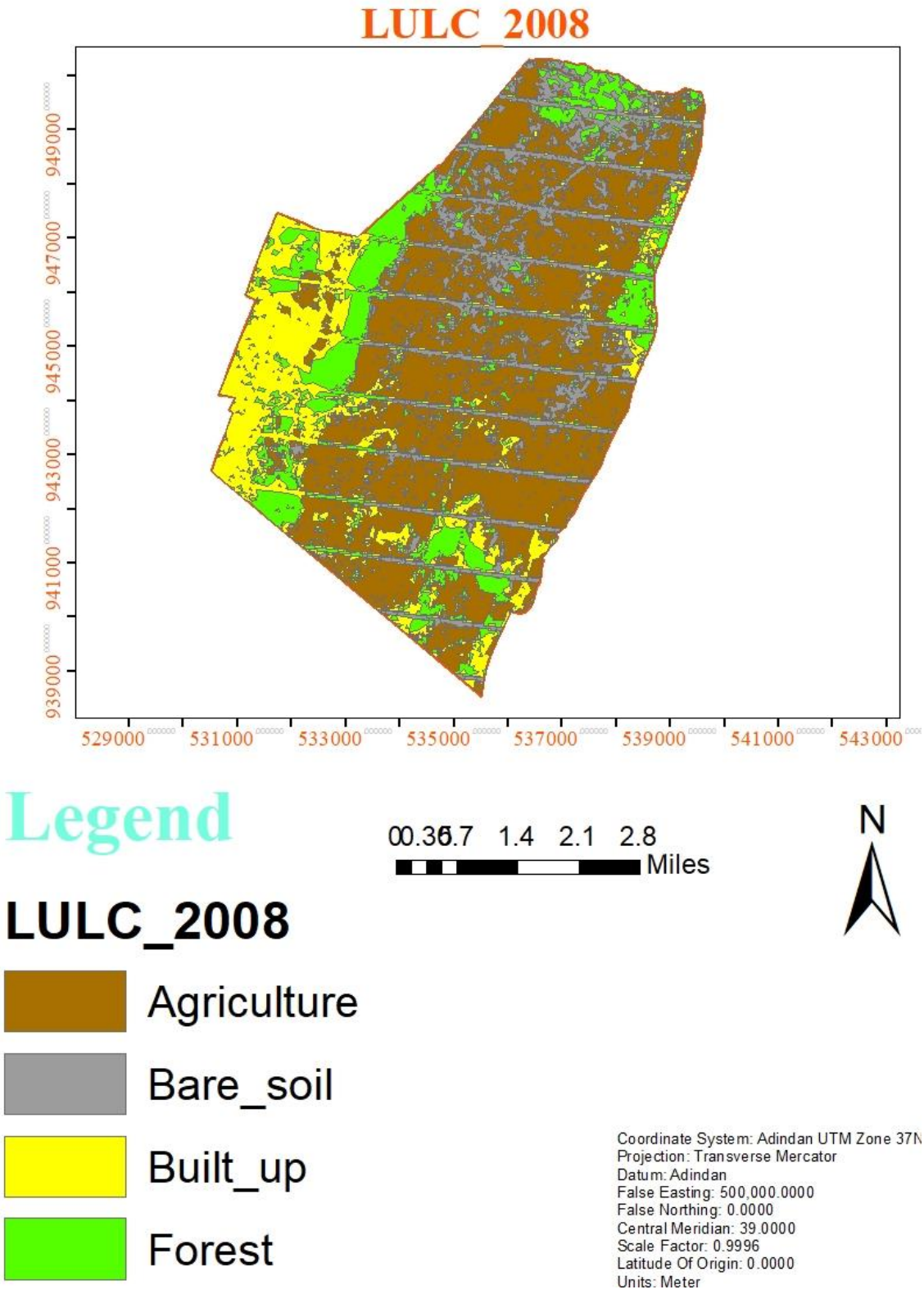



Figure 9. LU/LC in the study area during 2008

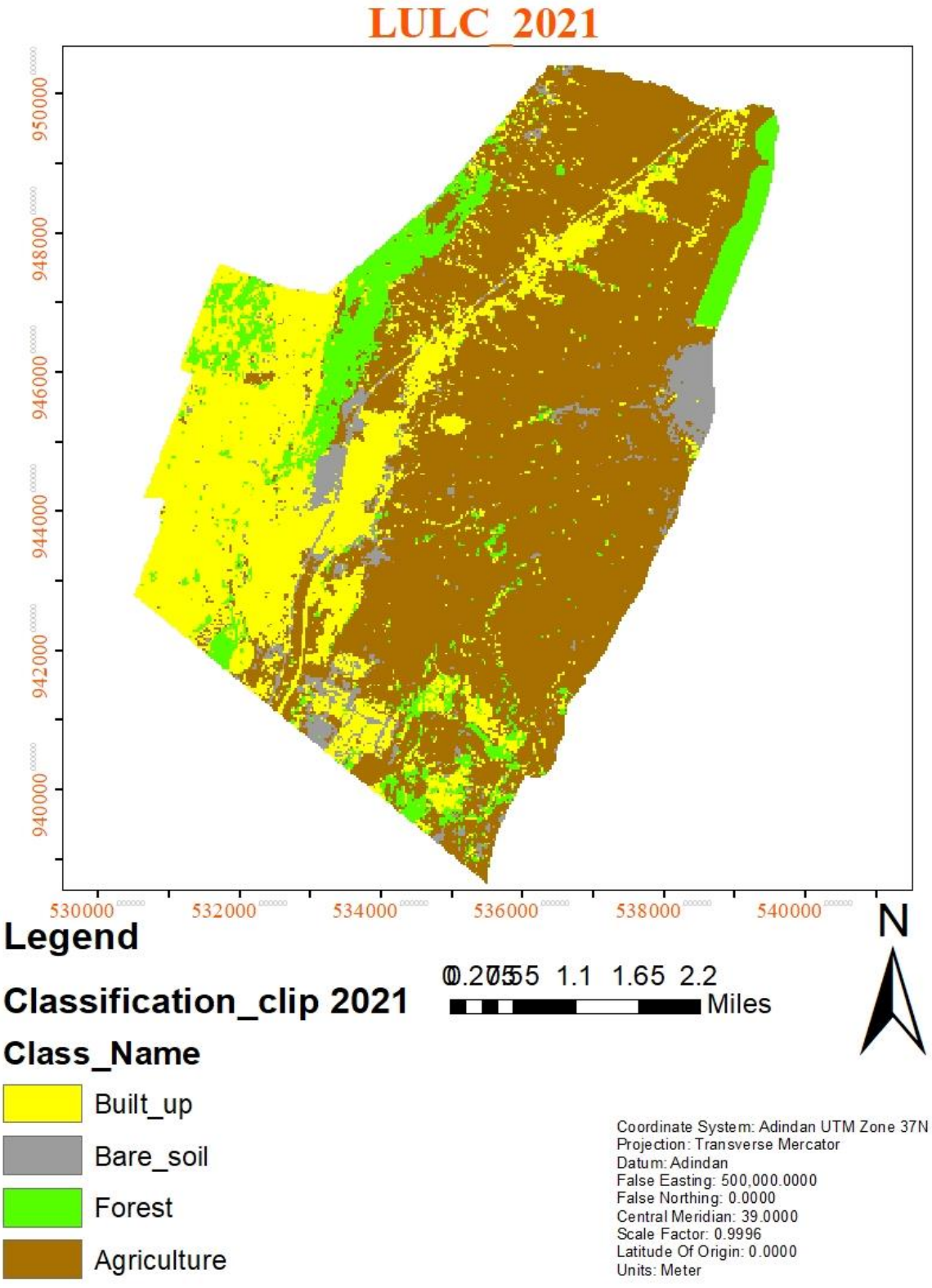



Figure 10 LU/LC in the study area during 2021

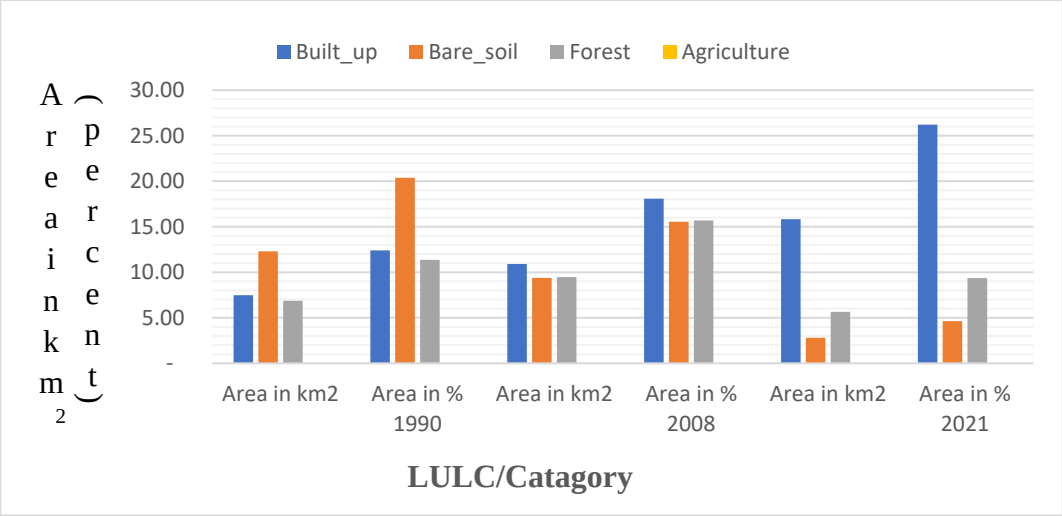



Figure 11 Land-use/land-cover distribution and changes in the study area 1990– 2021

## 4.4. Spatial extent of land-use/land-cover

Land-use/land-cover patterns in the study area have indicated a significant change between the 1990 to 2021 years. The total area of the study area was 60.33km$^2$ as described below, in table 10. For the total area, the built-up area was changed from 7.48% to 26.21%, which covers the major change in the study area decreased agricultural change was decreased 59.80 % to 52.89% due to the expansion of the city toward the farmer area (table 10). The percentage of bare soil and forest decreased over this time from 16.43 % to 11.53 and 11.37 to 9.36 percent respectively.

Table 10Land-use/land-cover distribution and net changes during 1990–2021.

| LULCClasses | 1990 | | 2008 | | 2021 | | Net change during 1990-2021 | |
|---|---|---|---|---|---|---|---|---|
| | Area in km$^2$ | Area in % | Area in km$^2$ | Area in % | Area in km$^2$ | Area in % | Area km$^2$ | % |
| **Built-up** | 7.48 | 12.40 | 13.21 | 21.90 | 15.82 | 26.21 | 8.34 | 13.82 |
| **Bare soil** | 9.91 | 16.43 | 7.14 | 11.85 | 6.69 | 11.53 | -3.22 | (4.90) |
| **Forest** | 6.86 | 11.37 | 6.28 | 10.41 | 5.65 | 9.36 | -1.21 | (2.01) |
| **Agriculture** | 36.08 | 59.80 | 33.7 | 55.84 | 32.17 | 52.89 | -3.91 | (6.91) |
| **Sum** | **60.33** | **100.00** | **60.33** | **100.00** | **60.33** | **100.00** | | |

## 4.5. Built-up expansion during 1990–2021

Overlay analysis of the built-up area detected from 1990, 2008 and 2021 land sat images of Adama city Dabe sub-city revealed that the agriculture, forest, and bare soil have changed in a different direction of the city. The spread of built-up area towards other LU/LC classes is shown in Figure 11.

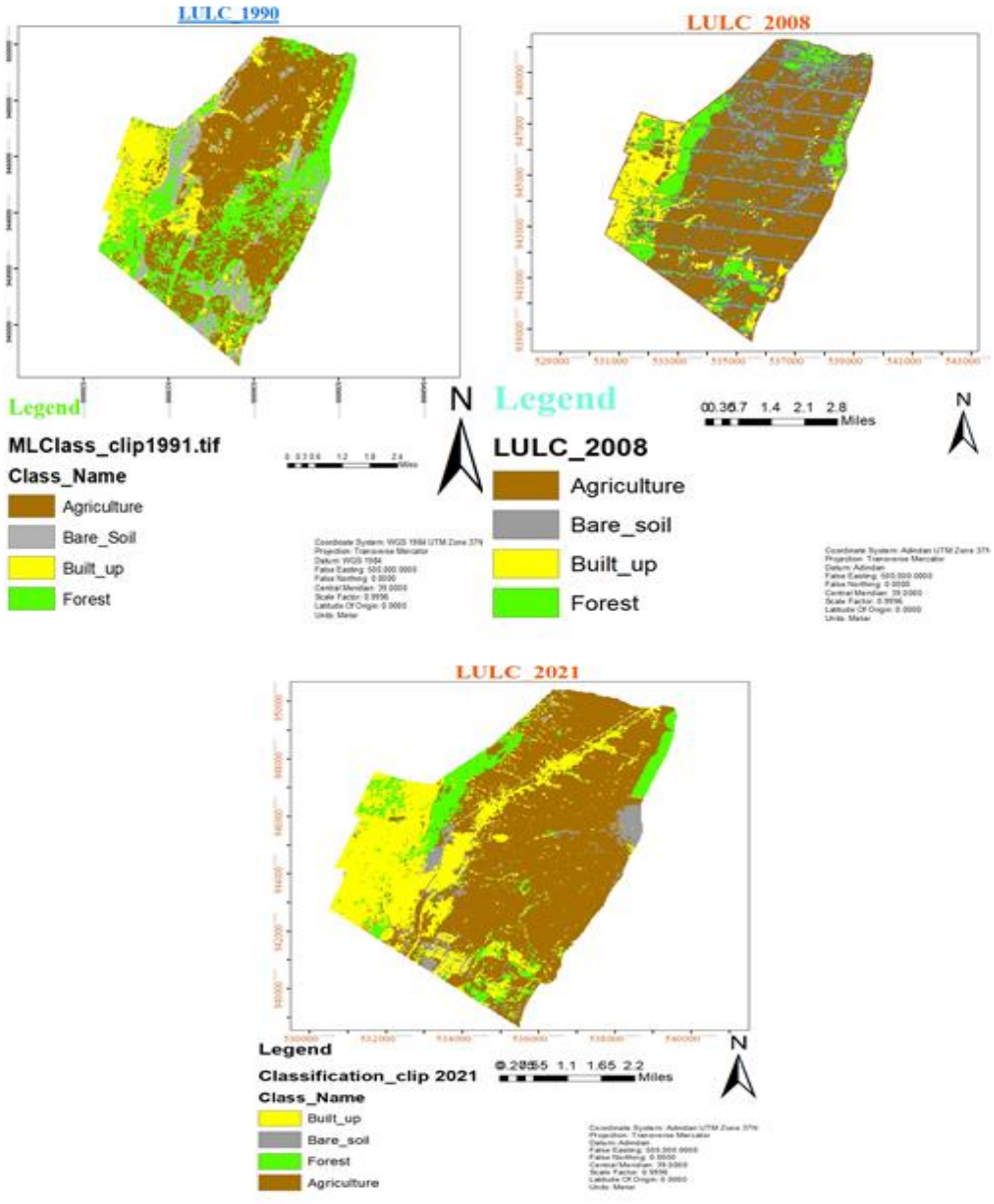



Figure 12the trend of expansion of settlement area from the year 1990 to 2021 in Adama city Dabe sub-city.

## 4.6. Respondents' perception toward LU/LCC in the study area

LULC change reflects both the biophysical conditions and the history of the socio-economic setting of a given area. Hence, a household survey was conducted to acquire data relating to the socio-economic and demographic conditions of households which would help to explain the changes observed in the LULC. Respondents were asked about changes occurring in land use/land cover in their area. Consequently, 96.7 percent of the respondents replied that there is a land use land cover change, while 3.3% stated that there is no change as such (table 11) below.

Table 11.Respondent's perception toward LU/LCC

| S. N | Respondents' **perception toward LU/LCC** | **Frequency** | **Percent** |
|---|---|---|---|
| **1** | Yes | 116 | 96.7 |
| **2** | No | 4 | 3.3 |
| | Total | 120 | 100.0 |

Source: Field Survey 2021

## 4.7. Cause of LULC Land use/land cover change

The underlying causes of land use/land cover change explain how and why local land cover developments were changed. With this regard, respondents were asked about the causes of land use land cover change, as of Table 12: 25.0% of the respondents agree that in the increasing of population, house needs are the cause for the change and 23.3% confirmed city expansion toward the farmland and 12.5% settlement was causing for land use/land cover change. While 23.3%, 10.8%, and 5.0% of the respondents realized that cheap construction cost and investment in the land contributes costs to land use/land cover change. Changes are influenced by a variety of factors related to human population growth, economic development, technology, and environmental changes. From the above analysis, it is clear that needs in the case of population growth were the major cause of land use land cover change in the study area. Table 12: report the perception of respondents toward the cause of the LU/LC changes in the study area. As to the analyzed research, 25% of LU/LCC is occurred by house needs which destroyed the forests and changed farmland by buying small parcels from the farmers

and settled the informal settlements and the implementation of Adama industrial park which dislocate many farmers from farmlands and returned to other places which formally occupied by farmers and scattered forests.

As the study discusses with more experts of Dabe sub-city land administration, Alemayehu Disasa and elders of the community who lived for more than two decades agree with the information listed below table 12.

Table 12the distribution of the respondents toward the cause for LU/LC change.

| S. N | Cause of LULC | Frequency | Percent |
|---|---|---|---|
| **1** | Investment | 6 | 5.0 |
| **2** | House need | 30 | 25.0 |
| **3** | Land price | 13 | 10.8 |
| **4** | Cheap construction material | 28 | 23.3 |
| **5** | City expansion | 28 | 23.3 |
| **6** | Informal settlement | 15 | 12.5 |
| | Total | 120 | 100.0 |

Source: Field Survey 2021.

## 4.8. Impacts of land use land cover changes in the study area

As below table 13: indicates that there was 100% impact of LULC changes. The change wasindicating positive and negative impacts as respondent's evidence given in the following (table13).

Table 13. Impact of LU/LCC

| S. N | Impact of land use land cover change | Frequency | Percent |
|---|---|---|---|
| **1** | **Yes** | **120** | **100.0** |

Source: Field Survey 2021

### 4.8.1. Positive Impacts of land use land cover changes in the study area

The underlying positive impact of land use/land cover change explains somehow there was benefit for settlers regarding to the following points. With this regard, respondents were asked the positive impact of land use land cover change, as of Table 14: 48.3% work opportunity ,14.2% of the respondents agree that positive impact in health center, 12.5 school and 8.3% were confirm 8.3% and 3.3% road. 2.5% and 2.5% of the respondents were water and recreational area. From the above analysis, it is clear that there was positive impact regarding land use land cover change in the study area. Table 14: report the perception of respondents there was some positive impact in the study area.

Table 14 positive impact of LU/LCC

| S, N | Positive impact of LULC | Frequency | Percent |
|---|---|---|---|
| **1** | Water | 3 | 2.5 |
| **2** | Road | 4 | 3.3 |
| **3** | Electricity | 10 | 8.3 |
| **4** | health center | 17 | 14.2 |
| **5** | School | 15 | 12.5 |
| **6** | recreation area | 3 | 2.5 |
| **7** | Employment | 10 | 8.3 |
| **8** | work opportunity | 58 | 48.3 |
| | **Total** | **120** | **100.0** |

Source: Field Survey 2021

### 4.8.2 Negative Impacts of land use land cover changes in the study area

The underlying negative impact of land use/land cover change explains there was highly negative impact regarding to the following points. With this regard, respondents were asked the negative impact of land use land cover change, as of Table 15: 51.7% loss of farm land (agriculture) was changed to residential and commercial settlements ,19.2% of the respondents agree that negative impact in social break (social assets) of the dislocated farming community have changed due to LU/LCC.

Information from community (respondents) revealed that the social assets usually manifested through social institutions such as Debo and jigi that brings them to work together were already abandoned. 14.2% displacement, 10.0% loss of ground water and 5.0% were confirm loss of vegetation. From the above analysis, it is clear that there was negative impact regarding land use land cover change in the study area. Table 15: report the perception of respondents there was negative impact in the study area regarding to land use land cover and changes from agriculture to residential and commercial.

Table 15 negative impact of LULC

| S, N | Negative impact of LULC | Frequency | Percent |
|---|---|---|---|
| **1** | Loss of farm land | 62 | 51.7 |
| **2** | Loss of Vegetation | 6 | 5.0 |
| **3** | Displacement | 17 | 14.2 |
| **4** | Social break | 23 | 19.2 |
| **5** | Loss of ground water | 12 | 10.0 |
| | Total | 120 | 100.0 |

Source: Field Survey 2021

## 4.9 The impacts LU/LCC on the land management in terms of environmental sustainability

Efficient land management provides environmental sustainability. Sustainable natural resources (environment) are used for a variety of purposes, which may include organic agriculture, reforestation, water resource management, and eco-tourism projects. However, changes in land use of land use, such as a decrease in the area coverage of the forest due to deforestation, and soil erosion, lead to degradation of the land that affects environmental quality due to changes in the LU/LCC. Thus, the conversion of forest land to other types of land use caused numerous negative impacts on the ecosystem as well as the livelihood of the society in the study area. The vegetated area of the Dabe sub-city deteriorated and thereby resulted in the loss of biodiversity. In this case, the quality of the environment was not sustained as a result of that negative change in land use land cover (land degradation, soil erosion, and vegetation destruction).

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

## 5.1 Conclusion

Land use and land cover changes have a wide range of consequences at all spatial and temporal scales. Because of these effects and influences, it has become one of the major problems of environmental change as well as natural resource management. Identifying the complex interaction between changes, impact, and their drivers over space and time is important to predict future developments, set decision-making mechanisms, and construct alternative scenarios.

The LU/LC changes experienced in the Adama City Dabe sub-city show a sign of population growth and the increase in the need for land for settlement. These changes have brought about a series of adverse impacts on the environment. Houghton (1994) revealed that human population growth, economic development, technology, and environmental changes are the major factors responsible for LU/LC variability. LU/LC changes have become major problems and they are a significant driving agent of environmental changes (Alemayehu.2008). The evidence shows that climate change includes the occurrence of drought, rising temperatures, floods, reduced annual rainfall, and rising sea levels.

The dynamics of land use during the period of analysis (1990 -2021) demonstrate profound changes involving an increase and decrease in patterns of land use. The pattern of LU/LCC in different categories shows variation during the study periods. The analysis results showed the percentage of agriculture, bare soil and forest has shown that decreased from 59.80% to 52.89%, 16.43to 11.53% and 11.37% to 9.36 % respectively, from 1990 to 2021. A corresponding increase has been observed in settlement (built-up), which increased from 12.4% to 26.21% in the same period.

The decrease in agriculture, bare soil and forest partly reflects the considerable degradation of natural vegetation in the area and the expansion of settlement(built-up). The socio-economic survey conducted also revealed that the major causes of the land use/land cover change were house needs, land price, informal settlement, cheap construction costs, city

expansion, and investment. The effect of the land use/land cover change was the other concern of the study and the analysis of the survey indicates that the current problems associated with land use and land cover changes can be related partly to the livelihoods of the local population (socioeconomic conditions) and land management increase demand/population growths, deforestation, development of the infrastructure, transaction of the land by different brokers, expansion of the informal settlement were encountered as the root cause for the land use land cover change. The current population pressure has caused a high demand for additional land; as a result, the increasing of house need is the major problem for LULC in the study area. Hence, the expansion of built-up into the peripheral land leads to more severe land degradation.

Built-up expansion is one of the major proximate or direct causes of LU/LCC in the study area. This implies that population pressure and migration from rural to urban is believed to be one of the major driving forces for the change of LU/LC in the study area. Land use-land cover has a significant impact on land management and tenure security. Overall, these changes affect the livelihoods of societies directly or indirectly. LU/LC dynamics are widespread, accelerating and significant processes majorly impelled by human actions and, at the same time, resulting in changes that impact human livelihood.

## 5.2. Recommendations

The focus of this study was to assess and examine Land Use Land, Cover Changes Dynamic and resulting socio-economic Impact on Resident of Adama City, in Case of Dabe Sub-City based on Land sat imagery of 1990, 2008 and 2021.

- From the study, LU/LCC of Adama city in the case of Dabe sub-city from 1990 to 2021 was dynamic impact on the socio economic, environmental aspects and other land covers. The planner and policy makers to develop urbanization not only in the horizontal dimension but in vertical dimension as well. Furthermore, implementation of building bylaws and land use plans is highly recommended.

- The use of high-resolution imageries such as IKONOS and Quick Bird are important in generating good quality of land cover maps. Because urban areas have complex and heterogonous features, a high-resolution imagery provide better information by

mapping these areas. Moreover, the use of additional data as ground truth helps for better accuracy of an image classification.

- Reliable multi-temporal Land sat satellite data for each year provides detail comparison of images and change analysis.
- Incorporating socio-economic data, land policy, biophysical and human factors (population density, technology, political) could improve the performance of land use models for future predictions. Hence, it is important to the planners, decision makers and stakeholders for efficient utilization of land.

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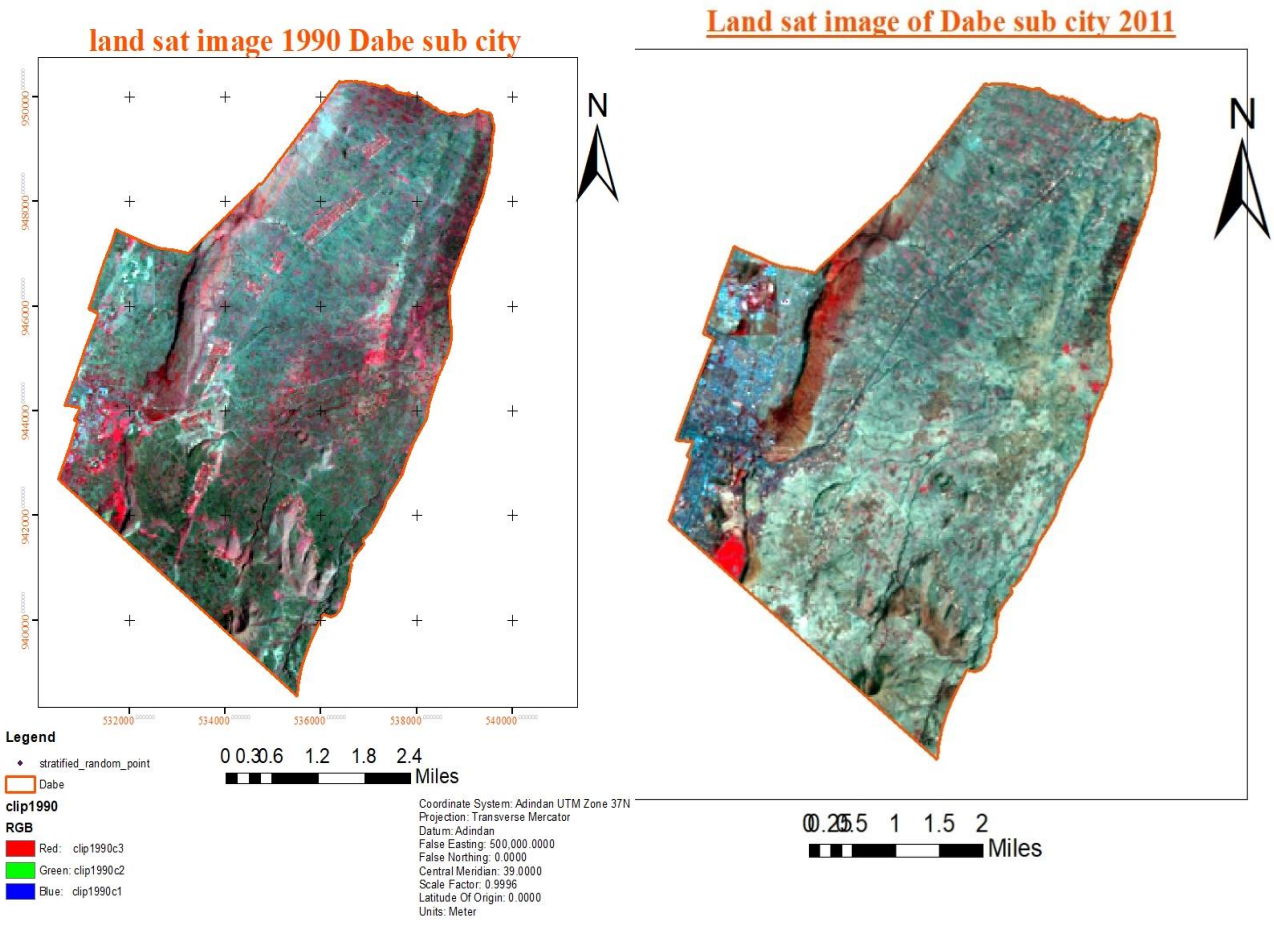
## Appendices

## Appendix -A: Figure land sat image of Adama city Dabe sub city



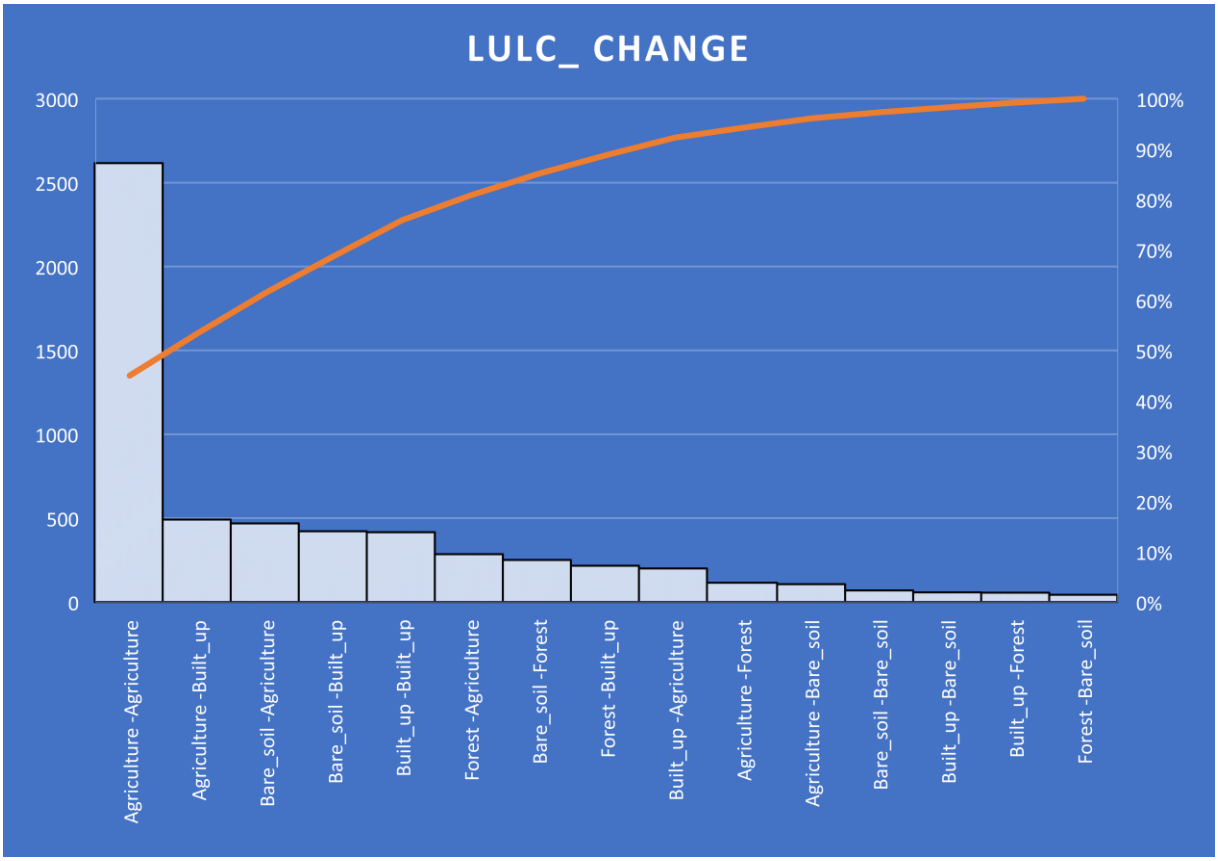



Figure of LULC -change

## Appendix -B: LU/LCC error matric table.

| S. N | Class _name | 1990 | | 2008 | | 2021 | |
|---|---|---|---|---|---|---|---|
| | | User's Accuracy | Producer's Accuracy | User's Accuracy | Producer's Accuracy | User's Accuracy | Producer's Accuracy |
| 2 | Built-up | 84.21 | 77.42 | 67.31 | 83.33 | 67.86 | 90.48 |
| 3 | Bare soil | 74.07 | 70.18 | 81.52 | 92.59 | 71.43 | 62.50 |
| 4 | Forest | 60.98 | 47.17 | 72.09 | 92.54 | 65.79 | 69.44 |
| 4 | Agriculture | 78.95 | 92.92 | 100.00 | 57.89 | 89.74 | 83.83 |
| 6 | Over accuracy | 0.87 | | 0.908 | | 0.912 | |
| 7 | Observed Accuracy | 0.53 | | 0.526 | | 0.526 | |
| 8 | Kappa(K) | 0.801 | | 0.806 | | 0.814 | |

| No. | Lulc_1990 | Area_1990 | Lulc_2021 | Area_2021 | Change | Area change |
|---|---|---|---|---|---|---|
| **1** | Built-up | 7.482466 | Built-up | 15.81673 | built-up - built-up | 415.739857 |
| **2** | Built-up | 7.482466 | Bare soil | 2.802085 | built-up -Bare soil | 58.14146 |
| **3** | Built-up | 7.482466 | Forest | 5.647661 | built-up - Forest | 55.962514 |
| **4** | Built-up | 7.482466 | Agriculture | 36.080438 | built-up - Agriculture | 200.231151 |
| **5** | Bare soil | 12.298423 | built-up | 15.81673 | Bare soil - built-up | 421.499033 |
| **6** | Bare soil | 12.298423 | Bare soil | 2.802085 | Bare soil - Bare soil | 69.601724 |
| **7** | Bare soil | 12.298423 | Forest | 5.647661 | Bare soil - Forest | 250.604875 |
| **8** | Bare soil | 12.298423 | Agriculture | 36.080438 | Bare soil - Agriculture | 468.388531 |
| **9** | Forest | 6.857688 | built-up | 15.81673 | Forest -built-up | 216.432564 |
| **10** | Forest | 6.857688 | Bare soil | 2.802085 | Forest -Bare soil | 43.431997 |
| **11** | Forest | 6.857688 | Forest | 5.647661 | Forest -Forest | 122.167113 |
| **12** | Forest | 6.857688 | Agriculture | 36.080438 | Forest - Agriculture | 285.05433 |
| **13** | Agriculture | 33.69629 | built-up | 15.81673 | Agriculture - built-up | 491.283267 |
| **14** | Agriculture | 33.69629 | Bare soil | 2.802085 | Agriculture - | 106.669892 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Bare soil | |
| **15** | Agriculture | 33.69629 | Forest | 5.647661 | Agriculture - Forest | 115.222174 |
| **16** | Agriculture | 33.69629 | Agriculture | 36.080438 | Agriculture - Agriculture | 2616.113139 |

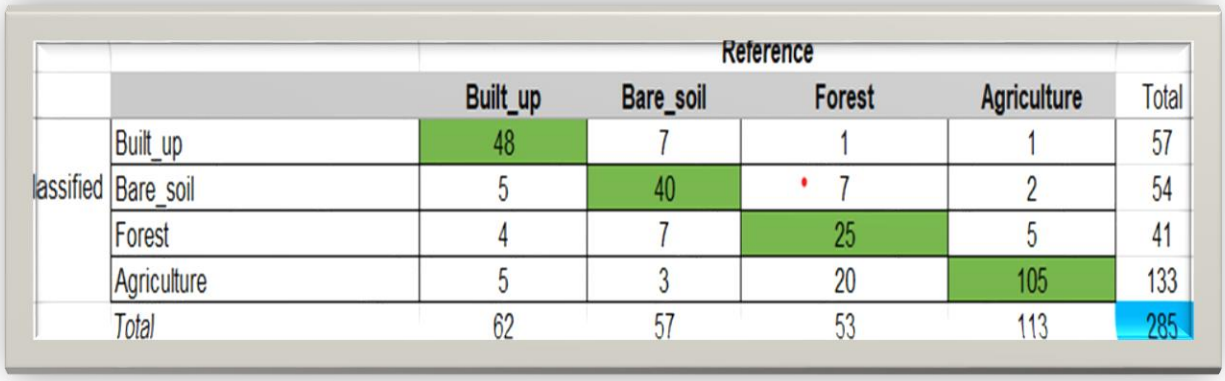
| | | **LULC_2021** | | | | |
|---|---|---|---|---|---|---|
| | | Agriculture | Bare soil | built-up | Forest | **Grand Total** |
| **LULC_1990** | Agriculture | 2,616.11 | 106.67 | 491.28 | 115.22 | **3,329.29** |
| | Bare_soil | 468.39 | 69.60 | 421.50 | 250.60 | **1,210.09** |
| | Built_up | 200.23 | 58.14 | 415.74 | 55.96 | **730.07** |
| | Forest | 285.05 | 43.43 | 216.43 | 122.17 | **667.09** |
| | **Grand Total** | **3,569.79** | **277.85** | **1,544.95** | **543.96** | **5,936.54** |

| **LULC-change** | Total |
|---|---|
| **Agriculture -Agriculture** | 2616.113139 |
| **Agriculture -Bare soil** | 106.669892 |
| **Agriculture -built-up** | 491.283267 |
| **Agriculture -Forest** | 115.222174 |
| **Bare soil -Agriculture** | 468.388531 |
| **Bare soil -Bare soil** | 69.601724 |
| **Bare soil -built-up** | 421.499033 |

| | |
|---|---|
| **Bare_soil -Forest** | 250.604875 |
| **Built_up -Agriculture** | 200.231151 |
| **Built_up -Bare_soil** | 58.14146 |
| **Built_up -Built_up** | 415.739857 |
| **Built_up -Forest** | 55.962514 |
| **Forest -Agriculture** | 285.05433 |
| **Forest -Bare_soil** | 43.431997 |
| **Forest -Built_up** | 216.432564 |

Table of lulc change

`



| | | Reference | | | | |
|---|---|---|---|---|---|---|
| | | Built_up | Bare_soil | Forest | Agriculture | Total |
| lassified | Built_up | 48 | 7 | 1 | 1 | 57 |
| | Bare_soil | 5 | 40 | 7 | 2 | 54 |
| | Forest | 4 | 7 | 25 | 5 | 41 |
| | Agriculture | 5 | 3 | 20 | 105 | 133 |
| | *Total* | 62 | 57 | 53 | 113 | 285 |

| | | Reference | | | | |
|---|---|---|---|---|---|---|
| | | Built_up | Bare_soil | Forest | Agriculture | Total |
| classified | Built_up | 35 | 2 | 0 | 15 | 52 |
| | Bare_soil | 2 | 75 | 5 | 10 | 92 |
| | Forest | 5 | 4 | 62 | 15 | 86 |
| | Agriculture | 0 | 0 | 0 | 55 | 55 |
| | Total | 42 | 81 | 67 | 95 | 285 |

| | | Reference | | | | |
|---|---|---|---|---|---|---|
| | | Built_up | Bare_soil | Forest | Agriculture | Total |
| classified | Built_up | 38 | 3 | 3 | 12 | 56 |
| | Bare_soil | 0 | 25 | 2 | 8 | 35 |
| | Forest | 2 | 4 | 25 | 7 | 38 |
| | Agriculture | 2 | 8 | 6 | 140 | 156 |
| | Total | 42 | 40 | 36 | 167 | 285 |

Tables of stratified random error matrix of land sat image 1990-2021

## Appendix -C: Household level questionnaires

**Adama Science and Technology University, department of Architecture, School of Civil Engineering and Architecture, Master's in Urban Planning and Design Program**

**Dear Respondents,**

This questionnaire is designed to collect data for Masters Study on "Land use land cover changes dynamic and its impact on resident of Adama city , in Dabe Sub city." To achieve the purpose and deeply investigate the case, your response to the questions given below has a crucial value.

Therefore, you are kindly requested to read the questions carefully and give accurate and real data which exists on the ground. The response that you replay will not be used for any other purpose other than this research work. So, be free and give your honest and genuine response. Please, I informed you, that your information will keepsecretly.

**Kabajamtootaa gaaffii kana gutan:** gaaffiin Kun kan qophaa'ee qorannoo maastarii hojachuuf oddefannoo funaanudhaaf kan qophaa'ee dha. Kunis mata-dureeLand use land

cover changes and its impact on resident of Adama city , in Dabe Sub city jechuudhaan kan qophaa'ee dha. Gaaffin asii gadii tareefaman bu'aa issinif keenuu waan gudda ta'eef iftoominaan ykn biliisaan akka keennitan kabajaan isiin gaafadha. Kanaaf ragaa yeroo kennitan kan dhuugaaratti kan hundaa'ee fi waan lafaara jiruu bilisaadhaan akka kennitan isiin gaafadha.Gaaffii kaniitan waan biraaf miti qorannoo qofaaf barbaadamee.Ragaa kennitanif iccitiin isiin qabama kanaaf waan kennitanii shakii tokko malee yaada kessanii naa laadha.

የተከበራችሁይህንቅፅምትሞሉ፡

ይህጥያቄየተዘጋጀውማስተርስጥናትለመስራትመረጃለመሰብሰብየተዘጋጀነው።ይህምበ Land use land cover changes and its impact on resident of Adama city , in Dabe Sub city በሚልርዕስየተዘጋጀነው።

ከዚህበታችየተዘረዘሩትየሚሰጣችሁጥቅምትልቅስለሆነበግልፅናበነፃነትሐሳባችሁንእንድትሰጡበአክብሮ ትእጠይቃለሁ።

ስለዚህመረጃስትሰጡአውነትላይየተመሰረትእናእመሬትላይያለውንእውነትእንድትስጡበአክብሮትእጠይ ቃለሁ።ይህጥያቄየተዘጋጀውለሌላጉዳይሳይሆንየማስተርጥናቱንለመስራትግባአትይሆንዘንድነው።

ለመሰጡትመረጃሚስጥሮየተጠበቀነው።ስለዚህለመሰጡትመረጃስጋትአይግባዎት።

**Further information (Oddeffannoo dabalataaf)**

If you need additional information concerning this study you can contact the researcher.

**(**Oddefannoo dabalataf qorranoo kanaratti hundaa'ee yoo jiratee bilbilaa armaan gadiin argachuu dandeesan) ለበለጠመረጃከዚህበታችየተጠቀሰውንአድራሻመግኘትይጠቀሙ።

**Address**

***Name:*** - Teshale Mezgebe Tesfaye

***Mobil no: 0920181897 Email: tmtc1818@gmail.com***

***Adama, Ethiopia***

**Thank you for your cooperation**

**Instruction:** Please oblige me by answering all questions by encircling on your choice. Write your opinions on some of the questions you are requested. You do not need to write your name.

Enumerator (Maqaa lakkawaa) የቆጣሪውስም----------

Date of interview (Guyyaa gaaffii) ቀን ----------

Questionnaire No. (Lakkofsaa gaaffii) የመጠይቅቁጥር----------

Village (Iddoo jireenyaa) የመኖርያቦታ----------

**A. Household characteristics and human assets**

(a) Age of respondent (umrii gaaffii kana guutuu)የመልስሰጪዉእድሜ: -----

(b) Sex of respondent (Sala): Male (Dhiraa) ወንድ ☐ Female (Dubaraa) ሴት ☐

(c) Marital status (Haala gaa'elaa) የትዳርሁኔታ:

| | | | |
|---|---|---|---|
| Single (Qeenxee) ያላገባ | | Divorced (Kan hikee/tee) የፈታ/ች | |
| Married (Kan fudhee/tee) ያገባ/ች | | Widowed (Kanjalaa du'ee) የሞተበት/ባት | |
| Refuse to answer (Deebiisuuf fedhii hin qabuu)ለመሙላትፍቃደኛአደለሁም | | | |

(d) The head of the households (Abbaa qabiyyee) የይዞታባለቤት: Sex of respondent (saala): ፆታMale (Dhiraa) ወንድ ☐ Female (Dubaraa) ሴት ☐

(e) What is the size of your household (Hamaa maatti)? ----------

(f) Family size by age and gender (Hamaa maatti lakkofsaan fi salaan) የቤተሰብቁጥር፤እድሜእናፆታ

| Age group (Umrii) ፆታ | Male (Dhiraa) ወንድ | Female (Dubaraa) ሴት | Total (Waligalaa) ጠቅላላ |
|---|---|---|---|
| ≤ 17 | | | |
| 18-30 | | | |
| >50 | | | |

(g) What is your occupation (Hojiin kee maalii) ስራዎምንድነዎ?

(Choose only one that applies) (Kaneen armaan gadii keessa tokko filadhuu) ከዚህበታችአንዱንይምረጡ

| | | | |
|---|---|---|---|
| Farmer (Qotte bulaa) አርሶአደር | | Student (Barata/ttu) ተማሪ | |
| Business (Daldalaa) | | Other (specify) (Kan biroo) | |

| | | | |
|---|---|---|---|
| ነጋዴ | | ሌላካለ | |
| Daily loubor (hojii guyya) | | | |

(h)What is the highest level of education (Haala barumsaa) የትምህርትሁኔታ

| No formal education (Kallatiidhaan barumsaa kan hin qabnee) በቀጥታትምህርትየሌለዎ | Primary (Sadarkaa tokkofaa) አንድኛደቀ ጃ | Secondary (Sadarkaa lamafaa) | Diploma or level (Dipiiloma a ykn gulantaa) ሁለተናደቀ ጃ | Degree (Digrii jalqabaa ) ድግሪ | Masters and above (Mastarsii fi isaa ol) ማስተርስናካዚያበላይ |
|---|---|---|---|---|---|
| | | | | | |

(i) How long have you lived in this area (Waggaa meqaa naannoo kanatti jiraatee) ለምንያህልጊዜእዚይኖረዋል?

| | | |
|---|---|---|
| <10 years (wagga 10 gadii) 10 አመት | 11-19 | ≥ 20 years ( Waggaa 20 ol) ከ 20 አመትበላይ |

(j) If less than 20 years in Question i, where did you live before (Gaaffi I irra wagga 20 gaddi yoo ta'ee duraa essa jiraata turee)? Village (Naanno) /Magaala/Anna/traditional authority /district ጥያቄ I ለይከ 20 አመትበታችከሆነመጀመሪያየትነበርየሚኖሩት ----------

(k) What was the reason for migration (Sababnii maalii gara naanno kana dhufuu keesanif) ምክነያቶምንድነዎወደዚህአካባቢየመጡበት?

| Employment (Hojiidhaaf) ለስራ | Marriage (Ga'eela) ትዳር | Death of a family member (Du'atii maatii) በቤተሰብሞትምክነያት | Other (specify) (Kan biro yoo jiraate) ሌላካለይገለፅ--------- |
|---|---|---|---|
| | | | |

**B. Population VS Land use land cover changes**

C. (a). Do you think the population of your community has increased over the past 30 years (Waggaa 30 keessa umnii naanno kanaa dabaluu isa ani beekta) በዚህ 30 አመትዉስጥየህዝብቁጥርመጨመሩንታዉቃለህ/ለሽ?

Yes (eyyeen) አዎ ☐ No (hin beekuu) አላዉቅም ☐

(b). If YES, what do you think has caused the population increase (Eyyeen yoo ta'ee deebiin kee sababnii maal si fakkata umanii naanno kana dabaluu isaa) መልሰአዎከሆነየህዝብመጨመርምክነያትምንይመስሎታል?

High birth rate (Namnii dhalamuu waan dabaleef) የሚወለደዉቁጥርስለቾመረ ☐ Immigration (Nama baadiyaara gara magaala galuu dabaluu isaa) ከገጠርወደከተማየሚገባዉስለጨመረ Reduced mortality (Du'aati namaa waan hir'ateef) የሞትቁጥርስለቀነሰ

Other (specify) (Kan biro yoo jiraate ibsi) ሌላካለይገለፅ ----------

**C. Land tenure and rights (Seeraa qabiyyee lafaa) የመሬትይዞታህግ**

(a). Land acquisition? Yes (Lafaa dhunfaa qabdaa) የግልመሬትአለህ/ሽ (Eyyeen) አዎ ☐ No (Hin qabuu) አላዉቅም ☐

(b). If you own land, how did you get it (Lafaa dhunfaa yoo qabaatee haala akkamiin argatee) ይግልመሬትካለህ/ሽእንዴትአገኘዉ/ሺዉ?

Bought it (Bitaadhaan) በግዢ ☐ Inherited it (Dhaalaan) በዉርስ ☐ Donation/gift (Keenaadhaan) ስጦታ renting (Kiraadhaan ☐ given by the government (Motumaadhaan kenamee) በመንግስትየተሰጠ ☐

(c). what do you think are the cause of land-use and land-cover change in your area?

(1) Investment ☐ (2) House need ☐ (3) Land price ☐ (4) Cheap ☐ construction cost ☐ (5) City expansion ☐ (6) Informal settlement ☐

3. Is there any impact on the resident due to the change positively or negatively (lafnii naannoo keessanii jijiramuu isaa rakkoo isiin irra ga'ee jira ykn faayyida argatanii jiraa)?

Yes (eyyan) አዎ ☐ No (hin jiruu) አላዉቅም ☐

If YES, (yoo eyyan ta'ee deebiin kee) መልሰአዎከሆነ

(a)What are the positive impacts of the resident (Fayyidaan jiraatootaf fidee maalii) ለኗሪዉያመጣዉመልካምአጋጣሚዉምንድነዉ?

(1) Water ☐ (2) Road ☐ (3) Electricity ☐ (4) Health ☐ (5) School ☐ (6) Recreaction

(7) Employment ☐ (8) Work opportunity ☐

(b) What are the negative impacts of the resident (midhaan jiraatootaf fidee maalii) ኗሪዉለይያመጣዉተፅኖምንድነዉ?

(1) Loss of farm land ☐ (2) Loss of vegetation ☐ (3) Displacement (4) Social break ☐ (5) loss of ground water ☐

## Appendix D; - Interview Guide

1.Can, you tell me the driving force of the different community comes in the area?

2. Can you tell me/us the impact of land use land cover change of the area?

3. what were your suggestions you to overcome the problem related to land use land cover?

**Thank you for your time**

**Thank you for your participation in this study**