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ADDIS ABABA UNIVERSITY  
ETHIOPIAN INSTITUTE OF ARCHITECTURE, BUILDING CONSTRUCTION AND CITY  
DEVELOPMENT (EiABC)

**ASSESSMENT OF SPATIAL IMPACTS OF THE EASTERN INDUSTRY ZONE ON  
THE DEVELOPMENT PATTERN OF THE SURROUNDING SETTLEMENT OF  
DUKEM TOWN, ETHIOPIA**

BY :  
HAILE TADESE FEYISA

JANUARY, 2024  
ADDIS ABABA, ETHIOPIA



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Addis Ababa University  
Ethiopian Institute Of Architecture, Building Construction and City Development  
(EiABC)

**Assessment of spatial impacts of the Eastern Industry zone on the development pattern of  
the surrounding settlement of Dukem Town, Ethiopia**

By:

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University, Ethiopian  
Institute of Architecture, Building Construction and City Development, in Partial Fulfillment of  
the Requirements for the Award of Masters of Science in Architectural Engineering.

Advisor:

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January 2024

Addis Ababa, Ethiopia

## **Declaration**

I hereby declare that all information in this document was gathered and presented following academic rules and ethical standards. I further certify that I have fully cited and referenced all materials and results that are not unique to this study, as required by these rules and conduct.

Name: Haile Tadese Feyisa

Signature

## Board of Examiners

As a member of the team of examiners for Haile Tadesse's final master's thesis formal defense, we have studied and assessed Haile Tadesse's thesis, " Assessment of spatial impacts of the Eastern Industry zone on the development pattern of the surrounding settlement of Dukem Town, Ethiopia." Additionally, mentioned that the Ethiopian Institute of Architecture, Building Construction, and City Development, located at Addis Ababa University, approve the thesis that meets the requirements for the award of a master's degree in Architectural Engineering.

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## **Acknowledgments**

I would like to express my sincere gratitude to the following individuals who have been with me through thick and thin. First and foremost, I would like to thank Lily for her unwavering support and encouragement throughout my academic journey. I am also grateful to Dr. Birhanu Girma for his invaluable guidance and mentorship. his expertise and insights have been instrumental in shaping my research. Last but not least, I would like to thank all my beloved ones who have supported me in every possible way. Their love, care, and motivation have been a constant source of inspiration for me. I would also like to extend my heartfelt appreciation to my professors and colleagues who have provided me with valuable feedback and suggestions throughout my research journey. Without their support, this accomplishment would not have been possible. Thank you all for being a part of my journey.

## Abstract

*This study is conducted to analyze the assessment of spatial impacts of the Eastern Industry zone on the development pattern of the surrounding settlement of Dukem, Ethiopia. Dukem town is becoming an industrial hub in the Oromia region of Ethiopia due to its proximity to the capital city, Ethio-Djibouti Railway, Bole international airport, and Expressways. Those facts impact the physical settlements of the town. The east industry zone is one of the major industry spots in town. The study included both qualitative and quantitative methodologies, including spatial analysis using GIS techniques and survey methods. According to research findings, industrial park expansion has both beneficial and negative effects on the spatial settlements surrounding the industrial parks. Specifically, the factors that positively the pattern of spatial settlements around industrial parks include the area of land acquired due to the construction of industrial parks) Establishments of EIZ, investment of other industries & manufacturing, housing preference, informal access to land, and the number of neighborhoods established after the industrial park is built. Accordingly, the trend analysis of spatial settlement impacts has shown that the built-up area increased dramatically following the establishment of EIZ from 13.91 hectares (1.31%) in 2012 to 173.14 hectares (16%) in 2012, from 316.01 hectares (30 %) in 2016 to 578.23 hectares (55%) in 2018. Built-up areas consumed a significant number of other types, increasing from 13.91 hectares (1.31 percent) in 2012 to 964.16 hectares (91 percent) in 2023, while agricultural land decreased dramatically in all years, from 1,046.77 ha (65.12 percent) in 2009 to 92.38 ha (8.71 percent) in 2023, indicating its highest contribution to built-up areas. The forecast for future growth also indicated that the surrounding settlement will be covered by additional industries and dwellings. The location is already landlocked in the north and south with Bishoftu. As a result, while developing Industrial Parks, the government's anticipated future expansion should be factored into all policy and planning decisions.*

Keywords: Spatial Settlement, Pattern, Industrial Park Development, Oromia Region, Ethiopia

## **List of Acronyms and Abbreviations**

ALC	Agricultural Land Conversion
BUA	Built Up Area
CSA	Central Statistical Agency
DC	Dynamic Change
DTM	Dukem Municipality
EC	Ethiopian Calendar
EGM	Exponential Growth Model
EIZ	Eastern Industry Zone
EQ	Equation
GC	Gregorian Colander
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
LULC	Land Use-Land Cover
NUDP	National Urban Development Policy
OUPI	Oromia Planning Institute
SP	Structural Plan
RS	Remote Sensing
RST	Remote Sensing Techniques
ULA	Urban Land Administration
UTM	Universal Transverses Mercator

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## CHAPTER ONE

### 1. INTRODUCTION

#### 1.1 Background of the study

Among the various outcomes of a changing climate is the emergence of urbanization around the world. Emerging urban areas and the migrations of unpredicted populations are becoming more prevalent, as the science about change grows progressively more drastic and alarming. Current projections indicate that rural-urban transformation will continue to grow in size and number. The formed urban area demands infrastructure, housing, processing industries, manufacturing, infrastructure, and job opportunities, resulting in plausible damage to the natural environment. In many cases, the manufacturing industry is considered to create job opportunities in urban areas. In recent years Ethiopia and foreign investors are constructing industry parks (IP) all over the country. In 2000, China agreed to share with African countries its experience in the field of investment promotion relating to the establishment and management of special economic zones. The Eastern Industry Zone was subsequently established. Because of the various zones being built in Africa, Ethiopia perhaps represents one of the biggest challenges to both the Chinese developers and the host government alike. (Philip Giannecchini, Ian Taylor, School of International Relations, University of St. Andrews, St Andrews KY16 9AX, Scotland, United Kingdom). The Eastern Industrial Zone in Ethiopia was initially planned in 2007 and launched in 2009. Located in Dukem, Oromia state, around 30 kilometers south-east of the capital, Addis Ababa, the original plan was to establish a 5 km<sup>2</sup> zone operated by the Yonggang Group and the Qi Yuan Group, which in five years would entice eighty separate investment projects, creating 20,000 jobs (Brautigam and Tang 2011). despite the job opportunity created by the eastern industry zone.

This industry park has many impacts on urban settlements since it could do with large spaces to build, the income level of the workers is unsatisfactory & most of the employers can't afford the housing at Dukem and Bishoftu towns subsequently it creates new settlements at the industrial surroundings. This situation could have a substantial impact on the urban settlements to the specific project site contexts, at the early stages of developing industrial parks, shocks are rising to the environment. And the nastiest part of the case is that the design of the projects does not consider the settlements and urban Covers around the project site.

## 1.2 Problem Statement

Ensuring the establishment of the east industry zone both Dukem and Bishoftu towns are expanding on the advantage of job opportunities created in the park. In this case, housing facilities are the most demanding situation for both towns, new settlement is increasing radically. As the result of aerial photographs taken over the past 12 years shows, most agricultural lands surrounding the park are now turning to informal settlements for delivering and housing at a cheap price. Those cases may have happened because there wasn't proper planning for the housing before the park was acupuncture to the area. In addition, there is no infrastructure planning like access roads, electricity, sewage line, water supply, waste treatment units, health services, etc. for those new settlements. Most of the new settler householders are EIZ workers and they are hired in the EIZ because of their cheap labor even if they can't pay initial payments for infrastructure supply. On the other side, displaced farmers around the EIZ have no benefit from the EIZ and newly formed settlement and income means. In other countries, before injecting this kind of rural-urban transformation there are planning ways that allow proper industrial urbanism transformations, but in this case, the settlement pattern has no direct planning guide with both towns' master plans. In all the above cases, observed impacts happened as a result of the establishment of IP, and many anticipated impacts follow if the research is not performed early. This research aims to measure the initial and extent of the impacts rising with settlements of existing industrial parks. And the findings will be incorporated as inputs to contribute guidelines for the future design and development of adaptive industry parks in Ethiopia.

## **1.3 Research question**

### **1.3.1 Specific Research Questions**

1. What is the spatial scope of the existing Eastern industry zone and its impact on the habitability of the surrounding settlement?
2. What is the timely morphological Pattern alteration of the settlement surrounding the eastern industry zone?
3. What is the consequence and spatial scale of the morphological alteration on the physical settlement due to the existence of the industry
4. What sustainable measures should be taken to combat the physical impacts?

## **1.4 Objectives**

### **1.4.1 General Objective**

The primary goal of this study is to measure the existing and anticipated impacts of the Eastern Industry zone on surrounding spatial settlement and to identify the existing problems in the pattern spatial settlement of the surrounding area. to evaluate the planning and future Covers of the Eastern industry zone.

### **1.4.2 Specific Objectives**

1. To evaluate the spatial scope of the Eastern industry zone and its impact on the surrounding.
2. To identify timely Cover patterns of settlement around the Eastern industry zone.
3. To assess the existing impacts of the Eastern industry zone on the physical settlement of the surrounding area
4. To solve the existing impacts, and anticipated impacts, and plan future Covers of the Eastern Industry zone and spatial settlement of surrounding areas.

## **1.5 Significance of the study**

In general, research into industrial parks (IP) is still in its early stages, and the application of its principles and the transformation to the circular economy have recently begun. In particular, existing literature has not paid enough attention to the urban dimension of IPs. As regards the

planned IPs (in the general sense of the term), it has mainly focused on developing the operations of the existing industrial areas which have been transformed into IPs. Concerning the self-organized IPs, it has attempted to only understand and map out their industrial operations. The physical/urban formation of these parks has not been adequately addressed. Only a few references discussed some concepts of IPs' site selection and planning.

The study, therefore, aims to contribute to bridging this research gap by addressing the urban planning and design of a new IP of which the authors were assigned the task of its urban planning and design. This attempt contributes to the ongoing scientific discourse which makes this study pioneering research in the field of urban planning and design of new IPs. This study's focus is supported by the fact that many IPs that started as conventional industrial areas have not successfully planned spatial settlements. It is intended that the findings of this research project will be used by local and regional authorities to assess and evaluate the currently existing industry parks' impacts on the physical settlements. These findings could be used for correction of the currently existing projects as well as for new project plans.

## **1.6 Scope of the Study**

The study covers the spatial planning and designs aspects of the Eastern Industry zone and surrounding cities. It goes to a survey including the planning of the surrounding town. The study covers the spatial planning of towns to the industry park design aspect. The research is mainly descriptive type, including surveys and fact-finding inquiries of different kinds. The major purpose of this research is a description the state of affairs as it exists at present and is anticipated in the future. Mainly quantitative research is followed because it is based on the measurement of quantity or amount, and it is used for phenomena that can be expressed in terms of quantity. In addition to the above, qualitative research is also entertained. On the other hand, it is concerned with qualitative fact, that is facts relating to or involving quality or kind. This research aims at discovering the underlying motives and desires, using in-depth interviews for the purpose.

### **I. Thematic Scope:**

The thematic issue of this research Assessment of spatial impacts of the EIZ on the development pattern of the surrounding settlement of Dukem Town.

## **II. Spatial scope:**

This study covers the Eastern Industry zone and the surrounding town of Dukem. Specifically, it covers 1,060.68 Hectares neighboring the EIZ

## **III. Social scope:**

It covers Government officials, neighboring communities, employees of the EIZ

### **1.7 Limitations of the study**

The distance between the industry park and the central capital city is the study's biggest constraint. During the research time, you will get daily access. The biggest limitation encountered while working on this project is obtaining high-resolution satellite photos and downloading them. However, I attempted to solve the problem by investigating another alternative for reducing the spatial resolution constraint. The budget for accessing the site is the second barrier. Another constraint could be secondary data or related site studies.

### **1.8. Organization of the Study**

The study is divided into five chapters; This is a brief discussion of the chapters' substance. As a result, the first chapter provides a comprehensive review of the background material from the perspective of the general to the specific research area, as well as background information on impacts, industry parks, and cities. This chapter also contains a statement of the problem, the objective of the study both general and specific objectives, the research question, the significance of the study, the scope of the study, the limitations of the study, and the organization of the study.

Reviewing scholarly discourses that were crucial to this study is covered in the second chapter. impact on changes in land use, GIS methods or tools for examining urban cover trends, and lastly an overview and analysis of the literature.

The third chapter discusses the sources of information and tools employed in this investigation. This chapter covers topics including the method and the justification for the method, the type of data, the sample size and methodology, the methods and tools for data collection, and the methods and tools for data analysis.

The findings and analysis of the study are covered in the fourth chapter. The findings and discussions related to the study topics are covered in this chapter. Data description, geographical

data analysis utilizing GIS mapping techniques, and qualitative and quantitative analysis using maps, graphs, charts, and tables were covered in the results section.

The fifth chapter discusses the verdict and advice. The conclusions of the paper are outlined concerning the research questions. The suggestion is supported by the answers to the research questions.

## CHAPTER TWO

### 2. LITERATURE REVIEW

#### 2.1 General Overview

The impact is the action of one object coming forcibly into contact with another. (Oxford Languages). The impact of the Industrial Park is a consequence that comes with forcibility on the surrounding physical settlements by the cause of the introduced Industry Park. ‘Since the Industrial Revolution, cities and industry have evolved together, company towns and entire metropolitan regions have grown around factories and expanding industries. However, despite this shared past, popular notions of manufacturing tend to highlight the negative aspects: pollution, environmental degradation, and the exploitation of labor caused by growing industry, on the one hand; and – almost paradoxically on the other – the blight, abandonment, and “shrinkage” resulting from the more recent decline of manufacturing from cities in the developed world. (Tali Hatuka, Eran Ben-Joseph, 2014)

#### 2.2 Physical Settlement

A "settlement" is a community made up of residential structures; it serves the same purpose as a shelter does for a home or family. Settlements in (small and big) towns and cities are supported by urban settlement alternatives. A territory's patterned landscape gives rise to a human settlement. While maintaining equilibrium between population needs, resource availability and allocation, economic dynamics, the improvement of living conditions, the provision of services, improving transportation networks, as well as recreational spaces, it takes into account the spatial allocation of functions. A settlement must take into account the requirements of the entire community and be created with the active participation of those who are of concern, partners, and all sectors.

The settlement describes the actual locations and settings where households are housed as well as the connections between those locations. The phrase is frequently used to refer to temporary or occasionally permanent housing arrangements of displaced families in the context of displaced populations. Settlements in this setting can include planned camps, dispersed housing in host villages or neighborhoods, collective centers, impromptu camps, rented housing, etc.

In an urban agglomeration, such as a town or city, displaced residents settle in urban settlements. Typically, a master plan separates towns or cities into zones that are governed by standards based on particular industries like housing, cleanliness, habitat, and environment. Residential areas, services, infrastructure, and places for business, industrial, and commercial operations are all included in zones.

Because there is a shortage of land in cities and towns, people of concern sometimes settle in underdeveloped or marginalized regions, which have problems with access, service accessibility, sanitary conditions, and shelter availability. The urban poor may mix in with the displaced populations, making targeted help difficult but even more crucial to make sure resources reach the intended receivers. (<https://emergency.unhcr.org>)

## **2.3 Industrial Park**

An industrial park is a portion of a city that is zoned for industrial use rather than residential or commercial needs. Industrial parks may contain oil refineries, ports, warehouses, distribution centers, and factories. Some industrial parks offer tax incentives for businesses to locate there, such as tax increment financing. (James Chen, Investopedia July 2023).

The model of industrial parks has been built and developed in countries as an effective capital mobilization channel to achieve socio-economic goals such as economic development of localities where industrial parks are built and put into operation, animate the development of service industries, supporting industries, job creation, boost income for local people and surrounding areas (Benayas et al., 2007; Bryceson, 1996; Thuận et al., 2018).

### **2.3.1 Eco-Industrial Parks:**

Eco-Industrial Parks most closely resemble the Industrial Parks identified previously, but they are organized around the common goal of environmental sustainability. Innovation Clusters are designed to benefit from agglomeration: that is, individual firms in similar industries can increase their productivity through their proximity to one another. These tend to be vertically integrated, including research, administration, production, and distribution. This chronological evolution had an enormous economic, social, and spatial influence on cities and contributed to the creation of three contemporary prototypes of industrial spaces: the integrated, the adjacent, and the autonomous, as follows. (Cohen, 2187)

### **2.3.1.1 Integrated.**

Residential, commercial, and industrial land uses are fused or closely located in space. Often resulting from (unplanned) growth, manufacturing is an integral part of the city's structure. Different use- areas do not have clear, distinct borders and tend to dissolve into each other across the urban fabric

### **2.3.1.2 Adjacent.**

Industrial and residential land uses are segregated by design and policy into distinct areas of the city (often via a physical barrier or natural elements), in an attempt to isolate incompatible land uses and prevent environmental hazard

### **2.3.1.3 Autonomous.**

Standalone industrial/business parks or large factories are suited to work autonomously. Functioning as independent campuses, industrial areas are surrounded by open spaces and located in proximity to railways, highways, and airports, prioritizing the efficient movement of materials, goods, and laborers. These prototypes — integrated, adjacent and autonomous — demonstrate three idealized stages in the separation of manufacturing from the city, the strengthening of the central management of industrial zones, and the influence of international companies on local economies and physical spaces. (Hatuka, 2014)

## **2.4 Industrial Urbanism**

Industrialization is present everywhere; in each product, we consume and use. Yet industrial production often takes place elsewhere, distant and detached from our daily routines and living spaces. The industry is something we rarely think about. This physical and perceptual distancing is connected to the way capitalism and planning have radically altered and alienated relationships between workers, products, and consumers. But this process of instantiation is gradually changing with the emergence of innovative technologies that cultivate new thinking about the interface between the city and industry. This new interface is not a radical shift but another phase in an ongoing city–industry dynamic that spans more than a century. The initial phase can be traced back to the First Industrial Revolution when water and steam were used to mechanize production. The mechanization process changed the social and physical fabric of cities, which functioned as labor pools and logistical hubs. The period of initial industrialization was characterized by

environmental degradation and increased pollution, resulting in the desire to separate industry and manufacturing from housing – an attitude that was further enhanced during the Second Industrial Revolution, with the increased use of electric power to support mass production. Planners, architects, and social reformers responded to this dynamic by putting forward propositions for a new model of an ideal industrial city. Towards the end of the 19th century, these models ranged from the design of new mill towns to the establishment of novel sets of zoning regulations to handle factories’ nuisance activities, leading to the establishment of stricter environmental laws and regulations. During the mid-to-late 20th century, the Third Industrial Revolution, which expanded automated production and the use of electronics and information technology, started a process of deindustrialization, especially in Europe and the US. Countries transformed their industrial activities and utilized urban planning tools to further segregate industry from other land uses. This position of disfavoring manufacturing, coupled with zoning practices that favored residential development above all other uses (especially manufacturing), led to the development of industrial parks in rural areas and a loss of industrial land in cities. The Industrial Revolution dramatically impacted the development of cities and the countryside. Each transformation left its spatial mark on the physical fabric, often without eliminating the footprints of the previous phase. This continuum resulted in three key spatial forms of industry–residential relationships: (1) integrated, in which there is a fusion or proximity of residential and industrial uses; (2) adjacent, in which there is planned segregation between the industrial and residential areas of the city; and (3) autonomous, in which standalone industrial/business parks or large factories are isolated from any existing settlements. Yet industrial changes have not stopped, but continue to have a spatial impact. The Fourth Industrial Revolution is pushing city governments, as well as planners and architects, to reconsider a more integrated city–industry dynamic in what is defined in this article as ‘New Industrial Urbanism’. (Tali Hatuka and Ben-Joseph, *New Industrial Urbanism: Designing Place of Production*, Routledge, forthcoming.)

## **2.5 Relationships between Urbanisms and Industrial Parks**

The relationship between cities and industry is constantly evolving. The industrial revolution spurred large-scale urbanization as new technologies enabled the adoption of water wheels, coal-fired steam power, and intercity railways, dramatically changing the urban landscape. From a

historical perspective, we can identify four key periods in the evolution of city-industry relationships (Tali Hatuka, Eran Ben-Joseph, 2014)

### **2.5.1 Mercantile City**

Pre-Industrial Revolution. The primary mode of production in this period was artisanal manufacturing in individual households; therefore, manufacturing activities were closely integrated with residential and commercial activities. The merchants' town that grew from the trade of goods and wholesale products became one of the defining patterns of urbanization in Western civilization. (Tali Hatuka, Eran Ben- Joseph, 2014)

### **2.5.2 Industrial City**

1750 – 1880. The evolution of textile manufacturing and steam-engine technologies revolutionized production processes. Consequently, cities experienced unprecedented population increases, with manufacturing driving urbanization and economic growth. (Tali Hatuka, Eran Ben- Joseph, 2014)

### **2.5.3 Planned City**

1880 – 1970. Toward the end of the 21st century, planning models suggested zoning regulations handle the problem of factories' nuisance activities. The attempt to provide healthier living conditions for factory workers took shape in the form of company towns and Garden Cities, which later served as a prototype for towns built after the end of World War II.<sup>8</sup> Countries such as the United Kingdom, Israel, Russia, Iran, Sweden, and Japan also implemented these principles in the construction of new towns, designating industrial lands as part of newly planned cities; however, these industrial areas were typically situated with the lowest possible effect on residential areas. (Tali Hatuka, Eran Ben- Joseph, 2014)

### **2.5.4 Perineal City**

1970 – present. During the 1970s, many countries, especially in the Western world, experienced rapid deindustrialization, and planning tools were developed to further segregate industrial activities from other land uses. The trend against locating manufacturing next to other uses, coupled with Euclidean zoning practices that essentially prioritized residential and commercial uses of real estate over all others, particularly manufacturing, resulted in a massive loss of industrial land to commercial and residential uses in many cities. This trend in urban planning

theory and practice further increased the divide between home and work, as the desire to maintain real estate values pressured development away from lower-valued industries towards other, more profitable uses. (Kim, July 2013.) The diagram depicts abstract relationships between industrial typology and geographical location. Storage & Distribution facilities are located in the hinterlands and tend to be sited where land values are the lowest. Industrial Parks are typically located far from city centers, either in the country or suburbs or on the urban periphery. This form emerged after World War II and often dominates the industrial landscape today. Office parks are similar to industrial parks but tend to support service industries, which are less land-intensive and depend less on rail and water transportation. They typically contain dense concentrations of white- and pink-collar employees, and due to their smaller footprints (and lack of harmful industrial waste), they may be located within cities. Legacy Urban Factories exist within the city itself, even within Central Business District. These factories have often been grandfathered into cities that have otherwise made industrial uses illegal through land-use regulations. (Tali Hatuka, Eran Ben-Joseph, 2014)

## **2.6 Ethiopian Industrial Parks**

Ethiopia's industrial parks, now consist of 10 active sites, 189 companies, and 71,000 employees. On the positive front, industrial park exports rose 16 percent to \$165mn this past year and they now make up nearly half of the manufactured exports. However, their export performance is well below expectations, especially as the COVID pandemic reduced monthly exports and employment starting in April 2023. Looking ahead, though some long-standing challenges remain (labor and logistics), the coming online of additional industrial parks, some switching in product mix by existing companies, and the now much more favorable exchange rate could bring gradually improving prospects. Ethiopia's industrial parks are a core component of the Government's plan to make the country a leading exporter of manufactured goods in Africa. Their performance is thus a key barometer of progress in this area and towards these aims. (Cepheus Research & Analytics, September 18, 2023 Ethiopia's Industrial Parks: A Data Pack on recent performance)

## **2.7 Research Gaps**

The majority of Ethiopian study has concentrated on assessing urban growth and its socioeconomic implications on the way of life of rural inhabitants in peri-urban areas (Ahlam, 2017; Abebe, 2012; Beka, 2016; Adem, 2010; Efa & Gutema, 2017; Firew, 2010; Tamirat, 2016; Kaleb & Samuel,

2017; Leulseged et al., 2011 and Shishay, 2011). Their main areas of study are urbanization, its effects on the environment, and the socioeconomic effects of population increase on the farming community's way of life in peri-urban areas. As a result, they didn't display detailed research on the trend map for urban expansion, the development pattern, the configuration, the growth direction, the measurement of the rate of spatial change, the quantity of land use and land cover change, and the direction of future growth. In Ethiopia, studies on urban growth and its effects utilizing GIS and RS approaches, especially for various urban-related studies, are often low, and as a result, the body of literature in the field is small.

One study was conducted by Diriba et al (2016) In the peri-urban kebeles of Dukem town, this study sought to identify the main drivers of urban sprawl and the effects it has on the conversion of land uses. It was found that urban sprawl has significantly increased agricultural land conversion (ALC), which harms agricultural land and production.

According to the study, the primary causes of ALC that harm the amount of arable land and food crop production in the town's hinterlands include industrial development, residential growth, and infrastructure development. However, there hasn't been much discussion about measuring horizontal expansions using GIS spatial analysis tools and remote sensing methods to characterize urban expansion characteristics, implications of LULC changes, and major aspects affecting land management, highlighting the need for future research. By focusing on this field, this study attempted to add to the scant literature on the main drivers of land use and land cover (LULC) change, horizontal expansions measurement using GIS and RS techniques to specify the characteristics of urban expansion in different periods in the case of Dukem town, including what the factors are and who is accountable for the town's expansion. (Girum Sisay 2022) also explored the topic of An Investigation of Urban Expansion, Land Use, and Land Cover Dynamics: The Case of Dukem Town, Oromia Special Zone.

As a result, the purpose of this research was to show how the development of the Eastern Industrial Zone affected the physical settlement patterns in Dukem Town over the past 15 years (EIZ). The study's goal is to show how much agricultural, open space and green space has been incorporated into the built-up region and the town's future.

## CHAPTER THREE

### 3. MATERIALS AND METHODS

#### 3.1 Study area Description

The research was carried out in Dukem Town, Oromia Regional State, Ethiopia, as well as the neighboring districts of the Eastern Industry Zone. Zone of Eastern Industry Dukem settlement is 37 kilometers southeast of Addis Ababa on the main road to Adama. Geographically, the research area is defined by latitude 8045'25"N-8050'30" N and longitude 38051'55"E-38056'5" E, and it encompasses a total area of 9630.6 hectares. It is situated at an elevation of 2100m above sea level on average (OUPI, 2017).

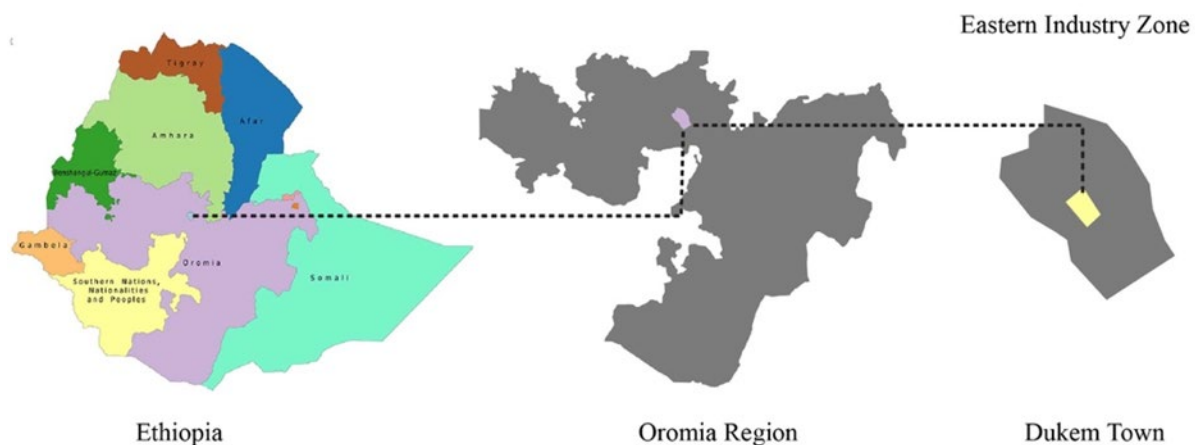


Figure 3. 1: Location map of Dukem Town and Eastern Industry Zone

(Data source: Generated by the author (2023))

#### 3.1.1 Dukem Town Urban Settlement

Since the construction of various dwellings, manufacturing, service industry, and institutions, the town has seen significant progress. Because of its proximity to the capital city of Addis Abeba and its economic importance, the population is fast increasing. Population increase, combined with industrialization, has resulted in fierce competition for land resources. (OUPI, 2017).

The railroad, the major highway, and the feeder roads that connected the rural areas with the town all had an impact on the settlement of Dukem town. The first is the southern slope of the hill, which faces the marketplace. The settlement layout was thus restricted to the south, following the railroad and the main right route. This lasted into the 1980s. Later, due to a change in market locations, the direction of Cover was also modified to follow the bank of the Dukem River. Quarter names like "Yerer Bar" and "Cuqqala Bar" were developed. Cover to the southward resulted in the establishment of a neighborhood known as "Quallaa Dhaab" (OUPI, 2009 cited in Abebe Ambaye).

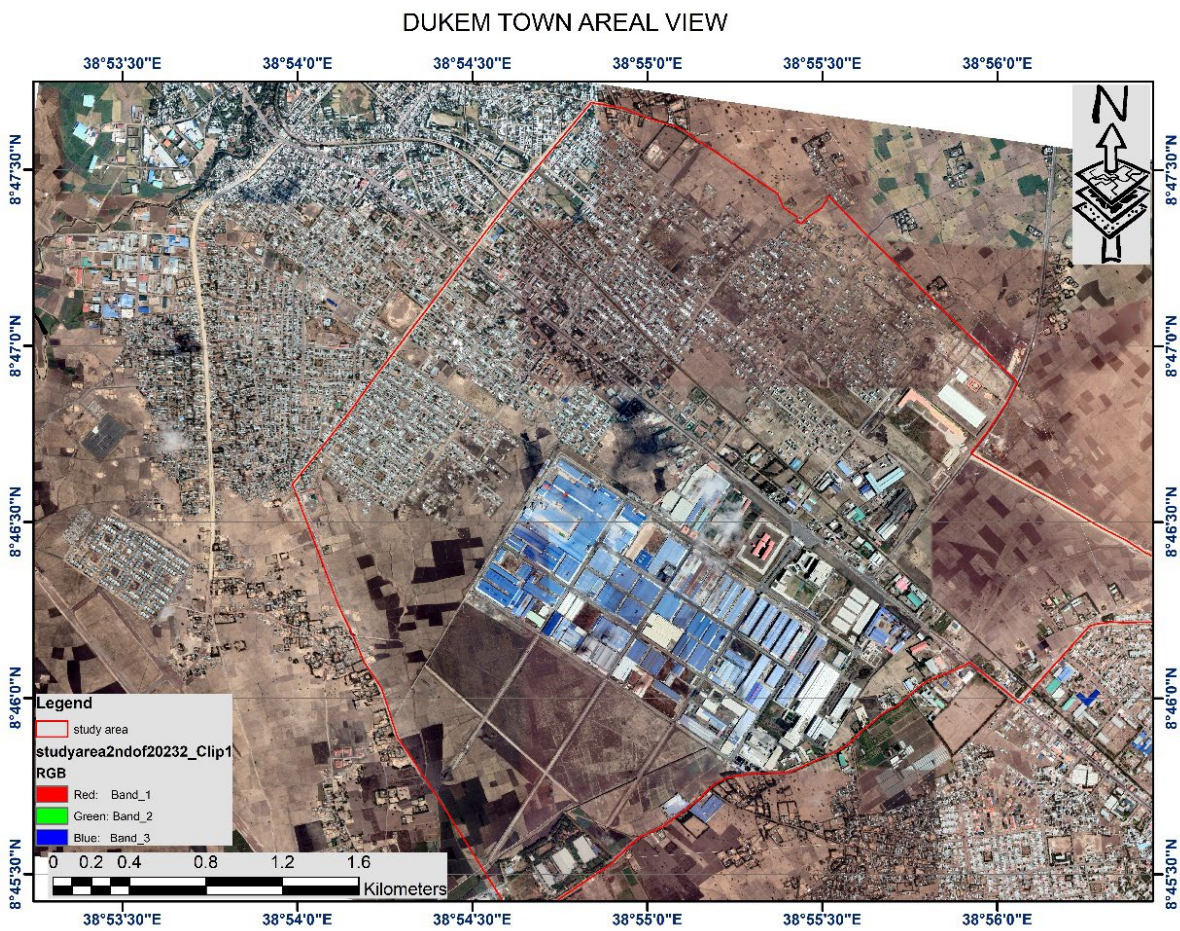


Figure 3. 2: Aerial maps of Dukem Town 2023

(Data source: Generated by the author from Google Earth satellite image (2023))

### 3.1.2 Eastern Industry Zone

Initially, the total planned area of the Eastern Industry Zone was 5 square kilometers, with Phase I (2.33 square kilometers) planned for 6 functions like residence, commerce, industrial warehousing, road, public utilities, and, greenery, etc. Its Industrial Orientation has to mainly cater to markets' demand in Ethiopia and other African countries in the fields of textile, leather, building materials, machinery, and, electronics industries. At the same time, Eastern Industry Zone was devoted to developing auxiliary service industries such as warehousing, logistics, commerce, and catering to form an integrated economic zone-based processing industry. (Skyscraper City July 5, 2009)

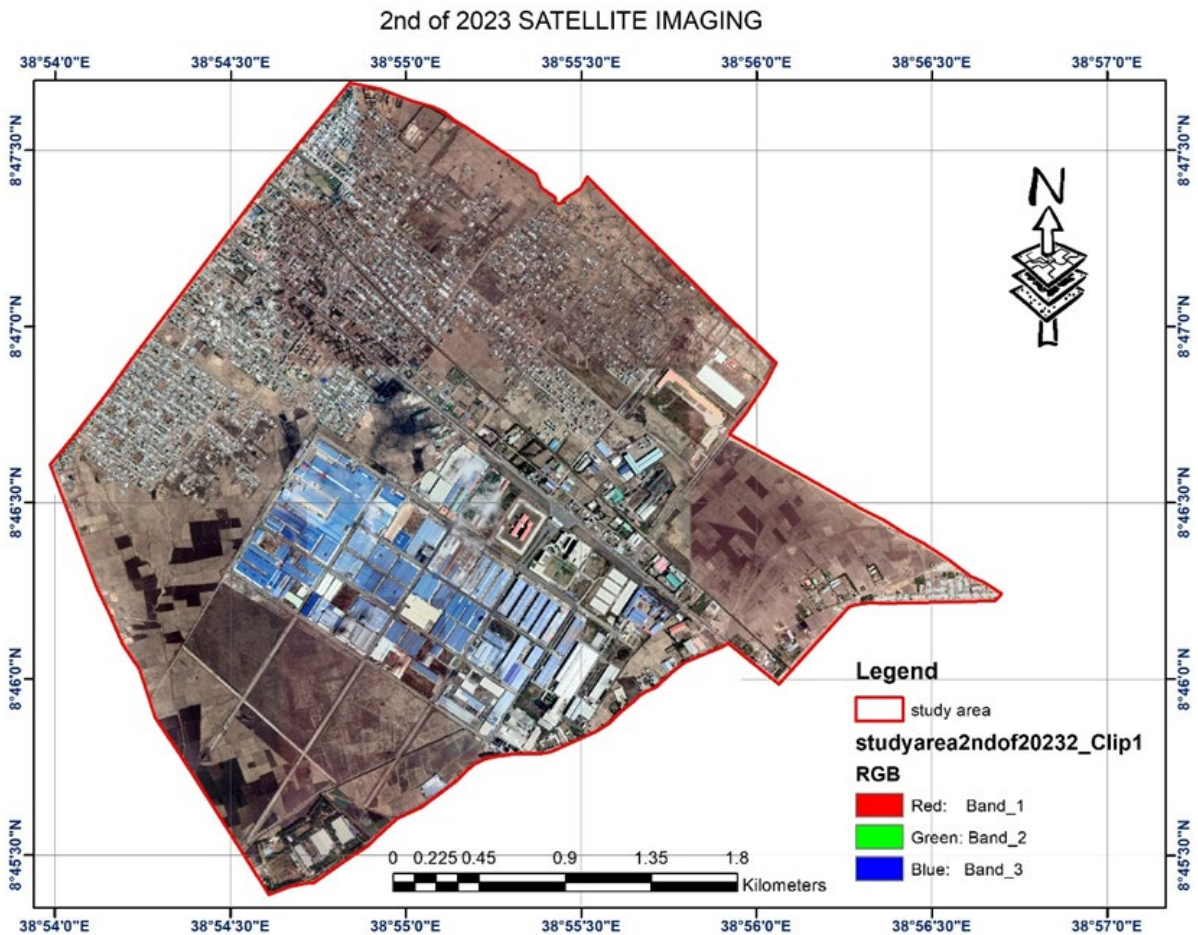


Figure 3. 3: Aerial Map of Eastern Industry Zone 2023

(Data source: Generated by the author from Google Earth satellite image (2023))

### 3.1.3 Physical Characteristics of the study area

#### I. Area and Planning

Dukem settlement is more stretched out along the asphalted roadway that connects Addis Ababa and Bishoftu. There is less elongation of the settlement in places where infrastructure development is lacking. Dukem town has a land area of 963 hectares. Dukem town's shape research indicates that it has more south-north extension (OUPI, 2017). The proposal for the eastern industrial zone in 2007 was to build a 500-hectare zone. The Ethiopian government began land acquisition that same year. However, the project was halted in 2009 due to the Global Financial Crisis but resumed in 2010 with funding from the Export-Import Bank of China, and the Zhangjiagang municipal and Jiangsu provincial governments. Construction accelerated afterward. According to multiple years of satellite imagery of the zone area (Table 1, Figure 3). Land development both inside and surrounding the EIZ was easily discernible in 2015. In 2016, additional factory sheds were built, enclosed land was developed, and new development was made in the surrounding area. (Fei, Ding, 2018. Work, Employment, and Training Through Africa-China Cooperation Zones: Evidence from the Eastern Industrial Zone in Ethiopia.

Table 3. 1: Occupied and Constructed EIZ Area (in hectares)

Year	Area Occupied (Ha)	Constructed (Ha)
2009	0	0
2012	60.48	12.04
2016	175.74	22.96
2018	175.74	63.99
2023	175.74	100.02

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

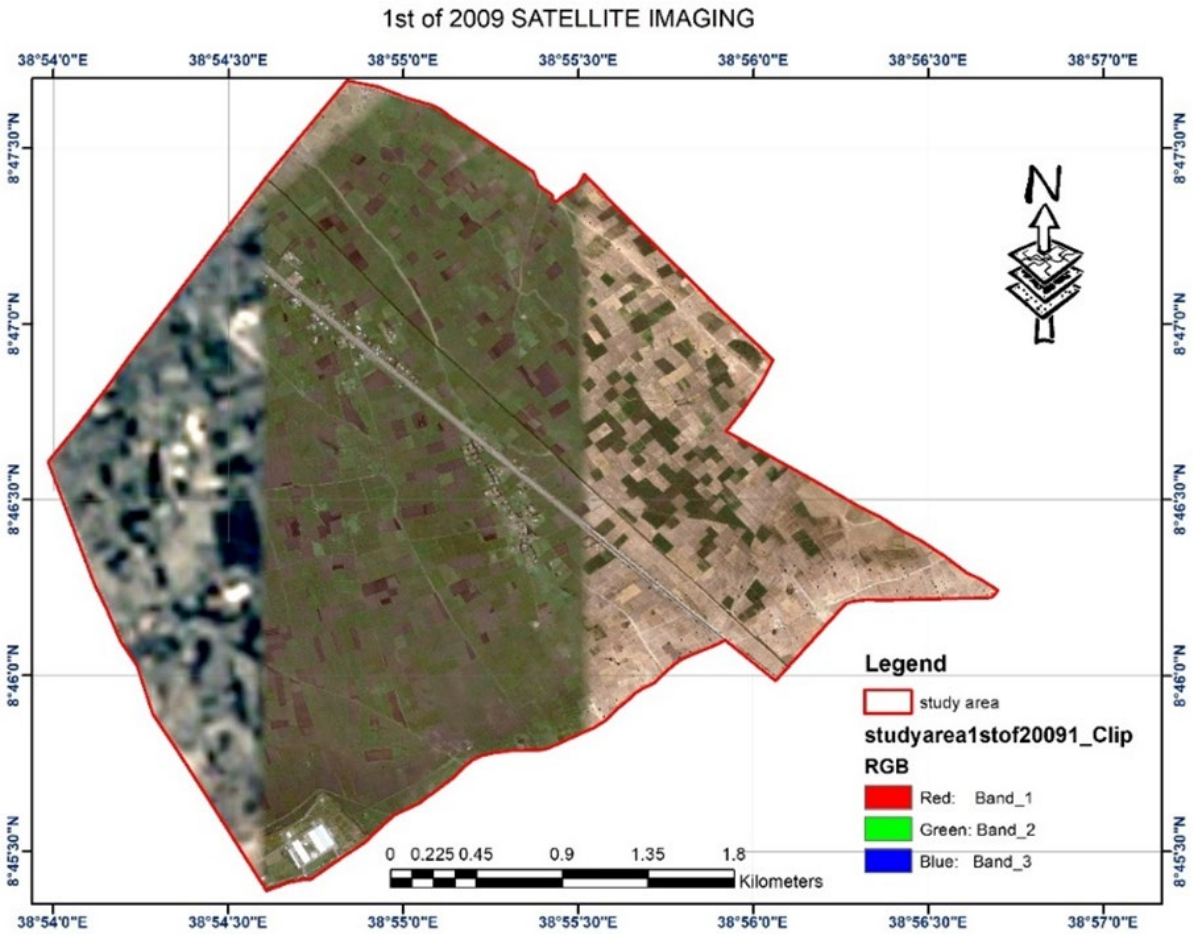


Figure 3. 4: Image of study area 2009

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

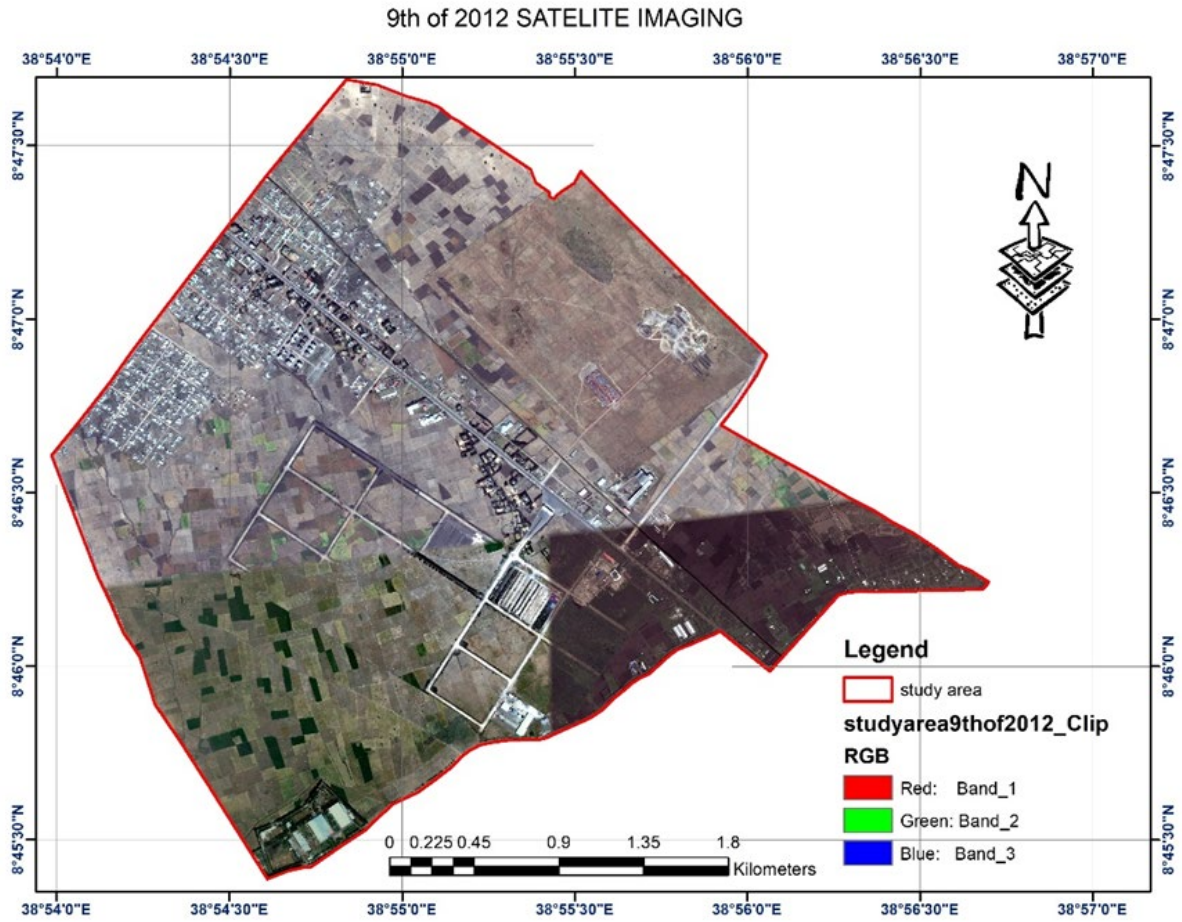


Figure 3. 5: Image of study area 2012

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

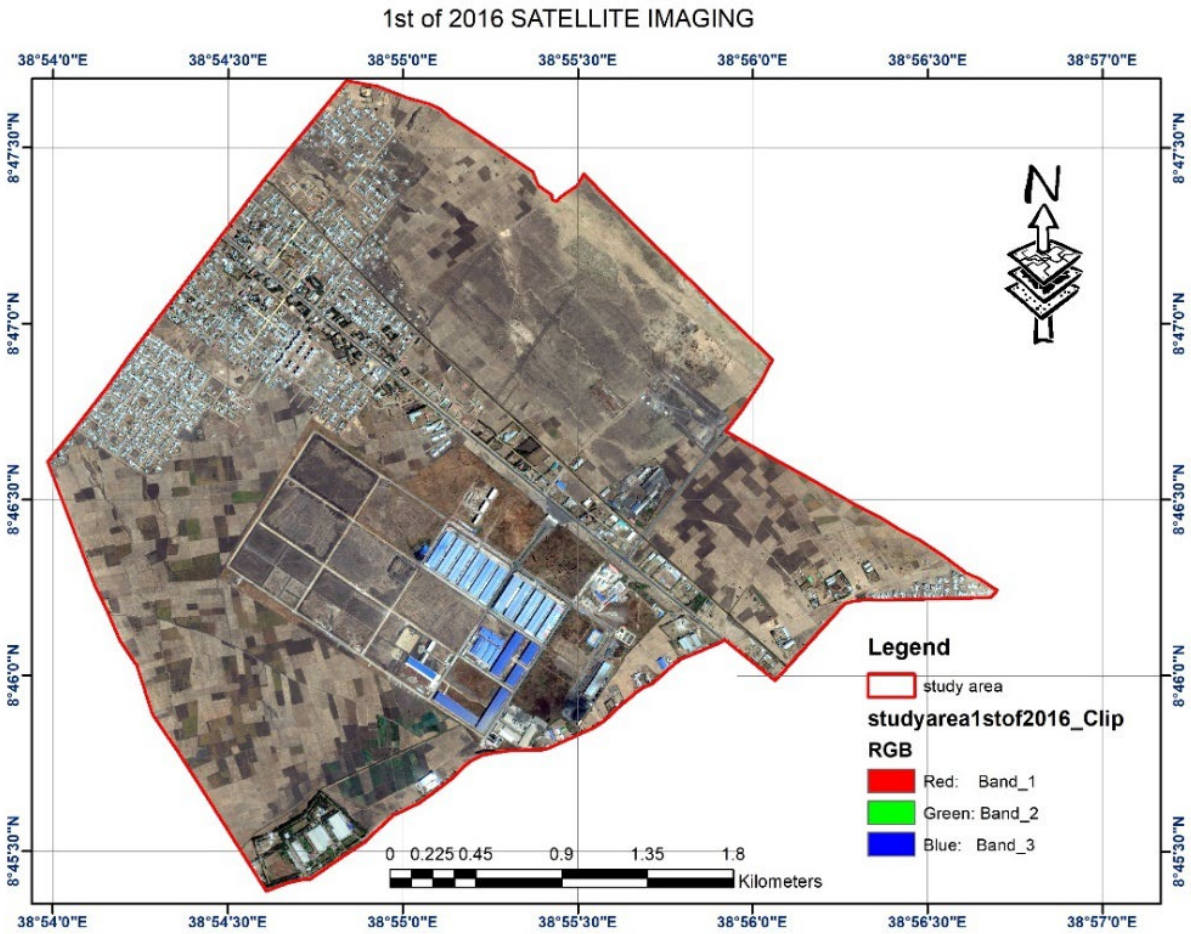


Figure 3. 6: Image of study area 2016

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

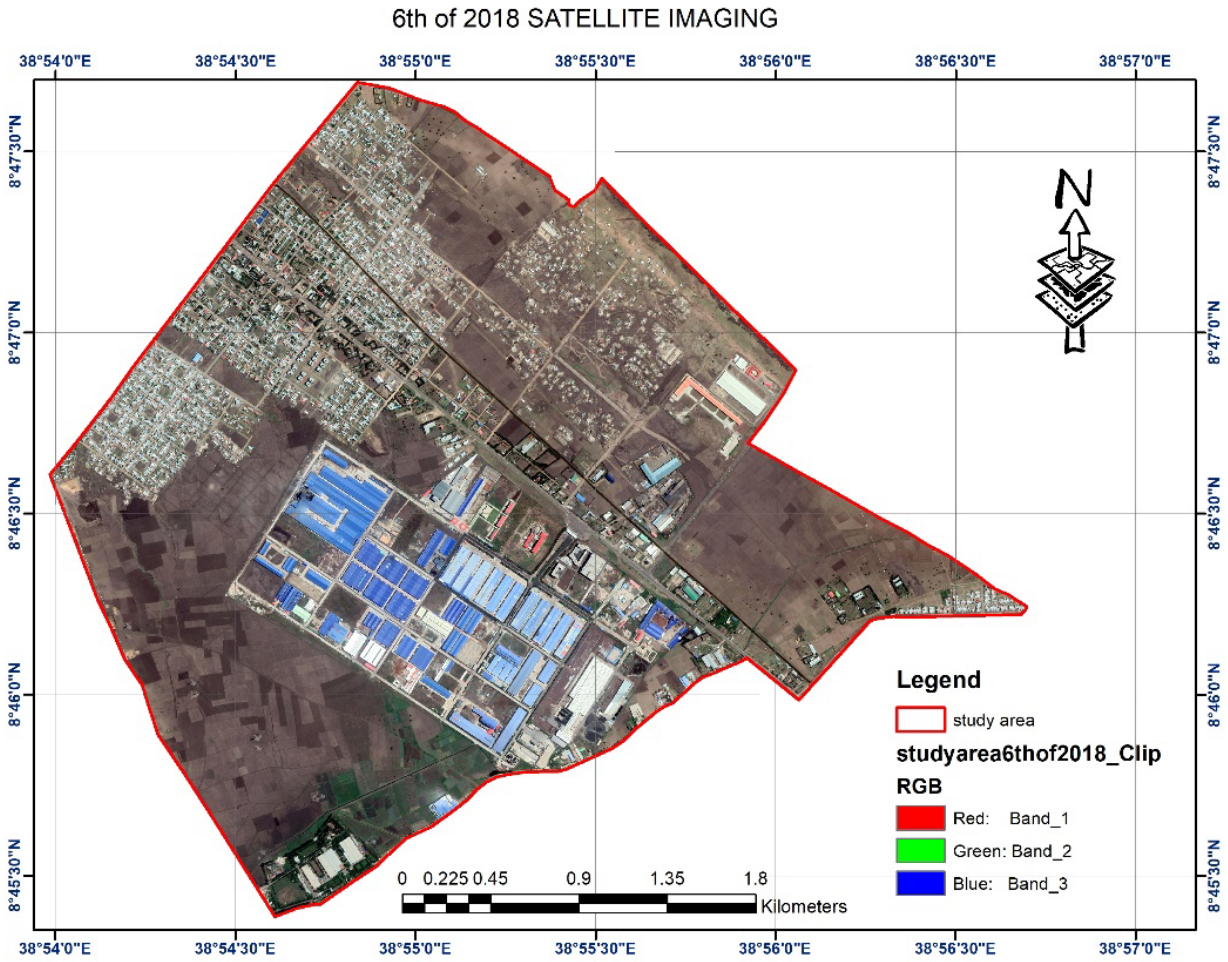


Figure 3. 7: Image of study area 2018

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

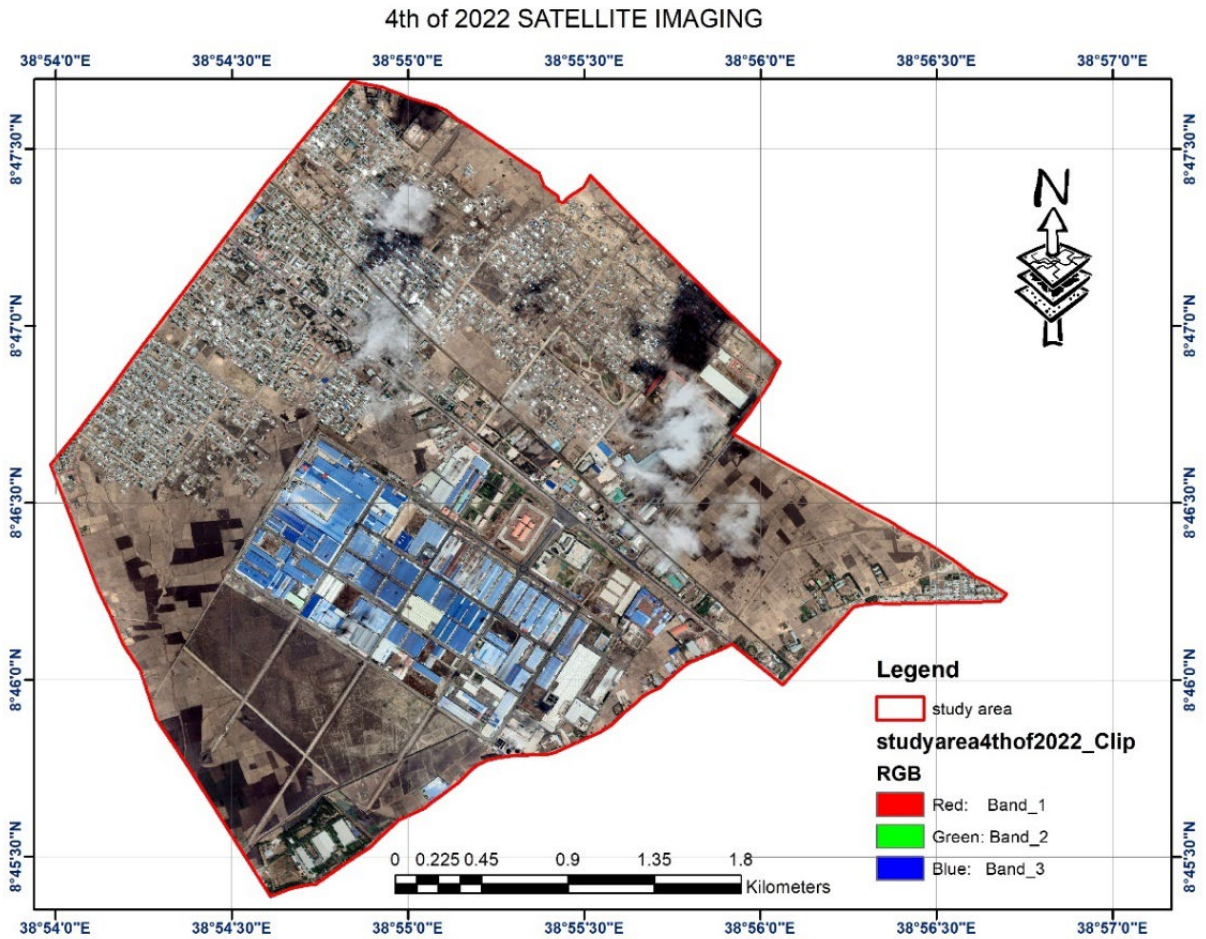


Figure 3. 8: Image of study area 2023

(Source: Measured by Author based on time series from Google Earth Satellite imagery (2023))

### 3.2 Research Approach

A descriptive research design was chosen in consideration of the assessment of spatial impacts of the Eastern Industry zone on the development pattern of the surrounding settlement of Dukem town. The strategy was chosen because it enabled clarification of the effects of EIZ on trends in urban Cover by mapping across time, as well as how this affected land use change. In this regard, both qualitative and quantitative methodologies as well as primary and secondary data sources were used to satisfy the study's stated objectives. Utilizing tools for data collecting including closed-ended and open-ended questionnaires, observations, and other primary data sources. Google Earth was used to gather the secondary data sources, which were then processed and evaluated using timelines in ArcGIS.

### 3.3 Research Design

According to Kothari (1984), a research design is the arrangement of a method for the collection and analysis of data in a manner that aims to combine relevance to the research purpose. It is the conceptual structure of conducting research from the start to the accomplishment (Table 3.2). To provide a more meaningful result and recommendation, the following procedure of the study was designed.

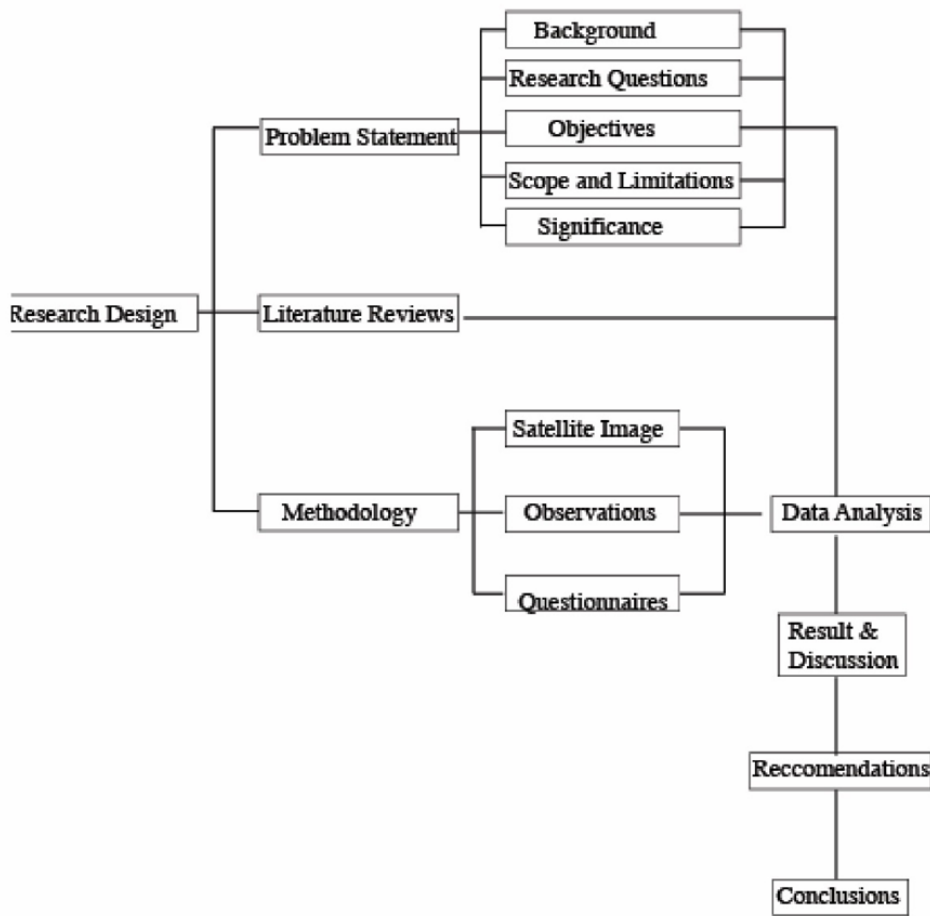


Figure 3. 9: Research Process Diagram

(Source: Generated by Author (2023))

### **3.4 Research Methods**

An important methodology for spatial analysis uses satellite photos of the research region to quantify the effects of the construction and Cover of the EIZ using chronological changes in pattern, which are then conclusively processed and analyzed using spatial mapping analysis. Graphs, pictures, and tables were used for data processing, data documentation, and for presenting the findings as percentages. To gather information about how the physical settlement was affected by the development of the EIZ, the researcher employed a survey approach with a variety of questionnaires from town inhabitants, government agencies, and long-term EIZ workers. Data processing software has been used to assess and compile the respondent's responses. Maps, tables, and graphs were used to organize, analyze, and show the data.

### **3.5 Data Type and Source**

The study will make use of both primary and secondary data sources, including both quantitative and qualitative data. Primary and secondary data are needed to carry out the study's objectives. One of the most important approaches for gathering data is through careful observations of the historical quarter. data collecting through talks, site visits, questioning, and the taking of demonstrative photos. Since it is regarded as a mechanism, many data analysis approaches, including timeline analysis with spatial, can be used to examine the stages of changes.

#### **3.5.1 Primary Data sources**

The primary sources were collected through questionnaires with positive and negative responses as well as verbal and nonverbal interviews with members of the public, officials of the government, and EIZ employees. Direct observation, photography, sketching, dialogue, and informal, cordial discussions were also conducted.

#### **3.5.2 Secondary Data Collections**

The secondary data source was collected from books, magazines, reports, articles, websites, and previous research documents from Dukem municipality, and satellite images are used as the main source has been listed in Table 3.2)

Table 3. 2: Secondary Data Source

No	Data	Year	Source	Platform
1	Satellite Image	2009	Google Earth	Landsat TM
2	Satellite Image	2012	Google Earth	Landsat TM
3	Satellite Image	2016	Google Earth	Landsat TM
4	Satellite Image	2018	Google Earth	Landsat TM
5	Satellite Image	2023	Google Earth	Landsat TM
6	Administrative Boundaries	2023	OPI	ArcGIS
7	Structural Plan	2023	OPI	CAD

(Source: Generated by Author (2023))

### 3.6 Data Collection Method

#### 3.6.1 Data Collection Instruments

A satellite image timeline technique, observations, and questionnaires. The extent of spatial impacts maps generated from satellite images quantify the Cover of the EIZ in Dukem town and its impacts on the physical settlements of the neighbor. The impact detection characteristics of physical settlements are used for measuring built structures such as houses, commercial buildings, and road changes in the study area, as well as identifying variations in settlement types by observing a specified area at different times using satellite images. Satellite photos from a specified study region were controlled and grouped to create themed maps for 2009, 2010, 2012, 2016, and 2023. Following that, ordered maps were completed and overlay to observe the changes in the area throughout time. The percentage change in escalation and/or decline of each category and year can be computed

#### 3.6.2 Primary data collection instrument

##### I. Questionnaires

Questionnaires were prepared in the form of lists and interviews, both in the form of Open and Close-ended questionnaires. Questionnaires' questions for the community, government officials, factory workers in addition officials, experts, and Dukem town to get the required information from the community could describe changes that resulted over time. Similar questions were used for all respondents. The survey questionnaire was written mostly in English and Afaan Oromo.

The researcher employed a similar questionnaire for all of the respondents in the sample. The study contained open-ended questionnaires to allow respondents to express any unlisted concerns about the elements and actors that contributed significantly to the consequences of the EIZ on the physical settlement of the neighborhood in Dukem town between 2009 and 2023. Furthermore, it is thought that the positive question aids in comparing the answer to the negative-ended inquiry. As a result, to ascertain town officials' and experts' viewpoints on the effects of EIZ on Dukem town between 2009 and 2023, there was a strong agreement to strongly disagree noticed.

## **II. Observations**

The researcher observed and collected the current actual physical settlements on the field during the study area. The researcher observed and collected the necessary visual information with the help of photographs and, sketches on the existence of the impacted area neighboring EIZ.

### **3.6.3 Secondary data collection instrument**

#### **I. Satellite Imageries**

Google Earth images for the years 2009-2023 were used as a source of data and gathered from the company's developed software to measure the impact of EIZ on the physical settlements of neighboring Dukem town. These data are used to generate historical land cover maps of the research area, as well as physical settlement Cover changes.

### **3.7 Data Sampling Method**

#### **3.7.1 The Sampling Method**

A purposive (judgmental or expert sample) sampling technique was used as a non-random sampling technique to select the representativeness of the target group from Dukem town government officials, EIZ workers, and neighboring communities because there was a variation in service year so that priority was given to service seniority. Another target group is community representatives. A purposive sampling strategy was also used since the communities have chosen were those who had resided in the area for 15 years or more, as they could describe changes that occurred through time and were thought to have more information than other existing new settlers in the town.

### 3.7.2 Sampling Frame

The population of interest from which the sample is drawn is referred to as the sampling frame. As a result, the respondents to this survey were members of the Dukem town society, government officials, and EIZ employees. To pick a sample size from the whole informant data for Dukem town society, government officials, and EIZ workers, as detailed in detail (Table 3.3). Based on this, data for the complete study population samples of society, government officials, and EIZ staff were collected and determined using sample size determination.

Table 3. 3: Sampling frame data used to identify Community

No	Population Targeted	Gender		Total Number
		Male	Female	
1	Dukem town government Staff	25	12	37
2	EIZ Employees	45	36	81
3	Neighboring communities	102	88	190
			Total	308

(Source: Generated by Author (2023))

### 3.7.3 Sample Size Determination

Different criteria, such as the study's goal and population size, influence sample size determination (Glenn, 2009). In addition to the study's objective and population size, three factors must normally be provided to establish the proper sample size: the level of precision, the level of confidence, and the degree of variability in the variables being studied (Miaoulis & Michener, 1976). There are numerous methods for calculating sample size. These include employing a census for small populations, replicating the sample size of similar research, and using algorithms to calculate the sample size. Using a sample size from a similar study means using the same sample size as studies similar to the one you're planning. Using formulas to compute a sample size is the use of one of the numerous formulas to calculate the required sample size for a given mix of precision, confidence, and variability. Purposive selection of informants was performed during the sample size selection phase. As a result, the first stage is to determine the sample size of all responders from Dukem town government officials, EIZ employees, and nearby villages. Because of the

modest population size, the sample size for this study was calculated using a simplified formula. The sample size is determined using the Yamane formula. Yamane (1967:886) offers a simple formula for calculating sample sizes (Glenn, 2009). As a result, with a 95 percent confidence interval and a 5 percent precision, the sample size for Dukem town government officials, EIZ personnel, and bordering villages in the town was 51, as computed and shown below in Equation 1)

Equation 1:

Where:

n = required sample size)

(N = Study Population)

(e = level of precision = 95% confidence i.e., e= 0.05%)

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

$n = \frac{308}{1 + 308(0.05)^2}$ ,  $n = (308/1.1025)$ ,  $n=279$

The sample proportional respondents' details were computed by dividing the total study population of each sampling frame by the total study population and then multiplying by a total calculated sample using the above formula, and the results are summarized as shown in (Table 3.4)

Table 3. 4: Sample size determination

No	Population Targeted	Total Number	Sample Size
1	Dukem town government staff	37	34
2	EIZ workers	81	73
3	Neighboring communities	190	172
Total		308	340

(Source: Generated by Author (2023))

Table 3. 5: Total sample size of each target population

No	Target Population	Sample Size	Selection Method
1	Dukem town government officials	12	Purposeful
2	EIZ workers	29	Purposeful
3	Neighboring communities	10	Purposeful
	Total	308	340

(Source: Generated by Author (2023))

As a result, 308 respondents from Dukem town society, government officials, and EIZ workers' towns were considered for the poll, as mentioned above (Table 3.5). Because of the variation of service years, a purposeful non-random sampling technique was utilized, with seniority taking precedence. The communities chosen were those who had been in Dukem town for 15 years or more since they could describe changes that occurred through time and were thought to have more information than other existing new settlers in the town.

### 3.7.4 Sample Years for Trend Analysis

The years 2009-2023 were chosen as input to map the consequences of the EIZ on the physical settlements of Dukem town since the EIZ development was rapid during those years; for additional explanation, the primary causes considered are explained in detail (Table 3.7).

Table 3. 6: Criteria of the selection of years

No	Sample	Selection Requirements
1	2009	To assess and demonstrate the amount of land usage before the establishment of the Eastern Industry Zone (EIZ).
2	2012	To assess and display the amount of Initial Development EIZ in Dukem Town and its surrounding areas.
3	2016	To assess and display the level of urban cover land cover change as a result of the construction of EIZ and related infrastructure.
4	2018	To measure and display the amount of development in Dukem Town's Second Phase EIZ and neighboring areas.

5	2023	To quantify and demonstrate the level of change in urban cover and physical settlements as a result of the development of EIZ, other manufacturing industries, residential buildings, roadways, and unidentifiable squatters.
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(Source: Generated by Author (2023))

### 3.8 Study Variable

For the study, study variables such as respondents' backgrounds, urban Cover driving causes and actors, land use characteristics, and rate of change were used to assess the consequences of EIZ on physical settlements and urban Cover change in the case of Dukem town. Address, gender, age, place of birth, degree of education qualification background, occupation, workplace, job position, and year of service in this position were variables evaluated for town community and government office employees (experts and officials). The factors considered in this study as determinants of the impact of the EIZ take various forms, but the most visible forces are variables such as housing preference (demand for more living space and better housing conditions, informal access to land, the establishment of industries and manufacturing, and development in road infrastructure and transportation. Investors, the community, and local farmers are among the primary actors who significantly contribute to the EIZ's influence. The detection properties were utilized to evaluate the spatial change in the research area. For this reason, the following physical settlement factors were chosen: a built-up area, an agricultural area, a green area, bare land/open space, and a forest. The total areas covered by each class were computed for each study year, and the amount and rate of change for each land cover class were examined. The variables employed in this study, as well as their analysis and measurement procedures, are outlined and provided in full in (Table 3.7).

Table 3. 7: Description of the study Variables

No	Variables	Types	Assessing Techniques
1	Gender, Age, Birthplace Education level Qualifications, Occupation, and year of service	Independent	Descriptive statistics graphs
2	Establishment of industries & manufacturing, Housing preference, Informal access to land, and Land Grabbing	Independent	Descriptive statistics graphs

3	Private Investors, Government officials, Community, and Local Farmers	Independent	Descriptive statistics
4	Agricultural land, green space, undeveloped land, and forest	Dependent	Maps and Charts
5	Rate of change	Dependent	Charts and Graphs

(Source: Generated by Author (2023))

**3.9 Data Processing Method**

**3.9.1 Data Processing Method**

The study's data processing involves the input of satellite photos for the fifteen years 2009, 2010, 2012, 2016, and 2023, image preprocessing, image classification and categorical map production, accuracy assessment, and physical settlement impact analysis.

**3.9.2 Data Image Method**

Image processing begins with photographs obtained from Google Earth software downloaded from the official website, followed by an analysis using a pattern on arc GIS to ensure the correctness of images with physical settlements on the ground. As a result, the classifications of those photos are done using the scheme provided, relying on the visual interpretation of the satellite images to achieve the goal of this research, which is to quantify the existing and predicted impacts of EIZ on the spatial settlement surrounding Dukem Town. The key Five (5) Categories chosen for categorization are depicted in (Table 3.8)

Table 3. 8: Major categories applied for classification of the study

No	Category	Description
1	Industrial Zone Cover	Areas covered from the initial phase to the current status
2	Residential Cover	Parts enclosed include all developed areas buildings, housing units,
3	Commercial Cover	Areas Covered by commercials
4	Street Cover	Extents shielded include all developed areas roads, trails, and access
5	Agricultural Land Cover, Bare, Green, and Forest	Agriculture and agricultural production are explored in detail (grazing). Areas covered by any type of vegetation, i.e., not constructed and covered by trees forming closed or nearly closed canopies

(Source: Generated by Author (2023))

### 3.10 Data Analysis Method

The study relied heavily on analysis methods such as trend analysis, change detection analysis, spatial coverage rate analysis, and qualitative data analysis.

#### 3.10.1 Trend Analysis

Since the impact has happened to the due yearly Cover of EIZ and other physical settlements following the change over some time trend analysis is considered in this study as analyzing method and presented by using Sketch, table, figures, charts, and Reports.

#### 3.10.2 Change Detection Analysis

The following phase is land cover change detection (LULC) change detection and spatial Cover analysis after finding the land cover characteristics in the image processing, image classification, and category map generation, reclassification section. The technique of analyzing the spatial and temporal land use/land cover change in the research area is known as land cover change detection (Ahlam, 2017). (Girum,2023). It involves the identification of variations in land cover types by viewing a specific area several times and using multi-temporal data sets derived from satellite

photos (Sewunet, 2017). Spatial-temporal satellite pictures of a specific geographic area were processed and classed to create themed maps for 2002, 2010, 2012, and 2016. The classified maps were then compared and overlaid to depict changes in the area through time. It is also feasible to compute the amount of increase or reduction in each category and view the change in percent in each year by using the formula described in (Sewunet, 2017). (Equation 2).

Equation 2

$$\text{Change in \%} = \left[ \frac{\text{Total Area in } T_2 - \text{Total Area in } T_1}{\text{Total Area in } T_1} \right] 100 \%$$

Where T1 is the earlier point in time in the series and T2 is the later or most recent point in time.

### 3.10.3 Spatial Cover Analysis

As a result, the Spatial Cover Rate Analysis used to comprehend the dynamic degree of spatial structure is an indicator that can reflect the rate of spatial Covers and was derived using the formula (Sewunet, 2017) as shown in the figure (Equation 3).

Equation 3

$$\text{DC} = \left[ \frac{\text{BA}_2 - \text{BA}_1}{\text{BA}_1} \times \frac{1}{T_2 - T_1} \right] 100 \%$$

Where DC denotes the dynamic change rate of urban Cover over time, T1 and T2 are specific years, BA1 denotes the total built-up area at time T1, and BA2 denotes the total built-up area at time T2. The total area covered by each class in each study year will be computed, and the amount and rate of change for each land cover class will be examined.

### 3.11 Software and Tools

Because the purpose of this study is to analyze the impact of EIZ on the spatial settlements neighboring Dukem town, the ArcGIS 10.2 software program was primarily used for data processing and urban Cover trends measurement in this study, and the details of tools and software program used are shown in (Table 3.9).

Table 3. 9: Software and Tools used for Research

No	Tools	
1	ArcGIS 10.2.2	Data analysis, management, and image processing are used to identify the path and row of the study area.
2	Google Earth	For time-based image analysis
	SPSS	To process statical data
3	Photography	For place Capturing
4	Adobe Suite	For Graphics and Presentation
5	MS word and Excel	For writing and Computations

(Source: Generated by Author (2023))

### 3.12 Methods and Materials Validity

To ensure the legitimacy of the research methodology, materials, and thesis outcomes, the following steps are taken. The data obtained through the simultaneous application of quantitative and qualitative approaches add to the value of the conclusion. Referring to the work of other researchers, consulting advisers, and experts on topics requiring their expertise, and cross-referencing information and data were all accomplished using survey questionnaires and data acquired from the town's concerned offices and community. Various Dukem town profiles, as well as produced and published materials, were also used, as were prepared and published materials on the subject. Almost all office respondents are professionals or experts in their field, bringing them closer to the subject at hand and assisting the researcher in ensuring the accuracy and authenticity of the data acquired. Remote sensing also provides the spatial and temporal dynamics of the mechanisms behind urban growth and land use change, as well as consistent historical time series data (Herold et.al., 2003). Geographic Information Systems (GIS) (GIS) As a result, multiple scholars have already proved that the method is useful for mapping urban zones and serving as a data source for studies and models of urban expansion and changes in land use and cover (LULC). Furthermore, analyzing the accuracy for each category as well as the overall image is critical for comparing the results of different categorization algorithms as well as the quality and dependability of the results provided.

## CHAPTER FOUR

### 4. RESULT AND DISCUSSION

#### 4.1. Introduction

This chapter discussed the principal findings of the study about the Assessment of spatial impacts of the Eastern Industry zone on the development pattern of the surrounding settlement of Dukem town. The results were discussed to achieve the objective of the study, which is to measure the existing and anticipated impacts of the Eastern Industry zone on surrounding spatial settlement, to identify the existing problems in the pattern spatial settlement of the surrounding area, and to evaluate the planning and future Covers of the Eastern industry zone. Using interviews, observations, RS, and GIS techniques between 2009 and 2023.

Since being separated into an industrial zone, Dukem has been growing quickly. In this study, an effort has been made to calculate the town's built-up growth from 2009 to 2023. Satellite pictures were used to estimate the spatial impact's size. The defined Dukem town boundaries are the main subject of the study. This covers an area that is roughly 4,245 hectares in size.

This chapter also covers the condition of the sample respondents. Following that, data gathered from Dukem Town government officials, EIZ employees, and adjacent villages were presented, analyzed, and interpreted. Through the use of positive and negative questionnaires, the respondents conducted surveys and interviews with individuals including Dukem Town government officials, EIZ employees, and nearby villages.

As a result, 308 people were questioned in person, including 32 EIZ factory workers, 11 villages near the EIZ, and 13 government officials. Of the 308 responders, every single one correctly completed all of the survey's closed-ended questions as well as its open-ended ones. While collecting data, the researcher focused on service seniority, degree of education, educational background, place of employment, job position, and year of service in the position to normalize data quality. As a consequence, 308 persons, including 32 EIZ manufacturing workers, 11 towns near the EIZ, and 13 government officials, were interviewed in person. Every single one of the 340 respondents properly answered all of the survey's closed-ended and open-ended questions. While collecting data, the researcher prioritized service seniority, degree of education, educational

background, place of employment, job position, and year of service in the role to standardize data quality.

## **4.2. Historical Background of Dukem town**

Urban areas typically develop as a result of people settling permanently near important political, religious, and commercial hubs. As a result, the development of a railway line between Djibouti and Addis Ababa in the late nineteenth century is responsible for Dukem's establishment as an urban hub. As a result, Dukem began to develop at the beginning of 1914, but because the site was under the landlord's tenancy and had not yet been parceled into a formal urban settlement under municipal administration, such cases as the issuance of trade licenses, taxation, and other related matters were handled and managed by the Bishoftu town municipality. Landlords gave renters to those who want land for various development objectives in the Dukem urban community. Houses in town were also owned by absentee landlords (OUPI, 2017). Then, the 1974 popular revolution changed the land tenure system in the country at large and thus changed the land tenure in Dukem and its surroundings. Although there was some progress in urban development during the revolutionary Derg period no fundamental transformation has taken place in this regard until the fall of the socialist military rule in 1991. Dukem has emerged as one of the industrial urban centers in the region and the country at large since the beginning of the 2000s and is known as the Eastern Industrial Zone (EIZ). It is one of the urban centers under reform by proclamation 65/1995 EC (2009 (OUPI, 2017).

## **4.3. Trend Detection and LU-LC Mapping**

The findings were reviewed to meet the study's goal of mapping the impact of EIZ on the spatial settlement of neighboring Dukem Town. Cover satellite pictures were utilized to determine the size of the urban area. The land use change trend has been detected using satellite photos processed by GIS, as illustrated in Figures (4.1 and 4.2). The findings were analyzed to achieve the study's purpose of mapping the impact of EIZ on the spatial settlement of neighboring Dukem Town. The size of the urban area was calculated using cover satellite images. The land use change trend was detected using satellite photographs processed by GIS, as shown in Figures (4.1 and 4.2).

### 4.3.1 Trending Detection Maps from 2009-2023

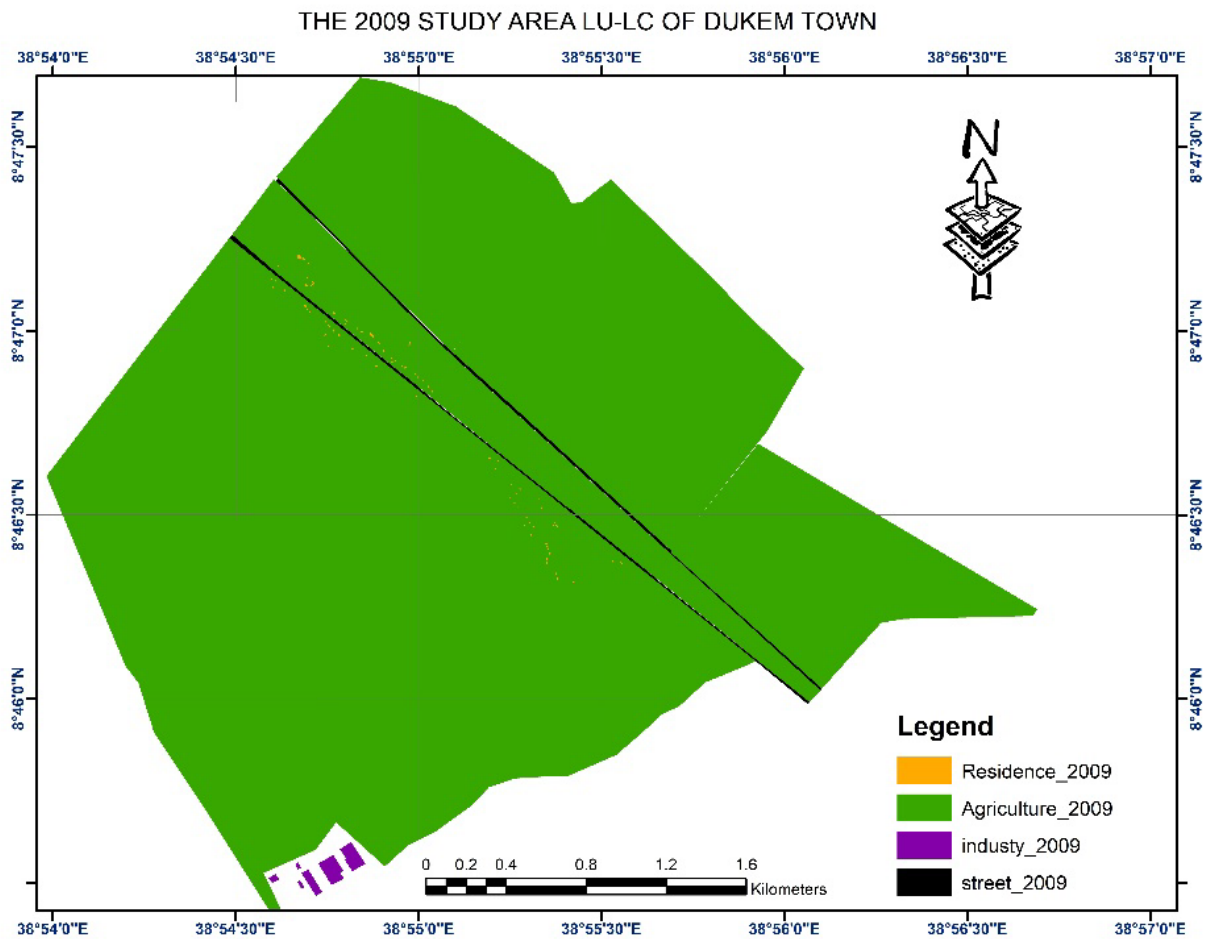


Figure 4. 1: Land Cover of the study site 2009

(Date Source: Generated by the Author, 2023)

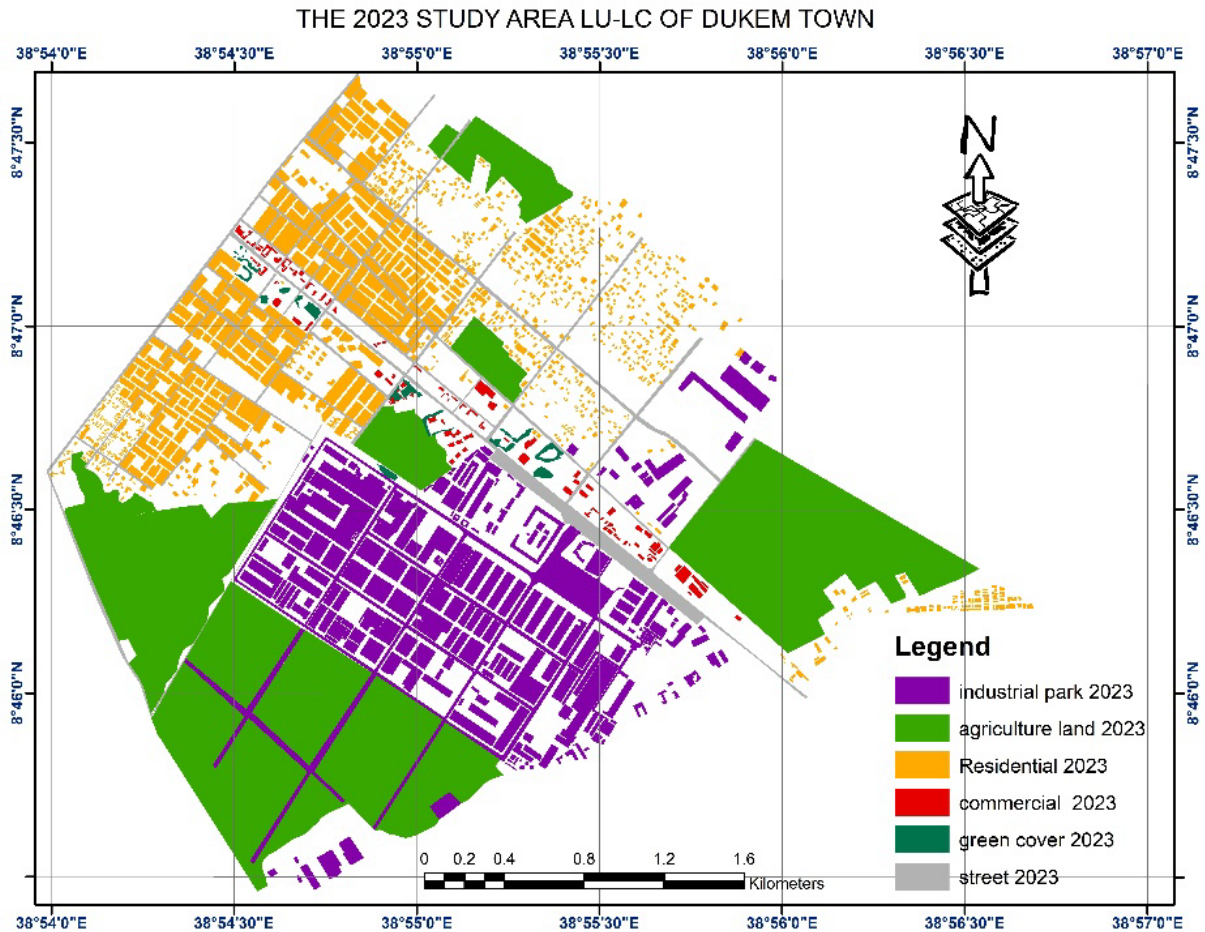


Figure 4. 2: Land Cover of the study site 2023

Date Source: Generated by the Author,2023)

### 4.3.2 LU-LC Analysis

#### 4.3.2.1 Land use Land cover (LULC) in 2009

Land use/land cover (LULC) of the Impacted area of town in quantity and map, as shown in (Figure 4.3) and (Graph 4.4). This year (2009), agricultural area cover was 1046.77 ha (98.69 percent) of the total area in the town boundary. In addition, an industrial area of 2.77 ha (0.26 percent), a residential area of 0.51 ha (0.05 percent), a commercial area of 0 ha (0 percent), a green cover of 0 ha (0 percent), and roadway cover of 10.63 ha covered a reasonably significant portion of the area (1 percent).

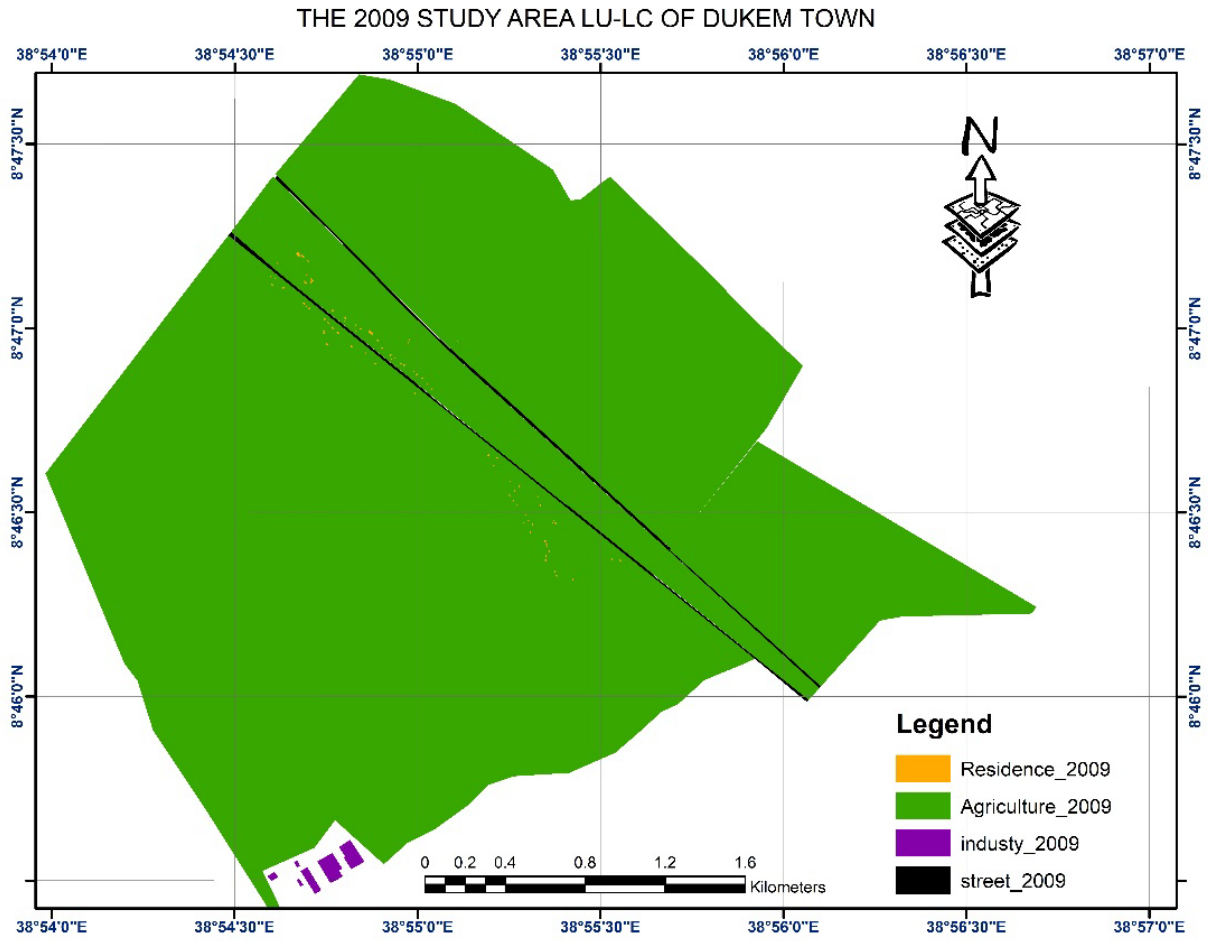


Figure 4. 3: Land Cover of the study site 2009  
 (Date Source: Generated by the Author,2023)

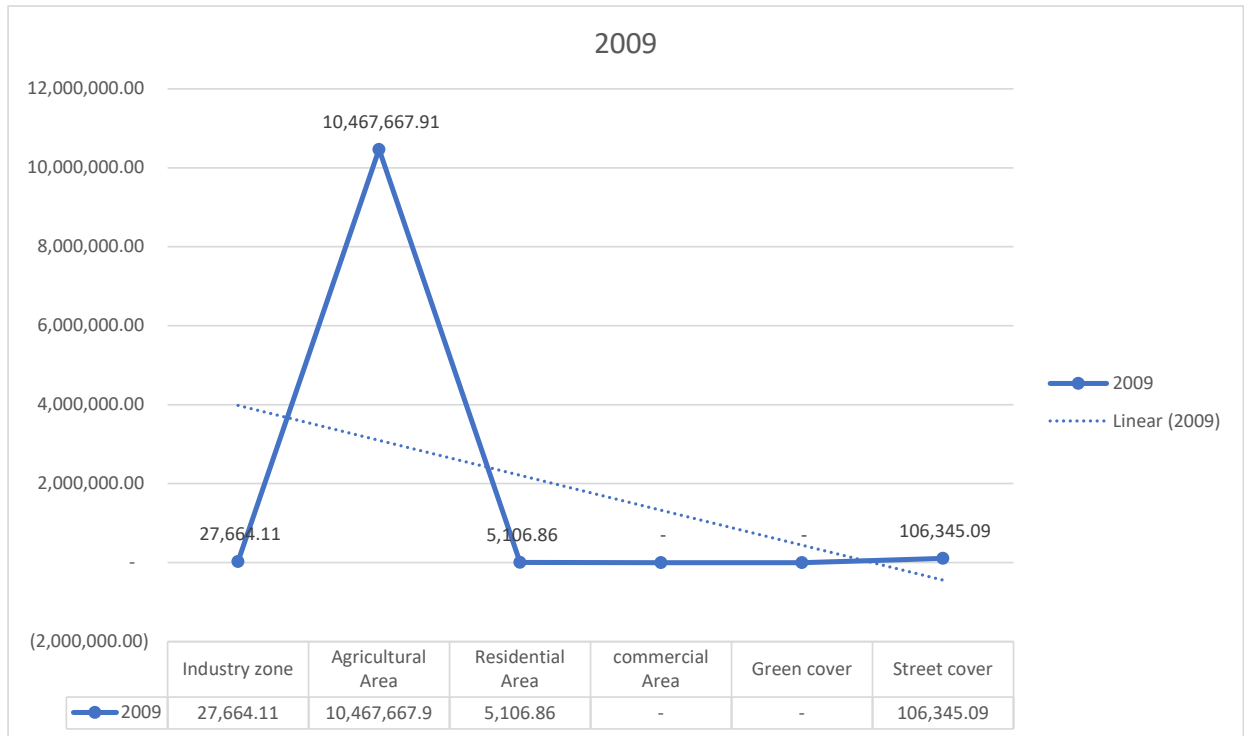


Figure 4. 4 Graph of Land Cover Classification on 2009

(Date Source: Generated by the Author,2023)

#### 4.3.2.2 Land use Land cover (LULC) in 2012

Land use/land cover (LULC) of the Impacted area of town in quantity and map, as shown in (Figure 4.5) and (Graph 4.6). This year (2012), agricultural area cover was the greatest in the town limit, with 882.63 ha (83.21 percent). Furthermore, a sizable portion of the territory was covered by an Industrial Area of 77 ha (7.26 percent), a Residential Area of 53.83 ha (5.08 percent), a Commercial Area of 2.37 ha (0.22 percent), a Green Cover of 4.91 ha (0.46 percent), and Street Cover 39.94 ha (0.46 percent) (3.77 percent).

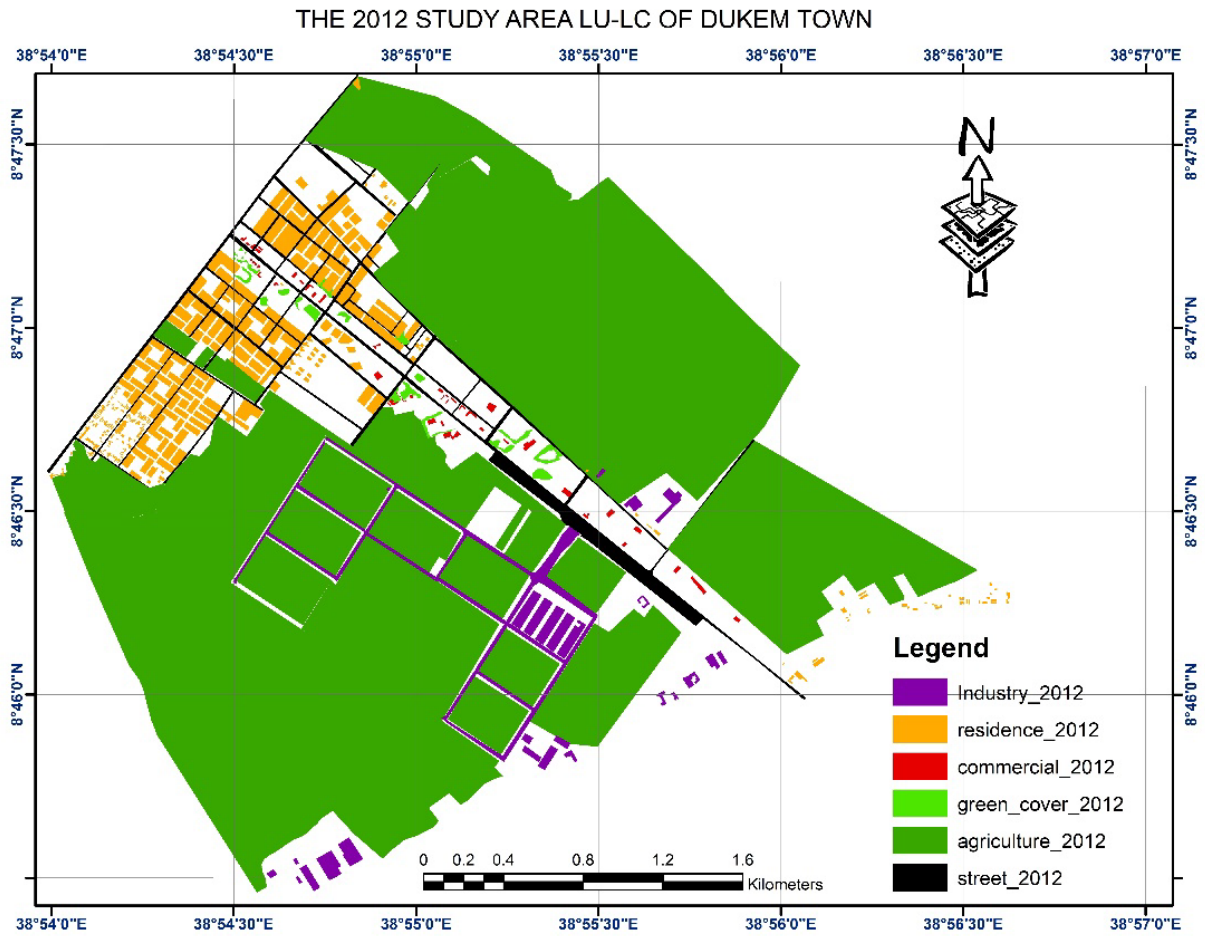


Figure 4. 5: Land Cover of the study site 2012

(Date Source: Generated by the Author,2023)

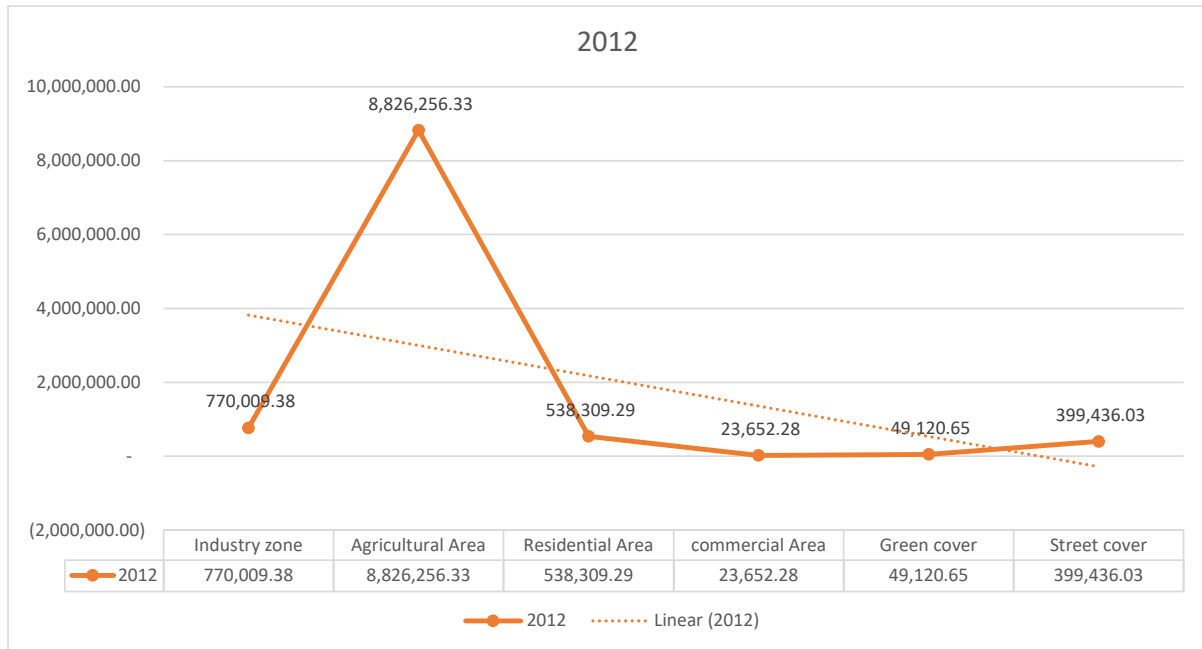


Figure 4. 6: Graph of Land Cover Classification on 2012

(Date Source: Generated by the Author,2023)

#### 4.3.2.3 Land use Land cover (LULC) in 2016

Land use/land cover (LULC) of the Impacted area of town in quantity and map, as shown in (Figure 4.7) and (Graph 4.8). This year (2016), agricultural area cover was 739.75 ha (69.74 percent) of the total area inside the municipal border. Furthermore, Industrial Region is 125.13 ha (11.80 percent), Residential Area 146.83 ha (13.84 percent), Commercial Area 4.12 ha (0.39 percent), Green Coverage 4.91 ha (0.46 percent), and Street Coverage 39.94 ha (11.80 percent) covered a sizable portion of the area (3.77 percent).

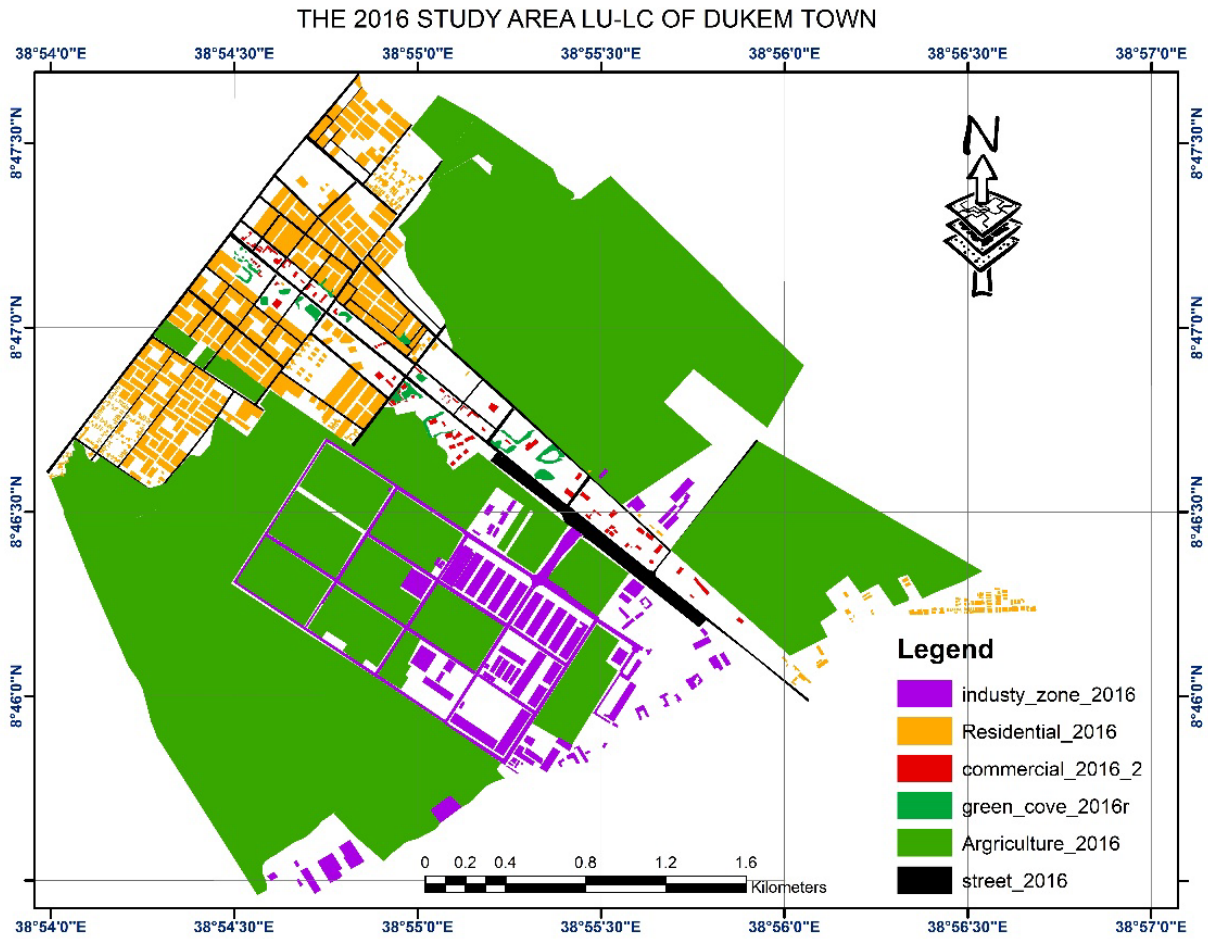


Figure 4. 7: Land Cover of the study site 2016

(Date Source: Generated by the Author,2023)

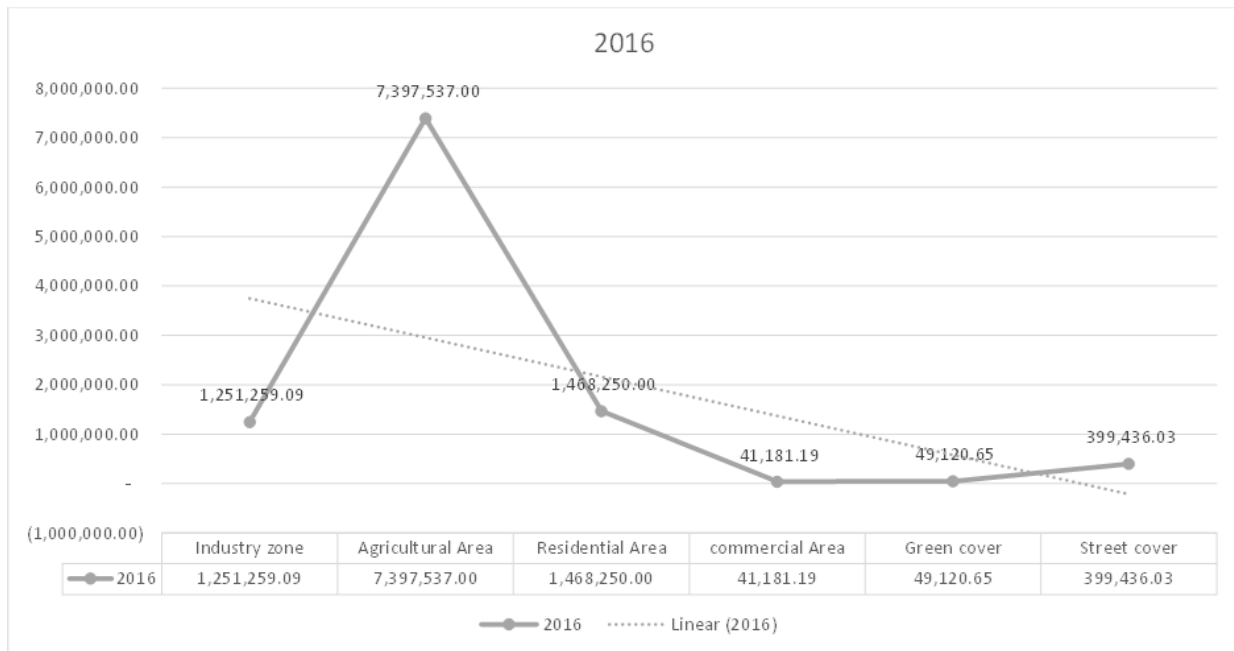


Figure 4. 8: Graph of Land Cover Classification on 2016

(Date Source: Generated by the Author,2023)

#### 4.3.2.4 Land use Land cover (LULC) in 2018

This year (2018) saw a significant change in the town's land use land cover (LULC). In number and on a map, the land use/land cover (LULC) of the affected area of town. This year, agricultural area cover was the highest in the town boundary, at 478.32 ha (45.10 percent). Also, a pretty large quantity of the territory was covered by Industrial Area 311.83 ha (29.4 percent), Residential Area 202 ha, (19.04 percent), Commercial area 5.81 ha, (0.55 percent), green Cover 4.14 ha (0.39 percent) and roadway cover 58.58 (5.52 percent). (5.52 percent). Over 11 years, the remaining land use land cover classes dropped drastically and transitioned into built-up regions. The rapid expansion of a built-up region at the detriment of other land uses.

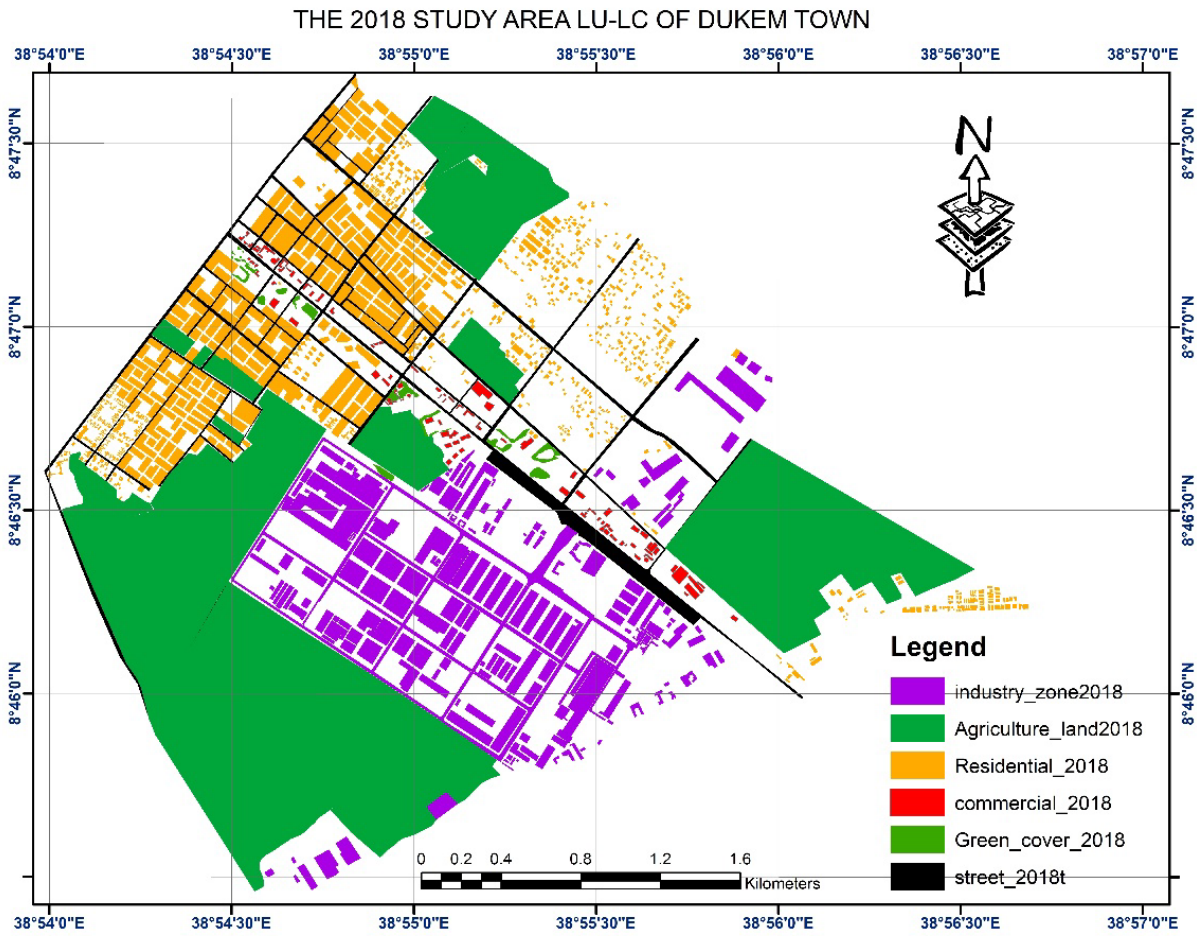


Figure 4. 9: Land Cover of the study site 2018

(Date Source: Generated by the Author,2023)

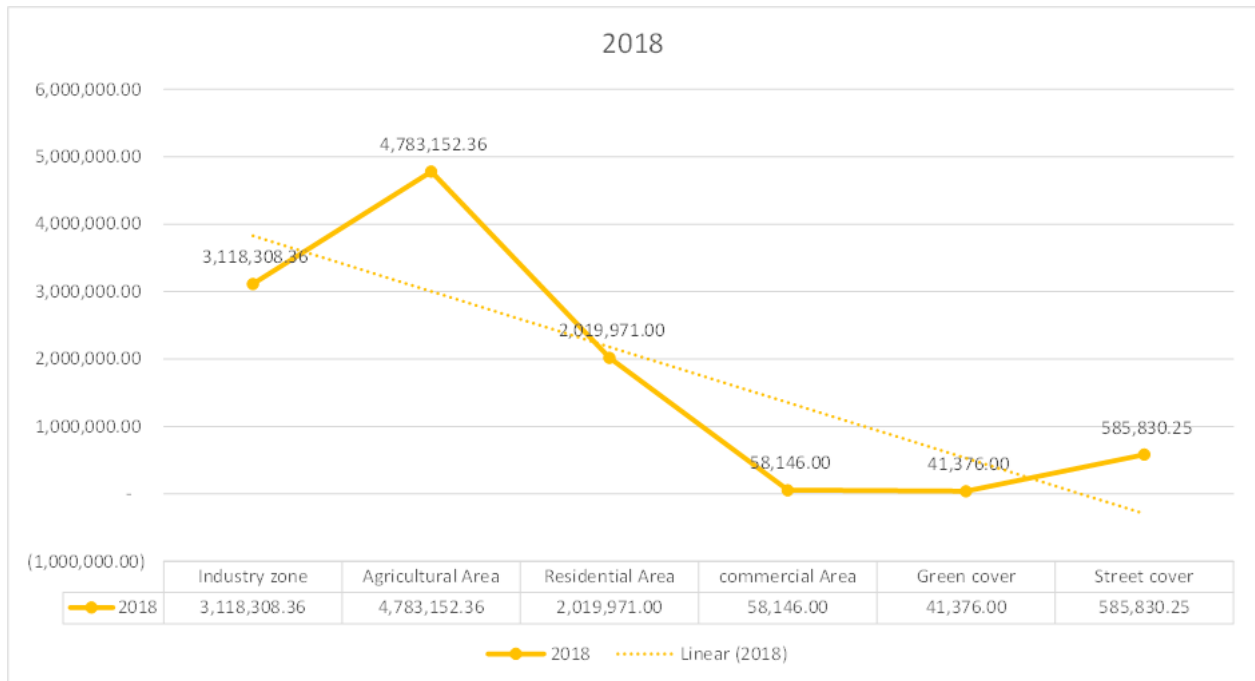


Figure 4. 10: Graph of Land Cover Classification on 2018

(Date Source: Generated by the Author,2023)

#### 4.3.2.5 Land use Land cover (LULC) in 2023

The town's land use land cover (LULC) changed considerably throughout this year (2023). This year, the Industrial area had the highest coverage, covering 550.2 hectares (51.87 percent) of the total area inside the town border. Furthermore, the agricultural area is 92.38 ha (8.71 percent), the residential area 322 ha (30.39 percent), the commercial area 13.06 ha (1.23 percent), the green cover 4.14 ha (0.39 percent), and the street cover 78.58 ha covered a relatively significant percentage of the region (7.41 percent). Over these 16 years, the remaining land use land cover classes dropped drastically and transitioned into built-up regions. The town's alarming rate of growth was linked to the fast increase in built-up area at the expense of other land use land covers (LULC).

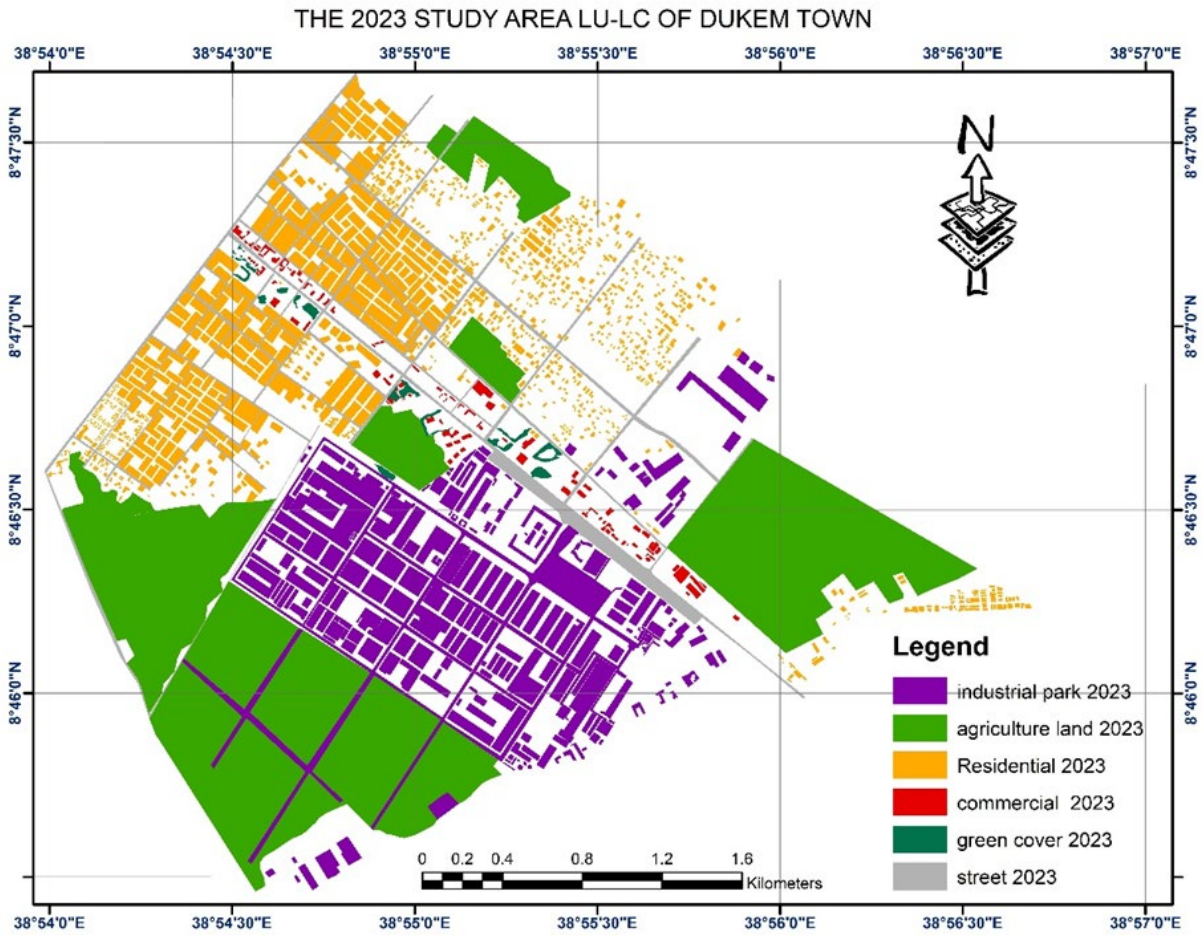


Figure 4. 11: Land Cover of the study site 2023

(Date Source: Generated by the Author,2023)

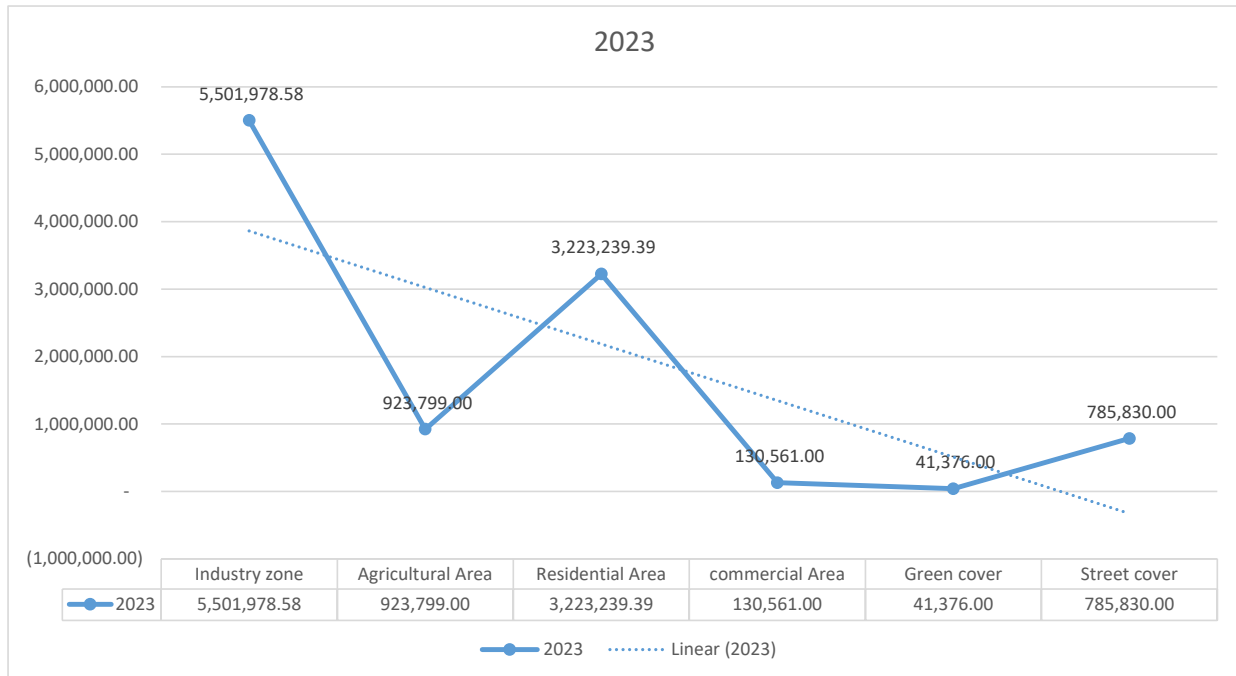


Figure 4. 12: Graph of Land Cover Classification on 2023

(Date Source: Generated by the Author,2023)

#### 4.3.2.6 Spatial Cover Analysis from 2009-2023

Furthermore, to compare and contrast the differences in each land use land cover (LULC) dynamics between 2009 and 2023, the total area in hectare (ha) covered by each land use land cover (LULC) change and its percentage in the land was also taken into account and performed using GIS in through calculating the area each category covered on the earth to quantify the amount of change as shown in (Table 4.9). Each year, the total area of each category is calculated in hectares and percentages.

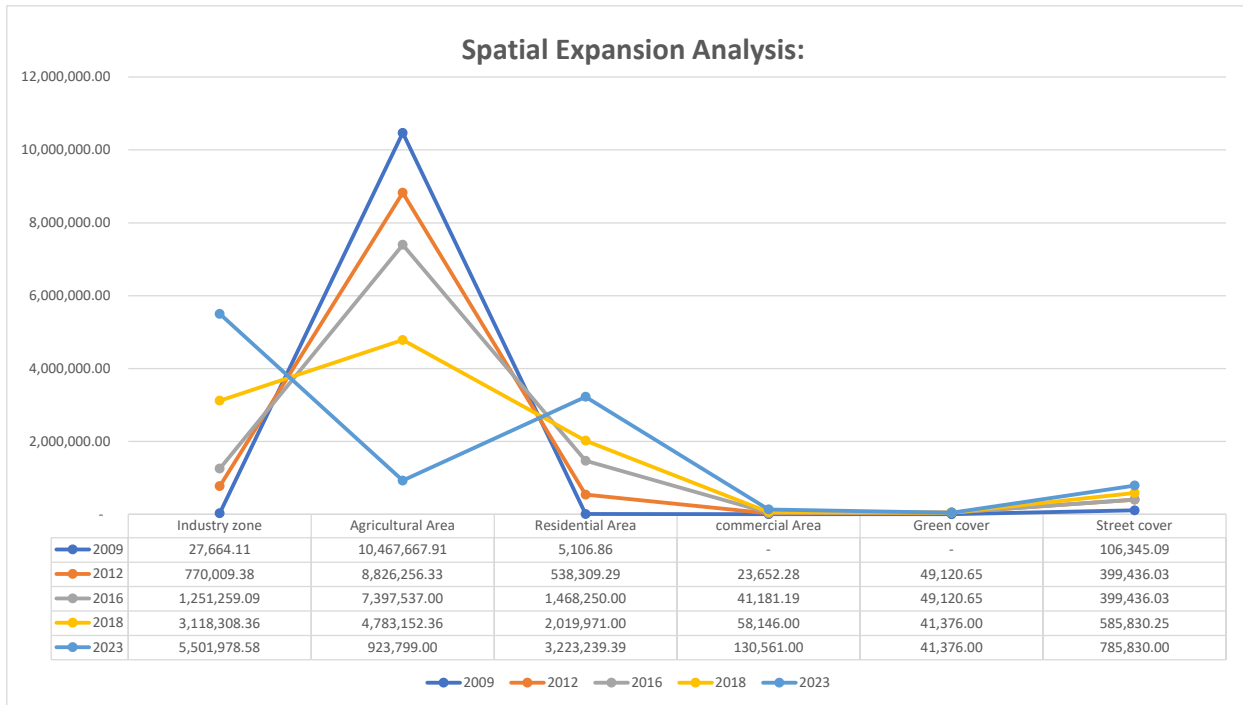


Figure 4. 13: Graph of Land Cover Classification on 2009-2023

(Date Source: Generated by the Author,2023)

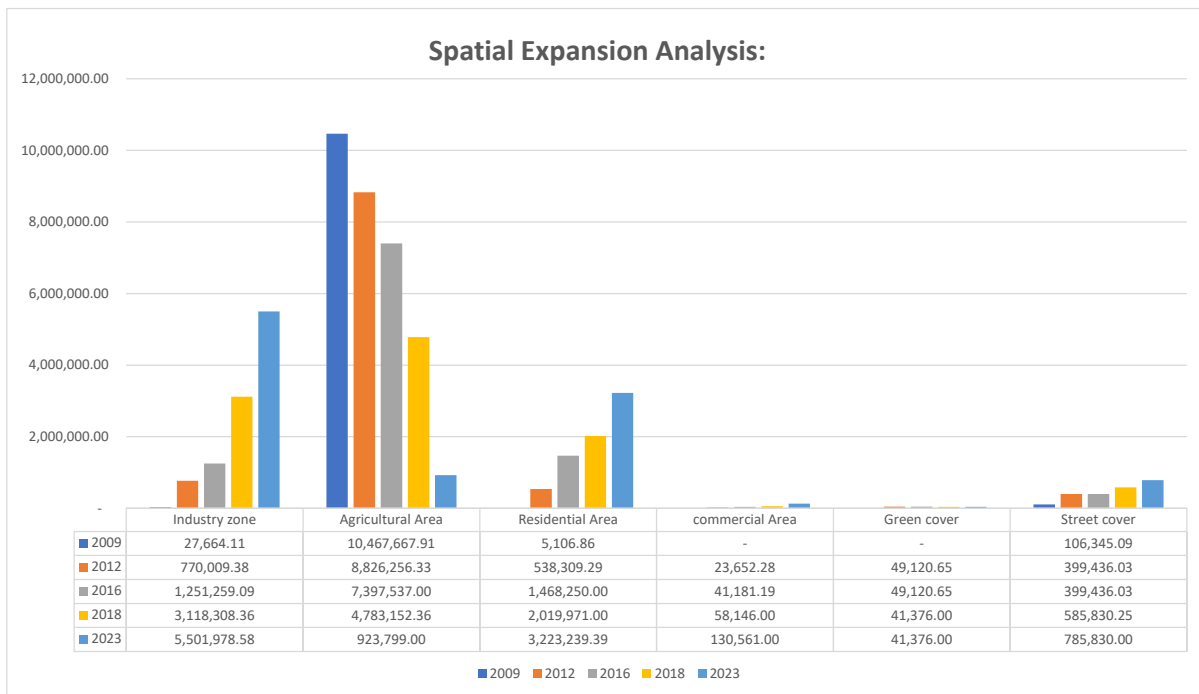


Figure 4. 14: Chart of Land Cover Classification on 2009-2023

(Date Source: Generated by the Author,2023)

	Area in square meters				
	2009	2012	2016	2018	2023
Industry zone	27,664.11	770,009.38	1,251,259.09	3,118,308.36	5,501,978.58
Agricultural Area	10,467,667.91	8,826,256.33	7,397,537.00	4,783,152.36	923,799.00
Residential Area	5,106.86	538,309.29	1,468,250.00	2,019,971.00	3,223,239.39
Commercial Area	-	23,652.28	41,181.19	58,146.00	130,561.00
Green cover	-	49,120.65	49,120.65	41,376.00	41,376.00
Street cover	106,345.09	399,436.03	399,436.03	585,830.25	785,830.00

Figure 4. 15: The 2009-2023 Landcover of the study area

(Date Source: Generated by the Author,2023)

#### 4.3.3 Change in Built-up Area 2009-2023

The change in a built-up area from 2009 to 2023 was mapped and compared to find the changes by visualizing all of the classification findings separately in a single map to illustrate the Cover of built-up regions in each year. The built-up area coverage from 2009 to 2023 was highly remarkable in that it nearly doubled the area expansion and rose by a considerable quantity of land, indicating rapid and unprecedented urban growth of the town consuming the surrounding non-built-up/Agricultural regions. Dukem town's built-up area coverage was 302.10 ha between 2009 and 2016, which was 28 percent coverage, and 648.15 ha between 2016 and 2023, which was 61 percent coverage.

#### 4.3.4 Detecting Dynamic Changes

To compute the built-up area between two time periods, the rate of change or rate of spatial Cover is utilized. As a result, the dynamic change in a built-up area between 2009 and 2012, 2012 and 2016, and 2016 and 2023 was computed as follows using (Equation 3).

$$\begin{aligned}
 \text{DC (2009-2012)} &= \left[ \frac{173.14 - 13.91}{173.14} \times \frac{1}{2009-2012} \right] 100 \% = \mathbf{15.9\%} \\
 \text{DC (2012-2018)} &= \left[ \frac{964.16 - 173.14}{964.16} \times \frac{1}{2012-2018} \right] 100 \% = \mathbf{26.6\%} \\
 \text{DC (2018-2023)} &= \left[ \frac{1060.68 - 964.16}{1060.68} \times \frac{1}{2018-2023} \right] 100 \% = \mathbf{96.52\%}
 \end{aligned}$$

Figure 4. 16: The dynamic of change in a built-up area between 2009 - 2023.

(Date Source: Generated by the Author,2023)

As computed and shown above (Figure 4.7), the built-up area of Dukem town grows by 8.6 percent per year from 2009 to 2008, 12.1 percent from 2008 to 2013, and 15.5 percent from 2013 to 2023. The dynamic change between 2009 and 2008 was less than in previous years. The rate of change for the two periods 2008 to 2013 and 2013 to 2023 was among the highest, indicating that the trend of urban Cover was increasing, notably in the previous eleven years. It means that agricultural land surrounding the town has been absorbed into urban regions, making it considerably more lucrative for new housing and industrial zones.

#### 4.4 Respondent Profile

Out of the 308 scheduled respondents for the survey (37 from office employees, 81 from EIZ employees, and 190 from communities), samples of respondents from each official, EIZ employees, and communities in the town were surveyed face to face. During data collecting, the researcher made a concerted attempt to standardize data quality by prioritizing service seniority, level of education, educational qualification background, place of work, work position, and year of living in the surrounding area. As a result, all 308 respondents correctly completed all of the close-ended survey surveys, while 88 from communities completed the survey's open-ended questionnaires.

#### 4.4.1 Backgrounds of office Government staff

Government employees' backgrounds, such as gender, age, level of education, educational qualification background, and year of service in the post, were collected, and the findings are provided below. Respondent gender is an essential aspect determining equity and participation. As a result, as shown in (Figure 4.17), the results revealed that 67.56 percent of the gathered 37 sampled respondents were males, while 32.44 percent were females. As shown in (Figure 4.18), the ages of the respondents range from a low of 3% for those aged 61-70 years to 6.1 percent for those aged 51-60 years, 21.2 percent for those aged 18-30 years, and 33.3 percent for those aged 41-50 years.

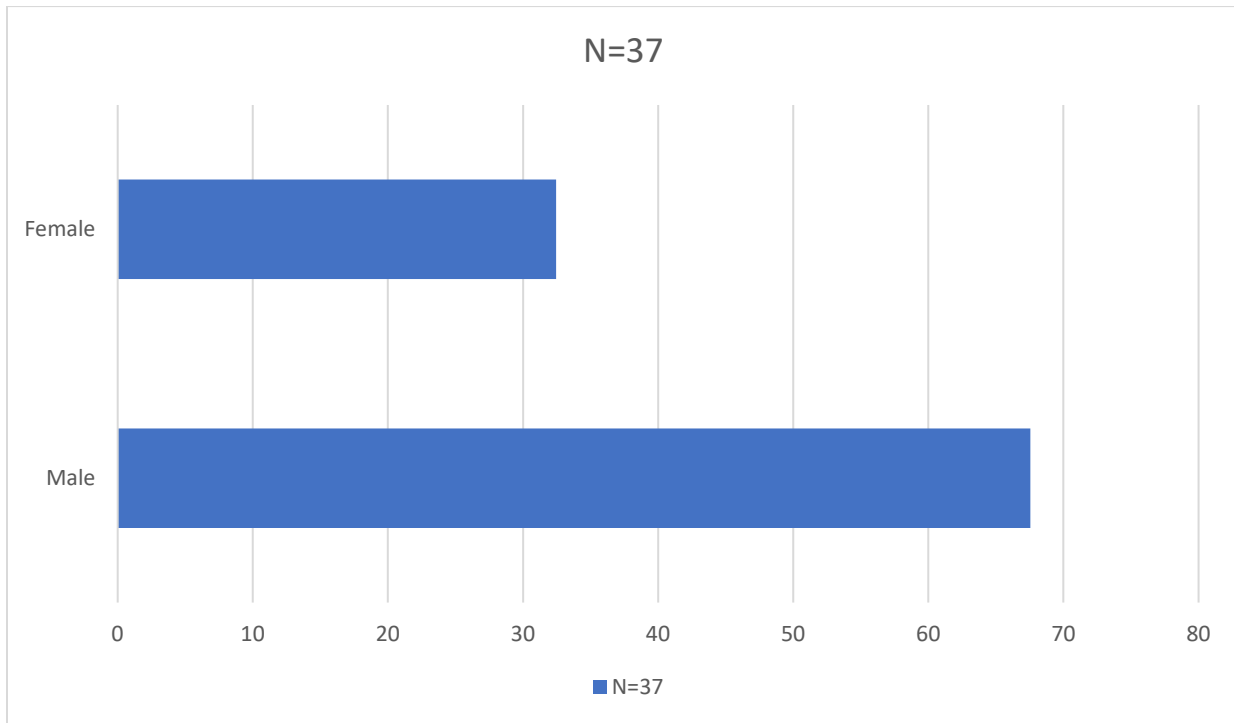


Figure 4. 17: Gender Background of Government Staff

(Date Source: Generated by the Author,2023)

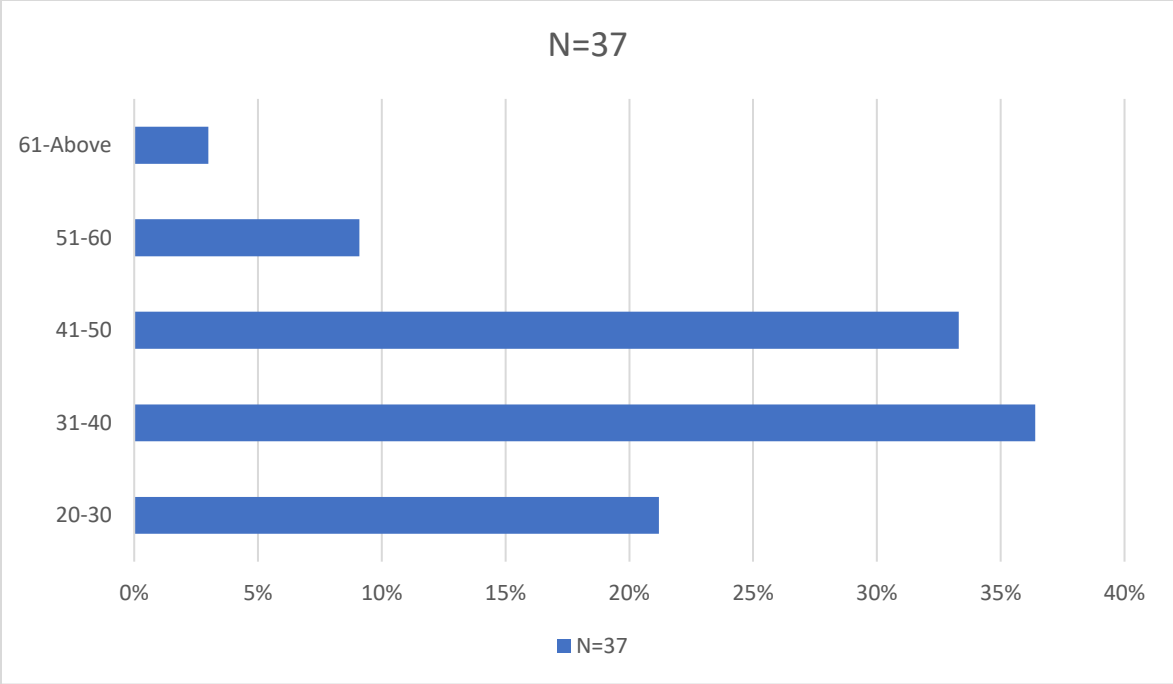


Figure 4. 18: Age Background of Government staff

(Date Source: Generated by the Author,2023)

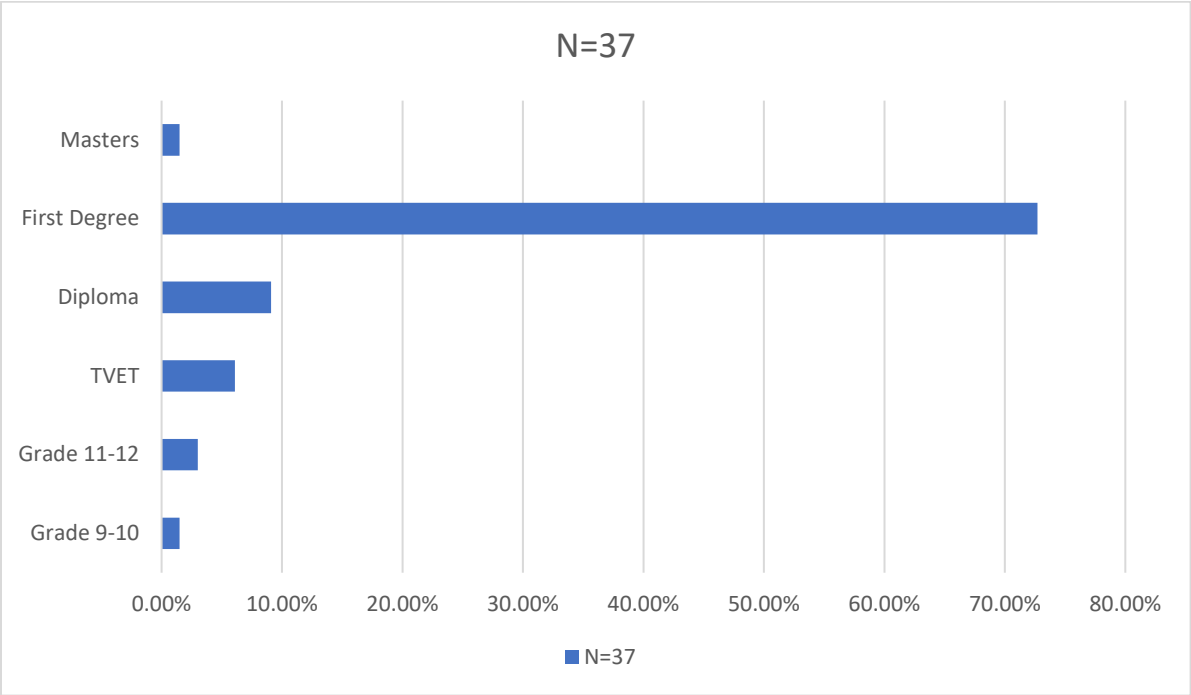


Figure 4. 19: Government staff Level of Education

(Date Source: Generated by the Author,2023)

The majority of the sampled office employees (72.7 percent) attended the first-degree program, followed by higher education diplomas (9.1 percent), master's 7.6 percent, TVET 6.1 percent, and those who attended preparatory 3 percent and secondary school 1.5 percent (see Figure 4.11) As shown in (Figure 4.19), the surveyor program accounted for approximately 28.8 percent of the sampled office employees' educational qualification background, followed by urban land development and management (ULDM) at 13.6 percent, urban land administration at 12.1 percent, geographers 9.1 percent, economists 7.6 percent, sociologists 6.1 percent, management 6.1 percent, engineers 4.5 percent, urban planners 3 percent, geologists 3 percent, and others. As a result, practically all of them are professionals or specialists in their specialized program; they are closer to the subject, which aids the researcher in determining the dependability and authenticity of the material generated.

#### **4.4.2 Backgrounds of the EIZ Employees**

The following information was gathered about EIZ employees' backgrounds, including gender, age, and occupation. Respondent gender is an essential aspect determining equity and participation. As a result, as shown in (Figure 4.20), the results demonstrate that of the 81 sampled respondents, 55.55 percent were men and 44.45 percent were females. AS shown in (Figure 4.21), the ages of the sampled EIZ Employees range from 2.9 percent for those over 70 years old to 5.3 percent for those between 18 and 30 years old, 10.6 percent for those between 61 and 70 years old, 20.6 percent for those between 51 and 60 years old, 23.7 percent for those between 31 and 40 years old, and 36.9 percent for those between 41 and 50 years old.

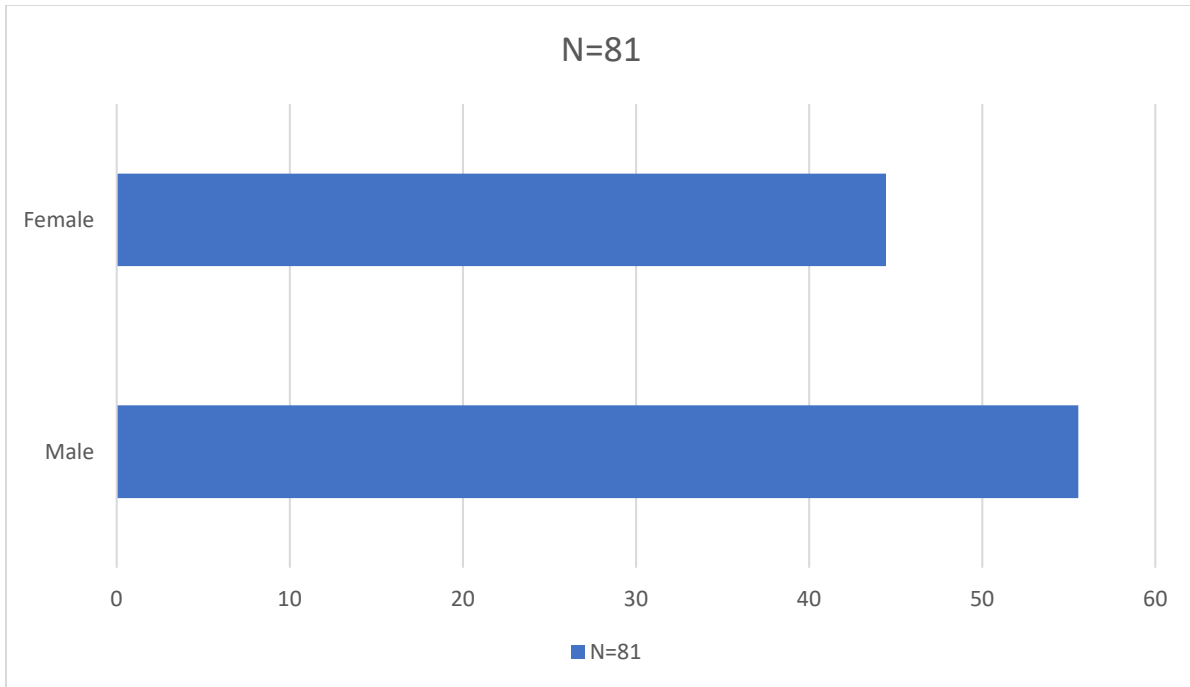


Figure 4. 20: Gender Background of EIZ Employees

(Date Source: Generated by the Author,2023)

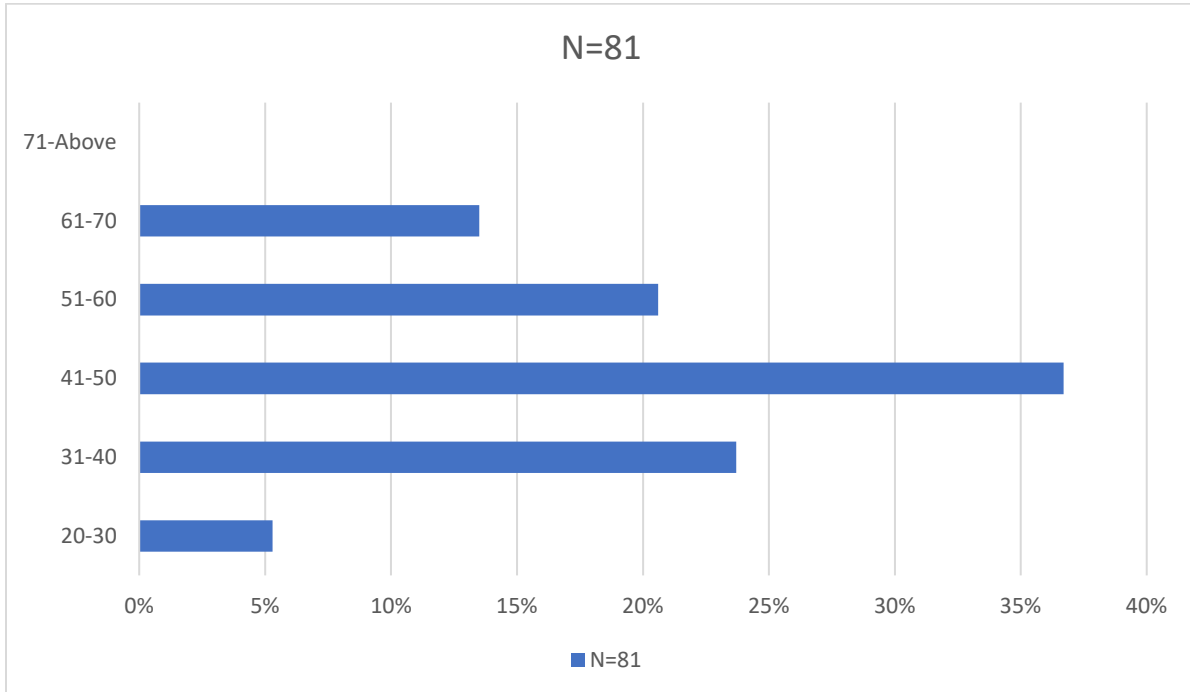


Figure 4. 21: Age Background of EIZ Employees

(Date Source: Generated by the Author,2023)

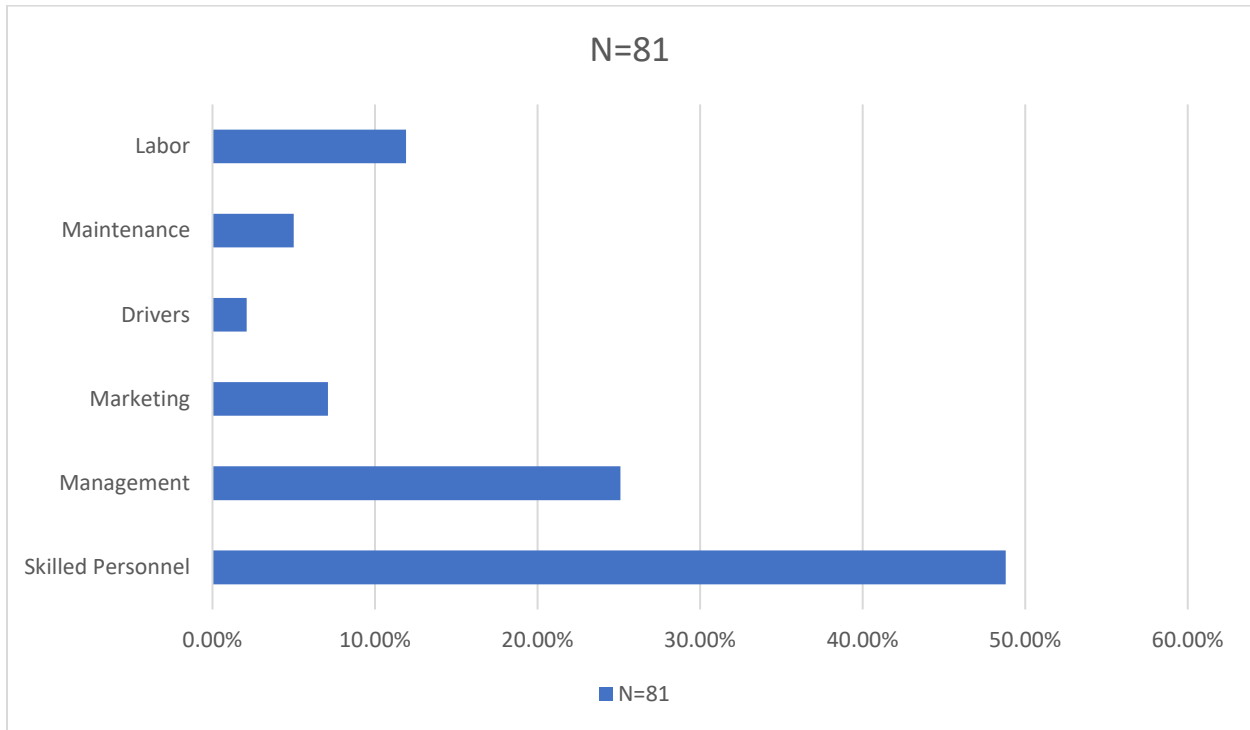


Figure 4. 22: Occupation Background of EIZ Employees

(Date Source: Generated by the Author,2023)

When the samples were described by occupation, it was discovered that the majority of EIZ Employees were confined to running their Skilled Personnel, which was approximately 48.8 percent, followed by management, which was approximately 25.1 percent, labor at 11.9 percent, marketing at 7.1 percent at, maintenance 5 percent, and driver’s 2.1 percent as shown on Figure 4.22.

#### 4.4.2 Backgrounds of the Community

The gender, age, and occupation of Dukem town communities were collected, and the findings are provided below. Respondent gender is an essential aspect determining equity and participation. As a result, as shown in (Figure 4.23), the results demonstrate that of the 327 sampled respondents, 53.68 percent were males and 46.32 percent were females. As shown in (Figure 4.24), the ages of the sampled communities range from 4.9 percent for those over 70 years old to 5.3 percent for those between 18 and 30 years old, 15.3 percent for those between 61 and 70 years old, 20.6 percent

for those between 51 and 60 years old, 10.7 percent for those between 31 and 40 years old, and 42.9 percent for those between 41 and 50 years old.

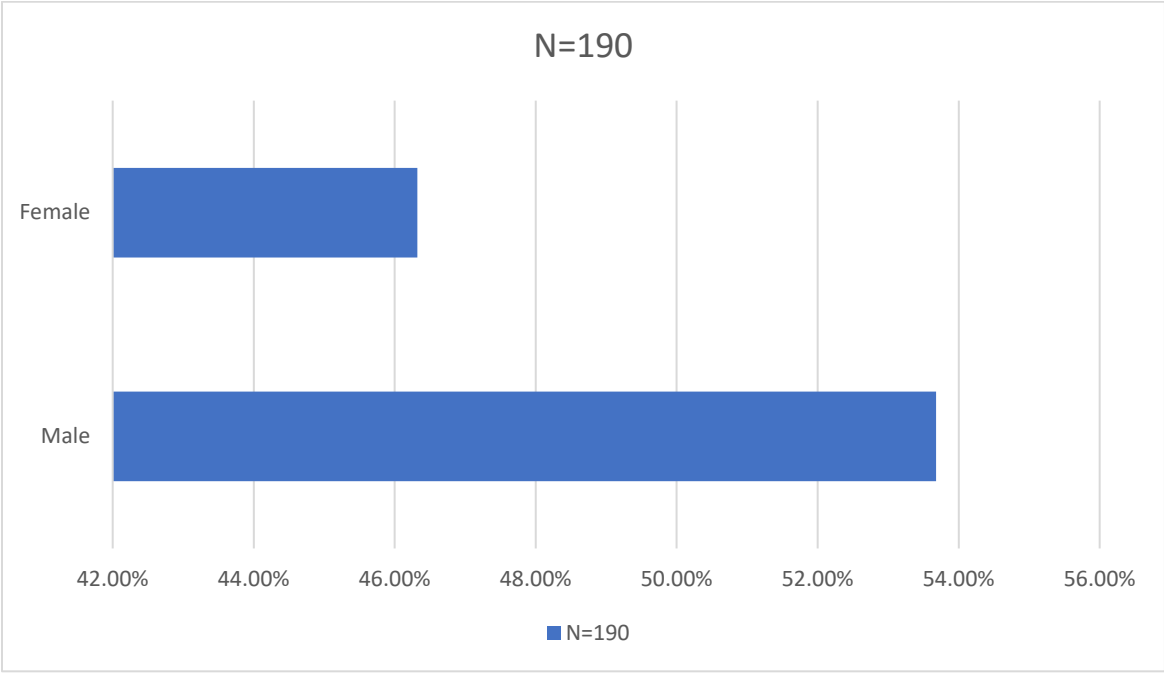


Figure 4. 23: Gender Backgrounds of Communities

(Date Source: Generated by the Author,2023)

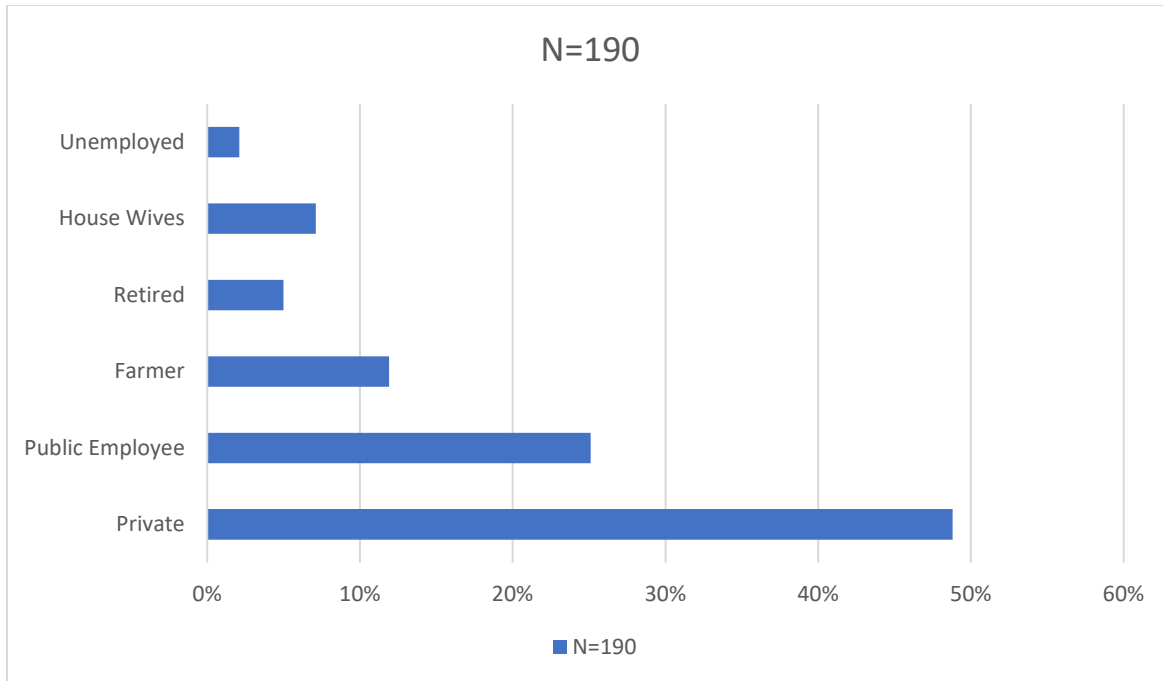


Figure 4. 24 Occupation Background of Community

(Date Source: Generated by the Author,2023)

When the samples were described by occupation, it was discovered that the majority of the communities were confined to running their own private business, which was approximately 48.8 percent, followed by public employees, which were approximately 25.1 percent, farmers 11.9 percent, homemakers' 7.1 percent, retired 5 percent, and unemployed 2.1 percent as shown Figure 4.24.

#### 4.5 The Driving Factors

The driving elements included in this study as determinants of the EIZ's consequences take several forms, but the most evident forces are assumed, such as increased population size, investment pressure in commerce and industry establishment, housing desire, and informal access to the property. The establishment of EIZ, as well as its economic, industrial, and commercial importance, has resulted in severe rivalry for resources such as housing and other basic supplies. Nowadays, the town is known as one of those with a strong concentration of enterprises. According to the OUPI (2017), The town's rapid growth was fueled by its proximity to Addis Abeba, transportation facilities, the highway, and the expressway to the southern and eastern parts of the

country, which are surrounded by agricultural productive areas and have poor policy implementation tools, resulting in squatter settlements.

#### **4.5.1 Perceptions of Government Staff on Driving Factors**

Four (4) Establishments of EIZ, investment of other industries & manufacturing, housing preferences, and informal access to land were included in the survey questionnaire for the respondents to measure the perception of office employees on the factors that contributed significantly to the Impacts of EIZ on the neighboring spatial settlements between 2009 and 2023. (Government staff). The survey results showed that 94 percent, 90.9 percent, 90.9 percent, and 90.9 percent of respondents (government staff) agreed with the following statements: Impacts of EIZ on neighboring spatial settlements between 2009 and 2023, Four (4) Establishment of EIZ, investment of other industries & manufacturing, housing preferences, and informal access to land.

#### **4.5.2 Descriptive Analysis of Government Staff on Driving Factors**

Four (4) Establishment of EIZ, investment in other industries and manufacturing, housing preferences, and informal access to land driving factors or forces were used to measure the perception of office employees on the factors that contributed significantly to the Impacts of EIZ on the neighboring spatial settlements between 2009 and 2023. As a result, descriptive analysis methods were utilized to analyze and measure these perceptions, as follows. A measure of central tendency (mean, median, and mode), a measure of dispersion (standard deviation and variance), and a measure of distribution are used to further describe and analyze the properties of perceptions (Skewness). (1) neutral, (2) agree, (3) strongly agree, and strongly disagree (4). The table's outputs were based on the value, which implies that values close to 4 indicated that office personnel strongly agreed with the respective specified impact-driving elements or forces. As a result, the majority of the driving factors have perception value around positive attitude strongly agree, which means more agreed to the listed urban Cover driving factors establishment of industries & manufacturing and town location are the driving factors that office employees rated as strongly agreed with an average score mean of 3.62 and 3.53, respectively. The driving factors, such as an increase in population size, housing preference, development in road infrastructures and transportation, informal access to land, investment pressure in commerce and services, and the prepared structure plan of the town, were the most office employees perceived, with average means of 3.35, 3.26, 3.18, 3.14, 2.92, and 2.64, respectively. Community Perceptions of Driving Factors

### **4.5.3 Perceptions of Communities on Driving Factors**

Similarly, to assess community perceptions of the factors that contributed significantly to the Impacts of EIZ on neighboring spatial settlements between 2009 and 2023, four (4) factors were included in the survey questionnaire for respondents (communities) using a five-point Likert scale measurement: establishment of EIZ, investment in other industries and manufacturing, housing preference, and informal access to land. Accordingly, the survey results showed that 81.8 percent, 76.6 percent, 74.4 percent, and 65.7 percent of the communities agreed with the listed urban Cover factors such as the establishment of industries and manufacturing, the location of the town, informal access to land, increase in population size, and investment pressure in commerce and service. And nearly half of the villages agreed with the town's proposed plans (53.1 percent). While significantly fewer than half of the communities agreed (i.e., more than half did not agree) on the town's topography (40.7 percent), housing choice (40.3 percent), and development in road infrastructures and transit (34.8 percent) all had a significant role. The survey's final section included open-ended questions for communities to voice their opinions. On the other hand, it is also thought that the linkages of respondents' responses by close-ended questions addressed additional aspects that contributed significantly to the Impacts of EIZ on nearby spatial settlements between 2009 and 2023 with open-ended questions. As a result, 29 replies from communities were forwarded to further driving reasons on the open-ended question from 308 surveys. As a result, the extra responses by communities on urban Cover driving factors are often classified into four (4) primary themes, including land grabbing and housing shortage.

### **4.5.4 Descriptive Analysis of EIZ employees on Driving Factors**

Similarly, to understand community perceptions of the elements that impact EIZ on a nearby spatial settlement between 2009 and 2023, four (4) EIZ establishments, investment in other industries and manufacturing, housing preference, and informal access to land were studied. As a result, descriptive analysis methods were utilized to analyze and measure these perceptions, as follows. To further explain and assess the properties of perceptions, the following measures of central tendency (mean, median, and mode), dispersion (standard deviation and variance), and distribution (skewness) were examined. The results in the table are based on Likert scale measurements ranging from 0 to 5, with strongly disagree (0), disagree (1), neutral (2), agree (3), and strongly agree (4) being the most common. The outputs were based on the value, which

indicates that values close to 4 indicated a high level of agreement between communities and the relevant stated urban Cover driving elements or drivers. As a result, the majority of the driving causes, such as the establishment of EIZ, investment in other industries and manufacturing, housing preference, and informal access to land, were the most often perceived by communities, with average means of 3.17, 3.02, 3.01, and 2.60.

#### **4.5.5 Perceptions of EIZ employees on Driving Factors**

Similarly, to assess communities' perceptions of the factors that contributed significantly to the Impacts of EIZ on neighboring spatial settlements between 2009 and 2023, four (4) factors were included in the survey questionnaire for respondents (communities) using a five-point Likert scale measurement: establishment of EIZ, investment in other industries and manufacturing, housing preference, and informal access to land. As a result, the survey results revealed that 81.8 percent of the communities d with the stated urban Cover elements, such as the creation of industries and manufacturing, and 74.4 percent with informal access to land, respectively.

The survey's final section included open-ended questions for communities to respond to. On the other hand, it is also thought that the linkages of respondents' responses by close-ended questions addressed additional aspects that contributed significantly to the Impacts of EIZ on nearby spatial settlements between 2009 and 2023 with open-ended questions. As a result, 29 replies from communities were forwarded to further driving reasons on the open-ended question from 308 surveys. As a result, the additional responses by communities on urban Cover driving factors were typically classified into four (4) primary themes: "land grabbing" with (13), "housing scarcity" with (11) "economic interest" with (3), and "appropriate climate condition" with (2) number of responses.

#### **4.5.6 Descriptive Analysis of Communities on Driving Factors**

Similarly, to understand community perceptions of the factors that influence EIZ on nearby spatial settlements between 2009 and 2023, four (4) EIZ establishments, investment in other industries and manufacturing, housing preference, and informal access to land were studied. As a result, descriptive analysis approaches were utilized to analyses and measure these perceptions. To further explain and analyses the properties of perceptions, a measure of central tendency (mean, median, and mode), a measure of dispersion (standard deviation and variance), and a measure of

distribution (skewness) were examined. The results in the table are based on Likert scale measurements ranging from 0 to 5, with strongly disagree (0), disagree (1), neutral (2), agree (3), and strongly agree (4). The outputs were based on the value, which indicates that values close to 4 indicated a high level of agreement between communities and the relevant stated urban Cover driving elements or drivers. As a result, the majority of the driving causes, such as the establishment of EIZ, investment in other industries and manufacturing, housing preference, and informal access to land, were the most often perceived by communities, with average means of 3.17, 3.02, 3.01, and 2.60.

#### **4.5.7 Driving Factors Analysis**

Five (5) Likert ratings of strongly agree to strongly disagree were utilized to provide information on the primary driving elements responsible for the Impacts of EIZ on nearby spatial settlements between 2009 and 2023. Because the data obtained was dependent on personal impressions, which differed depending on the attitude toward the factors and actors who contributed significantly to the town's rapid cover. The drivers of the Impacts of EIZ on nearby spatial settlements between 2009 and 2023 are four (4) EIZ establishments, investment in other industries and manufacturing, housing choice, and informal access to land. A comparison task was done specifically between government employees' and community views toward the stated criteria. A cross-checking task analysis was also completed utilizing different materials prepared, which was detailed in depth in the next section.

##### **4.5.7.1 Industry and manufacturing establishment**

Ethiopia's government has given fair consideration to private investment, including foreign investment. As a result, private sector involvement in development has expanded dramatically. Dukem town is distinguished as one of those towns with a high concentration of enterprises as a result of its proximity to the national market of the capital Addis Ababa city. According to the survey results from government employees, EIZ employees, and communities, the factor that the establishment of EIZ and other industries and manufacturing contributed significantly to the Coverage of the town was the most strongly agreed factor with 94.9 percent, 94.9 percent, and 94.9 percent, respectively. In terms of descriptive-analytical data, however, the majority of Government workers and communities perceived strongly agreed, with an average mean of 3.62 and 3.17, respectively. As a consequence of the survey results, both office employees and

communities felt a value of "highly agreed" with the construction of EIZ and other manufacturing contributed significantly between 2009 and 2023.

#### **4.5.7.2 Preference for Residence**

The enormous development of the urban population was driving an unusually rapid increase in the town's need for dwellings. Many individuals commute between Addis Abeba, Adama, and Bishoftu for work, and many prefer to live in Dukem town. This shows that the town's demand for residential properties was higher. The cover of enormous single-family houses does not exist due to living in apartment and multi-family high-rise structures, save for condominium housing, which has only lately become available in the town. As a result, privately constructed single-family residential homes were perceived in the town, and the excessive demand for land also prompted the development of investments and settlements on the outskirts into farming fields. As a result, the survey results from Government staff, EIZ employees, and communities on the factor that "housing preference contributed a lot to the Cover of the town revealed that most of the office employees agreed to this factor with 89.4 percent, while less than half of the communities agreed with 40.3 percent. In terms of descriptive-analytical data, the majority of government employees perceived agreed with an average mean of 3.26, while the communities perceived neutral with an average mean of 1.97. The study results revealed a contradiction between the two, with most office employees agreeing on average while communities are neutral to this driving element. As a result, this indicated that office employees have a positive attitude with the most "agreed" values to the factors, whereas the communities had neither negative nor positive attitudes with a value-neutral perception of the factor "housing preference," which contributed significantly to the Coverage of the town between 2009 and 2023. Furthermore, a town municipality undertook a significant residential land delivery in 2017/2018, specifically for farmer households and their families who lost agricultural land due to the expansion of large businesses and manufacturing. As a result, 227 farmer households earn 500 m<sup>2</sup>, and 635 farmer families over the age of 18 earn 140 m<sup>2</sup>, for a total of 20.24 ha of land delivered (DTLDMO, 2023).

#### **4.5.7.3 Informal Access to Land**

In 2018, the Dukem townland development and management office administration recorded approximately 1,866 accurate numbers of informal housing units. Informal access to land was also identified during the survey as a prominent factor that contributed significantly to the Coverage of

the town between 2009 and 2023 by government employees, EIZ employees, and communities. As a result, the survey results from Government workers, EIZ employees, and communities on the factor that "informal access to land" contributed significantly to the Cover of the town revealed that were the most strongly agreed factor with 81.9 percent and 74.4 percent, respectively. In terms of descriptive analysis, however, the majority of office personnel and communities perceived strongly agreed with an average mean of 3.14 and 3.01, respectively. As a consequence of the survey results, both government personnel, EIZ employees, and communities perceived an average of "agreed" with the "informal access to land" that contributed significantly to the Cover of the town between 2009 and 2022. According to Shodhganga (2013), the process of "informal access to land" was similar to a fresh parcel of land being placed on the market through an informal system with no preparation or paperwork. The exchange is typically between personal networks and a straightforward selling transaction between local administration officials, brokers, local farmers, and the town's community. Those who buy the land are gaining unauthorized access to it. Then, on the purchased parcel, they build a little hut until they are ready to be regularized in the future and build the main home or sell it for a profit. Furthermore, as determined, inadequacies in the public land management system, notably the land distribution process, have resulted in the growth of informal land markets (Tendayi, 2009; as cited by Shodhganga, 2013). In addition, Husen Tura (2018) stated that the inefficiencies of formal land supply have resulted in the emergence of informality.

#### **4.5.7.4 Land Grabbing**

Land grabbing (attitude of government officials) is commonly defined as the process by which governments acquire huge tracts of land driven by foreigners, transnational corporations, or investors, particularly in developing nations (Kenate, 2013). According to Kenate (2013), in his study drivers (determinants) of Addis Abeba Coverage and the Role of Actors, the land is sadly being abused by government agencies from the top to the bottom level administration for investment and national development. According to information obtained from government staff during the survey, large hectares of land are always prepared through land grab by displacing farmers from their agricultural land and storing it in a land bank, after which a massive amount of land is given to investors for housing and industrial establishments in the town. In his examination of the condition of informal actors in urban land management, Yirgalem (2009) concluded that "in

most situations, the direct benefits from the land were sold to foreign firms, and the local investors were government employees. In his study, Kenate (2013) also stated that the land lease policy has created opportunities for officials and other actors to engage in corruption, and he concluded his study by saying that corruption related to land lease holding and land grabs by government authorities in Addis Abeba and the surrounding Oromia special zone towns were observed. Similarly, corruption, lack of transparency, and injustice in the land administration system and distribution are not uncommon in Dukem town, which has generated a group of affluent collectors, land speculators, and brokers on public land and therefore contributed significantly to the rapid development.

## **4.6 Discussion of the Results**

### **4.7.1 Trend of Cover and Land use land covers (LULC) Change**

People's permanent settlements around religious, political, trading and other economic activities frequently culminate in the formation of urban settlements (G/Hiwot, 2006; Marshall et al., 2009; Aburas et al., 2017). According to historical trends, the formation of Dukem town is linked to the late-nineteenth-century construction of a railway line from Djibouti to Addis Abeba. As a result, Dukem started to spread in 1914. (OUPI, 2017). According to the study's trend analysis, the town stretches from the center to northern Addis Abeba and the southern Bishoftu direction along the major road to the eastern area corridor. Dukem, also known as the Eastern Industrial Zone, has evolved as one of the region's and the country's industrial urban hubs since the early 2000s (EIZ).

To meet the study's goal, the following results were produced: land use land covers (LULC) changing patterns in areal coverage for 2009, 2012, 2018, and 2023. Dukem town occupied only a little space in the town's core at the start of 2009. The town's growth then shifted substantially between 2009 and 2023 as a result of the construction of the Eastern Industry Zone (EIZ), and this continued between 2011 and 2023, particularly infill developments in terms of residential development. Similarly, investigations found that the results of the land use and land cover (LULC) change study revealed a rapid growth in built-up areas. According to this report, the built-up area rose drastically from 1.31 percent in 2009 to 90.9% in 2012. This demonstrated that constructed areas consumed a significant proportion of other land use land cover (LULC) categories, although agricultural land fell dramatically in all years from (98.69 percent) in 2009 to (8.71 percent) in 2023, suggesting its maximum contribution to built-up areas. Furthermore, the

spatial extent of EIZ built-up areas rose by 7.26 percent in 2012, 11.8 percent in 2016, 29.4 percent in 2018, and 51.87 percent in 2023. The dynamic change was lower between 2009 and 2012 than in previous periods. The rate of change for the two periods 2009 to 2012 and 2018 to 2023 was among the greatest, indicating that the trend of settlement Cover was more and more, particularly during the previous fifteen years. It means that rural land surrounding the EIZ has been absorbed into urban areas, making it considerably more valuable for new housing and industrial applications.

#### **4.7.2 Characteristics of Sampled Respondents**

Out of 37 respondents, approximately 72.7 percent attended the first-degree program, with higher education degrees accounting for the remaining 9.1 percent. While the majority of them were surveyor programs (28.8 percent), followed by urban land development and management (ULDM) (13.6 percent), urban land administration (12.1 percent), geographers (9.1 percent), and so on, this indicated that almost all of them are professionals or experts in their specific program and are closer to the issue. The majority of them worked for 11-15 years, accounting for 39.4 percent, with 6-10 years accounting for 27.3 percent, indicating that more than half of respondents are senior in terms of work duration and position. As a result, almost all of them could characterize changes that occurred over time and were thought to have more information than other new employers. Adults, by age group 41-50 (36.9 percent) out of 81, followed by age group 31-40 (23.7 percent) and age group 51-60 (51.7 percent) (20.6 percent). The majority of them were skilled laborers (48.8 percent), with 25.1 percent being born in Dukem. In contrast, the majority of the 190 surveyed communities matured by age group 41-50 (42.9 percent), followed by age group 31-40 (10.7 percent), and age group 51-60 (51.7 percent) (20.6 percent). The majority of them, approximately 59.8 percent, were migrants, while 40.2 percent were born in Dukem town. This indicated that there was rapid population growth in the town due to the establishment of many industries, as well as its geographical proximity to Addis Abeba, which increased the town's population and economic importance, with several commuters per day those who preferred to live in the town and work in Addis Abeba was a major reason according to the informants during the survey. In terms of education, the majority of them attended first-degree programs (36.4%), followed by TVET (12.4%), and higher education diplomas (11.3%). This result suggested that more than half of the planned sampled respondents were professionals in their specific program.

### **4.7.3 Driving Factors that contribute a lot to the impact of EIZ**

Dukem town is one of those places that has a large concentration of industries. Population increase, combined with industrial and commercial development, has resulted in fierce rivalry for resources such as housing in the city. According to Diriba et al., (2016), proximity to Addis Abeba, transportation facilities, the highway, and the expressway to the southern and eastern parts of the country pass through Dukem town, which is surrounded by agricultural productive areas and is plagued by poor policy implementation tools, resulting in squatter settlements, were the major driving factors for impact. The causes of influence covered in this study take several forms, but the most obvious forces are assumed, such as the establishment of industries and manufacturing, housing preference, informal access to land, and Land Grabbing. The survey results of "Government staff" revealed that the construction of industries and manufacturing, as well as land grabbing, were the key driving reasons, with an average score mean of 3.62 and 3.53, respectively. Housing preferences and informal access to land are driving factors 3.18 and 3.14. The survey results of "EIZ Employees," on the other hand, revealed that the construction of industries and manufacturing and land grabbing agreed with an average mean of 3.8 and 2.31, respectively. Other driving factors, such as housing preferences and informal access, were evaluated as neutral by the majority of EIZ employees, with an average mean of 2.31 and 1.97, respectively. Finally, the "communities" poll results revealed that the construction of industries and manufacturing and land grabbing agreed with an average mean of 3.17 and 3.02, respectively. Other driving factors, such as housing preferences and informal access, were viewed as neutral by the majority of communities, with an average mean of 2.31 and 1.97, respectively. When comparing the survey results of office employees, EIZ Employees, and communities on the driving factors that contributed significantly to the expansion of the town's physical settlement pattern between 2009 and 2023, all of them were perceived as an average of strongly agreed with the establishment of industries & manufacturing and land grabbing, and also all of them were perceived as an average of strongly agreed with housing preferences and informal acquiescence. Regarding the factor development in infrastructure and transportation, there were significant discrepancies between the three, with most office personnel and EIZ employees agreeing on average, while communities disagreed on average. On the other side, the outcome indicated that the communities were dissatisfied with the town's present infrastructure development.

#### **4.7.4 Future of the spatial settlement pattern**

Dukem town experienced a significant expansion in population as a result of the creation of industries (EIZ) and manufacturing, as well as commuters to Addis Abeba. According to studies, population expansion has a direct impact on the urban cover (Handy, 2009; Tilahun, 2016). According to OUPI (2017) population projections, Dukem town will have a population of approximately 171,653 people by the year 2027. Because the urban cover is changing dramatically as a result of the establishment of industries and manufacturing, housing preferences, informal access to land, and land grabbing, the impact will be projected on 100 percent of the spatial scope of the study by the end of 2024, according to the study.

## CHAPTER FIVE

### 5. CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusion

The research is being carried out to determine the impact of EIZ on the spatial settlement pattern of neighboring Dukem Town. GIS tools are also used to identify the primary driving factors and actors who make a significant contribution to EIZ Coverage between 2009 and 2023. The research questions define the study's final statements. Dukem was established in the late 1800s and was connected to the railway line that ran from Djibouti to Addis Abeba in early 1914. (OUPI, 2017). Dukem was founded in the early 2000s as the Eastern Industrial Zone, a single industrial urban hub (EIZ). Ethiopia's Eastern Industrial Zone was conceived in 2007 and inaugurated in 2009. The initial plan was for the Yonggang Group and the Qi yuan Group to establish a 5 km<sup>2</sup> zone in Dukem, Oromia state, about 30 kilometers southeast of the nation's capital, Addis Abeba. This zone would attract eighty different investment projects in five years, creating 20,000 jobs (Brautigam and Tang 2011).

As a result, a trend analysis of spatial settlement impacts revealed that, following the establishment of EIZ, the built-up area increased dramatically, from 13.91 hectares (1.31 percent) in 2012 to 173.14 hectares (16 percent) in 2012, from 316.01 hectares (30 percent) in 2016 to 578.23 hectares (55 percent) in 2018, and from 13.91 hectares (1.31 percent) in 2012 to 964.16 hectares (91 percent) in 2023. Furthermore, from 2009 to 2012, the built-up area increased by 15.9 percent per year, 26.6 percent from 2012 to 2018, and 96.52 percent from 2018 to 2023. The rate of change for the two time periods 2012-2018 and 2018-2023 is among the highest, indicating that the trend of urban Cover is increasing, particularly in the last ten years. It means that agricultural land surrounding cities is being absorbed into urban areas, making it much more lucrative for new housing and industrial applications. According to the study, the main drivers of the significant increase in spatial cover between 2009 and 2023 were the establishment of industries and manufacturing, housing preferences, informal access to land, and Land Grabbing. Other studies have discovered that the government or agencies, farmers who donated land, investors or communities who purchased land, communities who purchased land, and real estate land brokers are just a few of the various actors who have a role to play in spatial settlement change on either the demand or supply side of the land market (Yirgalem, 2009; Kenate, 2013; Husen, 2018).

In a similar vein, this study found that private investors, state agencies, and local communities were the primary players who had a significant impact on Dukem Town's phenomenal growth between 2012 and 2023. Neither the office employees nor the communities express positive or negative sentiments when speaking with acting specialists. Local farmers and land dealers, on the other hand, were frequently at odds. According to the forecast for future growth, the surrounding settlement will be covered by additional industries and dwellings. With Bishoftu to the north and south, the location is already landlocked. As a result, when developing Industrial Parks, all policy and planning decisions should take into account the government's anticipated future expansion.

## **5.2. Recommendations**

Based on the study's research objectives and findings, the following recommendations have been given for regulating the impact of the EIZ on spatial patterns and addressing the challenges caused by urban Cover. According to the study's findings, the area has experienced exceptionally rapid urban growth, especially in the last fifteen years, with a growth rate of 46.34 percent, and this trend is expected to continue in the coming decades. According to the research, the LUP and SP that OUPI had previously prepared to serve as a roadmap for development activities had not been effectively implemented. To accomplish this, government leaders, EIZ employees, and communities must plan for sustainable resource use while keeping up with the rate of urban growth. Using powerful, effective land management and monitoring tools, such as GIS and satellite imagery (RST), to supervise and ensure that urban land use change is carried out following the approved plan. Dukem Town is fortunate to be located near Addis Abeba, which has increased the town's population and economic significance as a desirable location for various urban activities such as industrial and residential. As a result, a growing number of performers, individual investors, and developers are interested in the area. However, because the town is still in its early stages, those investors should volunteer to assist in the creation of beautiful, green public spaces, thereby contributing to the promotion of environmental concerns. Many land-grabbing situations should be handled by the Anti-Corruption Commission, with increased community participation and involvement of other stakeholders, to avoid or limit the waste of public land. Corruption, lack of transparency, and injustice in the land administration system and distribution have established a group of wealthy collectors, land speculators, and brokers on public land, significantly contributing to the town's rapid cover. Corruption and transparency issues were raised, and it was

said that the study excluded apartment living or multi-family high-rise constructions, except condominium housing, which had only recently been erected in Dukem Town. Because so many agricultural and natural areas had been destroyed in the previous sixteen years, the town's astounding growth was attributed to privately built single-family houses and vast expanses of land given for manufacturing and industries for investment purposes. As a result, realistic planning plans should be developed and implemented to integrate the town's urban sections with neighboring rural villages for mutually beneficial development. A variety of factors contribute to the town's annual growth. As a result, urban infrastructure is deficient in growing areas, and municipalities are responsible for providing these urban infrastructures. It is suggested that the municipality form a collaboration across various sectors to address the issue. The patterns of the urban Cover plans that have been implemented thus far indicated that communities were not informed about the process or involved in its design and implementation. However, to deal with the effects of urban cover and dislocation, the cooperation of adjacent farming communities, in particular, is critical to maintaining sustainable growth. As a result, before program implementation, the agricultural community's approval, knowledge, and participation in the aforementioned program and decision-making process should be prioritized. More planning is needed to preserve the fertile agricultural area and natural habitats while also ensuring the town's horizontal growth is balanced. These planning concepts include smart growth, compact city high-density mixed-use, and infill development. Because of the capital Addis Ababa's Cover and the existence of the Oromia Special Zone, integrated planning was critical for the city's and neighboring regions' growth. However, the two areas have different intentions, and as a result, such autonomous or uncooperative actions will result in conflicts, similar to the land-related disputes that occurred between the two regions and contributed to the nation's political and economic upheaval. As a result, the government should develop an integrated regional development strategy that includes cooperation and coordination among Dukem, the Oromia Special Zone (OSZ), and Addis Abeba. Rethink the values, symbols, and social rewards associated with the integrated regional development plan's outcomes.

## REFERENCES

- Girum Sisay (2020). An Investigation of Urban Expansion Land Use Land Covers Dynamics: The Case of Dukem Town, Oromia Special Zone.
- Adem, K. (2010). Urban Cover and the Neighborhoods: The Case of Bishoftu Town, East Shewa Zone, Oromia Regional State, Public Administration, and Development Management.
- Afera, H., Asirat, T. and Ermias, S. (2018). „Applications of Remote Sensing and GIS in Land Use/Land Cover Change Detection: A Case Study of Woreta Zuria Watershed, Ethiopia“, Applied Research Journal of Geographic Information System, 1: 1-9.
- Ahlam, Y. (2017). Urban Cover and Its Impact on the Livelihood of Peripheral Farming Communities: The Case of Kutaber Town, Amhara Region, Ethiopia.
- Alsharif, A., Pradhan, B., Mansor, S. and Shafri, H. (2015). „Urban Cover Assessment by Using Remotely Sensed Data and the Relative Shannon Entropy Model in GIS: A Case Study of Tripoli, Libya“, Theoretical and Empirical Researches in Urban Management, 10: 123-138.
- Antos, S. E., Lall, S. V. and Gracia, N. L. (2016). The Morphology of African Cities. Social, Urban, Rural, and Resilience Global Practice Group, World Bank, 51 pp.
- Anupam, A. (2017). Unit 14-Accuracy Assessment, <https://www.researchgate.net/publication>
- Ambaye, A. (2012). Assessment of Urban Cover and Its Impact on the Livelihood of Peripheral Farming Communities in The Case of Dukem Town.
- Amaha, G. (2007). Urbanization, Urban Sprawl Pattern Recognition and Modeling of Hawasa-Shashemene: Addis Ababa University School of Graduate Studies GIS and Remote Sensing Program.
- Ariana, B.V., (2016). The Impact of Roads on Land-Use Change in Ethiopia: Evidence from Satellite Data.
- Bahiru, Z. (1991). A History of Modern Ethiopia, 1855-1974: Addis Ababa University Press, Addis Ababa.
- Balchin, P.N., et al. (2000). Urban Economics: A Global Perspective. Great Britain Macmillan Press Ltd.

Basel, M. and Hana, O. (2023). „Population Projection Model using Exponential Growth Function with a Birth and Death Diffusion Growth Rate Processes“, *European Journal of Scientific Research*, 15: 271-276.

Batty, M. (2004). *What is Urban Sprawl? Concepts and Perceptions*, Final Seminar of the Scatter Project Brussels.

Beka, G. (January 2016), *Urban Cover and Its Socio-Economic Impacts on the Livelihood of the Farming Community in Sululta*.

Bekure, W. (1999). „For men urbanized Ethiopia“, *Migration and Urbanization in Ethiopia: Proceedings of the Second Annual Conference*. Addis Ababa: Association of Ethiopian Geographers.

Berhan, G. and Woldeamlak, B. (2014). *Drivers and Implications of Land Use and Land Cover Change in the Central Highlands of Ethiopia: Evidence from Remote Sensing and Socio-demographic Data Integration*, Vol. X, No.2.

Bhatta, B. (2010). *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, 17 *Advances in Geographic Information Science*, Springer-Verlag Berlin Heidelberg.

Burton, E. (2000). „The Compact City: Just or just compact“, *A preliminary analysis*“ *Urban Studies*, 37(11): 1969-2007.

Ciparisse, G. (2009). *Multilingual Thesaurus on Land Tenure, English Version*. Rome: Food and Agricultural Organization of the United Nations, (FAO).

Congalton, R. G. (1991). „A review of assessing the accuracy of classifications of remotely sensed data“, *Remote Sensing of Environment*, 3: 35-46.

Dean, H. (2013). *Modeling Population Growth: Exponential and Hyperbolic Modeling*. (<http://www.scirp.org/journal/am>).

Dejene, N. (2011). *Rapid Urban Cover and Its Implications on Livelihood of Farming Communities in Peri-Urban Area: Addis Ababa, Ethiopia*.

Diriba, D., Azadib, H., Feyera, S., Ketema, A., Taherif, F. and Stellmacher, T. (2016). „Urban sprawl and its impacts on land use change in Central Ethiopia“, *Journal of Urban Forestry & Urban Greening*, 16: 132-141.

Diriba, D., Stellmacher, T., Azadib, H., Ketema, A. and Feyera, S. (2017). The Impact of Industrialization on Land Use and Livelihoods in Ethiopia: Agricultural Land Conversion around Gelan and Dukem Town, Oromia Region: <https://www.researchgate.net>

Efa, T. and Gutema, I. (2017). „Prospects and Challenges of Urbanization on the Livelihood of Farming Community Surrounding Finfinne“, *American Research Journal of Humanities and Social Sciences*, 315: 2378-7031.

Eyasu, S. (2007). The Impact of Urban Cover on the Livelihood of Peri-Urban Farming Communities in Alemgena Town: Addis Ababa University Schools of Graduate Studies Regional and Local Development Studies (RLDS).

European Environment Agency, (2006). Urban Sprawl in Europe the Ignored Challenge.

Fevera, A. (2005). Urban Cover and the Livelihood of the Peri-Urban Agricultural Community: The Case of Addis Ababa, Addis Ababa University Master of Arts in Regional and Local Development Studies.

Firew, B. (2010). The Impact of Horizontal Urban Cover on Sub-Urban Agricultural Community Livelihood: The Case of Tabor Sub-City, Hawassa city, Ethiopia.

G/Hiwot, B. (2006). Urban growth and its impact on land use, the case of Mekelle, M.A. thesis, Ethiopian civil service college, Addis Ababa.

Geist, H., McConnell, W., Lambin, E. F., Moran, E., Alves, D. and Rudel, T. (2006). "Causes and trajectories of land-use/cover change", *Local processes and global impact*, Berlin: Springer, 41-70.

Glenn, D. I. (2009). Determining Sample Size 1: Department of Agricultural Education and Communication, and extension specialist, Program Evaluation and Organizational Development, Institute of Food and Agricultural Sciences (IFAS), University Florida, Gainesville 32611 <http://edis.ifas.ufl.edu>.

- Haregewoin, B. (2005). Urbanization and Urban Sprawl.
- Herold, M. Goldstein, C.N. and Clarke, C.K. (2009). „The spatiotemporal form of urban growth: measurement, analysis and modeling Journal of Remote Sensing Environment, 86 286- 302.
- Husen, T. (2018). Land Rights and Land Grabbing in Oromia, Ethiopia, VL-70, Journal Land Use Policy: <https://www.researchgate.net/publication/321020098>.
- Kafi, M., Shafri, H. Z. and Shariff, M. (2014). An analysis of LULC change detection using remotely sensed data; A Case study of Bauchi City, Department of Civil Engineering, Selangor Malaysia IOP Conf. Series: Earth and Environmental Science.
- Kaleb, M. and Samuel, G. (2017). Investigation of Urban Sprawl Trends and its Impact on Socio-economy of Peri-urban Community in Addis Ababa: The Case of Akaki Kaliti Sub-city
- Kenate, W. (2013). Land use covers dynamic socio-economic and environmental transformations and implications in a geographical study of the fringe of finfinne Addis Ababa city, Ethiopia.
- Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
- Lambin, E. F., Geist, H. and Rindfuss, R.R. (2006). "Introduction: Local processes with global impacts" In E. F. Lambin and H. Geist, editors. Land-use and land-cover change: Local processes and global impact, Berlin: Springer, 1–7.
- Leulseged, K., Gete, Z., Dawit, A., Fitsum, H. and Heinemann, A. (2011). Impact of Urbanization of Addis Ababa City on Peri-Urban Environment and Livelihoods.
- Levin, N. (1999). Fundamentals of Remote Sensing: Tel Aviv University, Tel Aviv, 225 pp.
- Linda, L. (1996). Sociology of Periphery Versus A periphery of Sociology: Rural Sociology and the Dimensions of space, in Journal of Sociology, Vol.61, pp: 77-99
- Maria, E. F., Somik, L. and Danny, L. (2014). Africa’s Urbanization Challenges and Opportunities Africa’s Urbanization.
- Marshall, F., Waldman, L., MacGregor, H., Mehta, Land Randhawa, P. (2009). On the Edge of Sustainability. Perspectives on Peri-urban Dynamics, STEPS Working Paper 35, Brighton: STEPS Centre.

- Miaoulis, G. and R. D. Michener (1976). An Introduction to Sampling. Dubuque, Iowa: Kendall/Hunt Publishing Company.
- Nasir, J. and Saleem, A. (2018). Exponential Growth Model for Forecasting of Area and Production of Potato Crop in Pakistan. <https://www.researchgate.net>
- Negasa, J. (2017). Monitoring Urban Cover and Suitability Analysis for Residential Housing by Using Geographic Information System and Remote Sensing; the Case of Sululta Town; Oromia Regional State of Ethiopia. Addis Ababa University, Department of Geography and Environmental Studies.
- Oromia National Regional State Urban Planning Institute (2009). Revision of Dukem town Development plan, 2009 Addis Ababa.
- Parvaiz, A.B., Miftaul, S., Abaas, A.M and Pervez, A. (2017). „Urban Sprawl and its Impact on Landuse /Land Cover Dynamics of Dehradun City, India“, Gulf Organization for Research and Development International Journal of Sustainable Built Environment, International Journal of Sustainable Built Environment, 6: 513-521.
- Paul, N. (2000). Urban Economics: A Global Perspective, Great Britain Creative Print and Design (Wales) Ebb Vale.
- Pickett, S., Cadenasso, M.L., Grove, J.M., Nilon, C.H., Pouyat, R.V., Zipperer, W.C. and Costanza, R. (2001). „Urban ecological systems: linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas“, 32:127–157.
- Potter, R. (1992). Urbanization in the Third World, Oxford, Oxford University Press
- Reis, J. P., Silva, E. A. and Pinho, P. (2015). „Spatial metrics to study urban patterns in growing and shrinking cities“, Urban Geography, 1938–2847.
- Selam, G. (2017). The Challenges and Contributions of Industrial Park Development (IPD) in Ethiopia: The Case of Eastern Industry Zone (EIZ) PLC, Dukem town, Oromia.
- Sekela, T. and Manfred, F. B. (2023). Land-Use and Land-Cover (LULC) Change Detection in Wami River Basin, Tanzania, Land 2023, 8, 136.

- Seid, Y. (2007). Urban Cover and Suitability Analysis for Housing of Adama City Using Remote Sensing and Geographic Information Systems Techniques, Department of Earth Sciences Faculty of Science Addis Ababa University.
- Sewunet, S. (2017). Urban Sprawl Mapping and Landuse Change Detection Using Spatial Metrics Method: A Case Study of Addis Ababa City and Its Surrounding Areas, Ethiopia.
- Shishay, M. (2011). The Impacts of Urban Built-Up Area Cover on the Livelihood of Farm Households, in the Peri-Urban Areas of Mekelle City: The Capital of Tigray Regional State.
- Solomon, E. (2018). „Mapping urban Cover and its effect on the surrounding land use using GIS and remote sensing. A case study in Debre Tabor Town, Ethiopia“, Journal of Degraded and Mining Lands Management, Volume 6, Number 1.
- Tadesse, W., Tsegaye, T. D. and Coleman, T.L. (2001). Land use/cover change detection of the city of Addis Ababa, Ethiopia using remote sensing and GIS technology.
- Tamirat, M. (2016). „Horizontal Urban Cover and Livelihood Adjustment Problem among Ex-Farmers in the Kebeles Surrounding Jimma Town: The Case of Derba Kebele“, European Scientific Journal, 14: 1857-7881.
- Teshome, E. (2014). The Transforming Power of Urbanization: Changes and Uncertainties among the Farming Community in Laga Xafo-Laga Dadhi Town, Ethiopia. Addis Ababa University Department of Social Anthropology.
- Todaro, M.P. (1997). Economic Development (6th ed.), London: Addison Wesley Tsegaye, T. (2010). Urbanization in Ethiopia: Study on Growth, Patterns, Functions and Alternative Policy Strategy Stockholm University 2010.
- Ward, D., Phinn, S.R. and Murray, A.T. (2000). „Monitoring growth in rapidly urbanizing area using remotely sensed data“, Association of American Geographers, 52:371-386.
- Weng, Q.H. (2002). „Land use change analysis in the Zhujiang Delta of China using satellite remote sensing, GIS and stochastic modeling“, Journal of Environment Management, 64: 273-284.
- William, H. (1970). Urban Economics: Theory, Development and Planning, New York Macmillan Publishing Co., Inc.

Williams, K. (1999). „Urban intensification policies in England: problems and contradictions“, *Land Use Policy*, 16(3): 167-178.

UN-Habitat (2006). *State of the worlds; the millennium development goals and urban Sustainability. 30 years of shaping the habitat agenda.*

United Nations (2001). *World urbanization prospects. The 1999 revision.* New York: United Nations.

Yamane, T. (1967). *Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.

Yanping, Q. and Zhen, W. (2023). *Study on Urban Cover Using the Spatial and Temporal Dynamic Changes in the Impervious Surface in Nanjing*

Yirgalem, D. (2009). *The situation of informal actors in urban land management in one of the Sub-cities of Addis Ababa, the Kolfe-Keranio sub-city.*

## ANNEX

### Annex I: Publishable Manuscript

#### ASSESSMENT OF THE CONSEQUENCE AND SPATIAL SCALE OF MORPHOLOGICAL ALTERATION OF PHYSICAL SETTLEMENT DUE TO THE EXISTENCE OF THE EASTERN INDUSTRY ZONE ON THE, DUKEM TOWN

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Citation:

#### ARTICLE INFO    ABSTRACT

This study is conducted to analyze the assessment of spatial impacts of the Eastern Industry zone on the development pattern of the surrounding settlement of Dukem, Ethiopia. Dukem town is becoming an industrial hub in the Oromia region of Ethiopia due to its proximity to the capital city, Ethio-Djibouti Railway, Bole international airport, and Expressways. Those facts impact the physical settlements of the town. The east industry zone is one of the major industry spots in town. The study was conducted based on both qualitative and quantitative approaches using spatial analysis of GIS techniques and survey methods. Research findings show that industrial park development has both positive and negative impacts on the spatial settlements around the industrial parks. Specifically, the factors that positively influence the pattern of spatial settlements around industrial parks include the area of land acquired due to the construction of industrial parks (establishing EIZ, investment of other industries & manufacturing, housing preference, informal access to land, and the number of neighborhoods established after the industrial park is built). Accordingly,

the trend analysis of spatial settlement impacts has shown that the built-up area increased dramatically following the establishment of EIZ from 13.91 hectares (1.31%) in 2012 to 173.14 hectares (16%) in 2012, from 316.01 hectares (30 %) in 2016 to 578.23 hectares (55%) in 2018 from 13.91 hectares (1.31%) in 2012 to 964.16 hectares (91%) in 2023 this indicated that built-up areas consumed a considerable number of other types while agricultural land extremely decreased in all years from 1,046.77 ha (65.12%) in 2009 to 92.38 ha (8.71%) in 2023 which indicating its highest contribution to built-up areas. The prediction for future growth also showed that assuming the surrounding settlement will be covered by other industries and housing. The site is already a landlocked part and in the southern with Bishoftu. Therefore, the anticipated future growth of the government should be taken into account in all policy and planning decisions while proposing Industrial Parks.

Keywords: Spatial Settlement, Pattern, Industrial Park Development, Oromia Region, Ethiopia

## INTRODUCTION

Among the various outcomes of a changing climate is the emergence of urbanization around the world. Emerging urban areas and the migrations of unpredicted populations are becoming more prevalent, as the science about change grows progressively more drastic and alarming. Current projections indicate that rural-urban transformation will continue to grow in size and number. The formed urban area demands infrastructure, housing, processing industries, manufacturing, infrastructure, and job opportunities, resulting in plausible damage to the natural environment. In many cases,

the manufacturing industry is considered to create job opportunities in urban areas. In recent years Ethiopia and foreign investors are constructing industry parks (IP) all over the country. In 2000, China agreed to share with African countries its experience in the field of investment promotion relating to the establishment and management of special economic zones. The Eastern Industry Zone was subsequently established. Because of the various zones being built in Africa, Ethiopia perhaps represents one of the biggest challenges to both the Chinese developers and the host government alike. (Philip Giannecchini, Ian Taylor, School of

International Relations, University of St. Andrews, St Andrews KY16 9AX, Scotland, United Kingdom). The Eastern Industrial Zone in Ethiopia was initially planned in 2007 and launched in 2009. Located in Dukem, Oromia state, around 30 kilometers south-east of the capital, Addis Ababa, the original plan was to establish a 5 km<sup>2</sup> zone operated by the Yonggang Group and the Qi Yuan Group, which in five years would entice eighty separate investment projects, creating 20,000 jobs (Brautigam and Tang 2011). despite the job opportunity created by the eastern industry zone. This industry park has many impacts on urban settlements since it could do with large spaces to build, the income level of the workers is unsatisfactory & most of the employers can't afford the housing at Dukem and Bishoftu towns subsequently it creates new settlements at the industrial surroundings. This situation could have a substantial impact on the urban settlements to the specific project site contexts, at the early stages of developing industrial parks, shocks are rising to the environment. And the nastiest part of the case is that the design of the projects does not consider the settlements and urban covers around the project site. Ensuring the establishment of the east industry zone both Dukem and Bishoftu towns are expanding on

the advantage of job opportunities created in the park. in this case, housing facilities are the most demanding situation for both towns, new settlement is increasing radically. As the result of aerial photographs taken over the past 12 years shows, most agricultural lands surrounding the park are now turning to informal settlements for delivering and housing at a cheap price. Those cases may have happened because there wasn't proper planning for the housing before the park was acupuncture to the area. In addition, there is no infrastructure planning like access roads, electricity, sewage line, water supply, waste treatment units, health services, etc. for those new settlements. Most of the new settler householders are EIZ workers and they are hired in the EIZ because of their cheap labor even if they can't pay initial payments for infrastructure supply. On the other side, displaced farmers around the EIZ have no benefit from the EIZ and newly formed settlement and income means. in other countries, before injecting this kind of rural-urban transformation there are planning ways that allow proper industrial urbanism transformations, but in this case, the settlement pattern has no direct planning guide with both towns' master plans. In all the above cases, observed impacts happened as a result of the establishment of IP, and

many anticipated impacts follow if the research is not performed early. This research aims to measure the initial and extent of the impacts rising with settlements of existing industrial parks. And the findings will be incorporated as inputs to contribute guidelines for the future design and development of adaptive industry parks in Ethiopia. Lastly, the following particular aims are considered to acquire accurate findings:

1. To evaluate the spatial scope of the Eastern industry zone and its impact on the surrounding.
2. To identify timely cover patterns of settlement around the Eastern industry zone.
3. To assess the existing and anticipated impacts of the Eastern industry zone on the physical settlement of the surrounding area
4. To solve the existing impacts, and anticipated impacts, and plan future Covers of the Eastern Industry zone and spatial settlement of surrounding areas

## LITERATURE REVIEW

The impact is the action of one object coming forcibly into contact with another. (Oxford Languages). The impact of the Industrial Park is a consequence that comes with forcibility on the surrounding physical settlements by the cause of the introduced Industry Park. ‘Since the Industrial Revolution, cities and industry have evolved together, company towns and entire metropolitan regions have grown around factories and expanding industries. However, despite this shared past, popular notions of manufacturing tend to highlight the negative aspects: pollution, environmental degradation, and the exploitation of labor caused by growing industry, on the one hand; and – almost paradoxically on the other – the blight, abandonment, and “shrinkage” resulting from the more recent decline of manufacturing from cities in the developed world. (Tali Hatuka, Eran Ben-Joseph, 2014) A "settlement" is a community made up of residential structures; it serves the same purpose as a shelter does for a home or family. Settlements in (small and big) towns and cities are supported by urban settlement alternatives. A territory's patterned landscape gives rise to a human settlement. While maintaining equilibrium between population needs, resource availability and allocation,

economic dynamics, the improvement of living conditions, the provision of services, improving transportation networks, as well as recreational spaces, it takes into account the spatial allocation of functions. A settlement must take into account the requirements of the entire community and be created with the active participation of those who are of concern, partners, and all sectors.

The settlement describes the actual locations and settings where households are housed as well as the connections between those locations. The phrase is frequently used to refer to temporary or occasionally permanent housing arrangements of displaced families in the context of displaced populations. Settlements in this setting can include planned camps, dispersed housing in host villages or neighborhoods, collective centers, impromptu camps, rented housing, etc.

In an urban agglomeration, such as a town or city, displaced residents settle in urban settlements. Typically, a master plan separates towns or cities into zones that are governed by standards based on particular industries like housing, cleanliness, habitat, and environment. Residential areas, services, infrastructure, and places for business, industrial, and commercial operations are all included in zones. Because there is a shortage of land in cities and towns, people of concern sometimes settle in underdeveloped or marginalized regions, which have problems with access, service accessibility, sanitary conditions, and shelter availability. The urban poor may mix in with the displaced populations, making targeted help difficult but even more crucial to make sure resources reach the intended receivers. (<https://emergency.unhcr.org>)

## MATERIALS AND METHODS

### Study Area Description

The study was performed in the Dukem Town of Oromia Regional State, Ethiopia, and the surrounding areas of the Eastern Industry Zone. Eastern Industry Zone Dukem town is located 37km southeast of Addis Ababa along the main road to Adama. Geographically, the study area is located by latitude 8045'25"N- 8050'30"N and longitude 38051'55"E - 38056'5" E covering a total area of 9630.6 hectares. It is located at an average altitude of 2100m above sea level (OUPI, 2017). Physically, the study vicinity spans an area of 9,630.6 hectares between latitudes 8045'25" N and 8050'30" N and longitudes

38051'55" E and 38056'5" E. It is situated 2,100 meters above sea level on average. The town is bordered by the towns of Bishoftu and Gelan in the Southeast and most of the north, respectively. Four nearby peasant organizations of the Akaki District define the remaining eastern and western portions of the municipality (OUPI, 2017)

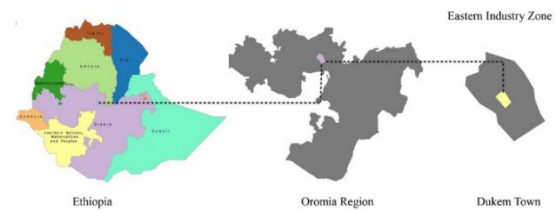


Figure 1. Location map of Dukem Town and Eastern Industry Zone (Source Generated by Author 2023)

Table 1. Depiction of the study variables

Variables	Measuring methods
Address, Gender, Age, Birthplace, Level of Education, Qualification background, Occupation, Workplace services	Descriptive statistics graphs were used.
Establishment of industries & manufacturing, Housing preference, informal access to land, and Land Grabbing	Using five-point Likert scales from strongly agree to strongly disagree, ranked data were used, & descriptive statistics were applied to the findings.
Private investors, government officials, professionals, society, neighboring farmers, and land brokers	Ranked data were five points of Likert scales from strongly agree to strongly disagree used, & descriptive statistics were used to describe their results.
Characteristics of LULC: Built-up area, Agricultural land, green area, Bare land, and Forest	There were maps, graphs, & charts to be used.
Rate of change	Graphs and charts were used.

(Source: Generated by Author 2023)

### **Data Collection, Analysis, and Methods**

The study's methodology is a survey method. The primary data were gathered using questionnaires. Five Likert ratings of powerfully agree to muscularly disagree were used to gauge respondents' perceptions of the factors and individuals that significantly influenced the rapid expansion of Dukem Town. Reports, court records, old study materials, and socioeconomic data were the primary sources for the secondary data. After the appropriate data had been gathered, SPSS 20 and Excel

software had been used to process the data. The mean, mode, median, and standard deviation were used to arrange and analyze the data using expressive and inferential arithmetical techniques. Also included were tables, graphs, and descriptive analyses that displayed ordered data.

### **Methods**

To measure the impact of EIZ on physical settlements of neighboring Dukem town, Google Earth images for the years 2009-2023 were used as a source of data and acquired from the developed software by the company. These data are used to produce the historical

land cover maps of the study area and physical settlement cover changes.

### **Sampling Techniques**

To generate information regarding the major driving factors and actors responsible for EIZ Cover in Dukem town a purposive (judgmental or expert sample) sampling technique was employed as a non-random sampling to select the representativeness of the target group from Dukem town government officials, EIZ workers, and neighboring communities because there was a variety in service year so that priority was given to service seniority.

Another target group is representativeness from communities. Also, a purposive sampling technique was applied because the communities selected were those who lived for 14 years and above in the area, the reason is that they could describe changes that resulted over time and were believed to have rich information than other existing new settlers in the town

### **Study Variables and Measuring Methods**

The sampling frame is the population of interest from which the sample is selected. Accordingly, the respondents of this study were Dukem town society, government officials, and EIZ workers.

To select the sample size from the total informant data regarding Dukem town society, government officials, and EIZ workers as specified in detail (Table 1). Based on this, the data regarding the total study population samples of society, government officials, and EIZ workers were acquired and decided under the sample size determination.

Table 2: Sampling frame data used to identify Community

No	Target Population	Gender		Total No
		M	F	
1	Dukem town government officials	25	12	37
2	EIZ Employees	45	36	81
3	Neighboring communities	102	88	190
<b>Total</b>				<b>308</b>

(Source: Generated by Author 2023)

## RESULTS

### LU-LC Change Result

At the beginning of 2009, Dukem town occupied only a small area at the center of the town. Then the growth of the town dramatically changed between the years 2009

and 2023 following the development of the Eastern Industry Zone (EIZ) See (Figure 2&3), and this continued between the years 2011 and 2023 particularly infilling developments in terms of residential development. Similarly, studies revealed that land use and land cover (LULC) change analysis results were shown to increase the rapid increase in built-up areas. This study showed that the built-up areas increased dramatically from (1.31%) in 2009 to (97.9% in 2012). This indicated that built areas consuming a considerable amount of other land use land cover (LULC) types while agricultural land extremely decreased in all years, from (98.69%) in 2009 to (8.71%) in 2023 which indicates its highest contribution to built-up areas. Moreover, the built-up areas of EIZ increased in spatial extent by 7.26% in 2012, 11.8% in 2016, 29.4% in 2018, and 51.87% in 2023, per year (Figure 4&5 ) According to the study's findings, the area has had extreme rapid urban growth, especially over the past twelve years with a growth rate of 46.34 %, and this trend is expected to continue in the ensuing decades.

### Driving Factors

The driving factors, as determinants of the impacts of EIZ on the neighboring spatial settlements between the years 2009 and 2023,

Four (4) Establishments of EIZ, investment of other industries & manufacturing, housing preference, and informal access to land.

## CONCLUSION

This study also concluded that the main drivers behind the spatial cover remarkable growth between the years 2009 and 2023 were the establishment of industries & manufacturing, housing preference, informal access to land, and Land Grabbing

## RECOMMENDATION

The following recommendations have been made for controlling the impact of the EIZ on spatial patterns and addressing the issues brought on by urban cover based on the study's research questions and findings.

According to the study's findings, the area has had extremely rapid urban growth, especially over the past twelve years with a growth rate of 46.34 %, and this trend is expected to continue in the ensuing decades. The analysis also revealed that the LUP and SP that OUPI had previously created to serve as a roadmap for development activities had not been carried out correctly in practice. Government representatives, EIZ employees, and communities must plan for the sustainable use of natural resources and keep

up with the rate of urban growth to achieve the balanced development that is necessary.

Utilizing powerful, effective land management and monitoring tools, such as GIS and satellite pictures (RST), to oversee urban land use change and ensure that it is carried out properly following the approved plan.

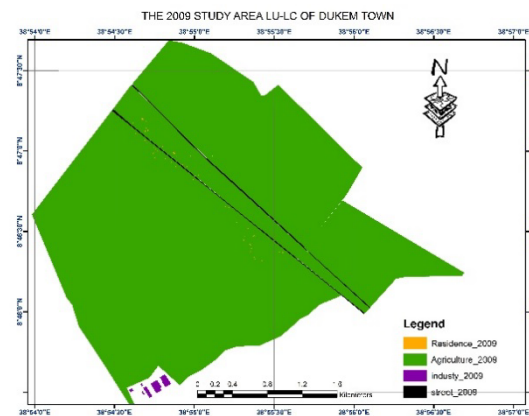


Figure 2: Showing the 2009 Landcover of the study area

(Source: Generated from GIS by Author 2023)

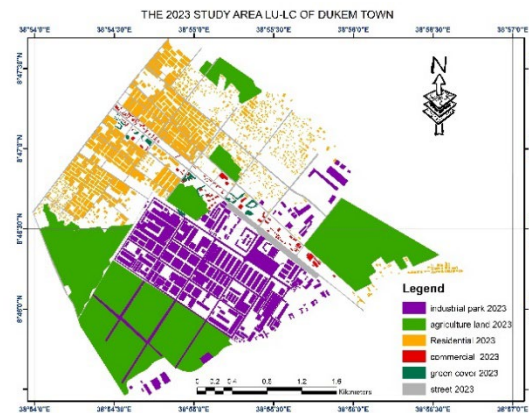


Figure 3: Showing the 2023 Landcover of the study area

(Source: Generated from GIS by Author 2023).

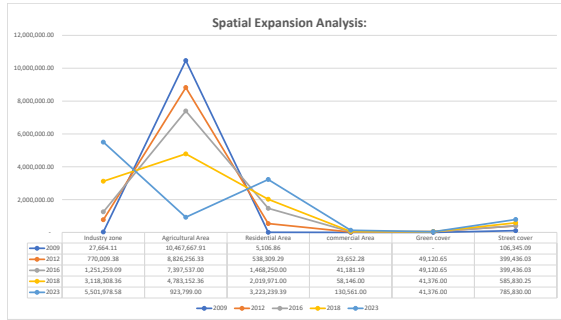


Figure 4: Graph of LU-LC 2009-2023

(Source: Organized by the author (2023)).

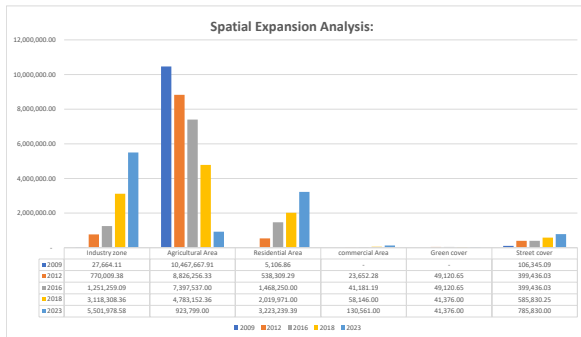


Figure 5: Showing 2009- 2023 Landcover of the study area

(Source: Organized by the author (2023))

## REFERENCES

- Girum Sisay (2020). An Investigation of Urban Expansion Land Use Land Covers Dynamics: The Case of Dukem Town, Oromia Special Zone.
- Adem, K. (2010). Urban Cover and the Neighborhoods: The Case of Bishoftu Town, East Shewa Zone, Oromia Regional State, Public Administration, and Development Management.
- Afera, H., Asirat, T. and Ermias, S. (2018). „Applications of Remote Sensing and GIS in Land Use/Land Cover Change Detection: A Case Study of Woreta Zuria Watershed, Ethiopia“, Applied Research Journal of Geographic Information System, 1: 1-9.
- Ahlam, Y. (2017). Urban Cover and Its Impact on the Livelihood of Peripheral Farming Communities: The Case of Kutaber Town, Amhara Region, Ethiopia.
- Alsharif, A., Pradhan, B., Mansor, S. and Shafri, H. (2015). „Urban Cover Assessment by Using Remotely Sensed Data and the Relative Shannon Entropy Model in GIS: A Case Study of Tripoli, Libya“, Theoretical and Empirical Researches in Urban Management, 10: 123-138.
- Antos, S. E., Lall, S. V. and Gracia, N. L. (2016). The Morphology of African Cities. Social, Urban, Rural, and Resilience Global Practice Group, World Bank, 51 pp
- Anupam, A. (2017). Unit 14-Accuracy Assessment, <https://www.researchgate.net/publicatio>
- Ambaye, A. (2012). Assessment of Urban Cover and Its Impact on the Livelihood of Peripheral Farming Communities in The Case of Dukem Town
- Amaha, G. (2007). Urbanization, Urban Sprawl Pattern Recognition and Modeling of Hawasa- Shashemene: Addis Ababa University School of Graduate Studies GIS and Remote Sensing Program.
- Ariana, B.V., (2016). The Impact of Roads on Land-Use Change in Ethiopia: Evidence from Satellite Data.
- Bahiru, Z. (1991). A History of Modern Ethiopia, 1855-1974: Addis Ababa University Press, Addis Ababa.
- Balchin, P.N., et al. (2000). Urban Economics: A Global Perspective. Great Britain Macmillan Press Ltd.
- Basel, M. and Hana, O. (2023). „Population Projection Model using Exponential Growth

Function with a Birth and Death Diffusion Growth Rate Processes“, *European Journal of Scientific Research*, 15: 271-276

Batty, M. (2004). What is Urban Sprawl? Concepts and Perceptions, Final Seminar of the Scatter Project Brussels.

Beka, G. (January 2016), Urban Cover and Its Socio-Economic Impacts on the Livelihood of the Farming Community in Sululta.

Bekure, W. (1999). „For men urbanized Ethiopia“, *Migration and Urbanization in Ethiopia: Proceedings of the Second Annual Conference*. Addis Ababa: Association of Ethiopian Geographers.

Berhan, G. and Woldeamlak, B. (2014). Drivers and Implications of Land Use and Land Cover Change in the Central Highlands of Ethiopia: Evidence from Remote Sensing and Socio-demographic Data Integration, Vol. X, No.2.

Bhatta, B.(2010). Analysis of Urban Growth and Sprawl from Remote Sensing Data, 17 *Advances in Geographic Information Science*, Springer-Verlag Berlin Heidelberg.

Burton, E. (2000). „The Compact City: Just or just compact“, *A preliminary analysis*“ *Urban Studies*, 37(11): 1969-2007.

Campbell, J. B. (1987). *Introduction to Remote Sensing*, The Guilford Press, New York.

Campbell, J. B. (1996). *Introduction to Remote Sensing*, Taylor and Francis, London.

Ciparisse, G. (2009). *Multilingual Thesaurus on Land Tenure, English Version*. Rome: Food and Agricultural Organization of the United Nations, (FAO).

Congalton, R. G. (1991). „A review of assessing the accuracy of classifications of remotely sensed data“, *Remote Sensing of Environment*, 3: 35-46

Dean, H. (2013). *Modeling Population Growth: Exponential and Hyperbolic Modeling*. (<http://www.scirp.org/journal/am>).

Dejene, N. (2011). *Rapid Urban Cover and Its Implications on Livelihood of Farming Communities in Peri-Urban Area*: Addis Ababa, Ethiopia.

Diriba, D., Azadib, H., Feyera, S., Ketema, A., Taherif, F. and Stellmacher, T. (2016). „Urban sprawl and its impacts on land use change in Central Ethiopia“, *Journal of Urban Forestry*

& Urban Greening, 16: 132-141.

Diriba, D., Stellmacher, T., Azadib, H., Ketema, A. and Feyera, S. (2017). The Impact of Industrialization on Land Use and Livelihoods in Ethiopia: Agricultural Land Conversion around Gelan and Dukem Town, Oromia Region: <https://www.researchgate.net>

Efa, T. and Gutema, I. (2017). „Prospects and Challenges of Urbanization on the Livelihood of Farming Community Surrounding Finfinne“, American Research Journal of Humanities and Social Sciences, 315: 2378-7031.

Eyasu S. (2007). The Impact of Urban Cover on the Livelihood of Peri-Urban Farming Communities in Alemgena Town: Addis Ababa University Schools of Graduate Studies Regional and Local Development Studies (RLDS).

European Environment Agency, (2006). Urban Sprawl in Europe: The Ignored Challenge.

Copenhagen, Luxembourg, 60 pp.

Feyera, A. (2005). Urban Cover and the Livelihood of the Peri-Urban Agricultural Community: The Case of Addis Ababa, Addis Ababa University Master of Arts in Regional and Local Development Studies.

Firew, B. (2010). The Impact of Horizontal Urban Cover on Sub-Urban Agricultural Community Livelihood: The Case of Tabor Sub-City, Hawassa city, Ethiopia.

Gao, J. (2002). „Integration of GPS with remote sensing and GIS: Reality and prospect“, Photogrammetric Engineering & Remote Sensing, 68:5 447–453.

G/Hiwot, B. (2006). Urban growth and its impact on land use, the case of Mekelle, M.A. thesis, Ethiopian civil service college, Addis Ababa.

Geist, H., McConnell, W., Lambin, E. F., Moran, E., Alves, D. and Rudel, T. (2006). "Causes and trajectories of land-use/cover change", Local processes and global impact, Berlin: Springer, 41-70.

Glenn, D. I. (2009). Determining Sample Size 1: Department of Agricultural Education and Communication, and extension specialist, Program Evaluation and Organizational Development, Institute of Food and Agricultural Sciences (IFAS), University Florida, Gainesville 32611 <http://edis.ifas.ufl.edu>

Handy, S., Paterson, R., Song, J. Rajamani, J., Jung, J., Bhat, C. and Kockelman, K. (2009).

Techniques for Mitigating Urban Sprawl: Goals, Characteristics, and Suitability Factors. The University of Texas, Austin, USA, 120 pp.

Haregewoin, B. (2005). Urbanization and Urban Sprawl

Herold, M. Goldstein, C.N. and Clarke, C.K. (2009). „The spatiotemporal form of urban growth: measurement, analysis and modeling *Journal of Remote Sensing Environment*, 86 286- 302.

Husen, T. (2018). Land Rights and Land Grabbing in Oromia, Ethiopia, VL-70, *Journal Land Use Policy*: <https://www.researchgate.net/publication/321020098>.

Kafi, M., Shafri, H. Z. and Shariff, M. (2014). An analysis of LULC change detection using remotely sensed data; A case study of Bauchi City, Department of Civil Engineering, Selangor Malaysia IOP Conf. Series: Earth and Environmental Science.

Kaleb, M. and Samuel, G. (2017). Investigation of Urban Sprawl Trends and its Impact on Socio- economy of Peri-urban Community in Addis Ababa: The Case of Akaki Kality Sub-city

Kenate, W. (2013). Land use covers dynamic socio-economic and environmental

transformations and implications in a geographical study of the fringe of finfinne Addis Ababa city, Ethiopia.

Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.

Lambin, E. F., Geist, H. and Rindfuss, R.R. (2006). "Introduction: Local processes with global impacts" In E. F. Lambin and H. Geist, editors. *Land-use and land-cover change: Local processes and global impact*, Berlin: Springer, 1–7.

Leulseged, K., Gete, Z., Dawit, A., Fitsum, H. and Heinemann, A. (2011). Impact of Urbanization of Addis Ababa City on Peri-Urban Environment and Livelihoods.

Levin, N. (1999). *Fundamentals of Remote Sensing*: Tel Aviv University, Tel Aviv, 225 pp.

Linda, L. (1996). *Sociology of Periphery Versus A periphery of Sociology: Rural Sociology and the Dimensions of space*, in *Journal of Sociology*, Vol.61, pp: 77-9

Lo, L. P. and Yeung, K. W. (2005). *Concepts and Techniques of Geographic Information System*: Prentice-Hall of India Private Limited, New Delhi, 492 pp.

Maher, M., Sabrina, H., Mohammad, F. and Zulfa, H. (2017). „Measuring and Mapping Urban Growth Patterns Using Remote Sensing and GIS Techniques“, *Pertanika Journal of Scholarly Research Reviews*, 3: 55-69.

Maria, E. F., Somik, L. and Danny, L. (2014). *Africa's Urbanization Challenges and Opportunities Africa's Urbanization*.

Marshall, F., Waldman, L., MacGregor, H., Mehta, L. and Randhawa, P. (2009). *On the Edge of Sustainability. Perspectives on Peri-urban Dynamics*, STEPS Working Paper 35, Brighton: STEPS Centre.

Mathias, T. A. (2016). *Remote Sensing and Geographic Information System Based Suitability Analysis of Urban Green Space Development in Addis Ababa: A Case Study of Bole Sub-city*. Addis Ababa University Addis Ababa, Ethiopia

Melesse, A. M., Weng, Q., Thenkabail, P. S. and Senay G. B. (2007). *Remote sensing sensors and applications in environmental resources mapping and modeling* 7: 3209-3241.

Miaoulis, G. and R. D. Michener (1976). *An Introduction to Sampling*. Dubuque, Iowa: Kendall/Hunt Publishing Company.

Nasir, J. and Saleem, A. (2018). *Exponential Growth Model for Forecasting of Area and Production of Potato Crop in Pakistan*. <https://www.researchgate.net>

Negasa, J. (2017). *Monitoring Urban Cover and Suitability Analysis for Residential Housing by Using Geographic Information System and Remote Sensing; the Case of Sululta Town; Oromia Regional State of Ethiopia*. Addis Ababa University, Department of Geography and Environmental Studies.

Oromia National Regional State Urban Planning Institute (2009). *Revision of Dukem Town Development Plan, 2009* Addis Ababa.

Oromia National Regional State Urban Planning Institute (2017). *Dukem town structure plan Study report, 2017* Addis Ababa.

Parvaiz, A.B., Miftaul, S., Abaas, A.M and Pervez, A. (2017). „Urban Sprawl and its Impact on Landuse /Land Cover Dynamics of Dehradun City, India“, *Gulf Organization for Research and Development International Journal of Sustainable Built Environment*, *International Journal of Sustainable Built Environment*, 6: 513-521.

Paul, N. (2000). *Urban Economics: a Global Perspective*, Great Britain Creative Print and Design (Wales) Ebb Vale.

Pickett, S., Cadenasso, M.L., Grove, J.M., Nilon, C.H., Pouyat, R.V., Zipperer, W.C. and Costanza, R. (2001).

Urban ecological systems: linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas“, 32:127–157.

Potter, R. (1992). *Urbanization in the Third World*, Oxford, Oxford University Press.

Potter, R.B. and Lloyd-Evans, S. (1998). *The City in the Developing World*, Harlow: Longman. Ravindra, K.V., Sangeeta, K. and Tiwary, R. K. (2009). *Application of Remote Sensing and GIS Technique for Efficient Urban Planning in India*.

Reis, J. P., Silva, E. A. and Pinho, P. (2015). „Spatial metrics to study urban patterns in growing and shrinking cities“, *Urban Geography*, 1938–2847.

Selam, G. (2017). *The Challenges and Contributions of Industrial Park Development (IPD) in Ethiopia: The Case of Eastern Industry Zone (EIZ) PLC, Dukem town, Oromia*.

Sekela, T. and Manfred, F. B. (2023). *Land-Use and Land-Cover (LULC) Change Detection in Wami River Basin, Tanzania*, *Land* 2023, 8, 136.

Seid, Y. (2007). *Urban Cover and Suitability Analysis for Housing of Adama City Using Remote Sensing and Geographic Information Systems Techniques*, Department of Earth Sciences Faculty of Science Addis Ababa University

Sewunet, S. (2017). *Urban Sprawl Mapping and Landuse Change Detection Using Spatial Metrics Method: A Case Study of Addis Ababa City and Its Surrounding Areas, Ethiopia*.

Shishay, M. (2011). *The Impacts of Urban Built-Up Area Cover on the Livelihood of Farm Households, in the Peri-Urban Areas of Mekelle City: The Capital of Tigray Regional State*.

Solomon, E. (2018). „Mapping urban cover and its effect on the surrounding land use using GIS and remote sensing. A case study in Debre Tabor Town, Ethiopia“, *Journal of Degraded and Mining Lands Management*, Volume 6, Number 1.

Tadesse, W., Tsegaye, T. D. and Coleman, T.L. (2001). *Land use/cover change detection*

of the city of Addis Ababa, Ethiopia using remote sensing and GIS technology.

Tamirat, M. (2016). „Horizontal Urban Cover and Livelihood Adjustment Problem among Ex-Farmers in the Kebeles Surrounding Jimma Town: The Case of Derba Kebele“, *European Scientific Journal*, 14: 1857-7881

Tegegne, G/E. (2002). „Urban poverty and the environmental: illustration from Addis Ababa, in Ethiopia“, *Ethiopian Development Forum Vol. No. 1*: 76-84.

Tilahun, S. (2016). *RS & GIS Integrated Study on Urban Sprawl with its Effects on Surrounding Farming Communities*

Todaro, M.P. (1997). *Economic Development* (6th ed.), London: Addison

Wesley Tsegaye, T. (2010). *Urbanization in Ethiopia: Study on Growth, Patterns, Functions and Alternative Policy Strategy* Stockholm University 2010.

Ward, D., Phinn, S.R. and Murray, A.T. (2000). „Monitoring growth in rapidly urbanizing areas using remotely sensed data“, *Association of American Geographers*, 52:371-386.

Weng, Q.H. (2002). „Land use change analysis in the Zhujiang Delta of China using satellite remote sensing, GIS and stochastic modeling“, *Journal of Environment Management*, 64: 273-284.

William, H. (1970). *Urban Economics: Theory, Development and Planning*, New York Macmillan Publishing Co., Inc.

## Annex II: Questionnaires Sample

Survey date \_\_\_\_\_ Survey place \_\_\_\_\_ Who collected the survey \_\_\_\_\_

### Dear Respondent:

The main aim of this questionnaire is to collect data as input for the study titled “*assessment of spatial impacts of the eastern industry zone on the development pattern of the surrounding settlement of Dukem town, Ethiopia*”. The purpose is to qualify for the requirement for awarding the Master of Science (MSc.) in Architectural Engineering at EiABC Addis Ababa University. Therefore, you are expected to provide genuine and accurate information.

### 1. Government Staff

#### Part I: Background of Respondents

1. **Address (Kebele):** Melka Dukem (1)  
 Tedecha (4)
2. **Gender:**  Male (1)  Female (2)
3. **Age:**  18 -30 (1)  31 -40 (2)  41 -50 (3)  51 -60 (4)  61 -70(5)  
 above 70 (6)
4. **Level of educations:**  Elementary (1 -8) (1)  Secondary School (9 -10) (2)  
 Preparatory school (11 -12) (3)  TVET (4)  Higher Educational Diploma (5)  
 First Degree (6)  Masters (7)
1. **Qualification background:**  Urban Planner (1)  Urban Land Administration (2)  
 Management (3)  Urban Land Development and Management (4)  
 Geographer (5)  Surveyor (6)  Engineer (7)  Economist (8)  
 Sociologist (9)  Geologist (10)  Other \_\_\_\_\_ (11)
2. **Work place:**  Dukem town land development and management office (1)   
Melka Dukem (2)  Gogecha (3)  Koticha (4)  Tedecha (5)
3. **Work position:**  Office Manager (1)  Deputy Office Manager (2)  Kebele  
administrators (3)  Deputy Kebele administrators (4)  Experts (5)  Site  
Supervisors (6)  Secretary (7)  Other \_\_\_\_\_ (8)

11-15

**Questions for Respondents**

1. What do you think about the following factors that contributed to the impact of EIZ on the Neighboring settlements between 2009 and 2023?

<b>Key Factors</b>	Strongly agree (4)	Agree (3)	Neutral (2)	Disagree (1)	Strongly disagree (0)
Establishment of industries & manufacturing					
Housing preference					
Informal access to land					

2 If you have any other Comments

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