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Urban Expansion Dynamics and its Contributing Factors in Case of Durame Town, Central Ethiopia Region

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Abstract
The major objective of this study is to examine urban expansion dynamics and its contributing factors in case of Durame Town, Central Ethiopia Region. A descriptive research design was used in the study, by employing both qualitative and quantitative methods. Data was gathered from primary and secondary sources. The target population consists of households. Both probabilistic and non-probabilistic sampling techniques were used for this study. To gather data, various methods were utilized, including questionnaires, interviews, focus group discussions, desk reviews, and field observations. Questionnaires were used to collect data from households, aiming to determine the contributing factors of urban expansion. Using the Likert scale, the Statistical Package for the Social Sciences software (Version 25.0) was used to analyze the gathered data. Additionally, Landsat images from the United States Geological Survey were analyzed using a supervised classification technique in geographical information system software (Version 10.7) to measure the historical growth of urban expansion. The findings of the study on Durame town's urban expansion the factors contributing to this expansion are ranked as follows in terms of their contribution, from highest to lowest: Land use policy and urban planning, Land values, Physical factors, Economic factors, Infrastructure factors, Technological factors, Neighborhood factors, Proximity factors, Industrialization factors, and Climate factors. The annual average rate of urban expansion in Durame town from 1994 to 2024 is 21.41%. The expansion of Durame town has resulted in significant environmental impacts, including deforestation, loss of farmland, and encroachment on wetlands, degradation, and pollution. Future studies should address limitations by incorporating urban expansion modeling and investigating factors such as cultural diversity, social cohesion, governance structures, population dynamics, and migration patterns. This will provide a more comprehensive understanding of urban development.

Keywords: Contributing Factors; Impact of Urban Expansion, Land Use Land Cover; Urban Expansion Dynamics; Urban Expansion

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1. Introduction

Urban expansion has emerged as a significant global issue in various parts of the world. The urban population has experienced significant growth, increasing from 751 million in 1950 to 4.46 billion in 2018 (Ritchie & Roser, 2018). The expansion of cities and the associated environmental challenges have escalated, particularly due to the lack of proper planning in the majority of urban areas (Ribeiro, 2021). Urban expansion refers to the geographical expansion or spread of urban settlements towards rural areas. It involves the horizontal expansion of urban areas, extending their boundaries into previously non-urban or rural territories (Bekele, 2018). Yue, Zhang, and Liu (2016) define it an unplanned type of urban growth that takes place outside of cities. The term "urban expansion" describes the unplanned and undesired spread of urban growth into neighborhoods close to a city's boundaries. This expansion often takes the form of low-density development, resulting in sprawling urban areas that encroach upon agricultural zones (McClellan, 2018; Mekuriaw & Gokcekus, 2019). A general perception of urban expansion is that it entails unregulated growth in an outward direction.

Globally, the policy debate surrounding the expansion of cities is not a new phenomenon. Whether or not to support, accept, or encourage urban expansion is the central topic at the center of this discussion. There have been opposing views throughout history, with some advocating for limiting city growth by any means necessary, while others embrace it and prepare for accommodating new migrants. Despite the passage of time, the question of how urban expansion should be approached remains largely unresolved. There is disagreement among

academics, decision-makers, and city dwellers on whether or not to allow expansion. This lack of agreement is evident in a survey conducted in the United States (Angel, Sheppard, Civco, Buckley, Chabaeva, Gitlin, and Perlin, 2005). Sahalu (2014) stated that meanwhile; it becomes evident that studying urban expansion from the dimension of measuring its dynamics, contributing factors, and possibly ways to harness each urban expansion in the case of a contiguous policy.

The population in Africa is expected to double in the next four decades, leading to rapid urban expansion and significant impacts on society, the environment, and health. To effectively prepare for these changes, it is crucial to gain a deeper understanding of urban growth dynamics in Africa and improve predictions regarding the conversion of rural areas into urban ones (Linard et al., 2013).

Three major Ethiopian cities Addis Ababa, Hawassa, and Adama have come to be recognized as crucial zones affected by urban dynamics (Terfa, Chen, Liu, Zhange, & Niyogi, 2019). These cities are grappling with the challenges posed by rapid and unregulated urban expansion, which has led to significant environmental degradation. The expansion of town processes has resulted in significant environmental degradation in many places (Terfa et al., 2019). It is essential to comprehend how cities in emerging nations are growing geographically. Is it important whether urban expansion is occurring in various ways in different regions? What factors influence the growth of cities? What recent developments are causing cities to grow? How can accurate measurements for urban expansion be created? What effects does the expansion of cities have? These are the questions that the urban growth management initiative seeks to answer, laying the groundwork for research and action to effectively manage urban expansion in developing-country cities.

Understanding and addressing the dynamics of urban expansion and the factors that contribute to it becomes essential in the case of Durame Town. One specific issue in Durame could be the rapid and uncontrolled growth of the town, leading to challenges in infrastructure development, environmental problems, and impacts on peri-urban communities. The most recent study conducted at the zonal level by Lamedjo (2022) examined the influence of urban expansion on land use and land cover among smallholder farmers in the Kambata Tembaro Zone. The findings show shifts in crop types and a decrease in forestland because of urban expansion. In addition, another study conducted by Abuto (2017) revealed that the rapid and chaotic expansion of Durame Town is causing the displacement of peri-urban agricultural communities. However, there is a lack of studies investigating the specific causes of this urban expansion. It is important to investigate the patterns of physical enlargement and the contributing factors. As a research gap, smaller towns like Durame often are overlooked in research, as studies tend to focus more on larger cities in developed countries when exploring urban expansion contributing factors. Even though those studies in larger cities do not adequately investigate, the new emerging factors that contributed to the expansion of cities. To close this research gap, the dynamics of urban expansion and the factors that influence it were the primary focus of this study.

2. Literature Review

2.1 The Factors Contributing to Urban Expansion

Factors contributing to urban expansion encompass a multitude of dimensions, including natural, socioeconomic, and demographic elements. Studies have highlighted the significance of various drivers such as terrain, population density, economic activities, and governmental policies in shaping urban growth (Bonilla-Bedoya et al., 2023; Feng et al., 2019; Guangjin et al., 2016; Sánchez et al., 2022; Wu et al., 2018). The spatiotemporal patterns of urban growth are influenced by the intricate interactions between these components. Topography and other natural restrictions initially limit growth, but over time, these tendencies loosen up and socioeconomic factors play a bigger role in influencing urban growth.

2.2 Dynamics of Urban Expansion

International capital flows, GDP per capita, and population increase are only a few of the variables that affect the dynamics of built-up expansion (Seto et al., 2011). Urban expansion in China has demonstrated a south-north divide, accompanied by an east-west separation in influencing variables (Jing et al., 2022). A transition from heterogeneity to homogeneity, coupled with a more robust coevolution process between cities and surrounding areas, characterizes the dynamics of global urban expansion (Angel et al., 2005). In China, the causes propelling urban expansion differ by region: in the east, secondary industries and economic development play a major role, while road building and population increase are more prominent (Guangjin et al., 2016).

Urbanization has been occurring since around 5000 B.C., thus it is not a recent phenomenon. The percentage of the population that lives in urban areas relative to the overall population is a key indicator of urbanization, and it

is consistently increasing each year. Urbanization grew rapidly all across the world after World War II. Over 50% of people live in urban areas in developed regions such as North America, Europe, and Oceania due to high levels of urbanization (Hussain & Imitiyaz, 2018).

2.3 Impacts of Urban Expansion

According to Knudsen (2010), there is a high demand for urban land in Ethiopian cities due to the rapid population increase. However, the current allocation system faces difficulties due to the illegal occupation of green buffer zones, inefficient land use, boundary conflicts, unoccupied plots, and unused spaces owned by individuals and organizations. Debela, Stellmacher, Azadi, Kelboro, Lebailly, and Ghorbani (2020) assert that surface water, air quality, and the aesthetic value of landscapes are among the environmental resources that are negatively impacted by urban growth and its associated activities. It also results in the habitats of species being destroyed. The increasing land requirement to accommodate the growing population emphasizes the negative consequences of urbanization.

Urbanization and expansion are viewed as centers of numerous human opportunities and contemporary lifestyles that have the potential to significantly improve and progress the socioeconomic system. However, as Gebeyehu (2022), and Mekuriaw and Gokcekus (2019) argue, the horizontal expansion of urban centers in Ethiopia gives rise to several socioeconomic issues, including tenure-related rights violations. Ethiopia's urbanization hinders the strategies and means of sustenance of the peri-urban populations, making them more vulnerable to various shocks.

3. Research Methodology

3.1 Description of the Study Area

In the Central Ethiopia Region, Durame Town is situated 125 kilometers west of Hawassa, Using Shashemene, travel 350 kilometers south of Addis Ababa, and 298 km through Hossaina. It is also located 80 km south of Hossaina town and 12 km west of Mazoria town. Which is located on the Shashemene-Woliata Sodo route, and spatially, located between 37o 53'38.815"E, 7o16'17.984"N and 37o54'24.676"E, 7o12'53.938"N with an elevation of 2101 meters above sea level. The town covers an area of 1,354 hectares (Durame town municipality, personal communication, March 11, 2024).

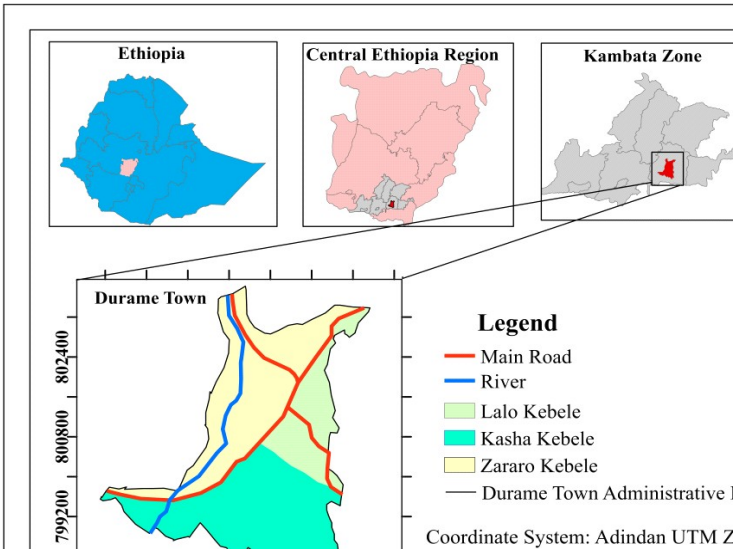

Figure 1 Location map of Study Area

3.2 Research Design

According to Siedlecki (2020), a research design is a set of guidelines that helps researchers investigate with the greatest amount of control over variables that can affect the results. A research design specifies the where, when, and how of data collection and analysis. To conduct the study, the researcher used a descriptive research design. Data for the descriptive study design is obtained from a carefully selected sample of people who belong to a certain target community. Information that describes, investigates, and quantifies social phenomena is gathered using a descriptive research design, which focuses on prevailing societal concerns, situations, and problems at a

particular moment in time (Cooper & Schindler, 2011; Mugenda & Mugenda, 2012). By gathering accurate and pertinent information, the descriptive research design that was used allowed for a thorough knowledge of the issue by analyzing the state and nature of current practices, circumstances, and trends.

The use of the descriptive design is beneficial since it provides ease of use for either questionnaire tools interviewing subjects, or both. The chosen descriptive research design was advantageous for this study as it allowed the researcher to employ questionnaires and interviews, ensuring thoroughness in the investigation. The study successfully investigated the dynamics of urban expansion and its contributing elements in the instance of Durame town by using a descriptive research approach.

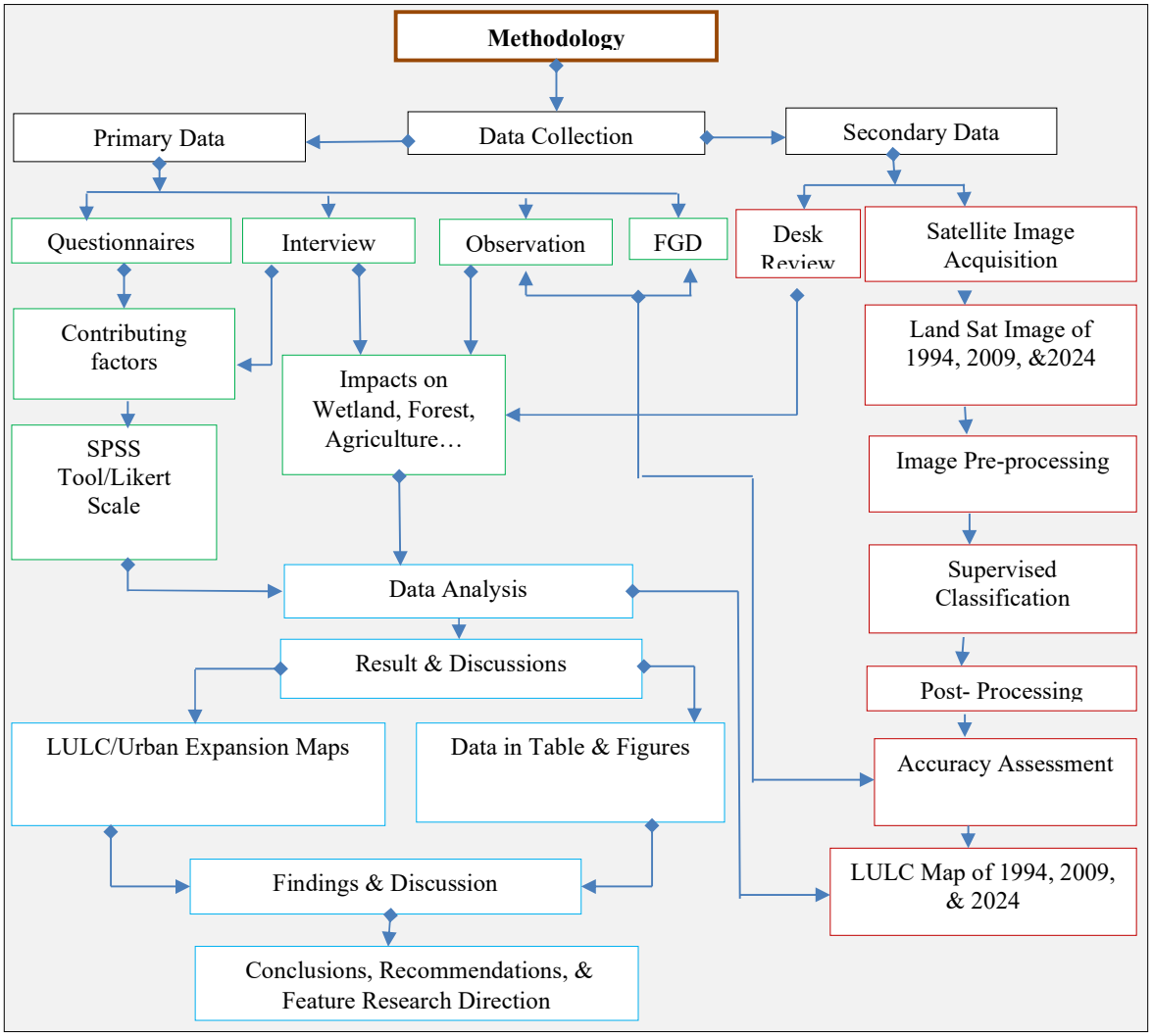

Figure 3.1 Methodology of the Study

Qualitative as well as quantitative approaches were used in this study. According to Maxwell, (2012), the methods and processes employed throughout the data collection process are referred to as the research methodology. The methodology employed a mixed methods approach, with a collection of qualitative data and the predominant use of quantitative data-gathering tools. The researcher conducted a critical examination of the results from both quantitative and qualitative analyses to determine whether the findings from these different sources align. This comprehensive approach allowed for a robust exploration of the research topic, enhancing the credibility and validity of the study's findings. The qualitative data played a supportive role in the study.

3.4 Types and Sources of Data

Primary and secondary data are among the data kinds used. Field observations, key informant interviews (KII), focus groups (FGD), and questionnaires were among the techniques used to gather primary data. These methods offer firsthand insights and perspectives from individuals. Secondary data sources, such as reports from Durame

town Municipality and remote sensing data obtained from sources like Landsat images, provide additional context and information on measuring urban expansion dynamics. Among the data sources utilized were primary data obtained through surveys, focus groups, key informant interviews, and field observations. Written document reports from the Durame town municipality provided secondary data. Additionally, Landsat images obtained through registration with the USGS site at EROS were utilized as a data resource to measure and understand the patterns and changes in urban expansion.

Table 3.1 Data from Satellite Image

№	ID of Space Craft	Path & Row	Date of Acquisition	Resolution
1	LANDSAT 4-5 TM C2L2	P169-R55	03/02/1994	30m*30m
2	L7 ETM + C2 L2	P169-R55	04/02/2009	30m*30m
3	LANDSAT 8-9 OLI/TIRS C2L2	P169-R55	11/02/2024	30m*30m

Source: https://earthexplorer.usgs.gov/, 2024

3.5 Sampling Design

3.5.1 Population and Sampling Frame

The study's population consists of households in Durame Town. The sampling frame for this study included a list of households based on housing number (ID) from each Kebele. The sampling frame for KIIs is a list of potential key informants - individuals who have in-depth knowledge and expertise on the research topic. The sampling frame for FGDs typically consists of a list of potential focus group participants who share characteristics relevant to the research topic. This could include things like age, educational background, duration of residence in the town, and career.

3.5.2 Sample Size Determination

Kothari's formula was utilized to calculate the sample size. By applying Kothari's formula for sample size, an appropriate sample size was derived to comprehensively explore the factors contributing to urban expansion in Durame town. It is used for determining the sample size due to its consideration of population size, confidence level, and margin of error. It provides separate equations for populations larger and smaller than 10,000, allowing flexibility in estimating sample sizes. This sample size ensures a statistically significant representation of the target population, enhancing the reliability and generalizability of the study's findings. According to Kothari (2004) to compute the sample size for a population of less than 10,000, the formula below can be used:

If N is greater than 10,000 (N > 10,000) using the formula of $n = \frac{Z^2pq}{e^2}$.

Where,

n= Desired sample size
N= Population size
Z = Z statistic (95 %) or the accepted standard parameter with the necessary confidence level
p= Estimated target population characteristics
q =1- p, Features of the target population that are not estimated
e = Margin of error or level of statistical significance (5%).

When N > 10,000, the researcher applied the following calculation, with P=0.5 and q=1-p=0.5, to acquire the appropriate sample size (n) at a 95% confidence level. The Z table yielded a Z statistic of 1.96 with a 95% confidence level. The intended precision was applied at the significance level of 0.05.

$$n = \frac{Z^2pq}{e^2}, \tag{5}$$

$$n = \frac{(1.96)^2 * 0.5 * 0.5}{0.05^2} = 384$$

According to Kothari (2004), the formula below can be applied if N is less than 10,000:

$$f_n - \frac{n}{1 + \frac{n}{N}}, \tag{6}$$

$$f_n - \frac{384}{1 + \frac{384}{9,676}} - 369$$

Where, if the target population is smaller than 10,000, f_n= the required sample size. When the population exceeds 10,000, the sample size is n=384, or 384 at a 95% confidence level. Accordingly, N= desired population size, n= 384, N= 9,676. Consequently, 369 households make up the study's sample size. From among the households, the researcher selected 369 respondents.

3.5.3 Sampling Techniques and Procedure

Both probabilistic and non-probabilistic sampling techniques were used in the investigation. While systematic sampling chose respondents, Durame Town was chosen using purposive sampling. This approach ensures a representative sample and enhances the generalizability of the findings. Probability sampling minimizes sampling error and ensures a rigorous approach to sampling. The study encompasses three Kebeles in Durame town: namely Kasha (01), Zararo (02), and Lalo (03).

The researcher used a systematic sampling technique to select the study participants. The target populations are listed in numerical order as 'N', and the sample size was determined as 'n'. The sample interval is calculated by dividing the total population by the sample size, denoted as $N/n=k^{th}$. The starting point of the sample was chosen at random from the first k^{th} number on the list, which represents each respondent in the study area. The subsequent elements were selected following the same procedure until the required sample size was achieved.

3.5.4 Methods of Quantitative Data Analysis

Analysis of changes in land cover and usage related to Durame town's expansion was done using USGS Landsat imagery (https://.usgsearthexplorer.com). The data was obtained from the Earth Explorer/USGS platform after registering with the EROS Center. ArcGIS software, specifically ArcGIS 10.7 and ERDAS Imagine 2015, was used to process the acquired data and measure urban expansion dynamics. Image processing activities were performed within the software to generate land use/land cover types.

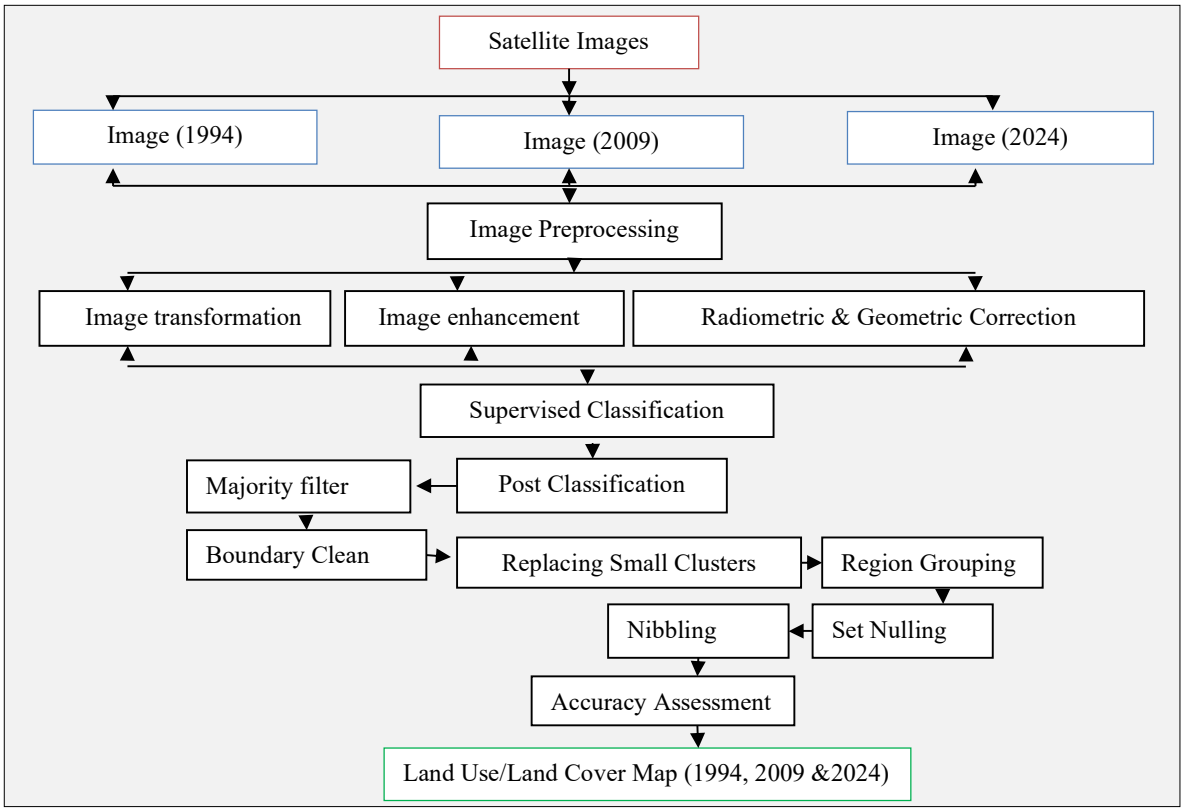

Figure 3.6 Image Processing Methodologies

3.5.5 Methods of Measuring Changes in LULC

An analysis was done on the change in land use/land cover (LULC) between 1994 and 2024. The selected method enables the identification and mapping of LULC changes during the specified period, allowing for the differentiation of various LULC types. For LULC maps covering two periods, the following percentage change statistics were computed:

$$\text{Percentage Change } \% = \frac{A_{\text{final year}} - A_{\text{initial year}}}{A_{\text{initial year}}} * 100, \quad (7)$$

A is the area coverage of each LULC type (in ha). Positive percentage values indicate an expansion or increase in area coverage, while negative values indicate a contraction or decrease in area coverage.

3.5.6 Techniques for Measuring the Rate of Built-up Area Expansion

In the study area, the rate of urban increase from 1994 to 2024 was computed. The average yearly increase of the urban area during the designated time is represented by the urban expansion rate. Built-up areas is defined according to Ouyang et al. (2016) as covering complexes that are commercial, residential, or industrial, as well as ground paving in addition to other facilities that is directly related to the built environment. After extracting the built-up areas, Equation (8) was used to calculate the annual rate of urban expansion (RUE) for the given periods (Xiao et al., 2006, as cited in Fenta et al., 2017).

$$RUE = \frac{(BUA)_{i+n} - (BUA)_i}{n(BUA)_1} * 100, \quad (8)$$

By comparing the built-up area at a prior period (BUA_i) with the built-up area at the current time (BUA_{i+n}), where n is the number of years between the two, the annual rate of urban expansion (RUE) was calculated.

3.5.7 Methods of Analyzing the Contributing Factors

The purpose of this study is to investigate the factors influencing Durame Town's urban expansion. The following factors were looked at industrialization, technology, climate change, infrastructure, neighborhood features, physical attributes, land values, land use regulation, and urban planning. A predetermined sample of households received questionnaires, which were used to gather quantitative data. Software called SPSS (version 25) was used to analyze the data, and descriptive statistics were used to determine mean values and standard deviations. These analyses provided insights into the influence of each factor on urban expansion and enabled to rank.

Table 3.6 provides concise descriptions of various land cover classes, such as forestland (dense tree canopies), farmland (crop and plantation areas), built-up areas (artificial surfaces), bare land (rocks, soil, mines), and wetland (swampy or marshy areas). They were arranged by the researcher's classification of the most prominent and/or accessible land use types in the town and categorized accordingly.

Table 3.6 Description of LULC Classes

LULC	Description
Forest land	Areas where trees are densely grown and almost completely enclose their canopies. This category encompasses common tree species, such as eucalypts and acacia that are frequently found near homesteads.
Farmland	Areas are used for growing crops, plantations, and growing.
Built-up	All artificial surfaces, including areas used for commerce, industry, and housing, as well as transportation infrastructure, fall under this category.
Bare land	Rocks, exposed soil, mines degraded land, and dunes.
Wet land	An area that is swampy or marshy land.

3.5.8 Methods of Qualitative Data Analysis

Thematic analysis was used to examine the qualitative data from the FGD and interviews. The collected data from the semi-structured interviews with the municipal experts of Durame town were analyzed thematically and qualitatively, aiming to derive meaningful insights. The researcher underwent a thorough review process to identify recurring themes, patterns, and significant findings. Thematic analysis was employed to organize and interpret the qualitative data, allowing for a comprehensive understanding of the influential elements to urban expansion in Durame town and the impact on the physical environment. This qualitative analysis gave the research important new information on the viewpoints, experiences, and views of the participants. The LULC analysis findings were used as input for the qualitative analysis. The findings enhanced understanding of the factors contributing to urban expansion in Durame town, providing qualitative evidence to complement the quantitative analysis conducted in the study.

4. Result and Discussions

Finding on Contributing Factors to Urban Expansion

Land Use Policy and Urban Planning Contributing Factors

On average, the finding was that urban expansion in Durame Town was caused in part by the informal settlements, inadequate enforcement of urban development limits, and the application of land use policies and urban planning. (Table 4.1).

Table 4.2 LUPUP Dimension

№	Land Use Policy and Urban Planning	Mean	SD
1	Urban land leasing policies encourage the development of new construction in the agricultural sector.	3.4092	.89262
2	There was jumping over large areas of open space because of the poor execution of urban planning and land use policies.	3.6070	.90593
3	Insufficient enforcement of regulations for urban development is responsible for the rapid expansion rate of Durame Town.	3.6883	.99066
4	Informal settlements in built-up areas or rental housing units on the fringe accelerate urban expansion.	3.4255	1.02972
Average		**3.5325**	**.84536**

The Land Values Dimensions of Urban Expansion Contributing Factors

Increased demand for land, conversion of agricultural land for various purposes, rising urban population, and rising land prices contributed to urban expansion in Durame town (Table 4.2).

Table 4.3 The Land Vale Contributing Factors

№	Land Values	Mean	SD
1	Eventually, as the property becomes more in demand, agricultural land is converted to residential use.	3.3523	1.00569
2	Human intervention resulted in the modification of agricultural land usage for infrastructure, manufacturing, transportation, and habitation.	3.1003	1.14836
3	The need for urban land is rising as the population of the town grows.	3.2873	1.03937
4	Residents started selling their property instead of farming due to the increasing cost of the changed fields (from agricultural to construction).	3.3713	1.09363
5	The direction of Durame Town's expansion was contributed by the increase in land value.	3.0542	1.07455
Average		**3.2331**	**.98040**

Source: Field survey, 2024

Physical Dimensions of the Contributing Factors

Table 4.3 presents results related to physical factors contributing to urban expansion in Durame town. The table includes five statements related to the suitability of topography, flat slopes, and presence of river water resources, and high demands for land aspects of physical factors. Each statement has a mean score and a standard deviation.

Table 4.4 The Physical Dimensions of Urban Expansion Contributing Factors

№	Physical Factors	Mean	SD
1	Among new residents, topographical appropriateness was chosen.	3.3333	1.12288
2	In Durame Town, the direction of urban expansion was influenced by the availability of flat slopes.	3.0379	1.11982
3	The need for the open areas that make up the current urban area increased as the population of the town increased.	3.2466	1.00617
4	The availability of river water resources presents prospects for the development of surrounding urban areas.	3.3442	1.08007
5	Substantial land needs came from the residents and businesses that were moving into the town from the outside.	3.0108	1.05804
Average		**3.1946**	**.98586**

Source: Field survey, 2024

Economic Dimensions of Urban Expansion Contributing Factors

Table 4.4 presents results related to economic factors contributing to urban expansion in Durame town. The table includes five statements related to different aspects of economic factors. Each statement has a mean score and a standard deviation.

Table 4.5 The Economic Dimensions of Urban Expansion Contributing Factors

№	Economic Factors	Mean	SD
1	New immigrants were attracted to the community by the reasonably priced land.	3.3171	1.08084
2	People were drawn to Durame town by the inexpensive rental housing.	3.0108	1.05547
3	It is simple to purchase, sell, and split the agricultural property into residential areas.	3.2412	.96619
4	Durame town urban expansion process heavily depends on the housing market.	3.3442	1.06231
5	Urban land was encouraged by economic development, and the need for new buildings often fueled urban expansion.	3.0434	1.04687
Average		**3.1913**	**.94635**

Source: Field survey, 2024

Infrastructure Contributing Factors

Infrastructure factors contributing to urban expansion in Durame Town include five statements related to different aspects of infrastructure factors. Each statement has a mean score and a standard deviation (Table 4.5).

Table 4.5 Infrastructure Dimension of Urban Expansion Contributing Factors

№	Infrastructure Factors	Mean	SD
1	The urban expansion was contributed by the availability of good roads and efficient public transportation systems.	3.3252	.99588
2	Many people in Durame town were attracted to the government's level of investment in the schools.	3.0379	1.10023
3	The availability of a clean enough supply of water for residential usage has aided in the expansion of the town.	3.2358	1.00337
4	The town's expansion has increased due to the presence of facilities for health service.	3.3388	1.07927
5	The town has drawn the interest of outside investors due to its communications service and electrical supplies.	2.9593	1.05087
Average		**3.1794**	**.93959**

Source: Field survey, 2024

Technology Dimensions of the Contributing Factor

Table 4.6 presents results related to technological factors contributing to urban expansion in Durame town. The table includes three statements related to aspects of technology factors such as advancements in technology, including communication infrastructure, and transportation. Each statement has a mean score and a standard deviation.

Table 4.6 Technological Contributing Factor

№	Technology	Mean	SD
1	Advancements in technology, such as improved communication infrastructure, have facilitated urban expansion by attracting businesses and individuals who rely on these technologies.	3.2276	.93669
2	Technology-driven sectors, such as information technology and e-commerce, have created job opportunities and economic growth, contributing to urban expansion.	3.2602	1.12895
3	Technological advancements in transportation, such as the development of mass transit systems and ride-sharing platforms, have influenced urban expansion patterns by improving mobility and accessibility.	2.9864	1.10204
Average		**3.1581**	**.97493**

Source: Field survey, 2024

The Neighborhood Dimensions of the Contributing Factors

Table 4.7 presents results related to neighborhood factors contributing to urban expansion in Durame town. The table includes four statements related to different aspects of neighborhood factors. There is a standard deviation and mean score for every statement.

Table 4.6 The Neighborhood Contributing Factors

№	Neighborhood Factors	Mean	SD
1	The probability of urban expansion was higher in areas closer to developed communities and urban infrastructure.	2.9485	1.08099
2	Urban expansion is linked to neighborhoods that are closer to urbanized settlements and that are more easily accessible to urban infrastructure at cheaper prices.	3.1382	1.01343
3	Urban expansion is a result of the massive push toward rural-urban land conversion.	3.3144	1.10031
4	The actual lifestyles of the residents and their preferences for single-family homes, open spaces, or house ownership are bringing in new immigrants.	2.9702	1.07424
Average		**3.1186**	**.97906**

Source: Field survey, 2024

Proximity Factors

Table 4.8 presents results related to proximity factors (proximity to work, preferences for urbanism, housing demand, accessibility, and the presence of administrative centers) contributing to urban expansion in Durame town. The table includes five statements related to different aspects of proximity factors. Each statement has a mean score and a standard deviation.

Table 4.8 Factors of proximity Urban Expansion Dimensions

№	Proximity Factors	Mean	SD
1	Newcomers favored living close to their place of work.	3.2249	1.12811
2	Gentrified neighborhoods in Durame Town reflected preferences for urbanism, driven by demands for new housing and accessible settlements.	2.9485	1.08099
3	Transportation accessibility distances to main roads contributed to urban expansion.	3.1382	1.01343
4	The potential for urban expansion increases with the town's proximity to a regional administrative hub.	3.2547	1.10834
5	Durame town is the seat of three organizations in the region which led to the expansion of the town.	2.9187	1.05753
Average		**3.0970**	**.98434**

Source: Field survey, 2024

Industrialization Dimensions of the Contributing Factors

Table 4.9 presents industrialization factors that contribute to urban expansion by contributing to the growth of industrial sectors (*M*=3.1843, *SD*=0.95762), creating employment opportunities (*M*=3.1734, *SD*=1.12397), attracting rural populations, and establishing new urban centers through the development of industrial and special economic zones (*M*=2.8726, *SD*=1.04909).

Table 4.9 Industrialization Dimensions Contributing Factors

№	Industrialization	Mean	SD
1	The growth of industrial sectors and manufacturing activities has been a significant contributor to urban expansion, as industries require infrastructure, labor, and access to markets.	3.1843	.95762
2	Industrialization created employment opportunities, attracting rural populations to urban areas in search of better economic prospects and contributing to urban expansion.	3.1734	1.12397
3	New urban centers have been established and existing cities have expanded because of the growth of industrial and special economic zones.	2.8726	1.04909
Average		**3.0768**	**.93919**

Source: Field survey, 2024

Climate Change Dimensions of the Contributing Factors

Table 4.10 presents results related to climate change factors contributing to urban expansion in Durame town. The table includes five statements related to different aspects of climate change factors. There is a standard deviation and mean score for every statement.

Table 4.10 Climate Change Dimensions of Urban Expansion

№	Climate Change	Mean	SD
1	Climate change-induced events, such as extreme weather events have led to population displacement and migration to urban areas, resulting in urban expansion.	3.1152	.89991
2	The need for climate resilience and adaptation has driven the expansion of urban infrastructure and the development of sustainable urban planning practices.	3.0788	1.14757
3	Climate change impacts on agriculture and rural livelihoods have led to increased urbanization as people seek alternative economic opportunities in urban areas.	2.7879	1.05800
Average		**2.9940**	**1.0352**

Source: Field survey, 2024

Discussion on Contributing Factors of Urban Expansion

I. Land Use Policy and Urban Planning

In Table 4.1, the LUPUP dimensions of urban expansion contributing factors in Durame Town were rated as high agreement. The findings demonstrate that the government's utilization of policies promoting new construction on agricultural land through urban land lease received moderate agreement (*M*=3.4092, *SD*=0.89262), demonstrating the role that urban planning and land use regulations have in promoting urban expansion. The weak implementation of LUPUP, resulting in the encroachment of open spaces, was rated as a moderate factor (*M*=3.6883, *SD*=0.99066), highlighting the need for improved policy implementation to manage urban expansion. Urban expansion was shown to be an important determinants influenced by the low quality and strictness of enforcement of urban development limits, highlighting the significance of efficient enforcement systems. The presence of informal settlements at the peripheries and the invasion of land by formal urban sprawl were seen as significant drivers of urban expansion, underscoring the impact of informal settlements and urban development on agricultural land. The findings emphasize the role of land use policy and urban planning in contributing to urban expansion in Durame Town. In addition, the present investigation validates the research conducted by Kassahun (2021) on investigating the reasons for sprawl in Lagatafo Lagadadi Town. The study concluded that Policies of the government, urban design, and the land and real property markets were the primary factors contributing to the spread of Lagatafo Lagadadi Town.

II. Land Values Factors

In Table 4.2, the factors that influenced urban expansion in Durame Town in terms of land values were identified. Regarding the idea that as land became more in demand over time, agricultural land was converted into residential areas, respondents' agreement was mediocre. Another moderate factor in land use change was human involvement in infrastructure, manufacturing, transportation, and settlement. The increasing urban population, leading to a higher demand for urban land, was rated as a significant factor. One major factor contributing to urban expansion was the increasing price of converted land, which forced some locals to sell their property rather than use it for farming. The rise in land value was identified as a moderate factor contributing to urban expansion.

The interview with the Durame Town Land Management Office experts reveals that the main drivers of urban expansion are increasing demand and rising prices of land, weak legal enforcement, limited availability of land in the Town center, and the presence of open space on the Town's periphery.

The findings from FGD indicate that the dynamics of land prices in suburbs, with reductions for buyers and increases for sellers, contribute to urban expansion in several ways. The affordability of land in suburban areas attracts potential buyers leading to increased demand for housing and the subsequent expansion of residential areas. This cycle of lower prices for buyers and higher prices for sellers creates a dynamic that fuels urban expansion by both meeting the demand for affordable housing and facilitating the transformation of suburban areas into vibrant urban centers. The finding is in line with the recent finding of Soltanifard et al. (2020) study on the driving factors behind urban sprawl in Mashhad City primarily stem from population growth, the incorporation of peripheral settlements, and the dynamics of land prices in the suburbs. These dynamics involve the reduction of land prices to attract buyers, while simultaneously increasing prices to sellers. These factors contribute to the expansion of urban areas and the conversion of peripheral lands into developed suburbs.

III. Physical Factors

The physical factors driving urban expansion in Durame Town are based on the respondents' ratings (Table 4.3). Regarding the suitability of topography (item 1), there was moderate agreement (*M*=3.3333, *SD*=1.12288),

indicating that it had a moderate impact on urban expansion. The suitability of flat slopes (item 2) was rated as a high contributing factor (*M*=3.0379, *SD*=1.11982), suggesting that it have a major role in contributing to expansion of the town. The need for the open areas that make up the current urban area increased as the population of the town increased (item 3) were considered moderate factors (*M*=3.2466, *SD*=1.00617) in urban expansion. The presence of river water resources (item 4) was rated moderate (*M*=3.3442, *SD*=1.08007), indicating that it was a significant contributing factor to urban expansion. On the other hand, there were moderate levels of agreement (*M*=3.0108, *SD*=1.05804) regarding the enormous land needs from households or firms at the edges of the Town (item 5), suggesting that this factor strongly influenced urban expansion. The data, along with information from the Durame Town Office of Land Management, indicate that Movement from countryside to townships and the preference for larger living areas were additional factors contributing to the rapid urban expansion.

According to information from key informants, it is confirmed that physical factors such as elevation and slope indeed play a significant role in shaping the spatial patterns of urban expansion in Durame Town. In contradiction to respondents, key informants have specifically highlighted the role of Bezna River, located on the west side of the town, as a significant geographical element that imposes restrictions on urban expansion. They have noted that the presence of the river serves as a natural barrier, limiting the extent to which urban areas can expand in that particular direction. This aligns with the understanding that rivers can act as important factors that influence the built-up expansion's geographical characteristics by constraining the expansion in certain directions. However, according to research conducted by Gupta and Kesarwani (2022), Lévêque (2020), and Tourinho et al. (2021), there is evidence to suggest that rivers significantly contribute to the growth of urban areas by attracting investments in sectors like hospitality and recreational amenities. This, in turn, stimulates various business activities. However, it is important to note that these findings may have limited generalizability, it is depends on the local conditions.

The focus group discussion revealed the significant influence of topography on the urban expansion of Durame Town. The favorable topographic conditions in the northern and eastern parts of the town have facilitated the expansion of urban areas in those directions. This suggests that the availability of suitable landforms and terrain has attracted new residents and supported development. However, the topography has only played a partial role in the expansion, as the presence of the mountain and the river in the western part of the town has acted as a barrier.

Physical factors play a significant role in shaping the spatial patterns of urban expansion in small towns. These factors include elevation, slope, and rivers, which exert influence on the expansion process. However, rivers, in particular, are crucial geographical elements that can act as constraints on urban expansion (Liu et al., 2021).

IV. Economic Factors

Table 4.4 indicates the economic factors contributing to urban expansion in Durame Town. The results indicate that affordable land, low-rental housing, the ease of converting agricultural lands, the housing market, and economic development initiatives all have moderate levels of influence on urban expansion. These factors, falling within the range of 2.5-3.49, collectively play significant roles in attracting new immigrants and contributing to the expansion of the urban area in Durame Town.

The findings suggest that the availability of affordable land and low-rental housing attracts new immigrants and contributes to urban expansion in Durame Town. The conversion of agricultural lands and a functioning housing market also play a role in contributing to urban expansion. Economic development initiatives, such as promoting urban land and construction demands, further contributed to the growth of the urban area. Therefore, policymakers and urban planners can use these insights to inform strategies for managing and facilitating sustainable urban growth.

Interviews with key informants and focus group discussions (FGD) were carried out to explore how urban expansion's economic component is acknowledged as providing more chances for employment, production, and the exchange of commodities and services. Rural-urban migration was further accelerated by these expanded prospects in cities. People were drawn to Durame Town by the superiority of economic elements, including the entrance of marketplaces for agriculture, a place to live and manufacturing, employment prospects, and the desire for affordable rental dwellings, according to KII. In addition, simple to bring farmland, sold, and split up into lots for residential use by informal land brokers. These findings support previous evidence that the tertiary industry and the development of the land market are specific economic factors that contribute to urban expansion in small towns (Liu et al., 2009). As policymakers prioritize the development of industries, housing, agricultural markets, job opportunities, and affordable rental housing to address the needs of the growing population in small towns, they should also take into account the promotion of sustainable urban expansion.

V. Infrastructure Factors

As can be seen in Table 4.5 various infrastructure factors contributed to urban expansion in Durame Town. Moderate contributing factors to urban expansion include the availability of hospitals for healthcare, adequate clean water supplies for households, accessible routes and mass transit system, Government funding for education, and the availability of electricity and telecom services. These findings indicate that these infrastructure dimensions played a significant role in attracting people, promoting investment, and supporting the growth of Durame Town.

The result suggests, based on interviews with experts from the Durame Town Land Management Office that the availability of poorly developed roads, contributed significantly to urban expansion in Durame Town. However, the town's expansion was partially fueled by the development of public transportation, government spending on hospitals, clean water supplies, schools, and telecom and energy infrastructure. Similarly, the government's encouragement of private investors to develop construction in open spaces has further fueled urban expansion. In Durame Town, there are still questions and concerns among residents regarding the availability and adequacy of infrastructure. However, it is important to note that the presence of infrastructure, albeit with some limitations, has indeed played a role in the expansion of the town. While the existing infrastructure may not fully meet the needs and aspirations of the residents, it has nonetheless contributed to the growth and development of the town.

Research on a wide range of infrastructure factors in small towns is limited, but most studies generally examine infrastructure-related aspects (Liu et al., 2009; Sun et al., 2022; Tokunova, 2018). The findings of this study will contribute to a more nuanced understanding of the relationship between infrastructure development and urban growth, providing practical recommendations for urban planners to support sustainable and inclusive urban expansion in Durame Town.

VI. Technological Factors

Table 4.6 presents the findings related to the role of technology in urban expansion. Respondents showed a moderate level of agreement regarding advancements in technology, with (M=3.2276, SD=.93669). This suggests that technology is seen as an important factor. Technology-driven sectors received a moderate level of agreement, with (M=3.2602, SD=1.12895), indicating their contribution to job opportunities and economic growth. Technological advancements in transportation received a moderate level of agreement, with (M= 2.9864, SD=1.10204), highlighting their role in improving mobility and accessibility within the town. These findings collectively emphasize the significance of technology in driving urban expansion.

The key informant highlights the significance of technology in transportation, such as motorbikes, Bajaj (a type of three-wheeler vehicle), and transportation services provided by institutions. These technological advancements enable residents to live on the outskirts of the town while still being able to commute to the central business district (CBD) for work and other business-related activities. This further supports the notion that technology plays a crucial role in facilitating urban expansion by enhancing transportation options and connectivity for residents. Advancements in communication technology, such as improved internet connectivity and mobile devices, have made it easier for residents to stay connected and engage in various activities without the need to be physically present in the CBD. This has facilitated remote work and telecommuting, allowing individuals to live in the outskirts while still actively participating in professional and social interactions.

It is evident that advanced transportation and communication technologies, like railways and ride service platforms, shape the growth and development of urban areas, particularly in large cities. On the other hand, small towns have their technological advancements. Therefore, it is crucial to study technological concerns and recognize the contributing elements that contributed to the development of small towns, instead of just copying policy approaches that have been effective in large cities. Understanding the contributing factors like technological advancements is essential to guide small towns towards smart growth and efficient urban growth (Baldi & Megaro, 2023).

VII. Neighborhood Factors

Table 4.7 indicates several factors have a moderate influence on urban expansion. These include the proximity of locations to urbanized settlements and urban infrastructures, which are associated with a higher probability of urban expansion. Additionally, communities that were closer to urbanized towns and had easier access to infrastructure at a lower cost facilitated urban expansion. The study also highlights the significant impact of rural-urban land conversion on urban expansion. Lastly, dwellers' preferences for lifestyles, such as closeness to open spaces, and ownership of property, moderately contributed to attracting new immigrants and driving urban expansion. These findings emphasized the multifaceted nature of neighborhood dimensions and factors influencing urban expansion in Durame Town.

The key informant responses indicated that urban expansion in Durame Town is influenced by several factors. The accessibility of urban infrastructure and proximity to urbanized settlements were important factors in influencing patterns of expansion. According to FGD, although the town mainly expands along the main road, the growth occurs in isolated pockets rather than in a unified and continuous manner. This expansion is influenced by factors such as the proximity to urbanized areas, the ease of accessing urban infrastructures at lower costs, the significant conversion of rural land to urban use, and the preferences of residents for open spaces, single-family homes, and homeownership. As a result, development takes place in scattered pockets along the main road. The expansion is driven by the town's proximity to urban centers and the desires of residents for specific housing options. However, managing this type of expansion and ensuring the provision of necessary infrastructure and services are important considerations for sustainable growth.

The finding aligns with the neighborhood factors contributing to urban expansion in small towns, which include affordable access to urban infrastructures and the conversion of rural land to urban use (HU & Han, 2004).

VIII. Proximity Factors

Based on the data presented in Table 4.8 several proximity-related urban expansion statements were evaluated. Evaluation criteria included being close to one's place of employment, favoring urbanization as a way of life, requiring new housing and making settlements accessible, living in an area nearer to an administrative hub, and having easy access to transportation. These factors were rated in terms of their significance on a scale ranging from very low to very high. The findings indicate that all of these factors were rated as having a moderate level of influence on urban expansion.

The results of the study indicate that new residents' preferences in Durame Town are influenced by their closeness to their place of employment. Gentrification of communities was also somewhat impacted by choices for urbanization as an aspect of existence. The accessibility of settlements and the need for new housing are two factors that influence urban expansion. Notably, the recent establishment of three regional government administrative institutions in Durame Town, along with the increased presence of other regional government institutions in neighboring towns like Hossana, and Halaba have resulted in the influx of new migrants and played a role in the ongoing urban expansion of Durame Town. Research by Liu highlights that urban proximity can determine the developmental trajectory of small towns, influencing economic outcomes and social structures (Liu, 2008). Additionally, studies emphasize that the distance from the city significantly affects the size of investment areas in suburban municipalities, with closer proximity leading to larger designated development areas (Gomes et al., 2018; Kukulska et al., 2017).

The generalizability of the results is limited by the fact that the study was conducted specifically in Durame Town. Therefore, the findings can suggest a modest level of association between closer towns and administrative centers. The influence of proximity to an administrative center on urban expansion can vary depending on the specific characteristics and dynamics of each location.

IX. Industrialization Factors

According to Table 4.9, the growth of industrial sectors and manufacturing activities has been identified as a significant contributor to urban expansion. This is because industries require infrastructure, labor, and access to markets, which in turn attract businesses and individuals to urban areas. The mean score of 3.1843 suggests a moderate level of agreement among respondents regarding the impact of industrialization on urban expansion. Furthermore, industrialization is seen as a driver of employment opportunities, which in turn attracts rural populations to urban areas in search of better economic prospects. This migration of individuals from the countryside contributes to the expansion of built-up area. The mean score of 3.1734 indicates a moderate level of agreement among respondents regarding the role of industrialization in creating employment opportunities and fostering urban expansion.

Additionally, the development of industrial zones and special economic zones has been identified as a factor leading to the establishment of new urban centers and the expansion of existing cities. The mean score of 2.8726 suggests a relatively moderate level of agreement among respondents regarding the impact of industrial zones on urban expansion. Findings from FGD and key informants indicate that the presence of small-scale factories, such as soap factories, clothes factories, wood product factories, and powder factories, has been identified as a significant contributor to job opportunities and urban expansion in the town. These factories provide employment opportunities for the local population, attracting individuals from rural areas to migrate to the town in search of better economic prospects. The availability of jobs in these factories contributed to the growth and expansion of the urban area. The availability of employment in these small-scale factories not only improves the economic conditions of individuals but also leads to urban expansion. As people migrated to the town in search of job opportunities, the demand for housing, services, and infrastructure increased, resulting in the expansion of the town. The findings of this study contradict the conclusions of Yang et al. (2022) highlighted that

industrialization, particularly the establishment of industries, is a dominant driver of town expansion in Shandong's town. However, in this study, industrialization is not the dominant factor that contributed to Durame Town's expansion.

X. Climate Change Factors

According to Table 4.10, climate change-induced events, such as extreme weather events have been identified as factors leading to population displacement and migration to urban areas. This influx of people has contributed to urban expansion. The average mean score of 2.9940 suggests a moderate level of agreement among respondents regarding the role of climate change-induced events in urban expansion.

Furthermore, the need for climate resilience and adaptation has driven the expansion of urban infrastructure and the development of sustainable urban planning practices. The mean score of 3.0788 indicates a moderate level of agreement among respondents regarding the role of climate resilience and adaptation in urban expansion. Moreover, climate change impacts on agriculture and rural livelihoods have led to increased urbanization as people seek alternative economic opportunities in urban areas. The mean score of 2.7879 suggests a relatively moderate level of agreement among respondents regarding the impact of climate change on agricultural and rural livelihoods and its contribution to urban expansion.

Lastly, it is recognized that urban expansion can exacerbate climate change through increased energy consumption, transportation emissions, and land-use changes. This emphasizes how crucial sustainable urban development methods are to reducing these effects. However, the average mean score of 2.9940 suggests a moderate level of agreement among respondents regarding the role of urban expansion in contributing to climate change; this factor is relatively the least contributor to urban expansion. Climate factors significantly impact urban expansion in small towns by influencing local climate change, such as the formation of urban heat islands, altered wind fields, and changes in precipitation patterns (Fabisch & Henninger, 2014; Huang et al., 2019; Poelmans et al., 2011; Trusilova et al., 2009). Those studies show that as urban areas grow, there is a notable increase in temperature and a decrease in specific humidity, affecting nearby regions during heat waves.

The Mean Rank of the Contributing Factors

Table 4.7 The Mean Rank of the Contributing Factors

№	The Contributing Factors of Urban Expansion in Durame Town	Mean	SD	Mean Rank
1	Land Use Policy and Urban Planning	3.5325	.84536	1st
2	Land Values Factors	3.2331	.98040	2nd
3	Physical Factors	3.1946	.98586	3rd
4	Economic Factors	3.1913	.94635	4th
5	Infrastructure Factors	3.1794	.93959	5th
6	Technology Factors	3.1581	.97493	6th
7	Neighborhood Factors	3.1186	.97906	7th
8	Proximity Factors	3.0970	.98434	8th
9	Industrialization Factors	3.0768	.93919	9th
10	Climate Change Factors	2.9940	1.0352	10th

4.2 Historical Growth of Urban Expansion in Durame Town

Findings of Historical Growth of Urban Expansion from 1994 up to 2024

Table 4.8 LULC of Durame Town in 1994

№	LULC Type	Area Cover in Hectare (ha.) in 1994	Percentage of LULC (%)
1	Built up	56.32	4.16
2	Forest	214.95	15.87
3	Bare land	96.02	7.09
4	Farm land	143.87	10.62
5	Wetland	843.09	62.26
Total		**1,354.24**	**100**

The map produced using GIS is presented in Figure 4.7 below. Wetland made up the majority of land class in the study area in 1994, accounting for 62% of the total land covered. In addition, it was found that built-up, bare, agricultural, and forestland covered 16%, 11%, 4%, and 7% of the total land area in hectares, respectively.

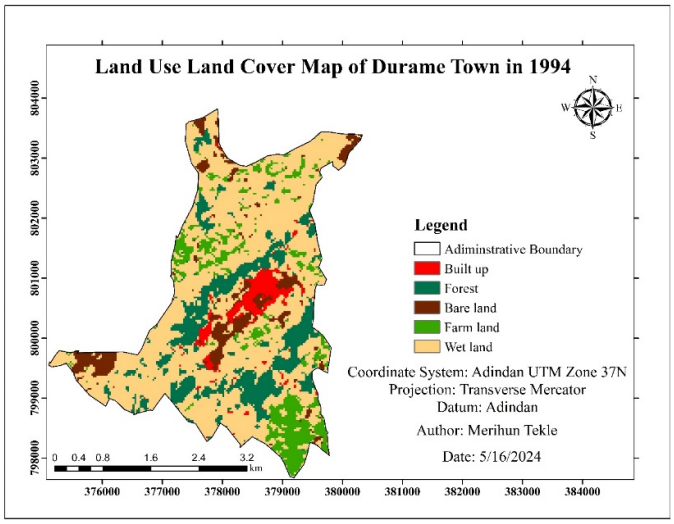

Figure 4.2 LULC Map of Durame Town in 1994

Table 4.9 LULC of Durame Town in 2009

№	LULC Type	Area Cover in Hectare (ha.) in 2009	Percentage of LULC (%)
1	Built up	186.58	13.78
2	Bare land	69.61	5.14
3	Wet land	568.10	41.95
4	Farm land	429.95	31.75
5	Forest land	99.99	7.38
Total		**1,354.24**	**100**

Source: Organized by the Researcher, 2024

Figure 4.8 below shows the land cover maps of Durame Town for the year 2009. In 2009, the study area's land cover included strikingly high 411.95% wetlands, along with 5.14% built-up, 31.75% bare land, 13.78% farms, and 7.38% forests.

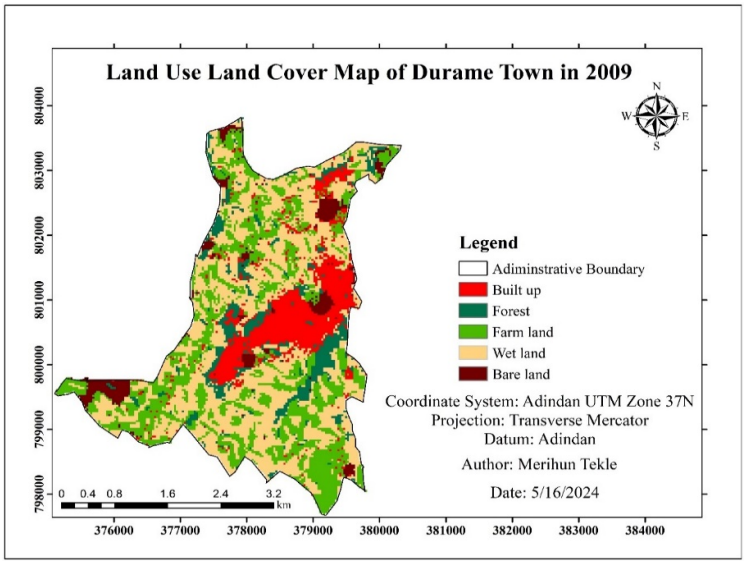

Figure 4.3 LULC of Durame Town in 2009

Table 4.10 LULC area of Durame Town in 2024

№	LULC Type	Area cover in Hectare (ha.) 2024	Percentage of LULC (%)
1	Built up	434.92	32.11
2	Forest	135.78	10.03
3	Bare land	142.43	10.52
4	Farm land	393.75	29.07
5	Wet land	247.52	18.28
Total		**1354.42**	**100**

The land cover map of Durame Town in 2024 can be observed in Figure 4.9 below. In 2024, the study area exhibited a distinct land cover composition. Built-up area was the leading prevalent land cover class, accounting for 32.11% of the total area. Forest, farmland, and bare land followed, covering 10.03%, 29.07%, and 10.52% of the study area, respectively.

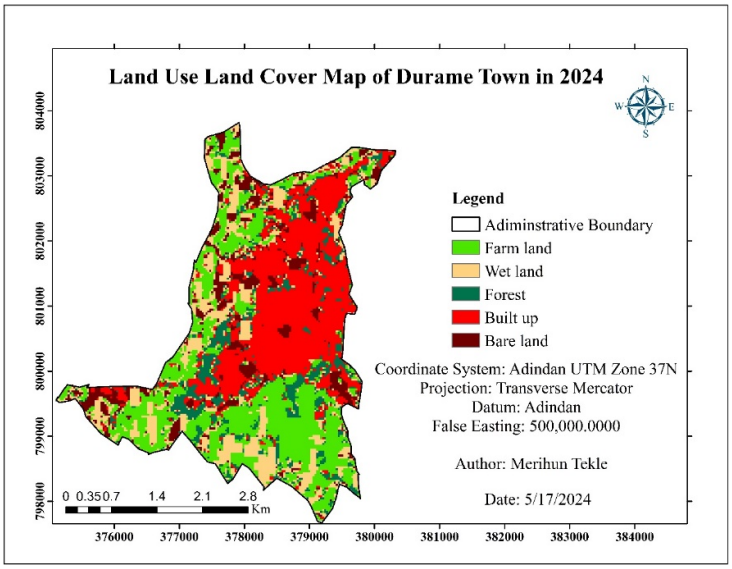

Figure 4.4 LULC Map of Durame Town in 2024

Urban Expansion from 1994–2024

Table 4.11 Description of Urban Expansion

Year	Area (ha)	Percent (%)	Period	Yearly expansion Area (ha/yr.)	Annual Growth Rate (%/yr.)
1994	56	4.134	-	-	-
2009	187	13.807	1994-2009	8.73.	15.60
2024	435	32.117	2009-2024	16.53.	8.84
			1994-2024	12.63.	21.41

Source: Organized by the Researcher, 2024

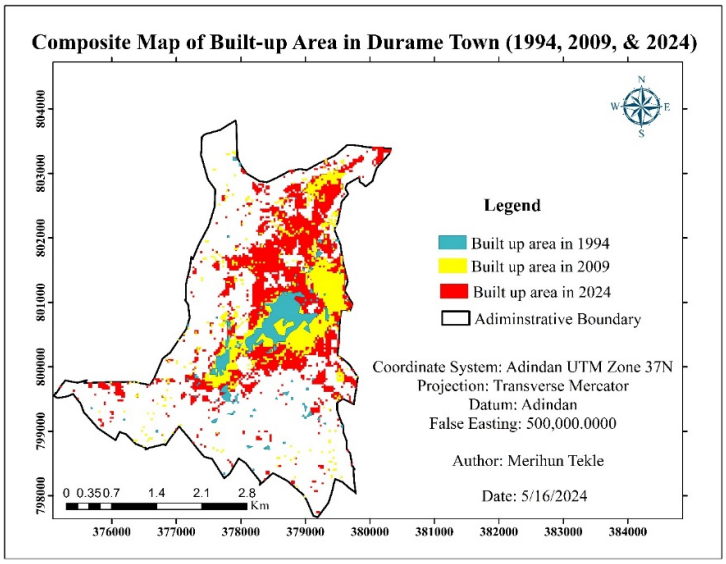

Figure 4.5 Composite Map of Urban Expansion 1994, 2009, & 2024

Change Detection (1994-2024)

Table 4.12 Change Detection (1994-2024)

№	Land Use Class Changed	Area Changed (ha.)
1	Forest - Built up	85.27
2	Forest - Farm land	37.19
3	Forest - Bare land	7.71
4	Bare land - Built up	9.12
5	Bare land - Farm land	35.53
6	Farm land - Built up	55.79
7	Farm land - Bare land	15.00
8	Wet land - Built up	244.81
9	Wet land - Farm land	230.23
10	Wet land - Bare land	114.53

Source: Organized by the Researcher, 2024

Discussion of Historical Growth of Urban Expansion from 1994 up to 2024

The study of dynamic changes in urban land use has primarily focused on the subjects of urban land expansion and urban LULCC. These aspects have been central to understanding the transformations occurring in urban areas (Min et al., 2022). The findings from Table 4.12, Table 4.13, and Table 4.14 provided valuable insights into the LULC dynamics in Durame Town over the years. In 1994, wetlands dominated the land cover, indicating a significant presence of an ecologically diverse environment. Forests and farming activities also had considerable coverage. The small area of built-up land indicated limited urbanization and infrastructure development at that time. However, the subsequent years witnessed notable changes. By 2009, built-up land expanded, indicating increased urbanization and infrastructure development. Wetlands decreased in coverage, raising concerns about potential ecological impacts. In 2024, the dominance of built-up areas continued, while the forest area became the smallest among land use types. These changes highlighted the impact of urban expansion and the conversion of natural land covers. In 1994, the built-up area covered only 4.16% of the total land area, but by 2009, it had increased to 13.78%. This trend continued in 2024, with the built-up area occupying 32.11% of the land. This substantial growth raises concerns about urban development patterns and potential implications for natural resources. The expansion of built-up areas has resulted in the conversion of other land types, such as forests, wetlands, and agricultural land, which can have negative consequences for biodiversity, ecological balance, and the overall sustainability of the town.

The growth rate analysis reveals that the town underwent rapid expansion in the initial period, with an annual growth rate of 16.9% from 1994 to 2009. However, the growth rate decelerated in the later period, with an

annual growth rate of 8.7% from 2009 to 2024, resulting in an overall growth rate of 21.41% between 1994 and 2024. The increasing annual growth area suggests that while the growth rate decreased, the actual area added to Durame Town each year increased. This indicates an accelerating rate of expansion during the later period. The results suggest a need for careful management and sustainable land use practices to balance development needs with environmental conservation. The findings provide a clearer understanding of the shifting land use patterns in Durame Town and emphasize the importance of considering these changes when planning. Small cities exhibit distinct patterns and rates of urban expansion, differing markedly from the dynamics observed in larger urban centers (Chai et al., 2019). This study confirms that the patterns and rates of urban expansion differ from those observed in larger cities. In addition, the utilization of dense Landsat time series data for spatio-temporal analysis has proven to be a successful approach in extracting the dynamics of urban expansion in small towns. These methods offer valuable insights into the long-term growth and development of small towns and contribute to our comprehension of urban expansion dynamics in various settings.

The land use changes observed from 1994 to 2024 reveal a significant transformation of the study area, with a clear trend towards urbanization and agricultural expansion at the expense of natural land cover. The substantial increase in built-up areas, by over 85 hectares, indicates rapid population growth and infrastructure development, while the concurrent loss of green areas, bare land, and over 600 hectares of wetlands is highly concerning, suggesting a decline in natural habitats and ecosystems. The changes in farmland, with a net increase of over 37 hectares but significant loss to other land uses, also raise questions about the sustainability of agricultural practices. The change detection analysis paints a picture of a landscape undergoing rapid transformation, with the delicate balance between human development and environmental preservation being challenged, and the need for careful consideration of long-term impacts and sustainable land use policies.

4.3 Impacts of Urban Expansion in Durame Town

Finding on Impacts of Urban Expansion on the Natural Environments

I. Impacts of Urban Expansion on Forest

The analysis of land cover changes in Durame Town from 1994 to 2024 provided several key findings. Firstly, there was a significant decline in forest cover over the study period, with forests accounting for 15.87% of the total land area in 1994, decreasing to 7.38% in 2009, and recovering slightly to 10.03% by 2024. The spatial distribution of forests also underwent notable shifts, initially surrounding the built-up areas in the east and west of the town, and later shifting to the south.

Findings from key informants were that the horizontal expansion and leapfrog development of Durame Town have posed a significant threat to valuable natural resources. Deforestation was identified as the primary consequence of the town's expansion. Notably, the forest coverage in three Kebeles, particularly Kebele 02 (Zararo), including the Fulasa area forest, experienced a substantial decline. Reports from the Durame Town municipality and Kambata Zone Environmental Protection Office showed that areas exceeding 72 hectares around Durame Industrial College were deforested for construction purposes. Furthermore, Kebele 03, which used to be forested, was cleared for residential purposes after 2004. This destructive trend continued as residents cleared the Fulasa area forest in Durame town starting in 2014. According to KII and researcher observation, the consequences of deforestation included biodiversity loss, soil erosion, climate change impacts, disruption of water resources, and overall environmental degradation.

II. Impacts of Urban Expansion on Cultivated Land

In 1994, farmland was concentrated in specific regions located in the northwest and southeast areas of the town. However, by 2009, there was a significant expansion of farmland, which became more dispersed throughout the entire area. In 2024, although the total area of farmland slightly decreased, it was still densely distributed across the entire town, excluding other land use categories.

The finding from the key informant was that the consequences of a rise in built-up on farmland were underscored. The expansion of residential areas into agricultural land on the urban periphery has led to the conversion of farmland, resulting in a loss of agricultural livelihoods for the affected farmers. Additionally, the town's horizontal expansion significantly encroached upon rural land, including wetlands, exacerbating the challenges associated with sustainable land use and farming practices.

III. Impacts of Urban Expansion on Wetlands

The findings of the land cover analysis in Durame Town reveal a significant reduction in the wetland area over the years. In 1994, the wetland covered 843.09 hectares, which decreased to 568.10 hectares in 2009 and further declined to 247.52 hectares by 2024. The reduction in wetland areas raises concerns about the loss of important habitats and potential consequences for water resources.

According to, the Durame Town Municipality Report, 2007 records around 91 hectares of wetland and grassland in three Kebeles were designated for residential use. These informants further stated that the Bezena River, situated nearby, has been witnessing a consistent decrease in water levels over the years. Hambaricho Mountain provided it with the natural advantage of having a wetland area. However, the expansion of the town had a significant negative impact on this wetland area.

Discussion of Impacts of Urban Expansion on the Natural Environments

I. Impacts of Urban Expansion on Forest

The analysis of land cover changes in Durame Town revealed a significant decline in forest cover. In 1994, forests occupied around 15.87% of the total land area, but this proportion decreased substantially to 7.38% by 2009. This finding indicates that the expansion of the urban area resulted in a considerable loss of forested land over the study period. However, there was a slight recovery by 2024, as forest cover increased to 10.03%. These findings highlight the complex relationship between urban expansion and the preservation of forested areas in Durame Town. The spatial distribution of forests also exhibited notable shifts, initially surrounding the built-up areas in the east and west of the town, but later shifting to the south. These findings highlight the dynamic nature of forest cover in Durame Town, with fluctuations in extent and spatial distribution over time. The results indicate the effect of urban expansion and potential deforestation on the forested areas within the town. According to the FGD, in response to the observed decline in forest cover, the government has made efforts to increase forest coverage by implementing reforestation initiatives, particularly over the last decade. Because of these efforts, there has been a slight increase in the forest area in Durame Town. This suggests that the government's interventions to promote afforestation and restore forested land have had a modest yet positive impact, counteracting the earlier trend of forest loss due to urban expansion.

The town's rapid development and horizontal expansion have put vital natural resources in jeopardy and destroyed them. It was discovered that the main consequence of Durame Town's expansion was deforestation. Key informants revealed that the forest coverage was declining in three of the Kebeles; Kebele 02, which contains the Fulasa region forest, had the greatest forest coverage in the town; nevertheless, Fulasa and other forest areas in Kebele 02 had large declines. The reduction in the amount of forest cover, especially in Kebele 02 which includes the Fulasa region forest, highlights the negative effects of population increase and urbanization on the surrounding ecosystem.

The rapid and unchecked expansion of urban areas, coupled with the destructive exploitation of forests, has led to significant environmental losses that have far-reaching implications from the local to the global scale. Residents near Durame Town have been clearing the Fulasa area forest since 2014, continuing until the present time. The literature also confirms that to rapid and unchecked expansion of urban areas is driving the alarming loss of primary forests across various parts of the developing world. Current estimates indicate that between 17 million to 20 million hectares of these irreplaceable forest ecosystems are being destroyed annually (Fagan et al., 2020). However, the global trend of forest loss in developing countries does not necessarily represent the localized positive outcomes observed in the study area.

II. Impacts of Urban Expansion on Cultivated Land

From 1994 to 2024, Durame Town has undergone notable transformations in the size and arrangement of farmland, indicating significant changes in extent and distribution. Initially, in 1994, farmland was concentrated in specific areas to some extent in the northwest and southeast sides of the town. In 2009, there was an expansion of farmland in Durame Town, with a more widespread distribution, indicating a broader presence of agricultural activities. In 2024, although the total area of farmland slightly decreased, it was densely distributed throughout the town, suggesting a high level of integration of agriculture within the urban fabric. The observed changes in land cover in Durame Town, such as the decline in forest cover and the conversion of agricultural land, likely reflect the broader processes of urbanization, population growth, and shifts in farming practices over the years. These transformations underscore the dynamic nature of land use in the town. Specifically, a major obstacle to the continued farming of agricultural land on the urban periphery is the conversion of agricultural land brought about by the expansion of the urban area. To mitigate these impacts, effective land use planning and support for sustainable farming practices are essential to preserve farmland and maintain agricultural viability in Durame Town.

When an urban plan is in place, there is a chance that population growth may cause urban space to become larger than the plan's self-organization threshold. The Durame structural plan documents from 2009 state that there is a 233.4-hectare increase in land from 1994 to 2024. Above 150 hectares of land were used for residential purposes, this additional area was used for agriculture. From 2009 to 2024, there were large amounts of land distribution for the construction of residences by changing agricultural lands and giving compensation to

farmers. Approximately 1,554 urban residents were officially registered. 500 m² and 200m² plots were distributed to households and their children. However, a 770.8-hectare agricultural area will be transformed into dwellings and eventually become a component of the local government. Generally, the town exhibited a pattern of horizontal urban expansion, encroaching year after year on large swaths of rural land, rather than pursuing a more compact, vertical development model. This sprawling growth dynamic, driven by population increase and prevailing urban development practices in the town, has contributed significantly to the rapid, unsustainable consumption of the surrounding agricultural and wetland areas. The consequences of this unchecked horizontal expansion are severe, leading to the irreversible loss of critical environmental resources, such as wetlands, as well as the displacement and disruption of agricultural livelihoods for the farmers on the urban periphery. The relentless global expansion of urban areas has resulted in the conversion of valuable farmland for urban development. This trend poses serious threats to food security and the long-term sustainability of agriculture worldwide (Hu et al., 2020). This study's findings support the global concern of urban expansion converting farmland, jeopardizing food security and agricultural sustainability by reducing available land for agricultural production.

III. Impacts of Urban Expansion on Wetlands

The findings indicate changes in the extent of wetlands in Durame Town over the years. In 1994, the wetland covered an area of 843.09 hectares, which decreased to 568.10 hectares in 2009 and further declined to 247.52 hectares by 2024. This suggests a significant reduction in the overall size of the wetland area. The reasons for this decline include factors such as land conversion, drainage, or changes in hydrological patterns. The decreasing wetland area raises concerns about potential ecological consequences, including the loss of important habitats and impacts on water resources. It emphasizes the importance of conservation efforts and sustainable land management practices to protect and restore wetland ecosystems in Durame Town.

Based on the findings regarding the impact of urban expansion on wetlands, it is evident that urban expansion in Durame Town has had a significant impact on the wetland area. Urban expansion, including land conversion and changes in hydrological patterns, has contributed to the loss of wetland habitats. This reduction raises concerns about ecological consequences such as biodiversity loss and impacts on water resources. To address these issues, it is crucial to prioritize wetland conservation efforts, including implementing regulations, promoting sustainable land use practices, and restoring degraded wetland areas.

According to Kumar et al. (2021), wetlands are land areas characterized by their close interaction with water resources, regular flooding, and the presence of vegetation adapted to saturated soil conditions. The study area's wetland is a significant and multipurpose natural setting that is impacted by human-induced activities like settlement. Wetlands need to be preserved because they are multifunctional natural ecosystem regions that carry out essential tasks and offer significant benefits. The wise and sustainable utilization of wetlands is crucial for the benefit of humanity, but it must be done in a manner that preserves the natural properties and integrity of these vital ecosystems. Based on municipality records from 2007, it was reported that a total of 91 hectares of wetland in three Kebeles of Durame Town were allocated for residential purposes. Furthermore, the nearby Bezena River has been experiencing a gradual decrease in water levels over the years. According to FGD participants, the effect of urban expansion include the loss of livelihood opportunities for farming, and gathering non-timber forest products. Traditional practices associated with the wetlands are also disrupted. Additionally, the encroachment on wetlands limited access to natural spaces for recreation and ecotourism. It diminished the sense of place and connection that local people have with their environment.

5. Conclusion

The study identified various factors that contributed to urban expansion in Durame Town from 1994 to 2024. Land use policy and urban planning is the most significant factors, followed by land values and physical characteristics. Therefore, to regulate urban expansion in Durame Town, land use regulations and urban planning techniques should be implemented effectively. Additionally, considering economic conditions, infrastructure availability, technology advancement, neighborhood factors, proximity factors, industrialization, and climate change is crucial for sustainable urban development. The factors influencing urban expansion and their relative importance vary significantly from one town to another based on the unique context and characteristics of each town.

According to the findings of this study, it was concluded that the town is currently experiencing significant expansion, and this trend is expected to persist in the future, indicating that urban expansion is an inherent characteristic of the town's development. The land use changes in Durame Town over the study period showed a shift from wetland dominance to built-up areas as the dominant land use type. Forest and agricultural land experienced a decrease, indicating conversion to urban land use. Built-up areas showed a significant increase, reflecting the conversion of other land types. Bare land initially increased but decreased in later years.

Agricultural/farmland use fluctuated, with an increase from 1994 to 2009 and a slight decline by 2024. The patterns and rates of urban expansion in small towns differ significantly from those in large cities.

The expansion of Durame Town has resulted in significant environmental changes. Deforestation, particularly in areas like Fulasa, has led to a decrease in forest cover. Productive farmland has been lost because of farmland being converted to residential areas, which has an impact on local food production and agricultural livelihoods. Wetland areas, crucial for ecological services and habitats, are often drained for urban development. Furthermore, problems with soil erosion and inappropriate waste disposal were among the environmental degradation factors that led to air and water pollution, which hurt ecosystems and human health. Sustainable urban planning and effective environmental management strategies are urgently needed to address these adverse impacts. Over the past decades, Durame has experienced rapid and unchecked urban expansion, which has come at a considerable cost to the region's natural environment. The town's sprawling growth has occurred largely at the expense of critical ecosystems such as wetlands and forests, as well as productive agricultural lands in the urban periphery and barren areas.

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