Evaluating Urban Land Use Plan Implementation: A Case of Structural Plan of Dukem Town, Ethiopia

Roba Eshetu

A thesis submitted to

The Department of Geomatics Engineering

School of Civil Engineering and Architecture

Presented in Partial Fulfillment for the degree of Master's in Geo-Informatics

Office of Graduate Studies

Adama Science and Technology University

September, 2022

Adama, Ethiopia

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APPROVAL SHEET

I, the advisor of the thesis entitled “Evaluating Urban Land Use Plan Implementation: A Case of Structural Plan of Dukem Town, Ethiopia” and developed by Roba Eshetu, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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Advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Roba Eshetu have read and evaluated the thesis entitled “Evaluating Urban Land Use Plan Implementation: A Case of Structural Plan of Dukem Town, Ethiopia” and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Geoinformatics Engineering.

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

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Office of Postgraduate Studies, Dean	Signature	Date

DECLARATION

I, Roba Eshetu hereby declare that this Master Thesis entitled “Evaluating Urban Land Use Plan Implementation: A Case of Structural Plan of Dukem Town, Ethiopia” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Roba Eshetu	_____	_____
Name of the student	Signature	Date

RECOMMENDATION

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled "Evaluating Urban Land Use Plan Implementation: A Case of Structural Plan of Dukem Town, Ethiopia" prepared under my guidance by Roba Eshetu submitted in partial fulfillment of the requirements for the degree of Mater's of Science in Geo-Informatics Engineering. Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

Dejene Tesema (PhD) _____ _____

Advisor Signature Date

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BCR:	Boundary containment ratio
BSR:	Boundary Sufficiency Ratio
GIS:	Geographic Information System
LUP:	Land Use Plan
PLU:	Physical Land Use
SP:	Structural Plan
UGB:	Urban Growth Boundary

ABSTRACT

An urban land-use plan is regarded as a useful tool to achieve sustainable urban development. However, presently, it is unclear how well the plan is being implemented, and major factors contribute to the variation of its implementation in Dukem Town, Ethiopia. This research examines the extent to which the land-use plan of Dukem Town, which functioned from 2008 to 2018, guided and controlled all spatial developments during the planning period by measuring the degree to which actual land-use outcomes over a 10-year period conformed to the plan's intention. Land-uses in the town as of 2008 and 2018 were mapped, and built-up expansion between 2008 and 2018 at urban land-use level was determined. Built-up areas outside of the planned urban growth boundary, as well as n*onconforming and unfulfilled developments were identified through spatial overlay analysis in a geographic information system environment. The degree of conformance success of the plan over the planning period was explored using two indicators: boundary sufficiency ratio (BSR) and boundary containment ratio (BCR). A descriptive exploratory approach was used to determine potential factors influencing the plan's implementation from the data collected by expert interview. The findings show that overall built-up expansion has grown at an average annual rate of 8.6%. The extent of social service land use classes increased by about 216%, followed by industry and storage (141.5%). The findings also demonstrate that although the plan proposed a reasonable area, it has failed to guide the spatial location of new developments in social services, industry and storage, and commercial land use classes. The limitation is due to a combination of geographic variables, an absence of regular monitoring and evaluation, and political leadership influence. The study would support the government and potential stakeholders in formulating sustainable spatial policies and directions of spatial development with respect to sustainable urban environments and creating a balance between ecological and socio-economic needs.*

Keywords *Land use plan; Urban plan; Plan evaluation, Sustainability, Plan implementation*

CHAPTER 1: INTRODUCTION

1.1 Background

Urban land use plan's primary objective is to ensure the sustainable growth of urban areas. It protects ecologically vulnerable areas by limiting urban growth within the intended boundary. An urban growth boundary (UGB) is a local government regulation that establishes boundaries for urban growth over time (Bhatta, 2009). Planners and municipal governments have used UGB as useful instruments for controlling urban sprawl and promoting smart growth during the past few decades. On the other side, an urban land use plan makes sure that resources are used efficiently, development is balanced, and wise growth is supported (Zhou et al., 2016).

An essential and fundamental component of urban planning is monitoring urban development to ensure that it adheres to the guidelines set forth in land-use plans. The majority of cities in sub-Saharan African nations, including Ethiopia, are governed by urban plans, but despite this, they face a number of development-related issues that the plans are meant to address, such as the growth of slums, increased urban sprawl, and environmental pollution. In this light, monitoring the implementation of urban plans is becoming increasingly important to ascertain whether and how effectively they have been implemented (Loh, 2011). Understanding and evaluating the implementation of urban land use plans determines the efficacy and success of the plans, approving the improvement of the plans and the planning process in subsequent planning (Oliveira and Pinho, 2009; 2010). Additionally, it will assist the direction of spatial development and sustainable spatial policy in terms of a sustainable urban environment and striking a balance between ecological and socioeconomic needs.

Utilizing the most widely accepted theories, conformance-based approach and performance-based approach, evaluation of plan implementation has been studied for decades (Berke et al., 2006, Loh, 2011). The conformance-based approach emphasizes the alignment between actual physical development and the goal of the plan, which is appropriate for physically oriented plans. If actual land use outcomes match plan aims, plan implementation is deemed successful in this sense (Faludi, 2000, Laurian et al., 2004a). The performance-based approach, on the other hand, looks at how a plan's ideas are communicated and carried out. It is suitable for assessing strategic plans. It is not necessary to strictly adhere to the intended outcome in order for a plan to be considered implemented if it is used or consulted during the decision-making process. Planned deviations may also be regarded as implemented if they are rational.

The effectiveness of urban growth boundaries has been examined (Tian and Shen, 2007; He, 2012; Ranasinghe and Silva, 2013), and the effectiveness of land-use planning and plan implementation has been evaluated (Tian and Shen, 2007, He, 2012, Ranasinghe and Silva, 2013), among other studies, using a conformance-based approach (Brody et al., 2005). Although these studies have shed light on the problem, evaluation of plan outcomes should be done in a wide sense that takes into account the area's particular physical characteristics as well as environmental, socioeconomic, and human aspects. Additionally, plan implementation is a complicated process that is influenced by a number of elements, indicating the need for additional research to gain a thorough grasp of the factors. On the other hand, since plans and existing land use may not match precisely, leading to areas of non-conformance, urban planners search for ways to assess if and how successfully urban land-use plans have been executed (Loh, 2011).

1.2 Statement of the problem

Dukem town is one of special zones of Oromia Regional State located in the central part of the region. The town is among rapidly growing Ethiopian urban centers, due to its location nearest to Adddis Ababa, at about 37 Kilometres. Like other secondary towns in Ethiopia, the land-use plan for Dukem Town has been prepared and implemented recently. The first land use plan of the Town is prepared, and it is referred to as DLUP08 in this research. DLUP08 was in effect from 2008 to 2018 and was updated in 2018 to guide the development for the next 10-yrs (i.e., up to 2028). The town, on the other hand, is facing a number of development-related issues that the plan is supposed to address. This includes irregular and uncontrolled expansion of the town, a lack of infrastructure, emergence of informal settlements and imbalance between different land uses. Such urban problems are usually indicators of non-implementation or inadequate implementation of land use plans, or a disparity between plan proposal and land-use outcomes (Chigara et al., 2013).

Hence, an empirical assessment of the existing land-use against the intention of land-use plan is critical, as it can provide information required for the development of sound management strategies, so as to ensure implementation of urban plans. On the other hand, Urban planners look for means of determining whether and how well urban land-use plans have been implemented (Loh, 2011) since plans and existing land-use do not match perfectly, giving rise to areas of non-conformance.

In Ethiopia, evaluation of urban land-use plan implementation is uncommon. To date. only few studies have been conducted with regard to land use plan implementation, such as the study of major land use conflicts and problems of the land use plan implementation with respect to environment in Sululta Town (Merga, 2012); investigation of the challenges of urban plan implementation and land management in Gelan Town (Habtamu 2011). However, these studies

did not offer a thorough analysis of the morphological conformity and implementation success of land use plan as compared to actual development in the analysis areas. Addressing these issues could have practical benefits for Dukem Town to take a more coordinated and proactive approach to combat the potential problem due to non-conforming developments and could inform urban planning policy objectives.

1.3 Objectives of the study

General objective

To analyze the extent to which land-use plan of Dukem town functioned from 2008 to 2018 is implemented using conformance-based approach.

Specific objectives

- To determine built-up expansion in Dukem town from 2008 to 2018 at land use level
- To decide the built-up outside of planned urban growth boundary
- To discuss conforming and non-conforming developments in the town over 2008-2018 as compared to the intention of DLUP08
- To regulate the degree of conformance success of DLUP08 over the planning period
- To know factors affected implementation of the plan

1.4 Research questions

- How has built-up expansion in Dukem town been expanded between 2008 and 2018
- How well built-up area expansion of Dukem town during 2008-2018 was maintained within the planned growth boundary?

- Where is spatial location and distribution of conforming, unfulfilled and non-conforming developments within the planned growth DLUP08?
- What is the degree of conformity success of the DLUP08 over the planning period?
- What are the underlying factors influenced the implementation of DLUP08?

1.5 Significance of the study

The findings of this research highlight implementation successes or failures of DLUP08. This can create awareness the effectiveness of the plan in guiding the physical development of the town during planning period. It also helps planners to recognize where there is nonconformity or significant deviation from original plan design that may adversely influence urban environments. It serves as a monitoring tool with which to guide the direction of plan implementation, to adjust course to updated information, or to plan a new heading before negative outcomes become irreversible.

The study provides a better understanding of major factors contributing to nonconforming development and sprawling growth of Dukem town in particular and possibly serves as spring board for the country's urban centers in general. Identification of why development occurs in unintended areas can support the government to formulate sustainable spatial policies and direction of spatial development with respect to sustainable urban environment and creating a balance between ecological and socio-economic needs. Most importantly, adaptive approach and techniques used in this study provide a basis for monitoring and evaluation of other land-use plan implementation in the region and country as well. Finally, it can initiate further researches on issues in line with Master Plan Implementation in the country and Dukem Town.

1.6 Scope of the study

There are some demarcating lines up to which the study extends. These are potential variables, level of detail, and spatial extent which the analysis uses as inputs to produce the aimed result. The DLUP08 proposal is through structural plan (SP) which defines major land-use categories or zones and local development plan which indicates detail land-use to support implementation of SP. The study analyzed the implementation of the plan at land-use zone level using structural plan. Which means the detail specific locality, density, height regulation etc. are not gone through as it takes more time, budget, and detail datas.

1.7 Limitation of the study

This study has its limitation as any type of research done. The main constraints of this research not in corporate all population size during open semi ended interview and computability of land use pan implementation are not gone through as it takes more time, budget, and detail data,

1.8 Structure of the thesis

This thesis is composed of five chapters. The current chapter presented the background of the study, statement of the problem, objectives, research questions and significance of the study. Chapter 2 presents a review of related literature. The materials and methods used in the study are discussed in chapter 3. Chapter 4 presents the results and discussion of the study. The last chapter presents conclusions drawn from the study and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Urban land-use plan in Ethiopia

According to "Urban Planning Proclamation No. 574/2008", Part Two #7 and 8, hierarchy of plans are National Urban Development Scheme, Regional Urban Development Plan, and Urban Plans. Urban plan as a tool for urban development has been practiced in Ethiopia since 1930's. The types of urban plans recognized in the proclamation are City-Wide Structure Plan (SP) and Local Development Plan (MUDC, 2012).

Contextually, Structure Plan is strongly linked with global and national plans, strategies and policies, and regional plans on one hand and sectoral development plans, local development plans and projects, on the other. However, based on the Urban Plan Proclamation No. 574/ 2008 which acknowledges only four levels of plans.

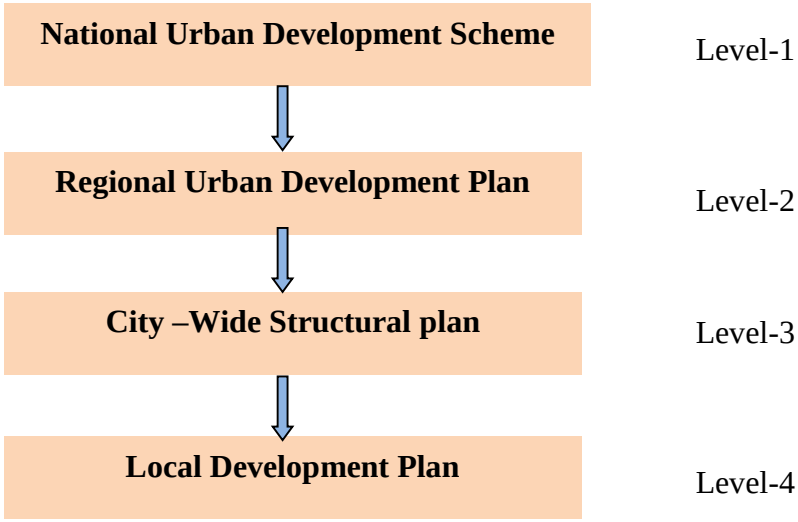


Figure 2-1 A framework of the Hierarchy in the Current Ethiopian Urban Planning System

Structural plan indicates the distribution and extent of major land-use categories. It contains the general mandatory provisions for the development of a planning area. It sets out the basic minimum requirements regarding spatial developments whose fulfillment would produce a coherent urban development in social, economic and spatial spheres. The structure plan is a basis for rational decisions regarding an urban areas' long-term physical development. It serves as a bridge between community values, visions and objectives on one hand and decisions on physical developments on the other.

Structural plans shall be valid for the period of up to 10 years from the date of approval. SP is guided by a long term (20 years or more) Regional Urban Development Plan, which in turn is guided by National Urban Development Scheme, that gives an overall long term policy direction, strategies, vision and goals. Though Regional Urban Development Plan may not be part of SP, influence area study that also consists rural - urban and urban - urban linkages should be considered as part of SP and should be conducted while preparing SP (MUDC, 2012).

According to the Urban Plan Proclamation, any structure plan shall indicate: the magnitude and direction of growth of the urban center; principal land-use classes; Housing development; the layout and organization of major physical and social infrastructure; urban redevelopment intervention areas of the urban center; environmental aspects; and industry zone.

2.2 Importance of planning evaluation

Planning is the process of analyzing information, making decisions and formulating plans of action for future. It can be undertaken by government in many sectors with appropriate methodologies and techniques to achieve relevant goals and objectives. Development plan will provide the spatial framework for promoting and regulating the physical development of lands and buildings in each

of the urban area to ensure the sustainable urbanization. Patton (1989) states that plan evaluation is the systematic assessment of plans, planning processes, and outcomes compared with explicit standards or indicators. It is important as it can contribute to the accountability of, and trust in, public managers and institutions, and guide improvements in plans and practices (Berke et al., 2006, Lunt, 2003). Understanding the degree to which plans are implemented and the determination of effective implementation benefit planners for making better plans.

Since land-use plans and planning activities regularly come under attack for being costly, imposing undue controls and burdens on land-owners, and failing to make a difference, there is an increased demand for confirming the value-added outcome of planning. Planning evaluation can be conducted for different purposes as a priori or ex ante evaluation (Alexander 2006) on-going monitoring or formative evaluation and ex post facto or retrospective evaluation (Baum, 2001; Snyder and Coglianese, 2005). While "in the final analysis, outcome evaluation is the true test of management effectiveness" (Hockings et al., 2000) ex post facto attempts to evaluate the outcomes of land-use planning are rare (Carmona and Sieh, 2008). Most ex post studies evaluate planning outputs (that is, policies, programmers, projects, regulations) rather than outcomes (Baum, 2001), and most show how scarce ex post outcome evaluations are in planning practice rather than evaluate implementation (exceptions include Berke et al., 2006; Day et al., 2008; Laurian et al., 2004a, 2004b).

2.3 Urban plan evaluation approaches

Since evaluation is concerned with the "success" of plans, the theories used for plan evaluation should be able to identify how successful plans are. In order to achieve a proper evaluation for different plans, evaluation theories need to be selected based on the nature of plans. Urban plans can be categorized into two types: project-oriented plans and strategic plans (Ferreira et al., 2009).

Projected-oriented plans refer to traditional plans which mostly provide blueprints of the designated end-state of the physical environment. On the other land, strategic plans deal with the coordination of diverse actors. Apparently, project-oriented plans are more physical and material while strategic plans are concerned with decisions and more characterized as a dynamic process (van Dijk, 2021).

There exists a divergence of approaches proposed in plenty studies to evaluate urban planning implementation and they are generally categorized into two approaches: conformance-based approach and performance-based approach (Feitelson et al., 2017). Selection of approaches to evaluate planning implementation depends on ones understanding of spatial planning.

Table 2-1: Summary of project orented and Strategic plan

	Project plans	**Strategic Plans**
Object	Material	Decisions
Interaction	Until adoption	Continuous
Future	Limited to phasing	Central to problem
Time element	Blueprint	Minutes of last meeting
Effect	Detriment	Frames of reference

2.3.1 Conformance–based evaluation

Planning conformance refers to the conformity between plan and actual development. This theory follows a technocratic view and emphasizes the role of planning as a rational tool to draw a blueprint. Specifically, planning conformance theory assumes that once a plan is adopted, a definite image of the future is confirmed. The underlying tenet of this plan is to fulfill the designated task precisely. Thus, the plan evaluation can be undertaken by identifying how closely

plan outcomes conform to plan prescriptions or whether plan goals are achieved (Oliveira and Pinho, 2010). Planning conformance theory lends itself particularly to the evaluation of project-oriented plans (Faludi, 2000).

Hence, conformance-based evaluation means judging the success or failure of planning by measuring the conformance degree between the outcomes of urban development and the previously designed plan proposals. It concerns planning outcomes and the linkages between plans and actual development. It assumes a rational model of planning, which are specific enough to guide future development. Conformance-based evaluations are best suited to evaluate the outcomes of discrete plan elements (Laurian, 2010). A high conformance degree indicates the implementation is well achieved and vice versa. In other words, a plan is considered implemented if development patterns adhere to plan intention.

2.3.2 Performance-based evaluation

Performance-based approach focuses on whether and how the plan is consulted in subsequent planning process. It insists that planning is a process of decision making under conditions of uncertainty, as long as the outcomes are beneficial, departures from previous plans may be considered acceptable. Performance-based evaluation is well suited to evaluate comprehensive and strategic plans. This approach should correspond to a detailed analysis of the decisions and actions of a number of actors that are supposed to receive the plan messages (Oliveira and Pinho, 2010). In this regard, a plan is considered implemented if it is used or consulted in decision-making processes, no need to be strictly adhering to the actual outcome. Departures from a plan may be also considered implemented if they are rational or inevitable.

2.4 Factors affecting plan outcomes

Identifying the factors affecting implementation is as important as plan implementation. According to Laurian et al. (2010), plan implementation was a rather complex process that was influenced by various factors, and suggests the need for more researches to develop a sufficient understanding with regard to the factors influencing plan implementation.

Bengston et al. (2004) summarized the factors influencing public policies implementation to control urban growth in more systematic way. Their findings showed that (1) administrative efficiency and other details of policy implementation; (2) the use of multiple policy instruments; (3) vertical and horizontal coordination; and (4) meaningful stakeholder participation throughout the planning process and implementation are rather crucial in determining urban growth control policies' effectiveness. Couch and Karecha (2006) found the growing market force became the major challenge for implementing urban growth control policies. Yang and Zhou (2007) believed (1) an unrealistic forecast of urban growth in Beijing; (2) absence of key stakeholders in the planning and implementation process; and (3) overemphasis of functional separation mainly contributed to the failure of UCP in Beijing.

In the context of Ethiopia, Merga (2012) identified that poorly implementation of Sululta land-use plan is related with lack of public participation as well as shortage of the commitment of officials, experience and disciplinary gap of the plan preparation team, lack of policy, shortage of implementation tools, skilled man power, and community awareness. Ingda (2013) conclude that the Limited emphasis of professional exercise and lack of community participation have mainly contributed to failure of master planning implementation of Arba Minch town. According to Yohannes (2012), the major problem contributes to implementation of Master plan of Dilla town is associated with plan quality. And direct implementing bodies at the local government level (the

Dilla municipality at the top level and Zonal urban development department). Similarly, challenges such as Absence of action plan, implementing bodies and time schedule in line with legal framework of structure plan, poor quality of the plan were manifested in Gelan town master plan implementation (Habtamu, 2011).

In summary, influential factors of land-use plan implementation mentioned in the relevant literature into three main categories: plan quality, implementation quality and contextual characteristics. Plan quality encapsulates elements in the plan formulation process, such as the suitability of the planning techniques, involvement of different stakeholders and so on. Implementation quality refers to elements in the implementation process, like plan monitoring, supportive regulations and legislations, etc. These two categories cover factors that are directly related to plans. Contextual characteristics mainly contain external factors that influence plan implementation like policy environment and socioeconomic changes.

2.5 Review of empirical studies

Facing the issue of urban planning implementation evaluation, no uniform approach could be adopted. Standing at different positions, scholars, planners and urban managers adopt different approaches and plenty of effort has been devoted to urban planning implementation evaluation in either conformance-based approach or performance-based approach. Since the late 1970's several categories of conformance approaches have been developed with the advancing computer technology to provide solid support to the assessment of plan implementation by comparing the actual outcome with plan intension using selected indicators.

Brody et al. (2005) have assessed the efficiency of land-use planning and plan implementation in Florida by measuring the degree to which wetland development over a ten-year period conforms

to the original design of adopted comprehensive plans of Southern Florida. They spatially identified concentrated areas of wetland alteration permits and compare with the adopted future land-use maps of the Southern portion of the state. As the result, they indicated a well-defined spatial pattern of nonconforming wetland development and isolate specific socioeconomic, demographic, and geographic variables impacting these deviations from the original spatial intent of local plans. Tian and Shen (2007) evaluated the Implementation of Guangzhou City Master Plan and identified accordance and deviation between the land-use plan (LUP) and physical land-use (PLU) through grid overlays. They concluded that the degree of accordance with the master plan is very low, except the land for open space. In addition, there has been substantial deviation from the land-use plan in Guangzhou, and these deviations are due to rapid population and economic growth.

More recently, Jinghuan (2012) evaluated planning implementation of Shanghai Master Plan: 2001-2020 (01SHMP) through comparing the 01SHMP and actual spatial development based on conformance-based approach. They conclude that the 01SHMP has been strategically successful in guiding urban restructuring and peripheral development. However, enormous breakthroughs such as extra land development, urban expansion on the edge of the central City, extensive population growth has occurred. Degree of planning implementation also varied between measuring variables, locations and indicators. Ranasighe and Silva (2013) evaluated the outcomes of Moratuwa urban development plans focusing on ex post facto evaluation considering the outcomes of action projects of development plans using Plan outcome evaluation method. Zhong et al. (2014) assessed the implementation of China's National General Land-use Plan (1997-2010) using combined conformance-based and performance-based criteria.

The conformance analysis was carried out by contrasting outcomes with planning goals. Regarding the performance-based criteria, they focused on the role of decision-making elements in plan implementation, such as subsequent plans relevance to the plan being evaluated, policies developed to implement the plan being assessed, and, local government's strategic response to the implementation of subsequent plans. They highlighted the critical role of uncertainty, as well as the structure related to the plan implementation. The results showed that the National General Land-use Plan (1997-2010) conformed and performed poorly, and failed to achieve its goals. The study also indicated that the failure of the plan implementation was a result of uncertainty, difficulty in coordination, policy bugs and redundant governance, and weak plan implementation monitoring. Han (2014) analyzed the effectiveness of Urban Growth Control Boundary (UGCB) in Beijing by comparing the morphology of planned UGCB with that of the actual urban boundary using Geographic Information System (GIS) technique. They concluded that UGCB in Beijing failed to curb in urban expansion because there were a plenty of developments occurring out of the boundary.

In the context of Ethiopia, Merga (2012) has evaluated land-use planning and implementation with respect to environmental issues in Sululta town. He evaluated the major land-use conflicts and environmental problems of the land-use plan and implementation with respect to environment in the study area. He identified that different land-uses are proposed on environmental sensitive areas, proposal of incompatible land-use in a plan. Moreover, the study boldly rationalizes that the misuse of urban greenery, dumpsite, abattoir, industrial development and quarrying activities during plan implementation. Habtamu (2011) attempted to investigate the challenges of urban plan implementation in Gelan town. He drew a conclusion that structure plan of the town was implemented poorly which is manifested by irregular and irrational development as well as

incompatible land-uses. Ingda (2013) examined the practice of master planning and the extent of its implementation and challenges of land management in Arba Minch.

Overall, it can be seen that evaluation of land-use plans mainly focused on the planning outcome. By identifying the level of conformity between planning proposal and actual outcome, researchers judged to what extent urban land-use plans had successfully implemented.

2.6 Research and Knowledge gaps

Although the above reviewed studies have shed light on the problem, evaluation of plan outcomes should be done in a wide sense that takes into account the area's particular physical characteristics as well as environmental, socioeconomic, and human aspects. Additionally, plan implementation is a complicated process that is influenced by a number of elements, indicating the need for additional research to gain a thorough grasp of the factors. On the other hand, since plans and existing land use may not match precisely, leading to areas of non-conformance, urban planners search for ways to assess if and how successfully urban land-use plans have been executed. In Ethiopia, evaluation of urban land-use plan implementation is uncommon. To date. only few studies have been conducted with regard to land use plan implementation; however, these studies did not offer a thorough analysis of the morphological conformity and implementation success of land use plan as compared to actual development in the analysis areas.

CHAPTER 3: MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Location of study area

Dukem town is one of fast growing cities in Ethiopia with an estimated total population of 25,214. Dukem town is located 37 km to the south of Addis Ababa within the Oromia National Regional State (Figure 3-1), is one of the reform towns of that region and has a city administration municipality and four kebeles, or neighborhood associations, which are the smallest unit of local government in Ethiopia. It is the administrative center of Akaki woreda that is defined by the third-level administrative division of Ethiopia and is composed of a four kebeles. It is understood that formulating good land governance is the main challenge for the urban development, pressure that is shared between the federal, regional and district administration,

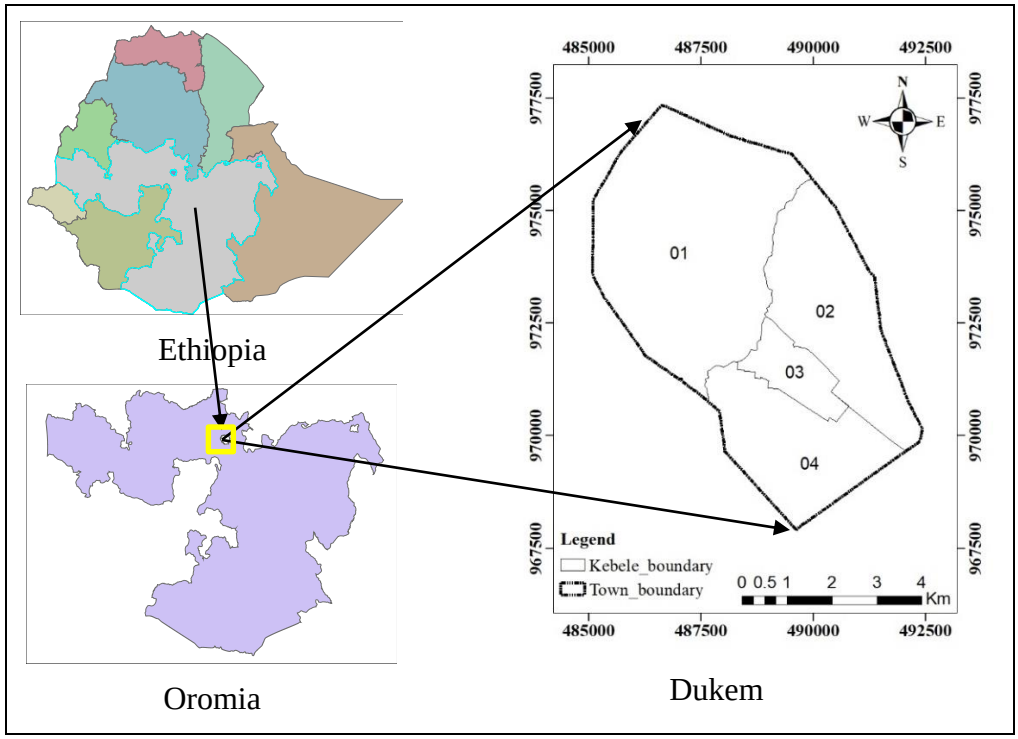


Figure 3-1: Location map of the study area

3.1.2 Demography

According to the last three consecutive censuses conducted in the country, Dukem Town showed a large increase in population. In the first Ethiopian population and housing census, which was held in May 1984, Dukem town had a population of 5,138. According to the third Ethiopian population and housing census which was conducted in 2007 (the most recent year for which data are available), 83,118 people of whom 42,388 males and 40,730 females were inhabited in Dukem. According to Dukem town communication office in 2009 the town had a total population of 137,734 of whom 70,079 were males and 67,655 were females and also this rate is increased by 6.93%. Based on this the projected population of Dukem Town administration in 2018/19 was 275,000.

3.1.3 Climate and Vegetation

Dukem town is located near the western border and experiences temperate climate of the central Rift valley of Ethiopia. The mean annual rainfall of the area according to 1996 to 2003 year's meteorological data at Bishoftu station is 606.13 mm, and the mean maximum and mean minimum annual temperature of the area are 25.83^0C and 11.9^0C respectively. The maximum temperature is during February to May and the minimum temperature is from mid-October to January.

3.1.4 Topography

The study area has flat topography generally possesses east and southeast and south west of Dukem Town extends to Bushoftu Town and the known Chukala mountain. The existing landscape of the area is formed by the formation of the great east African rift formation and subsequent volcanism, erosion and deposition. A ridge extends northeast and southwest to Yerer Mountain in the north east and to Guji and Bilbilo Mountain in the southwest (Abate Chekol et al., 2020).

3.1.5 Geology

Dukem is found in the main Ethiopian rift valley near the western escarpment. Volcanic rock materials of various compositions cover the area. Due to weathering of the rock, and subsequent erosion and deposition, thick residual clay and silt clay soil covered most part of the plain topographic landforms. The volcanic rocks found exposed along Dukem stream, Mandalo stream, Gogecha stream, rigs and slopes. According to the litho logical log of existing borehole, near Dukem stream, (488800mE, 972368mN), that was drilled in December 2002 the area can be depicted by alternating layers of ignimbrite, scoraceous Basalt, aphanitic Basalt, scoria and clay. Litho logical log of the newly drilled borehole in September 2005 for Bishoftu town, in the plain land of Garbi Ballo, at the distance of 5km from Dukem, located at the geographic grid coordinate 969255mN and 492816mE, shows from top to bottom, the area formed from thick clay deposit, scoriacious basalt flow (14meters), and reworked pyroclastic deposits of different size, fine to medium grained sand of different composition, and medium to fine gravel of different rock type. Due to the location of the study area in the main Ethiopian rift valley near the western escarpment parallel faults and step faults are prevalent in the area, which are governing ground water flow directions at depth and the flow of drainage pattern. A ridge extends northeast and southwest to Yerer Mountain in the north east and to Guji and Bilbilo Mountain in the southwest demarcated the western escarpment of the rift (Abebe, 2012).

3.2 Data and acquisition techniques

3.2.1 Data sources

The study involves analysis of physical development of the town compared to the land-use plan. Required data were collected from both primary and secondary sources. Existing land-uses data

were collected using digital orthophoto of the town as of 2008. Proposed land-uses by the plan were extracted from structural plan map of DLUP08.

Table 3- 1: Descriptions of data used in the study

Data	Data source	Year	Purpose
Land use as of 2008	Aerial photo/ google earth/ field survey	2008	For extraction of actual land use as of 2008
Proposed land use	structural plan map (.JPG)	2008	For extraction of proposed land use and UGB for planning period
Land use as of 2018	Google earth image	2008 & 2018	To verify the digitized data
	Orthophoto (15 cm resolution)	2018	For extraction actual land use as of 2018
Influential factors	Survey data	2022	To verify the extracted data and to make corrections

3.2.2 Software and Equipments

Table 3- 2: Software and equipments used in this study

Software/Equipment	Purpose
ArcGIS	For processing spatial data and preparation of output maps
Handheld GPS	Collection of spatial data

3.2.3 Data acquisition techniques

Proposed land-use

The sources of input data in GIS includes: ground surveying, aerial photographs, and hard copy map. Extraction of spatial data from existing map to standard required for GIS spatial analysis involves geo-referencing, creation of Geodatabase, digitization, creation of topology and correcting digitization errors.

In this research, one of the data sources of land-use plan was a scanned map of structural plan maps in .JPG format. The map contains important cartographic information. Ground coordinates of map grid lines are labeled in both Easting and Northing directions. Intersection of these lines was selected for control points in geo-referencing process as they can be easily identified on the map. Hence, eight intersections as control points with uniform distribution are selected and their ground coordinates are recorded. In ArcGIS software, using geo-referencing function coordinates of all control points are entered into their respective grid intersection point. Finally, the image is rectified with acceptable (<0.5) root mean square error of each point.

Physical land-use as of 2008 (DPLU08) and proposed land-use by DLUP04 were digitized from maps to common Geodatabase with Universal Transverse Mercator Projection system (Adindan UTM Zone 37 N). Physical developments as of 2018, was digitized from digital orthophoto having 15 cm spatial resolution acquired in 2018 and ground surveying using handheld GPS. Next, topology was created and applied for the datasets and digitization errors were corrected. Handheld GPS was used to verify and guide the collection of information of actual function of a plot of land (land-use) as of 2008 and 2018.

Existing land-use

Spatial mapping of existing land-uses for urban land-use classification involves, collection and integration of spatial data and non-spatial data, and mapping. Spatial data for this study was existing locational data of major features of the study area such as different land-use classes and road network. Topological errors were corrected in ArcGIS environment and projected to common Geodatabase.

Non-spatial data

Non-spatial information, mainly land-use as of 2008 was initially identified from aerial photograph with 15cm resolution and land-use map of 2008, which was prepared by DLUP08 project. The information was then verified and corrected based on information collected using simple questions to help making conversation with residents during verification. In this case, minimum of two (2) dwellers lived in the area for more than 15 years were asked for information. Since it was only for verification, taking the importance of reducing data saturation into account, application of survey sampling was considered unnecessary. Similarly, the non-spatial data were collected during spatial data collection in 2022 supported by simple interview questions to trace back information of land-use as of 2018. Moreover, for more significant nonconforming developments archives and ownership documents were consulted.

3.2.4 Variables and indicators

The conceptual framework for the Structure Plan of the City identified elements that have direct and strong impact on the development of the town. The plan was mainly focused on six framing elements: Urban growth, Housing, Social Services, Manufacturing and storage, road network, and Environment and Green space. Hence, the present study selected these as variables and explained

under since they are significant to demonstrate the conformity of actual land-use outcome with plan intention.

1. **Urban growth:** Land development crucially shows the direction of urban growth. Period of land development reflects spatial organizations according to the economic situation and policies. The main aim of DLUP08 is to rein all developments in planed urban growth boundary. It addressed importance to the land-use plan and identified functions and their densities deliberately in different locations. It proposed new expansion areas and thus redefined urban construction boundary targeting at bringing compact development as much as possible and practicable in view of the local climatic conditions.
2. **Housing:** Housing expansion area was proposed to accommodate fast growing population in the City. The proposal is mainly at periphery areas focusing to the north and south. Some parts of vacant areas within the City boundary are also proposed to be used for new housing construction.
3. **Social service:** Location and spatial distribution of social services were proposed in such a way that to be integrated with hierarchy and size of centers to provide social services in the deprived parts of the City. Moreover, it identifies their density in different locations to ensure balanced development and to provide uniform services.
4. **Commercial:** Commercial land use was among one of the major issues tackled during structural plan preparation of the town. Hence, evaluating the conforming and deviation of this land use development was interesting.
5. **Industry storage:** Industrial restructuring was the most important target of the DLUP08. Lands for industrial use were proposed at different parts of the periphery Kebeles. Locations of Sites for manufacturing and warehouses were mainly intended to decentralize activities

and minimize the need for transportation and also bring about balanced development. Moreover, the plan was aimed at relocating existing manufacturing and warehouses that create disturbance at the City core. In accordance with this, large areas for manufacturing and storages are reserved at the north, south, southwest and southeast.

6. **Road network:** development of infrastructure was the most important strategy in DLUP08 to improve living environment and enhance City competitiveness. It influences the future urban development through establishing a transport framework.

Each variable was measured through different indicators (Table 3-3) depending on the degree of indicators' significance.

Table 3- 3: Indicators of the selected variables for evaluation DLUP08 implementation

Variables		**Indicators of conformity**	
Main	**Sub variables**	**Quantitative**	**Morphological**
Built-up expansion	Built up land	Area	Growth boundary
Housing	Residential	area	Spatial distribution
Social Service	Education	area	Spatial distribution
	Health		
	Religion		
	Cultural		
Industry and storage	Industries, warehouse	area	Spatial distribution
Commercial	Commercial	Area	Spatial distribution
Road network	Road network	length	Spatial distribution
Environment and Green space	Urban Agriculture		Spatial distribution
	Informal green		
	Formal green		

3.3 Methods of data analysis

DLUP08 is essentially a material-oriented blueprint plan with a clear envisaged end-state (such as the total amount of proposed construction land, reserved open spaces for future development, etc.). In other words, the future is closed in the framework of the plan. Additionally, the time element in the plan is limited to specific period. The effect of all the arrangements set in the plan starts when the plan is approved and terminates when the planning period comes to an end. In this study, considering that more features of project plans are embedded in DLUP08, the theory of planning conformance is hence deemed as the most appropriate theory to guide the evaluation.

3.3.1 Delineation of urban construction control boundary

DLUP08 map encompasses different principal land-use categories. In order to delimit urban growth boundary (UGB), proposed land-uses were categorized into two classes: constructible and construction forbidden areas (Table 3-4). This classification was a base for generation of map of "two areas". The delineation of the boundaries of these areas provide reasonable basis for studying the spatial growth boundary of the town, deciding the construction land scale and identifying the scope of construction lands.

Table 3- 4: Reclassification of proposed land-use categories in DLUP08 into "two areas"

Proposed Land-use category in DLUP08	New class
Housing expansion, Mixed land-use, Social service, Industry and Storage, Administration, and Transport	Constructible area
Formal green, informal green, farm land, urban agriculture, Horticulture	Construction forbidden area

3.3.2 Containment of urban growth

DLUP08 was targeted at bringing compact development as much as possible and practicable in view of the local situations. By controlling the total amount and regulating the spatial location of urban built-up land, DLUP08 is expected to be able to rein the development in the intended growth boundary. The extent to which the developments are kept within the growth boundary can be seen as one of the indicators of effectiveness of the plan. In this study, the delineated UGB was used to determine the effectiveness of the plan to keep the developments within the intended boundary. In this case, UGB was spatially overlaid with the actual built up area map of 2018. The built up areas outside the UGB were extracted and the spatial extent was computed.

3.3.3 Conformity assessment

It was carried out to identify the conformity of existing development within the growth boundary with that of plan proposal. Conforming and non-conforming developments were examined through spatial overlay analysis in GIS environment. In this regard, actual land-use outcomes as of 2018 was spatially overlaid with map of proposed each variable in DLUP08 and land-use as of 2008. This helped to identify three types of developments: conforming, nonconforming and unfulfilled developments.

- *Conforming*: if the use of land as of 2018 is consistent with proposed land-use.
- *Unfulfillment*: if the use of a piece of land as of 2008 and 2018 are consistent, but different from plan proposal for the variable, then the Plan is not yet implemented. But it might or might not be implemented in the future.
- *Nonconforming*: if the actual land-use as of 2018 is different from both that of 2008 and plan proposal.

Field investigation was carried out for the purpose of collecting further detailed information of nonconforming developments.

3.3.4 Assessment of degree of conformance success

Degree of conformance success was assessed to evaluate the level of spatial extents of actual physical developments of each variable conform to the extent proposed by the Plan. It was examined using two basic indicators: boundary containment ratio (BCR) and boundary sufficiency ratio (BSR) widely used by similar studies (Bulti and Sori, 2017).

Boundary Containment Ratio

Boundary containment ratio was used to identify to what extent area of actual land-use outcomes as of 2017 deviate from intended land-use in the Plan. In this regard, if the plan is to be considered effective to contain the specific variable development, less nonconforming developments should occur than conforming developments. BCR is measured by the ratio of area of nonconforming developments to area of conforming development (Equation 1). The higher value of BCR indicates limited implementation and vice versa.

$$BCR_i = \frac{(Nonconforming\ area)_i}{(Conforming)_i} \quad (1)$$

Where

$$BCR = 0, \quad complete\ effectiveness$$

$$0 < BCR < 1, \quad limited\ effectiveness$$

$$B\mathrm{CR} \geq 1, \quad \text{complete failure}$$

Boundary Sufficiency Ratio

Boundary sufficiency ratio was used to define the total possible increase of developed land for selected variable. In this case, in order to achieve effective containment, total developed land of selected variable should be less than or equal to total area of proposed land for the variable in DLUP08 at the beginning of planning period. In other words, the area of actual total development of the variable should not be more than area of proposed for the variable. It was measured by the ratio of total area of actual developments to area of proposed land in DLUP08 (Equation 2). BSR is inversely proportional to sufficiency of the size of proposed area.

$$BSR_i = \frac{(Total\ \ development\ of\ the\ variable\ from\ 2008\ to\ 2018)_i}{(proposed\ area\ for\ the\ variable\ in\ DLUP08)_i} \qquad (2)$$

where

BSR ≤1, planned area is large enough to accommodate the development

BSR > 1, planned area is insufficient to accommodate the development

3.3.5 Analysis of factors affecting implementation of DLUP08

Data used for analyzing of potential factors impacted the plan implementation were collected through expert interview. This method is widely applied in various research similar to the present study (Ryan et al., 2019). In this study, using the results of conformity assessment as a base, experts working in Dukem town administration were interviewed to understand the factors likely impacted DLUP08 implementation. For the interview, experts who have worked for the town administration for at least ten years were chosen. This helped to guarantee that respondents had an exposure to the plan for at least half of the planning period. Although more than ten (10) experts were invited

for the interview, only seven (7) of them were able to participate. The departmental composition of the participants was: four experts from land administration and development department and three experts from construction department.

Open ended semi-structured interview questions were used. During the interview, different examples of nonconforming and unfulfilled sites were selected and the responses of respondents were recorded on field notes. On top of this, information about availability of infrastructure and services collected during field visits were used as a supportive. Finally, the collected data were analyzed through descriptive exploratory approach.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Proposed land uses and expansion area by DLUP08

4.1.1 Proposed land uses by DLUP08

Land use plan of Dukem town functioned from 2008 to 2018 contains eleven land uses (Appendix A). These land uses were aggregated based on the general land use category into five: Environment and green (forest, park, urban agriculture, green areas, and quarry). Social service (administration and service), Commercial, industry and storage, and housing. Figure 4-1 shows reclassified land uses proposed by DLUP08 and the expected maximum spatial extents of each land use type in the ending year of planning period (i.e., 2018) is computed and summarized in Table 4-1.

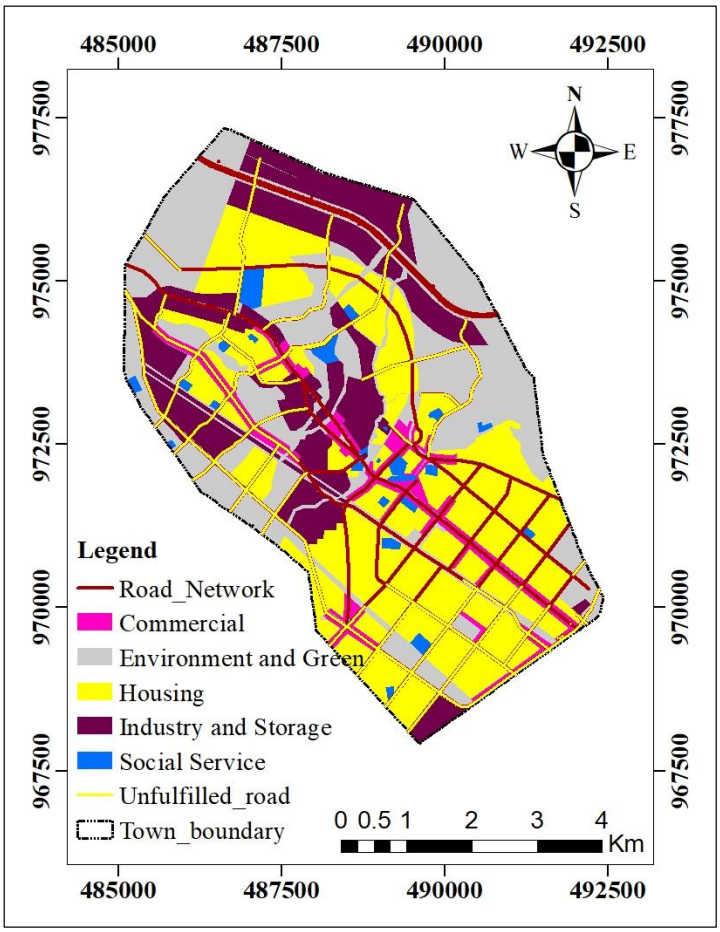


Figure 4- 1: Land use proposed DLUP08 for the planning period 2008-2018

The plan proposed significant area for housing and industry and storage. This could be the town is close to the capital Addis Ababa with transportation facilities that can attract investments, whereas provision of large area for housing can be related with expected rapid urbanization.

Table 4- 1: Spatial extents of proposed urban land use in Dukem town by DLUP08

Land Use_DLUP08	Area (ha)
Housing	1464.2
Commercial	188.8
Social service	90.4
Industry and storage	747.8
Environment and green	1511.7
Road network (km)	108.1

4.1.2 Proposed urban growth area

Further the four land use classes are aggregated to give constructible area. The result of aggregated two area classification for UGB demarcation in this study is depicted in Figure 4-2. This area is built-up expansion area proposed for the planning period, regardless of land use type. Any built-up land outside of the constructible area indicates the less effectiveness of the urban construction boundary. According to DLUP08, area within UGB is the land that reserved to meet the urban growth need up to the end of planning period; i.e., 2018. Land within the UGB allows urban development, while the land outside of this boundary remains primarily non-built-up.

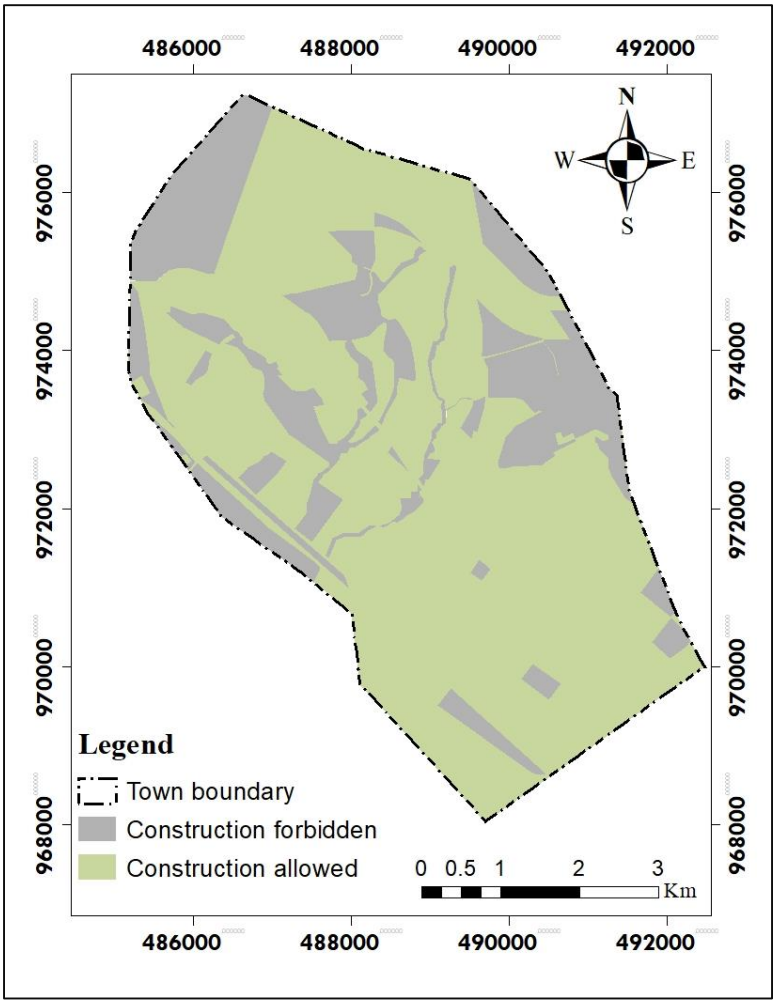
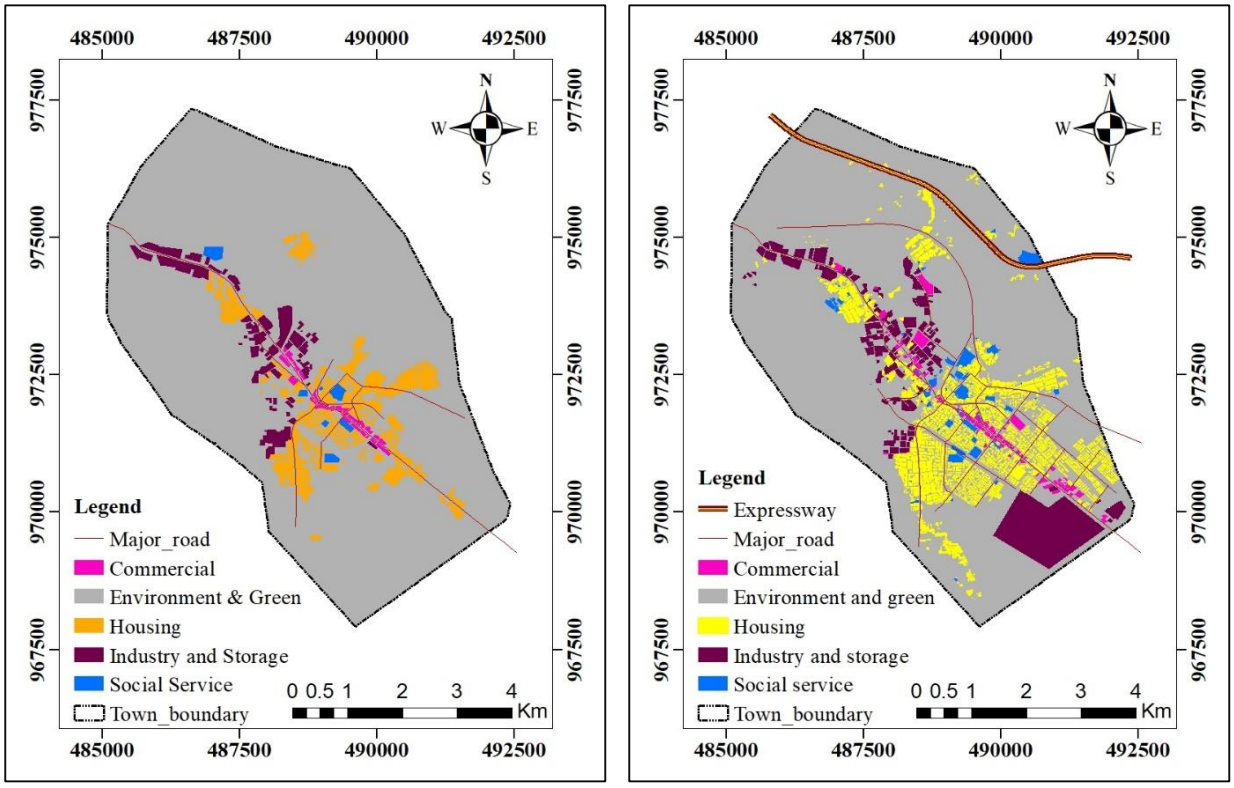


Figure 4-2: Aggregated proposed constructible and non-constructible areas by DLUP08

By controlling the total amount and regulating the spatial location of urban built-up land, DLUP08 was expected to be able to rein the development in proposed urban construction boundary. UGB of DLUP08 is predictive type formulated based on the prediction of urban land development required for expected population growth in planning period. The computed total area inside UGB is 2491.3ha (about 62.2% of the total area) for four urban land uses: housing, commercial, Industry and storage, and social service. The remaining 1511.7ha (37.8%) outside of UGB within the Town Administration boundary was for open spaces using strategic green frame to conserve resources for future development.

4.2 Built-up expansion from 2008 to 2018

Figure 4-3 shows the actual land-uses in Dukem town in starting (2008) and ending (2018) year of the DLUP08 and Table 4-2 gives information about the spatial extents of land use classes computed in hectare as well as the percentage increase in the planning period. The Figure shows four land use categories on the top of environment and green. Close look at the Figure 4-3 reveal that housing developments during planning period was significantly occurred adjacent to previous residential areas in the direction of south and south-east of the town. Moreover, there are residential developments in the north part of the town towards expressway.



(a) (b)

Figure 4- 3: Actual land uses in Dukem Town in (a) 2008 and (b) 2018

Results in Table 4-2 also reveal that as compared to actual development in an initial year (2008), overall built-up expansion is found to be 86.0% in 10 years, indicating 8.6% average annual growth. Further analysis, in terms of land use class relative to the respective developments in 2008 shows that the extent of social services was increased by about 216% (more than double) followed by industry and storage, which resulted 141.5% increase. The least percentage expansion was identified in housing development, which showed about 48.1% of the actual housing development in the year 2008. The large difference in percentage increase is due to the difference in the initial (base) spatial extent of each land use class. Moreover, during the planning period, the significant expansion of road network is found, specifically about 150.9% of the length of road as of a base year (2008).

Table 4- 2: Percentage expansion of urban land uses in Dukem town between 2008 and 2018

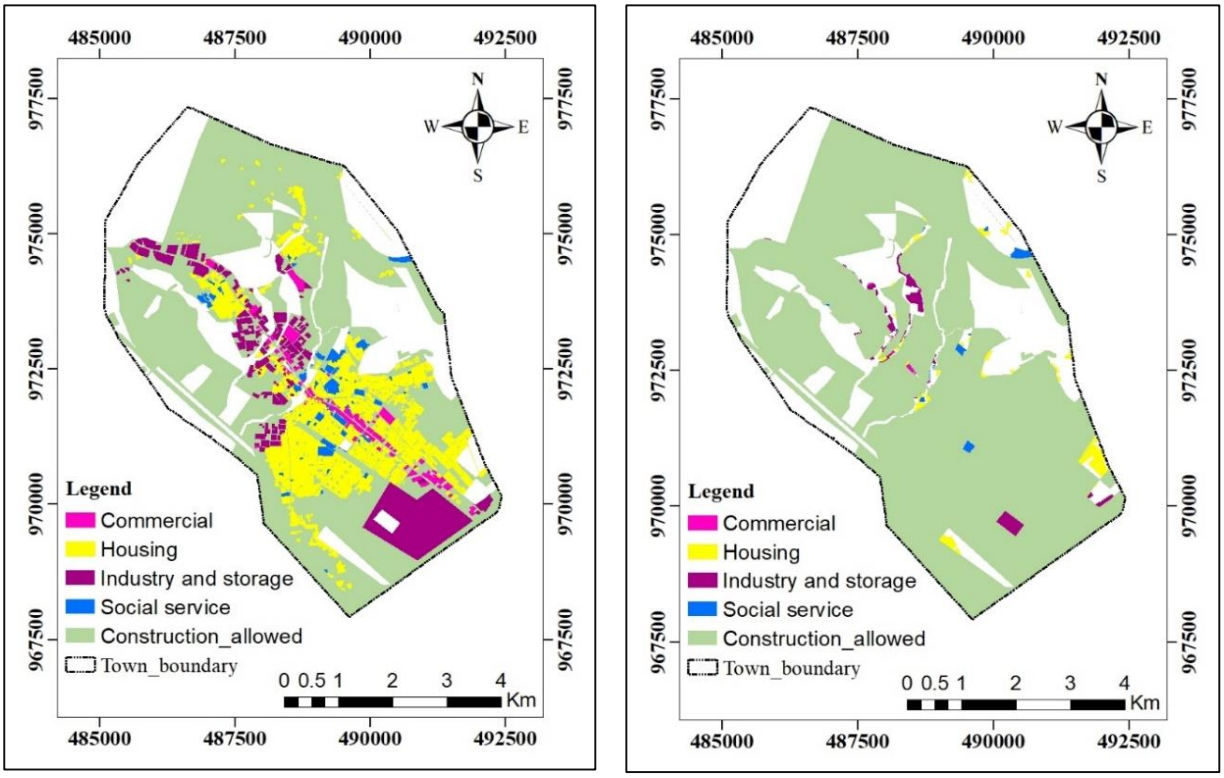
Land use	Area (ha)		Built-up expansion	
	2008	2018	Area (ha)	%
Housing	287.7	426.2	138.5	48.1
Commercial	29.0	58.1	29.1	100.3
Social service	23.5	74.4	50.9	216.6
Industry and storage	133.5	322.4	188.9	141.5
Road (km)	21.2	53.2	32.0	150.9

In accordance with these findings, different studies documented that Dukem town has undergone rapid expansion during the past decade. However, the studies were deliberated on the overall expansion of built-up land. In the present study rather detail land uses were investigated, which provides information at more scale and could enhance planning process. The methodology employed in this study might also be seen as a benchmark in response to the high resolution needed

to investigate urban development at the level of land use, which has been acknowledged as the primary reason for the limited studies of urban land use expansion.

4.3 Effectiveness of built-up expansion control boundary

The results of spatial overlay analysis of actual built up area as of 2018 and urban expansion area proposed by DLUP08 is depicted in Figure 4-4. The results show that developments occurring outside of expansion area during the planning period. This shows the limitation of the plan in controlling the location of urban construction and preserve open spaces for future development. Majority of these environment and green space encroachments are adjacent to construction allowed area.



(a) (b)

Figure 4-4: Spatial distribution of developments occuring (a) inside (b) outside of UGB in Dukem town as of 2018

Further spatial analysis of total actual urban growth in planning period reveals that new built up land inside the UGB is 810ha consisting of 91.9% of the total built up expansion. At the same time, built up land outside UGB is found 71.1ha consisting of 8.1% of the total built up expansion over the planning period. On the contrary, despite it is reserved for urban growth, 1610.2ha (64.6% of construction allowed area) of land inside UGB located at northern and eastern parts of the Town is not yet developed indicating poor implementation of the plan in guiding direction of spatial growth.

Further, the results summarized in Table 4-3 indicates the developments occurred outside of the construction allowed area includes all land use categories considered in this study. Industry and storage shared large area (nearly 27.9ha) followed by housing developments (27.5ha), whereas commercial land use is identified to be the least covering about 1.8ha. However, in terms of percentage expansion relative to the total expansion of respective classes, social service development outside construction allowed area resulted highest percentage (18.6%) followed by industry and storage (8.7%).

Table 4- 3: Spatial extents of different land uses occurring inside and outside of built-up expansion area from 2008 to 2018

Land use	Expansion (2008-2018)	Inside UGB		Outside UGB	
		ha	%	ha	%
Industry and Storage	322.3	294.4	91.3	27.9	8.7
Housing	426.2	398.7	93.5	27.5	6.5
Social service	74.4	60.6	81.4	13.8	18.6
Commercial	58.1	56.2	96.9	1.8	3.1
Total	**881.1**	**810.0**			**8.1**

4.4 Conformity of developments

4.4.1 Road network

Improvement of infrastructure became the most important strategy in order to enhance living environment and town competitiveness. The result of spatial overlay analysis of existing road network as of 2018 and the proposed development by DLUP08 is depicted in Figure 4-5. It gives information about unfulfilled road developments in Dukem town as compared to proposed development for the years between 2008 and 2018.

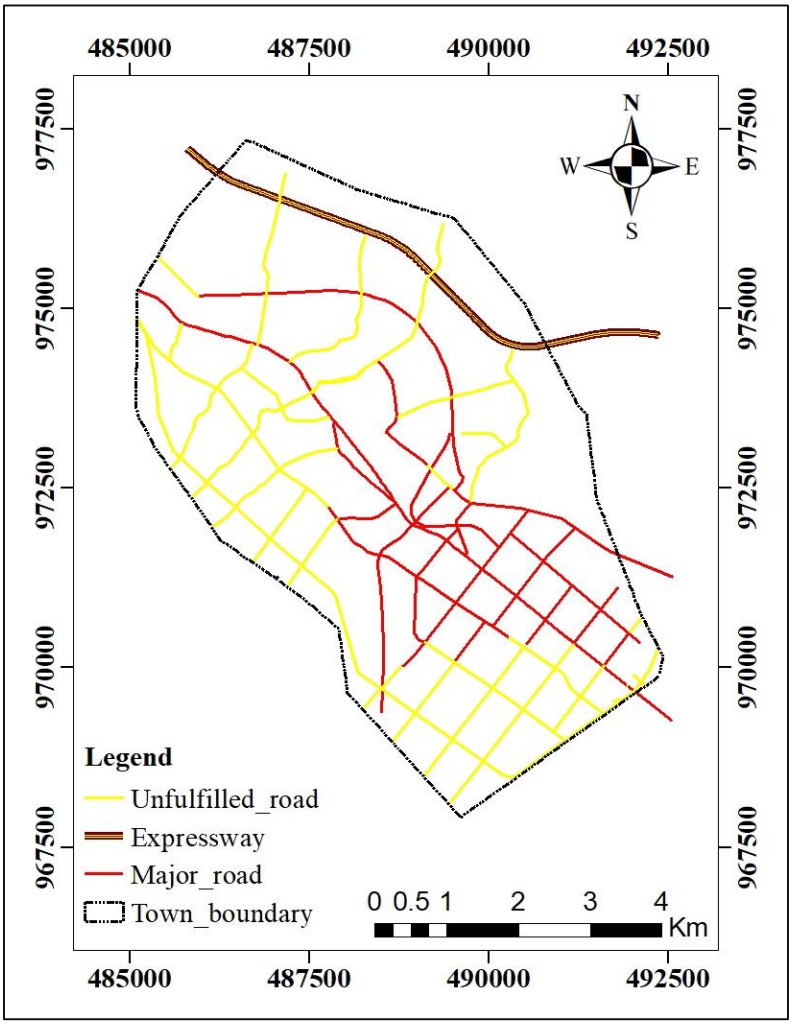


Figure 4-5: Existing roads and unfulfilled road development proposed in DLUP08

According to DLUP08, improvement of the existing road network, development of streets in expansion areas were through increasing length of the road network to 108.1 km as computed from plan proposal. However, result of spatial analysis of existing road network as of 2018 and the proposed road network shows that only 53.2km was developed, indicating total 54.9km (more than 50% of the proposal) was not developed (unfulfilled) until the end of planning period. Unfulfilled road development is distributed overall direction, except in south-east part of the town as shown in Figure 4-5. As transportation is the main engine of development, the limitation of implementation directly affects other developments to follow the plan.

4.4.2 Housing development

Residential development was one of the main planning issues for DLUP08. Accordingly, new housing development areas were proposed predominantly 1464.2ha at the northern and southern parts of the Town. This area caters for land requirement of housing. The result of spatial overlay of proposed land-use and spatial mapping of actual residential developments as of 2018 is depicted in Figure 4-6. It demonstrates that despite of undeveloped reserved land area exists; significant non-conforming residential developments are occurred at town center, south-east, north-west, and northern of the Town.

Further spatial analysis conducted in this study reveals that spatial extent of deviation/nonconforming and unfulfilled land-use occupies 102.4ha and 863ha, respectively. The percentage of nonconforming housing development as compared to the total housing development is found to be 24%. The spatial distribution of each type in different Kebeles is summarized in Table 4-4. Results in Figure 4-6 and Table 4-4 show that residential development was not fully covered the reserved area. Proposed land for housing developments in Kebele 03 is completely utilized. This Kebele is suited at central parts of town with more access to infrastructure. By the

contrary, there are large areas of land in Kebele 01 and Kebele 04, particularly where there is shortage of urban infrastructure.

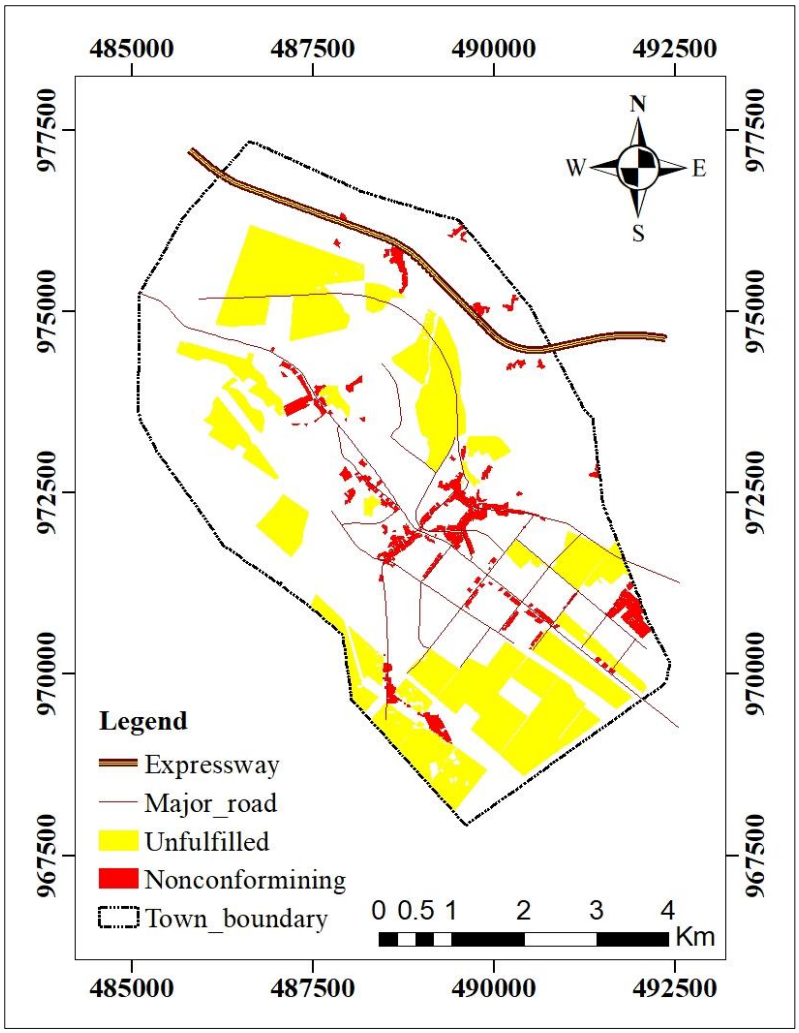


Figure 4-6: Spatial distribution of deviation and unfulfilled housing development compared to DLUP08

The results also indicate that new residential developments along the expressway and south-east parts on the top of the central part of the town unplanned. These non-conforming developments are identified in an area having better infrastructure developments. On contrary, proposed land for residential development has not fully utilized. Mainly large area of reserved land

but not yet developed was identified in the north-west and south-west parts of the Town. Further, field observation reveals that these areas are manly characterized by low infrastructure development. Overall, large percentage of nonconforming housing development is found in Kebele 02 (40%) followed by Kebele 01 (28.4%).

Table 4-4: Spatial extents of unfulfilled and nonconforming housing developments in Dukem town as of 2018

Kebele	Unfulfilled		Nonconforming	
	ha	%	ha	%
01	332.0	38.5	29.0	28.4
02	175.7	20.4	40.9	40.0
03	-	-	22.3	21.8
04	355.3	41.2	10.1	9.9
Total	**863.0**	**100.0**	**102.4**	**100.0**

4.4.3 Commercial development

Commercial land use development was another main planning issues for DLUP08. Results of spatial overlay of proposed land and actual development (Figure 4-7) shows that non-conforming developments identified mainly at south-east and central parts of the Town following the main road to Addis Ababa. Unfulfilled commercial developments are also distributed in Southern, central, and North-west parts of the Town. Spatial distribution of all types along with their spatial extent is summarized in Table 4-5.

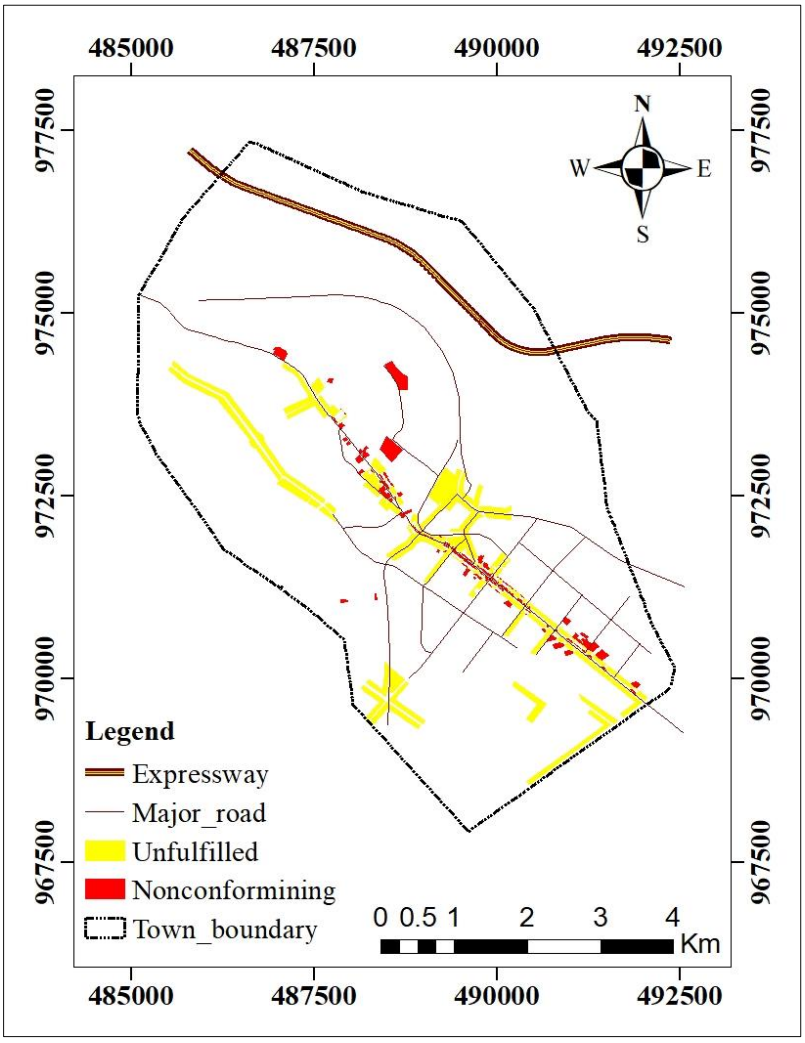


Figure 4-7: Spatial distribution of deviation and unfulfilled commercial developments

Further spatial analysis reveals that actual land-use outcome utilized by industry and storage outside of the planned area (deviation) is found 31.6ha, which has 54.4% share of total commercial land use growth (58.1 ha) during the planning period. On the other hand, despite the proposal of the plan, 211.3ha reserved land is not yet developed. Results demonstrate that more non-conforming industrial developments mainly warehouses are identified in Kebele 01 (17.8ha), whereas the least nonconforming commercial development is found in Kebele 04 (2.3ha).

Conversely, 211.3ha of land is not fully utilized which results unfulfilled developments distributed in all kebeles, regardless of significant variations in spatial extent. Unfulfilled land in Kebele 03 is the highest covering about one-third of unfulfilled commercial developments. This large area has relatively better infrastructures, yet not utilized up to the end of planning period that might be due to lack close supervision and monitoring.

Table 4- 5: Spatial extents of unfulfilled and nonconforming commercial developments in Dukem town as of 2018

Kebele	Unfulfilled		Nonconforming	
	ha	%	ha	%
01	54.1	25.6	17.8	56.2
02	37.1	17.6	5.9	18.7
03	67.6	32.0	5.6	17.7
04	52.5	24.8	2.3	7.4
Total	**211.3**	**100.0**	**31.6**	**100.0**

4.4.4 Social services

Social service sites were proposed using equitability, efficiency, centrality, and accessibility issues as the main principles. The aim was to optimize service providing to the community. However, the spatial overlay analysis result (Figure 4-8) shows that significant non-conforming developments are occurred at different parts of the Town, particularly at central and north-east

parts. In contrary majority of proposed land at north-west and southern parts of the Town are not fully utilized.

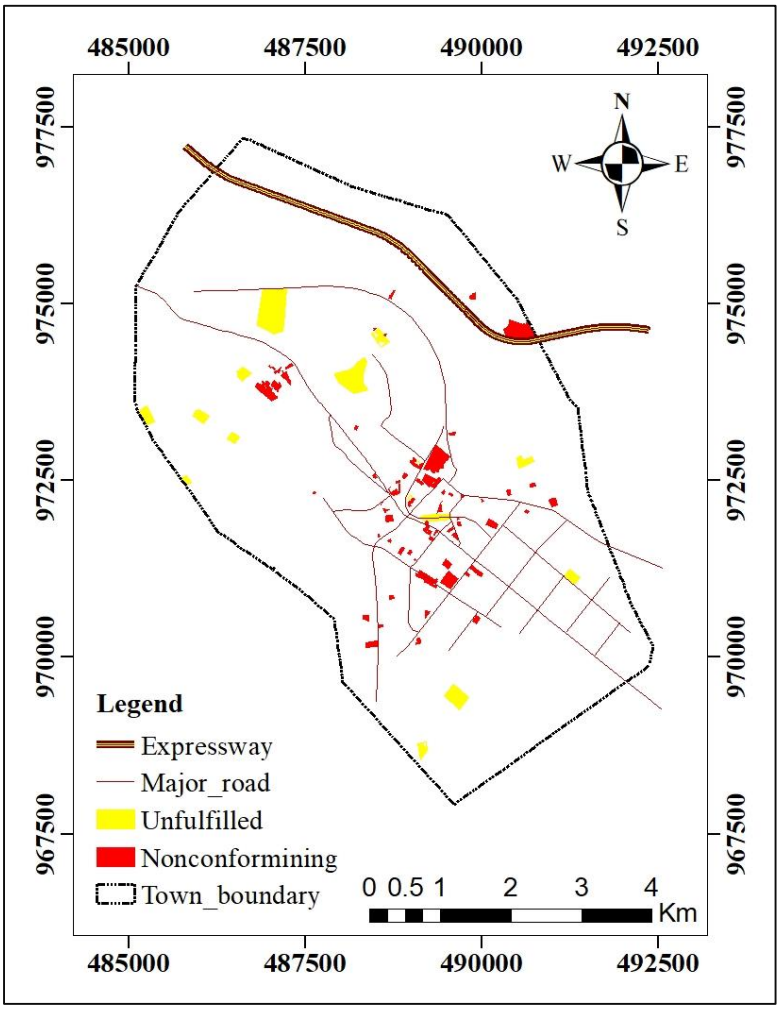


Figure 4-8: Spatial distribution of deviation and unfulfilled social service development

Further spatial analysis using the results summarized in Table 4-6 reveals that unfulfilled land covers 63.1ha and waiting for development, whereas 51.5 ha of social service developments is unplanned, which has 69.2% share of total social service land use growth (74.4ha) during the planning period. Quantitative conformity assessment also shows that the actual social service land-

use development exceeded what was planned in the DLUP08. The spatial distribution among Kebeles is shown in Table 4-6. The results demonstrate that deviation of social service development is more perceived in Kebele 02 (25.5ha) and Kebele 03 (13ha). Further analysis of misused land especially in Kebele 02 might be occurred due to provision of expressway. On the other hand, majority of unfulfilled development area (47.1ha) identified in Kebele 01 might be related to low development in the area and might not attract developers.

Table 4-6: Spatial extents of unfulfilled and nonconforming social service developments in Dukem town as of 2018

Kebele	Unfulfilled		Nonconformance	
	ha	%	ha	%
01	47.1	74.6	9.5	18.4
02	4.6	7.3	25.5	49.6
03	3.4	5.3	13.0	25.3
04	8.0	12.7	3.4	6.7
Total	**63.1**	**100.0**	**51.5**	**100.0**

4.4.5 Industry and storage

Industry and storage is also one of the main planning issues for DLUP08. It was mainly intended to decentralize activities and minimize the need for transportation and also bring about balanced development. However, spatial overlay of proposed land and actual development (Figure 4-9) shows that non-conforming developments identified mainly at south-east and central parts of the

Town. It can also be seen that majority of reserved land at eastern and northern parts are not fully utilized.

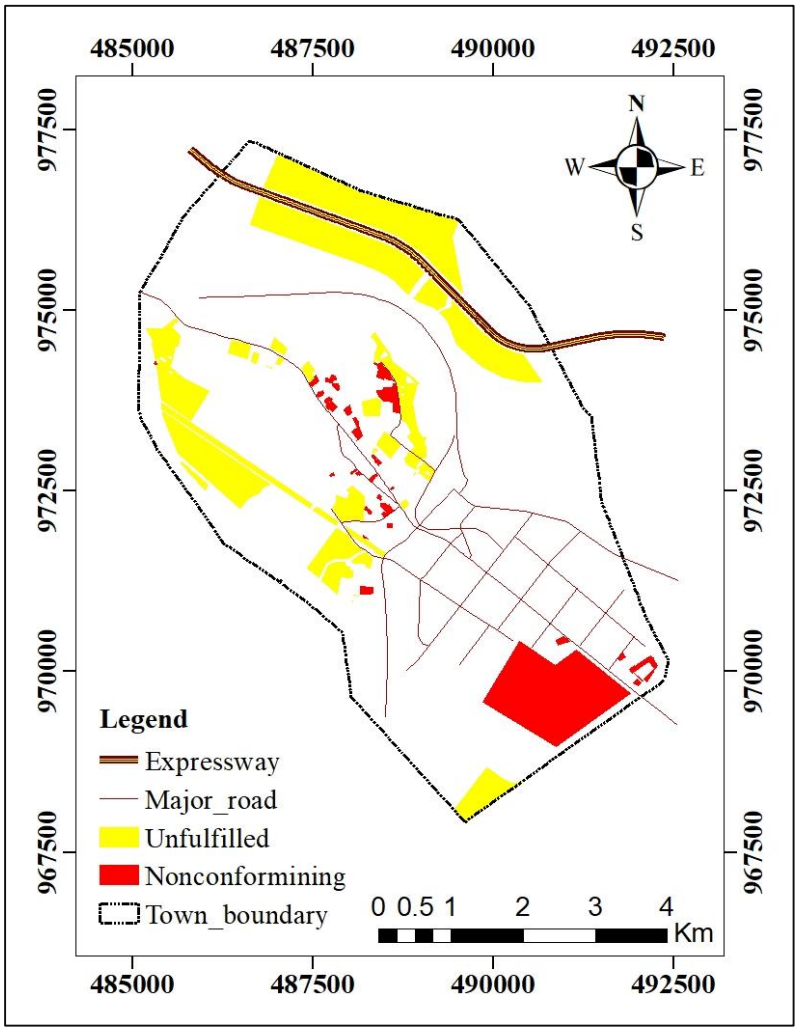


Figure 4-9: Spatial distribution of deviation and unfulfilled industry and storage development compared to DLUP08

Further spatial analysis reveals that actual land-use outcome utilized by industry and storage outside of the planned area (deviation) is found 349.6ha, which has 58.7% share of total industry and storage land use growth (322.4ha) during the planning period. On the other hand, despite the

proposal of the plan, 557.9ha reserved land is not yet developed. Spatial distribution of all types along with their spatial extent is summarized in Table 4-7.

Results demonstrate that more non-conforming industrial developments mainly warehouses are identified in Kebele 04 (163.2ha) and Kebele 01 (21.5ha). The large area resulted as a nonconforming development in Kebele 04 is Eastern industry zone. This area was supplied for foreign investment by the decision of regional government. Conversely, 557.9ha of land is not fully utilized which results unfulfilled developments distributed in all kebeles, regardless of significant variations in spatial extent. Unfulfilled land in Kebele 01 is greater by far covering about 83% of unfulfilled industry and storage developments. This large area has relatively better infrastructures, such as expressway, yet not utilized up to the end of planning period that might be due to lack close supervision and monitoring.

Table 4-7: Spatial extents of unfulfilled and nonconforming industry and storage developments in Dukem town as of 2018

Kebele	Unfulfilled		Nonconforming	
	ha	%	ha	%
01	460.9	82.6	21.5	11.4
02	55.2	9.9	4.6	2.4
03	0.7	0.1	-	-
04	41.2	7.4	163.2	86.2
Total	**557.9**	**100.0**	**189.3**	**100.0**

4.5 Degree of conformance success

The results summarized in Table 4-8 give information on the computed values of selected indicators for the assessment of the degree of the conformity success of developments in Dukem Town from 2008 to 2018. Six variables were examined: Total growth, housing, social service, commercial, industry storage, road network. Overall, computed boundary sufficiency ratio of all variables is less than 1, indicating it is within a limit. This implies, planned area for each land use expansion was much enough to encompass all new developments.

On the other hand, the plan has met difficulties to guide and control spatial developments. Detail analysis reveals that the computed value of BCR of housing developments is 0.32, indicating DLUP08 has limited effectiveness in controlling the spatial location of newly residential development. However, three land use classes: social services, industry and storage, and commercial BCR has been found 2.25, 1.42, and 1.19, respectively. These values (>1) suggests, the complete failure of the plan to guide spatial development of proposed land uses. However, it can also be seen from the table that road development was completely effective.

Table 4-8: Summary of boundary containment ratio (BCR) and boundary sufficiency ratio (BSR)

Variable	Area (ha)		BSR	Conformity		BCR
	2018	DLUP08		Nonconforming	conforming	
Housing	78.5	1176.5	**0.29**	102.4	323.8	**0.32**
Commercial	29	159.8	**0.31**	31.6	26.5	**1.19**
Social service	50.9	66.9	**0.82**	51.5	22.9	**2.25**
Industry and storage	188.9	614.3	**0.43**	189.3	133.1	**1.42**
Road network (km)	53.2	108.1	**0.49**	0	53.2	**0.00**

In general, the findings reveal that the level of conformity is acceptable when measured by the size or quantity. In other words, the total area of increased developed land in planning period remains in the limit of the land-use quota proposed by the plan.

In contrary, level of conformity between the plan intention and actual land-use outcomes is low when measured in terms of the morphology. There are significant new developments occurring outside of proposed area, indicating limitation of DLUP08 in controlling spatial location of new housing developments. Moreover, it shows complete failure in guiding the developments of social service followed by industry and storage and commercial developments. The findings of this study is inconsistent with that of Bulti and Sori (2017) who looked into the implementation of Adama City structural plan and noted that limited effectiveness of the plan in controlling spatial distribution of land uses. The disparity between the present study and that of Buliti and Sori (2017) could be the level of urbanization, spatial planning, level of management. Non-conforming development areas are spatial indicators of urban and suburban sprawl (Brody and Highfield, 2005). On the other hand, the plan has meet difficulties to preserve strategic green frame indicated by encroachment of farm land, informal green, and formal green indicating limitation in preventing urban sprawl. Such limitation of a plan in curbing unplanned urban expansion is an indicator of lack of plan implementation (Zhong et al., 2014).

Based on these evidences, it is enough to conclude that DLUP08 has failed to play its role in guiding and controlling spatial development of Dukem town. In spite of the morphological deviation, the total area of new developments occurring during 2008-2018 has not exceeded the area allowed by DLUP08, which at least shows that the size of reserved land was reasonable. The

values of both indicators underline that even the most well intentioned spatial planning designs cannot guarantee conformity or prevent the adverse impacts of sprawling growth patterns.

4.6 Factors influenced implementation of DLUP08

Various interview questions were used to examine the potential factors that influenced the implementation of DLUP08. Particularly, the questions were focused on determining the main causes for unfulfilled developments; why built-up expansion occurred outside of the growth boundary; whether nonconforming developments are illegal/informal; and factors attracted nonconforming developments to the location where they are occurred. The questions also allowed investigators to figure out why illegal houses built prior to the start of DLUP08 had not been demolished.

In this regard, the participants were invited to reflect on the possible causes of unfulfilled developments identified in the northern and southern parts of the Town. According to the respondents, these areas were provided to developers before the end of the planned period by around three years. The respondents agree that the limited availability of basic urban infrastructure (e.g., roads, water supply, electricity) in these areas has slowed projected housing (Figure 4-6), social services (Figure 4-8), and industry and storage (Figure 4-9) expansions. These limitations were also confirmed during the study's field observations. In addition, information obtained during field visits reveal that these areas are characterized by better infrastructure development and located close to urban services. From this it is possible to assume the site and services were affected the implementation of the plan.

The participants were also asked about how often implementation of DLUP08 was evaluated during planning period. The respondents feel that evaluation of land-use plans is unusual in Dukem

town, and they are certain that DLUP08 implementation has not been assessed. They also revealed that the major causes were due to a lack of initiation, which necessitates professional dedication. Moreover, they feel that less attention paid to monitoring of the plan implementation has led to failure to transfer undeveloped land to potential developers in timely manner and ensure balanced development in planning period. Through regular monitoring and evaluation of implementation of the Plan, it would have been possible to identify unplanned developments and take measures to stop the construction in a timely manner.

When asked for formality of industry and storage developments, such as Eastern industry zone located at south-east part of the town as a nonconforming, the experts confirmed that the land was formally supplied by the City administration. According to DLUP08 proposal, this area should only be used for farming purpose, however, it has been supplied for construction by management decision which entails some reasons. In this regard, the participants agree that there was a belief that attracting developers through land supply was an effective way to maintain a rapid economic growth. Therefore, when development projects come to Dukem, the town administration would satisfy the site selection proposed by developers as much as possible, even area outside of UGB was chosen. Especially ones with large economic added-value showed their interests in the town, investors were almost free to select any sites they needed regardless of the limit of urban growth. In order to retain the investment, the Town Administration ultimately accepts their applications. Considering the potential economic values of the developments to the town the area was supplied to developers based on management decision.

Absence of regular evaluation and monitoring had also contributed to poor implementation of DLUP08. The results show that despite the developments outreached the UGB, proposed area had not been fully utilized. Moreover, most of the unfulfilled development areas are already supplied

to developers before three years of end of the planning period of DLUP08. However, either these areas were not developed within the time limit given by the Town Administration which is usually six (6) months or had not been transferred to potential developers in timely manner. Through regular monitoring and evaluation, it would be possible to identify, where and why delays of developments occurred and propose practical solutions for improving the implementation of the plan as well as for insuring balanced development. In accordance with this finding, Habtamu (2011) reported the structural plan of Gelan town was poorly implemented mainly due to absence of monitoring, evaluation, and updating taskforce.

Combined with political leadership influence, absence of commitment of officials significantly affected effective implementation of the Plan. In line with the findings of this study, Merga (2012) claimed that authorities' commitment was a main factor in the poor planning and implementation of the Sululta town land use plan. Furthermore, Zhong et al. (2014) found that political leadership influence was one of the factors that influenced China's general land-use plan implementation.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study evaluated the implementation DLUP08 using six variables: manufacturing and storage, housing, commercial, road network, social service, and total land growth. The findings show that overall built-up expansion is grown at 8.6% average annual growth. The extent of social services was increased by about 216% followed by industry and storage (141.5%). There are also nonconforming developments identified in the study area. The findings reveal that the level of conformity is acceptable when measured by the size or quantity. In other words, the total area of increased developed land in planning period remains in the limit of the land-use quota proposed by the plan. Moreover, the level of conformity between the plan intention and actual land-use outcomes is low when measured in terms of the morphology. There are significant new developments occurring outside of proposed area, indicating limitation of DLUP08 in controlling spatial location of new developments. More importantly, the plan has failed in controlling spatial distribution of new developments of social services, industry and storage, and commercial land use classes. The study also reveals that the limitation in implementation is due to combined result of geographic variables, absence of regular monitoring and evaluation, and political leadership influence.

5.2 Recommendations

Although this study provides important information on the implementation of Dukem town Land-use plan and major influencing factors, the results should be considered only an initial step towards understanding the links between urban land-use plan and its implementation. Hence, further researches are needed on several fronts.

- First, the study has examined Dukem town Land-use plan. It is recommended that level of implementation urban land-use plans in more urban centers in Ethiopia should be examined. Comparative analyses would provide an increased understanding of the effectiveness of spatial planning and plan conformity in general.
- Moreover, more researches are needed on compatibility of nonconforming developments and its effect on spatial distribution of public facilities. Finally, underlying factors influenced the implementation of DLUP08 were determined through expert interview. Further study with addition of more participants and using different data collection instruments could enhance the findings of this study.

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