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GEOMATICS ENGINEERING PROGRAM

Evaluating Implementation of Adama City Land Use Plan Using Conformance-Based Approach

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ABSTRACT

Urban land-use plan is regarded as a useful tool to achieve urban sustainable development. However, presently it is unclear that how well the Plan is being implemented and major factors contribute to the variation of its implementation in Adama city, Ethiopia. This research examines the extent to which Land-use plan of Adama city functioned from 2004 to 2014 has guided and controlled all spatial developments during planning period by measuring the degree to which actual land-use outcomes over a 10-year period conform to the Plan intention. Land-uses of the City as of 2004 and 2014 are mapped; conforming, nonconforming, and unfulfilled developments are identified through spatial overlay analysis in geographic information system environment; effectiveness of boundary containment and proposed land sufficiency are explored. Descriptive exploratory approach was used to determine potential factors influenced the plan implementation from data collected by expert interview. The findings demonstrate that although the Plan proposed reasonable area, it has met difficulties to control and guide new spatial developments of housing land-uses followed by social services and total urban growth. The limitation is due to combined result of geographic variables, absence of regular monitoring and evaluation, lack of commitment, and political leadership influence. The study would support sustainable spatial policy and direction of spatial development with respect to sustainable urban environment.

Keywords Land use planning; Urban planning; Conformance based approach; GIS; Plan evaluation

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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
UCCB:	Urban Construction Control Boundary
UGB:	Urban Growth Boundary
UGCB:	Urban Growth Control Boundary

1. INTRODUCTION

1.1. Background and justification

The fundamental goal of urban land use plan is to ensure sustainable development of urban areas. On one hand, by controlling urban expansion within the planned boundary, it conserves ecological sensitive areas. Urban growth boundary (UGB) is a regulatory measure of local government for delineating limits of urban growth over a period of time (Bhatta, 2009). Over the past decades, UGB has been regarded as effective tools applied by planners and local governments to control urban sprawl and support smart growth. On the other hand, urban land use plan ensures effective use of existing resources and balanced development; and support smart growth (Zhou et al., 2016).

Monitoring urban development to follow the guidelines formulated in land-use plans is a crucial and indispensable part in urban planning. Despite they are guided by urban plan, most cities in sub-Saharan African countries, like Ethiopia are confronted with a number of development-related problems that the plan is supposed to address, such as the formation of slums, increased urban sprawl and environmental pollution. In this regard, evaluation of urban plan implementation receives more and more attention to determine whether and how well urban plans have been implemented (Loh, 2011). Understanding and appraisal of urban land use plan implementation determines the plans' effectiveness and success, consenting for the enhancement of plans and the planning process in subsequent planning (Oliveira and Pinho, 2009; 2010). Moreover, it will support sustainable spatial policy and direction of spatial development with respect to a sustainable urban environment and creating a balance between ecological and socio-economic needs.

Evaluation of plan implementation has been studied for decades using the most acknowledged theories: conformance-based approach and performance-based approach (Berke et al., 2006, Loh,

2011). Conformance-based approach highlights conformity between actual physical development and plan's intention, which fits physical-oriented plans. In this regard, plan implementation is considered as a success if actual land use outcomes fit into plan intentions (Faludi, 2000, Laurian et al., 2004a). On the other hand, performance-based approach explores how the ideas within a plan are delivered and implemented. It is well suited to evaluate strategic plans. 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.

Conformance-based approach has been used in variety of studies, such as evaluation of the degree to which actual land use outcomes conforms to plan intention (Tian and Shen, 2007, He, 2012, Ranasinghe and Silva, 2013); examination of the effectiveness of urban growth boundary (Han 2014); and assessment of the efficiency of land-use planning and plan implementation (Brody et al., 2005). Although these studies have provided insights into the issue, evaluation of plan outcomes should be considered in a broad context, encompassing specific physical location of the area and human, socio-economic, and environmental factors. In addition, plan implementation is a rather complex process that is influenced by various factors, and suggests the need for more researches to develop a sufficient understanding with regard to the factors influencing plan implementation (Laurian et al., 2010). 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 the context of 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 conformity and implementation success of land-use plan as compared to actual development in the analysis areas.

Like other urban centers in Ethiopia, land-use plan for Adama City have been prepared and implemented since 1937. The latest plan is prepared in 2004 and denoted by LUP04 in this study. LUP04 is functioned from 2004 to 2014. However, presently it is unclear that how well the plan is implemented. The City, on the other hand, is facing a number of development-related issues that the plan is supposed to address. This includes irregular and uncontrolled built-up expansion, 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 land-use plans. Moreover, it could have practical benefits for Adama City 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.

The purpose of this study is to evaluate the extent to which Adama City land-use plan functioned from 2004 to 2014 was guided and controlled spatial development of the City within the intended growth boundary during the planning period using conformance-based approach and highlight major driving factors for unfulfilled and non-conforming developments.

1.2. Objectives

General objective

To analyze the extent to which Adama City land-use plan functioned from 2004 to 2014 is implemented using conformance-based approach.

Specific objectives

- To determine the built-up outside of urban construction control boundary
- To determine conforming and non-conforming developments in Adama City over 2004-2014 as compared to intention of LUP04
- To determine the degree of conformance success of LUP04 over the planning period
- To determine the factors affected implementation of LUP04

1.3. Research questions

- How well built-up area expansion of Adama City during 2004-2014 was maintained within the planned growth boundary?
- Where is spatial location and distribution of conforming, unfulfilled and non-conforming developments within UCCB of LUP04?
- What is the degree of conformity success of LUP04 over the planning period?
- What are the underlying factors influenced the implementation of LUP04?

1.4. Significance and beneficiaries

The findings of this research highlight implementation successes or failures of LUP04. This can create awareness the effectiveness of the plan in guiding the physical development of the City 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 Adama City 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 Adama City.

1.5. 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. Latest revised master plan of Adama City is functioned from 2004 to 2014. The 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 data.

The conceptual framework for the Adama City Structure Plan consists of elements that have direct and strong impact on the development of the City. They are the main framing elements used in revised structural plan. The study used these elements or variables to evaluate the level of implementation of the plan. These variables are total land growth, housing development, social services, manufacturing and storage, infrastructure, and green frame.

Spatially, Adama City has total 14 smallest administrative units (Kebeles). Kebeles located at the central part of the City were fully covered with mixed built-up during LUP04 preparation. As a result, spatial expansion of the City is manifested at the periphery Kebeles since beginning of implementation of the plan. Due to this, analysis of developments in these Kebeles is considered more appropriate. Hence, the study is conducted using developments in Kebele 01, Kebele 04, Kebele 14, Kebele 02, Kebele 03, Kebele 09, and Kebele 05.

1.6. Limitations

Some limitation ought to be known concerning the study. First, beside the delay of budge release, the limit for the budget to be released in different phases set by the School (maximum of 50% of granted budget in each phase) did not consider the nature of activities in the study. This was one of the main causes of additional overhead cost in data collection phase, delay of data analysis, not to follow time schedule, and additional burden to a researcher. Second, change in rules and regulation in budget handling especially in the second phase, did not create supportive environment and rather it hinders facilitation and results unnecessary time extension. New regulation of financial management set especially related with rental instruments and purchase of

instruments hindered utilization of more than 35% of the granted budget for the study that significantly affect the research. For instance, GPS instruments are not rented. Hence, the researchers forced to establish ground control points using less accurate surveying instruments and more time consuming techniques with more labors. Moreover, digital orthophoto used in spatial mapping is acquired with additional research's personal expenses. Above all, transportation could not be facilitated as per submitted action plan. To overcome this problem, the researchers used extra expenses for transportation and additional expenses thus required.

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.

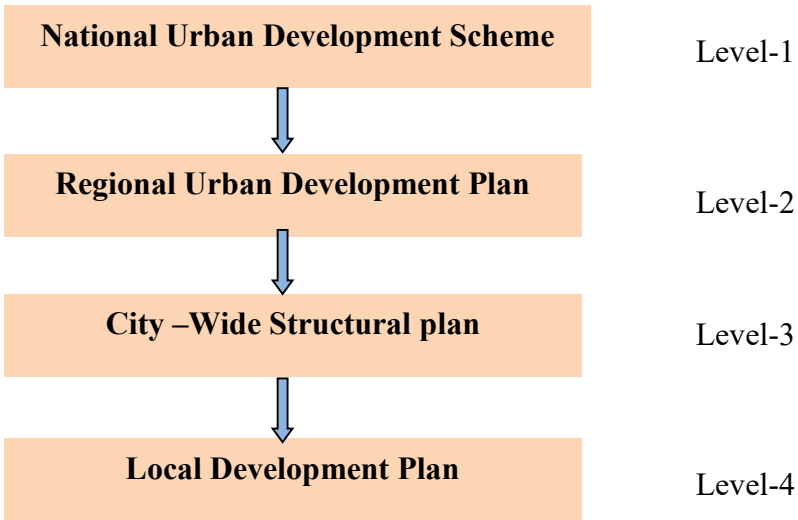

Figure 2-1: A framework of the Hierarchy in the Current Ethiopian Urban Planning System (source: MUDC, 2012)

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. Methods of urban plan evaluation

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. World experiences on evaluation of plan outcomes

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 indictors.

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.

2.5. 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.

3. MATERIALS AND METHODS

3.1. Description of the study area

Adama City is one of fast growing cities in Ethiopia with an estimated total population of 343,212. It is situated in Rift valley within Awash River Watershed in Oromia Regional State of Ethiopia. It was established in 1916 on flat terrain characteristics and surrounded by plateaus, mountainous and ridged topography along Addis Ababa (capital City of Ethiopia) to Harar road at distance of about 96 km. It is located between $8^0$26'15"–$8^0$37'00" N, $39^0$12'15"-$39^0$19'45" E.

It is located at a distance of about 96 km from capital City, Addis Ababa. Altitude of the area ranges from 1489 m - 1976 m a.s.l. Average annual rainfall of Adama City is about 866.25 mm. Most of the rain occurs in rainy season (June - September). The minimum wind speed occurs during September is about 1.65m/s, while the wind with high velocity occurs during December, January and February ranging 3.05 m/s - 3.2 m/s. Mean temperature in the City varies from 11.5 °C to 31 °C. Flooding is a significant natural hazard in Adama City mainly attributed to its location within the flat lying rift and its impervious surface due to urban construction.

The City has totally 14 smallest administrative units called Kebele. 6 Kebeles are located at the central part covering 5.8 square kilometer. They were dense mixed built up areas when LUP04 is prepared. The rest 8 kebeles are located at the periphery covering 127.9 square kilometer. Even though the LUP04 proposal covers the whole Kebeles, new expansions were mainly proposed in periphery Kebeles (Figure 3-1) including Kebele 01, 04, 14, 13, 02, 03, 09, and 05. Hence, these Kebeles are deemed to demonstrate new developments under LUP04 control in planning period and selected for this study.

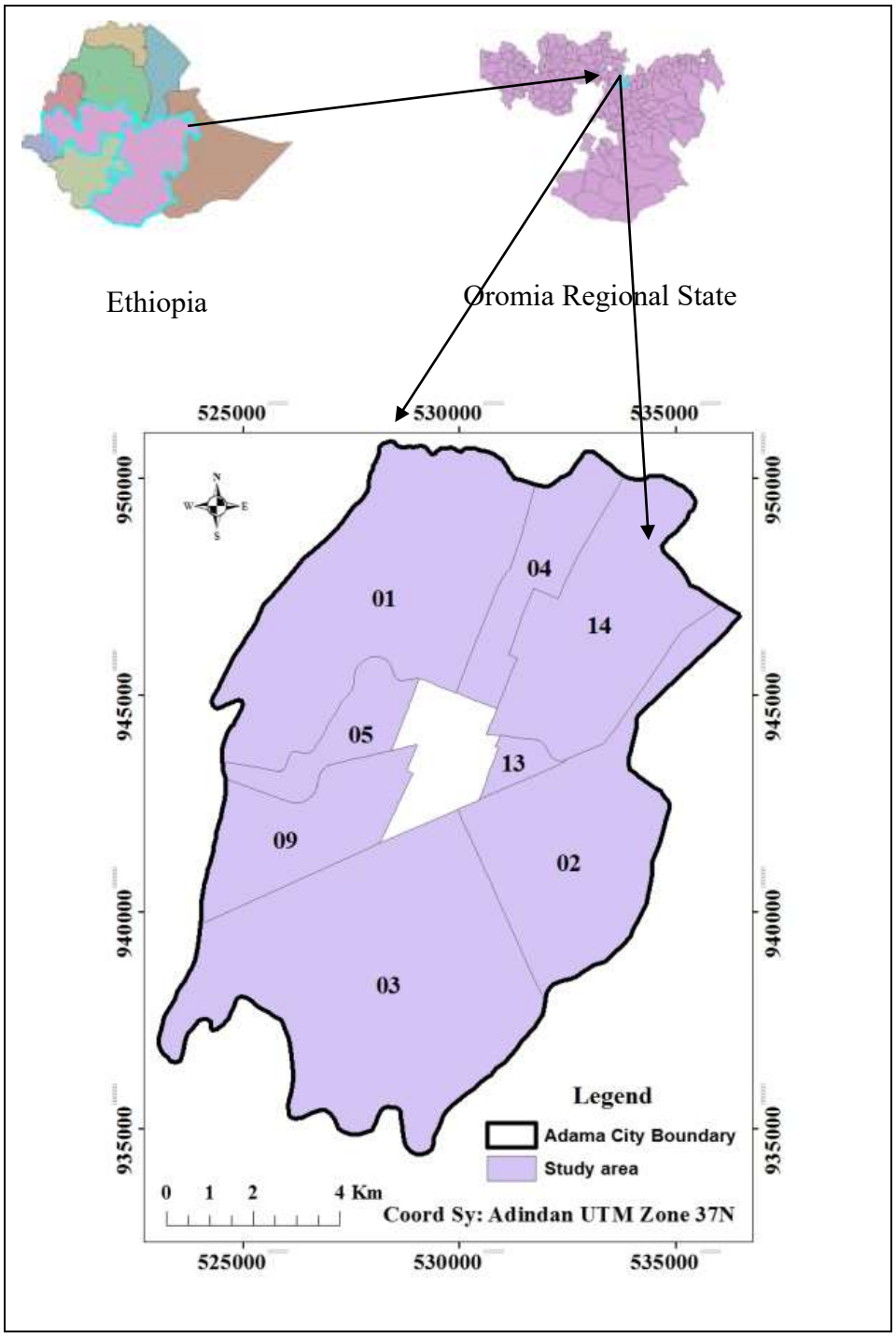

Figure 3-1: Location map of the study area

3.2. Adama city land-use plan 2004

According to Adama city master plan revision project report by National Regional State of Oromia dated June 2004, land-use plan for Adama city have been prepared and implemented since 1937, and updated for four planning periods in 1959, 1971, 1995, and 2004. The latest plan updated in 2004 (LUP04) was functional from 2004 to 2014, and was selected for this study for different reasons. As this study is conducted in the year about the end of the planning period of LUP04, it is ease to accurately map the plan outcome. In addition, the revision project to update LUP04 is currently ongoing; hence, the findings can be considered and enhance the planning process. Moreover, the availability of data of the plan was a main reason why it was selected.

3.3. Data sources and data acquisition techniques

3.3.1. Data and data sources

The study involves analysis of physical development of the City compared to the land-use plan. Required data were collected from both primary and secondary sources. Existing land-uses data were collected using ground surveying techniques and digital orthophoto of the City as of 2004. Proposed land-uses by the plan were extracted from structural plan map of LUP04.

3.3.2. Data acquisition techniques

Proposed land-use

The sources of input data in GIS includes: ground surveying, satellite image, aerial photographs, and hard copy map. Extraction of spatial data from existing map to standard required for GIS spatial analysis involves scanning of maps, 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 2004 (PLU04) and proposed land-use by LUP04 were digitized from maps to common Geodatabase with Universal Transverse Mercator Projection system (Adindan UTM Zone 37 N). Physical developments as of 2014, was digitized from digital orthophoto having 15 cm spatial resolution acquired in 2014 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 2014.

Existing land-use

Spatial mapping of existing land-uses for urban land-use classification involves ground control point establishment, 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. It was collected using surveying instruments in conjunction with orthophoto acquired from Adama City Administration. All spatial data were transferred (downloaded) to computer and processed. Topological errors were corrected in ArcGIS environment and projected to common Geodatabase.

Non-spatial data

Non-spatial information, mainly land-use as of 2004 was initially identified from aerial photograph with 15cm resolution and land-use map of 2004, which was prepared by LUP04 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 13 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 2016 supported by simple interview questions to trace back information of land-use as of 2014. Moreover, for more significant nonconforming developments archives and ownership documents were consulted.

3.3.3. Selection of 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 City (NRSO, 2004). 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 LUP04 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. **Manufacturing and storage:** Industrial restructuring was the most important target of the LUP04. 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.
5. **Road network:** development of infrastructure was the most important strategy in LUP04 to improve living environment and enhance City competitiveness. It influences the future urban development through establishing a transport framework.
6. **Environment and Green space:** LUP04 provided green space as an important strategy to prevent unplanned urban expansion, to protect natural setup of the City through proposal of

open spaces: formal green, informal green, farmland, and ground water protection area. Hence, evaluation of planning implementation in terms environmental preservation would be interesting.

Each variable was measured through different indicators (Table 3-1) depending on the degree of indicators' significance.

Table 3-1: Indicators of the selected variables for evaluation LUP04 implementation

Variables		Indicators of conformity	
Main	**Sub variables**	**Quantitative**	**Morphological**
Urban growth	Built up land	Area	Growth boundary
Housing	Residential	area	Spatial distribution
Social Service	Education	area	Spatial distribution
	Health		
	Religion		
	Cultural		
Manufacturing and storage	Manufacturing, warehouse	area	Spatial distribution
Road network	Road network	length	Spatial distribution
Environment and Green space	Farmland	area	Spatial distribution
	Informal green		
	Formal green		
	Ground water protection zone		

3.4. Methods

LUP04 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 LUP04, the theory of planning conformance is hence deemed as the most appropriate theory to guide the evaluation.

3.4.1. Delineation of urban construction control boundary

LUP04 map encompasses different principal land-use categories. In order to delimit urban construction control boundary (UCCB), proposed land-uses were categorized into two classes: constructible and construction forbidden areas (Table 3-2). This classification was a base for generation of map of "two areas". The delimitation of the boundaries of these areas provide reasonable basis for studying the spatial growth boundary of the City, deciding the construction land scale and identifying the scope of construction lands.

Table 3-2: Reclassification of proposed land-use categories in LUP04 into "two area"

Proposed Land-use category in LUP04	New class
Centers and markets, Housing expansion, Mixed land-use, Social service, Health service, General service, Manufacturing and Storage, Government office, and Transport	Constructible area
Children play ground (formal green), Informal green, farm land, ground water protection zone, Horticulture	Construction forbidden area

3.4.2. Containment of urban growth

LUP04 was targeted at bringing compact development as much as possible and practicable in view of the local situations (NRSO, 2004). By controlling the total amount and regulating the spatial location of urban built-up land, LUP04 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 UCCB was used to determine the effectiveness of the plan to keep the developments within the intended boundary. In this case, UCCB was spatially overlaid with the actual built up area map of 2014. The built up areas outside the UCCB were extracted and the spatial extent was computed.

3.4.3. 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 2014 was spatially overlaid with map of proposed each variable in LUP04 and land-use as of 2004. This helped to identify three types of developments: conforming, nonconforming and unfulfilled developments.

- *Conforming*: if the use of land as of 2014 is consistent with proposed land-use.
- *Unfulfillment*: if the use of a piece of land as of 2004 and 2014 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 2014 is different from both that of 2004 and plan proposal.

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

3.4.4. 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) initially developed by Han et al. (2009). Figure 3-2 helps to illustrate these indictors.

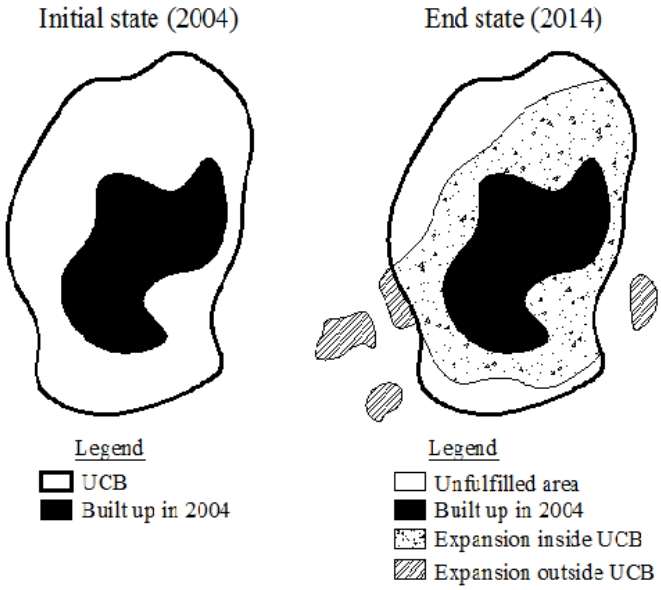

Figure 3-2: Illustration of the area analysis

Boundary Containment Ratio

BCR was used to identify to what extent area of actual land-use outcomes as of 2014 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. It 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

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

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

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

Boundary Sufficiency Ratio

BSR 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 LUP04 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 LUP04 (Equation 2). BSR is inversely proportional to sufficiency of the size of proposed area.

$$BSR_i = \frac{(Total\ \ development\ of\ the\ variable\ from\ 2004\ to\ 2014)_i}{(proposed\ area\ for\ the\ variable\ in\ CMP04)_i} \quad (2)$$

where

BSR $\leq$1, planned area is large enough to accommodate the development

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

3.4.5. Analysis of factors affecting implementation of LUP04

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 (Tian and Shen, 2011; Feitelson et al., 2017; Ryan et al., 2019). In this study, using the results of conformity assessment as a base, experts working in Adama City administration were interviewed to understand the factors likely impacted the plan implementation. For the interview, experts who have worked for the City administration for at least eight 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 nine experts were invited for the interview, only six (6) of them were able to participate. The departmental composition of the participants was: four experts from land administration and development department and two 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.

4. RESULTS

4.1. Urban construction control boundary of LUP04

The result of aggregated two area classification for UCCB demarcation in this study is depicted in Figure 4-1. According to LUP04, area within UCCB is the land that reserved to meet the urban growth need up to the end of planning period. Land within the UCCB allows urban development, while the land outside of this boundary remains primarily non-urban.

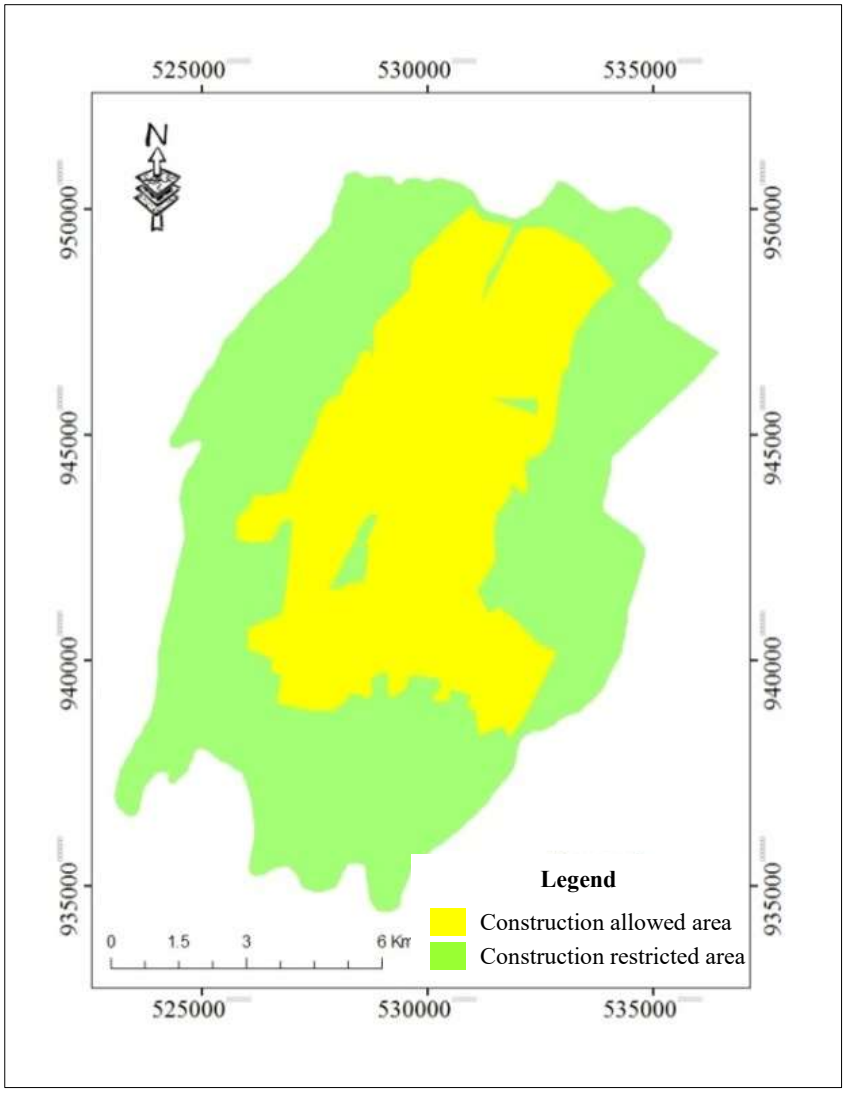

Figure 4-1: Aggregated proposed constructible and non-constructible areas by LUP04

By controlling the total amount and regulating the spatial location of urban built-up land, LUP04 is expected to be able to rein the development in proposed urban construction boundary. UCCB in LUP04 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 UCCB is 5579.6 ha and that of outside of UCCB within City Administration is found to be 7887.9 ha. The area outside UCCB was reserved for open spaces using strategic green frame to conserve resources for future development and support smart growth.

4.2. Effectiveness of urban growth boundary

Results of spatial overlay of actual built up as of 2014 and planned urban growth boundary in LUP04 is depicted in Figure 4-2. The results show that non-conforming developments occurring outside of planned boundary during planning period. Majority of these open space encroachments are adjacent to UCCB at western and eastern parts of the City along the main road from Addis Ababa-Harar. In addition, significant leapfrogging developments away from the dense nodes can also be seen in North-West, South-West, and South-East directions, regardless of the UCCB set in between. This shows the limitation of the plan in controlling the location of urban construction and preserve open spaces for future development.

Further spatial analysis of total actual urban growth in planning period reveals that new built up land inside the UCCB is 1615.2 ha consisting of 74% of the total built up expansion. At the same time, built up land outside UCCB is found 570.44 ha consisting of 25% of the total built up expansion. Most of non-conforming developments are informal developments as of 2004 and not considered during plan preparation. They are supposed to be removed gradually by City administration. However, spatial expansion occurred around them. On the contrary, despite it is reserved for urban growth, 1124.6 ha of land inside UCCB located at northern and southern parts

of the City is not yet developed indicating poor implementation of the plan in guiding direction of spatial growth.

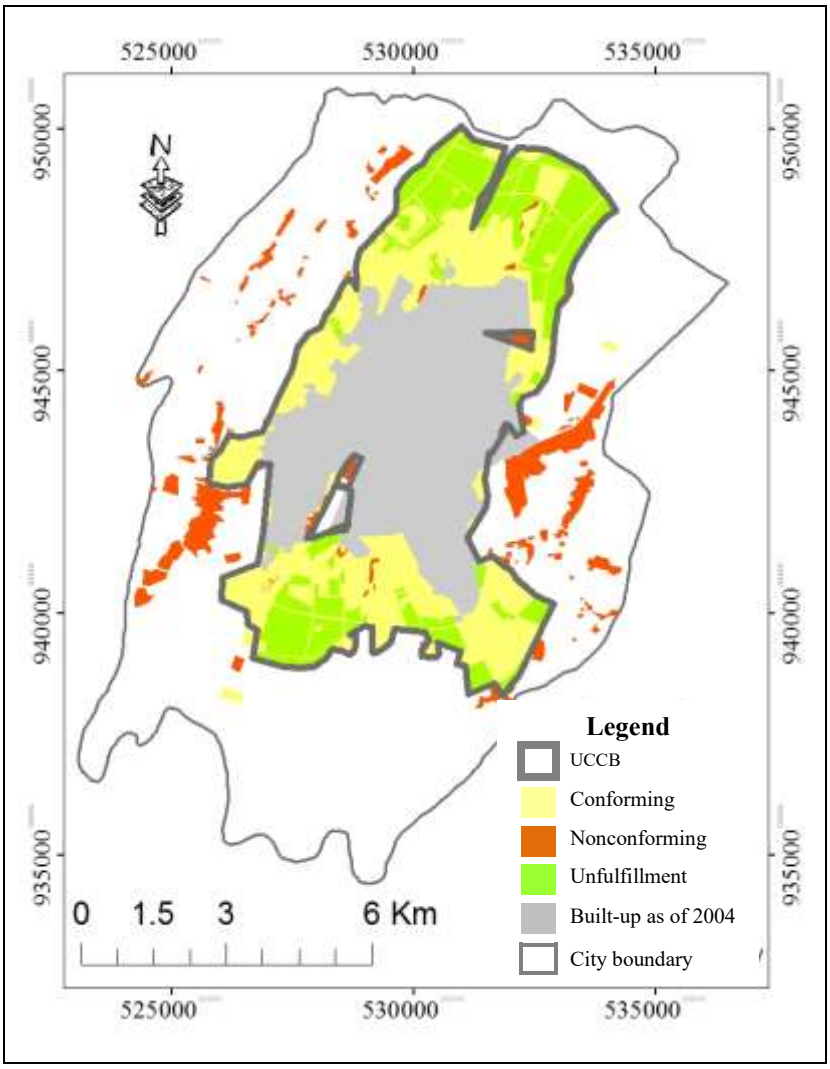

Figure 4-2: Spatial distribution of developments occuring inside and outside of UCCB in Adama City as of 2014

4.3. Conformity of developments

Housing development

Residential development was one of the main planning issues for LUP04. Accordingly, new housing development areas were proposed predominantly 1071.262 ha at the northern and

605.112ha at southern part of the City. This area caters for land requirement of housing and related facilities. However, spatial mapping shows total actual increased residential development during planning period is found to be 1215.508 ha. The result of spatial overlay of proposed land-use and spatial mapping of actual residential developments as of 2014 is depicted in Figure 4-3. It demonstrates that despite of undeveloped reserved land area exists; significant non-conforming residential developments are occurred at Western, Eastern, and Northwest parts of the City.

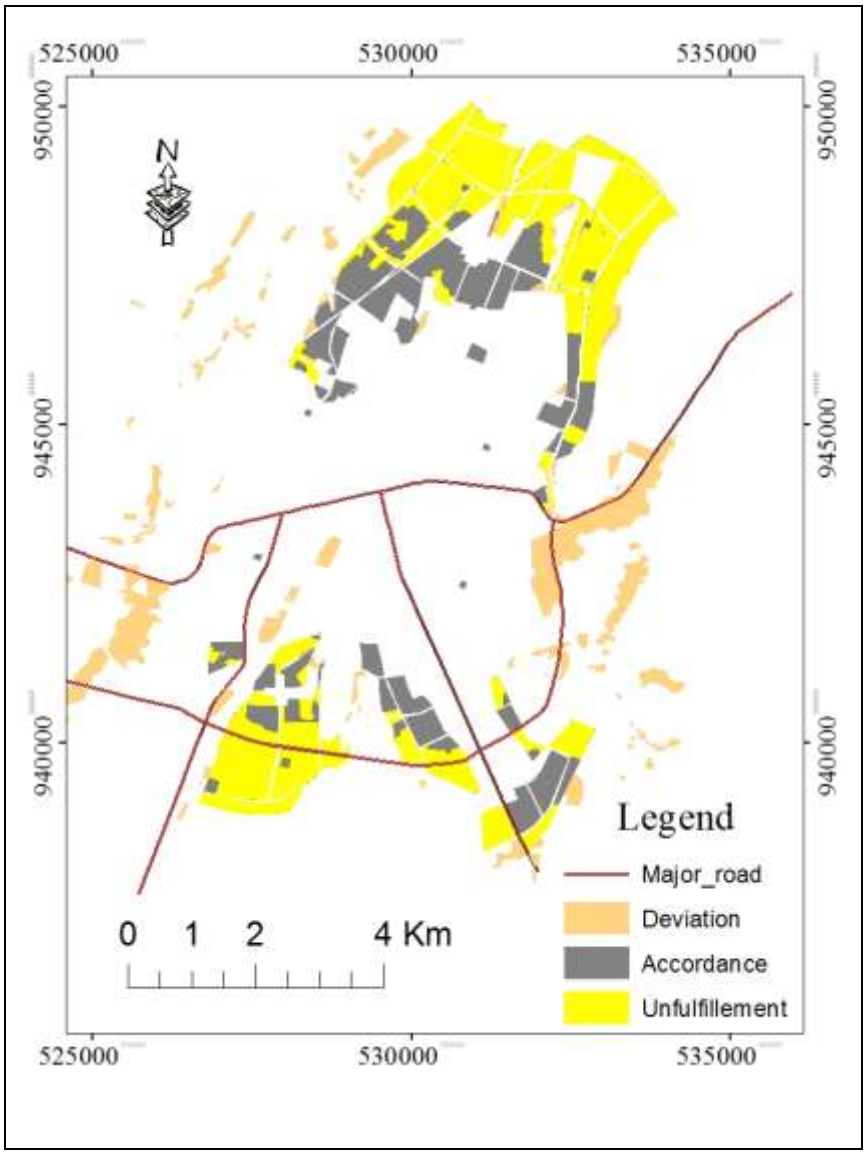

Figure 4-3: Spatial distribution of accordance, deviation, and unfulfilled housing development compared to LUP04

Further spatial analysis conducted in this study reveals that spatial extent of accordance, deviation, and unfulfilled actual land-use occupies 657 ha, and 512.5 ha, and 1019.4 ha respectively. The spatial distribution of each type in different Kebeles is summarized in Table 4-1.

Table 4-1: Spatial extent of evaluated housing developments in Adama City

Kebele	Spatial extent in hectare		
	Accordance	**Deviation**	**Unfulfillment**
03	140.8	31.1	329.7
09	17.1	104.2	5.5
05	1.0	7.8	-
02	77.4	225.7	51.5
14	85.4	30.5	251.0
04	95.1	8.2	148.2
01	240.3	105.0	233.4
Total	**657.0**	**512.5**	**1019.4**

Results in Figure 4-3 and Table 4-1 show that residential development was not fully covered the reserved area. It suggests that Kebele 01 and Kebele 03 have attracted many developments compared to the others. Moderate residential development during planning period is perceived in Kebele 04, Kebele 14, and Kebele 02. In contrast, Kebele 09 and Kebele 05 did not attract new housing development, as they are mainly industrial area. The result also indicates that new residential developments along the main road in both east and west part of the City are unplanned. These non-conforming developments are identified in an area having better infrastructure developments in addition to Addis- Adama expressway. 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 northern and southern parts of the City; despite it is supplied to developers. Further, field observation reveals that these areas are manly characterized by low infrastructure development and serving for farming activities.

Manufacturing and storage

Manufacturing and storage is also one of the main planning issues for LUP04. It was mainly intended to decentralize activities and minimize the need for transportation and also bring about balanced development (NRSO, 2004). However, spatial overlay of proposed land and actual development (Figure 4-4) shows that non-conforming developments identified mainly at south and southwest and west parts of the City. It can also be seen that majority of reserved land at southern, northern parts are not fully utilized. Some unfulfilled developments especially at southern part are existing warehouses during LUP04 preparation and proposed to be removed by City administration gradually during planning period.

Further spatial analysis revealed that actual land-use outcome utilized by manufacturing and storage within planned area (accordance) is about 277.7 ha and that of outside of the planned area (deviation) is found 51.6 ha. On the other hand, despite the proposal of the plan, 185.8 ha reserved land is not yet developed. Spatial distribution of all types along with their spatial extent is summarized in table 4-2.

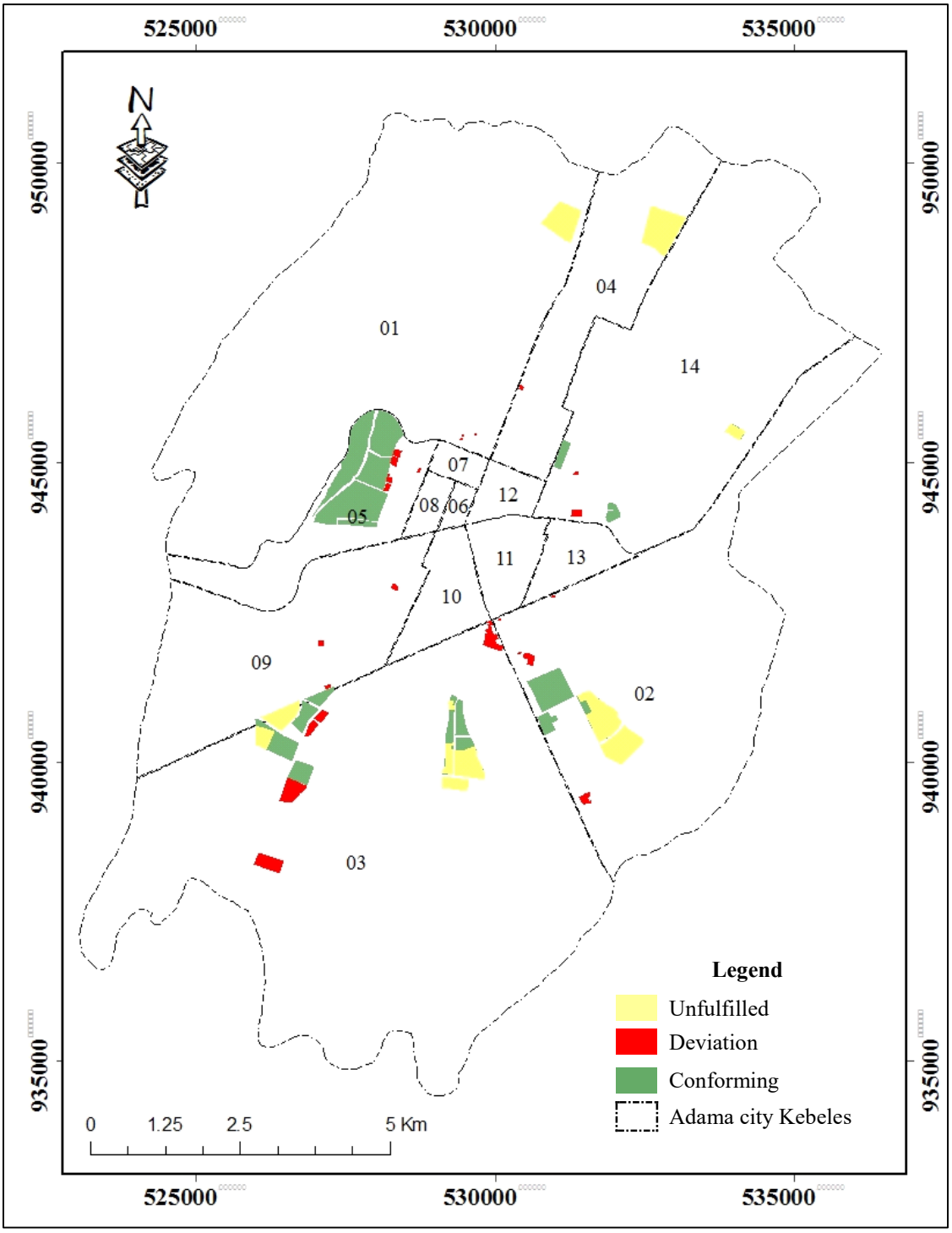

Figure 4-4: Spatial distribution of accordance, deviation, and unfulfilled manufacturing and storage development compared to LUP04

Result of this study depicted in Figure 4-4 and table 4-2 demonstrate that more non-conforming industrial developments mainly warehouses are identified in Kebele 03, 02, and 05. The area located in Kebele 03 is characterized by low infrastructure developments, illegal construction and low living standard. Non-conforming developments in Kebele 05 are adjoining planned boundary. This is a type of adjacent boundary developments which mainly encouraged by nearest neighborhood land values. The rest are existing developments before LUP04 approval and proposed to be removed. However, City administration did not remove them indicating lack of commitment.

Table 4-2: Spatial extent of evaluated manufacturing and storage development in Adama City

Kebele	Spatial extent in hectare		
	Accordance	**Deviation**	**Unfulfillment**
01	-	-	25.9
02	43.6	6.2	56.2
03	59.7	33.9	62.8
04	-	0.5	36.2
05	153.2	5.6	-
09	9.2	3.0	-
14	12.1	2.4	4.8
Total	**277.7**	**51.6**	**185.8**

Conversely, reserved land is not fully utilized which results unfulfilled developments distributed in five Kebeles. Unfulfilled land in Kebele 04 might be due to its location at about extreme northern part of planning area. This area mainly lacks infrastructure developments and used for farming activities. According to a worker in Adama City administration, compensation payment for farmers was not effective for long time due to budget constraint and it is considered

as challenges in using the land for proposed use during planning period. Other unfulfilled area in Kebele 03 and 02 are occupied existing unplanned and illegal developments as of 2004 proposed to be removed gradually to implement land-use proposal indicating lack of commitment of City administration.

Social services

Social service sites were proposed using equitability, efficiency, centrality, and accessibility issues as the main principles. Accordingly, 336.989 ha of land was reserved at different parts of the City. The aim was to optimize service providing to the community. To ensure balanced developments, the spatial distribution of reserved land focused at North, south, and southwest parts of the City (figure 4-6a). However, the spatial overlay analysis result (Figure 4-5) shows that significant non-conforming developments are occurred at different parts of the City. In contrary majority of proposed land at southern and northern parts of the City are not fully utilized.

Further spatial analysis revealed that actual developed land is found 353.9 ha of which only 263.1ha is developed following the plan. The rest 90.8 ha is unplanned developments. On the other hand, 73.889ha within planned area is waiting for development. Quantitative conformity assessment also shows that the actual social service land-use development exceeded what was planned in the LUP04. The spatial distribution among Kebeles is shown in Table 4-3.

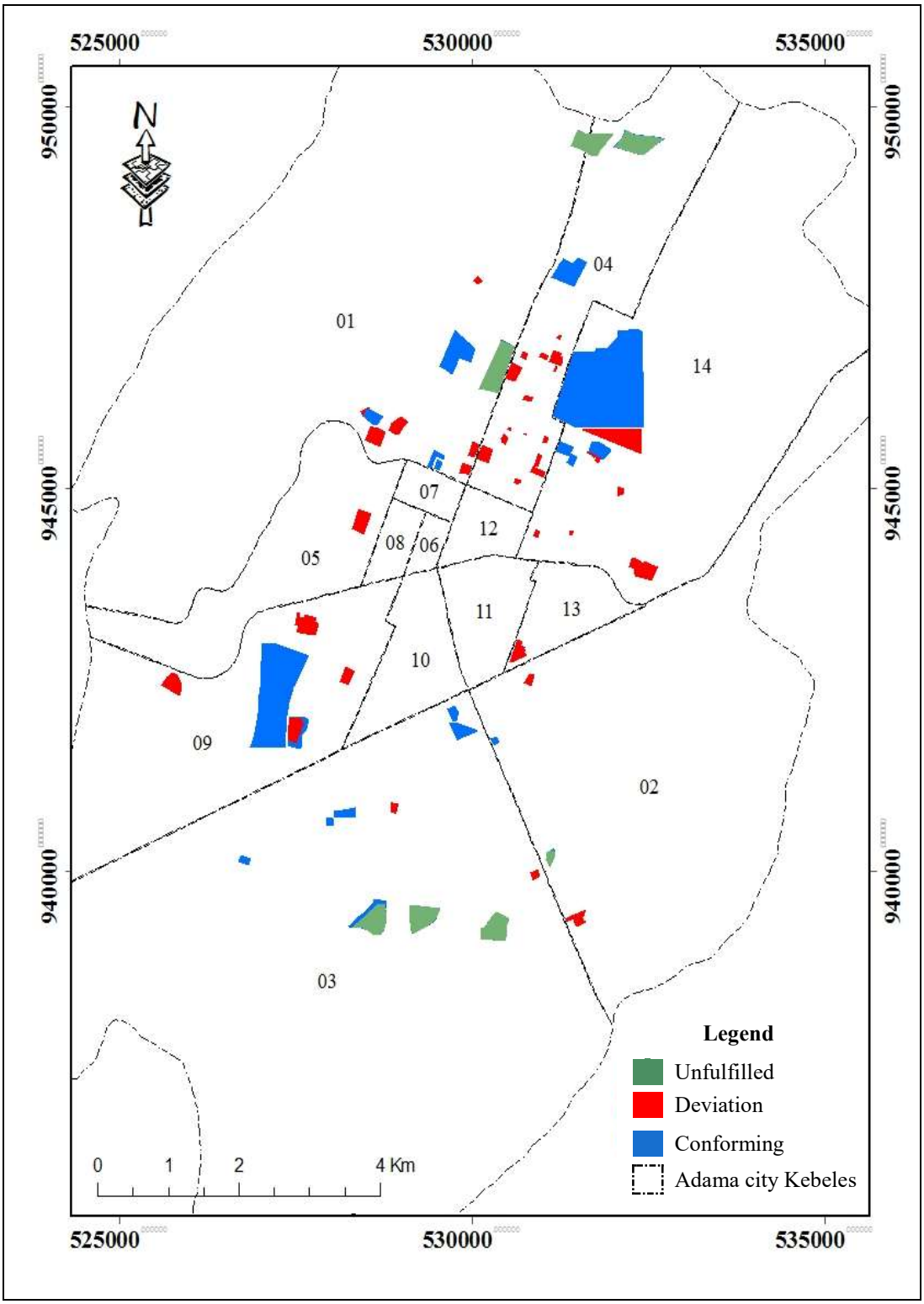

Figure 4-5: Spatial distribution of accordance, deviation, and unfulfilled social service developments compared to LUP04

Table 4-3: Spatial extent of evaluated social service developments in Adama City

Kebele	Spatial extent in hectare		
	Accordance	**Deviation**	**Unfulfillment**
01	42.7	14.1	-
02	2.9	4.6	-
03	16.3	2.5	33.3
04	11.3	17.8	19.1
05	-	5.5	-
09	76.2	20.9	-
14	113.7	25.4	21.5
Total	**263.1**	**90.8**	**73.9**

Results depicted in Figure 4-5 and Table 4-3 demonstrate that deviation of social service development is more perceived in Kebele 14, 09, 04, and 01. Further analysis of misused land especially in Kebele 14, shows that land in front of Adama Science and Technology University covering large land area supplied for expansion and land occupied by T/Haimanot Orthodox church located at eastern part of the City within this Kebele are significant non-conforming developments. Majority of misused land in the rest Kebeles are primary and secondary schools. On the other hand, majority of unfulfilled development area identified in Kebele 03 might be related to low development in the area and might not attract developers. In Kebeles 04 and 14, even though the areas are supplied to developers, geographical location at extreme north and absence of infrastructure developments may be affected the development.

Environment and Green Space

The result of spatial overlay analysis (Figure 4-6) depicts significant nonconforming developments occurred in construction prohibited areas in LUP04 (Table 4-4). Spatial distribution indicates that

open space encroachments are composed of 412.4ha (72.3%) from farmland, 73.7ha (12.9%) from formal green, and 84.4 ha (14.8%) from informal green.

The result reveals that proposed ground protection area is well preserved while farmland, informal green, and formal green areas are meet more difficulties to follow the plan. Further analysis of spatial extent and location of each land-use indicates that agricultural land-use was highly encroached by nonconforming developments. This encroachment is perceived at the outlet to Addis Ababa in front of "Abba Geda". It is strategic site suited close to main road and office of regional government and considered potential business site. Furthermore, nonconforming developments are located at the junction point of Adama-Addis Ababa expressway and Main road passing through the City at both ends. These sites are perceived suited to ease transportation access.

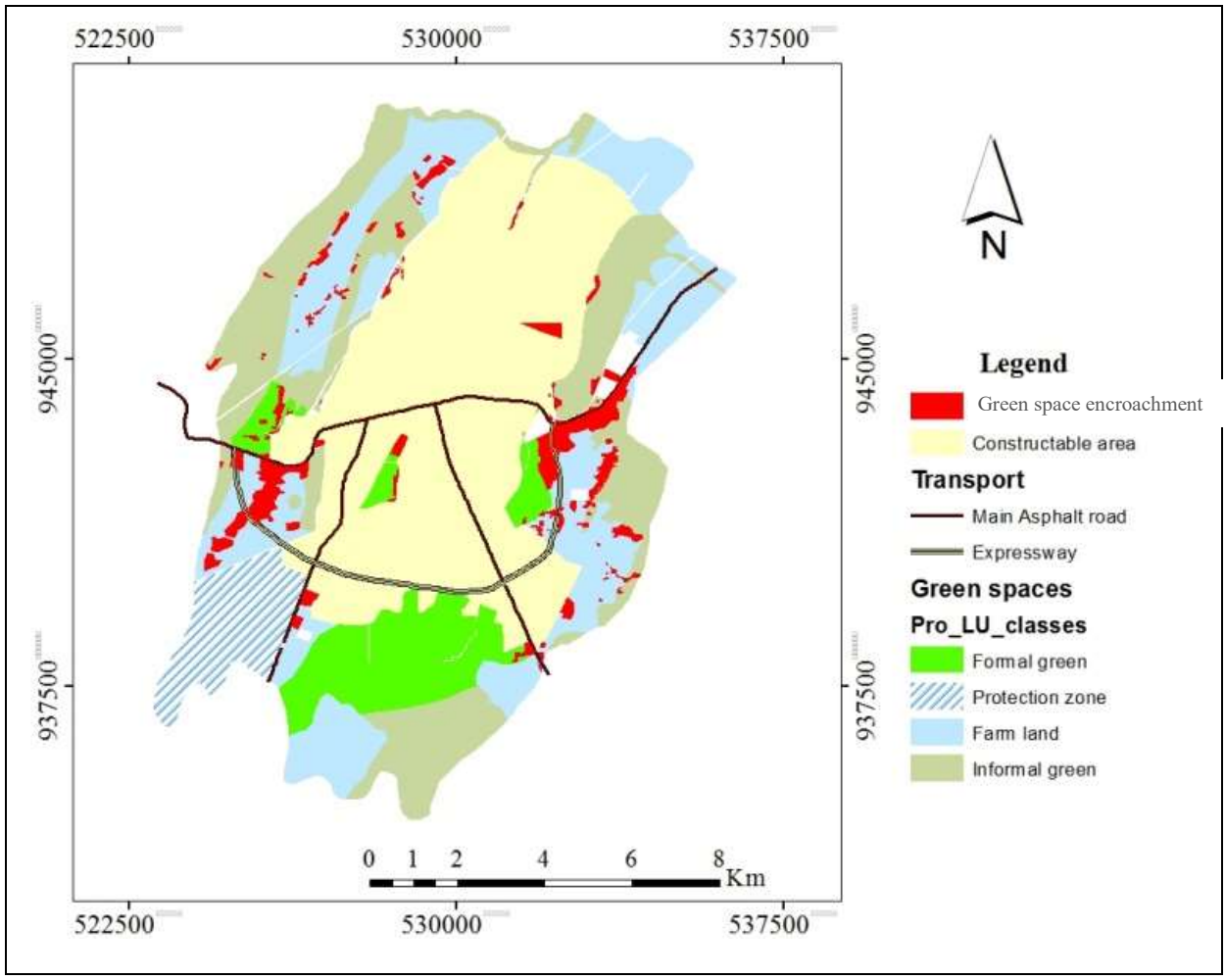

Figure 4-6: Spatial distribution of unplanned developments encroaching proposed green frame

Table 4-4: Spatial extent of Misused strategic green frame

Land-use class	Area in ha		
	Proposed	**Preserved**	**Misused**
Farmland	3149.6	2737.2	412.4
Formal green	1291.4	1217.7	73.7
Informal green	2758.1	2673.7	84.4
Ground water protection	688.9	688.9	-
Total	**7887.9**	**7317.5**	**570.5**

Road network

Improvement of infrastructure became the most important strategy in order to enhance living environment and City competitiveness (NRSO, 2004). A strong ring system consisting of an inner and outer ring is introduced to collect and tie traffic flow from and to the center and different parts of the City. These are extended south and north to further facilitate mobility from intermediate and periphery areas. According to LUP04, improvement of the existing road network, development of streets in expansion areas were through increasing length of three main components of the road network proposal: 91.4 km Principal Arterial Street (30-50m width); 74.1km Minor Arterial Street (20-30 m width); and 29.5 collector roads (12-20m width) as computed from plan proposal.

The main objective of LUP04 was to direct the urban growth to North and South (NRSO 2004). However, result of spatial analysis of existing road network shows that total actual length of existing road as of 2014 in study area was only 131.6 km indicating 64.1 km was not developed until the end of planning period. Unfulfilled road development is distributed mainly at northern and southern part of the City (Figure 4-7). However, as transportation is the main engine of development, the limitation of implementation directly affects other developments to follow the plan. Further, the spatial extent of each road type is computed and summarized in table 4-5.

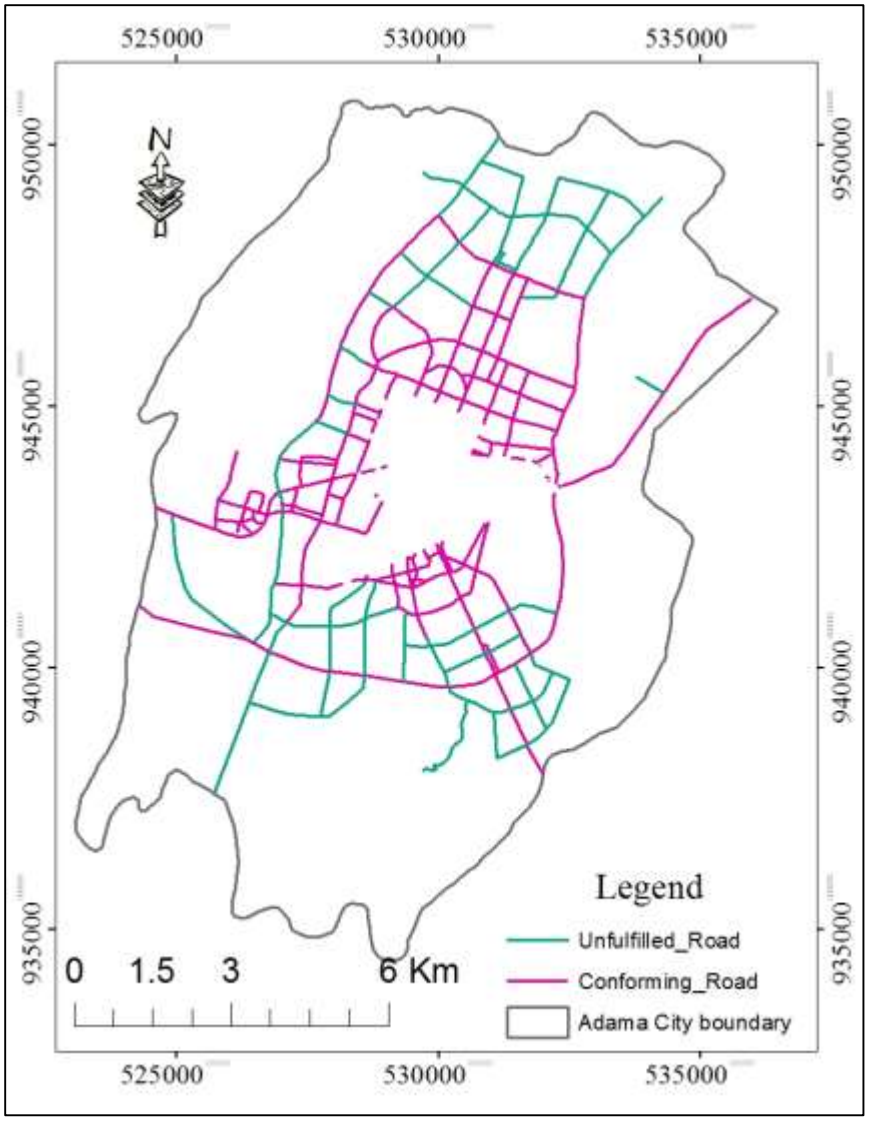

Figure 4-7: Spatial distribution of existing roads and unfulfilled road development proposed in LUP04

Table 4-5: Total length of existing road network compared to LUP04 proposal

Type	Length in kilometer		
	Accordance	**Deviation**	**Unfulfillment**
Principal arterial	69.1	2.7	19.7
Minor arterial	33.4	-	40.7
Collector street	26.5	-	3.0
Total	**129.0**	**2.7**	**63.4**

Further spatial analysis of the result depicted in Figure 4-7 and tables 4-5 demonstrates that principal Arterial Street is reached about 78.5%; minor arterial is about 45%; and Collector Street about 89.9% of plan intention. In this regard, collector streets are more implementaed than others. This might be due to their smaller width thus relatively required less budget. In addition to this most of these roads are Cobbele stone roads financed by donares/NGO. On the other hand principal Arterial streets including Expressway and main road passing through the City are mostly constructed by National government. Deviation occurred at western part of the City is due to design change of expressway at western end. In contrary, development of minor arterial street is very less compared to the others. This might be due to shortage of budget as it needs larger width and better paviment material usually asphalt than collector and requires large budget.

4.4. Degree of conformance success

The results summarized in Table 4-6 give information on the computed values of selected indicators for the assessment of the degree of the conformity success of developments in Adama City from 2004 to 2014. Six variables were examined: Total growth, housing, social service, manufacturing and storage, environment and green, road network. Since there is no unfulfilled land area for environment and green space, BSR was not computed. Overall, computed boundary sufficiency ratio of all variables is within a limit. 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 0.78, indicating LUP04 has limited effectiveness in controlling the spatial location of newly residential development. On the other hand, value of BSR was found 0.68 indicating the planned area for residential land-use was much enough to encompass all new housing developments. Regarding social services, the computed value of BCR (0.35), shows the LUP04 has limited effectiveness in

controlling the spatial location of newly developed social service land. Value of BSR (1.05) indicates the social service development a bit exceeds the proposed land area. This may be due to existing schools located in proposed mixed built up. In the case of manufacturing and storage, LUP04 has limited effectiveness (BCR=0.19) in controlling the spatial location of manufacturing and storage. On the other hand, value of BSR was found 0.71, demonstrating the Plan was designed encompassing area large enough to accommodate all industrial developments. This means the total area of developed land is within a land-use quota proposed by the plan.

Table 4-6: Summary of boundary containment ratio (BCR) and boundary sufficiency ratio (BSR)

Variable	BCR	BSR
Housing	0.78	0.68
Social service	0.35	1.05
Manufacturing and storage	0.19	0.7
Urban growth	0.35	0.21
Road network	0.02	1
Environment and green	0.08	-

Effectiveness of the plan in controlling urban growth within UCCB is analyzed using computed value of selected indicators. BCR from area of built up outside and inside UCCB; and BSR from area of total built up expansion in planning period and area of proposed land for urban growth in LUP04. The result shows that value of BCR is 0.35, indicating urban growth outside the UCCB has a significant share of the total growth indicating the plan has not effectively controlled the spatial location of new developments. On the other hand, value of BSR was found 0.21. It indicates that UCCB in LUP04 was planned encompassing area large enough to accommodate all new urbanization if measured by the actual development density. 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.

4.5. Factors influenced implementation of LUP04

Various interview questions were used to examine the potential factors that influenced the implementation of LUP04. 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 LUP04 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 City. 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 4-3), social services (Figure 4-5), and manufacturing and storage (Figure 4-4) expansions. These limitations were also confirmed during the study's field observations. In contrary, most of the nonconforming developments occurred outside of UCCB are close to major road and expressway passing through the planning area. 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 LUP04 was evaluated during planning period. The respondents feel that evaluation of land-use plans is unusual in Adama City, and they are certain that LUP04 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.

In response to the questions about the failure to remove the majority of illegal developments as of 2004, experts suggest various reasons. According to their response, illegal/informal houses are mostly densely populated and characterized by urban poor. It is regarded by the city managers that any attempt to remove these illegal houses could result mess and violence, as the city had experienced a number of such incidents. Furthermore, it may result in a loss of votes for the ruling political party in the future national elections. In this respect, because the city's political leaders are focusing more on political security, which is normally one of the factors used by regional government to evaluate the accomplishments of city leaders, they chose the existing illegal houses to be untouched.

Regarding the questions about why the city administration could not control the new expansion of illegal houses, the participants agree that there were some attempts to control; however, it was not as such strict. Illegal/informal housing expansion has been occurred both within and outside of UCCB due to various factors. Land-use management for the areas outside of the UCCB in the periphery was handled by the rural Kebele administration, forcing city planners to concentrate on

areas within the UCCB. Illegal development has proliferated as a result of poor land-use management in rural Kebeles in comparison to that of the planned area managed by city planners.

Regarding the expansion of illegal/informal constructions identified in the UCCB, the respondents agree that such constructions are occurred mostly due to absence of strong controlling and monitoring. It was possible to keep new illegal/informal dwelling construction under control by taking the necessary measures in a timely manner, yet the efforts made so far in this regard have been insufficient, which can represent the limited commitment of the concerned stakeholders to some extent.

When asked for formality of developments existing in front of regional administration office, the experts confirmed that the land used for high-rise buildings adjacent to main road was formally supplied by the City administration. According to LUP04 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 Adama, the City Administration would satisfy the site selection proposed by developers as much as possible, even area outside of UCCB was chosen. Especially ones with large economic added-value showed their interests in the City, investors were almost free to select any sites they needed regardless of the limit of urban growth. In order to retain the investment, the City Administration ultimately accepts their applications. Considering the potential economic values of the developments to the city, the area was supplied to developers based on management decision.

5. DISCUSSION

In summary, the primary function of urban land-use plan is to guide and control spatial development of urban areas during planning period. Thus, the effectiveness of the plan should be measured by the level of conformity between actual land-use outcomes and proposed land-use in the plan from both morphological and quantitative perspective.

This study evaluated the implementation LUP04 using six variables: manufacturing and storage, housing, road network, social service, total land growth, and green frame. 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 LUP04 in controlling spatial location of new developments. This limitation is indicated by computed value of BCR. It is more in Housing followed by social service and total urban growth. 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 LUP04 has met difficulties to play its role in guiding and controlling spatial development of Adama City. In spite of the morphological

deviation, the total area of new developments occurring during 2004-2014 has not exceeded the area allowed by LUP04, which at least shows that the size of reserved land is reasonable. Furthermore, the level of non-conformity is different for selected variables. Since the area allowed by the plan for development is large enough, one might ask why there are non-conforming developments.

This study was able to determine various factors influenced plan implementation in addition to evaluating plan implementation. Proximity to likely public infrastructures and major transportation corridors significantly affected the degree of implementation. As noted in different studies, transportation routes are responsible for linear branch developments of urban area (Brody et al., 2005; Bhatta, 2010), and they are commonly considered in modeling and forecasting urban sprawl. In this study, most of nonconforming developments occurred outside of UCCB are close to major road and expressway passing through the planning area. In addition, these areas are characterized by better infrastructure development and urban services. In the contrary, absence of these infrastructures at northern and southern parts of the City has retarded the proposed developments.

Absence of regular evaluation and monitoring had also contributed to poor implementation of LUP04. The results show that despite the developments outreached the UCCB, 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 LUP04. However, either these areas were not developed within the time limit given by the City 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. Because illegal/informal developments existed in 2004 were not considered during LUP04 preparation, and proposed to be removed gradually during planning period. However, in practice, the City Administration had not removed many of these developments. Instead, spatial expansion occurred around them; even some of them are recognized and legalized. As a result, the majority of the informal dwellings and warehouses that existed in 2004 still exist in 2014. 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.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

By spatial mapping of actual land-use under LUP04 control and measuring the degree of plan conformance, this research evaluates the effectiveness of the plan implementation. The value of the study can be explained in different ways. First, the variables used in this study: manufacturing and storage, housing, road network, social service, total land growth, and green frame highlighted the level of conformity between actual land-use outcomes and plan intention. Second, morphological conformity assessment using spatial overlay analysis provides spatial extent and distribution of conforming and nonconforming developments. This can be important information to be considered in the next planning course. And also keeping a plan on track and ensuring effective implementation of unfulfilled planned areas over the planning period. Moreover, it can help planners recognize where there is nonconformity or significant deviation from original plan intention 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. Third, quantitative conformity assessment using BCR and BSR highlight the effectiveness of the plan in guiding and controlling spatial development of the City. This provides insight into land-use plan implementation as sufficient plan design only by itself will not insure plan implementation. Fourth, the findings of the study provide a better understanding of the major factors contributing to nonconforming development and sprawling growth in Adama City. Identification of why development occurs in unintended areas can help planners to reduce such an occurrence in the future. Moreover, it helps the government to design spatial policies to the context to improve plan implementation, to mitigate sprawling development patterns, and to conserve environment. Most importantly, the

techniques used in the study could facilitate an adaptive approach to evaluate land-use plan of other urban centers in the country. An adaptive approach to long-term planning can more effectively reduce undesirable outcomes such as sprawl or prevent development patterns from taking major detours from the originally intended path.

6.2. Recommendations

Although this study provides important information on the implementation of Adama City 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, only one approach is outlined to examine the implementation of urban land use plans, which by itself is not sufficient. Other evaluation techniques must be used, and plan implementation should be evaluated with the use of multiple approaches of analysis. In addition, the study has examined Adama City Land-use plan of single planning period. Future research should analyze plans in different planning periods to identify the trend of effectiveness of plans prepared and implemented in different planning periods. 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 LUP04 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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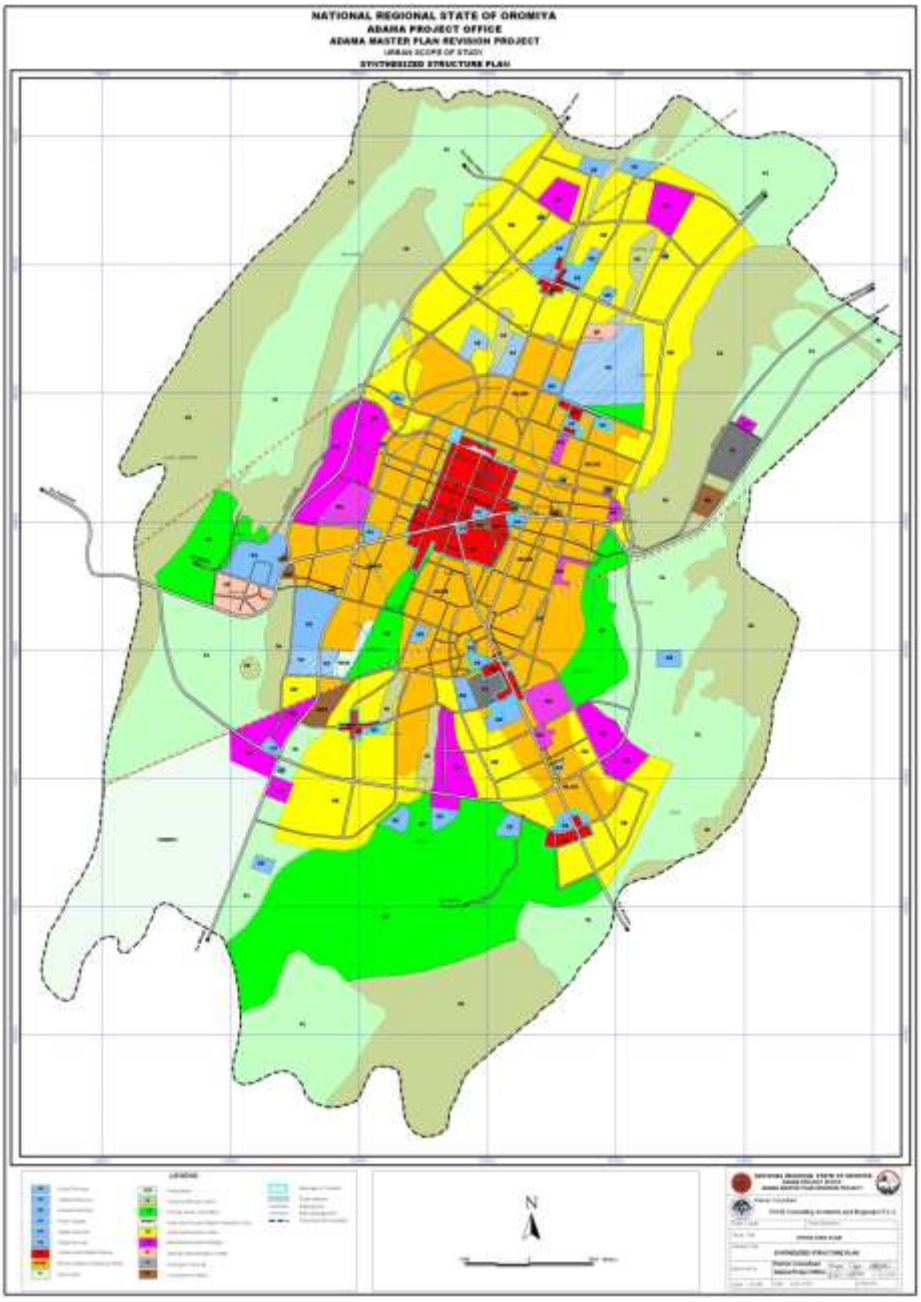
APPENDICES

6.3. Appendix A

Structural plan map of Adama City 2004



6.4. Appendix B

B-1: Related publications

- Bulti, D., T. and Sori, N., D. (2017). Evaluating land-use plan using conformance-based approach in Adama city, Ethiopia. Journal of Spatial Information Research. https://doi.org/10.1007/s41324-017-0125-3
- Bulti, D., T. (2017) Success or Failure: Evaluating Effectiveness of Adama City Master Plan in controlling urban growth and preserving Green Spaces. The Ethiopian Journal of Science and Sustainable Development (EJSSD) 4(1): 65-80.

B-2: Conference Presentations

- Bulti, D., T. (2017). Evaluating Implementation of Adama City Land Use Plan Using Conformance-Based Approach. In: ASTU 2nd International Research Symposium, June 8-10, 2017.
- Bulti, D., T. (2017). Success or Failure: effectiveness of Adama City Master Plan in Managing Urban Growth and Preserving Green Spaces. In: 1st National conference on Science, Technology and Innovation for Sustainable Development (STI_2017) organized by Kombolcha Institute of Technology, Wollo University. July 1-2, 2017.

Approval of Investigators

We hereby declare that the research report entitled "**Evaluating Implementation of Adama City Land Use Plan Using Conformance-Based Approach"** is our original work; all sources are duly acknowledged and the report is compiled by incorporating the necessary comments and suggestions given by the reviewers.

	Name	Signature	Date
Principal Investigator	Dejene Tesema Bulti (PhD)	_____	_____
Co- Investigator	Ing. Hika Dinsa Sori	_____	_____

Approval of Reviewers

I hereby confirm that (PI) **Dr. Dejene Tesema Bulti** has accomplished his/her work as per the approved proposal and incorporated all the comments given by the reviewers in his/her terminal report of the project entitled **Evaluating Implementation of Adama City Land Use Plan Using Conformance-Based Approach** and hence the report qualifies for submission as standard research output.

	Name	Signature	Date
Reviewer 1.	Dr. Yared Girma	_____	_____
Reviewer 2.	Mr. Tesfu G/Selassie	_____	_____

Approval: **School Ethical Review Board (School Scientific Committee)**

	Name	Signature	Date
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____