URBAN POVERTY AND POOR HOUSING CONDITION

IN

ADDIS ABABA METROPOLICE

USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Dissertation submitted for Partial Fulfillment of the Requirements for the Degree of MASTER OF SCIENCE

IN

REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

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Table of Content..... pages

List of Tables.....pages

List of Figures……..……pages

Acronyms

AACAHB. …….Addis Ababa City administration Healthy Bureau

AAMPP…….....Addis Ababa Master Plan Program

ADR ……..Africa Development Report

AHP……...Analytic Hierarchy Process

CSA ……..……Central Stastics Authority

CoBWAS……...Community office Based Water and Sanitation Supply Arada

EMA ……..Ethiopian Mapping Agency

GCPs …….Ground Control points

GIS …….....Geographic Information System

GPS ……...Global Positioning System

HICE ……..……...Household Income Consumption and Expenditure

HHs……Households

Kcal…….Kilo calorie

IDG ……....International Develop Goals

IDW….....Inverse Distance Weighting

LDA ……..…….Land Development Agency

ORRAMP……...Office for the Revision of Addis Ababa Master Plan

RHA……....Rent House Agency

RMS……..……..Root Mean Square

UPPID…….……....Urban Plan Preparation Inspection Department

WHO……..….World Health Organization

WM... ……....Welfare Monitoring

Abstract

This study explores the urban poverty and intends to contribute to the study of the phenomena of rapid urban poverty and poor housing condition in Arada and Lideta sub-cities of Addis Ababa. The study was conducted on primary and secondary data collected from various households of the sub-cities. Four hundred households were surveyed to investigate the access to toilet, the status of the house, the water supply, socio-economic and sanitation situation. The study was made urban land classification of Arada and Lideta using Remote sensing technique and poverty area map using GIS technique. In order to achieve this objective the collected sample of households, Aerial photographs, Ikonos image and other data were analyzed. An overlay analysis is carried out by evaluating the layers obtained according to their weight and the poverty susceptibility map is produced. And then classified into four classes: low, moderate, high, and very high. From the result more residential parts of Lideta sub city are found in the highest poverty area than Arada sub city. The major reason for the occurrence of poverty area is their monthly income is very low and inadequate so that they can not construct, buy, or rent decent dwelling unit. Furthermore, lack of adequate sewerage and water supply, poor housing condition, over crowdedness are among the main problems. Still more can be inferred that the surveyed households live in an unhygienic and congested environment lacking the basic necessities of a healthy life. On the other hand the remote sensing processed result reveals that the urban land classification area changed through different period of time. Between 1965 and 1984 the built up area and the road distribution had increased. During 1984 and 2004 the two sub cities had changed that built up area and road distribution increased. Generally the magnitude of their problems is worsening from day to day. To improve these conditions the community needs to be actively participation with volunteer investor and small microfinance for the construction of houses and financial advancement.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

In developing countries, urban poverty area developments are without infrastructure and dense with dwellings without ownership, and built from simple materials at hand.

Urban poverty (slum) areas occur due to many reasons and among which are migration from the rural to urban area, population growth, and inadequate incomes are the main ones.

Mass migration from rural to urban areas is a global phenomenon. More than a million people move to the cities of the world, seeking jobs and public services, stability, promise and a better quality of life. In much of the developing world, the migration has given rise to slum areas that are unsafe and offer unacceptable standards of living. Many occupy land illegally and families never know when they will be Cities grow because of the natural increase of their populations.

Ethiopia is one of the poorest and least developed countries in east Africa. Its urban poverty is best reflected in housing conditions. Poor quality dwellings, homelessness, the proliferation of slum and informal settlements, over crowding and a total lack of services and infrastructures characterize much of the urban housing stock in the country. Global reports indicated that the country has the highest percentage of slum inhabitants. The same as true the above problems existed in the big city i.e. Addis Ababa. For instance the houses of the poor people in the city are so crammed and built by inadequate construction materials. Hence most houses in such areas have no kitchen at all or else many families share a single kitchen. Many of them are forced to cook in the main room of their houses or else a separate single area as an alternative, which inevitability will be overcrowded and unhygienic. In addition to this people use low quality kerosene stoves which can easily lead to a fire breakout. Often fire breakouts in such poor neighborhoods are not easy to control for they are crammed and the roads between them too are extremely narrow to worsen the condition.

The majority of the houses which prevail to these days were built 30 years before from simple materials such as mud and wood. Most of them are double or single roomed with no

ventilation, aggravating the spread of respiratory and other closest diseases. No doubt that it has a tremendous impact on the welfare of as well as the competence of the management. At present the land use management is becoming more and more challenging both to the management of offices and public, due to increase of population growth.

Generally slums are characterized by high occurrence of poverty and unemployment and are proliferation centers for many social problems such as crimes, drug addictions, alcoholisms, and depression.

Due to the occurrence of slum areas the city expanded with out control. In order to show how far the problem is disastrous of the area, the most indicative, powerful, and advance ways of analysis are Remote sensing and GIS.
Assessing the general aspect of land usage, past and present through satellite images, Aerial photography and existing topographic map could give as a view of the slums and the condition of life in them.

1.2 Statement of the Problems

Often the presence of urban poverty in many of the developing countries is characterized by continuous emergence the expansion of slums and informal settlements. Any such emergency is characterized by the sprouting of substandard housings due to financial problems. It is so obvious that Addis Ababa too is a city with multitudes of complicated problems. As the city is situated on a mountainous landscape mounds and clefts, many parts of it suffer from seasonal floods. The development of infrastructure is very low; the sewerage system in such areas is very poor in quality.

In addition to the poor settlement areas, the subcities of Addis Ababa suffer from the problem of an increasing inequity between the existing supply of housing and the growing demand of the population. For instance population versus the number of houses. This shortage has aggravated the degree of poverty in the old and inner parts of Addis Ababa sub cities. For this study the two Sub-cities (Arada and Lideta) are selected due to the fact that they are among the oldest residential areas of the city with high population density.

By using the mass of information obtained from household as well as satellite image and aerial photos the study shows urban classification and the map of poverty. The best way to

show the extent of poverty engulfing the sub cities is to map out the poverty stricken areas, and then further investigate about the provision of services like water, toilet, and others. Spatial information on poor housing conditions or slum areas locations as well as physical locations of facilities through Geographic Information Systems (GIS) is a significant input in order to understand the socioeconomic condition of a city.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of the study is mapping urban poverty area of Arada and Lideta using GIS techniques and to recommend the best strategy by indicating the possibilities of enhancing solutions for the improvement of the poor settlement in the study area.

1.3.2 Specific Objective

- Assessing the existing housing condition of the two sub cities.
- Analyze the urban poverty and housing conditions as well as associated aspects such as land use expansion and change in the study areas and recommend possible solutions.

1.4 Limitation of the Study

While conducting the research the major limitations were:

- Information, particularly secondary sources, such as statistics, and census have been found to be insufficient for providing detail population information.
- At the time of the interview due to fear and mistrust, individuals could not provide adequate response to related to income, expenditure and age.

1.5 Significance of the Study

- It provides a clear picture about poverty, housing conditions, and land use changes in these sub-cities.
- The study can make an important contribution in the task of identifying the characteristics of the poor settlements of the areas, especially at the kebele levels.
- It provides information for the town planner and policy makers.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Urban Poverty Area

Generally speaking the formation of slums or poor areas is associated with poverty and lack of affordable houses. The condition in Addis Ababa too differs not much from this fact, severe housing problem and widespread poverty are among the main challenges of the city (Haregewoin Bekele, 2005).

Moreover these slum areas are characterized by, among others, unplanned and densely populated neighborhoods with no or little basic infrastructure and municipal services, illegal occupation of land and thus absence of tenure security, poor housing condition. And also over crowdedness, polluted environment created by lack of proper sanitation facilities, disaster prone settlements, high rate of HIV/AIDS, high birth and mortality rate, higher crime rate and , vulnerability to all kind of risks and high rate of unemployment are amongst the environmental, social, and economic characteristics of slums in Addis Ababa (Solomon,2005).

In recent years, the (World Bank, 1992) has stated that 60 % of its dwellers are below the poverty line i.e.1 dollar per day. Hence, estimates are not any different from the above facts dwellers are vulnerable in the face of poverty, diseases, hunger, illiteracy, unemployment and environment degradation. During the initial establishment of resident site in almost all parts of Addis Ababa, no criteria had been used except in some areas occupied by foreigners (Italian invaders1935-41).

The World Bank defines poverty as a ‘pronounced deprivation in well-being’ (World Bank, 2000). Poverty comprises of both income and human poverty, the two basic categories of measures often used in measuring poverty. Income poverty involves the inability to fulfill basic material needs, including securing adequate nutrition, health, education and shelter. Income poverty can be further classified into extreme (absolute) poverty which is a lack of income necessary to satisfy basic food needs and overall (relative) poverty which is a lack of income necessary to satisfy essential non-food needs, such as for clothing, energy and shelter

as well as food needs. A person is considered poor if he or she is unable to secure the goods and services to meet these basic material needs. Human poverty widens the concept of deprivation to include quality of life, risk, and vulnerability to poverty, powerlessness and lack of self respect (World Bank, 2002).

In addition to this, human poverty is lack of basic human capabilities: illiteracy, malnutrition, abbreviated life span, poor maternal health, illness from preventable diseases. Indirect measures are lack of access to goods, services and infrastructure, energy, sanitation, education, communication, drinking water, all necessary to sustain basic human capabilities (UNDP, 2000).

Many authors have discussed in detail the issues associated with factors of poverty include:

Economics Factors

- Unemployment.
- Capital flight by which the wealthy in a society shift their assets to off-shore tax havens and deprive nations of revenue needed to break the vicious cycle of poverty.

Health Care Factors

Health care factors can indicate the degree to which the poor are underserved by healthy services, with implications for heath of the poor.

- Poor access to affordable health care makes individuals less resilient at the face of economic hardship and so more vulnerable to poverty.

- Inadequate nutrition in childhood undermines the ability of individuals to develop their full human capabilities and makes them more vulnerable to poverty.

- Disease, specifically diseases of poverty: AIDS, malaria and tuberculosis and the likes.

- Clinical depression undermines the resilience of individuals and when not properly treated makes them vulnerable to poverty.

- Similarly substance abuse (including for example alcoholism and drug abuse) when not properly treated, undermines resilience and can consign people to vicious poverty cycles.

Governance Factors

- Lack of democratic system in poor countries.
- Effectiveness of governments has a major impact on the delivery of socioeconomic outcomes for poor populations.
- Failure by governments to provide essential infrastructure worsens poverty.
- Poor access to affordable education and countries in cycles of poverty.

Demographics and Social Factors

- Overpopulation and lack of access to birth control methods.
- Cultural causes which attribute poverty to common patterns of life.
- War and genocide.
- Discrimination of various kinds, such as age discrimination, gender discrimination, racial discrimination, caste discrimination.
- Individual beliefs, actions and choices.

2.2 Urban Poverty in Africa

One of the biggest challenges in many least developed countries is lack of permanent income thus most people leads their life they acquire from the informal sectors. Usually such an income is so little and it doesn't cover the expenses of basic necessities as well as medical expenses due to health problems and other determinants.

The world population is increasingly becoming urban, and so, by 2015, the time on which Millennium Development Goals targets are expected to be reached, 60 out of every 100 people will become city dwellers (UN-Habitant, 2002). Unfortunately, this rapid rate of urbanization is not accompanied by healthy urban development. In Africa, almost two out of three urban citizens live in slums.

As a result, Poor environmental condition, changes in prices of basic goods, lack of social network, violence, and insecure tenure status further aggravate the problem (Haan, 1997).
(ADR, 2002) states that the spread of poverty can be measured as the proportion of people who live below a given poverty line. The depth of poverty is measured by the poverty account the extent to which consumption of the poor falls below the poverty line. Evidences reveal that while poverty in the majority of sub Saharan Africa is widespread, deep and severe, its extent in fact varies from country to country.

Poverty in the context of the International Development Goals (IDG) is defined and measured in terms of the head-count ratio using the money metric approach. The definition of the head-count ratio depends on mean consumption expenditure, a poverty line and a measure of the inequality in the distribution of consumption. According to this approach the poor people are those with consumption expenditure below a certain poverty line and in the case of IDG global bench mark line of $1 a day per person in 1985 purchasing power parity was used (ADR, 2002). For instance poverty measure for urban sectors in sub-Saharan Africa shown in table 1.

Table 1 Urban poverty in sub Saharan Africa

Country	Urban mean expenditure ($/person/month)	Urban poverty line ($/person/month)	Urban Head-count (%)	Urban poverty gap (%)	Urban squared poverty gap ratio (%)
Ethiopia	32.6	28.1	67.17	29.32	15.91
Kenya	109.3	52.8	33.91	11.93	5.63
G.Bissau	38.7	29.5	56.61	25.22	15.39
Swaziland	89.5	45.3	52.73	28.65	19.19
Tanzania	27.6	26.8	65.57	26.39	13.48

Source (ADR, 2002)

In terms of depth of poverty, Ethiopia is clearly a high urban poverty country with a poverty gap ratio of 29.32 % while in terms of severity Swaziland is the country with the highest squared poverty gap ratio 19.19 %. To further value the extent of depth of urban poverty, it has to be noted that the mean expenditure of the urban poor in Ethiopia is only 29 US cents per person per day (ADR, 2002).

The (UN-Habitat, 2003) defines a slum household as a group of individuals living under the same roof in an urban area lacking one or more of the following: durable housing, sufficient living space, easy access to safe water in sufficient amounts at an affordable price, access to adequate sanitation, and security of tenure that prevents forced evictions.

In addition to lack of permanent income disease is often linked to the general state of poverty. According to (ADR,2002), the Human Immunodeficiency Virus (HIV) and its associated disease, as such as AIDS and TB cases are causes of deaths in Africa.

AIDS and poverty have an intimately two-way relationship. Because of low income those affected group specifically get inadequate intake of calories and nutrients.

2.3 Urban Poverty in Ethiopia

2.3.1 Poverty in Ethiopia

Like most developing countries, serious rural to urban migration is a common phenomenon. Poverty is emerging in different parts of cities, especially the capital, and is the only choices for the majority of the city dwellers that are poor. Additional population increase in bigger cities is accommodated by crowding of existing houses. Rather than new construction developments, existing houses are often extended or divided illegally so that they would be rented for migrants.

Generally, informal settlements and land misuse in Ethiopia is a result of population pressure (both from natural births and migration), poor land policies, lease system and planning, and regional imbalance (Haregewoin Bekele, 2005).

As stated by Tadesse, T. D. Tsegaye, and T. L. Coleman (2001) cited in (Haregewoin Bekele, 2005), in 1964, the most notable feature of agricultural zone surrounding the city was full of eucalyptus trees. This forest belt had been beneficial for limitation of urban expansion as well as the provision of commercial and recreational centers for the people of the city, which has been called ’Eucalypt polis’. The major land-use/cover changes that had taken place between 1987 and 1999. Urban built-up areas increased significantly, whereas bare, undeveloped land decreased.

2.3.2 Poverty in Addis Ababa

Addis Ababa the capital city of Ethiopia, is located between 08º 49´ and 09º 06´ north and 38º 38´ and 38º 54´east, which is not far from the geographical center of the country.

Historically Addis Ababa was founded in 1886 by emperor Menilik II. Addis Ababa was chosen as the residence of the emperor because of its thermal spring at a spot known as Filweha, and its climate was more favorable than that of Entoto. The original central core of the city become a consolidated urban area as it filled up rapidly from the earliest days with the small homes of working people, which tended to clusters in sefers or villages within the city, composed of people who had migrated to the new capital from the various regions of Ethiopia (National Atlas of Ethiopia, 2004).

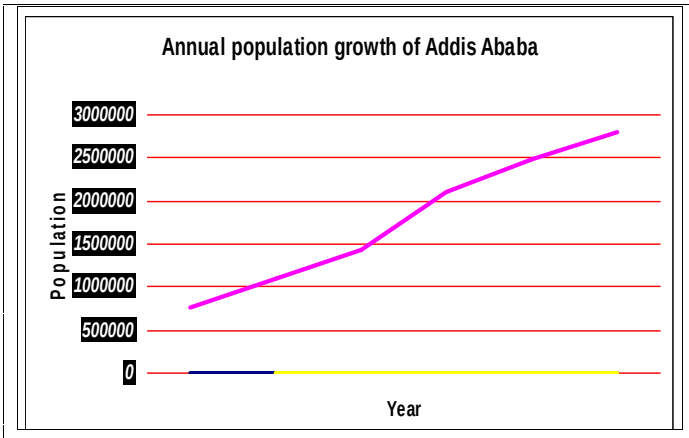
At the time of the Italians invasion there were very few buildings or even roads in what is now the southern half of the city. A single road ran straight up the hill side from the rail way station, completed in 1917 to the old commercial center of Arada. During the fascist occupation of (1935-41) a network of good roads radiating from Addis Ababa and connecting the capital to the main Administrative centers in the regions was built. The establishment of some factories and the introduction of modern means of transportation attracted larger numbers of people to the city. The northern boundary of the capital runs along the crest of the Entoto hills and western limits are found along the flanks of Mt.Wechecha. To the south of the city extends over the plain towards the Akaki River. Whilst on the eastern limits the road leads to Debre Berhan and Dese climbs up towards the plateau of northern Shewa (National Atlas of Ethiopia, 2004).

At present the city has five out let, radiating from its center and area covers 540 sq.kms (ORRAMP, 2002).

According to the 1994 Ethiopian population and Housing Census the population of Addis Ababa was 2,112,737 of which about 98.5 % of the population had conventional homes (CSA, 1999). It also indicated that most resident of the city were living in poverty. (AACAHB, 2002) added that among the 1.12 million of the total population who were economically active, only 65.3 % of were actually employed.

Addis Ababa has witnessed considerable changes in land-use, demographics, socio-economic conditions and environmental stability over the past 30 years. During this time highest population growth has occurred and the urban areas expanded from densely vegetated area to complex mixture of residential, commercials, and industrial urban areas.

Over the past three decades the city has had an increase in population of approximately annual growth (from 750,530 in 1970 to 1.10 million in 1976), (from 1.10 million in 1976 to1.42 million in 1984), etc (CSA, 2004/5). The majority of the populations have increased occurred between 1970 and 1976 (shown in figure 1). After 1976 the population growths have been lower relatively to the population growth between 1970 and 1976.



Year	Population
1970	750,530
1976	1,099,851
1984	1,423,111
1994	2,112,737
2000	2,495,000
2004	2,805,000

Figure 1 Average annual population growth of Addis Ababa

According to the newly division of Addis Ababa city (by LDP) indicated that the first four highest population densest areas out of the ten sub cities are Addis Ketema, Arada, Lideta, and Cherkos kefle ketema which account for 455.3, 325.5, 262.5 and 240 person per ha respectively. The rest of the six sub cities of Addis Ababa are low in population density relatively to the others. Table 2 shows the newly division of Addis Ababa.

Table 2 Population distribution of Addis Ababa in 2006

Item No	Sub-city	No of kebeles in the sub-city	Estimated population size (2006)	Area (ha)	Density person/ha
1	Arada	10	330,344	995	325.5
2	Addis Ketema	9	397395	764	455.3
3	Lideta	9	333976	1226	262.5
4	Cherkos	11	374842	1518	240
5	Bole	11	325022	12314	25.2
6	Nifas Silk-Lafto	10	366747	6044	57.7
7	Yeka	11	355575	8546	39.5
8	Akaki-Kaliti	8	220740	12797	14.8
9	Kolfe-Keranio	10	312450	6543	43.4
10	Gulele	10	346,023	3252	106.4
	Total	99	3,363,114	54000	57.8

2.3.3 Poverty Indicators

2.3.3.1 Income Poverty Indicator

Income is one of the indicators of poverty. The distribution of income shows the extent of poverty. The distribution of income tells us how much income is available in the hands of households but it does not tell us if the income is sufficient to meet the expected standard of living or not.

In 1992, a World Bank study on urban areas estimated that the poverty line for urban areas is Birr 244 per month for a family of five. More recent studies using a cost of basic needs approach found Birr 58.61 and Birr 96.08 per adult per month to represent food and total poverty line (Mekonen, 1997). This equals to birr 293.05 and Birr 480.4 per month for a family of five adults for food and poverty line respectively.

2.3.3.2 Expenditure or Consumption Indicator

Both expenditure and consumption are based on data that assess whether an individual or household can afford a basic basket of goods (typically food, housing water, clothing,

transport, etc.). Consumption is generally considered to be a better measure than income because incomes tend to fluctuate over time, there are problems of under-reporting (particularly income derived from the private and informal sectors). Money metric measures can be adjusted to account for the higher cost of living in urban areas when measuring poverty.

The other method of knowing poverty is based on household income, consumption and expenditure. Two methods are commonly used to derive the poverty line; the 'food energy intake' and 'food share' methods (Ravallion, 1994). Both approaches are based on the assumption that there is a minimum energy requirement for a typical person to keep up normal activities such as the 2,200 kcal per day threshold predetermined by the WHO, (1985). Thus, the 'food energy intake' method attempts to identify the total consumption expenditure at which a person is expected to attain the minimum food energy requirement.

2.3.3.3 Health and Education Outcome Indicators

The extent to which poor households have access to basic social services is an indication of their overall level of living standards. Under-five mortality rate, infant mortality rate, maternal mortality rate, Malnutrition rate of children, Literacy rate, years of schooling are among this indicator.

2.3.3.4 Asset Indicators

This has been used increasingly with the Demographic and Health Surveys. A range of variables on the ownership of household assets are used to construct an indicator of house holds socio-economic status. These assets include: a car, refrigerator, television, dwelling characteristics (type of roof, flooring, toilet), and access to basic services including clean water and electricity (Falkingham, J. and C. Namazie, 2002).

2.3.3.5 Access Indicators

This approach defines a minimum threshold for several dimensions of poverty classifying those households who do not have access to these basic needs. They include characteristics such as literacy, school attendance, piped water, sewage, adequate housing, overcrowding,

and some kind of caloric and protein requirement. If a household is deficient in one of the categories, they are classified as having unsatisfied basic needs.

2.3.3.6 Non-Income Deprivation Indicators

The other poverty indicator factors are unemployment, child labor and discrimination.

2.4 Poor Housing Condition in Addis Ababa

Today three billion people of the world's population live in urban centers. Of this one third of them live in poor houses or slums. Currently 900 million people worldwide are living in spontaneous, illegal settlements and slums and their number is growing from year to year (UN-habitat, 2002). Some of them live in extremely overcrowded conditions; un safe buildings with poor hygienic conditions, no piped water or electricity connection, no sewage or waste disposal are absent in historic cities. The valuable fabric of the buildings is crumbling, as more and more inhabitants move out. One billion people worldwide are living without clean drinking water (UN-habitat, 2002).

According to (ORAAMP, 2002), 80% of slum dwellers in Addis Ababa are the poor, of which 60 % are below the poverty line. In addition, 60 % of the city core is in a bad condition and about one fourth of the housing units have been built informally.
Based on UN-Habitat survey (UN Chronicle, 2006), 560 million (over 25%) of urban population in developing countries lack adequate sanitation.

The percentage of population with access to suitable sanitation, which stands at 12%, is significantly lower than the 53% average for the sub-Saharan Africa (UNDP, 2003).
In Addis Ababa, 29.2% of the city residents have no sanitation facilities. Out of 658 tones of waste generated per day, only 70% tones were collected by the municipal refuse collection system the remaining 30% left uncollected (Addis Ababa Health Bureau, 1997).The major sources of solid waste identified by the city government are households, commercial institutions, industries, hotels and hospitals, of which households take the lions share (Beyene, 1999).
The houses in the study area are also mostly in bad condition and inadequate for human habitation. Density of population in the area is one among the highest in the city. Rooms are over-crowded reaching well above 2.5 people per room (Liku, 2005).

UN-habitat, 2004 shows (Figure 2) the percentage non-poor households in Addis Ababa city.

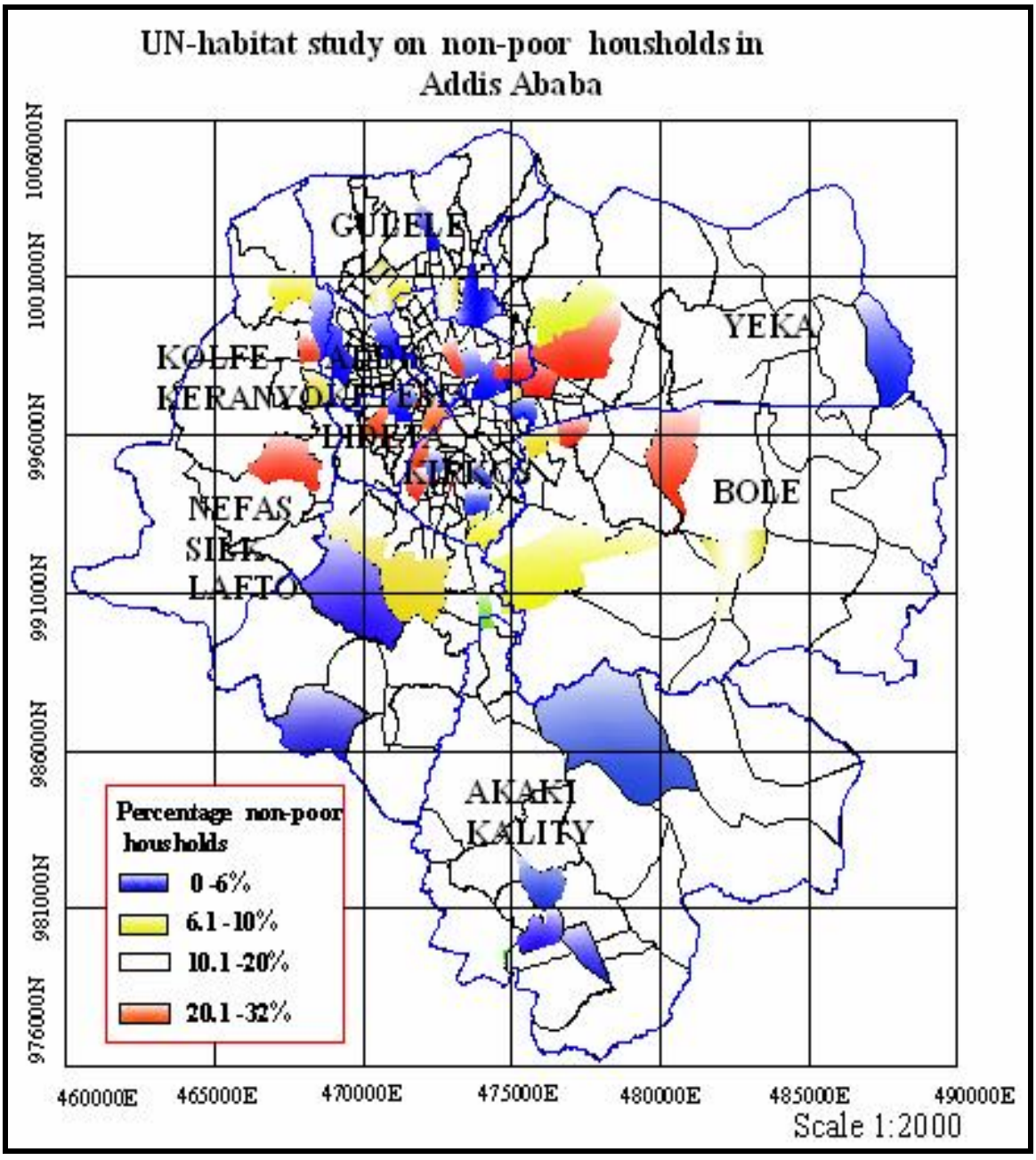


Figure 2 UN Habitat study on non poor households in Addis Ababa

2.5 Master Plan of Addis Ababa

Addis Ababa city grew spontaneously without a master plan and it was not until 1936 with the Italian occupation, that the first sketch of Addis was developed by French architect Le Corbusier but was not realized on the ground. Two Italians, Guid and C. Valle, in the same year prepared the City's master plan by dividing it into two parts "the European city" and "Native city". Some of the effects of this master plan are still evident today. The third City's master plan was prepared by Sir Patrick Abercrombie (Great London planner) and completed in 1956 with the concept of neighborhood units, radial and ring roads, and introduced satellite settlements in all directions of the City. In 1965 Luis De Marine prepared another master plan. In this plan, Arada was the center for all cities and considerable part of it was implemented. The latest master plan was prepared by Addis AAMPP during 1984-86 to serve for 20 years. The plan gave much attention to regional, metropolitan and urban hierarchy. Due to spatial and socio-economic change of the City and replacement of command economic to market led to the 1986 master plan and was revised by (ORAAMP, 2002).

The revised master plan of the Addis Ababa city was by Local Development Plan (LDP) and identified the renewal areas. This revision covers the inner city of Addis Ababa which consisted settlement areas with poor physical conditions, without proper access of basic facilities. In order to solve these problems the LDP studies for selected areas in the city. This study covered part of Arada and Lideta especially around Tekelhimanot and Piassa. The result shows that these areas are very poor in sanitation, water supply and highly populated when compared to other part of the sub cities and the place will be for renewal as its program. The LDP for Arat Kilo/Piazza was developed by the Technical University of Braunschweig (Brunswick) Institute for Sustainable Architecture and Settlement Planning in collaboration with the GTZ Low cost Housing Project. This plan consists of an integrated plan for urban renewal containing a road network, green areas, rainwater and sewage density and land use and building structures. Historical buildings would be preserved. The implementation consists of a step by step approach involving the dwellers in the renewal process. The Arada Sub city planned to establish a special LDP office responsible for the detailed planning and implementation process. The basis for the LDP is the revised by Addis Ababa Master Plan approved in 2004. Successive master plans were prepared to guide the development of the city, but their realization was very limited (Mathewos, 2000).

2.6 Contribution of Remote Sensing and GIS

Remote Sensing consists of techniques and methods to observe the earth's surface at a distance and to interpret the images or numerical values obtained in order to acquire meaningful information of a particular object on earth. Remote sensing methods are based on the use of image data acquired by a sensor such as aerial cameras, scanners or radars form a representation of the real world. An urban planner needs to identify areas in which dwellings have been built illegally (Lucas L.F. Janssen, 2001).

Nowadays, remotely sensed imageries, especially higher spatial resolution imageries like IKONOS have become indispensable to provide such kinds of needed information. Remotely sensed imageries reflect the biophysical features of the earth surface through recording their electromagnetic characteristics. The outlook features can be readily altered by the changes in land use/land cover and the changes can be relatively easily detected using remotely sensed data. Many researchers have been involved in searching for methods to obtain land use/land cover information from high resolution imageries for various urban development activities.

A unique feature of Geographic information systems particularly in regard to poverty analysis is their suitability to generate and manage data that refer to spatial areas (FAO, 2000).

GIS data consists of geographic location as a reference for each database record and can be very powerful within cities for identifying spatial growth patterns, slum locations and access to public infrastructure and land use patterns. This information can be combined with census and other data to determine the spatial dimensions of poverty and access within a city.
GIS provides the opportunity to revisit traditional methods of poverty analysis through the use of spatial data integration and innovative graphics. Perhaps more importantly, GIS allows for the examination of the innumerable causes and effects of poverty from multiple approaches, giving new outlooks into the issue. This gives a more layered and balanced view of poverty, which provides a more accurate representation of the nature of the problem.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Overview of Study the Area

Arada and Lideta sub-cities are the oldest residential and business centers in Addis Ababa located between 08º 49′ and 09º 03′ north and 38°42′ and 38°44′east.

Arada sub city contains ten kebeles and its total area is about 942ha. Besides residential areas many schools, universities, hotels, hospitals, also has big market areas like Ataklt tera, Piassa. Lideta sub city is also found in the inner city and contains nine kebeles. Its total area is about 1066ha. The sub city is mainly used for residential purpose though there are some schools, big organizations, colleges and small commercial centers.

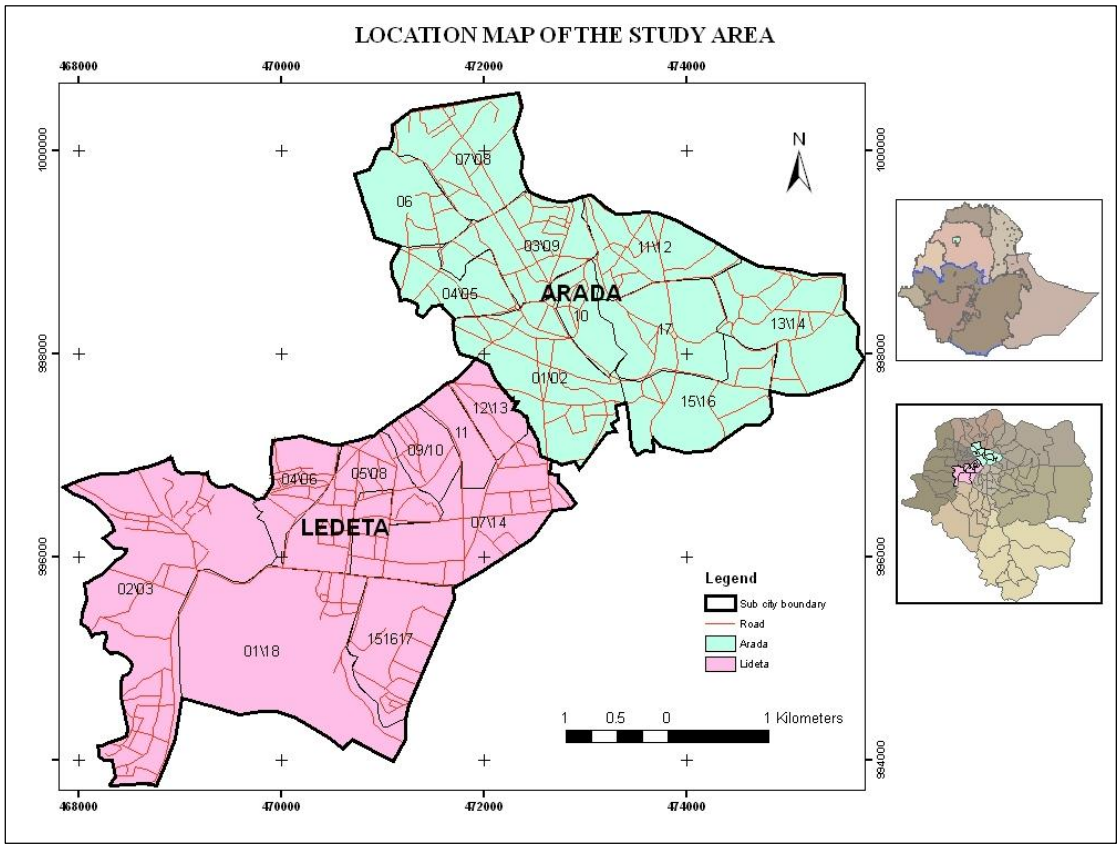


Figure 3 Location map of the study area

3.2 Data Collection

Both primary and secondary sources of data have been used. The secondary data were collected from research papers, journals, published and unpublished materials, web-sites, Topography map (1:50,000) and Addis Ababa map (1:25,000), Aerial photographs, remotely sensed satellite images (Ikonos) and other available works. Primary data were colleted from households using questionnaire.

3.2.1 Site and Sample Selection of the Study

The selection was performed based on the following criteria: -

1. All sub-cities of the inner city of Addis Ababa were considered with regard to their population density and age of settlements.

2. Two sub-cities i.e. Arada and Lideta were selected due to the highest prevalence of poverty and poor housing conditions in them when compared to the others.

3. After identifying the two sub cities, at first stage, from each kebele's house numbers list, list of sampled households were prepared and numbered from the general list of residential house number of respective kebeles (which were used as a sample frame). Then from the sample frame the sample of households were drawn by using systematic random sampling. Following that 400 households were chosen from total households of 120207 by using quota sampling method with equal proportion of households irrespective to their total proportion.

3.2.2 Data Collected from the Study area

For the purpose of analysis both primary data and secondary data were collected from the two sub cities of Addis Ababa**.** Primary data were collected in the study area included water supply and toile use.

Questionnaire was developed to conduct the survey and collect quantitative data from the socio-economic, housing conditions and infrastructure development of the area. The survey was mainly conducted with the household head but whenever the heads were not available the heads spouses were interviewed. After having gathered the required information, the responses were tabulated and analyzed by using different statistical tools. In order to see the

effect of household characteristics such as age, sex, marital status, education, occupational status, and housing quality and ownership patterns, the change in percentage were used. Such technique has given the highest and lowest value. Using the value or it can express the data precisely and meaningfully. In addition to support the survey questioner the housing type and building materials were collected. Photographs were used as visual data collection tools. Besides, the secondary data were collected from kebele administration and CSA like population data, existing number of houses and expenditure of each kebele.

According to the recently division the two sub cities (Arada and Lideta) having nineteen sub division kebeles. The secondary data were used for the analysis such as expenditure or daily food intake of individual households collected by CSA. Additionally population data and total number of houses in each kebele were collected from Kebeles administration, and Addis Ababa Finance Bureau. For the urban poverty map production the criteria were selected based on the poverty indicators mentioned in chapter two such as access indicators and expenditure indicators. For the purpose of analysis the researcher used population and house densities of each kebele got from kebele stastics. In addition water supply, toilet use access and expenditure situation of the two sub cities were derived.

3.3 Data Processing

Remote Sensing, GIS and Multicriteria Decision Making method used to accomplish the analysis based on the aim of the objectives. The survey data were collected from the field put into a computer using Excel 2003 software. Depending on the nature of the data gathered, the information were made into tables and then analyzed using percentage and simple correlation analysis, followed by interpretations. Both the data from documents as well the information acquired through households surveys were considered as qualitative data. Then the data were analyzed using GIS 9.1 Software. ERDAS 8.6 was used to analyze remotely sensed data such as georeferenced, digitized images, and clipped. Finally, the data presented as such by using tables, graphs, ratios, rates and percentages were used to make the generalizations and the conclusions of the study. IDRISI 32 was used to derive weight or a best-fit set of weights for the calculation of the principal eigenvectors. Each standard criterion maps multiplied by its weight, then the results were summed and then used to produce poverty map.
Figure 4 shows the general flow of work in the study.

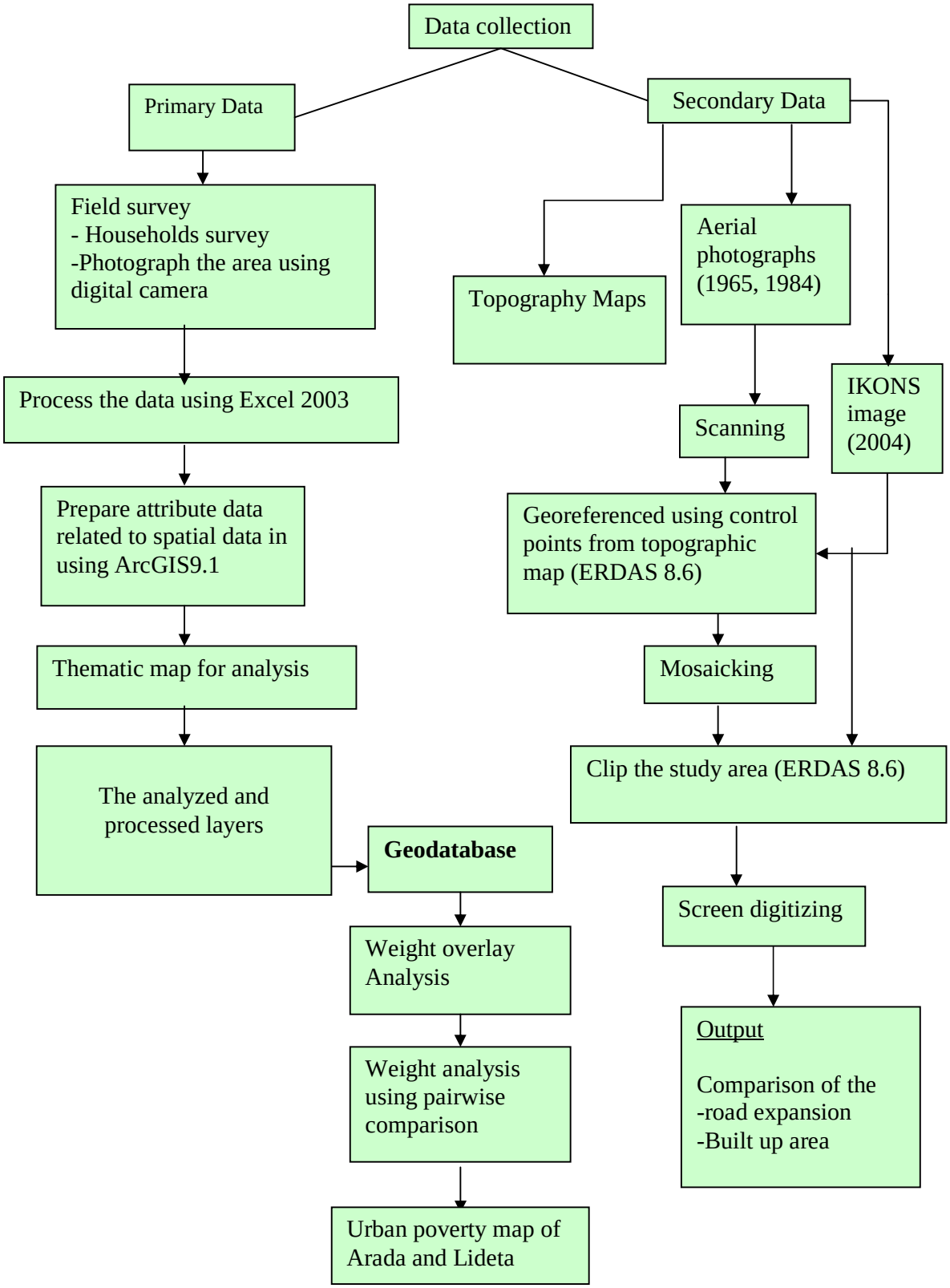


Figure 4 General flow of work

In order to create poverty area map of Arada and Lideta the following primary and secondary data were used as input as follow as:-

3.3.1 Population Data

The distribution of total population collected from each kebele administration of the two sub cites shows in table 3.

Table 3 Total population in each kebele

	kebele	Population	Sub city	Kebele	Population
Arada	01/02	38441	Lideta	01/18	29902
	03/09	38613		02/03	35511
	04/05	35365		04/06	43766
	06	21253		05/08	48587
	07/08	41191		07/14	53946
	10	22511		09/10	55259
	11/12	33153		11	28998
	13/14	42511		12/13	28020
	15/16	35412		15/16/17	20937
	17	22553			

Source: Kebele administration, 2006

3.3.2 Number of Households

These data collected from in each kebele administration

Table 4 Total number of households in each kebele

Sub city	kebele	Households	Sub city	Kebele	Households
Arada	01/02	7688	Lideta	01/18	5980
	03/09	6435		02/03	5918
	04/05	7073		04/06	7294
	6	4250		05/08	8098
	07/08	8238		07/14	7707
	10	3216		09/10	7894
	11/12	6631		11	4833
	13/14	8502		12/13	4670
	15/16	7082		15/16/17	4187
	17	4511			

Source: Kebele administration, 2006

3.3.3 Expenditure

The input data obtained from the 2004/5 household income, consumption and expenditure surveys and the Welfare monitoring survey of the central statistical Agency. Data processing activities were undertaken by chosen the amount of daily food in take below 2200 kcal per person. This approach uses by WHO and CSA for under developing countries. The following table 5 shows the number of population below the minimum food intake using CSA standard.

Table 5 Daily food intake below 2200kcal/person in each kebele

Sub city	kebele	Population	Sub city	Kebele	Population
Arada	01/02	16145	Lideta	01/18	13157
	03/09	14673		02/03	5327
	04/05	8841		04/06	9629
	6	-		05/08	25265
	07/08	18124		07/14	23197
	10	8779		09/10	1175
	11/12	17240		11	9859
	13/14	5952		12/13	15691
	15/16	17352		15/16/17	11934
	17	6540			

Source: CSA, 2004/05

3.3.4 Toilet Use

The availability of toilet facilities in housing units is essential for assuring a suitable environment for the well being of the community. This data were collected from interviews using questioners. The data incorporated with household who have no toilet and communal toilet users and toilet who owned by private were collected in the two sub cities. The following table 6 shows the toile availability in the two sub cities.

Table 6 Toilet availability in the two sub city

Sub city	Kebele	Sample taken	Communal and no toilet	Private toilet use	Sub city	Kebele	Sample taken	Communal and no toilet	Private toilet use
Arada	01\02	24	16	8	Lideta	1\18	20	6	14
	03\09	20	12	8		02\03	20	4	16
	04\05	22	11	9		04\06	20	14	6
	6	17	10	7		05\08	26	19	7
	07\08	25	16	9		07\14	25	19	6
	10	15	12	3		09\10	25	18	7
	11\12	20	11	9		11	20	15	5
	13\14	27	6	21		12\13	19	13	6
	15\16	22	15	7		15\16\17	15	9	6
	17	18	7	11					

Source: Field Survey, 2008

3.3.5 Water Use

The data were collected from the households that have no water and communal use with around their yards. Those who have no water access they used from public tap or private water vendors.

Table 7 Water availability in the study area

Sub city	Kebele	Sample taken	Communal and no water	Private water users	Sub city	Kebele	Sample taken	Communal and no water	Private water users
Arada	01\02	24	10	14	Lideta	1\18	20	7	13
	03\09	20	13	7		02\03	20	3	17
	04\05	22	11	11		04\06	20	16	4
	6	17	10	7		05\08	26	5	21
	07\08	25	15	10		07\14	25	18	7
	10	15	7	8		09\10	25	18	7
	11\12	20	11	9		11	20	14	6
	13\14	27	6	21		12\13	19	13	6
	15\16	22	6	16		15\16\17	15	10	5
	17	18	5	13					

Source: Field Survey, 2008

CHAPTER FOUR

4. Results and Analysis

4.1 Remote Sensing Analysis

The temporary change of the study area for the past three decades was derived from Arial photograph which was prepared by EMA 1965, 1984 and IKONES image. All the Aerial photograph image data were georeferenced in WGS84.

Digitizing features that represent urban built-up areas and roads were performed the classification scheme used for this research. This has allowed an overall assessment of changes over the past three decades.

4.1.1 Geocoding and Georeferencing

The aerial photographs data were georeferenced using a minimum four points from the known map projection of 1:50,000 topographic maps.

4.1.2 Mosicking Aerial photographs and Clipping Study Area

The Georegistered images were converted into mosicking according to their common characteristics. Therefore, each composite grid was resampled, using the nearest neighbor resampling to have the same map extent as the zonal grid reproduced from the vector map coverage.

4.1.3 General Classification and Analysis Using Remote Sensing

The georeferenced aerial photograph and Ikons images were used to extract information i.e. built up area and road network of the two subcities. The digitized layer was edited and created topology in order to generate boundary relationships between lines and polygons. Followed by the area and length calculation for each built up and land using ArcGIS 9.1.

4.1.3.1 Road Network

Road distribution is one of the crucial factors for a city where the transportation of materials and the passengers. It has strong impact on the development activity of urban land use. Figure 5, 6, and 7 shows the road network in the year 1965 to 2004.

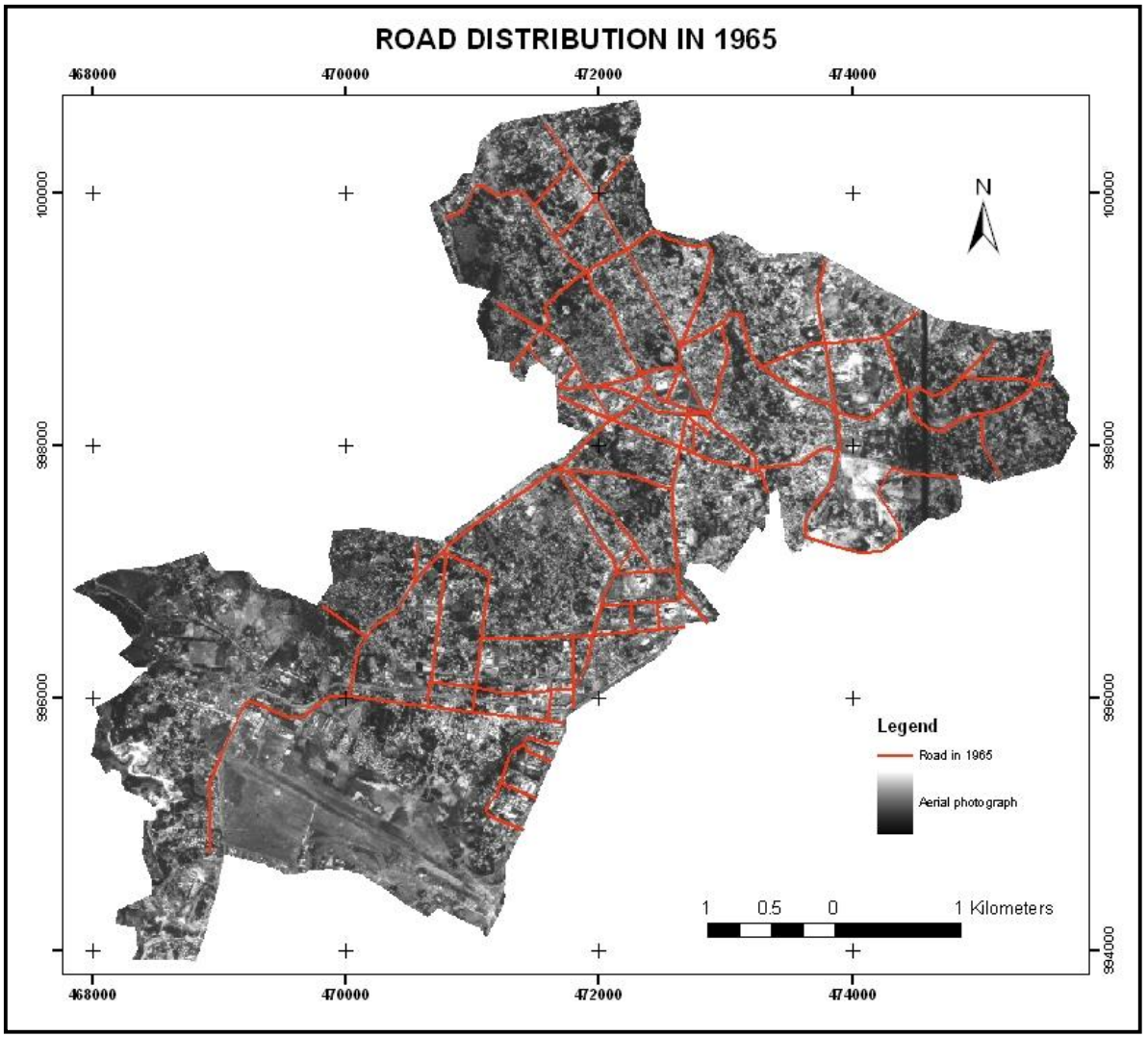


Figure 5 Road distribution in 1965

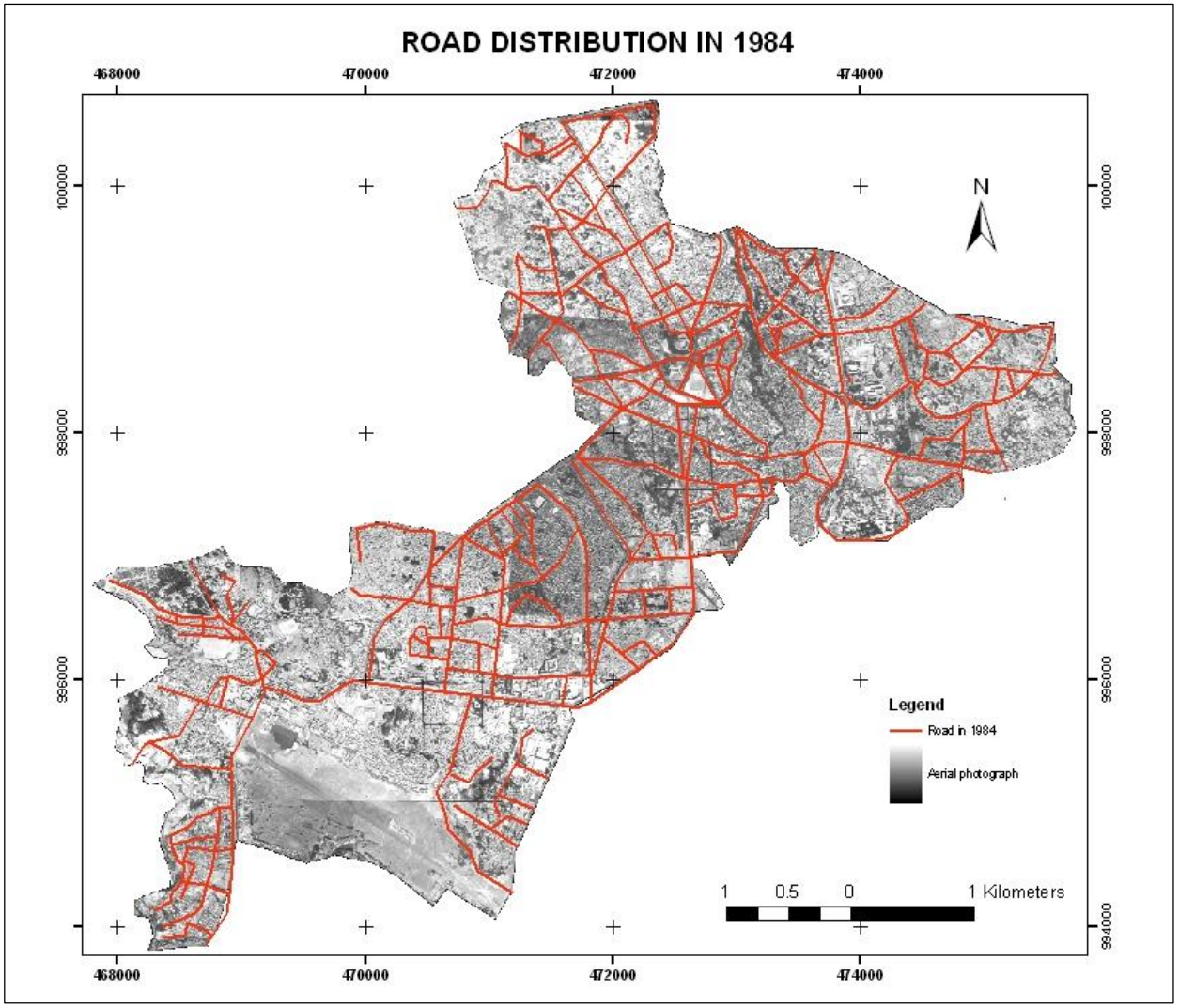


Figure 6 Road distribution in 1984

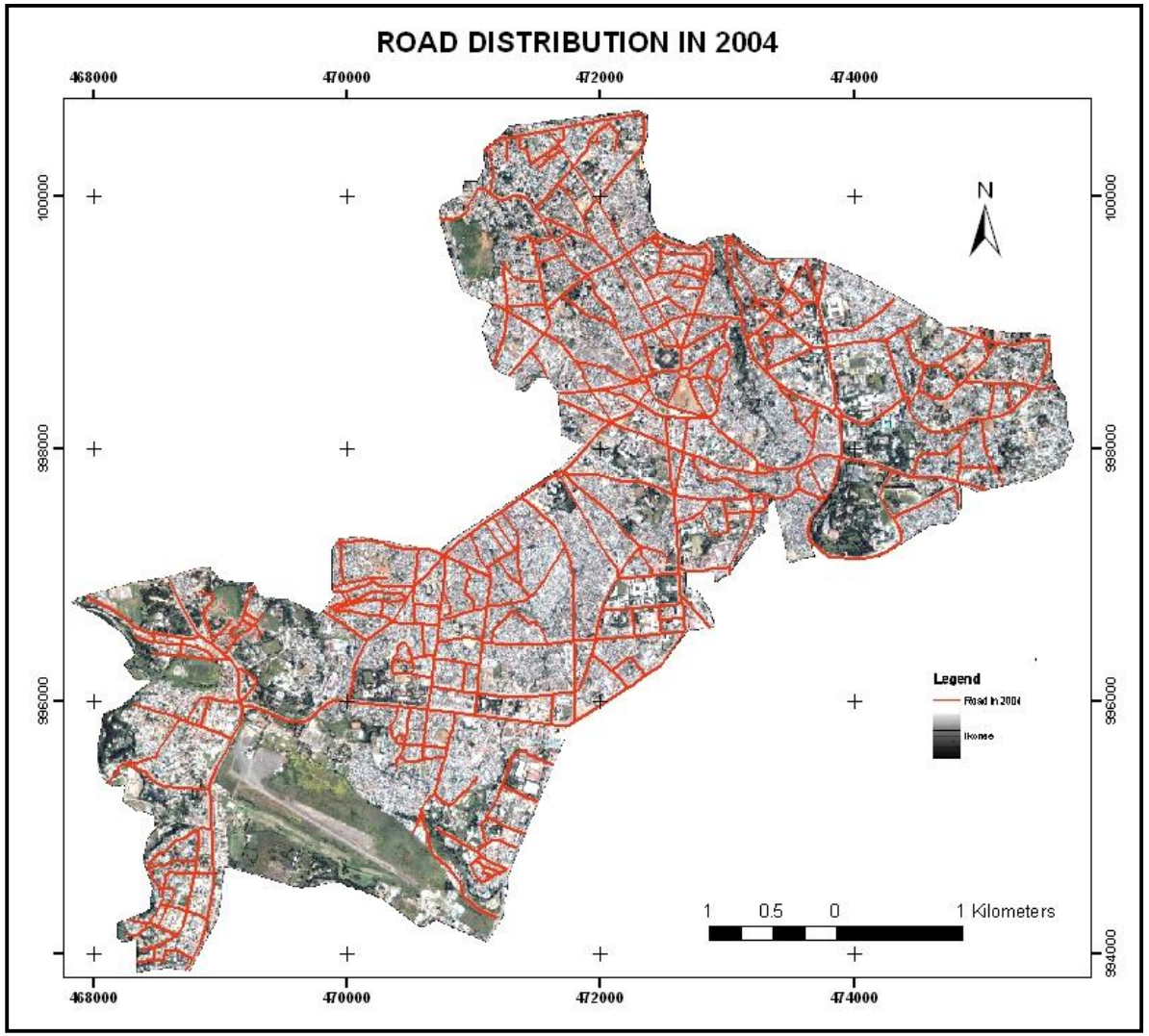


Figure 7 Road distribution in 200

Table 8 Percentage change of road between year 1965 to 1984 and 1984 to 2004

Year of image captured	Types of image	Length of roads(Km)	Change	% change
1965	Aerial photograph	55.51	-	-
1984	Aerial photograph	112.68	57.17	103
2004	Ikonos	126.05	13.37	11.87

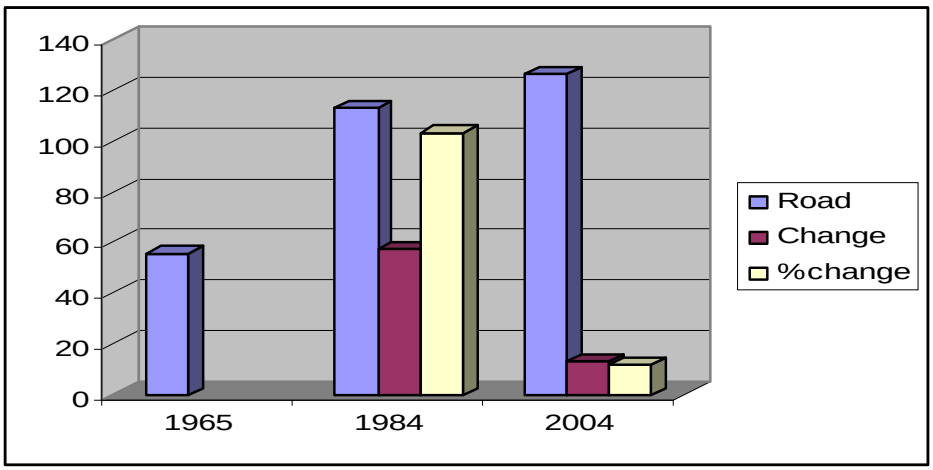


Figure 8 Percentage change of road from 1965 to 1984 and 1984 to 2004

4.1.3.2 Built up Area

The built area of Arada and Lideta subcities are considerably expanding since their establishments. The Classification and temporal change analysis using remote sensing data helps to show frequent land Changes in the two subcities. Using ArcGis9.1 the georeferenced images were digitized for the extraction of built up area and then the area calculated in different years. The change of built up area in the two subcities from year 1965 to 2004 shows in figure 9, 10, and 11.

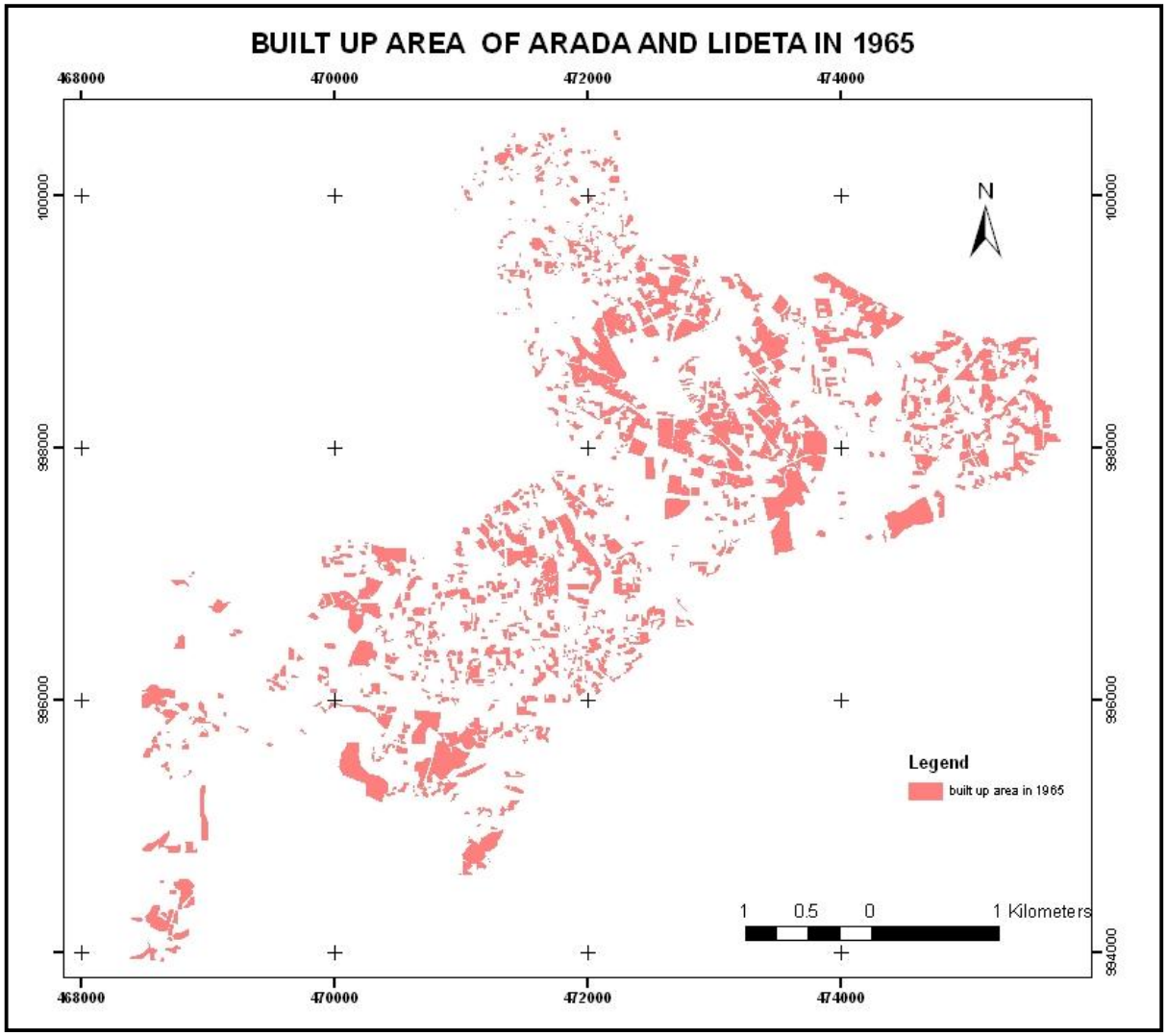


Figure 9 Built up area in 1965

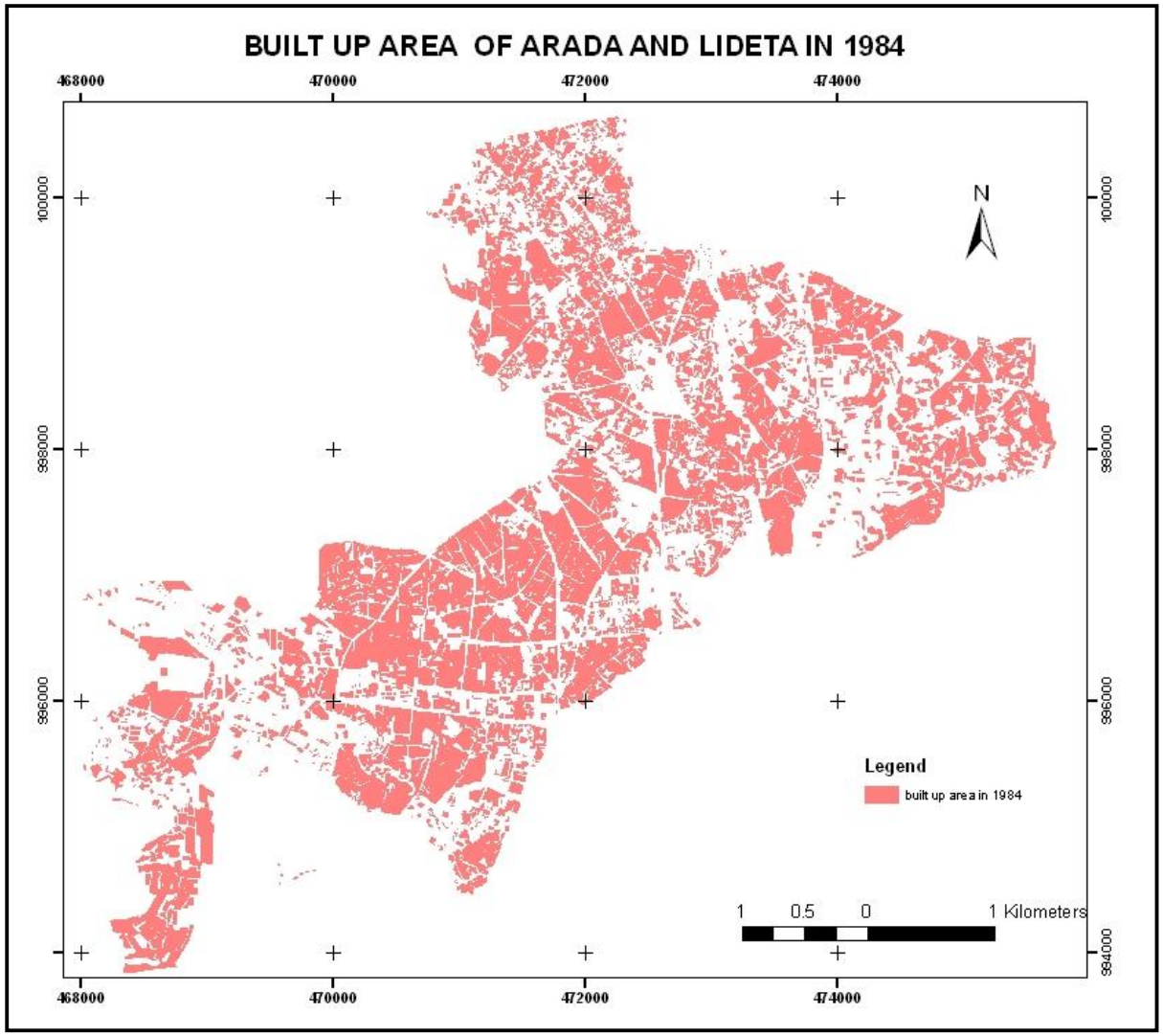


Figure 10 Built up area in 1984

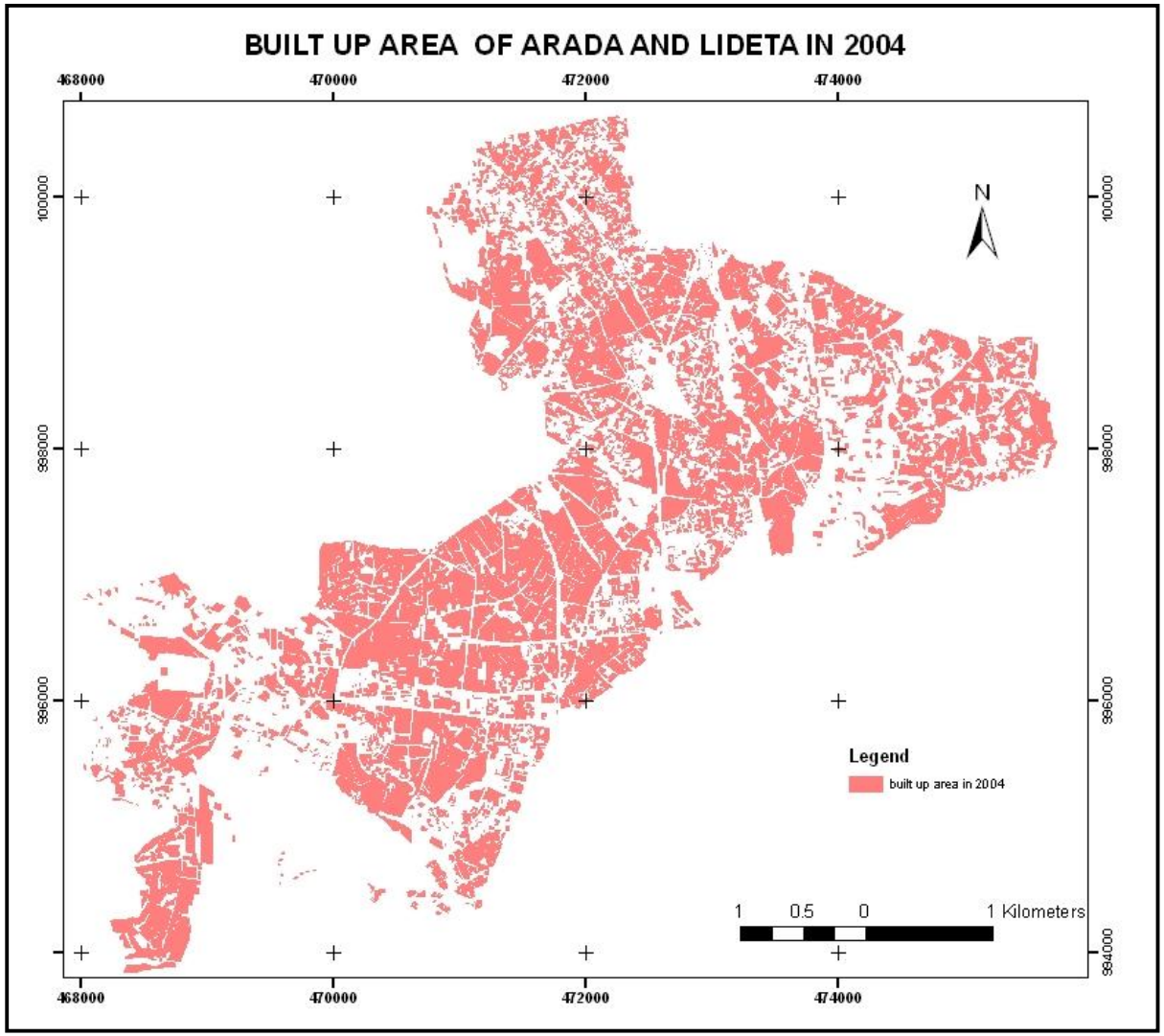


Figure 11 Built up area in 2004

Table 9 Percentage change of built up area between year 1965 to 1984 and 1984 to 2004

Year when image was captured	Types of image	Built up Area (ha)	Change (ha)	% change
1965	Aerial photograph	440	-	-
1984	Aerial photograph	983	543	123.4
2004	Ikonos	1016	33	6.1

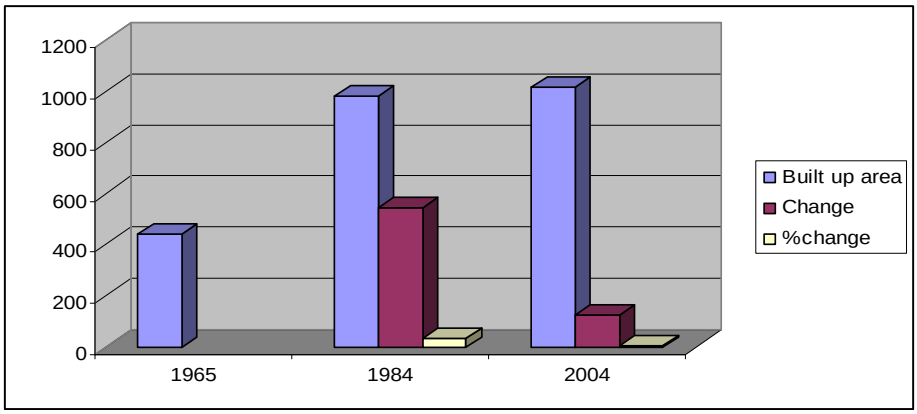


Figure 12 Percentage change of built up area from 1965 to 1984 and 1984 to 2004

4.2 GIS Analyses Method

The secondary data obtained from CSA and population data from kebele stastics were processed in ArcGis9.1 that is used for the analysis. In addition the collected primary data about water supply and toilet uses were used for the analysis.

4.2.1 Population Density of Arada and Lideta

Population density is one of the criteria used for the production of poverty map. It was computed from the population data and the area of each kebele. Table 10 shows the processed population density of each kebeles in the two sub cities.

Table 10 Population density per ha in each kebele

Sub city	Kebele	Population	Area(ha)	Population Density (people per ha)
Arada	01/02	38441	146	263
	03/09	38613	96	402
	04/05	35365	56	632
	06	21253	62	343
	07/08	41191	114	361
	10	22511	39	577
	11/12	33153	91	364
	13/14	42511	133	320
	15/16	35412	105	337
	17	22553	100	226
Lideta	01/18	29902	255	117
	02/03	35511	297	120
	04/06	43766	58	755
	05/08	48587	86	565
	07/14	53946	155	348
	09/10	55259	44	1255
	11	28998	31	935
	12/13	28020	38	737
	15/16/17	20937	102	205

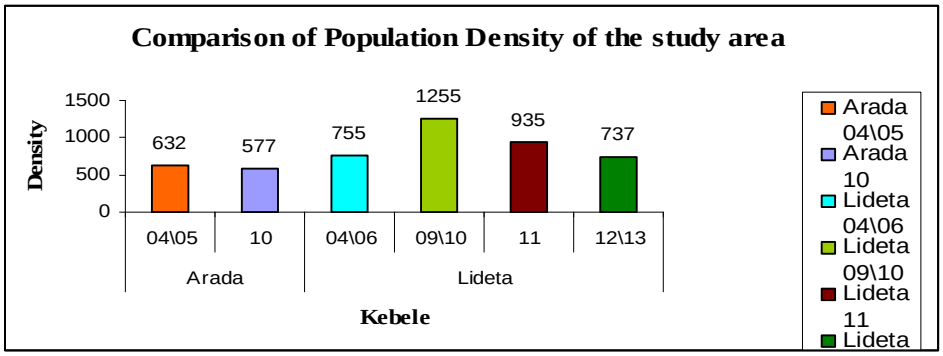


Figure 13 Comparison of population density of Arada and Lideta

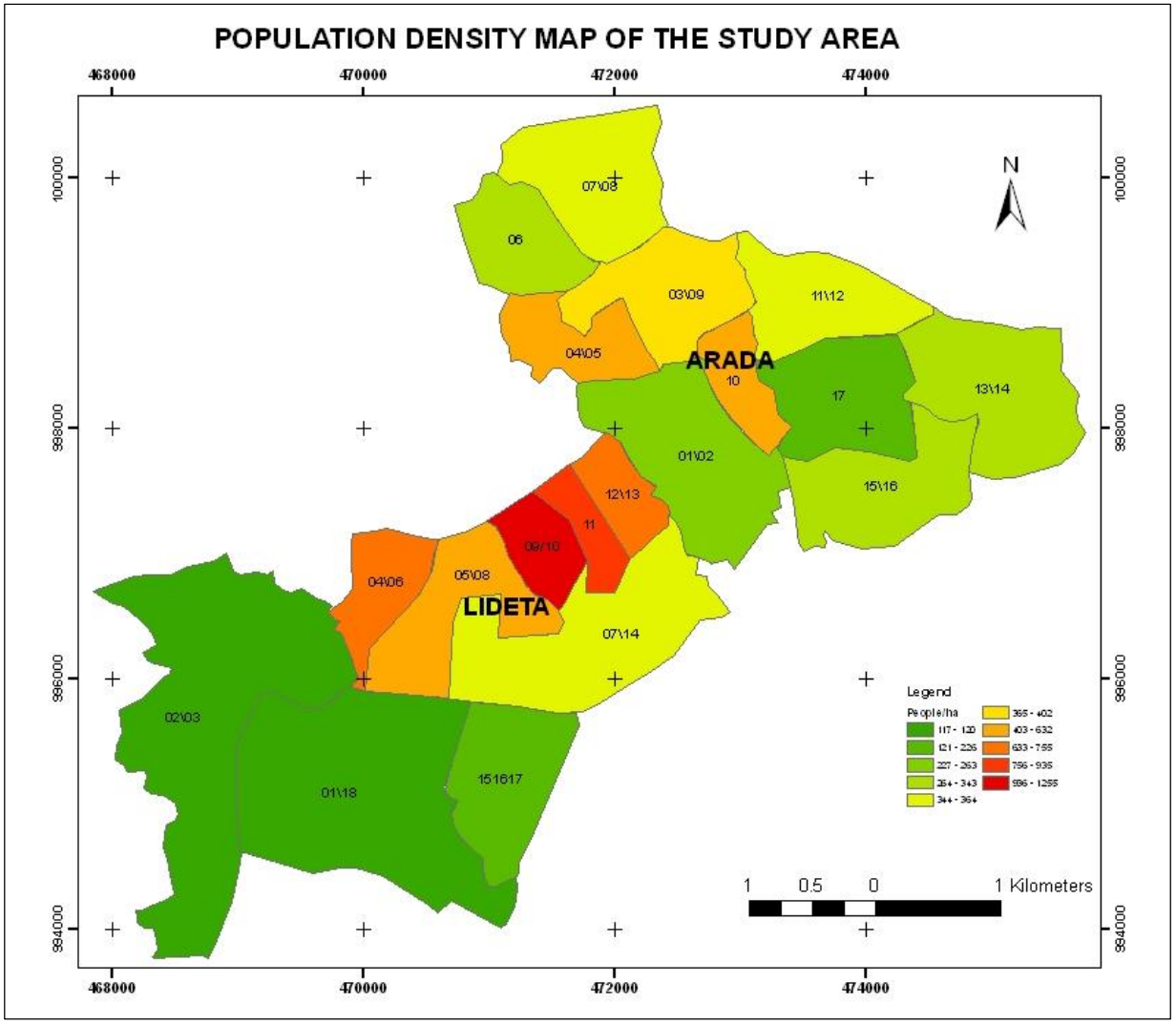


Figure 14 Population density map of the study area

4.2.2 Housing Density

The house density was computed from total number houses and area of each kebele. House density of the two sub cities (Kebele statistics, 2006) shown in table 11.

Table 11 Total house density per ha in each kebele

Sub city	kebele	Number of household	Area (ha)	House Density per ha
Arada	01/02	7688	146	53
	03/09	6435	96	67
	04/05	7073	56	126
	06	4250	62	69
	07/08	8238	114	72
	10	3216	39	82
	11/12	6631	91	73
	13/14	8502	133	64
	15/16	7082	105	67
	17	4511	100	45
Lideta	01/18	5980	255	23
	02/03	5918	297	20
	04/06	7294	58	126
	05/08	8098	86	94
	07/14	7707	155	50
	09/10	7894	44	179
	11	4833	31	156
	12/13	4670	38	123
	15/16/17	4187	102	41

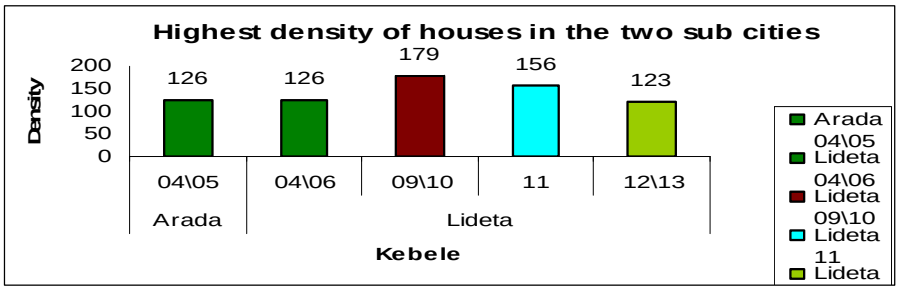


Figure 15 Highest house densities in the two sub cities

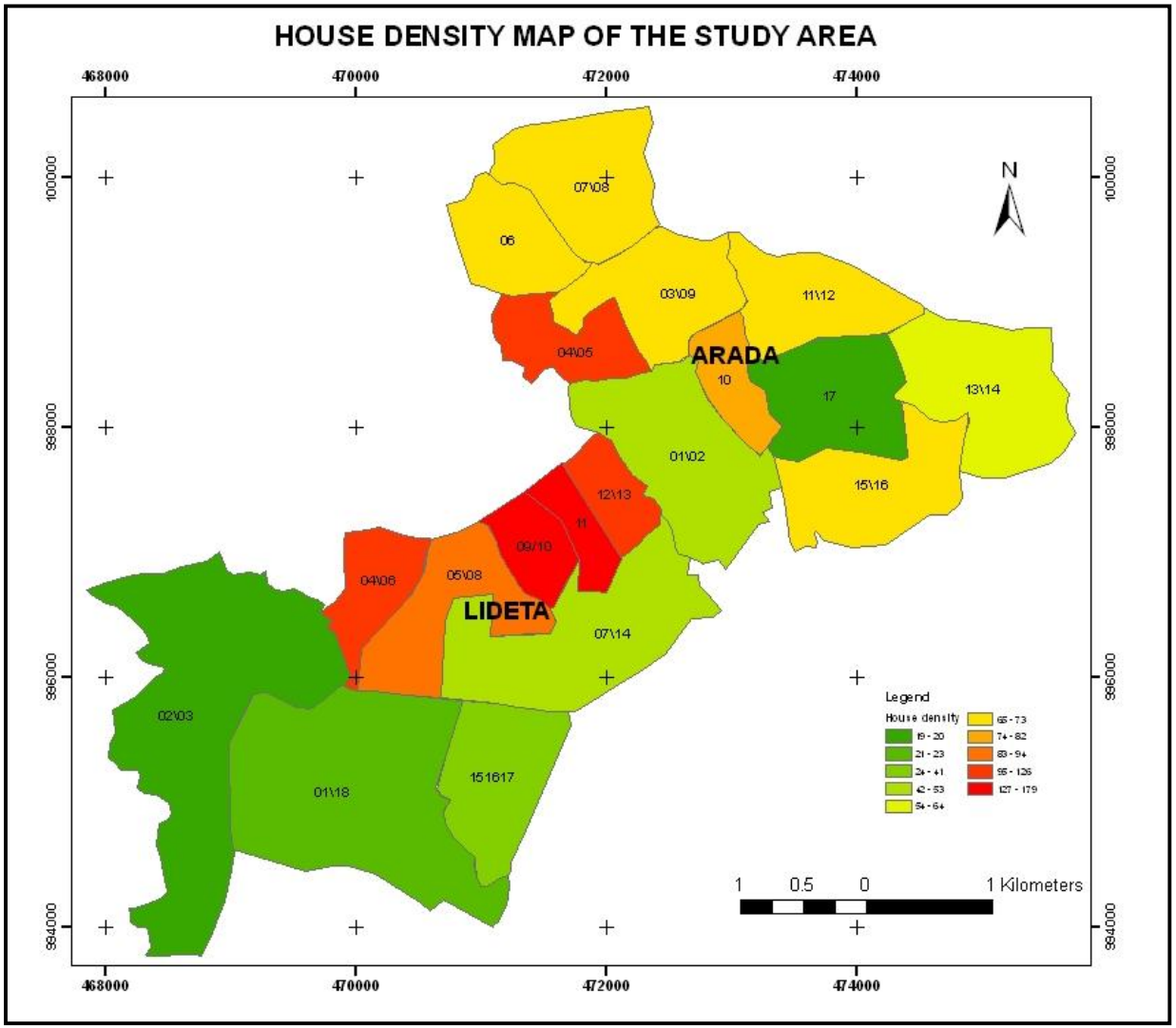


Figure 16 Houses density map of the study area

4.2.3 Expenditure

The calculated population density of daily calorie intake less than 2200 kcal per person in each kebele shown in table 12.

Table 12 Population density of minimum food per day/person

Sub city	Kebele	Population minimum energy per day	Area(ha)	population Density of daily consumption<2200kcal/person)
Arada	01\02	16145	146	111
	03\09	14673	96	153
	04\05	8841	56	158
	6	-	62	-
	07\08	18124	114	159
	10	8779	39	225
	11\12	17240	91	189
	13\14	5952	133	45
	15\16	17352	105	165
	17	6540	100	65
Lideta	1\18	13157	255	52
	02\03	5327	297	18
	04\06	9629	58	166
	05\08	25265	86	294
	07\14	23197	155	150
	09\10	1175	44	27
	11	9859	31	318
	12\13	15691	38	413
	15\16\17	11934	102	117

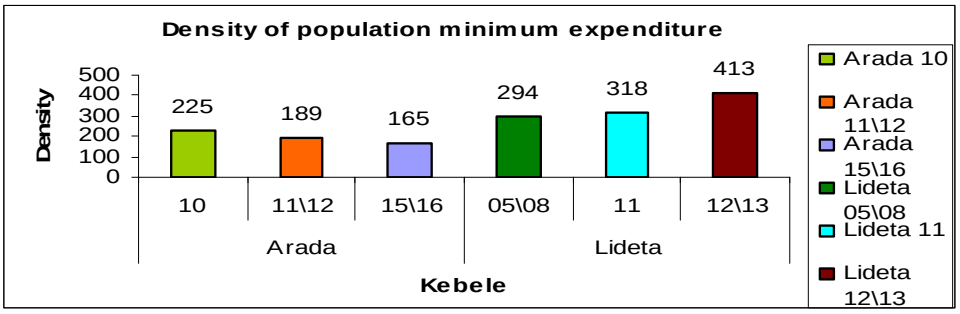


Figure 17 Highest population densities of minimum expenditure in the two sub cities

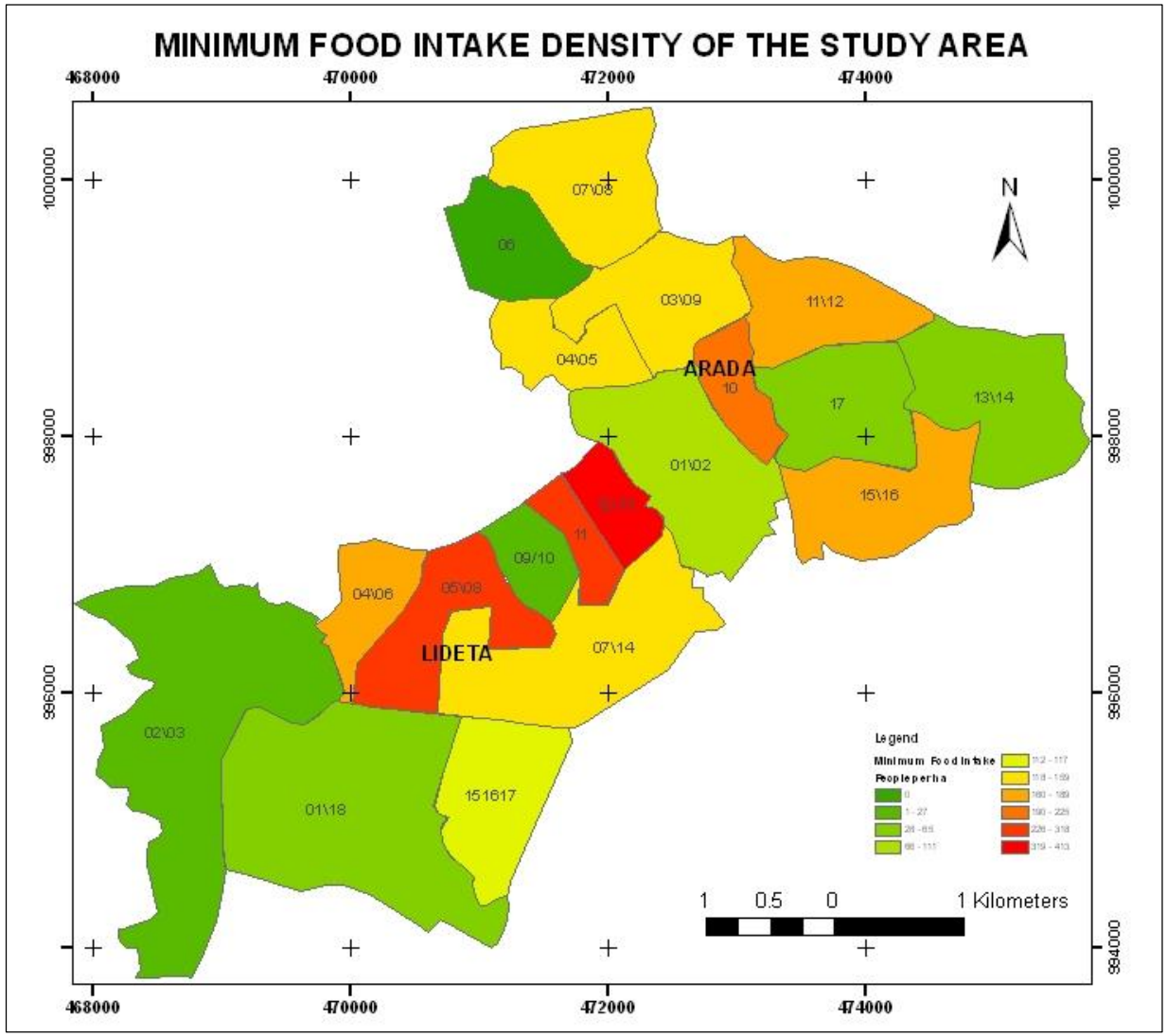


Figure 18 Minimum food intake density map of the study area

4.2.4 Toilet use Density

Toilet use data were collected from households survey using questionnaire converted in to percentage and then multiplied by the total households in each kebele. For instance the percentage toilet shortage of kebele 01/02 in Arada is 65%. This percentage multiplied by the total households (7688). Finally the houses density that has no toilet and toilet use in common in the two subcities was computed from the above result by dividing the area of each kebele. Table 13 shows the calculated toilet shortage households density.

Table 13 Households density who have no and shared one toilet for many

Sub city	Kebele	HHs who have no toilet and Communal toilet	Area(ha)	Density of houses
Arada	01\02	4997	146	34
	03\09	3926	96	41
	04\05	3466	56	62
	6	2593	62	42
	07\08	5190	114	46
	10	2541	39	65
	11\12	3647	91	40
	13\14	1785	133	13
	15\16	4887	105	47
	17	1804	100	18
Lideta	1\18	1914	255	8
	02\03	1065	297	4
	04\06	5281	58	91
	05\08	5830	86	68
	07\14	5703	155	37
	09\10	5763	44	131
	11	3576	31	115
	12\13	3176	38	84
	15\16\17	2554	102	25

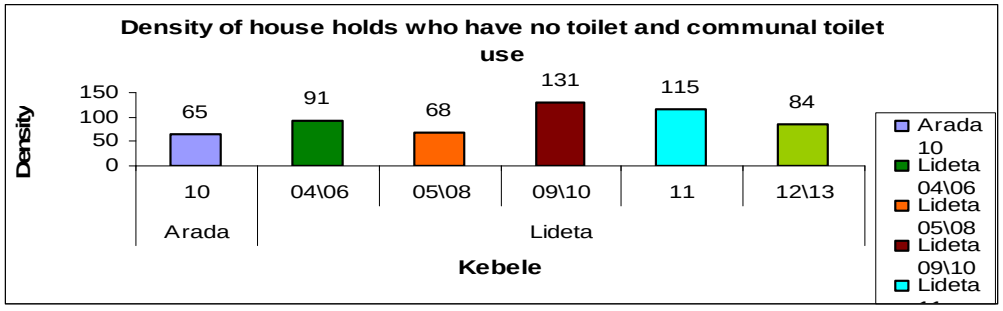


Figure 19 Densities map of who have no toilet and common toilet use

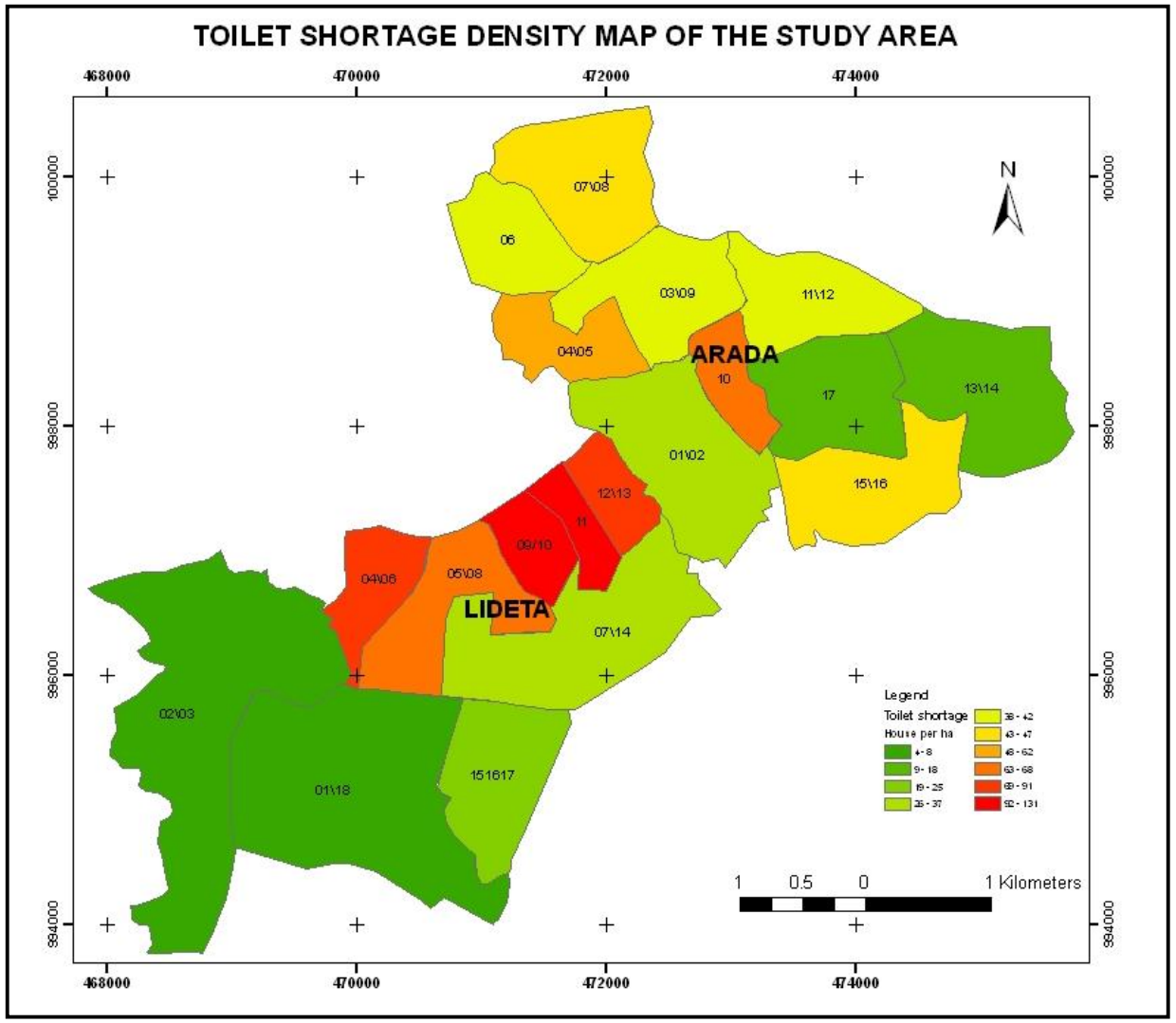


Figure 20 Densities of households who have no toilet and shared toilet use

4.2.5 Water Scarcity Households Density

The shortage of water scarcity density data were computed based on the households surveyed results. The percentage result multiplying by the total households in each kebele was given the density of households in each kebele. For example kebele 01/02 in Arada sub city, 43% (7688) of the water supply is communal and public or private vendor water tape users. Followed by the water scarcity households density was calculated dividing the above result by the area of each kebele. The result shows in the following table 14.

Table 14 Water scarcity households density

Sub city	Kebele	Public and Communal water tap use in the Kebele	Area (ha)	Density of house holds in each kebele
Arada	01\02	3306	146	23
	03\09	4183	96	44
	04\05	3537	56	63
	6	2508	62	40
	07\08	5025	114	44
	10	1479	39	38
	11\12	3779	91	42
	13\14	1956	133	15
	15\16	2054	105	20
	17	1218	100	12
Lideta	1\18	2093	255	8
	02\03	888	297	3
	04\06	5690	58	98
	05\08	1620	86	19
	07\14	5549	155	36
	09\10	5684	44	129
	11	3480	31	112
	12\13	3269	38	86
	15\16\17	2889	102	28

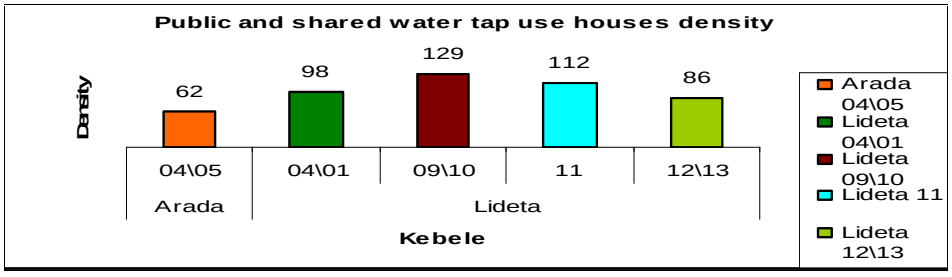


Figure 21 Density of households public and shared water use in the two sub cities

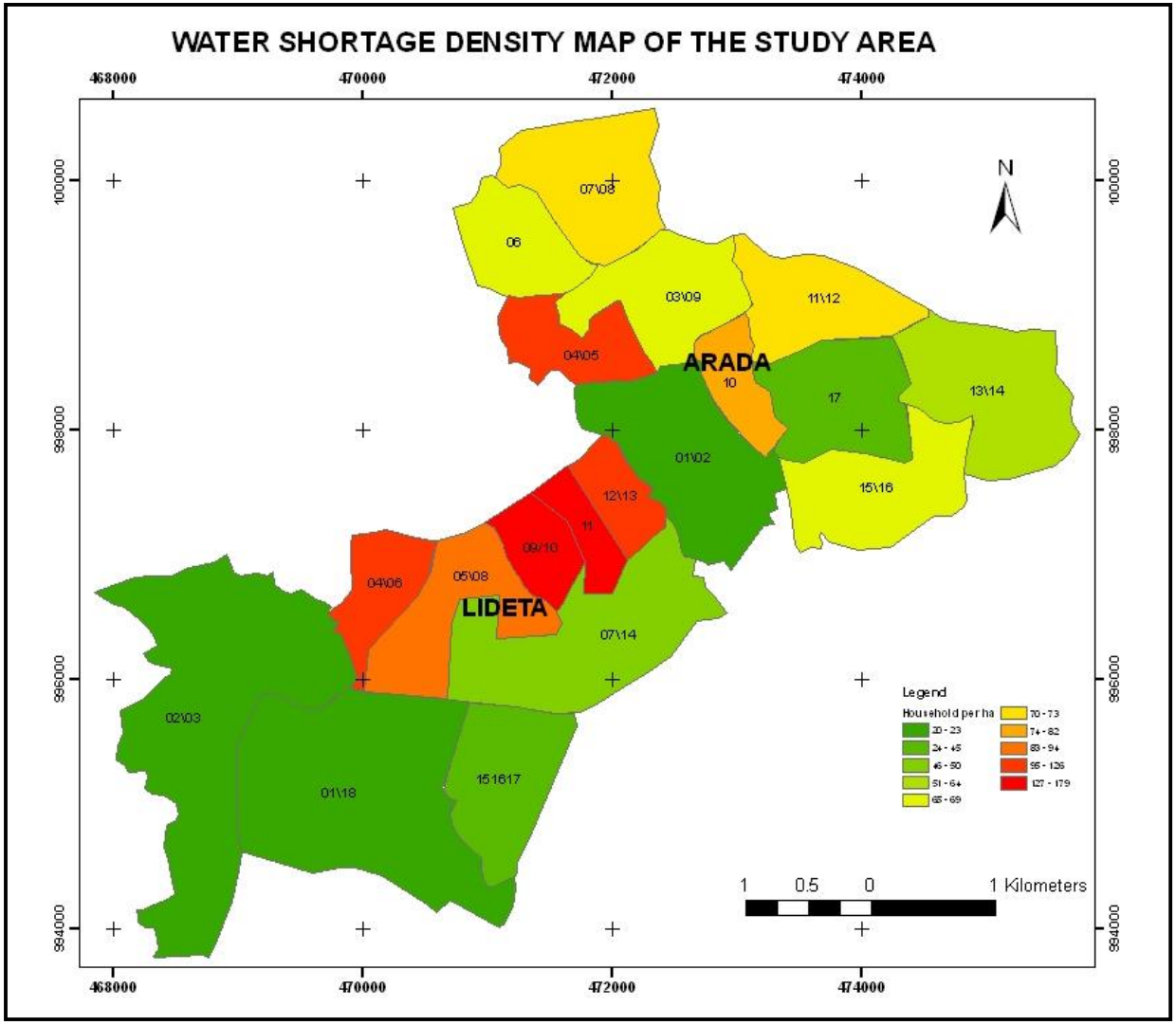


Figure 22 Public and shared water use density map of the two sub cities

4.3 Tabular Data for Standard Criteria Map

4.3.1 Multicriteria Decision Making

Multi-Criteria Decision Analysis (MCDA), or Multi Criteria Decision Making (MCDM), is a discipline aimed at supporting decision makers who are faced with making numerous and conflicting evaluations. MCDA aims at highlighting these conflicts and deriving a way to come to a compromise in a poverty analysis process (Malczewski Jacek, 1999).

4 .3.2 Reclassification

By reclassifying, the researcher modified the values in an input raster and save the changes to a new output raster. When reclassifying by ranges of values, the reclassification functions require the lower and upper bounds of the existing values on the input raster and the alternative value to assign to the range of values. All values on the original raster that fall within the specified range of values were received the alternative value assigned to that range. The range boundary breaks were handled differently in the different functions. That is, if the ranges are specified 1–4, the value 4 was assigned to the lower density, and the value 1 assigned highest density in the two sub cities. The value existed in between 1 and 4 ranked according to the concentration of their density.

In the following maps, ranges to new reclassified values reclassified the original values from Base Raster. The reasons of this, including replacing values based on new information, grouping entries, reclassifying values to a common scale (the reclassified criterion maps shown in figure 23, 24, 25, 26, and 27).

4.4 Criteria Maps

4.4.1 The five criterion maps

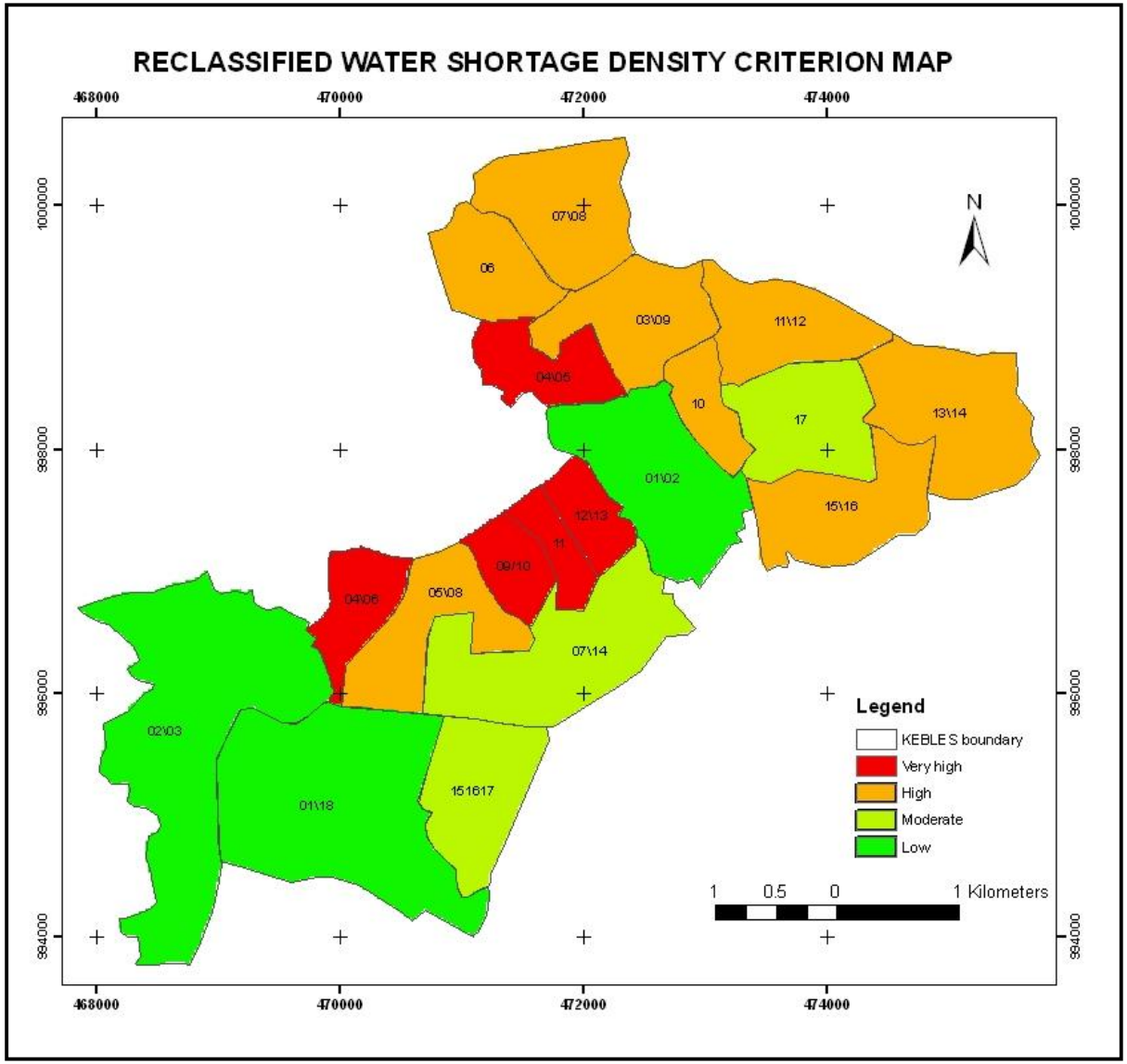


Figure 23 Reclassified water supply shortage density criterion map

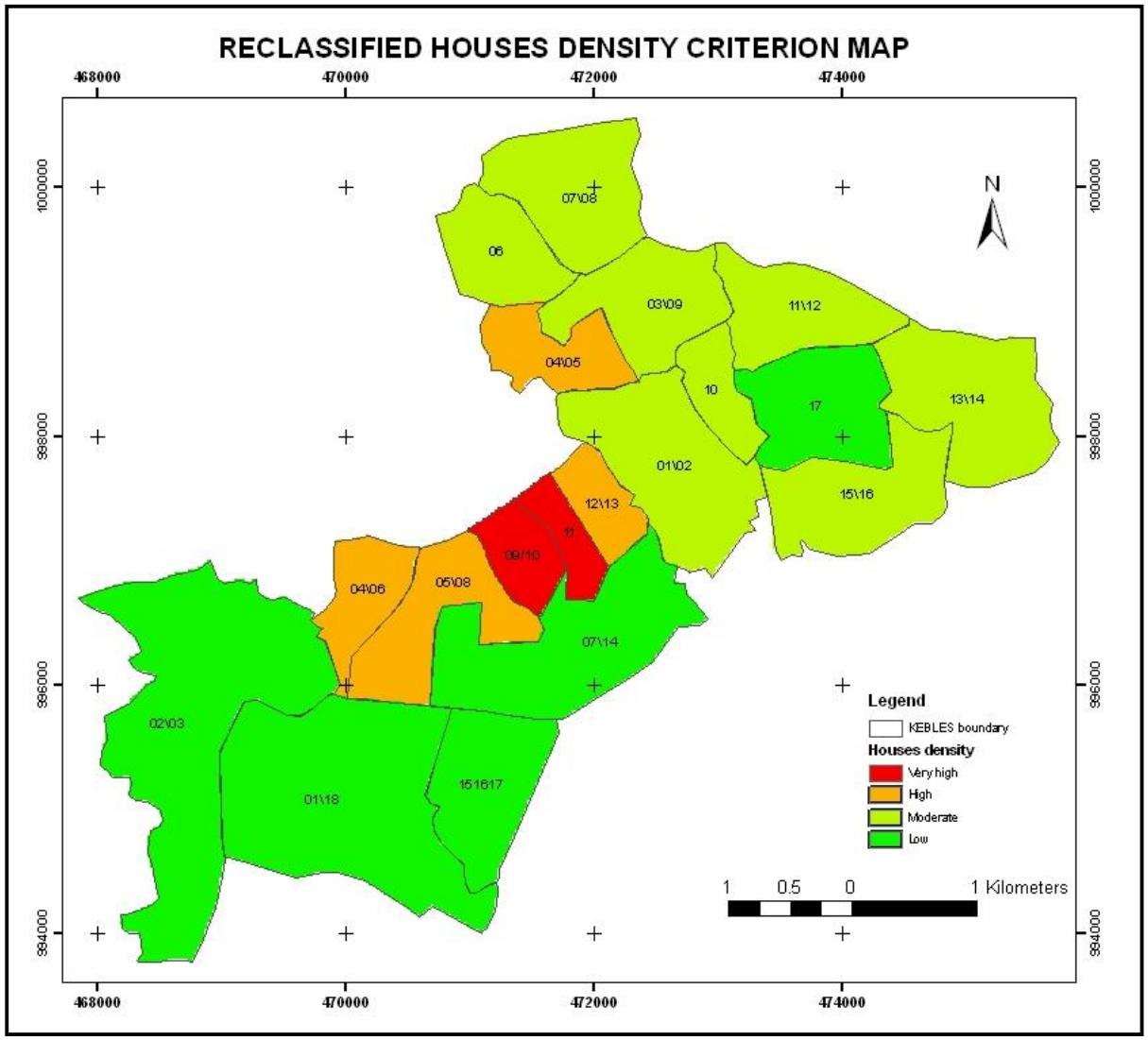


Figure 24 Reclassified house density criterion map

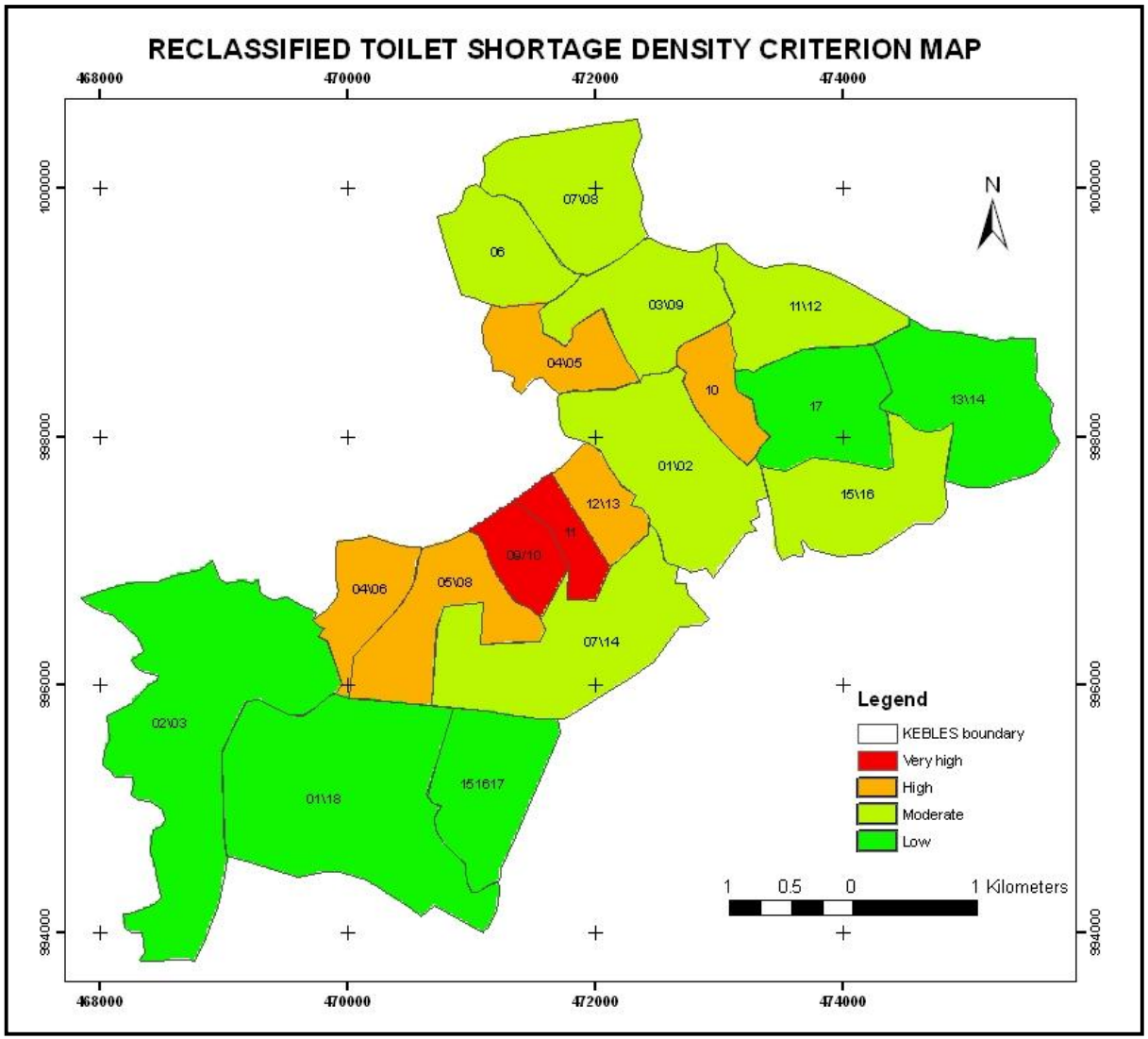


Figure 25 Reclassified toilet shortage density criterion map

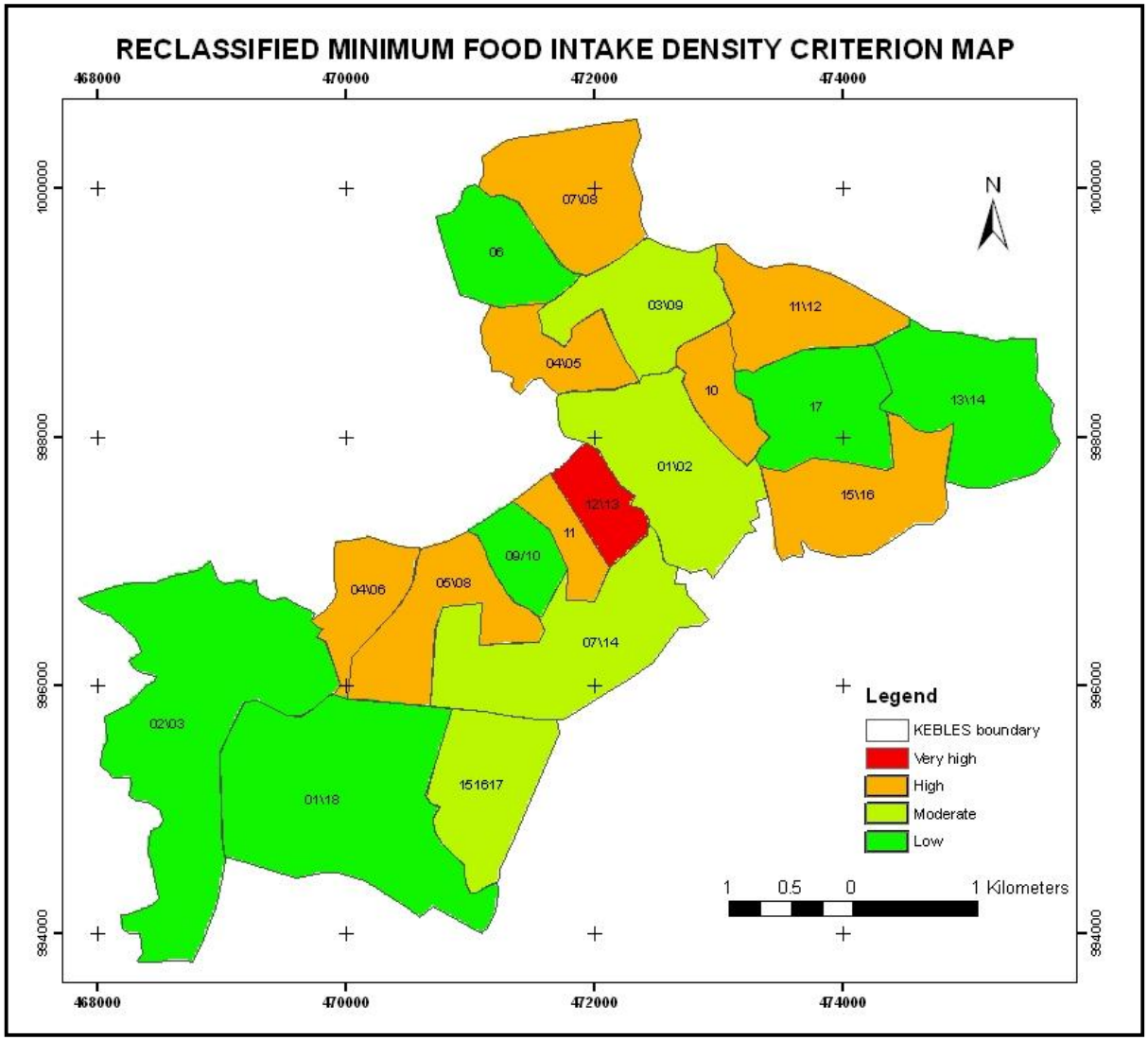


Figure 26 Reclassified density of minimum food in take criterion map

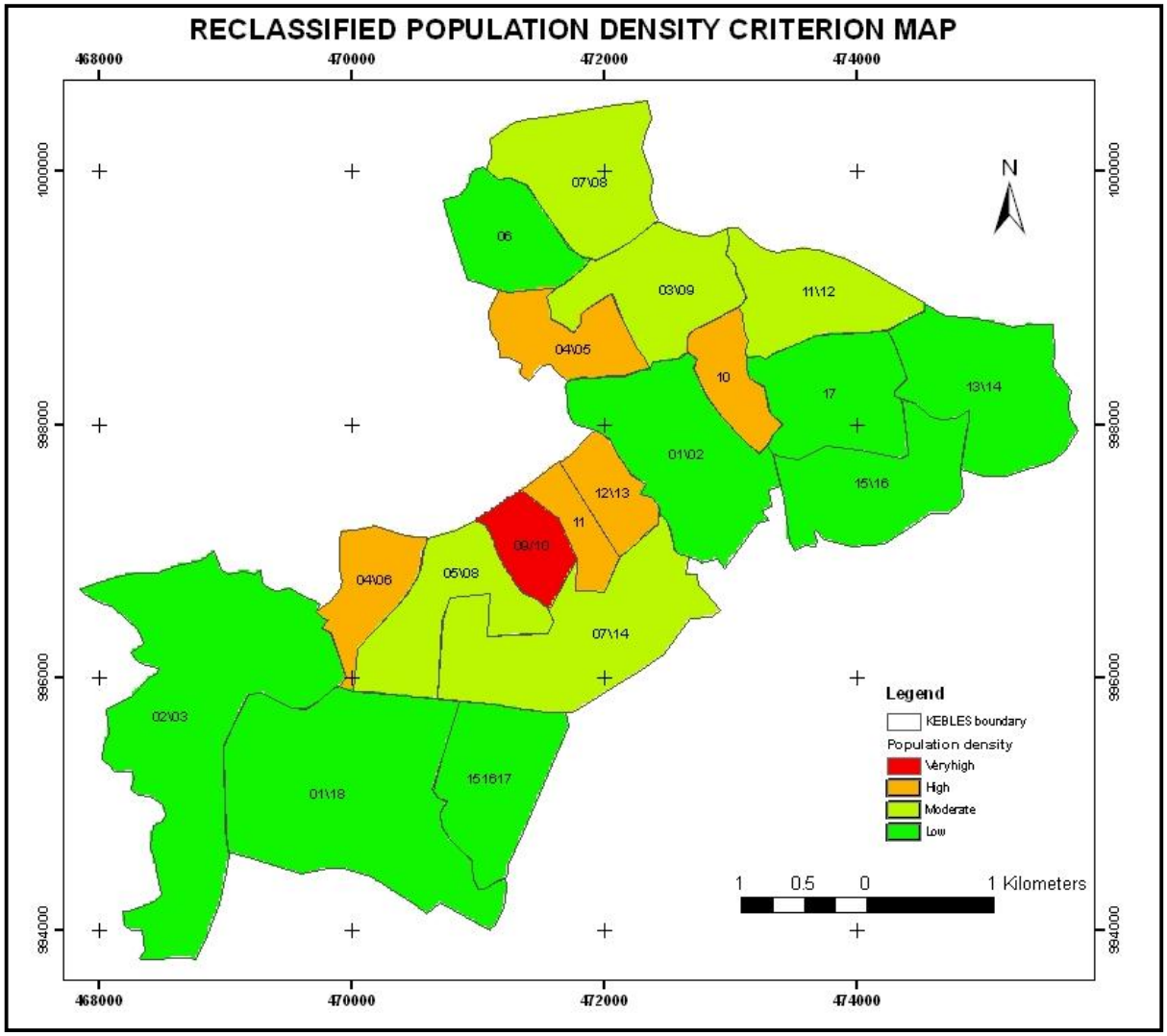


Figure 27 Reclassified population density criterion map

4.4.2 Pairwise Comparison Method

The pairwise Comparison method was developed by (Saaty, 1980) in the context of the analytic process (AHP). This method involves pairwise comparisons to create a ratio matrix. It takes as an input the pair wise comparisons and produces the relative weights as out put. Specifically, the weights are determined by normalizing the eigenvector associated with the maximum eigenvalue of (the reciprocal) ratio matrix.

The procedure consists of three major steps

1. Generation of the pair wise comparison matrix

   The method employs an underlying scale with values from 1 to 9 to rate the relative preferences.

Table 15 Scale for pairwise comparison

Intensity of Importance	Definition
1	Equal importance
2	Equal to moderate importance
3	Moderate importance
4	Moderate to strong importance
5	Strong importance
6	Strong to very strong importance
7	Very strong importance
8	Very to extremely strong importance
9	Extreme importance

Source Saaty (1980)

2. The criterion weights comparison

- Entering values according to their importance of every two factors with respect to the problem.
- Sum the values in each columns of the pairwise comparison matrix
- Divide each element in the matrix by its column total
- Compute the average of the elements in each row of the normalized matrix.

This average provides an estimate of relative weight of the criterion being compared.

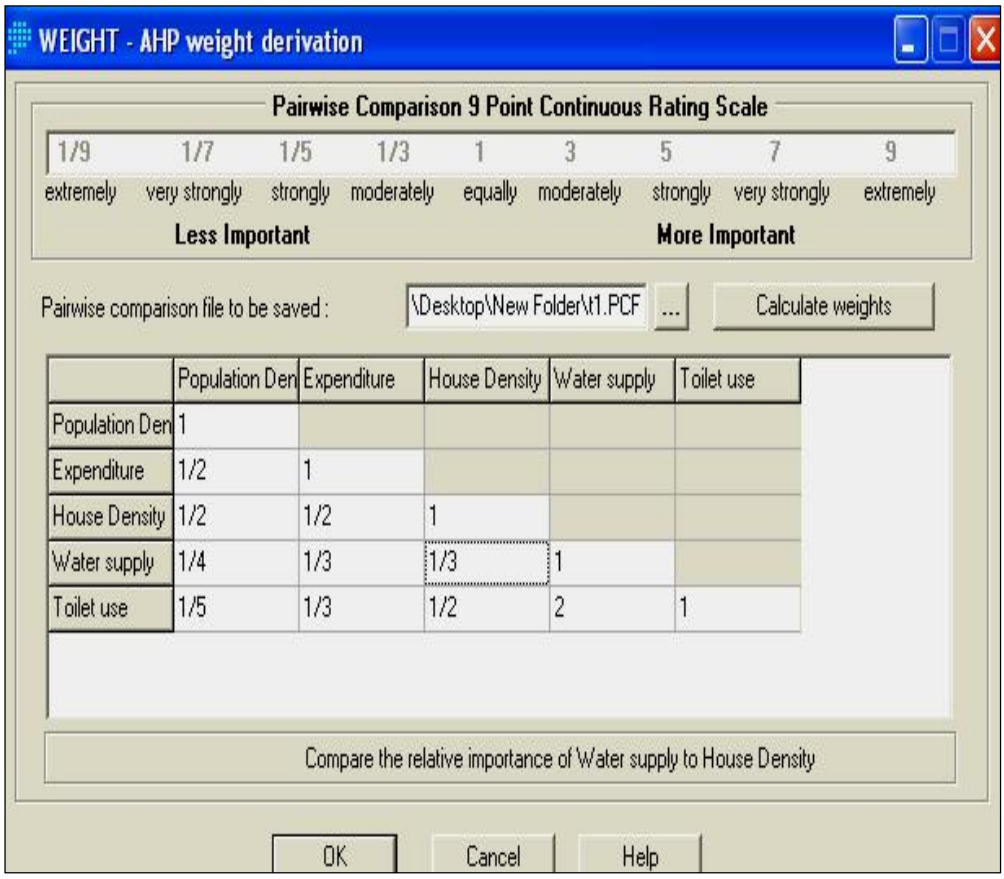


Figure 28 Scale for pairwise comparison (Saaty, 1980)

3. The consistency ratio estimation

The consistency ratio (CR) estimation determines the consistency of the comparisons. The consistency ratio is designed in such a way that if it is less than 0.10, the ratio indicates a reasonable level of consistency in pairwise comparison. The CR computation was done using IDRISI 32 software based on the criteria weights comparison for the five parameters.

The eigenvector of weights is:

Population Density: 0.3975	Population Density: 39.75%
Expenditure: 0.2569	Expenditure: 25.69%
House Density: 0.1781	House Density: 17.81
Water supply: 0.0711	Water supply: 7.11%
Toilet use: 0.0963	Toilet use: 9.63%

Consistency ratio = 0.03
Consistency is acceptable.

4.4.3 Weighted Overlay Analysis

Weighted overlay Analysis is a technique for applying a common scale of values to diverse and dissimilar input to create an integrated analysis. The five input raster were weighted according to their importance and added to produce an output raster.

Poverty Map = ∑ [Criteria map (cn Table 90) * Weight (wn)]

Where,
cn = standardized raster cell,
wn = weight derived from AHP pair wise, comparison, and

Poverty map = Reclassified Population Density* 0.3975 +Reclassified Minimum Food intake density *0.2569 + Reclassified House Density*0.1781 + Reclassified Water Supply shortage density * 0.0711 +Reclassified Toilet Use scarcity density *0.0963

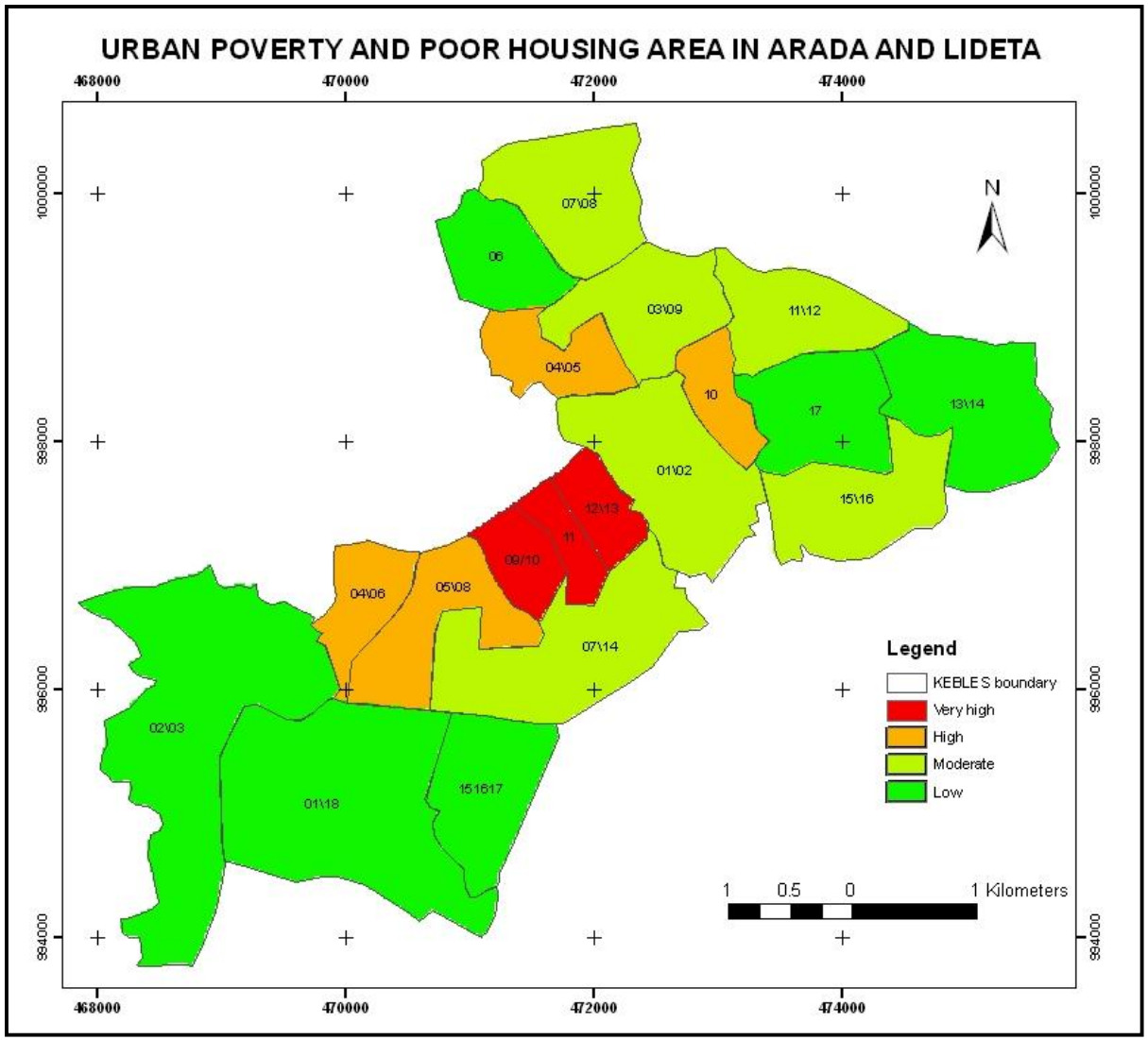


Figure 29 Urban poverty and poor housing area in Arada and Lideta

CHAPTER FIVE

5. DISCUSSION

5.1 General overview of Sample data of the two sub cities

The general socio-economic and demographic condition of households has greater implication on their living style. The satisfaction of basic needs as well as the access to social services, among other things, is largely depending on the general socio-economic background of the household. Among those basic needs, which have greater linkage with the socio-economic and demographic characteristics of the households concerned, is housing.
The age, gender, place of birth, marital status, utility service and household size have been collected from the study area.

5.1.1 Age Structure

The assessment of the age structure of a population will help to identify the economically active population from the dependents and it is one of the major factors that can influence the overall socio-economic performance of a society.

The household owner age group (16-65 years) constitutes about 65.2% of the residents in the area. And children below the age 16 years and old people above the age 60 years together constitute 32.75 % of the population in the area. Table 16 shows the age structure of the two subcities.

Table 16 Age structure of household heads

Age group	Sample	%age
20 and below	36	9
21-30	49	12.25
31-40	55	13.75
41-50	78	19.5
51-60	87	21.75
above 60	95	23.75
Total	400	100

5.1.2 Gender Composition

In economically backward or traditional societies, gender differences have a remarkable influence on the general well being of the household. That is, in such communities female headed and child households relative to men are disadvantaged in getting access to economic resources and other opportunities. Based on the sample of households 53% are male headed and 47 are female headed, grandparent headed and child headed in the area.

5.1.3 House hold size

The sampled households have an average family size of 6.5 persons per household. This result shows a bit higher level comparing to the national average (five persons per household). The family size ranges from 1 to 17.

5.1.4 Marital status and religion

Regarding marital status 54.6 % were married, 24.1% were widowed, 9.2 % were divorced, and near to 8.6 % were single. Of the entirely household surveys, 54 % were Christian, 41 % were Muslims and the rest were followers of other religion category.

5.1.5 Education status

Another characteristic of the study area is that, the educational status of most of the household heads is very low. Many of the residents never attended school when they were young. The following data (Table 17) explains the educational status of the household heads.

Table 17 Education status of household head from sample

Item No	Educational Status	No. of Household heads	%age
1	Illiterate	147	36.6
2	Read and write	62	15.3
3	Primary and junior	77	19
4	Secondary	47	11.2
5	Higher education	71	17.5
	Total	400	100

5.1.6 Place of Origin

Most of the household heads are migrants in the sample area of the study. As the sample survey shows majority of them migrated from the northern part of the country particularly from Amhara region (See table 18). Followed by 28.3% of total sample migrated from SNNPR.

Table 18 Distribution of households by regional origin

Item no.	Origin of migrants	Frequencies	%age
1	Amhara	152	38.2
2	Oromia	57	14.1
3	SNNPR	113	28.3
4	Tigray	53	13.1
5	Others	25	6.3
	Total	400	100

5.1.7 Housing Condition

According to the socio - economic survey, it is found out that in the study area, the houses are used for residential purposes. As shown in table 19, the two rooms and one room households dominate in the study area, which accounts for 38.8%and 32.15% respectively. Numbers of rooms three and above constitute 29.1 % of the surveyed households.

Table 19 Number of rooms in the two sub cities

Item	No. of Rooms	Number of housing unit	Percentage	Average Family size
1	One Room	128	32.1	5
2	Two rooms	155	38.8	5.7
3	Three rooms	67	16.8	6.6
4	Four and above Rooms	50	12.3	8.5
Total		400	100	

Table 20 Ages of houses in the study area

Age of house	Kebele houses	Private Houses	RHA	Total	percentage age of houses
<20	8	-	-	8	2
20-40	72	11	-	83	21
40-60	225	15	28	268	67
60+	41	-	-	41	10
Total	346	26	28	400	100

The other finding as regards to housing condition in the household surveyed was the age of the houses in the two subcities. Age is one of the fundamental factors for housing deterioration. With respect to the age, most of the kebele houses in the study area have longer age and have deteriorated. As revealed in table 20, of the total houses 67% of houses are the age between 40 and 60 years. 21% of the total houses, which accounts 20 to 40 years and 10% of the total houses, consist of the age more 60 years.

5.1.8 Water Supply

Availability of water, were assessed in the two sub cities, out of the surveyed households, 49.3 % of the households have privately owned water supply. 51.7 % of the households have shared water tap and of the households have neither private nor shared water supply who use either from public tap water or buy water from individual owners. Therefore, the large number of houses in the study area do not have individual water supply. Out of the total sample households, 34.7%, 19.0%, and 46.3% used the water from public water tap, private vendor and communal water tap, respectively. In the study area private water vendors charge 10 to 50 cents per 20 liter or one bucket. The public water distributors also have their own problem during the frequency of water distribution. Most of them working morning at 7 o'clock and before evening at 5 o'clock in short period of time. This condition creates shortage of water in the two subcities at large. Figure 30 shows one of the public water tape distributor in the study area.

Figure 30 Public water tap in the study area

5.1.9 Sanitation

Wastes from Arada and Lideta sub-cities are collected in to two ways: door to-door and container system. In the case of container system both the community and street sweepers use the nearby bins. Currently, both human and engine powered equipments are being used by the sub-cities for waste collection and disposal services. This includes hand pushcarts, two wheeled dollies, and side load trucks. The sewerage systems are not sufficient in most of the settlement sites. Most of the households use common toilets or else out of toilets and this in turn subjects the area for high environmental degradation. Because of the small number of toilets multiple families use a single toilet. Many have to use the open or share whatever limited facilities available tend to offer no privacy, safety or hygiene. In this condition it is virtually impossible to remain healthy and clean.

The result revealed that the availability of toilet have been assessed in the study area out of the surveyed households, 41.7% of the households have private toilets. 58.3 % of the households have no toilet and use communal toilets. Although most of those shared toilets are open, deteriorated and the construction material from wasted local material (shown in figure 31).

A. Open air or uncover area

B. Constructed from waste materials

C. Communal toilet built by local NGOs toilet condition in the study area

Figure 31 Toilets condition in the study area

5.1.10 Road Distribution

The development of urban city is identified in accordance to the density of road in the area. However the existing roads are having no sufficient internal as well as external access for the

users due to the narrowness. And some areas the roads are blocked and inaccessible for vehicles. There is also disconnection between road networks due to steep river crossings, unplanned construction of houses and buildings. Generally the road development and distribution is poor in these areas (Shown in figure 32). On the other hand the road distributions through the past three decade slightly have been changed in major activity areas.

Figure 32 Poor road distributions in the study area

5.2 Urban Land Classification Using Remote Sensing

As a result of the population growth, migration from rural area, unplanned use of land, informal settlement and rapid urbanization, Addis Ababa has expanded rapidly and causing many changes in land use. Urban land use planning can help and guide urban development away from vulnerable ecosystems. The subcities under the study area are changing into over density areas with unplanned residential sites. Most of the residential areas are low standard of living with poor housing.

The analysis of urban land changes is an important issue in planning and controlling unwise uses of land. Remote sensing and geographic information systems are considered the most

efficient techniques for this type of study. These techniques had been applied to investigate the effects of urbanization on changes of lands and to quantify urban growth of the area. The classification product provides an overview of the major land features of the two sub cities of Addis Ababa in 1965, 1984 and 2004. Tabulations and area calculations provide a complete data set in terms of the overall landscape and the types and amount of change, which have occurred.

Generally, the land covers were identified in space and time using aerial photographs, and Ikonos of different times. The study has shows that the built up area had increased by 71 ha between 1965 and 2004, which represents 129 % of the original built up area.
The urban expansion between 1965 and 2004 was assessed and analyzed using Remote Sensing technique for different periods.

5.3 Result from Standard Criterion Maps

The GIS maps have been developed from different criterion maps. The feature that makes this approach so attractive for poverty analysis is its suitability to associate socio-economic and environmental variables with population distribution. This provides a better possibility of analyzing relationships among these variables. An accurate mapping of where the poor live and are concentrated within cities is an important input required for targeting appropriate responses.

Spatial information on land use patterns, slum location, and physical location of facilities through Geographic Information Systems (GIS) are also critical inputs. In order to analyze and produce the poverty map some indicator data were taken from households surveys. Accordingly, silent literature on poverty indicators was presented in chapter two. For the purpose of the analysis the researcher used accesses indicators as such as sanitation, and sewerage, and water supply condition. All the collected sample data were processed into an appropriate format and then used for analysis to produced poverty map from the following five different criterion maps.

5.3.1 Population Density

Population data of the year 2006 of each kebele of Arada and Lideta were used for computation of population density. Highest populations are found in the Lideta sub city than the Arada sub city. Those kebeles located in the woreda 3 and partially in woreda 4 (now a days they call them kebele 09/10, 11, 04/06 and 12/13). From the analysis Kebele 09/10 of Lideta having 1255 people per ha, Kebele 11 of Lideta having 935 people per ha, kebele 04/06 having 755 people per ha and Kebele 12/13 of Lideta having 737 people per ha. Those Kebeles are exhibits highest population density in Lideta. Followed by kebele 04/05 and 10 shows the highest population density in Arada sub city.

5.3.2 Houses Density

In order to evaluate the housing condition of the study area, the statistics on housing density provides useful information. Density is one of the fundamental factors indicators for housing urban poverty. Regarding the size, the vast majority of urban housing is small with one and two room housing units. Due to this reason the house density is very high this means that within small areas a large number of houses existed in the two sub cities. Most of the houses are constructed from cheka and they are overcrowded, unclean and dilapidated housing conditions.

Noticeably the highest houses densities are found in Lideta subcity compared to the two sub cities. Those areas existed in the woreda of 3 and part of woreda 4 (the newly division of kebeles 09/10, 11, 05/08, 04/06, and part of 07/14 and 04/05). Very highest house density existed in kebele 09/10 of Lideta sub city shown considerably to other. Within the two sub cities the highest density of houses is found in Kebele 09/10, 04/06, 11 and 12/13 of Lideta where as in Arada subcity the smaller density houses shown.

5.3.3 Minimum Food Intake

The highest number of households having the minimum food intake or below 2200 kcal per person found in Lideta sub city compared to Arada sub city. Those areas located in woreda 3 and partly in woreda 4 such as kebele 12/13, 11, 05/08 of Lideta. And kebele 10, 11/12 and 15/16 are from Arada.

5.3.4 Water Supply Shortage Density

From the analysis it could be understood that the highest number of households water use from public tap and common tap around their yards are Kebele 04/05 and 06 from Arada and Kebele 09/10, 11, 04/06 and 12/13 from Lideta. When we compared to the two sub cities the highest water shortage have seen in Lideta sub city i.e. 129 households per ha of kebele 09/10 where as in Arada sub city the highest density registered 62 households per ha of kebele 04/05.

5.3.5 Toilet Scarcity Density

Considerably highest number of the households has no toilet or else use in share, as a result the problem is more. Due to this reason the shortage of toilet in the two subcities was taken one of the criteria for produced poverty area indicated map. And thus the absence of utilities, poor housing condition and over crowded situation and polluted environment created by lack of proper sanitation facilities. Much of toilet scarcity has shown in Lideta sub city in woreda 3 (kebele 09/10, 11 and 12/13) and woreda 4 (Kebele 04/06 and 05/08).

5.4 Poverty Area Map of Arada and Lideta

Finally from the five standardized criterion maps the reclassified maps were obtained and then overlying the reclassified map accordingly their weight. Followed by the output of poverty area map was produced. The map shows the level of poverty in the two sub cities.

The highest level of urban poverty and poor housing was found in kebeles 11, 9/10 and 12/13 in Lideta sub city. Followed by kebele 04/06 and 05/08 of Lideta sub city and kebele 04/05 and 10 of Arada sub city considerably are poverty areas. When we compared the two sub cities Lideta sub city is the highest poverty area coverage than the Arada sub city.
Of the total area of Lideta sub city 11% (113ha) is seen very high level of poverty.
14 % (144 ha) and 10 % (95) of the total area of Lideta and Arada area are the second highest poverty area respectively. The remaining part of the two sub cites are categorized under moderate and low poverty relative to other.

The following table 21 shows the summarized poverty area and percentage poverty area of the two sub cities.

Table 21 Percentage poverty areas of Arada and Lideta

Sub city	Area (ha)	Level of poverty	% age poverty Area	Kebele
Lideta	113	Very high	11	09/10,11,and 12/13
	144	High	14	04/06,05/08
	155	Moderate	15	07/14
	654	Low	61	02/03, 01/18,and 15/16/17
Total	1066		100	
Arada	0	Very high	0	-
	95	High	10	04/05, 10
	552	Moderate	59	01/02,03/09,07/08,11/12,and 15/16
	295	Low	31	06,17,and 13/14
Total	942		100	

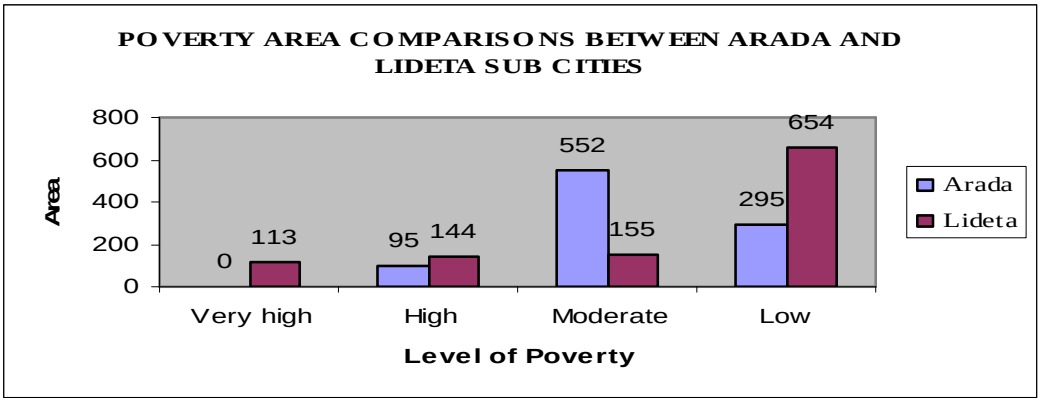


Figure 33 Poverty area comparisons between Arada and Lideta sub cities

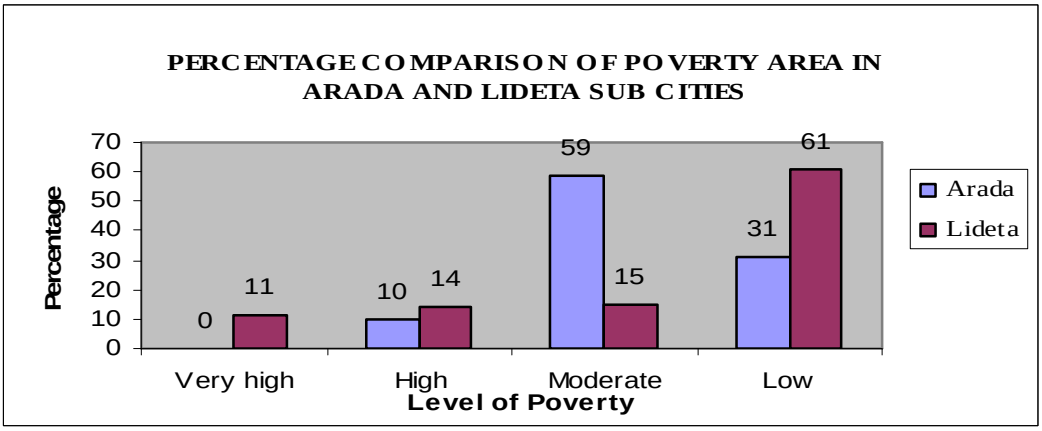


Figure 34 Percentage comparisons of poverty area in Arada and Lideta sub cities

CHAPTER SIX

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study was performed using the Integration of Remote sensing and GIS analysis. From the analysis urban built up map, road distribution map and poverty map were obtained. The result shows that the built up area of the case study (Arada and Lideta) has been increasing from year to year. The built up area expansion of the two sub cities between 1965 and 1984 was 545 ha which is 123.4 %. The built up area change between 1984 and 2004 was 33 ha, which is 6.1%. Using Aerial photographs of 1965, 1984 and Ikonos image of 2004 the road distribution change of the two subcities in terms of length were computed. The road was increased by 57.17 km (103 %) between 1965 and 1984. And also, it was increased 13.37km (11.87 %) from 1984 to 2004.

It is clear that the rapid population growth has a direct impact on urban expansion and creation of poor or informal settlements. Thus the population growth with out proper uses of land has forced the emergence of informal settlements in the prevailing area. The occurrence of informal settlement leads the area to over crowd and expansion of poor house settlements or slums. So using GIS technique the poverty area map was produced. The result revealed that more than 25% of Lideta and 10% of Arada area are critically in poverty. 59 % of Arada built up area covered relatively moderate poverty area and 31 % is low poverty area. Hence 15% of Lideta built up area covered relatively moderate poverty area and 61% low poverty area. The reason of this a significant portion in both sub cities occupied by some institutes, recreational areas, schools and collages, churches and other non residential area. Generally of the two sub cities the highest poverty area is indicated in Lideta sub city than Arada sub city.

The study also revealed that most inhabitants of the sub cities earn a very low income, which is not sufficient to buy minimum food basket and basic non-food items. The majority of house holds are engaged in the informal sector, which is characterized by low income, poor working conditions and less bright prospect.

The provision of services such as water, sanitation, and solid waste disposal is inadequate in these sub cities at large. The unfulfilled requirements of water installations and the absence of adequate public taps are expose the poor people to higher water charges by private water vendors. The available services for sludge removal, sewerage and solid and liquid waste management could not meet the demand of the house hold in general and the poor in particular. The poverty situations in the area are not showing improvements and the problem seems to deepen more and more in the city as a whole. The causes of poverty in the city are quite complex and have many deep-seated roots.

6.2 Recommendations

To improve the poverty situation of the poor people and their poor housing conditions the following solutions are recommended:

- The existing small micro finance in the surrounding cooperate with the institution that was established by the inhabitants such as Ider, Ekube as well as other saving system for building houses that meet minimum standard for urban shelter at urban areas need to be constructed to improve housing conditions for households in the study area.

- Proper disposal mechanisms of solid and liquid waste need to be established.

- The city administration should give priority for the implementation of Development Plan (LDP). Since Implementing this LDP can change the entire situation of the study area and the surrounding as well.

- As the analysis of the study indicates that most of the problems in the urban poverty areas are economic in nature and therefore their solutions must be economic. To this end, income generating activities should be put in place, to create job opportunities for the poor and sustainable employment ought to be there in the area.

- The government has to encourage the participation of Voluntary organizations, NGO's in association with research institutions, professionals and other concerned individuals or bodies in the improvement of the poor areas or slum of the city.

- The targeted societies make them associations and contact the volunteer investor to aid the construction of communal buildings. From the construction building both the investor and the society has an advantage. For instance the ground floor of the building the investor can use for commercial purpose, rent for bank, and other activities. Above the ground floor it is used for residential purpose. Such type of building used to reduce the horizontal expansion of the city.

- Housing cooperatives can be taken as other alternatives to address housing problems for people who live in the slum areas.

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Appendix

Annex 1

Questionnaire

DEMOGRAPHIC CHARACTERSTICS

Name of house holds_____

House Number _____

Date of filling the questionnaire _____

1. Sex of the family head
   1.1. Male ☐ 1.2 Female ☐
2. Age of family head _____years
3. Place of birth: Region _____Woreda_____
4. If born outside of Addis, how long has he/she lived in Addis Ababa? _____years.
5. If the house holds was born outside of Addis Ababa, reason for immigration to Addis Ababa?
   - 5.1 Transferred on duty ☐
   - 5.2 In search of job ☐
   - 5.3 For medical reasons ☐
   - 5.4 For schooling ☐
   - 5.5 Some relatives living in Addis ☐
   - 5.6. Recurrent drought ☐
   - 5.7 Floods ☐
   - 5.8 Shortage of land ☐
   - 5.9 Government policy of land ☐
   - 5.10Other (specify
6. How long have you lived in this kebele? _____ Years.
7. Marital Status
   - 7.1 Married ☐
     - 8.1.1 Living with spouse ☐
     - 8.1.2 Divorced ☐
     - 8.1.3 Widow/widower ☐
   - 8.2 Unmarried ☐
9. Total house hold size: _____ persons.

HOUSING CONDITION

10. The house you own is used for:
    - 10.1 Residence ☐
    - 10.2 Business ☐
    - 10.3 Both for residence and business ☐
11. The age of the house
    - 11.1 Below 20 years ☐
    - 11.2 20-40 years ☐
    - 11.3 40-60 years ☐
    - 11.4 above 60 years ☐
12. How many rooms do you have in the house?
    - 12.1 One ☐
    - 12.2 Two ☐
    - 12.5 Five ☐
    - 12.6 Six ☐

12.3 Three ☐ 12.7 Seven and Above ☐

12.4 Four ☐

13. Your toilet and bath room:

13.1 Separate ☐ 13.3 No toilet and bathroom ☐

13.2 Common ☐ 13.4 other (specify) _____

Utility

14. Is the electricity supply in your kebele sufficient?

14.1 Yes ☐ 14.2 No ☐

15. What is/are the sources of water for household consumption?

15.1 Private taps ☐ 15.3 Purchase ☐

15.2 Communal taps ☐ 15.4 other (specify) _____

17. Liquid waste disposal:

17.1 Private modern latrine ☐

17.2 Shared modern latrine ☐

17.3 Private pit latrine ☐

17.4 Shared pit latrine ☐

17.5 No latrine of any kind ☐

17.6 River ☐

18. Solid waste disposal:

18.1 Municipal collection ☐ 18.4 Rive ☐

18.2 Open field ☐ 18.5 Private solid waste collectors ☐

18.3 Collection bin ☐

19. Your kitchen:

19.1 Private and modern type (indoor) ☐

19.2 Shared but modern type (outdoor) ☐

19.3 Traditional and private (indoor) ☐

19.4 Traditional and shared (Outdoor) ☐

19.5 No kitchen of any kind ☐

Annex 2
Water supply in the study area

Kebele	Sample taken	Communal and no water	%age	Total Number of house holds	House holds no and Communal water in Kebele	Area(ha)	Density of house holds in each kebele
01\02	24	10	43	7688	3306	146	23
03\09	20	13	65	6436	4183	96	44
04\05	22	11	50	7073	3537	56	63
6	17	10	59	4251	2508	62	40
07\08	25	15	61	8238	5025	114	44
10	15	7	46	3216	1479	39	38
11\12	20	11	57	6631	3779	91	42
13\14	27	6	23	8502	1956	133	15
15\16	22	6	29	7082	2054	105	20
17	18	5	27	4511	1218	100	12
1\18	20	7	35	5980	2093	255	8
02\03	20	3	15	5919	888	297	3
04\06	20	16	78	7294	5690	58	98
05\08	26	5	20	8098	1620	86	19
07\14	25	18	72	7707	5549	155	36
09\10	25	18	72	7894	5684	44	129
11	20	14	72	4833	3480	31	112
12\13	19	13	70	4670	3269	38	86
15\16\17	15	10	69	4187	2889	102	28

Annex 3

Toilet use in the study area

Kebele	Sample taken	Communal and no toilet	%age	Total house holds in each Kebele	Total no. house holds no and Communal toilet in Kebele	Area(ha)	Density of hh in each kebele
01\02	24	16	65	7688	4997	146	34
03\09	20	12	61	6436	3926	96	41
04\05	22	11	49	7073	3466	56	62
6	17	10	61	4251	2593	62	42
07\08	25	16	63	8238	5190	114	46
10	15	12	79	3216	2541	39	65
11\12	20	11	55	6631	3647	91	40
13\14	27	16	21	8502	1785	133	13
15\16	22	15	69	7082	4887	105	47
17	18	7	40	4511	1804	100	18
1\18	20	6	32	5980	1914	255	8
02\03	20	4	18	5919	1065	297	4
04\06	20	14	72	7294	5281	58	91
05\08	26	19	72	8098	5830	86	68
07\14	25	19	74	7707	5703	155	37
09\10	25	18	73	7894	5763	44	131
11	20	15	74	4833	3576	31	115
12\13	19	13	68	4670	3176	38	84
15\16\17	15	9	61	4187	2554	102	25

Annex 4

House holds expenditure in the study area

ebele	Number of house e hold Sample survey	%age	Total house holds in each kebele	Total number of house hold annual expenditure<8000	Area(ha)	Density(house hold annually expenditure<8000/Area)
01\02	2045	42	7688	3229	146	22
03\09	2054	38	6436	2445	96	25
04\05	4614	25	7073	1768	56	32
6	-	-	4251	-	62	-
07\08	1658	44	8238	3625	114	32
10	757	39	3216	1254	39	32
11\12	1316	52	6631	3448	91	38
13\14	1226	14	8502	1190	133	9
15\16	2192	49	7082	3470	105	33
17	840	29	4511	1308	100	13
1\18	813	44	5980	2631	255	10
02\03	1167	15	5919	888	297	3
04\06	693	22	7294	1605	58	28
05\08	697	52	8098	4211	86	49
07\14	616	43	7707	3314	155	21
09\10	-	-	7894	1175	44	-
11	20	34	4833	1643	31	53
12\13	19	56	4670	2615	38	69
15\16\17	15	57	4187	2387	102	23

Declaration

I the under signed declare that this thesis is my original work. It has not been presented for degree in this or any university and all the source materials used for this thesis have been duly acknowledged.

Name of the candidate	Mebrate Samuel
Signature	
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This thesis has been submitted for examination with the approval as university advisor.

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