# MAPPING OF URBAN MORPHOLOGY TYPES AND ASSESSMENT OF RECREATIONAL ECOSYSTEM SERVICES OF BISHOFTU TOWN, OROMIA REGIONAL STATE

**M.Sc. thesis in Environmental Planning and Landscape Design**

**Author: BINIYAM ABEBE**

**Advisor: Kumelachew Yeshitela (PhD)**

**Ethiopian institute of Architecture, Building**

**Construction and City Development, Addis Ababa University**

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This thesis is submitted to the Ethiopian institute of Architecture, Building Construction and City Development (EiABC) and to the School of Graduate Studies of Addis Ababa University in the Partial fulfillment of all the requirements for the degree of Masters of Science in Environmental Planning and Landscape Design.

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**Author: Biniyam Abebe Asefa**

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**Approved by Board of Examiners:**

| | | |
|---|---|---|
| **Kumelachew Yeshitela (PhD)** | _____ | _____ |
| **Advisor** | **Signature** | **Date** |
| **Ato Hayal Desta (M.Sc.)** | _____ | _____ |
| **External Examiner** | **Signature** | **Date** |
| **Ato Sisay Seifu (M.Sc.)** | _____ | _____ |
| **Internal Examiner** | **Signature** | **Date** |
| **Fisseha Wegeyehu (PhD)** | _____ | _____ |
| **Chair Person** | **Signature** | **Date** |

## DECLARATION

I, the undersigned, declare that this thesis is my own and original work and has not been presented a degree in any other University, and that all sources of material used for the thesis has been duly acknowledged, following the scientific guidelines of the institute.

**Student's Name: BINIYAM ABEBE ASEFA**

Signature: _____

Date: _____

## CONFIRMATION

The thesis can be submitted for examination with my approval as an institute's advisor.

**Advisor's Name: Dr. Kumelachew Yeshitela**

Signature: _____

Date: _____

# Table of Contents

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATION

| | |
|---|---|
| CEH | Centre for Ecology and Hydrology |
| CES | Cultural Ecosystem Service |
| CLUVA | Climate Change and Urban Vulnerability in Africa |
| EiABC | Ethiopian institute of Architecture, Building Construction and City Development |
| ES | Ecosystem Service |
| FDI | Foreign Direct Investment |
| GDP | Gross Domestic Product |
| Hrs. | Hours |
| I.e. | That Is |
| LULC | Landuse and Landcover |
| MEA | Millennium Ecosystem Assessment |
| Mins. | Minutes |
| UMTs | Urban Morphology Types |
| UK | United Kingdom |
| Yrs. | Years |

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## ABSTRACT

*Identifying, describing and mapping of land cover are important for global monitoring studies, resource management, and planning activities. Differing characteristics of urban areas can be conceptualized and subsequently mapped through the idea of Urban Morphology Types (UMTs). The Millennium Ecosystem Assessment (2003) divides ecosystem services (ES), benefits that ecosystems provide to people, into four categories: provisioning, regulating, supporting and cultural ecosystem services (CES), the non-material benefits obtained from ecosystems; e.g. recreational ecosystem service obtained from recreational parks. The general objective of the study was identification and mapping of UMTs, assessment of recreational ecosystem services provided by recreational parks and providing planning recommendations for the development and management of urban green spaces in Bishoftu Town. To achieve these objective, intensive desktop work was done on identification of UMTs of Bishoftu town based on the Structural Plan of the town and image from Google earth. Based on collected data from structural plan and image from Google earth, UMTs of the town were defined by ArcGIS and Auto CAD. The data during the recreational ecosystem service assessment period were obtained from primary and secondary sources. Regarding the sampling method female and male users of the recreational parks were asked to fill questionnaires. The result indicated that Bishoftu town have 12 high level UMT classes and 37 UMT sub classes; and most people who visit recreational parks in the town gained recreational ecosystem services from the landscapes of parks, fresh air obtained in these areas, the different kinds of activities they practiced while staying in the recreational parks, like fishing, swimming in pools and boat ridings. Mapping of UMTs facilitate the assessment of ecosystem services provided by different groups of UMT classes. So, to maximize the recreational ecosystem services delivered from recreational parks, combined work amongst local government bodies, environmental planners, investors and professionals is obligatory. Generally, co-operative work is crucial between different stakeholders for the attainment of maximum recreational ecosystem services from recreational parks.*

# CHAPTER ONE: INTRODUCTION

## 1.1. Background of the Study

Rapid urbanization and urban sprawl have significant impact on conditions of urban ecosystems. Accurate and updated information on the status and trends of urban ecosystems is needed to develop strategies for sustainable development and to improve the livelihood of cities. The ability to monitor urban land-cover/land-use changes is highly desirable by local communities and by decision makers‘ alike (Yang *et al.*, 2003).

Although the terms "land cover" and "landuse" are sometimes used interchangeably, they are actually different. Simply put, land cover is what covers the surface of the earth and landuse describes how the land is used. Examples of land cover classes include: water, snow, grassland, deciduous forest, and bare soil. Landuse examples include: wildlife management area, agricultural land, urban, and recreation area. It is important that each class on the map be clearly defined and distinct from other classes (Horning, 2003).

Identifying, delineating and mapping of land cover are important for global monitoring studies, resource management, and planning activities (Gunaid and ElHag, 2013).

Urban morphology is the study of the form of human settlements and the process of their formation and transformation. The study seeks to understand the spatial structure and character of a metropolitan area, city, town or village by examining the patterns of its component parts and the process of its development. This can involve the analysis of physical structures at different scales as well as patterns of movement, landuse, ownership or control and occupation.

Typically, analysis of physical form focuses on street pattern, lot (or, in the United Kingdom (UK), plot) pattern and building pattern, sometimes referred to collectively as urban grain (Wikipedia, 2015).

Essentially UMTs are the foundation of a classification scheme which brings together facets of urban form and function. Their application allows the delineation of geographical units which are functional in terms of their biophysical processes. Connections to urban functions (landuses) allows biophysical functions to be combined with a planning orientated perspective. Thus UMT units can be seen as *"integrating spatial units linking human activities and natural processes"*. Such an approach is often necessary because biophysical units such as discrete green spaces may not be very well represented by existing administrative units. Similarly existing landuse frameworks do not normally consider aspects of urban form and structure together.

Differing characteristics of urban areas can be conceptualized and subsequently mapped through the idea of urban morphology types. Mapping UMTs involves the process of digitizing, which transforms information into digital format, such as from a paper map, or creates new data from other geospatial sources, such as from digital imagery. It is most likely that this step will involve on-screen digitizing of UMT units from orthorectified aerial photography in GIS or tools like Google Earth. On-screen digitizing involves creating a map layer on the screen by tracing units with a curser using reference information (aerial photography) as the background (Cavan *et al*., 2012).

Ecosystem services provide innumerable services that are underestimated in most economic development decisions; however, these services contribute to development objectives (Example; scenic quality of the land) and to realizing quality of life goals. For example, the flood control

service of wetlands can help to protect homes, infrastructure and communities during extreme weather events (Raudsepp-Hearne *et al*., 2011).

Ecosystem services are the many benefits large and small, direct and indirect that ecosystems provide to people. These consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature. For example, forests provide wood products and a host of non-timber products and act as a venue for recreation and spiritual renewal; they also help to mitigate climate change by sequestering carbon. Wetlands absorb pollutants, purify water, and help reduce floods. Since different ecosystems provide different bundles of ecosystem services, there are tradeoffs and synergies amongst ecosystem services. For example, conversion of forest to agriculture lowers the wood supply and potentially the water flow regulation but it increases food production from crops. On the other hand, restoring a wetland may remove more pollutants from drinking water supplies and increase recreation benefits for bird watching (Landsberg *et al*., 2011).

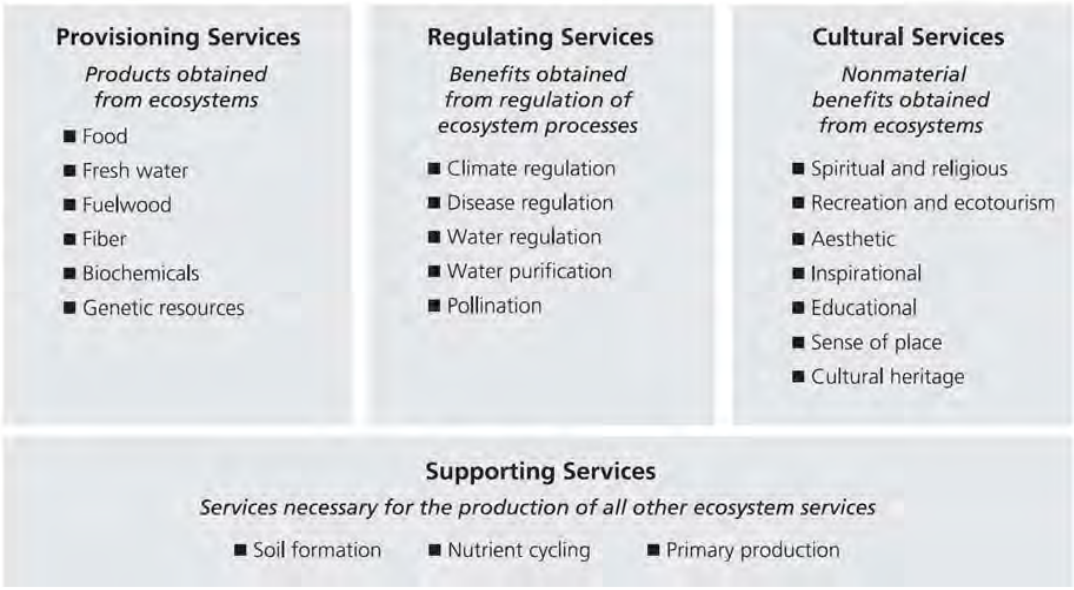
Ecosystem services are increasingly promoted as a means for documenting the values humans place on ecosystems and evaluating benefits derived from natural resources. This is an important trend, and particularly important in the case of biodiversity conservation where values are often difficult to describe in economic terms and rarely well-explained in natural resource decisions. If ecosystem services are to provide an effective framework for natural resource decisions, they must be classified in a way that allows comparisons and trade-offs amongst the relevant set of potential benefits. In the language of the Millennium Ecosystem Assessment (2005), this means that the full range of benefits reflecting human well-being from ecosystems must be represented in any effective typology of ecosystem services (Wallace, 2007).

We manage natural resources to maintain, or bring about a change, in ecosystem composition and structure more favorable to human well-being, which is taken here to incorporate spiritual/philosophical benefits, including ethical matters, as well as more material benefits. That is, we manage ecosystem processes with the goal of re-organizing ecosystem elements to deliver ecosystem services that better meet human values (Wallace, 2007).

The benefits of ecosystems are conferred at many scales and many different beneficiaries. At the local level, ecosystem services are frequently the basis for rural livelihoods and subsistence, particularly for the poor. Artisanal fishing of coastal waters and inland lakes and rivers, for example, provides both cash income and food for millions of low-income families. Benefits can also be regional, such as the provision of water to communities and businesses from a forested watershed. At the global scale, well-functioning ecosystems regulate climate and act as a reservoir of biodiversity that underpins biological production of all types, including agriculture. Ecosystem services also work over different temporal scales, from the annual production of crops to the long cycles of soil formation and climate regulation (Landsberg *et al*., 2011).

The Millennium Ecosystem Assessment (2003) divides ecosystem services into four categories: provisioning services include the basic necessities we consume and require for our well-being; regulating services provide us with a habitable environment; cultural services benefit people in a nonmaterial manner; supporting services enable ecosystems to flourish (Table 1).

**Table 1: Classification of Ecosystem services according to MEA**




**(Source: Millennium Ecosystem Assessment, 2003).**

An ecosystem‘s ability to provide services is improved when preserved, reconnected and restored and compromised when disturbed, fragmented and degraded (Voora and David, 2008).

Cultural ecosystem services are defined as the nonmaterial benefits obtained from ecosystems. Among these recreational pleasure that people derive from natural or managed ecosystems is defined as recreation service. Natural and semi natural ecosystems, as well as cultural landscapes, provide a source of recreation for mankind. People enjoy forests, lakes or mountains for hiking, camping, fishing or bird watching, or just for being there. Recreation is also supplied by managed ecosystems, such as agricultural lands. Relative to provisioning and regulating services the capacity and the flow of benefits associated with cultural services may be much more intangible and difficult to measure (Maes *et al.,* 2011).

Recreational UMTs are recreational green areas which give public recreational services to the users, human beings. High level recreational UMTs class consists of parks, mainly having lakes, stadium and festival sites as its sub class. Parks are green spaces covered with perennial vegetation (tree, shrub and herbs) and mostly constructed nearby lakes. They serve as public recreational centers and places where wedding ceremonies, meetings and parties are undergoing. Stadiums are open spaces, mostly green, used for sport and political activities whereas festival sites are open spaces, mostly around water bodies, which are used for practicing religious activities, and public events, like celebration of _Irrecha' festiva in Bishoftu town.

Bishoftu is one of the worth note towns in the history of early urbanization process of the country in general and Oromia in particular. It is one the pre-Italian town of the country. It is also one of the rail-way towns whose history is so fascinating. The town's topographical attraction and natural beauty such as the attractive lakes makes the area one of the top tourist attraction areas. The area in which Bishoftu town emerged at the early twentieth century is endowed with fascinating history as it was one of the food provider area for the imperial palace. This had contributed to the origin of the town in addition to the construction of the Djibouti-Addis Ababa railway which remains an important historical development in the history of the country as a whole, contributing much to the socio-economic transformation of the country (Gudina, 2009).

Bishoftu is located in area where there are a great number of cultural and historical sites. Important Gada sites that are essential in Oromo history and tradition are located in this area. It is currently significance is realized by the government and the town is listed as a number one tourist destination city. Therefore, all planning considerations is required to make use of the town's potential as a tourist attraction area and due consideration has to be made to exploit the

high potential in the area and in the town in particular of exploit the cultural sites as a common heritage that is crucial in enhancing the unity in diversity of the country (Gudina, 2009).

There are some examples in mapping of UMTs in European Cities like Greater Manchester but little similar knowledge is available in an African context. The characterization in the urban environment of Addis Ababa based on UMTs developed from aerial photographs taken in 2011 resulted in 35 UMTs classified under 11 landuse classes (Cavan *et al*., 2012). So that, this paper tries to identify and map the UMTs present in Bishoftu town, by adopting the methodology used in Addis Ababa and Greater Manchester, and assess recreational ecosystem services provided by recreational parks.

## 1.2. Statement of the Problem

Land is definitely one of the most important natural resources, since life and developmental activities are based on it. Landuse refers to the type of utilization to which man has put the land. It also refers to evaluation of the land with respect to various natural characteristics. But land cover describes the vegetal attributes of land. Landuse and land cover data are essential for planners, decision makers and those concerned with land resources management. Monitoring and analysis of the urban environment make use of up-to-date Landuse and Land cover (LULC) information, for proficient and sustainable management of urban areas (Ezeomedo and Igbokwe, 2013).

Urban morphological analysis aims to understand the development of overall urban form. Different types of urban forms, Urban Morphology Types, are existing in different towns. These different types of UMTs need to be identified and mapped. Through the identification and Mapping of UMTs in urban areas, it is possible to know the existence or absence of the different

types of urban forms, which have great contribution in landuse planning program and thereby this helps for planning urban green spaces, recreational parks, for the benefits of both people and wildlife and conservation of ecosystem.

Ecosystems provide different types of services to human well-beings. So knowing and assessing the different categories of ecosystem services was very important for proper planning of land covers, specifically urban green spaces. Therefore, the properly obtained recreational ecosystem services, which are provided by recreational parks, are the results of properly planned and managed urban green spaces.

Without proper identification, mapping and analysis of UMTs, recreational parks, in Bishoftu town it is difficult to appreciate the recreational ecosystem services provided by urban recreational parks and at the same time it is difficult to create comfortable living environment in the stressful town. Therefore this study aims at identifying, mapping and analyzing UMTs, specifically recreational parks, for proper landuse planning, urban green planning, and then this result would facilitate assessment of ecosystem services, particularly recreational ecosystem services provided by recreational parks existing in Bishoftu town.

## 1.3. Objectives of the Study

### 1.3.1. General Objective

The general objective of the study was, identification and mapping of UMTs, assessment of recreational ecosystem services provided by recreational parks and providing planning recommendations for the development and management of Urban Green Spaces in Bishoftu Town.

### 1.3.2. Specific Objectives

- ☞ Identification of Urban Morphology Types in the study area,
- ☞ Mapping of Urban Morphology Types in the study area,
- ☞ Assessment of recreational ecosystem services provided by recreational parks in the study area and
- ☞ To provide Planning recommendations for the development and management of Urban Green Spaces in the study area.

## 1.4. Research Questions

A) Which Urban Morphology Types are currently present in the study area?

B) How does recreational parks provide recreational ecosystem services?

## 1.5. Significance

This research paper was aimed to identify and map the UMTs present in the study area, to assess recreational ecosystem services provided by recreational parks and to provide planning recommendations for the development and management of Urban Green Spaces in Bishoftu town. Moreover, the study, would also create interest among students so that they would appreciate the study and do further studies on related issues.

## 1.6. Scope and Limitation

### 1.6.1. Scope of the Study

The scope of the study was limited in space and subject. The research was conducted on Identification and Mapping of Urban Morphology Types and Assessment of Recreational Ecosystem Services provided by recreational parks in Bishoftu town, Oromia Regional State. So

that, the scope of the study was on the Identification and Mapping of Urban Morphology Types and Assessment of Recreational Ecosystem Services provided in purposively selected five recreational parks of Bishoftu town.

### 1.6.2. Limitation of the Study

The limitations while doing the research includes: unwillingness to give some basic material or documents needed for doing this research paper from governmental officials, especially some Bishoftu‘s administrative employees and Oromia urban planning institute officers. The other limitation was the financial resource shortage encountered, developing countries experience. In some cases problems have been seen on some respondents of the questioner and owners or administrators of the recreational parks, which were not willing to give accurate and genuine response and permission during data collection respectively, which have important value especially to the recreational ecosystem services assessment part of the research paper.

Finally, availability of limited research articles done mainly on such topic and on related topics particularly on Bishoftu town and generally in Ethiopia, except some studies undergoing in Addis Ababa by Climate Change and Urban Vulnerability in Africa (CLUVA) was the other limitation.

# CHAPTER TWO: METHODOLOGY

## 2.1. Description of the Study Area

### 2.1.1. Location

The geographical/astronomical/ location of Bishoftu town is at $8^0$44‘40‘‘N latitude and $38^0$59‘9‘‘E longitude and covers about 5,444 hectares of area. It is found in Oromia Region, North Shewa zone of Ada‘a *Wereda.* The town has got a first rank urban grade level as per the classification of urban grade levels of Oromia Region urban centers. Bishoftu town is found at about 47kms to the southeast of Addis Ababa and situated between Dukem and Mojo towns along Addis Ababa-Djibouti road **(**Gezahegn, 2009).

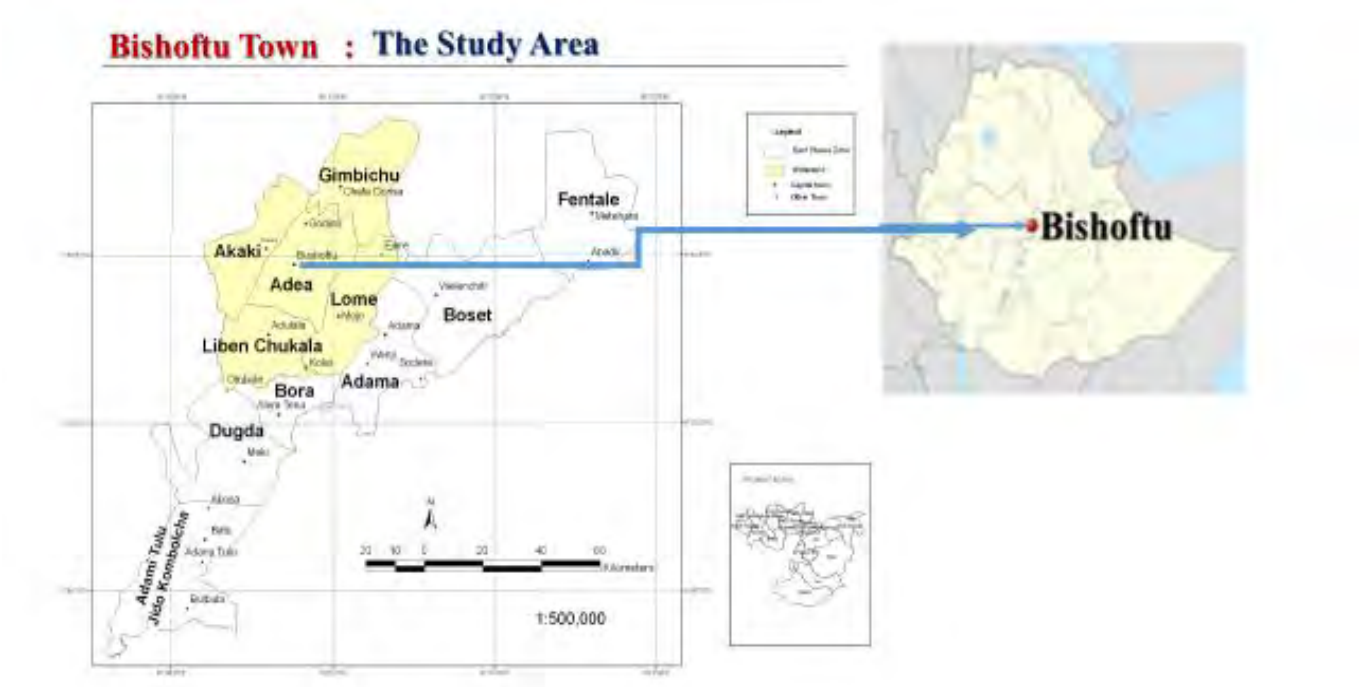



**Figure 1: Map of Bishoftu town and the surrounding Weredas.**

**Location Advantages**

Due to its proximity to the national capital, Bishoftu was very important for the attraction of both domestic and foreign direct investment (FDI). It shares part of the Great East African Rift Valley hence, endowed with several lakes, hot springs and crater lakes, which contribute for different developmental activities **(**Gezahegn, 2009).

*2.1.1.1. Descriptions of Recreational Parks*

1. **Adulala Resort and Spa:** located only 47 km from Addis Ababa in the flourishing tourist destination of Bishoftu / Debre Zeyit city. Adulala resort and spa is a spacious, nature flavored, unique and luxurious resort. It is built along the bank of Babo Gaya Lake (Bishoftu Guda) and offers a range of services in harmony with its wonderful environment nature. It is easily accessible for those who use their own car as transportation means but very difficult for any one which use other transportation means like, taxi, bicycle and on foot.

2. **Asham Africa:** is located in the North East direction of the town almost in the same distance like Adulala Resort and Spa from Addis Ababa. The word _ASHAM‘ means welcome in many of the languages in southern of Ethiopia, so that it is named like this to show the welcoming features of the park. It is constructed on the shore / coast of Lake Bishoftu. It is easily accessible for any user because it is very near to the main road.
3. **Babogaya Resort:** is a luxury design mixed into one of Bishoftu‘s attractive dip lakes, Babo Gaya Lake (Bishoftu Guda), like Adulala Resort and Spa. Give the facilities of a five star hotel. It is far from the bus station of the town (around 3km to North West of the town), so that other transportation means other than own car and rental car is not possible to think.

4. **Dreamland Hotel & Resort:** is one of the medium range accommodations in Bishoftu. Built at about hundred meters away from the main road, the hotel enjoys a great top view of Lake Bishoftu. It is the place for breathtaking and clear view of the beautiful Lake Bishooftu surrounded by a chain of lush, green mountains viewable from the resort.
5. **Hagemaf**: this park is located on the southern west part of the town. And it is about hundred meters far from the main road, to the left side of the road when you travel from Addis Ababa to Adama on the old asphalt road, and is very easily accessible by any means of transportation. It have high vegetation cover and is the only park which do not have any water body, mainly Lakes, nearby.
6. **Kuriftu Resort and Spa:** is fantasy, with wonderful weather all-year round and a breathtaking crater lake setting, with a beautiful landscape and perfect views to the Lake Kuriftu. It is an eco-friendly paradise. There is Entertainment and sporting activities except the motor boat. The park's transport accesses is very difficult except for those visitors using their own car.
7. **Lisak Resort:** is located in Northern West part of Bishoftu town. Ethiopian Marine Institute is in close proximity to the hotel. The resort is built on Lake Babogaya. Again there is transportation problem to reach and enjoy the landscape and services provided by this Resort, except visitors having their own car or which have capital to rent a car.
8. **Mekoninoch No. 2:** is located almost in the central part of the town and constructed on the lake Hora, sometimes called _Arsadi', attractive Lake where Oromo cultural and ceremonial *irrecha* (the worship of *Waaqa tokkicha*) is conducted. The park have good vegetation coverage and is easily accessible to all kinds of visitors.

### 2.1.2. Population and Demographic Characteristics

Although a Wereda administrative center, Bishoftu Town is the fourth largest urban center in Oromia Region in population size, next to Adama, Jimma and Sashemene and indeed one of few towns in the country with a population of over 100,000. According to the May 2007 National Population and Housing Census, the total enumerated population of the Town was 100,114 and is estimated to reach 106,840 as of July 2009. Demographic records for Bishoftu Town existed as far back as 1967G.C. It was one of the 195 towns in the country that were covered by the national first and second round surveys. Since then the Town has been covered by almost all major surveys and, of course, the three national population and housing censuses.

Thus in 1967 and 1970 surveys, the total estimated populations of the town were 21220 and 27747 respectively. In the first and second national censuses, in May 1984 and October 1994, the total population of the Town was counted to be 55655 and 73372 respectively. During the last 40 years the Town has shown a steady growth, but at a consistently declining rate. The data demonstrate that the average annual rate of growth declined from 8.9 percent between 1967 and 1970 to 4.8 percent between 1970 and 1984 to 2.7 percent between 1984 and 1994 and finally to 2.3 percent between 1994 and 2007 (Hagos and Chuta, 2009).

## 2.2. Method of Data Collection and Analysis

### 2.2.1. Identification of UMTs

Intensive desktop work was done on identification of UMTs of Bishoftu town based on the Structural Plan of Bishoftu town and from Google earth image. UMTs were classified and identified based on Bishoftu town‘s land cover classification legend and by adopting

identification techniques of other cities, like Addis Ababa and Great Manchester. This was done using ArcGIS and Auto CAD. The result obtained was again analyzed by ArcGIS and Auto CAD software into the land cover classes, urban forms, identified in Bishoftu town and used as feedback to identify UMTs.

–Ground truth" data were collected primarily through ground-based field work. Ground truth was done on new established agricultural and vegetation areas, recently built condominium sites, cultivated bare lands, newly constructed residential areas, newly built industry and business areas, newly established utilities and infrastructures, community services and newly established urban recreational parks and stadiums, basically on plots that met a criteria of size one hectare, minimum threshold size and homogenous composition. All these data were collected using visual estimates of land cover elements, including the approximation of amount of area coverage of each land cover types.

### 2.2.2. Mapping of UMTs

Mapping UMTs involves the process of digitizing, which transforms information into digital format, such as from a paper map, or creates new data from other geospatial sources, such as from digital imagery. It is most likely that this step will involve on-screen digitizing of UMT units from orthorectified aerial photography in GIS or tools like Google Earth. On-screen digitizing involves creating a map layer on the screen by tracing units with a curser using reference information (aerial photography) as the background (Cavan *et al*., 2012).

The high level UMTs were mapped out from the identified land cover types, where first individual land cover types were recognized and defined with their detailed characteristics, using

a combination of ArcGIS, and Auto CAD software. With the help of ArcGIS software, each high level UMT units were independently selected and many polygons which were morphologically identical and belong to the same UMT units were grouped into one unit, and named as sub classes of high level UMTs. Finally, the polygons of both high level UMTs units and sub classes of high level UMTs were mapped with the help of Arc GIS software and hatched with different colors by using an Auto CAD software respectively.

### 2.2.3. Assessment of Recreational Ecosystem Services Provided

The data during the recreational ecosystem services assessment period were obtained from primary and secondary sources. The Primary data, were collected directly from the respondents, visitors of recreational parks on working, weekends and holiday through questionnaires. Both closed-ended and open-ended questionnaires were developed and distributed to park visitors. Closed-ended questionnaires were prepared to focus the respondents on the subject matter, particularly recreational ecosystem services. Open-ended questionnaires were used to seek the opinion and suggestions of the respondents to the improvement of the subject matter and other factors which have direct and indirect impact on the main issue, recreational ecosystem services. The secondary data were collected from the official‘s documents of City administrative and from different web sites.

Regarding the sampling method, female and male respondents, ten representatives from five selected recreational parks, within different age, sex, nationality and marital status at different time of the day were involved. The study employed simple random sampling and purposive sampling techniques. Simple random sampling was used in order to avoid bias and to ensure that

each respondent have equal chance of being selected during the assessment period. Whereas, purposive sampling was used to select recreational parks which meet minimum threshold size, 1ha.

### 2.2.4. Data Analysis

Based on collected data from Structural Plan of the town and image from Google earth, the high level UMT classes and UMT sub classes of the town were identified and the major noticeable land cover types were visual characterized, and thereby mapped. Then after, the counts of each high level UMT units and their sub classes with their area coverage were calculated by using ArcGIS and hatched with different colors by using AutoCAD software. With respect to recreational ecosystem services, the data obtained from questionnaires conducted were tabulated, analyzed and interpreted quantitatively. So that, recommendations can be developed from interpreted results and used as inputs for conducting further studies on urban green infrastructure planning and management in Bishoftu town in the future.

# CHAPTER THREE: LITERATURE REVIEW

## 3.1. Mapping

Generally, land cover mapping is done by segmenting the landscape into areas of relative homogeneity that correspond to land cover classes from an adopted or developed land cover legend. Technical methods to partition the landscape using digital imagery-based methods vary. Unsupervised approaches involve computer-assisted delineation of homogeneity in the imagery and ancillary data, followed by the analyst assigning land cover labels to the homogenous clusters of pixels. Supervised approaches utilize representative samples of each land cover class to partition the imagery and ancillary data into clusters of pixels representing each land cover class. Supervised clustering algorithms assign membership of each pixel to a land cover class based on some rule of highest likelihood. Supervised-unsupervised hybrid approaches are common and often offer advantages over both approaches.

It is important to point out that a land cover map is never considered a perfect representation of the landscape. Improvements to land cover maps can, and should be made as additional ―ground truth" information about actual land cover components and spatial patterns is acquired through time. These improvements should be based on independent assessments of the map's quality (Lowry *et al*., 2005).

Surface, or land, cover mapping in the UK from satellite imagery has primarily focused on rural areas. The Institute for Terrestrial Ecology of the Centre for Ecology and Hydrology (CEH) produced digital land cover maps for the UK for 1990 and 2000 using satellite information (CEH, 2007). The land cover map for 2000 has 26 sub-classes and is available in vector or raster

formats, the latter at resolutions of 1 km and 25 m. This has limited utility for mapping the fine-grained mosaic of different land covers within urban areas. Indeed, there are only two categories that refer specifically to urban areas: suburban/rural development and continuous urban. These include all urban land, rural development, roads, railways, waste and derelict ground, including vegetated wasteland, gardens and urban trees (Gill *et al*., 2008).

### 3.2. Definition of UMTs

Urban morphology is the study of the form of human settlements and the process of their formation and transformation. The study seeks to understand the spatial structure and character of a metropolitan area, city, town or village by examining the patterns of its component parts and the process of its development. This can involve the analysis of physical structures at different scales as well as patterns of movement, landuse, ownership or control and occupation. Typically, analysis of physical form focuses on street pattern, lot (or, in the UK, plot) pattern and building pattern, sometimes referred to collectively as urban grain. Analysis of specific settlements is usually undertaken using cartographic sources and the process of development is deduced from comparison of historic maps. Special attention is given to how the physical form of a city changes over time and to how different cities compare to each other. Another significant part of this subfield deals with the study of the social forms which are expressed in the physical layout of a city, and, conversely, how physical form produces or reproduces various social forms.

Urban Morphology Types are distinguished by their specific configuration of built and open spaces. UMTs have characteristic physical features and are distinctive according to the human activities that they accommodate (i.e. land uses). Physical properties and human activities are assumed to be key factors that largely determine the ecological properties of urban areas. The

distinction of UMTs is a suitable basis for the spatial analysis of cities for urban environmental and landscape planning.The essence of the idea of morphology was initially expressed in the writings of the great poet and philosopher Goethe. However, the term as such was first used in bioscience. Recently it is being increasingly used in geography, geology, philology and other subject areas.

Urban morphology is considered as the study of urban tissue, or fabric, as a means of discerning the environmental level normally associated with urban design. Tissue comprises coherent neighborhood morphology and functions (human activity). Neighborhood exhibit recognizable patterns in the ordering of buildings, spaces and functions (themes), within which variation reinforced an organizing set of principles. This approach challenges the common perception of unplanned environments as chaotic or vaguely organic through understanding the structures and processes embedded in urbanization. Complexity science has provided further explanations showing how urban structures emerge from the uncoordinated action of multiple individuals in highly regular ways. Amongst other things this is associated with permanent energy and material flows to maintain these structures (Wikipedia, 2015).

### 3.3. Mapping of UMTs and UMT Categorization in Selected Cities

#### 3.3.1. Mapping of UMTs

Urban morphological analysis aims to understand the development of overall urban form but has also been applied at a detailed level to housing types. Adolphe in 2001 analysed urban morphology using a range of geometrical and topological indicators (including rugosity, porosity, sinuosity, occlusivity, compacity, contiguity, solar admittance, and mineralization)

derived for their relevance to urban climatology. Another development in urban morphological research is space syntax analysis which employs mapping techniques to explore the relationships between urban space patterns and their use. Whilst interesting, such approaches are still in their developmental stages. The characterization of urban morphology using visual aerial photograph interpretation is a well-established technique (Gill *et al*., 2008).

The UMT maps can be used as the basis for producing a green structure map through extracting the UMT classes which primarily relate vegetation structures. Since UMTs are biophysically relevant units which take account of the boundaries of natural and vegetated zones this is a straightforward process. Whilst the UMT-based green structure maps provide a good starting point for assessing ecosystem services these maps alone provide an incomplete picture of green structures. Complementary land surface cover assessment is required in order to recognize the green structures which are present within other urban morphological units. Datasets combining urban morphology and land surface cover can support the production of ‗extended' green structure maps which provide a rich database to support the assessment of ecosystem services and, ultimately, the generation of green infrastructure plans.

Mapping UMTs involves the process of digitizing, which transforms information into digital format, such as from a paper map, or creates new data from other geospatial sources, such as from digital imagery. It is most likely that this step will involve on-screen digitizing of UMT units from orthorectified aerial photography in GIS or tools like Google Earth. On-screen digitizing involves creating a map layer on the screen by tracing units with a curser using reference information (aerial photos) as the background (Cavan and Lindley, 2010).

### 3.3.2. UMT Categorization and Mapping in Greater Manchester

Map for Greater Manchester shows the locations of the various town centers, including Manchester, Rochdale, Oldham, Stockport, Bolton, Bury and Wigan, (grouped under the primary UMT category of _retail' in the black and white version of the image). These are largely surrounded by residential areas, with higher density areas typically located closer to the town centers. Trafford Park, a major industrial and retail area, can be seen to the west of Manchester city center. The main transport infrastructure, including Manchester airport in the south and Manchester ship canal to the west, are clearly visible. Farmland surrounds the urban core and in certain instances extends into the urban areas. Here development is often constrained by designation as Green Belt to prevent coalescence of settlements and urban sprawl to the northeast in particular unimproved farmland heads up into the higher ground of the Pennine foothills which partly encircle the conurbation. Towards the south the open land of the Mersey valley forms a green space corridor intersecting the mainly residential areas.

Some 506km2, or just under 40%, of Greater Manchester is farmland, with the remaining 60% (793km2) representing the _urbanized' area. Residential areas account for just under half of the urbanized area and can thus be viewed from landscape ecology perspective as the _matrix'— representing the dominant landscape category in the urban mosaic. Recreation and leisure is the next major landuse, covering 12% of the urbanized area. Again, from a landscape ecology perspective these units may be viewed as the _patches' within the urbanized area. Industry and business, and previously developed land each cover 9% of the _urbanized' area. Woodland covers 5% of the _urbanized' area, or 3% of Greater Manchester. The UMT units are largest in the farmland category, with a mean size of 173.8 ha and a median of 20.6 ha. The farmland units

also vary the most in size, with a 25th percentile value of 7.3 ha and a 75th percentile of 96.7 ha. The UMT units within the other categories display less of a size range. Community services have the smallest UMT units, with a mean of 6.4 ha and median of 4.7 ha (Gill *et al.,* 2008).

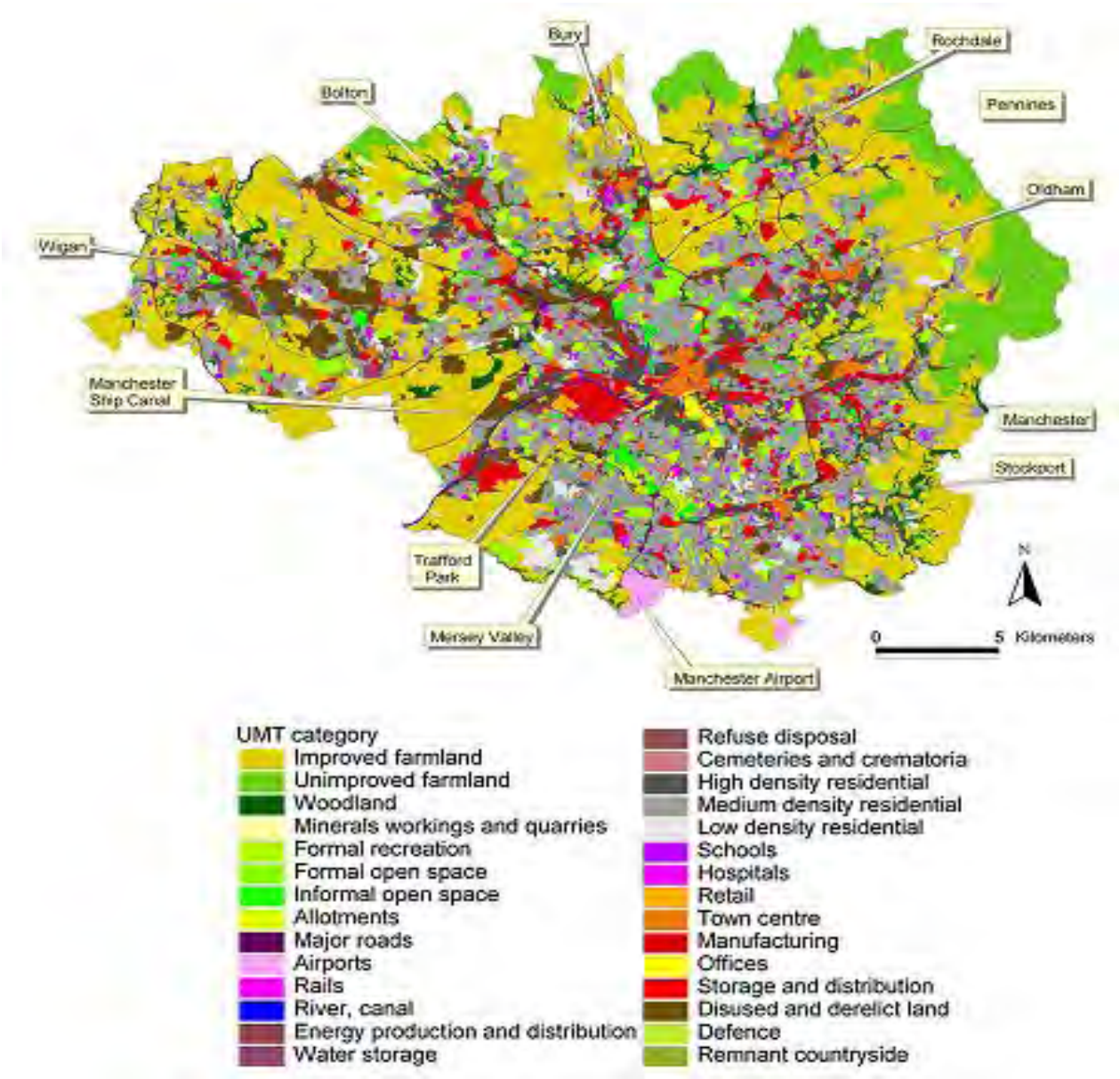



**Figure 2: UMT map for Greater Manchester**

**Source: Gill *et al*., 2008.**

### 3.3.3. UMT Categorization and Mapping in Addis Ababa

The UMT mapping result for Addis Ababa shows, field crops currently make up over one quarter of the land area of the Addis Ababa study area, by far the largest area associated with a single sub-UMT category. Much of the land devoted to field crops exists towards the south and south east. To the north, Addis Ababa is fringed with the exotic plantation species Eucalyptus. Around 44% of the land area of the city is associated with sub-UMT classes which are primarily green in nature. Over one third of the city is associated with residential urban morphology types and of these housing of mud/wood construction has the largest proportion (46%). Indeed, these areas make up the second highest proportional cover of the city at around 16%. Whilst there is some evidence of an urban core, the maps also illustrate Addis Ababa‘s multi-nucleated character. There is a large proportion of bare land (9%) at least some of which is likely to be associated with development. There are distinct parcels of bare land throughout the city with very large areas, some up to 781 hectares, identified to the north east, around the airport and around riverine corridors.

Comparison with 2006 data will enable the exploration of UMT change and when combined with land cover assessment it will also be possible to investigate which particular UMT classes experience the most development pressure and assess the impact on green structures in the city. This is important because pressures on green structures come from both climatic and non-climatic drivers. Furthermore, the extents to which green infrastructure related climate adaptations can be built into city planning are also sensitive to these issues.

The UMT dataset is expected to add value to the existing land-use map used in Addis Ababa as well as providing the basis for assessment of ecosystem services and wider CLUVA integration. The landuse map of Addis Ababa, which was produced for the implementation of the existing master plan of the city, classifies the city into 8 landuse classes. These are: Airport, Mixed use, Stadium festival site, cemetery, slaughter house, Industry, manufacturing and storage, urban agriculture, Main and sub-center, Forest, green along river and park and Reserved area.

This classification, however, ignores several landuses; for example minerals, transport (only airport indicated), utilities and infrastructure, community services are not represented in the landuse plan. The characterization of the environment of Addis Ababa based on UMTs is exhaustive in terms of covering both the built and green structure types with more or less clear subdivision among the UMT subclasses. Therefore, this methodology provides important data and information for the management of the urban ecosystem services based on effective urban planning procedures (Cavan *et al*., 2012).

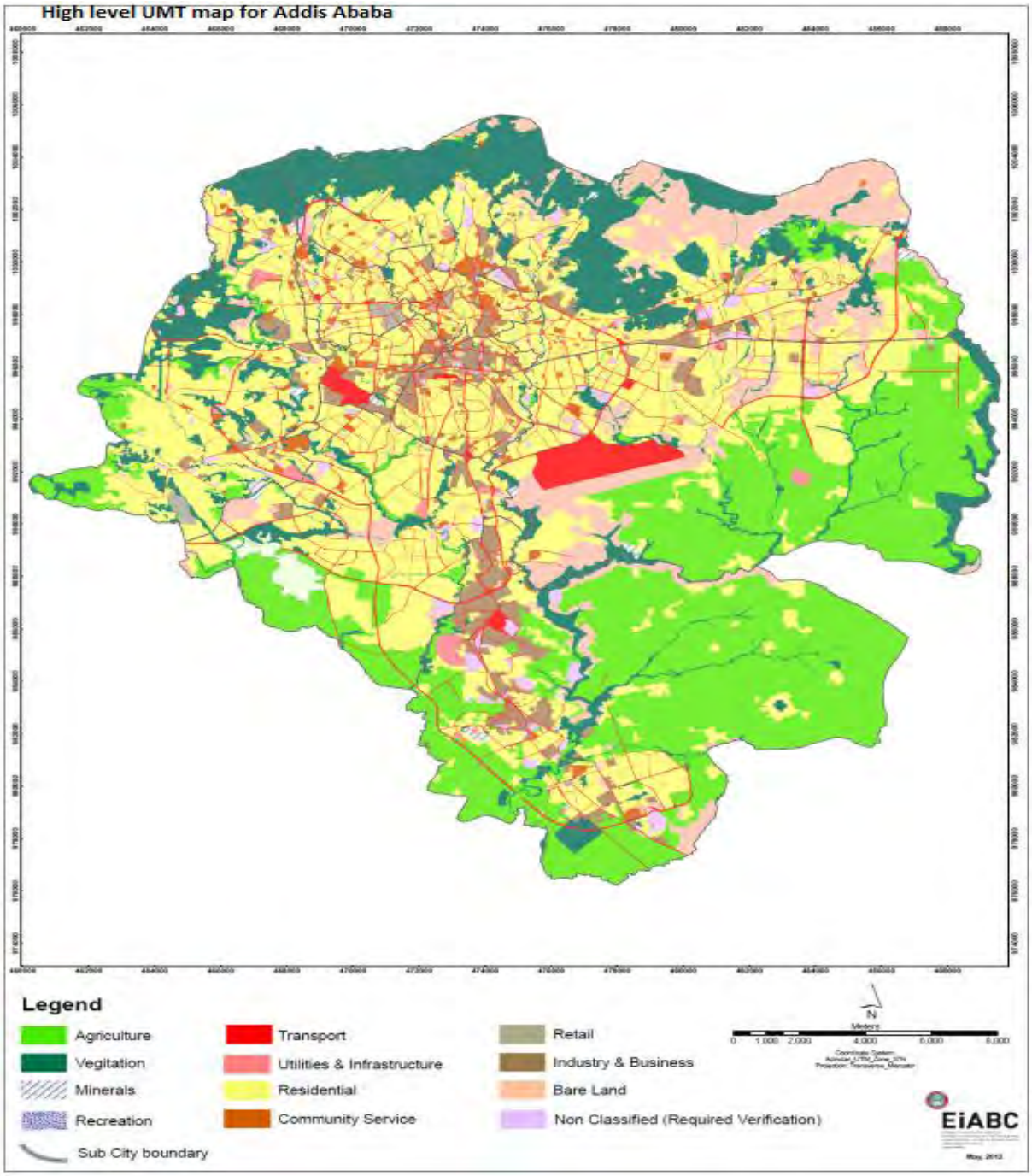



**Figure 3: Map of the high level UMT for Addis Ababa**

**Source (Cavan *et al*., 2012).**

### 3.3 4. UMT Categorization and Mapping in Dar es Salaam

The UMT map for Dar es Salaam indicates the UMT units that were verified using the orthorectified aerial photography from 2008 and field surveys. The unverified extent will be considered later through analysis of historical imagery on Google Earth together with local expert input at the Dar es Salaam meeting in July 2012.

Summary statistics of the UMTs for Dar es Salaam displays the percentage contribution of each UMT category to the total area of Dar es Salaam. Of all the UMTs in Dar es Salaam, mixed farming contributes the largest proportion, of 41% of the total area, mainly found on the outskirts of the city. Scattered settlement is the second largest UMT, contributing to 17% of the total area in Dar es Salaam. This UMT is found between areas in the city center and the most outlying areas of the city. Villa and single storey stone/concrete contribute 11% of the total area of Dar es Salaam. Although this UMT is mostly found in planned areas, there are other unplanned areas which also fall into this UMT category. Mixed residential UMT contributes 9% and this includes residential and commercial landuses and different building materials, consisting mainly of cement and sand blocks. These UMTs are found throughout the city and tend to decrease towards the outskirts of the city: they are found in both planned and unplanned areas. Field crops contribute 4% and these UMTs are found mostly on the outskirts of the city. Bush land contributes just less than 4%, and some areas of bush land are also used for mixed farming so the percentage area of bush land may be slightly higher.

Military, marsh/swamps, riverine, and mud/wood/sand brick construction UMTs have between 1- 3% each. Military areas are spread across the city from the city center in Upanga to the outer-most parts of the city in Bunju. Mud/wood/sand brick construction UMTs are mostly found in

the vicinity of the city, and with time this UMT is changed to either mix or villa and single storey stone and concrete. Major road corridors are around 1% and all other UMTs are less than 1% of the total area of Dar es Salaam.

In general, the UMTs of Dar es Salaam do not follow specific patterns because its urban morphology is very heterogeneous, certainly compared to European cities. In some areas residential areas are located within or very close to industrial areas, such as Tabata Reli, Keko, and along Nyerere Road. Urbanization due to rapid population growth and other factors has led to people constructing houses in areas not zoned for residence. Often, the landuse plan and regulations governing urban landuse management are violated and in many cases recreational landuses, especially open spaces designated as parks or playground are encroached. This makes UMT delineation a challenge but also highlights the need for stronger planning frameworks.

A number of UMTs especially those under transition are not fully developed and therefore, are expected to change in the near future. These UMTs include mixed farming, scattered settlement and field crops. The government has surveyed some of these areas specifically for residential use and the process of allocating plots to home builders is on-going. Currently these UMTs have few inhabitants. Recently more than 2400 plots were surveyed in Mabwe Pande which is categorized as mixed farming, and the plots are being given to victims of flash floods which swept across the city in December 2011. With time, and as owners of these plots start to develop them, the UMT will eventually change.

Similarly to mixed farming, the scattered settlement UMT is also under transition due to various development activities taking place. With time, this UMT is transformed to either mixed, condominium or villa and single storey stone/concrete. In comparison, the rate at which area

categorized as scattered settlement is diminishing is faster than the rate at which mixed farming is being transformed. This is because expansion of the city starts from the city center moving outward, and accordingly formally scattered settlements come closer to the city center. If the city expands at its current rate and no planning protection is established these UMTs (together with mixed farming) are likely to be converged within the urban center (Cavan *et al*., 2012).

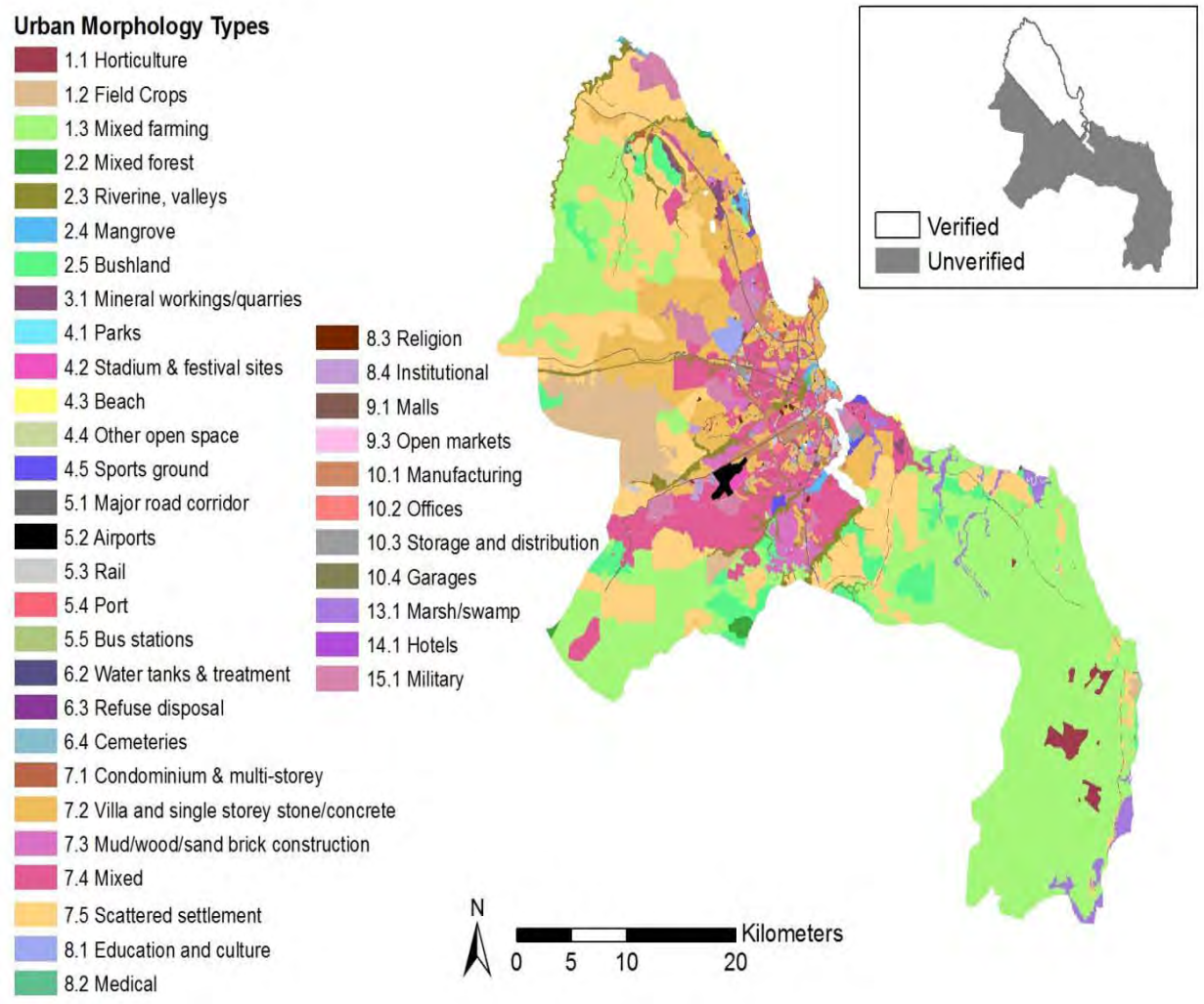



**Figure 4: UMT map for Dar es Salaam**

**Source (Cavan *et al*., 2012).**

### 3.4. What are Ecosystem Services?

Ecosystem services are the many benefits large and small, direct and indirect that ecosystems provide to people. These consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature. For example, forests provide wood products and a host of non-timber products and act as a venue for recreation and spiritual renewal; they also help to mitigate climate change by sequestering carbon. Wetlands absorb pollutants, purify water, and help reduce floods. Since different ecosystems provide different bundles of ecosystem services, there are tradeoffs and synergies amongst ecosystem services. For example, conversion of forest to agriculture lowers the wood supply and potentially the water flow regulation but it increases food production from crops. On the other hand, restoring a wetland may remove more pollutants from drinking water supplies and increase recreation benefits for bird watching (Landsberg *et al*., 2011).

Alternative definitions of ecosystem services were investigated. For example, Binning *et al*., 2001 have defined ecosystem services as one of the means by which ecosystem goods are produced, rather than as the goods and services themselves. However, neither this nor alternative approaches investigated developed effective separation of means and ends within their typologies. It is also acknowledged that although in everyday language there is a general differentiation between goods (such as food, furniture, timber) and services (such as health services, aesthetic provision); in the ecological and related economic literature the term services is sometimes used to include both goods and services, and at other times not. Thus, it may ultimately prove preferable to introduce a new term, such as ecosystem benefit, for ecosystem services. Nevertheless, the definition used by the Millennium Ecosystem Assessment (2005) is

generally consistent with current usage in the literature examined, and was adopted in this work (Wallace, 2007).

We advance the following definition of a final ecosystem service: Final ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being. This deceptively innocuous verbal definition is in fact quite constraining and has important properties from the standpoint of welfare measurement. In the remainder of this section we discuss three features of our definition: that final ecosystem services are directly enjoyed or used, that they are components, and that they are a quantity to be paired with a price (value). We conclude the section with a discussion of the contrast between ―services" and ―capital" or ―assets" (Boyd and Banzhaf, 2007).

The first important aspect of this definition relates to the language ―directly enjoyed, consumed, or used." This signifies that final services are end-products of nature. The distinction between end-products and intermediate products is fundamental to welfare accounting. If intermediate and final goods are not distinguished, the value of intermediate goods is double counted because the intermediate goods are embodied in the value of final goods. Consider a conventional market good like a car. GDP only counts the car's value, not the value of the steel used to make the car. The value of steel used in the car is already part of the car's total value. The same principle holds with ecosystem services. Clean drinking water, which is consumed directly by a household, is dependent on a range of intermediate ecological goods, but these intermediate goods should not be counted in an ecosystem service account. Many, if not most, components and functions of an ecosystem are intermediate products in that they are necessary to the production of services but are not services themselves. We emphasize that this does not mean these intermediate products

are not valuable, rather than their value is embodied in the measurement of final ecosystem services. Thus, final services should be the top priority in developing accounting units (Boyd and Banzhaf, 2007).

Note that, as end-products of nature, final ecosystem services are not benefits nor are they necessarily the final product consumed. For example, recreation often is called an ecosystem service. It is more appropriately considered a benefit produced using both ecological services and conventional goods and services. Recreational benefits arise from the joint use of final ecosystem services and conventional goods and services (Boyd and Banzhaf, 2007).

Consider, for example, the benefits of recreational angling. Angling requires ecosystem services, including surface waters and fish populations, and other goods and services including tackle, boats, time allocation, and access. For this reason, angling itself–or ―fish landed"–is not a valid measure of ecosystem services. More fish may be landed simply because better tackle are used—surely an undesirable feature of a measure intended to capture changes in nature's provision of beneficial services (Boyd and Banzhaf, 2007).

The fish population, surroundings, and water body are the ―ecosystem end products" directly used by anglers to produce recreational benefits. Thus, they are the ecosystem services that should be counted. The case of commercial fishing is similar, but here aesthetics are unimportant, so only the target fish populations need to be counted as ecosystem services (Boyd and Banzhaf, 2007).

The recreational and commercial examples also highlight the difference between final ecosystem services and final economic goods — final economic goods being things directly enjoyed or consumed by households. In the recreational case, the fish population is both the final ecological

service and the final economic good. In the commercial case, fish purchased by households are the final economic good. Here, the value of the fish population (relating to commercial harvest) is embodied in the value of fish purchased. Because the distinction between intermediate and final goods and services is so important to welfare accounting, we reiterate that while ecosystem services are nature's end−products, they are not necessarily –end products" for the purposes of GDP (Boyd and Banzhaf, 2007).

In addition to being directly used, another important aspect of our definition of ecosystem services is that they are –ecomponents." This means that services are ecological things or characteristics, not functions or processes. Ecosystem components include resources such as surface water, oceans, vegetation types, and species populations. Ecosystem processes and functions are the biological, chemical, and physical interactions between ecosystem components. Functions and processes are not end-products; they are intermediate to the production of final ecosystem services. A manufacturing process can be thought of as an intermediate service in the conventional economy. The value of a manufacturing process is not included in GDP, again because its value is embodied in the value of its end-products (Boyd and Banzhaf, 2007).

Often, ecological processes and functions are called services–nutrient cycling, for example. But nutrient cycling is an ecological function, not a final service. To be sure, it is a valuable function, but it is an intermediate aspect of the ecosystem and not an end-product. A third feature of our definition is that it facilitates a distinction between the quantity (physical measure) of ecosystem services and the value of those services. This distinction is always present in conventional economic accounts, but is often lost in discussions of ecosystem services (Boyd and Banzhaf, 2007).

The benefits of ecosystems are conferred at many scales and to many different beneficiaries. At the local level, ecosystem services are frequently the basis for rural livelihoods and subsistence, particularly for the poor. Artisanal fishing of coastal waters and inland lakes and rivers, for example, provides both cash income and food for millions of low-income families. Benefits can also be regional, such as the provision of water to communities and businesses from a forested watershed. At the global scale, well-functioning ecosystems regulate climate and act as a reservoir of biodiversity that underpins biological production of all types, including agriculture. Ecosystem services also work over different temporal scales, from the annual production of crops to the long cycles of soil formation and climate regulation (Landsberg *et al*., 2011).

### 3.4.1. Classification of Ecosystem Services

According to the MA, ecosystem services are seen as _the benefits ecosystems provide' (MA, 2005). By way of describing these _benefits' four broad categories of service are identified, namely: those that cover the material or provisioning services; those that cover the way ecosystems regulate other environmental media or processes; those related to the cultural or spiritual needs of people; and finally the supporting services that underpin these other three types. Although this categorization has been widely accepted, as is evident from the recent debate many have found it difficult to apply this definition and the classification (Haines-Young *et al*., 2009).

## Scientists generally divide ecosystem services into four categories:

1. ***Provisioning Services****:* are the products obtained from ecosystems (MA, 2003), also known as ecosystem goods. The provisioning services assessed by the sub-global assessments included: fresh water, food, fuel wood, fiber, and to a lesser extent, biochemical. Among these, freshwater provisioning was the service most commonly assessed.
2. ***Regulating Services****:* are the benefits obtained from the regulation of ecosystem processes (MA, 2003). Regulating services assessed by sub-global assessments included:
   - Runoff regulation, flood protection and soil protection,
   - Regulation of water quality,
   - Regulation of air quality,
   - Disease regulation and
   - Climate regulation (local regulation through albedo, and global regulation through carbon sequestration)
3. ***Cultural Services:*** The MA conceptual framework defines cultural services as the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, and recreation (MA, 2003). These benefits include cultural diversity, a sense of place, tourism, educational values, and aesthetic values. As is obvious from this definition, cultural services are complex and perceptions of these services vary across individuals and communities. Recognizing and evaluating the condition of cultural services is relatively new and the MA aimed to explore new ways of evaluating these services and their condition (Bohensky *et al*., 2005).

The sub-global assessments evaluated a few of the wide range of cultural services. Most assessments—including Caribbean Sea, Laguna Lake Basin, Portugal, Downstream Mekong, SAfMA Regional, and Sa˜o Paulo—focused on tourism as a cultural service. India Local assessed spiritual services through expert workshops; SAfMA Livelihoods and Sweden KW assessed spiritual and aesthetic services; Sweden SU assessed recreational and educational services. Trinidad assessed a wide variety of cultural services including recreation, eco- and agro tourism, cuisine, and religious and spiritual values. Coastal BC found that in rural societies provisioning and cultural services are often viewed as being identical. Thus the assessment grouped services into economic services (provisioning services that provide direct monetary benefits) and cultural services (provisioning services that provide material and nonmaterial benefits including the provision of food, raw materials for art, and sites of spiritual value) (Bohensky *et al*., 2005).

4. ***Supporting Services***: are those that are necessary for the production of all other ecosystem services (MA, 2003). The supporting services assessed by sub-global assessments include primary production (Western China, Laguna Lake Basin, SAfMA), soil formation (Portugal, Tropical Forest Margins, Norway), nutrient cycling (Tropical Forest Margins), and habitat provisioning (Altai-Sayan). The distinction between a supporting service and a regulating service was in many cases uncertain. For instance, the Portugal assessment analyzed soil protection as a regulating service, but this analysis also included an assessment of the soil condition in terms of nutrient supply, accumulation of salts from irrigation, and pollution from point sources. All of these components were part of an assessment of the soil as a resource base on which other services depend, which is a supporting service. Similarly,

primary production is closely related to the regulating service of carbon sequestration (Portugal), and the habitat provisioning service is often an integral component of a biodiversity assessment (Bohensky *et al*., 2005).

According to the Millennium Ecosystem Assessment, approximately 60% of all ecosystem services are degraded, often at the expense of enhanced provisioning services (Ringler, 2008).

Wider understanding of environmental processes may be a necessary part of any ecosystem assessment; it is the role of the natural world in delivering human wellbeing which is central to assessments of ecosystem services. It is this human focus that necessitates the integration of economic analysis within such assessments so that we can quantify and value ecosystem services ensuring that their importance and worth can be incorporated within decision making (Bateman *et al., 2010).*

Delineating, quantifying and valuing ecosystem services pose significant challenges. Ecosystem services emerge from whole and interconnected ecosystems that cannot truly be disaggregated (Voora and David, 2008).

### 3.4.2. Benefits of Bundling Ecosystem Services

There are several potential benefits involved with combining or bundling ecosystem services. Most ecosystem services are produced as joint products or bundles of services from intact ecosystems. Bundling ecosystem services offers the potential for reducing the high transaction costs of establishing individual markets for carbon, water, wetlands and species conservation. Bundling may also reduce trade-offs that would occur across ecosystem services, promoting synergies at the same time. There is potential to reap additional dividends if conservation of one

ecosystem service leads to the conservation of other services including biodiversity. However, for efficient decision making, managers must account for the full bundle of ecosystem attributes that are affected by any management action. Some of these benefits of bundling include consolidating regulatory requirements, providing deeper markets that are more economically viable, and connecting broader markets for wetlands, water quality and quantity, carbon and species conservation. Other important considerations for bundling include demonstrating additionally and avoiding double-counting of credits when bundling several services together such as combining credits for wetlands, habitat and carbon. A multi-resource market would also provide a greater suite of environmental benefits and a broader, more ecologically effective strategy than would be possible by management of any one service (Deal *et al*., 2012).

### 3.5. Assessment of Ecosystem Services

In order to better understand and communicate the complex concept that is _œcosystem services‘, the ES pilot developed a conceptual map of the relationship between ecosystem assets (e.g., wetlands), ecological functions, services and benefits. Using the example of *water storage and supply*, natural assets lead to ES and provides examples of the specific benefits that people obtain from this service. Wetlands are assets on a landscape, and incorporate many ecological functions, such as water infiltration and regulation of hydrological cycles and micro-climates. A resulting ES is water storage, and people might benefit from this service by having a reliable source of water for drinking or watering livestock, by swimming or recreating in water bodies downstream from the wetland, by living close to a beautiful wetland and appreciating the aquatic species that the wetland supports.

An ES ‗cascade' diagram was developed for each ES in order to identify indicators to be used in their assessment. Because data was not available to assess every component of the system (a common experience in ES assessment work according to experts), ES were assessed using one or several indicators that might represent the asset, the function, the service or benefits. In a more comprehensive ES assessment, the more indicators that can be used to understand the entire ES cascade across time and space, the more informative the results will be to decision makers. In addition, the beneficiaries and benefits for each ES are ideally identified and quantified in order to understand who relies on which ES and thus how decisions affecting ES will affect people. Due to the limitations of undertaking a pilot project, this report gathered partial information on the ES cascades and on the beneficiaries of each ES. We hope that these results will provide information that will be useful to decision makers and also present ideas for the types of information that can be developed from the ES perspective. For each ES, we identify questions that we could not answer due to project limitations that could provide important insight into wetland management in the study area (Raudsepp-Hearne *et al*., 2011).

### 3.5.1. Assessment of Recreation Ecosystem Services

Cultural ecosystem services are defined as the nonmaterial benefits obtained from ecosystems. Among these recreational pleasure that people derive from natural or managed ecosystems is defined as recreation service. Natural and semi natural ecosystems, as well as cultural landscapes, provide a source of recreation for mankind. People enjoy forests, lakes or mountains for hiking, camping, hunting, fishing or bird watching, or just for being there. Recreation is also supplied by managed ecosystems, such as agricultural lands. Relative to provisioning and

regulating services the capacity and the flow of benefits associated with cultural services may be much more intangible and difficult to measure.

The capacity of ecosystems to provide recreation depends on multiple factors: their beauty, their uniqueness, the culture that generated them, the possibility for outdoor activities etc. We call the associated flow of benefits –fruition" which may be measured by performance indicators such as the number of visitors that annually visit a site or the appreciation of sites based on questionnaires. The relation between capacity and fruition is likely to be positive and is influenced by the accessibility of ecosystems to humans and the infrastructure that is in place to host or to guide visitors: Fruition ~ Capacity × Accessibility.

Ecosystems may be of extreme beauty but if they are not accessible, they will not provide a flow of cultural services. Also, ecosystems may be highly accessible but their quality is low, the benefit flow they provide is low as well. Following this conceptual model we need to find spatial indicators that approximate the capacity of ecosystems to provide recreation services, the fruition or flow of such a service and the infrastructure in place to support the capacity of ecosystems in order to generate a service flow (Maes *et al*., 2011).

### 3.5.2. Recreational Values of Ecosystem Services of Green Spaces

While specific activities are clearly important, it is the general, informal activities which form the bulk of ecosystem service related recreation. Clearly these outdoor visits generate substantial recreational value and it is likely that changes to the natural environment would affect those values. Such changes in recreational values should be considered within environmental policy and decision making institutions. Here one of the major problems facing assessment is that the outdoor recreation values generated by any given resource are likely to vary substantially

depending upon the spatial context. Put simply, the same resource located in different areas will generate very different numbers of visits and values (Bolund and Hunhammar, 1999).

A city is a stressful environment for its citizens. The overall speed and number of impressions cause hectic lifestyles with little room for rest and contemplation. The recreational aspects of all urban ecosystems, with possibilities to play and rest, are perhaps the highest valued ecosystem service in cities. All ecosystems also provide aesthetic and cultural values to the city and lend structure to the landscape. Vegetation is essential to achieving the quality of life that creates a great city and that makes it possible for people to live a reasonable life within an urban environment. According to the Swedish economist Nils Lundgren, a good urban environment is an important argument for regions when trying to attract a highly qualified workforce. The appearance of fauna, e.g. birds and fish, should also be accounted for in recreational values (Bolund and Hunhammar, 1999).

# CHAPTER FOUR: RESULTS

## 4.1. Identification and Mapping of Urban Morphology Types of Bishoftu

### 4.1.1. Identification of Urban Morphology Types

The different categories of the Urban Morphology Types of Bishoftu town have been identified and characterized from the Structural Plan and Google earth images of the town. Then after, the identified UMTs classes were categorized under 12 high level UMT classes and 37 UMT sub classes (Table 2). The characterization in the urban environment of Addis Ababa based on UMTs developed from aerial photographs taken in 2011 resulted in 35 UMTs classified under 11 landuse classes (Cavan *et al*., 2012).

**Table 2: High level UMT classes and sub classes of Bishoftu town and their descriptions.**

| High Level UMT class | Descriptions of the landuse class | UMT sub class | Descriptions of key characteristics of UMT sub classes |
|---|---|---|---|
| **1.** Agriculture | This is a UMT class characterized by field crops and Urban Horticulture | **1.1.** Field crops | The field crops, especially cereals like wheat, teff and pulses such as, horse bean, field peas, chick peas, are grown using rain, therefore the land appears green during the rainy season (June-August). After crop harvest (November & December), the land could be covered by crops grown by irrigation. |

| | | | |
|---|---|---|---|
| | | **1.2**.Urban Horticulture | This UMT class include vegetable production sites, mainly based on irrigation from nearby river, Wodecha, and mostly produce onion, tomato, carrot, garlic etc., and flower farms producing cut flowers mostly for export and some to the local markets and different type of ornamental trees, ornamental shrubs, bushes and bedding plants propagated on nursery sites. |
| **2.** Vegetation | This UMT unit is characterized by a permanent land cover of woody and non-woody vegetation. | **2.1.** Plantation | Plantation is a unit dominated by a uniform plantation of Eucalyptus trees**.** Which are mostly used for fuel wood and construction. |
| | | **2.2.** Nature Forest | Natural Forest is a closed stand of different indigenous trees and is mainly composed of Junipers and Podocarpos trees and other shrubs. |
| | | **2.3.** Riverine | Riverine vegetation is an open stand of mixed type of vegetation composed of trees and shrubs found along rivers banks. |

| | | | |
|---|---|---|---|
| | | **2.4.** Grassland | Grass land is land with grass cover and used for livestock feeding. |
| **3.** Minerals | This UMT class includes an excavated site used for quarrying. | **3.2.** Mineral working and quarries | Quarry mining area is a site used for extensive quarrying for the production of selected material, red ashes and stones. |
| **4.** Recreation | This UMT class consists of green areas which are used for public recreation and for celebrating religious events. | **4.1.** Parks | Parks are green spaces covered with perennial vegetation (tree, shrub and herbs) and mostly constructed nearby to lakes. They serve as public recreational centers and places where wedding ceremonies, meetings and parties are undergoing. |
| | | **4.2.** Stadium /sport field | Stadium are open spaces, mostly green, used for sport and political activities. |
| | | **4.3.** Festival /cultural sites | Are open spaces, mostly around water bodies, which are used for practicing religious activities, and public events, like celebration of _Irrecha' festivals. |
| **5.** Transport | The transport UMT is used for public and freight | **5.2.** Asphalt road (>=15m width) | This UMT sub class is a road constructed from asphalt and used for transport passengers inside the town and to the nearby cities by using Taxis and bigger buses. |

| | | | |
|---|---|---|---|
| | transport terminal. | **5.3.** Coble stone road(>=15m width) | This UMT sub class is a road constructed from coble stone and used for transport passengers inside the town by using Bajaj and Horse carts. |
| | | **5.4.** Bus Terminal | Give transport to travelers to the nearby cities like Adama, Modjo and Addis Ababa by using minibuses and other bigger buses like ‗ISUZU Qitiqit'. |
| | | **5.5.** Air port | Give transport for military workforces only for defense purpose and used as training place for Air force pilots. |
| **6.** Utilities and Infrastructure | This UMT class is characterized by structures that help the provision of various utilities to the public, industry and business. | **6.2.** Energy Distribution | Energy distribution includes electricity transmission sites and Transmission line. |
| | | **6.3.** Sewerage Disposal | Sewerage disposal is a site for disposing liquid waste collected from residence, industries and business areas. |
| | | **6.4.** Refuse Disposal | Refuse disposal is a site for disposing solid waste collected from residence, industries and business areas. |
| | | **6.5.** Cemeteries | This UMT sub class are areas where the remains of dead people are buried, and |

| | | | |
|---|---|---|---|
| | | | are mostly in churches with good vegetation cover. |
| **7.** Residential | The different types of residential houses constituted in this class. | **7.2.** Condominium & multi-storey | The Condominium and multi-storey residential sub class is where more than 75% of the houses are with two or more storeys and built from concrete. |
| | | **7.3.** Villa and single storey | Villa and one storey residential is where more than 75% of the houses are villa type or with only one storey, all built from concrete. |
| | | **7.4.** Mud/wood construction | Mud / wood construction residential is where more than 75% of the houses are built from mud and wood. |
| | | **7.5.** Mixed | The mixed subclass residential is where a residential area contains a mixture of any of the above three sub classes. |
| **8.** Community Services | This UMT class include institutions that provide educational, | **8.2.** Education | Educational institutions are those that provide elementary, secondary or tertiary education. |
| | | **8.3.** Medical | Are institutions providing medical service for both inpatients and outpatients. |

| | | | |
|---|---|---|---|
| | medical and religious services to the community. | **8.4.** Religion | Religious institutions are churches and mosques for practicing spiritual commitments. |
| **9.** Retail | This UMT class is a commercial area where commodities are exchanged with money. | **9.2.** Formal Shopping | Formal shopping area is when more than 75% of commodity exchange takes place in multi-story buildings. |
| | | **9.3.** Open Market | Are when more than 75% of the commodities are exchanged in open field or in small shops with single-story. |
| | | **9.4.** Mixed Market | The mixed subclass is when multi-story buildings, small shops and open fields are found together for commodity exchange. |
| **10.** Industry and Business | This UMT class consists of subclasses of manufacturing and storage, public and private offices, hotels, and freight terminal and | **10.2.** Manufacturing and Storage | Is when more than 75% of the site is occupied by manufacturing industries and storages, sites used for merchandise storage and distribution. |
| | | **10.3.** Offices | Is when more than 75% of the site is occupied by government private Offices. |
| | | **10.4.** Hotel | Hotel is when more than 75% of the sites are occupied by Hotels. |

| | | | |
|---|---|---|---|
| | vehicle repairing garages. | **10.5.** Freight terminal and Garage | Freight terminal and garage is when more than 75% of the site is used for freight terminal and vehicle repairing. |
| | | **10.6.** Mixed | When a site is occupied by any mixture of the above subclasses, it is termed mixed. |
| **11.** Water Bodies | This UMT class consists of lakes, ponds and river | **11.2.** Lakes | This UMT class represents a land covered by water, lakes, which is mostly stagnant in nature. |
| | | **11.3.** Ponds | This UMT class represents an area which is covered by shallow water bodies that used for irrigation purpose and for drinking water. |
| | | **11.4.** River | This UMT class represents water bodies which are flowing in a ditch / waterway in their nature and existing most of the time in a year. |
| **12.** Bare land | This UMT class represents bare lands | **12.2.** Bare land | This UMT class represents a land which has never been occupied with any structure or a land which used to be covered by built structure but is now demolished and the land remains bare. |

Table 2, shows the descriptions of all the 12 high level UMT classes and 37 sub classes of Bishoftu town. This result help to group different sub classes of high level UMTs, which have relatively the same characteristics / descriptions, under one high level UMT, and thereby contribute its part in mapping the high level UMTs classes and sub classes of high level UMTs successfully.

### 4.1.2. Mapping Urban Morphology Types of Bishoftu

*4.1.2.1. Map of High level UMT classes of Bishoftu town*

The high level UMTs of Bishoftu town has been mapped after the classification and identification processes of High level UMT classes are done (Table 3 and Figure 5). As a result, Bishoftu town have twelve high level UMTs classes. The characterization in the urban environment of Addis Ababa based on UMTs developed from aerial photographs taken in 2011 resulted in 35 UMTs classified under 11 landuse classes (Cavan *et al*., 2012).

The percentage area coverage of Agriculture is almost one third of the total area, i.e. 32.61%, followed by Vegetation cover and its area coverage is 19.09% and Bare land having percentage cover of 17.27% ranked on the third. Minerals, Utilities and Infrastructure and Retail with area coverage of 0.06%, 0.18% and 0.56% respectively, characterized the least three scores of high level UMT. Others, Water Bodies, Residential, Transport, Industry and Business and Community Services ranked from 4, 5, 7, 8 and 9 with their respective area coverage of, 7.56%, 6.76%, 6.23%, 2.68% and 0.82%. The Recreational UMT class, which is the other concern of this research paper, ranked sixth with its area coverage of 6.2% (Table 3).

**Table 3: Summary Statistics of the High level UMT classes**

| High level UMT Classes | Count of UMT units | Sum of Area | Percentage Area coverage |
|---|---|---|---|
| 1. Agriculture | 31 | 1775.08 | **32.61%** |
| 2. Vegetation | 32 | 1039.08 | **19.09%** |
| 3. Minerals | 2 | 3.46 | **0.06%** |
| 4. Recreation | 14 | 337.44 | **6.20%** |
| 5. Transport | 7 | 339.14 | **6.23%** |
| 6. Utilities and Infrastructure | 4 | 10.13 | **0.18%** |
| 7. Residential | 88 | 367.91 | **6.76%** |
| 8. Community Services | 24 | 44.04 | **0.82%** |
| 9. Retail | 21 | 30.26 | **0.56%** |
| 10. Industry and Business | 42 | 145.94 | **2.68%** |
| 11. Water Bodies | 10 | 408.59 | **7.56%** |
| 12. Bare land | 12 | 940.21 | **17.27%** |

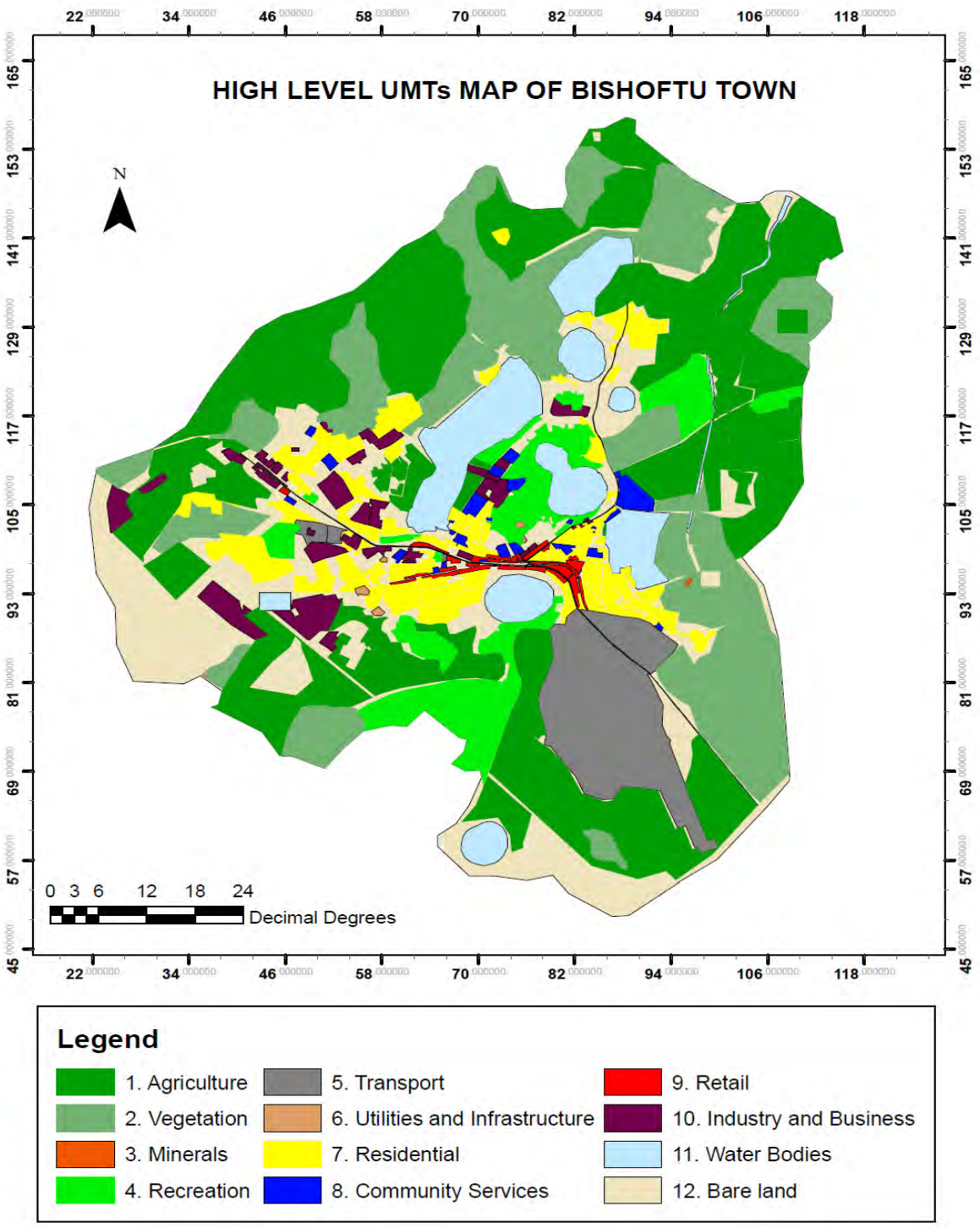



**Figure 5: Map of High level UMT classes of Bishoftu town**

*4.1.2.2. Map of the UMT sub classes of Bishoftu town.*

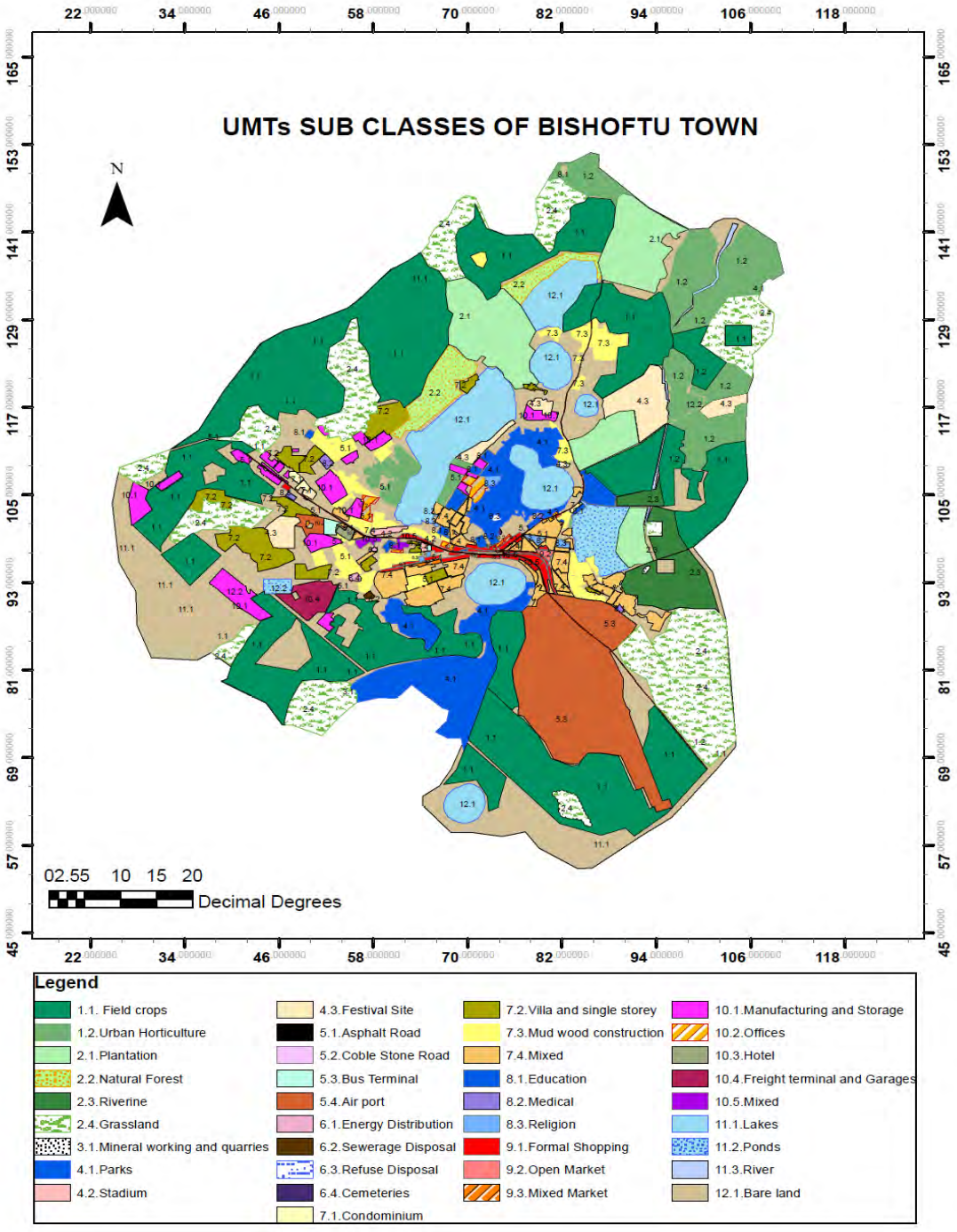



**Figure 6: Map of the UMT sub classes of Bishoftu town**

**Table 4: Summary Statistics of the UMT sub-categories**

| UMT Classes | Count of UMT units | Min. Area (Ha) | Max. Area (Ha) | Mean Area ( Ha) | Sum of Area coverage | Percentage Area (%) |
|---|---|---|---|---|---|---|
| 1.1. Field crops | 18 | 0.46* | 197.44 | 81.75 | 1471.46 | **27.03** |
| 1.2. Urban Horticulture | 13 | 0.42* | 81.96 | 23.28 | 302.63 | **5.56** |
| 2.1. Plantation | 4 | 2.67 | 117.39 | 70.64 | 282.57 | **5.19** |
| 2.2. Natural Forest | 12 | 2.19 | 49.64 | 6.15 | 73.83 | **1.36** |
| 2.3. Riverine | 1 | 104.15 | 104.15 | 1 | 104.15 | **1.91** |
| 2.4. Grassland | 13 | 1.13 | 121.11 | 44.50 | 578.53 | **10.63** |
| 3.1. Mineral working and quarries | 2 | 1.64 | 1.82 | 1.73 | 3.46 | **0.06** |
| 4.1. Parks | 8 | 0.20* | 137.11 | 29.79 | 238.35 | **4.38** |
| 4.2. Stadium | 2 | 1.02 | 3.51 | 2.27 | 4.53 | **0.08** |
| 4.3. Festival Sites | 7 | 1.17 | 49.67 | 13.51 | 94.56 | **1.74** |
| 5.1. Asphalt roads | 3 | 1.17 | 5.34 | 2.71 | 8.4 | **0.15** |
| 5.2. Coble Stone roads | 1 | 2.45 | 2.45 | 1 | 2.45 | **0.05** |
| 5.3. Bus Terminal | 2 | 0.88* | 3.51 | 2.2 | 4.39 | **0.08** |
| 5.4. Air port | 1 | 323.90 | 323.90 | 1 | 323.90 | **5.95** |
| 6.1. Energy Distribution | 2 | 0.43* | 1.44 | 0.94 | 1.87 | **0.03** |
| 6.2. Sewerage Disposal | 1 | 1.09 | 1.09 | 1 | 1.09 | **0.02** |
| 6.3. Refuse Disposal | 1 | 0.96* | 0.96 | 1 | 0.96 | **0.02** |
| 6.4. Cemeteries | 4 | 1.40 | 3.01 | 1.55 | 6.21 | **0.11** |
| 7.1. Condominium and multi-storey | 5 | 0.29* | 2.05 | 0.96 | 4.80 | **0.09** |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7.2. Villa and single storey | 13 | 0.83* | 33.47 | 8.17 | 106.20 | **1.95** |
| 7.3. Mud/wood construction | 29 | 1.25 | 17.26 | 4.50 | 130.40 | **2.40** |
| 7.4. Mixed | 41 | 0.50* | 13.61 | 3.09 | 126.51 | **2.32** |
| 8.1. Education | 13 | 1.19 | 13.83 | 2.46 | 31.98 | **0.59** |
| 8.2. Medical | 4 | 0.39* | 2.17 | 1.03 | 4.12 | **0.08** |
| 8.3. Religion | 7 | 1.14 | 2.83 | 1.13 | 7.94 | **0.15** |
| 9.1. Formal Shopping | 19 | 0.46* | 3.39 | 1.41 | 26.69 | **0.49** |
| 9.2. Open Market | 1 | 1.88 | 1.88 | 1 | 1.88 | **0.04** |
| 9.3. Mixed Market | 1 | 1.69 | 1.69 | 1 | 1.69 | **0.03** |
| 10.1. Manufacturing and Storage | 23 | 1.34 | 21.35 | 4.16 | 95.77 | **1.76** |
| 10.2. Offices | 13 | 0.24* | 7.34 | 1.29 | 16.81 | **0.31** |
| 10.3. Hotel | 3 | 0.51* | 2.91 | 0.97 | 2.91 | **0.05** |
| 10.4. Freight terminal and Garages | 1 | 25.58 | 25.58 | 1 | 25.58 | **0.47** |
| 10.5. Mixed | 2 | 2.06 | 2.81 | 2.63 | 4.87 | **0.09** |
| 11.1. Lakes | 7 | 7.77 | 138.76 | 48.27 | 337.92 | **6.21** |
| 11.2. Ponds | 2 | 7.99 | 52.70 | 30.33 | 60.66 | **1.11** |
| 11.3.River | 1 | 13.16 | 13.16 | 1 | 13.16 | **0.24** |
| 12.1. Bare land | 12 | 1.25 | 239.91 | 78.35 | 940.21 | **17.27** |

* NOTE: When some sub classes of high level UMT were very important, they were kept less than a minimum threshold size; i.e. 1ha. E.g. Park, sub classes of Recreational UMT, since they were very important in the recreational ecosystem assessment study of the town.

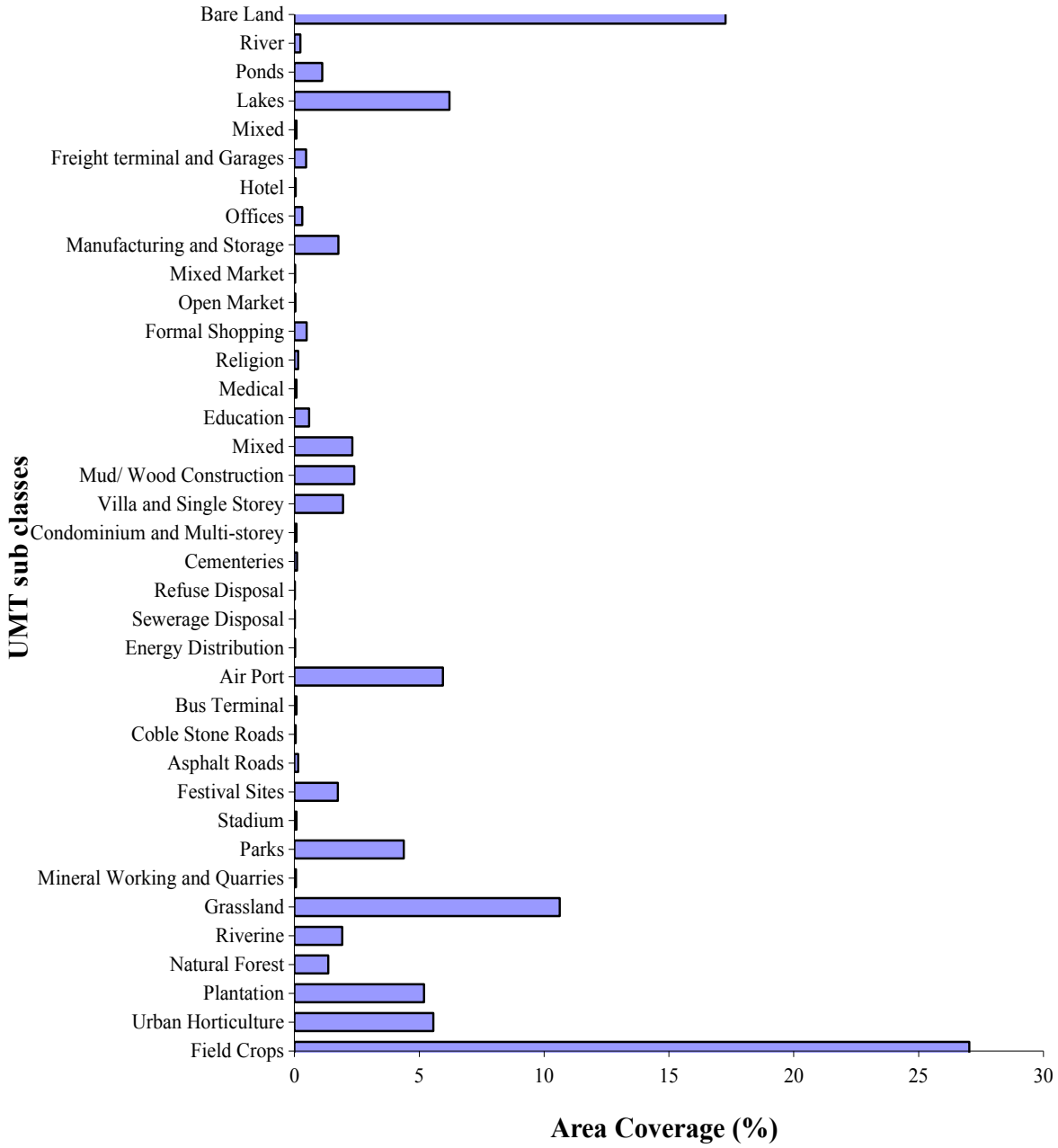



**Figure 7: Percentage area coverage of UMT sub classes of Bishoftu Town**

The results of Map of the UMTs sub classes of Bishoftu town were indicated on Figure 6, 7 and Table 4. Table 4, shows the detail information of the sub classes, i.e. it tells the number of count for each sub classes, the minimum and maximum value scored in a single sub class, the mean area of the sub class, the total area coverage for specific sub class and the percentage area coverage of each sub class in the high level UMTs. The sub classes were grouped under 37 categories with their respective percentage area coverage. The characterization in the urban environment of Addis Ababa based on UMTs developed from aerial photographs taken in 2011 resulted in 35 UMTs classified under 11 landuse classes (Cavan *et al*., 2012).

The percentage area coverage of high level UMT sub classes, Field crops, which belong to the Agricultural high level UMT class, led by 27.03%, followed by Bare land having area coverage of 17.27%, Grassland, which belongs in the Vegetation high level UMT with its area coverage of 10.63%, ranked on the third. The next bigger sub UMT class were the Lakes, which were the characteristic features of recreational parks existing in the town, and have 6.21% area coverage, the fifth big sub class by area coverage was the Airport, air force airport, having 5.95% area coverage.

Concerning other sub classes like Sewerage disposal and Refuse disposal have the most minimum value, 0.02%, area coverage; Energy distribution and Mixed market have 0.03% area coverage, and Open market have the third least area coverage, i.e. 0.04% of all sub classes. Parks, which were the sub classes of Recreational UMT and the selected sub class for the assessment of cultural ecosystem services, recreational ecosystem services, have a total area coverage of 4.38% or 238.35ha. The percentage area coverage of other sub classes were explained with all their details on Table 4.

### 4.2. Recreational Ecosystem Service Assessment

Cultural ecosystem services are defined as the nonmaterial benefits obtained from ecosystems. Among these recreational pleasure that people derive from natural or managed ecosystems is defined as recreation service (Maes *et al*., 2011). To assess these services questionnaires were distributed in selected five parks to visitors.

#### 4.2.1. General Information About the Visitors

**A) Nationality**: during the assessment period different peoples coming from different corners of the country and world were obtained. So that, the percentage composition for nationality of the respondents indicated that; out of the total 50 respondents, 43 (86%) of them were Ethiopians and while the rest 7(14%) were other nationality. Out of these 14%, 2 of them were from Canada, 3 from Germany, 1 from Russia and 1 from Israel.

**B) Age composition:** when evaluated the age composition of the park visitors, it was found that the recreational parks were visited by different age group; teenagers, youths and elders.

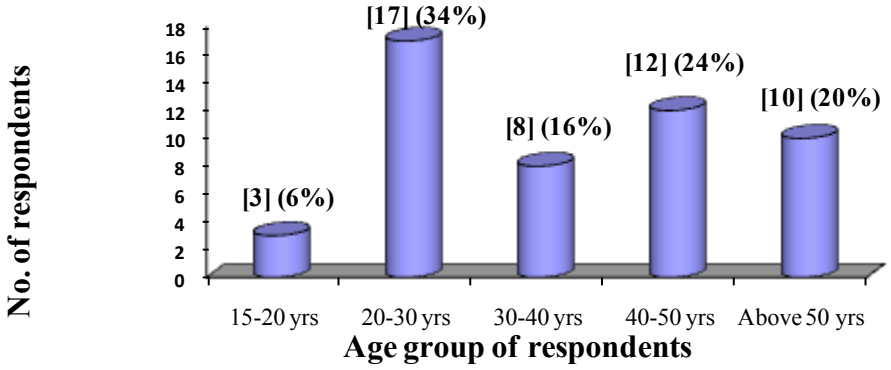



**Figure 8: Age composition of park visitors**

C) **Sex composition:** while collecting data during the assessment period both female and male respondents were questioned, 29(58%) of respondents were male and the rest 21(42%) were female.

D) **Marital status:** during the assessment period, marital status of the visitors was the other subject addressed (Table 5).

**Table 5: The marital status of respondents**

| | **Married** | **Engaged** | **Single** | **Total** |
|---|---|---|---|---|
| **No. of Respondents** | 13 (26%) | 4 (8%) | 33 (66%) | 50 (100%) |

### 4.2.2. Attitudes of Visitors Towards Visiting Recreational Parks

Under this part of the questionnaire respondents were asked and they replied about the different aspects of their park visiting habits, comfortable time to visit parks, the reliefs that they get while staying in the parks, services provided in the parks, transportation facilities, etc. of parks.

I) **Park Visiting habits of respondents**: in this section of the questionnaire the respondents were asked for their visiting habit of recreational parks existing in the town. Out of 50 respondents which were asked as; _Have you ever visited any park? 32 respondents (64%), replied _YES' and the remaining, 18 respondents (36%) responded _NO'.

**II) Reason for not visiting parks:** 18 respondents were asked for their reason for not visiting parks and their response were presented on Figure

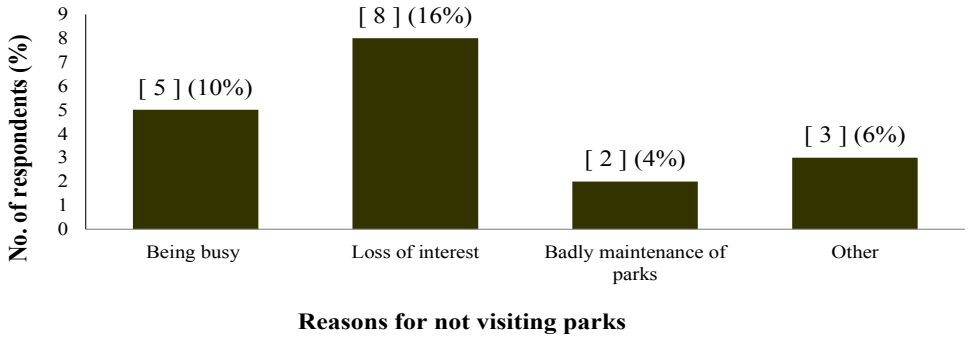



**Figure 9: Reason for not visiting parks**

**III) Parks commonly visited in Bishoftu town:** 32 respondents which have experience in visiting parks in Bishoftu town, have listed some of parks they have been visited before (Figure 10).

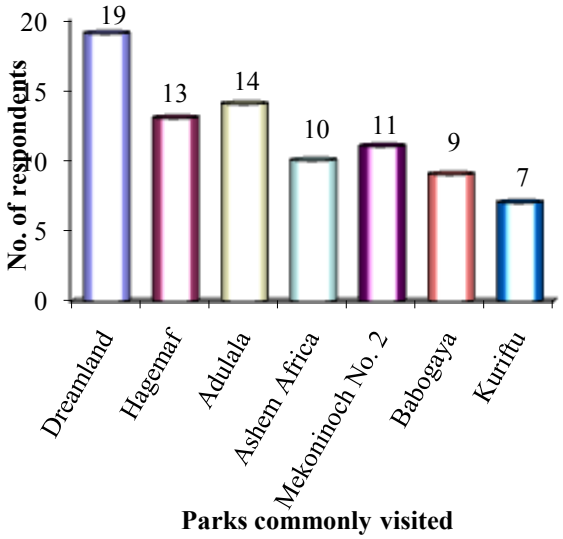



**Figure 10: Parks commonly visited in Bishoftu**

**IV) Visiting frequency of parks:** respondents were asked for their visiting frequency of parks in Bishoftu, and they replied in different ways (Table 6).

**Table 6: Visiting frequency of parks**

| | Once/twice in a week | Once/twice in a Month | Once in a yr. | 2 - 3 times in a yr. | Others | Total |
|---|---|---|---|---|---|---|
| **No. of respondents** | 6 | 7 | 14 | 19 | 4 | 50 |
| | 12% | 14% | 28% | 38% | 8% | 100% |

**V) Favorable date for visiting parks:** respondents were asked for their favorite day of a week to visit parks in Bishoftu, and different visitors indicated their difference in preference of the day during their visit (Figure 11).

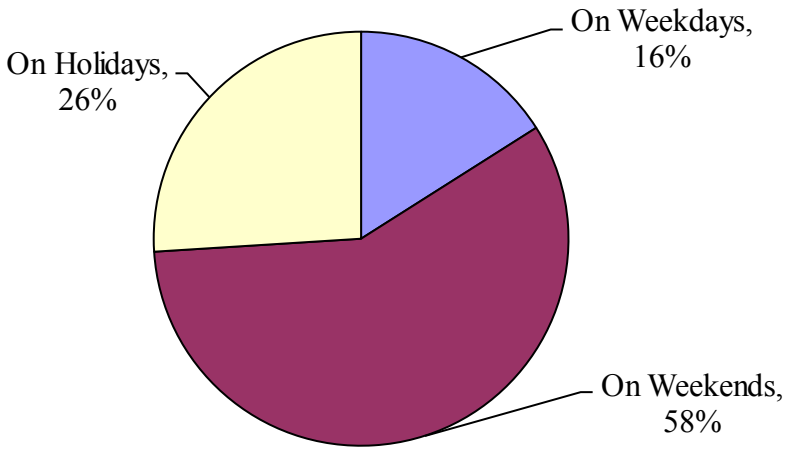



**Figure 11: Favorable date for visiting parks**

**VI) Favorite time of the day for visiting parks:** Table 7 shows the respondent's favorite time of the day for visiting parks and were categorized as those which visit in Morning (2:00-5:00), Lunch time (5:30- 5:30), Afternoon (8:00-11:00) and after work (11:30-2:30) .

**Table 7: Favourite time of the day for visiting parks**

| No. of respondents | Morning | Lunch time | Afternoon | After work | Total |
|---|---|---|---|---|---|
| | 4(8%) | 9(18%) | 13(26%) | 24(48%) | 50(100%) |

**VII) Comforts of parks:** visitors were asked for their comfort while visiting parks. Hence, the respondents were grouped into two groups depending on the answer they gave. As a result, 29 respondents (58%) are comfortable with parks whereas, 21 respondents (42%) are not comfortable with parks in Bishoftu town.

**VIII) Things making parks uncomfortable:** park visitors were asked as what makes them uncomfortable with parks and replied their different types of problems (Table 8).

**Table 8: Things making parks uncomfortable**

| No. of Respondents | Cleanness | Services | Safety | Other | Total |
|---|---|---|---|---|---|
| | 11(22%) | 16(32%) | 18(36%) | 5(10%) | 50(100%) |

**IX) Things making parks comfortable:** park visitors were asked about things that make them to feel comfortable while visiting parks and they replied; services provision, closeness to their living home, for enjoying the landscape and the fresh air they can get there (Figure 12).

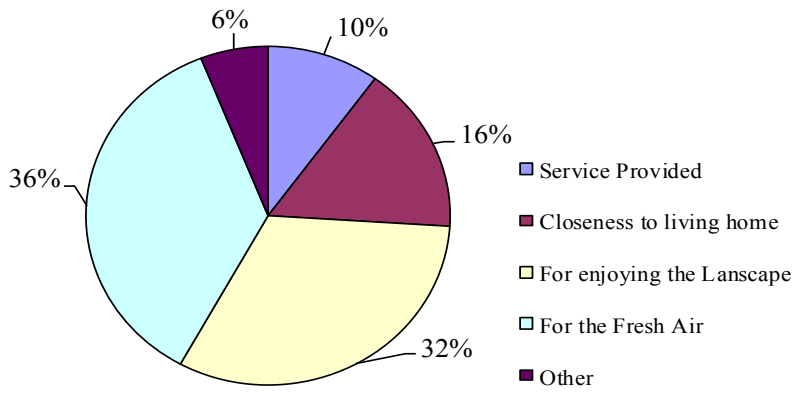



**Figure 12: Things making parks comfortable**

X) **Satisfaction level by visiting parks:** whatever the reason for satisfaction obtained, its level need to be measured. So that, the satisfaction level of respondents was measured qualitatively and the result of this measurement was presented on Table 9.

**Table 9: Satisfaction level by visiting parks**

| No. of Respondents | Very Satisfied | Satisfied | Not Satisfied | Very Dissatisfied | Total |
|---|---|---|---|---|---|
| | 13(26%) | 23(46%) | 9(18%) | 5(10%) | 50(100% |

XI) **Durations in staying inside parks:** the length of time that visitors stay in the parks was the other question asked during the assessment period. It was found that majority of visitors stay up to 2 hours and in contrast others would stay even for less than 30 minutes (Table 12).

**Table 10: Durations in staying inside parks**

| No. of Respondents | Less than 30 min. | 30min. - 1hr | 1-2 hrs | 2-4 hrs | Total |
|---|---|---|---|---|---|
| | 7(14%) | 12(24%) | 19(38%) | 12(24%) | 50(100%) |

**XII) Means of transportation and time taken to reach the parks:** the time taken to reach to these parks from different corners of the town were variable depending on the distance from parks and the type of transportation visitors were using. Different visitors use different types of transportation systems to reach these parks. Some of these transportation systems were; taxis, bicycles, buses, private cars and on foot (Figure 13 and 14).

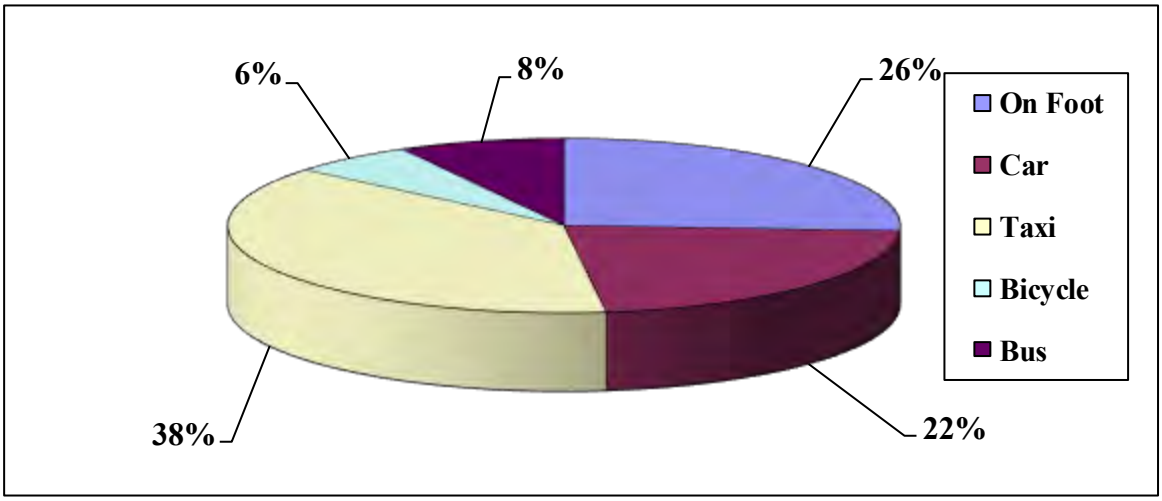



**Figure13: Means of transportation used**

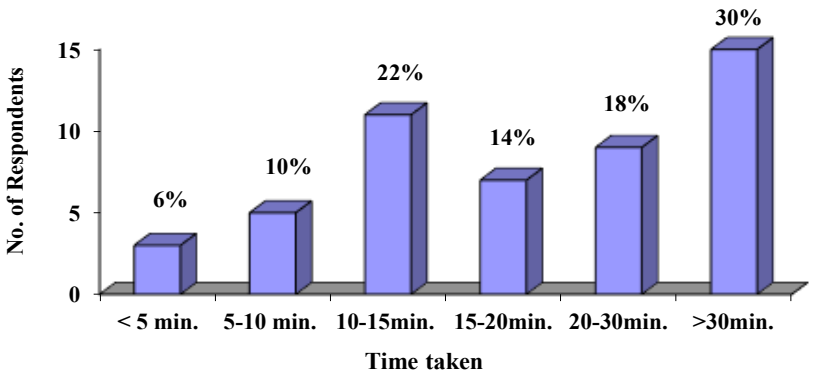



**Figure 14: Time taken to reach the parks**

# CHAPTER FIVE: DISCUSSION

## 5.1. High level UMT classes of Bishoftu town

The map of high level UMT classes of Bishoftu town shows, the Agricultural UMT class have the higher amount of coverage, 32.61%. This indicates that the town is very suitable for the cultivation of different types of crops and the major income of the dwellers is from agricultural products. The other high amount area coverage, 17.27%, is for the Bare land UMT class and presented on the peripheries of the town. This indicates that the boundaries of the town is not used to any developmental activities, so that, these places are the potential part of the town for the new development of residential, small scale and bigger scale industries, for framing activities or to any other UMT class that need to be expanded. The third high level UMT class is the Vegetation class and it covers about 19.09% of the total coverage. This indicates that almost one fifth part of the town is covered by greenery. The Water body coverage of the town is the other UMT class which scores the higher amount, 7.56. This UMT make the parks in the town very attractive to visitors and very comfortable while visiting throughout the year. Such areas, water bodies, maximize the ecosystem services provided by recreational parks because they create much diversified ecosystems around the parks and add beautification to recreational parks.

Others UMTs, like Minerals, Utilities and Infrastructure, Retail and Community services have very small amount of area coverage. This indicates that the town need to have additional mineral sites for the further development of utilities and infrastructure. The Retail activities and Community services in the town cover only small portion of the total area, so further additional area are needed to be selected and added to expand these activities and services. Industry and Business, Recreational areas, Transportation facilities and Residential are the other four high

level UMTs of Bishoftu town. The Recreational UMT class which covers 6.20% of the total area coverage is providing recreational ecosystem service, by enjoying the landscape, through fishing, and by boat ridings for not only visitors coming from different angles of the Bishoftu town but also from different towns of Ethiopia and the whole world.

### 5.2. The UMT sub classes of Bishoftu town

The result on the identification and mapping of UMT sub classes of Bishoftu town indicates that the town has 37 sub classes under 12 high level UMTs. The characterization in the urban environment of Addis Ababa based on UMTs developed from aerial photographs taken in 2011 resulted in 35 UMTs classified under 11 landuse classes (Cavan *et al*., 2012).

Out of these 37 sub classes the Field crops area coverage is by far large, 27.03%, this indicates that field crops are produced in the town in large amount and the area are rich in agricultural products especially in field crops. The other high amount is again the Bare land sub class like in the high level UMTs, i.e. 17.27%. So by doing good planning those bare lands can be filled with appropriate land covers and by doing so the development and growth of the town can be facilitated.

The other sub UMT classes like Grassland, Lakes, Airport, Urban horticulture and Parks have relatively higher amount of area coverage than the left once. The Grass land which has 10.63% area coverage indicates that the town has large amount of land used for grazing animals and this again indicates that the town is rich in the production of animals and their products. The Lakes having 6.21% of area coverage are mostly the typical features of recreational parks and give beauty to the town. The Airport, Ethiopian Air Force, has area coverage of 5.95% and is very

important place in the army of the country. On the other hand the Urban horticulture, which focused on the production of cut flowers, vegetables and different types of landscape plants have an area coverage of 5.81%, again this sub UMT class, especially the landscape plants / seedlings which present on sides of the main road are the other interesting sub classes that add beauty to the town as a whole. Plantations which have an area coverage of 5.19% have important role on controlling the atmospheric temperature of the town, by doing this it has high contribution in creating very comfortable atmosphere in recreational areas. Parks which have 4.38% are the other focus of this paper, and are in a good amount of area coverage to provide recreational ecosystem services to the wellbeing of human living in the town and coming from other areas.

Other sub UMT classes of the town have very less amount of area coverage ranging from 0.02-2.4%. These sub classes can be expanded by doing intensive study on the importance and significance of these areas. But those small amount of area coverage does not mean that, these UMT sub classes are not important or less important (Table 4 and Figure 7).

### 5.3. Recreational Ecosystem Service provided by Recreational Parks

Concerning the nationality composition of park visitors, most visitors are Ethiopians and only 14% of the total respondents are foreigners. The age composition of recreational parks visitors, grouped as age between 15 - 20 years and are small in number; other group of visitors are in the age between 20 - 30 years and have the maximum number. Whereas, others in the age between 40 - 50 years have the second higher number.

Regarding sex composition, male dominate over female, this may be cultural problem we have, the safety problem of some recreational parks and the attitude difference towards visiting parks.

The marital status indicates that singles dominate over the married once. This may be due to the less responsibility single share over their houses than married, since either they live alone or dependent on their parents.

Concerning the different attitudes of respondents towards visiting recreational parks, most visitors stated that as they have visiting habits and quite small number of respondents have no visiting habit. The later groups give reasons like shortage of time, loss of interest and the badly maintenance of recreational parks as a reason for not visiting parks.

Out of recreational parks presented in Bishoftu town, Dreamland is the one which mostly visited by most visitors, it may be because it is easily accessible to all visitors, Adulala is the secondly ranked for visiting, and it may be because it have very attractive landscapes and atmospheric condition. Hagemaf, which is again accessible and with high vegetation coverage, is visited on the third rank.

The visiting frequency of recreational parks vary from respondents to respondents. Most of the respondents said that they visit 2-3 times in a year, others only once in a year but some of them visit once or twice in a month.

Recreational parks are mostly visited by large number of visitors on weekends, this may be due to the time freedom and freeness from work. Others visit on holidays but small amount of peoples visit on working days.

For most visitors, the most favorable time for visiting parks are in the late afternoon (after work). Other enjoy visiting in the early afternoon and few during their lunch time. This comfortable time of the day may largely depend on the work nature of the respondents.

While visiting recreational parks most of the respondents are uncomfortable because of the safety feeling they have there, the services provided in the parks and the cleanness of the recreational parks. Respondents which are comfortable with parks, want to go and enjoy the landscape design of parks because they get satisfied by looking at different art and science of these designs. Other respondents give priority for the fresh air they get in these parks during their visit. The different services provided, like fishing, swimming in pools and boat ridings, are also reasons for some respondents comfort while staying in these parks. As a result most respondents (46%) were satisfied, some are very satisfied (26%) and fairly small number of visitors, (10%), are very dissatisfied mainly because of the service delivery system, i.e. lack of trained persons for delivering services, longer time taken to get services and lack of sanitation of the service giving areas, especially outdoors places.

Most visitors stay 1 - 2 hours in these parks, others stayed 2 - 4 hours and others less than 30 minute, these all depend on mostly the attitude / frame of mind / visitors have during their stay. While talking about the transportation means, most visitors which use their private car can reach to the parks within 5 - 15 minute, those which use other transportation system like Bus, Taxi, Bicycle and Bajaj can reach within 15- 30 minutes, but those which go to the recreational parks on foot need more than 30 minutes to reach and to enjoy recreational parks in the town.

# CHAPTER SIX: CONCLUSION AND RECOMMENDATION

## 6.1. Conclusion

The concept of Urban Morphology Types and its mapping techniques are newly emerging sciences. In Ethiopia the techniques has been recognized as a useful tool for communicating about the values of urban forms for sustainable development and management of the urban ecosystem, from which human beings can benefit. The study identified 12 high level UMTs and 37 UMT sub classes in Bishoftu town. So that, knowing mapping techniques of Urban Morphology Types facilitate the assessment of ecosystem services provided by different groups of UMT classes in the town and this result can be used for further improvement of quality of life of people living in the town.

The study of ecosystem service is becoming increasingly very important for many benefits that human beings gain from ecosystems. There are different types of ecosystem services, these are provisioning, regulating, cultural and supporting services. The maximum ecosystem services benefit can be obtained from an ecosystem, if the ecosystem biodiversity is well planned and managed before starting any developmental activity in urban and rural areas. For effective usage of ecosystem services, assessment of the different categories of services provided by the different urban forms need to be studied and the result should be used during the planning process.

Cultural ecosystem services, recreational ecosystem services, the non-material benefits obtained from an ecosystem, are the most common services obtained from urban greeneries, especially from recreational parks. In Bishoftu, most people who visit recreational parks in the town gained recreational ecosystem services from the landscapes of parks, fresh air obtained in these areas,

the different kinds of activities they practiced while staying in the recreational parks, like by fishing, swimming in pools and boat ridings. Therefore, to maximize the recreational ecosystem services delivered from recreational parks, combined work amongst local government bodies, environmental planners, investors and other professionals is obligatory.

### 6.2. Recommendation

As there is a rapid growth of urbanization, the same is true for Bishoftu town, there is also a rapid increase in the need for properly planned and managed recreational parks. If proper planning is done over recreational parks, the recreational ecosystem services provided can be used up efficiently and effectively. Moreover, by doing advertisement and by creating awareness about the presence of recreational parks primarily owners and ultimately the government, city administrative bodies, need to maximize the profit they make out of recreational parks. To get recreational ecosystem service, provided by recreational park in Bishoftu town organized work in the town is important.

- To get the maximum benefit from the recreational parks of the town in the future; continuous identification and mapping of UMTs, recreational parks, of Bishoftu town is necessary.
- The ecosystem must not be disturbed, kept disturbance to the minimum, during the construction of the recreational parks.
- Think in advance which ecosystem services want to be provided before starting construction of parks.

- The administrative bodies of the town need to encourage any development on green areas, especially recreational parks to get maximum benefit from them.
- Work on creation of public awareness and promote the importance of recreational parks on the wellbeing of human beings and the entire environment.
- Encourage participation of the private sector in the construction and maintenance of recreational park in the town.
- Provide sufficient transportation facilities to recreational parks with affordable price to visitors.
- Allocate sufficient resources, skilled man power, financial supports and some other incentives for investors to invest on green areas, especially on recreational parks.
- Provide training for workers inside the parks, particularly to gardeners and sanitary workers because they are very important for the attractiveness of the recreational parks.
- Provide training to urban planners, engineers and to the environmentalist, which have high contributions in planning, construction and managing practices of recreational parks.

So that, professionals, business owners and government bodies need to work together hardly and in a planned way for the improvement of the recreational ecosystem services provided, for the safety of visitors, for the profitability of the business sector and for maximizing the domestic national income gained from recreational parks. Generally, co-operative work is crucial between different stake holders; environmental planners, engineers and government bodies, for the attainment of the maximum possible recreational ecosystem services out of recreational parks in the town.

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**APPENDIX A: Questioner filled by park visitors.**

## Ethiopian Institute of Architecture, Building Construction and City Development

## Questioner to be responded by Park visitors

Dear respondents, first of all I want to thank you in advance for your willingness to fill this questioner paper, which is planned for the study of **Recreational Ecosystem Services** provided by parks in Bishoftu town, Ethiopia. In filling the questioner try to be very **honest**, **free** and **open**; because your responses to each and every question on the questioner paper will have high contribution for the truthfulness of the paper as a whole.

### 1. General information on the visitors

1.1. Nationality …… 1.2. Age ……

1.3. Sex ……. 1.4. Marital status ……

### 2. Factors while visiting the park

**2.1.** Have you ever visited any park? Yes ☐ No ☐

**2.2.** If no, why? I am too busy / not enough time ☐ They are badly maintained ☐

They do not interest me ☐ Other _____.

**2.3.** Have you ever visited any park other that this in Bishoftu town? Yes ☐ No ☐

**2.4.** If yes, which park did you visited? _____ _____ .

**2.5.** How often you visit these parks? Once or twice a week ☐ Once or twice a month ☐

Once a year ☐ 2 or 3 times a year ☐ other _____.

2.6. When did you mostly visit parks? On Weekday ☐ On Weekend ☐ On Holidays ☐

2.7. Which is you favorite time for visiting?

Morning (2:00 - 5:00) ☐ Lunch time (5:30 – 7:30) ☐

After noon (8:00 – 11:00) ☐ After work night (after 11:30 – 2:30) ☐

2.8. Are you comfortable with these Parks? Yes ☐ NO ☐

2.9. If no, what did you miss in the Parks (Please thick as many as appropriate)?

Cleanness ☐ Service ☐ Safety ☐ Other _____.

2.10. If yes, what makes you comfortable in the Park?

The service that you get there ☐ Its closeness to your home ☐

To enjoy the Landscape ☐ The fresh air that you get there ☐

Other _____.

2.11. Over all, how satisfied are you with the Parks?

Very satisfied ☐ Satisfied ☐

Neither nor Satisfied ☐ Very dissatisfied ☐

2.12. How long you stay there?

Less than 30 minutes ☐ 30 minutes – 1 hour ☐

1 – 2 hours ☐ 2 – 4 hours ☐

Please specify (if other) _____.

2.13. How would you normally travel to these Parks?

On foot ☐ Car ☐ Taxi ☐ Bicycle ☐ Bus ☐

2.14. How long does you normal journey take to reach these parks? (Please tick one only).

<5 min ☐ 5 -10 min ☐ 10-15 ☐ 15-20 ☐ 20-30 ☐ >30min

3. Generally, did you have anything to comment about the recreational services, safety, and flexibility of activities in these parks? _____

_____ .

## APPENDIX B: Images of Sample Recreational Parks.

**A) Adulala Resort and Spa**: Built along the bank of Babo Gaya Lake (Bishoftu Guda). The name Adulala means ―see the sun" in the local language of, Orommifa.

**Source : www.sefere.net.**

**B) <u>Babogaya Resort:</u>** Located on Babogaya Lake.

**Source : www.hotelplanner.com**

**C) Dreamland:** The smallest park enjoys a great top view of Lake Bishoftu.

**Source : www.panoramio.com.**

**D) Kuriftu Resort and Spa:** Built on Kuriftu Lake.

**Source : www.safarinow.com.**

**E) <u>Liesak Resort:</u>** Situated right on the coasts of the beautiful Bishoftu Guda Lake.

**Source : airpotstay.co.za.**