Mapping Urban Morphology Types (UMTs) of Arba Minch Town, and Assessment of Recreational Ecosystem Services

M.Sc. Thesis in Partial Fulfillment of the Requirements for the degree of Master of Science in Environmental Planning and Landscape Design

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Declaration and Confirmation

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

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ABSTRACT

Urban Morphology Types (UMTs) provide an opportunity to link socio-ecological systems as they link different human activities and natural processes. Such linkages are important in understanding urban and urban influenced environments and in providing guidance to those who make decisions regarding urban areas. This paper is aimed at mapping UMTs of Arba Minch town and assessment of recreational ecosystem service at Park UMT of Arba Minch town. The study began by identifying UMTs, 12 high level UMTs and 32 sub UMT classes based on the morphology, land use and structural plan of the town. In the study, the identified UMTs categories were digitized in ArcView GIS for Arba Minch town. It was identified that filed crops contributes the largest portion, 29.91% of the total area of the town. Assessment of recreational ecosystem service was conducted at three park UMTs from the developed subclass UMTs map of the town. The assessment was carried out by collecting data's from users of recreational areas and concerned local government officials through interviews, questionnaire, document and literature review. The interviews and questionnaires were held by purposive sampling method at the study areas mainly at weekends in the afternoon. For the case of government officials questionnaires were submitted and collected in their respective offices. The assessment results and findings show both the capacity of park UMTs of Arba Minch town to provide recreational ecosystem service and the demand of societies for recreation is high. However, due to management problem by local government and concerned officials, low development and maintenance of recreational areas and the growth of town to the recreational areas, the provision of recreational ecosystem service is low. The local government of the town should give attention for urban green spaces and open space in the town, which provide recreational ecosystem service to the societies and should develop UMTs approach since the approach considers urban form and green space together. Effective implementation of those recommendations and future planning solutions in the study should provide attractive recreational areas in the town and enhance the proper provision of recreational ecosystem services in the future for the users of recreational areas.

Key words: Assessment, Ecosystem Service, Recreational Ecosystem Service, Urban Morphology Types

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ASCCUE Adaptation Strategies for Climate Change in the Urban Environment

CES Cultural Ecosystem Service

CICES Common International Classification of Ecosystem Services

CLUVA Climate Change and Urban Vulnerability in Africa

EiABC Ethiopian institute of Architecture Building Construction and City Development

EPSRC Engineering and Physical Sciences Research Council

ES Ecosystem Service

GDP Gross Domestic Product

GIS Geographic Information System

NGO Non-Governmental Organization

NLUD National Land Use Database Classification

MA Millennium Ecosystem Assessment

SNNPRS Southern Nations, Nationalities and Peoples Regional State

TEEB The Economics of Ecosystem and Biodiversity

TV Television

UK United Kingdom

UMT Urban Morphology Type

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

The provision of fresh air in cities is one of the main drivers for sustainability. Cities depend on a healthy natural environment that continuously provides a range of benefits, known as ecosystem services (Boyd and Bazhaf, 2007). The composition of urban forms, known as urban morphology, can crucially influence the performance of the microclimate at the urban canopy layers. It is how the case that because of serious urbanization and inconsiderate planning, numerous urban areas suffered from inadequate ventilation with the resultant adverse impact on occupants' well-being and energy loads (Hsie, 2008).

Urban Morphology Types (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 (CLUVA, 2012). UMTs are derived from categories used by urban spatial planning rather than ecological classifications. The underlying assumption behind UMTs is that they are distinctive land use categories characterized by physical features and the human activates that occur within them (Gill et al, 2008). As urban morphology, structural units and types are the expression of past and recent human decisions on the use and form of land, they offer the potential to serve as interfaces between natural and social sciences, on the one hand, and planning on the other (CLUVA, 2012).

The approach based on UMT's has been increasingly adopted in Europe for studies in urban ecology, but its application in urban studies in Africa is very recent. A consolidated framework, but for cities an adapted set of approximately 30 UMT's (some illustrated above or below) is taken to delineate UMT's for the whole city from Arial photos, land use map and from high resolution satellite images by local experts (Moudon, 1997). In Germany, the UMT approach has been in use since the early 1980s under the name of "urban structural types", i.e. which can be distinguished by their characteristic pattern of built and open spaces. The approach assumes that "the physical features of these entities and the various human activities they accommodate largely determine the social and environmental quality of the urban system" (Pauleit, 2000).

The approach based on UMTs is very recent in Africa and is currently ongoing in some cities of Africa by CLUVA project. In this case, specific guiding methodology used is originated from a UK research project, Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE), funded by the UK Engineering and Physical Sciences Research Council (EPSRC). This methodology, outlined in Gill et al. (2008), has been specifically adapted to the context of African cities, whilst still utilizing the same general principles (CLUVA, 2012).

For many developing countries, the urban population is already becoming larger and further increases in size and rates of growth will no doubt stress already impacted environments. This increasing urbanization radically modifies (changes) the ecology of landscapes. Urbanization has had and continues to have a negative impact on green space within cities (Tratalos et al., 2007). The effects include alteration of habitat, such as loss and fragmentation of natural vegetation, and the creation of novel habitat types; the alteration of resource flows, including reduction in net primary production, increase in regional temperature, and pollution of air and water quality (Tratalos et al., 2007).

The process of urbanisation influences natural processes, thereby influencing both human and wildlife populations. Despite its widely reported negative effects, particularly those on climate and wildlife populations, urbanisation also brings with it many advantages. These advantages largely benefit human populations with improved housing arrangements, better employment prospects, better access to health and social care, education and cultural activities. Furthermore, urban areas play a large role in the flow of economic capital, labour, goods and services (Gail et al, 2012).

Despite awareness of the numerous drawbacks associated with urbanisation, cities and urban environments are still expected to continue to expand rapidly. Thus, making it increasingly important to develop methods of tackling the problems associated with urbanisation. In recent times, in order to do this, the focus has been on the conservation and enhancement of ecosystem functions and ecosystem services, concepts which have become increasingly important models for linking the functioning of ecosystem services to environmental sustainability, and human health and wellbeing (Gail et al, 2012).

As human well-being is inseparably linked to the provision of goods and services (ecosystem services) by the rest of the living planet, and this does not change just because most humans now live in urban areas. There are a surprising number of such ecosystem services, ranging from reduction of atmospheric pollution from traffic, to spiritual feelings induced by being in nature. Even within urban areas, the non-human living environment provides substantial support to human activities, support that is only now beginning to be recognized. In trying to understand and quantify the support given by nature to people in cities, now a day's attention has moved from individual elements (trees, ponds, gardens, parks, etc.) to the urban forest as a whole. This is because most of ecosystem services accrue from urban nature acting as a network or system, that is, from the combination of nature elements to form green infrastructure. Therefore, to understand how the ecosystem services in a city came about, and how resilient they are likely to be, we must understand urban forms in their socio-cultural contexts (Boyd and Bazhaf, 2007).

Human domination (urbanization) of the biosphere is rapidly altering the composition, structure, and function of ecosystems often eroding their capacity to provide services critical to human survival (Palmer et al, 2004). Ecosystem services are ecological functions that sustain and improve human life (Daily, 1997). A recent classification of ecosystem services divides them into four categories: provisioning services, regulating services, supporting services, and cultural services. Cultural services provide humans with recreational, spiritual, and aesthetic values (MA, 2003). Now days; focus upon the role played by planning, design and management in dealing with interactions between 'green spaces' and built-up areas (Ostfeld, 2005).

This study is aimed at mapping UMTs of Arba Minch town and assessment of recreational ecosystem service within park UMTs. The study develops both high level and detail level UMTs map for Arba Minch town. Further, it assesses the provision of recreational ecosystem service to the societies within the park UMTs of the town. Finally, it gives remarkable recommendation and future planning solutions to enhance the provision of recreational ecosystem service within the green UMTs of the town in the future.

1.2. Statement of the Problem

The consequent loss and degradation of urban and peri-urban green space could adversely affect ecosystems as well as human health and well-being (Tzoulas et al, 2007). As human influence on

the natural environment increases, setting priorities for environmental protection becomes ever more important and urgent (Daily, 2000).

Although founded only about three decades ago, Arba-Minch town was marked by a tremendous population growth, physical expansion and development of various institutions (Demeke and Aregu, 2006). According to town's municipality office, there were only 150 tukules[1] with a total population between 1500 to 2000 people in 1964 (Demeke and Aregu, 2006). However within three decades the number of housing units increased to 8776 with a total population of 40,020 in 1994 and 57,223 in 2001 (CSA., 2007, Endale, 2003, Aramde, 2012). This makes Arba Minch one of the fastest growing towns of Ethiopia. Population growth of Arba Minch town had strongly been affected by migration (Demeke and Aregu, 2006). According to census (2007) reports, 66%, and 62% of the total population were immigrants, respectively.

In fact, several factors could be mentioned for the rapid expansion of the town; among them the establishment of state farms, the development of different institutions and the amount of immigrants together with other development processes are few. This expansion directly or indirectly contributed to the removal of green infrastructure and decrease in provision of ecosystem services of the town (Demeke and Aregu, 2006; Aramde, 2012).

Although, Arba Minch town has a lot of plant and animal species that provide the ecosystem services, but currently the town is losing its biodiversity (both plant and animal species). This is due to population growth, urbanization, fuel wood collection, improper planning to green structures, management problem of urban green spaces (Demeke and Aregu, 2006); which may lead the town in the near future to climate change and decrease in ecosystem services provision. Therefore, it is clear that a new approach of addressing urban problems is needed. This would have to be efficiently integrated, sensitive to ecosystem services and community, respectful of uncertainties, and open to citizen involvement than what now prevails to have sustainable urban morphology and to have the benefits of urban ecosystem services.

Thus, UMT approach can be seen as "integrating spatial units linking human activities and natural processes" (Gill et al., 2008). Such an approach is often necessary because biophysical

[1]Small houses with grass attached roof

units such as discrete green spaces may not be very well represented by current administrative units and existing planning approaches such as Land Use and Structural/ Developmental planning approach in Arba Minch town. Similarly, existing Land Use and Structural/ Developmental planning approach in Arba Minch town do not normally consider aspects of urban form and green structure together.

A relationship between land use and ecosystem services in urban areas has been noted in the Millennium Ecosystem Assessment (MA, 2005). Hence, UMTs can be used as a tool through which ecosystem services in urban areas might be studied and the approach adopted in the UMTs provides a possible way to explore the provision of ecosystem services within city cores (Tratalos et al., 2007).

Since UMTs are biophysically relevant units which take account of the boundaries of natural and vegetated zones this is a straightforward process. The approach is better in mapping ecosystem services and for assessing provision of ecosystem services. However, the existing Land Use and Structural/ Developmental planning approach in Arba Minch town fails to do so.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this study is mapping Urban Morphology Types (UMTs) of Arba Minch town and assessment of recreational ecosystem services within the park UMTs of the town.

1.3.2. Specific Objective of the Study

The specific objective of this study is:

1. To identify the existing UMTs categories and map UMTs of Arba Minch town.
2. To assess the provision of recreational ecosystem service within the green UMTs of the town.
3. To provide recommendation and future planning solution to enhance the proper provision of recreational ecosystem services in the future within the green UMTs of the town.

1.4. Research Questions

This study will be aimed to answer the following research questions:

1. What are the existing UMTs in Arba Minch town?

2. Does the green spaces in Arba Minch town provide proper recreational ecosystem services to the people?
3. What actions could be taken in the future to address the proper provision of recreational ecosystem services in the green UMTs?

1.5. Significance of the Study

The necessity of this study on mapping UMTs and assessment of recreational ecosystem service is to develop a better UMT map to assess the provision of ecosystem service. The developed UMTs map provide the town with classification schemes based on urban morphology types both at high and detail level classification. Further, it gives GIS attribute data set, which shows the area in hectare and percentage contribution of each UMT to the total area of the town. In addition, it shows where ecosystem services are produced, at what quantities taking into account the spatial scale of assessment and furthermore, where ecosystem services are needed.

Assessment of recreational ecosystem service should help public and private institutions to understand dependencies and impacts between natural and human induced systems. They should also characterize the risks and opportunities associated with changes in the nature and characteristics of biodiversity while identifying opportunities to enhance ecosystems, their adaptive capacities and their ability to contribute to the well-being of future generations (Ervin et al, 2013).

The study will influence those who do not really value biodiversity and ecosystem but understand money and helps to clarify current intangible benefits of ecosystem services to the public. Those, the societies should be aware of ecosystem service provision (Rouquette, 2013). This enables a more systematic understanding of how changes in the environment affect human wellbeing and the likely winners and losers. Ultimately, it promotes a holistic and sustainable approach to decision making.

Finally, such an assessment is necessary for the development of ecosystem services map and models in order to estimate where ecosystem services are produced, to quantify the changes in service provision over time, to describe the production of ecosystem services as a function of patterns of land use, land cover, climate and environmental variation (Europe, 2001).

1.6. Scope and Limitation of the study

The issues around UMTs and ecosystem services are very wide. There are economic, social, environmental, health and many other issues that are related to the idea of ecosystem service in a city and there are a wide number of ecosystem services. This study focuses only on the assessment of recreational ecosystem service provided for the public. Recreational ecosystem service could be provided in different urban morphology types. These could be condominium, administrative, educational, religion, water bodies, forest, bare land etc. However, this study is limited to the assessment of recreational ecosystem service provided by park UMTs of Arba Minch town.

Policy making concerning ecosystem services is extremely difficult because of the concept ecosystem services is relatively new in environmental policy. Even though it in part addresses several topics already well known, such as agricultural production and water purification, these topics currently are mostly dealt without using the new term.

The limitations for this paper are mainly the lack of documented information on the subject of mapping UMTs. The fact that the concern for UMTs in urban planning and design in Ethiopia is recent and has created a lack of specific official body to get information. There is a shortage of literature mainly focusing on mapping UMTs and related topics generally in Ethiopia, in particular in Arba Minch town.

Due to the production of maps with a high resolution is expensive, and even maps with high spatial details are often challenging from the local level, land cover analysis is not carried out in this study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Urban Morphology Types (UMT's)

The definition of urban morphology according to Bentley and Butina (1990) 'an approach to studying and designing urban form which considers both the physical and spatial components of the urban structure of plots, blocks, streets, buildings and open spaces'. All of these are 'considered as part of the history/evolutionary process of development of the particular part of the city under consideration'. The first stage of the urban characterization is the UMTs mapping. This was under taken in order to disaggregate the city into distinctive categories (Bentley & Butina, 1990).

An awareness of the relationships between land use and biodiversity is fundamental to understanding the links between people and their environment. On the one hand, land use change and transformations in the way land is managed are key drivers of changes in biodiversity at global, national and local scales. On the other, given the need to sustain ecosystems and the benefits that people derive from them, the biodiversity of a site, or of an area of land, may often place constraints on our choices about how it can be used (Young, 2009).

It is widely acknowledged that 'land cover' and 'land use' are not the same thing. 'Land cover' refers to the physical surface characteristics of land (for example, the vegetation found there or the presence of built structures), while 'land use' describes the economic and social functions of that land. Clearly the two may be linked, but the linkages are complex. A single type of land cover, perhaps grassland, may support many uses, such as livestock production, recreation and turf cutting, while a single use, say mixed farming, may take in a number of different cover types including grassland, cropped and fallow areas. However, while the distinction between land cover and land use is accepted, they are often conflated in classification schemes. Therefore, that result information on change is difficult to interpret, particularly in terms of its consequences for biodiversity (Lambin, 2001).

In the context of understanding the links between land and biodiversity, it is not always clear quite what 'land use change' means. Does it mainly refer to gross changes in which there is complete replacement of one type of cover or use by another, or does it also include the

qualitative changes in the characteristics of land? These latter are what Lambin (2001) has described as 'land cover modifications', and he suggests they are probably more common that wholesale conversions. These kinds of change are slight and often difficult to characterize, but their implications for the biodiversity characteristics of the land can, as we shall see, be as important as a complete transformation (Lambin, 2001).

Urbanization, through changing local land use and land cover, is a direct driver of change in ecosystem services (MA, 2005). For example, replacing vegetated with built surfaces leads to a modified energy exchange, reducing evapotranspiration and increasing the thermal mass of an area, thereby contributing towards the urban heat island effect (Bridgman, 1995). The higher proportion of impervious built surfaces instead of pervious vegetated surfaces also leads to an altered hydrological regime in urban areas, increasing the rate and volume of surface water runoff (Bridgman, 1995). Climate change is another direct driver of change in ecosystem services (MA, 2005). Amongst the many aspects of global change, land use change has been highlighted as a key human induced effect on ecosystems (Turner, 1997).

Land use has been changing since people first began to manage their environment. Such land use change directly influences the provision ecosystem services (e.g. provision of food and timber, climate regulation, nutrient cycling, and cultural identity) (Daily, 1997). Thus, in order to plan effectively to maintain ecosystem services and natural processes, given urbanization and climate change as two drivers of change, a good understanding of both land use and surface cover is required. Previous studies have shown that land uses have their own distinctive surface cover (Akbari et al, 2003).

Landscape planners have long recognized the link between green space provision in the urban environment and environmental quality (Hough, 2004). There is a growing body of analytical work on the beneficial impacts of urban green space on microclimate, air quality and hydrology, reduction of energy consumption in adjacent buildings, carbon storage and sequestration as well as biodiversity. Green infrastructure also offers significant potential to help adapt urban areas to climate change through moderating microclimates and reducing surface water runoff and the management of land use and land cover can help to facilitate climate adaptation (Gill et al, 2008).

Studies have suggested that the distinction of UMTs or urban structural types at a 'meso'-scale (i.e. between the city level and that of individual plots) is a suitable basis for the spatial analysis of cities for urban environmental and landscape planning. The underlying assumption is that 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 key factors that largely determine the ecological properties of urban areas (Gilbert, 1989). This approach has a close affinity to land use categories commonly used in urban planning, thus enhancing the transfer of ecological information into the planning process (Pauleit, 2000).

A better understanding of the morphology of cities is one component of a strategy to address the impacts of urbanization, and to find better ways to accommodate development in an ecologically sensitive manner (Bryant, 2004). In urban areas, maintaining the connectivity of habitat patches, allowing the exchange of individuals and genes, and settlement processes is a way of slowing down the loss of biodiversity (James and Bound, 2009).

2.2. Review of Urban Morphology Types in Selected Cities

2.2.1. Urban Morphology Types of Greater Manchester

Greater Manchester is a large city (with population of 2.5mill.) located in the North West of England. It consists of 10 local authorities: Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford, and Wigan, covering an area of approximately 1300km². Greater Manchester was selected (as one of two case study sites for the ASCCUE project) since it offers sufficient size for full expression of urban environmental character, contrasting soil types, a full range of neighborhood and land use types (including restructuring and urban extension areas with substantial scope for climate change adaptation), as well as various built forms (Gill et al, 2008).

The initial stage of the investigation was to map the UMTs within Manchester city center. The UMT categories are based upon those specified in the National Land Use Database classification version 4.4 NLUD, (2003) and adapted from those used by Gill et al, (2006). The UMTs selected for the study were those that reflect the composition of a city center, from an initial survey 13 UMTs were identified in the city center. Having identified those lists a mapping process was

under taken by placing a grid of 234 squares each 125×125m over a base map of central Manchester. The dominant UMT of each square was identified using satellite imagery from Google Earth supplemented by field surveys and the percentage of grid squares for each UMT calculated. They used 29 detailed UMT categories based upon those identified by LUC, (1993) and grouped into 13 primary categories. These were adapted to be compatible with the UK National Land Use Database classification (Gill et al, 2008).

In the study, UMTs were digitized in ArcView GIS for Greater Manchester from 1997 aerial photographs (resolution: 0.25 m, source: Cities Revealed). The process was mainly undertaken by one person, so that any judgments were consistent throughout. A lower limit of one hectare was set on the size of the individual UMT units, since the classification should be used at the city level. Each unit was classified according to the dominant UMT of the polygon (Gill et al, 2008).

Table 1 UMTs developed for Greater Manchester, UK.

1/ FARMLAND 1.1 Improved Farmland 1.2 Unimproved Farmland	7/ RESIDENTIAL 7.1 High density Residential 7.2 Medium density Residential 7.3 Low density Residential 7.4 Rural settlement
2/ WOODLAND 2.1 Woodland	8/ COMMUNITY SERVICES 8.1 Schools 8.2 Hospitals
3/ MINERALS 3.1 Mineral workings and quarries	9/ RETAIL 9.1 Retail 9.2 Town center
4/ RECREATION AND LEISURE 4.1 Formal Recreation 4.2 Formal open space 4.3 Informal open space 4.4 Allotments	10/ INDUSTRY AND BUSINESS 10.1 Manufacturing 10.2 Offices 10.3 Storage and distribution

5/ TRANSPORT 5.1 Major Roads 5. 2 Airports 5.3 Rail 5.4 River, Canal	11/ PREVIOUSLY DEVELOPED LAND 11.1 Disused and derelict land
6/ UTILITIES AND INFRASTRUCTURE 6.1 Energy production and distribution 6.2 Water storage and treatment 6.3 Refuse disposal 6.4 Cemeteries and crematoria	12/ DEFENCE 12.1 Defence 13/ UNUSED LAND 13.1 Remnant countryside

Source: Gill et al., 2008

In the paper, the authors have explored the use of UMTs as a method to gain insights in to the structure of vegetation within the urban core. UMTs provide an opportunity to link socio-ecological systems as they link different human activities and natural processes. Such linkages are important in understanding urban and urban influenced environments and in providing guidance to those who make decisions regarding urban centers.

The analysis conducted has demonstrated that UMTs can be differentiated along two main axes, which correspond to both human and natural processes. These data provide insights, which allow those planning urban environments to identify directions for change, and how this change might be achieved (James and Bound, 2009).

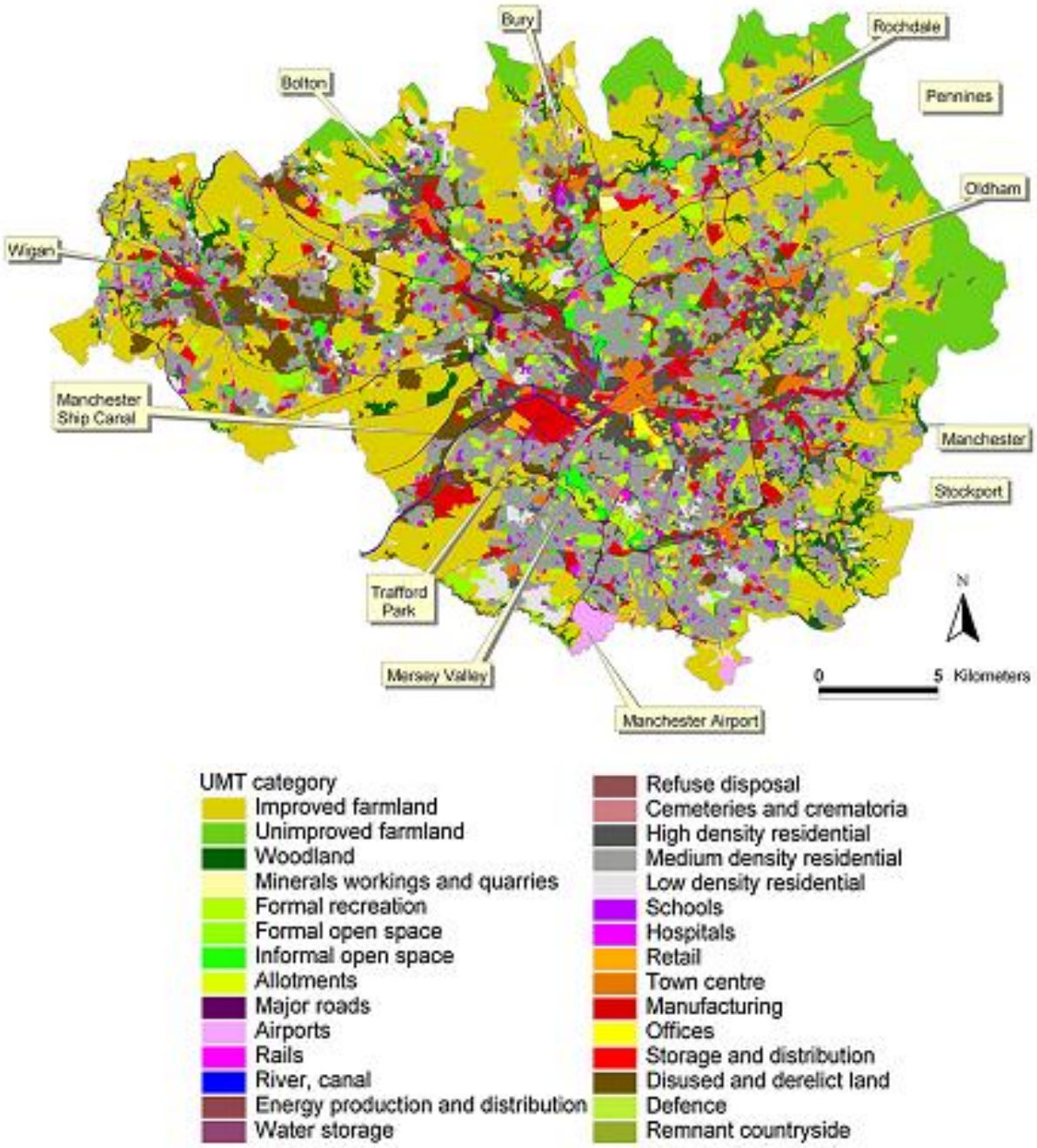

Figure 1 UMT map for Greater Manchester (based on 1997 aerial photographs from Cities Revealed)

Source: Gill et al., 2008

2.2.2. Urban Morphology Types of Addis Ababa

In Addis Ababa, the study of urban morphology types was divided into two main sections. The first detailing the work undertaken for the initial UMT production and the second the work to date on alternative land cover assessment work which will complement results generated through the main methodology (CLUVA, 2012).

UMTs and their creation in Addis Ababa

In Addis Ababa, an initial UMT classification scheme was drafted during a workshop in Addis Ababa in June 2011. The CLUVA task 2.2[2] researchers from EiABC, UM and TUM and stakeholders from the Addis Ababa Environmental Protection Authority and Gulelle Botanic Garden contributed in drafting the UMT scheme (CLUVA, 2012).

In the study 11 high level and 35 sub UMTs classes was identified. Based on the identified UMTs classes both the high level and subclass UMTs map was digitized in ArchView GIS for Addis Ababa city.

Table 2 The UMT classification scheme for Addis Ababa

1. AGRICULTURE 1.1 Field crops 1.2 Vegetable Farm	7. RESIDENTIAL 7.1 Condominium & multi-story 7.2 Villa & single story stone/concrete 7.3 Mud/wood construction 7.4 Mixed
2. VEGETATION 2.1 Plantation 2.2 Mixed forest 2.3 Riverine 2.4 Grassland	8. COMMUNITY SERVICES 8.1 Education 8.2 Medical 8.3 Religion
3. MINERALS 3.1 Mineral workings and quarries	9. RETAIL 9.1 Formal shopping area 9.2 Open markets

[2] Task 2.2 Vulnerability and adaptation potential associated with urban ecosystems.

	9.3 Mixed formal and open
4. RECREATION 4.1 Parks 4.2 Stadium and festival sites	10. INDUSTRY & BUSINESS 10.1 Manufacturing 10.2 Offices 10.3 Palace 10.4 Hotel 10.5 Storage and distribution 10.6 Garages 10.7 Mixed
5. TRANSPORT 5.1 Major road corridors (>= 15m width) 5.2Bus terminals 5.3 Rail way 5.4 Train station 5.5 Airports	11. BARE LAND
6. UTILITITES AND INFRASTRUCTURE 6.1 Energy distribution 6.2 Water treatment 6.3 Refuse disposal, including landfill 6.4 Cemeteries	

Source: (CLUVA, 2012)

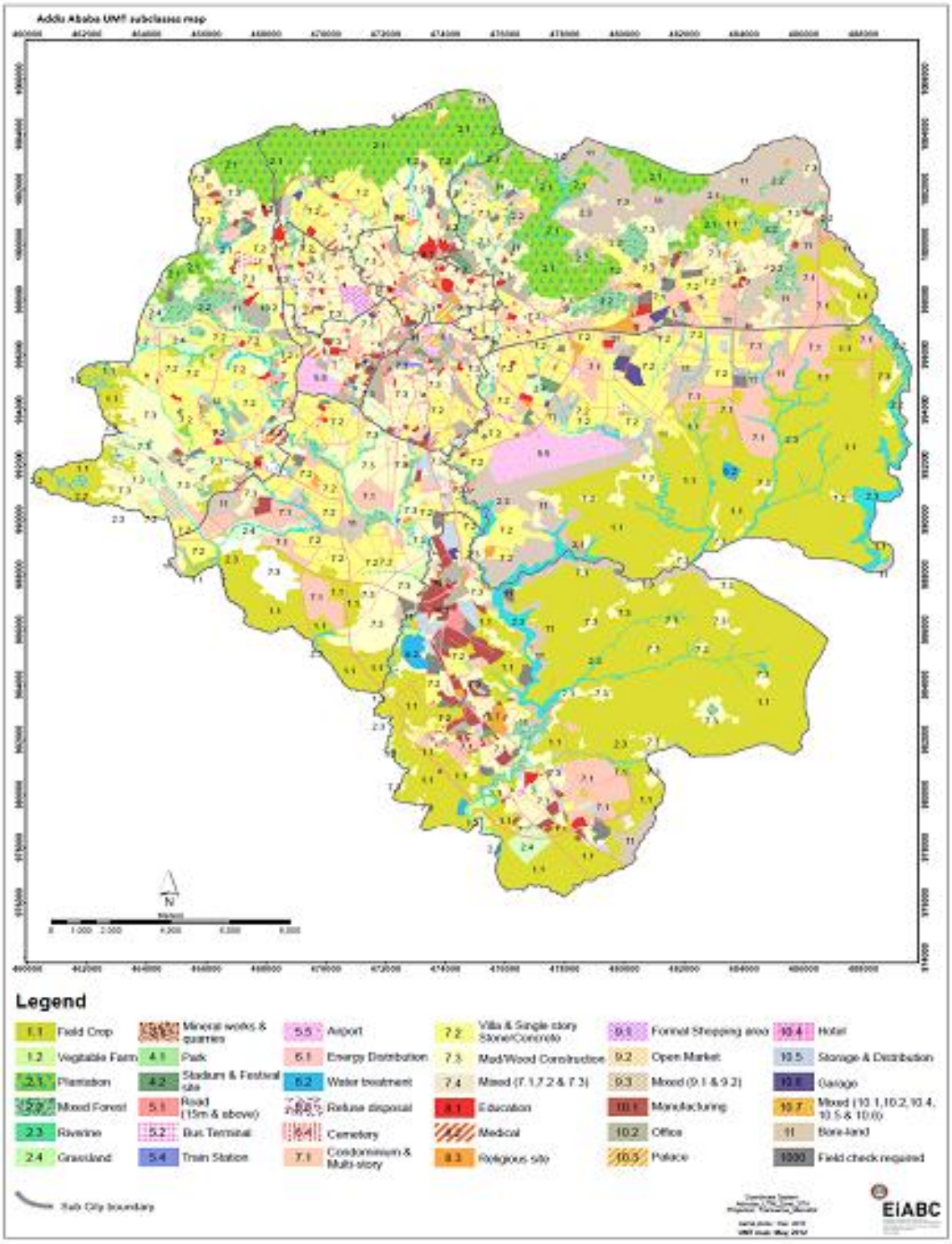

Figure 2 Map of the UMT subclasses for Addis Ababa

Source: (CLUVA, 2012)

2.3. Ecosystem Services

2.3.1. Short History of Ecosystem Services

"Humanity's reliance upon nature for welfare and survival is complete. The history of civilization is, at its most basic, a story of people trying to access resources and seek protection from the elements. Around 10,000 years ago when people began to domesticate nature, the story changed a bit. Through husbandry and agriculture, we were managing nature's services more directly in order to increase productivity. In this way humans have always recognized the importance of what we now call ecosystem services" (Fisher et al, 2009). The ancient Greeks knew the importance of soil retention, a knowledge predicated by deforestation related soil thinning. The classic, oft-cited example is the Easter Island society whose cultural beliefs led them completely deforests their island leading to loss of soils, and raw materials for building (Ponting, 1993).

The term ecosystem services emerged in the early 1980s to describe a framework for structuring and synthesizing biophysical understanding of ecosystem processes in terms of human well-being. Understanding ecosystems from the perspective of humans as beneficiaries has tremendous potential for protecting ecosystems and the services they provide. The ecosystem services framework links conservation and development by relating environmental health to human health, security, and material goods necessary for well-being (Kate et al, 2007).

Researching these links between welfare and ecologies under a concept like 'ecosystem services' is increasingly been fleshed out over the past few decades. In (1977), Westman suggested that the social value of the benefits that ecosystems provide could potentially be enumerated so that society can make more informed policy and management decisions. He termed these social benefits 'nature's services' (Westman, 1977). Now we commonly refer to Westman's, (1997) services as 'ecosystem services' a term first used by Mooney and Ehrlich 1981 (Fisher et al, 2009).

2.3.2. Defining Ecosystem Services

Ecosystem services are the aspects of ecosystems utilized (actively or passively) to produce human well-being. The key points are that first services must be ecological phenomena and second that they do not have to be directly utilized (Boyd and Bazhaf, 2007). Ecosystem services

include ecosystem organization or structure as well as process and/or functions if they are consumed or utilized by humanity either directly or indirectly. The functions or processes become services if there are humans that benefit from them. Without human beneficiaries, they are not services.

Ecosystems provide society with services that stretch far beyond just raw materials. Daily, (1997) defines ecosystem services as the "conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life''. Examples of ecosystem services include air filtration, climate regulation, waste treatment, aesthetics, and recreational expenses.

Ecosystem structure is a service to the extent that it provides the platform from which ecosystem processes occur (Boyd and Bazhaf, 2007). How much structure and process is required to provide a diversity of ecosystem services in a given ecosystem is still an active research question (Turner et al, 1998). Clearly, some minimum configuration of structure and process is required for healthy functioning and service provision. This 'infrastructure' has value in the sense that its prior existence and maintenance is necessary for service provision, and is therefore a service in itself (Turner et al, 1998).

This does not mean that structure, function, and services are identical or synonymous. Ecosystem structure and function had identified and studied for years with no reference to services. So, while most ecosystem structures and processes do provide services they are not the same thing. One can best see this distinction with a simple thought experiment. What if there was an Earth-like planet with no humans? It could have a wide array of ecosystem structures and processes, but no services (Fisher et al, 2009).

For example, nutrient cycling is a process in which one outcome is clean water. Nutrient cycling is a service that humans utilize, but indirectly. Clean water provision is also a service that humans utilize, but directly. Clean water, when consumed for drinking, is a benefit of ecosystem services. The benefit being the point at which human welfare is directly affected and the point where other forms of capital (built, human, social) are likely needed to realize the gain in welfare. Here, clean water provision is a service and clean water for consumption requiring extraction tools or knowledge is a benefit (Fisher et al, 2009).

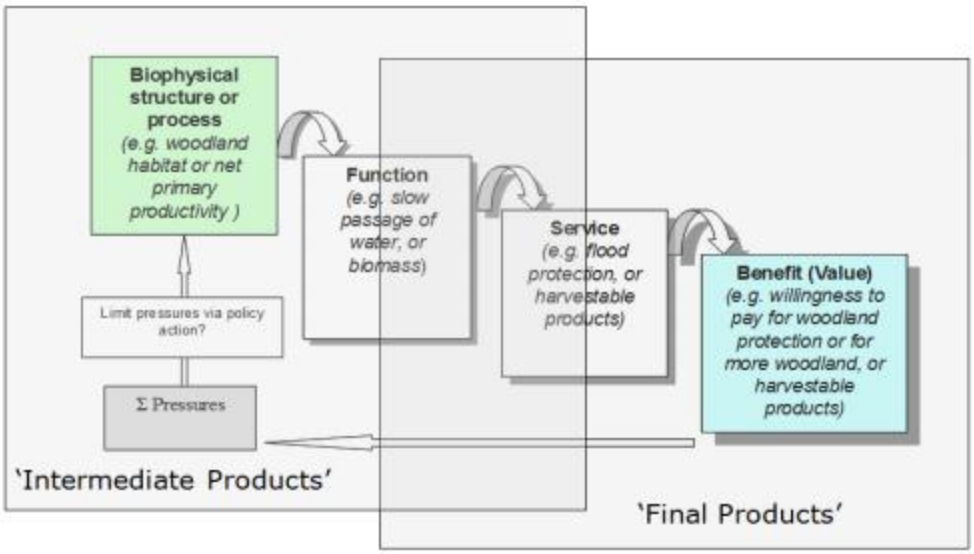

Figure 3 The relationship between biodiversity, ecosystem function and human wellbeing

Source: (Young, 2009)

The MA, (2005) defined ecosystem services as "the benefits provided by ecosystems" with understanding that the benefits are towards human wellbeing. These benefits can be divided into market and non-market ecosystem goods or services and classified in multiple ways (Fontana et al, 2013). In recent days the MA, (2005) opened a wider understanding and use of ecosystem services and offered an excellent heuristic and classification system.

The Ecosystem service concept has become a useful tool for connecting the goals of conservation and environmental health with the ultimate benefits, which are provided, to human societies (MA, 2005). Societies derive benefits from ecosystem structures and functioning, for example through food and fiber production, water filtration, climate regulation and maintenance of soil fertility. Ecosystem services are those aspects of ecosystems that are consumed or utilized to yield human well-being (Turner et al, 1998).

The Millennium Ecosystem Assessment has increased the awareness of the negative consequences of biodiversity loss to human welfare by addressing the value of ecosystems and biodiversity for sustaining livelihoods, economies and human well-being (MA, 2005).

Ecosystem services tend to fall into the categories of open access and pure public services. This means that they tend to have no producer property rights, ambiguous entitlement structures and

prohibitive transaction costs (Sternberg, 1996). As no one ‘‘owns’’ or has ‘‘rights’’ to these services and others cannot be excluded from using or benefiting from them, little incentive exists for beneficiaries to manage ecosystem services sustainably (Sternberg, 1996). Additionally, it is difficult to extract compensation payment from beneficiaries for redistribution among intra- and intergenerational parties that might be affected by negative outcomes such as loss of biodiversity, pollution or irreversible degradation and depletion of ecosystem services (Chee, 2004).

The evaluation of the condition of cultural ecosystem services is more difficult. Some cultural services are linked to a provisioning service (such as recreational fishing or hunting) that can serve as a proxy measure of the cultural service. However, in most cases no such substitute exists. Moreover, unlike provisioning or regulating services, assessing the condition of cultural services depends heavily on either direct or indirect human use of the service. For example, the condition of a regulating service such as water quality might be high even if humans are not using the clean water produced, but an ecosystem provides cultural services only if there are people who value the cultural heritage associated with it. Information about the condition of cultural services can be obtained by identifying the specific features of the ecosystem that are cultural, spiritual, or aesthetic significance and then examining trends in those features (MA, 2003).

2.3.3. Definition of Terms in Ecosystem Services

Ecosystem: is dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. Humans are an integral part of ecosystems. Ecosystems vary enormously in size; a temporary pond in a tree hollow and an ocean basin can both be ecosystems (Daily, 1997). So, one can easily think of a system dominated by woody biomass as forest ecosystem, freshwater ecosystem, marine ecosystem, coastal ecosystem, cultivated ecosystem etc. The ecosystems, if in a good condition perform functions that are of bio-geophysical in nature. These functions result in the flow of various services and benefits for humans and their society (Kumar, 2008).

Urban ecosystems: An ecosystem can be defined as ‘‘a set of interacting species and their local, non-biological environment functioning together to sustain life’’ (Bolund, 1999). In the case of

the urban environment, it is both possible to define the city as one single ecosystem or to see the city as composed of several individual ecosystems, e.g. parks, lakes, etc. (Bolund, 1999).

Ecosystem functions: refer to the habitat, biological or system properties or processes of ecosystems. Functions are constituted by different combinations of processes, traits, structures and represent the potential that ecosystems is deliver services irrespective of whether or not they are useful for humans (Kate et al, 2007).

Ecosystem processes: are the complex interactions (events, reactions or operations) among biotic and abiotic elements of ecosystems that lead to a definite result. In broad terms, these processes involve the transfer of energy and materials (Young, 2009). An important distinction between ecosystem elements (both biotic and abiotic) and processes is that the former are generally tangible entities described in terms of amount, while the latter are operations and reactions and generally described in terms of rates (for example, production per unit time)

Ecosystem services:

- Conditions and processes through which natural ecosystems and the species that make them up sustain human life (Daily, 1997).
- The benefits of nature to households, communities and economies (Boyd and Bazhaf, 2007).
- Consist of flows of materials, energy and information from natural capital stocks, which combine with manufactured and human capital services to produce human welfare (Costanza et al, 1997).
- The benefits provided by ecosystems with understanding that the benefits are towards human wellbeing (MA, 2005).

Human well-being: are benefits, values and response. Benefits are positive changes in our wellbeing from the fulfillment of our needs and wants. Wellbeing depends substantially, but not exclusively, on ecosystem services. Here only four top-level categories are included: nutrition, health, safety, and enjoyment, which can all be delivered by multiple ecosystem services. The Millennium Ecosystem Assessment adopted a broad definition of “wellbeing” that includes material security, personal freedoms, good social relations and physical health (MA, 2003).

Natural capital: is a stock of materials or information that exists at a point in time. Each form of capital stock can generate a flow of services that may be used to transform materials, or the spatial configurations of material, to enhance the welfare of humans (Costanza et al, 1997).

Ecosystem goods: these are tangible outputs provided from ecosystems to humans through human activities (Fisher, 2009).

Ecosystem dis-services: conditions and processes that reduce productivity or increase production costs, and detract from contributing to productivity (Zhanga et al, 2007).

Ecological foot-print: the area of biologically productive land and water that a population (an individual, a city, or country or all of humanity) uses to generate the resources it consumes and absorb its waste under prevailing technology (Fisher et al, 2009).

2.3.4. Urban Ecosystem Services

Humanity is rapidly urbanizing, and by 2030 more than 60% of the world population is expected to live in cities. However, even if humanity is increasingly urban, we are still as dependent on nature as before. An ecosystem can be defined as ‘‘a set of interacting species and their local, non-biological environment functioning together to sustain life’’. In the case of the urban environment, it is both possible to define the city as one single ecosystem or to see the city as composed of several individual ecosystems, e.g. parks, lakes etc. (Bolund, 1999).

Urban green spaces can be defined as outdoor places with significant amounts of vegetation, and exist mainly as semi-natural areas. Urban green spaces are viewed as the last remnant of nature in urban areas, and typically perform important functions. This includes maintaining biodiversity, preventing soil erosion, absorbing rainwater and pollutants, and mitigating urban heat island effects (Bolund, 1999).

Urban green spaces can also provide considerable socioeconomic benefits, such as providing amenity-recreation venues, reducing work-related stress and increasing property values. Rapid urbanization and increased leisure time make people more aware of urban green space, and there is an increasing realization that it is difficult to live without some contact with nature. Even though humanity becomes urban in their way of life, the desire for contact with nature will continually increase rather than decrease. At the same time, governments are beginning to

recognize the importance of healing the gap between humans and nature. Green space is becoming an important measure in judging the ecological sustainability of urban areas. Planners and designers need efficient tools to quantitatively evaluate and compare the impact of alternative plans and designs so that more informed development choices could be made (Kong, 2006).

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’’ (Bolund, 1999).

2.3.5. Classification of Ecosystem Services

Three international classification systems are available to classify ecosystem services: MA, TEEB and CICES. In essence, they relate to a large extent to each other; all three include provisioning, regulating and cultural services. Each classification has its own advantages and disadvantages due to the specific context within which they were developed (Union, 2013). The MA was the first large scale ecosystem assessment and it provides a framework that has been adopted and further refined by TEEB and CICES (Union, 2013).

The MA, (2005) identified four categories of ecosystem service, these are:

- **Provisioning services:** tangible physical and energetic goods obtained from ecosystems, (e.g. food, fresh water, wood and fiber, fuel, genetic resources, bio-chemicals, natural medicines, ornamental resources, etc.).
- **Regulating services:** benefits obtained from ecosystem processes that regulate aspects of the environment, (e.g. climate regulation, flood regulation, disease regulation and water purification, air quality regulation, pest regulation, pollination).
- **Cultural services:** non-material benefits people obtain from ecosystems, (e.g. cultural diversity, spiritual and religious values, recreation and ecotourism, aesthetic values, knowledge systems, educational values).

- **Supporting services:** services comprising internal processes within ecosystems essential for the production of all other ecosystem services, (e.g. nutrient cycling, soil formation, and biological primary production, photosynthesis, primary production)

2.3.6. Cultural Ecosystem Services

Cultural ecosystem services (CES) are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences; those include cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values and recreation and ecotourism. Recreation is sometimes used similarly or combined with tourism services. Recreational activities include hiking, biking, swimming or game viewing. Recreational activities may be carried out in natural or semi-natural areas. However, protected areas remain a key element for recreation and tourism (MA, 2003).

The MA, (2005) states that the importance of cultural services and values is not currently recognized in landscape planning and management and that these fields could benefit from a better understanding of the way in which societies manipulate ecosystems and then relate that to cultural, spiritual and religious belief systems. Ecosystem approach implicitly recognizes the importance of a socio-ecological system approach, and that policy formulations should empower local people to participate in managing natural resources as part of a cultural landscape, integrating local knowledge and institutions (MA, 2005).

Provisioning and regulating ecosystem services are largely regarded as having stronger linkages to human wellbeing than cultural services, particularly with regard to obtaining or maintaining security, basic materials for a good life, and health (MA, 2005). Yet, CES are those services with the least potential for mediation by socioeconomic factors. This means that, once degraded, cultural services are unlikely to be replaced by technical or other means (Morcilloa et al, 2013).

As CES present some of the most compelling reasons for ecosystem conservation, they are considered as fundamental component of all current ecosystem services frameworks. Worldwide, CES are influential motivators for owning and managing land, often more important than traditional commodity production. However, compared to other categories of ecosystem services, there have been very few assessments of CES, and the study of CES has been considered one of

the most difficult and least accomplished tasks in ecosystem services research (Tengberg et al, 2012).

This lack of empirical evidence concerning the value of CES not only has consequences for ecosystem services research. But, may also put the ideas at the core of the green economy discourse at large into question: valuing natural assets correctly, investing in natural assets and seeking out actions that can deliver economic, social and environmental benefits simultaneously all depend on effective assessment of the cultural services of ecosystems (Morcilloa et al, 2013).

This underrepresentation of CES data can result in biased ecosystem service assessments and landscape planning, hampering their integration into conservation policies and threatening the creation of meaningful links between society and nature. It also overlooks that peoples' differing preferences regarding CES find their way into socio-political discourses around important issues such as rural development, natural resource management and nature conservation (Morcilloa et al, 2013).

The categories of cultural services have evolved significantly from the original classifications: at first recognizing merely recreation and culture, but now broadened in the consolidated framework developed by the MA in 2005. The following categories and definitions are established by the MA, (2005) and are used in the present study:

- Cultural diversity: The diversity of ecosystems is one factor influencing the diversity of cultures.
- Spiritual and religious values: Many religions attach spiritual and religious values to ecosystems or their components.
- Knowledge systems (traditional and formal): Ecosystems influence the types of knowledge systems developed by different cultures.
- Educational values: Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.
- Inspiration: Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.

- Aesthetic values: Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations.
- Social relations: Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.
- Sense of place: Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem.
- Cultural heritage values: Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species.
- Recreation and ecotourism: People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.

2.3.7. Recreational Ecosystem Services

Cultural ecosystem services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. Among this, recreational pleasure that people derive from natural or managed ecosystems is defined as recreational ecosystem service.

People often choose where to spend their leisure time based on the characteristics of the natural landscapes in a particular area. Natural ecosystems have an important value as a place where people can come for rest, relaxation, refreshment and recreation. Through the aesthetic qualities and almost limitless variety of landscapes, the natural environment provides many opportunities for recreational activities, such as walking, hiking, camping, fishing, swimming and nature study. With increasing numbers of people, affluence and leisure-time, the demand for recreation in natural areas ('eco-tourism') will most likely continue to increase in the future (Bolund, 1999).

When we come to urban ecosystem, 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 (Bolund, 1999). The recreational aspects of all urban ecosystems, with possibilities to play and rest, are per-haps the highest valued ecosystem service in cities. All ecosystems also provide aesthetic and cultural values to the city and lend structure to the land-

scape (Bolund, 1999). ‘‘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’’ (Bolund, 1999).

Natural or traditional landscapes are suitable for outdoor recreation (e.g. hiking, cycling, hunting, camping etc.). For simplicity, all non-urban land uses except conventional cropland (including bio-energy crops) were deemed suitable for outdoor recreation. Conventional cropland was not deemed suitable because it is mostly inaccessible for recreational purposes. Furthermore, the scenic value of cropland is considered lower than for grassland.

2.3.8. Assessement of Ecosystem Services

Urban growth puts pressure on the use of land, often in the disadvantage of greenspace. It seems that urban green space has togive in to construction buildings, housing, industries and community services, although green space does offer multiple benefits for human populations. It leads to recreational or leisure opportunities, it is an important place for children to play and stay and for people to meet and therefore has a clear social function. It reduces stress, fear, violence and aggression. Green space furthermore creates health benefits and environmental benefits, stimulated by the fact that it creates alternative transportation networks, such as cycling routes, which will have a lower impact on nature and the environment and will increase the physical activity levels of citizens (Vandermeulen et al, 2011).

These multiple functions of green space have been studied extensively in literature in the past. It seems that scholars as well as policy makers agree that the demise of green space poses a threat to natural and environmental protection; however, the relation to other societal functions is often not recognized. This has leads to a lack of application of these studies in policy implementation with respect to regional development, urban and spatial planning (Boyd and Bazhaf, 2007). This lack can be explained by the less obvious and indirect benefits of green infrastructure in several societal fields and the location specific effects of green space. Therefore, to make policy makers aware of the benefits to incorporate green functions in development and planning processes, it is necessary to assess the multiple functions of green spaces in a correct, understandable and easily repeatable way. This assessment will then create persuasive arguments to demonstrate the benefit of green space, not only to the direct concerned stakeholders, but also to the regional economy as a whole (Vandermeulen et al, 2011).

Ecosystem services (ESs), i.e., the benefits that humans receive from ecosystems contribute to the livelihood of about a billion people around the world (Bank, 2006). For many year humans have benefited from provisioning services such as meat from hunting of wild animals, raw material and livestock grazing; regulating services such as water and climate regulation; supporting services such as soil fertility; and cultural services such as recreation.

The flow of services from ecosystems as benefits to people does not come for free. Ecosystem services in order to be beneficial and valuable to humans normally require additional investments (e.g. energy, labor, management) by humans. The energy content of ecosystem services is therefore in almost all cases a combination of natural (ecosystem processes based) energies and human based energies. Therefore, these inputs are also explicitly addressed in the framework (Union, 2013).

The MA, a global study commissioned by the World Bank was instrumental in highlighting the contribution of natural ecosystems to human well-being and in measuring the status and trends of ecosystem services around the world (MA 2003, 2005). According to this report, 60% of ecosystems and their services are being degraded or used unsustainably around the world.

The MA was completed in 2005 and assessed global ecosystem changes and their impacts on human well-being. The MA developed a conceptual framework linking ecosystem services and human well-being through socio-economic factors. Thus, ecosystem services were grouped into four categories (provisioning, regulating, supporting and cultural) and human well-being into five categories (security, access to basic resources, health, good social relations and freedom of choice) (MA, 2003). Although the well-being categories of the MA Conceptual Framework include broad social and environmental factors, they do not explicitly distinguish between the biological, psychological and epidemiological aspects of health (MA, 2003).

The United Nations Environment Programme (UNEP) has recently published an Ecosystem and Human Wellbeing Assessment Manual. The purpose of the Manual is to guide ecosystem assessments by presenting best practice experiences. The target audience for the Manual is assessment practioners involved in designing and carrying out environmental or developmental assessments following the MA approach. The Manual mainly recommends quantitative methods and indicators for assessing ecosystem services and their trade-offs, which potentially is a problem for integration of cultural ecosystem services into the assessments. However, an

assessment of CES also needs to include a historical perspective as well as the differing perspectives and perceptions of different groups of stakeholders that are not easily translated into quantitative indicators.

An indicator can be defined as a measure based on verifiable data that conveys information about more than itself. Assessments are being increasingly called upon to account for ecosystem services in terms of concrete results. In order to make this possible, indicators are expected to be 'SMART' (specific, measurable, achievable, relevant and time-bound). SMART objectives and/or indicators play an important role in results-based management and in discussions on accountability. Indicators also need to be objectively verifiable, meaning that different researchers should be able come up with similar information when using a given indicator (Morcilloa et al, 2013).

As for any evaluation, when assessing CES, minimum conditions should be met to guarantee indicator quality. For example, the UK National Ecosystem Assessment argued that cultural services measures should be context specific, fluid and mutable, as meanings, values and people's behaviors change over time and space in response to economic, technological, social, political and cultural drivers. Accordingly, the process of creation seems almost more important than the resulting measure itself when designing effective cultural ecosystem service indicators (Morcilloa et al, 2013).

An important step towards safeguarding ecosystem services is to identify areas that are crucial for providing ecosystem services. Secondly, the condition of such areas should be examined and thirdly, an assessment of the threats facing them needs be conducted. Several studies have quantified ESs spatially and assessed the relationship with biodiversity, analyzed trade-offs amongst services, or evaluated ESs in monetary terms (Turner, 1997). However, limited research has evaluated the degradation and conservation status of ESs. In addition to assessments that have been published as part of the MA, (2003, 2005), only a few studies have evaluated the degradation and transformation status of areas providing ESs and the associated impacts on service provision. Understanding such degradation and the associated threats from local to continental scales is important in designing management strategies to safeguard them.

There is a growing consensus that there is a need to assess the value of non-marketable goods and services from ecosystems to balance the values from production related activities. The challenge with assessing cultural ecosystem services is their intangibility and non-use values, which often renders them difficult to classify and measure. However, they recognize that it is not possible to map one service to one benefit for cultural services, as spiritual, inspiration and place values are not products of single experiences, but products of all manner of experiences associated with ecosystems. They therefore recommend more inclusive valuation approaches and integration with biophysical and economic service models (Tzoulas et al, 2007).

Working with the concept of cultural services brings forth a number of challenges to ecosystem services accounting. One is the inherent difficulty of establishing a clear relationship between possible CES that might be assigned to certain elements of the ecosystem and its functions; for example, a panoramic site could be a recreational attraction while also serving as an information function about the area for students. Additionally, CES assessment requires identifying distinct 'operational units', to which functions, benefits and values can be assigned (Young, 2009).

Researchers working with CES must not only consider the services generated by the ecosystem, but also the relationship between the observer and the environment, including personal and social driving forces that influence the demand side in all ecosystem services. Consideration of the demand side is crucial for provisioning and regulating services as well, but most current ecosystem services assessments are focused on the supply side only (Morcilloa et al, 2013).

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1. Description of the Study Area

Arba Minch town is found in Gamo Gofa zone, the Southern Nations, Nationalities and Peoples Region. It is located at 505km distance south of Addis Ababa (capital city of Ethiopia) and 275km southwest of Hawassa (capital town of the regional state). It is geographically located in southern part of east African rift valley at the absolute location of between 6° 08'N latitude and 37°33'E to 37°37'E longitude.

Three agro-ecological zones can be found in the Arba Minch wereda, with 5%, 15% and 80% of the land area classified as Dega (highland), Woinadega (mid altitude) and Kolla (lowland), respectively. According to the Arba Minch wereda bureau of Agriculture, the average annual rainfall of the wereda ranges from 750 to 1100 mm. It has two rainy seasons, with the main rainy season from February to May and the short rainy season from June to September (Minda, 2014).

Arba Minch town is bordered by Arba Minch Zuria woredas in the north, west and south and Nech-Sar National park in the east and some part of northeast. It lies at an altitude of 1285m above sea level, its average temperature is 29°c and average annual rainfall is 900mm. The total area of the town is estimated about 4011ha and it is structured or divided in to 4 sub city and 11 kebeles in order to facilitate socio-economic development of the town residents. The town has facilities vital for the implementation and operation of industrial activities, and have 24 hours electricity service, pipe water network and the others services.

Demography

According to population census, (2007) data Arba Minch town has population of 74,879 of which 39,208 (52.36%) are men and 35,671 (47.64%) are women. The majority of the habitants were followers of Orthodox Christianity with 56.04%, Protestant 38.47%, and 4.16% were Muslims.

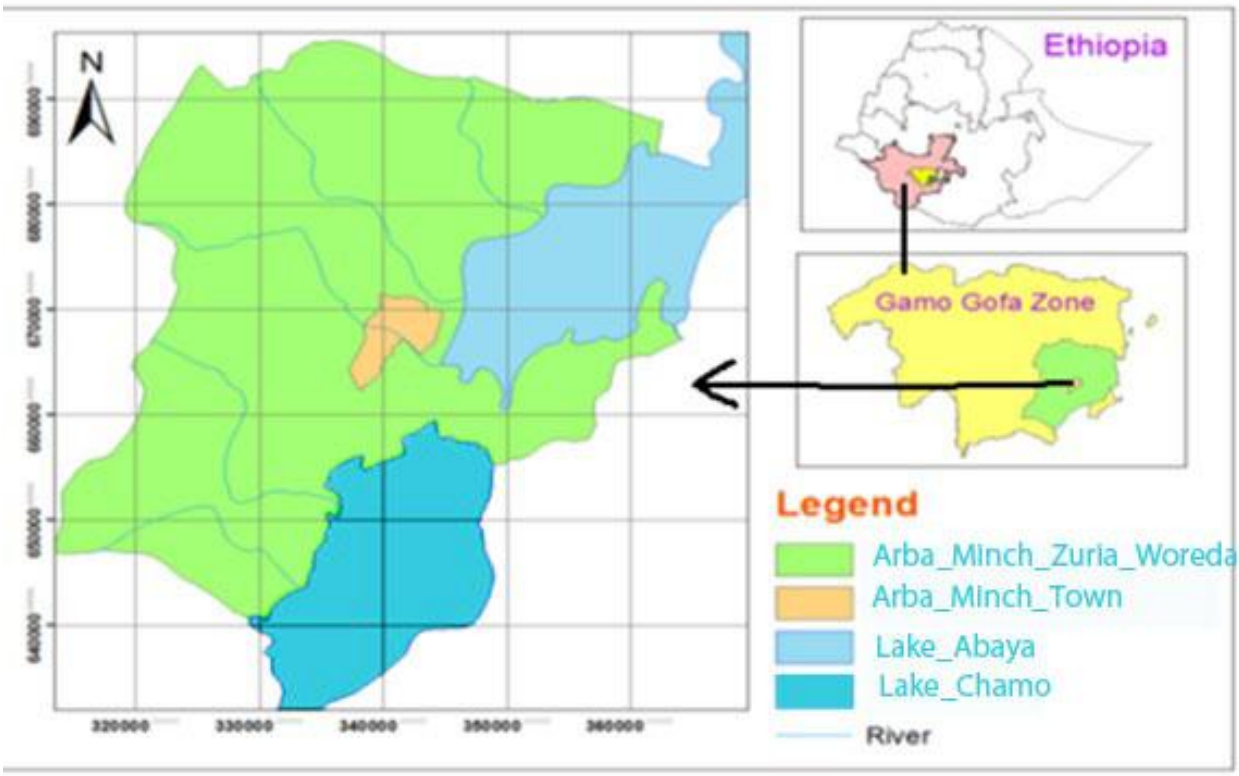

Figure 4 Map of Arba Minch and Surrounding Region

Source: (Minda, 2014)

Assessment Area Description

Assessment of recreational ecosystem service was conducted at selected three park UMTs from developed UMTs map of Arba Minch town. The selected three park UMTs are located in 'Nech-Sar' sub city (specifically Wuha-Minch kebelle) and 'Secha' sub city (specifically at Chamo kebelle) of the town. These three park UMTs are located along the eastern border of the town and named as 'highland' area by the society. They cover 23.6ha, 8.0ha and 30.8ha and contribute 0.59, 0.20 and 0.77% respectively, to the total area of the town.

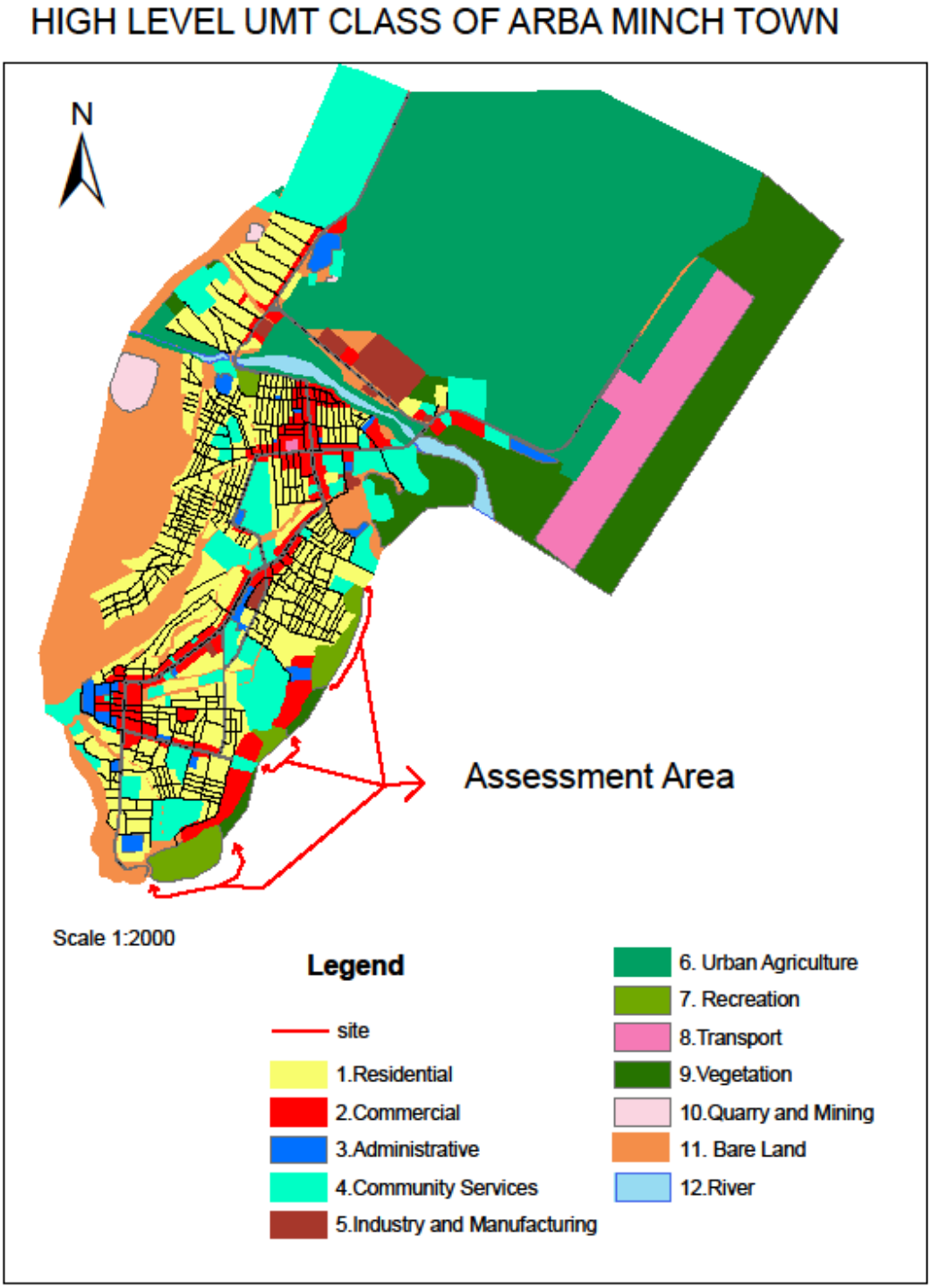

Figure 5 High level UMT map of Arba Minch, showing selected assessment areas

3.2. Method of Data Collection and Analysis

3.2.1. Identification of Urban Morphology Types

For mapping Urban Morphology Types, first identification or categorization of UMTs is necessary to know what is to be mapped. The identification was done by using land use map and structural plan of the town supported by transect walk observation based on the morphology of the town. The result obtained from visual analysis of the map and transect walk observation (UMT) were categorized in table and further used as an input for mapping UMTs of Arba Minch town.

3.2.2. Mapping Urban Morphology Types (UMTs)

Based on identified UMTs classes (categories) and structural plan of the town arrangement of UMTs polygon was done on AutoCAD. By using the result of AutoCAD as a background, UMTS map was digitized in ArcView GIS for Arba Minch town. Here, a lower limit of 0.25 hectare threshold was set on the size of the individual UMT units, since the classification was used at town level. Each unit was classified according to the dominant UMT of the polygon. Before finalizing the UMTs map, verification of both the UMTs map and attribute data was carried by ground truthing on each UMTs class. This work was done to classify the town based on UMTs and to identify the green UMTs of the town for assessment of recreational ecosystem service.

3.2.3. Assessment of Recreational Ecosystem Services

The assessment of ecosystem service was conducted for recreational ecosystem service within park UMT of the town. The developed UMTs map was used for identifying park UMTs for assessing the provision of recreational ecosystem services of the town. Therefore, first three park UMTs were identified from the developed UMTs map of Arba Minch town since the assessment was carried out at three park UMTs only. Then data's were collected from this UMTs of the town through interviews and questionnaire of focused groups, users of recreational ecosystem services and management institution of concerned staffs and document reviews of the concerned institutions. Data collections were supported by site observation of the ongoing recreational ecosystem service. This work was conducted on selected different days of a week and different times of a day because; the public demand for recreation depends on days of a week and times of

a day. The collected data's through observation, interviews, questionnaire and document review were analyzed in notes and tables and were used as guide for assessing the current provision of recreational ecosystem services and recommending future planning solutions to enhance proper provision of recreational ecosystem service of the town.

During the collection of data, both female and male respondents using recreational area within different age group were included. The interview questions and questionnaire were developed based on the indicators of the provision of recreational ecosystem service aiming at the benefits from green structure. First, the interview questions and questionnaire were developed by using on site observation of ongoing recreational ecosystem service provision indicators and further additional comments from the respondents are considered. Note that each indicator may not be equally important; however, the respondents were not uniform in responding specific question so no ranking of importance of these various indicator can be given.

In the study interviews and questionnaires are developed for both the users and concerned government officials. For users of recreational area thirty (30) interviews were conducted at study area and the interviews were held mainly at weekends in the afternoon. For the case of government officials, six (6) questionnaire are distributed and collected in their respective offices.

Finally, based on the obtained data and comments from users and concerned local government officials SOWT analysis is developed to provide future planning solutions for the recreational areas.

3.2.4. Data Sources

Primary Data

The primary data was collected through interviews of users of recreational areas, questionnaire of focus group and observation through transect walk of ongoing recreational activities. Interviews were filled by using purposive sampling method and female and male users of the recreational sites within different age group were included. For collecting this data selected different days of a week and different times of a day was used, since the users need for recreational ecosystem services depended on days of a week and times of a day. The collected primary data's were used for assessing the recreational ecosystem services of the town.

This study employs purposive sampling techniques. Purposive sampling is used for selecting administrative bodies working on nature conservation, which have high coordination with this subject matter in the town. Questionnaires were administered to these groups of respondents to get their views and perception on the status of recreational ecosystem service provided in the park UMTs of the town. In addition, personal site observations were also made to assess the provision of recreational ecosystem services of the town.

Secondary Data

The secondary data for this study was the old Land Use map and the current Structural Plan of Arba Minch town and collected from the town municipality office. These data's were used because; the town had no current (existing) land use map and Arial photography. The data were collected for identification of UMTs and mapping UMTs of Arba Minch town.

Moreover, Internet browsing and literature reviewing of best practices from selected cities in the areas of mapping UMTs, ecosystem service and assessment of ecosystem service were discussed.

3.2.5. Data Analysis

Based on the urban morphology of the town, the identified UMTs classes and the developed land use map (form the old land use map and the current structural plan) of the town, the UMTs map was digitized in ArcView GIS. From the developed UMTs map, the park UMTs was selected for further assessment of recreational ecosystem services. For assessment of recreational ecosystem service the data analysis was conducted in tables and notes.

Materials used and sources

Geographic Information System (ArcView GIS), AutoCAD, Adobe Photoshop and Adobe Illustrator were used to develop Urban Morphology Types (UMTs) map of Arba Minch town. The old land use map (developed in 2008) and the current structural plan (developed in 2013) obtained from municipality office were used in the development of UMTs map.

Table 3 Summery of data used and data analysis

Sr. No.	**Data used in the study**	**Data source**	**Data use**	**Remark**
1	Old land use map of Arba Minch town	Arba Minch town Municipality office	Development of current land use map of Arba Minch town	Is used because the town have no current land use map
2	Current structural plan of Arba Minch town	Arba Minch town Municipality office	Development of current land use map of Arba Minch town	Is used because the town have no current land use map
3	Results from observation	Site observation of urban morphology of the town and Site observation of ongoing recreational activities	• Development of current land use map of Arba Minch town • Identification of UMTs categories • Mapping UMTs of Arba Minch town • Assessment of recreational ecosystem services	
4	Current land use map of Arba Minch town	Developed from old land use map, current structural plan and findings from observation on Auto CAD	Development of UMTs map of Arba Minch town	
5	Identified UMTs	Urban morphology of the town and	Development of UMTs map of Arba Minch town	

Sr. No.	Data used in the study	Data source	Data use	Remark
	categories	land use map		
6	UMTs map of Arba Minch town	Developed from current land use map, identified UMTs categories and findings from observation on ArcView GIS	• Classifying the town based on urban morphology types of the town • Identifying the park UMTs for assessment recreational ecosystem services • Provide the town UMTs map • Input for other researchers who needs UMTs map of Arba Minch town	
7	Attribute data	GIS data base of UMTs map	To obtain the areas and percentage of each UMTs class	
8	Interview and questionnaires	Respondents	For conducting assessment of recreational ecosystem service in park UMTs of the town	
9	Images	On site capturing	• Verifying ongoing recreational ecosystem service • Verifying different types of problems that hinders the provision of recreational ecosystem service to the societies	

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Mapping Urban Morphology Types of Arba Minch (UMTs)

4.1.1. Identification of Urban Morphology Types (UMTs)

For mapping UMTs of Arba Minch town (the study area) the total area of the town (4011ha) was categorized under 12 high level UMT class and 32 sub (detail level) UMT class (see Table 4 for the full list of high and detailed UMTs). Table 4 shows both the high level and UMT sub classes that are identified in this study for Arba Minch.

Table 4 Identified high level and detailed UMTs class and their description in Arba Minch town.

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
1. Residential	Constitute of different types of residential houses.	1.1 Condominium	The Condominium sub class is where the houses are with two or more story's and built from concrete.
		1.2 Villa and Single Story Building	This UMT include single story; stone and concert residential buildings
		1.3 Mud and Wood Constructed Building	This UMT include single story residential buildings constructed from mud and wood structure
2. Commercial	This UMT class is a commercial	2.1 Commercial Activities	This UMT include formal shopping, boutique,

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
	area where commodities are exchanged with money.		pharmacy
		2.2 Open Market	This UMT include general open market, Local guilt, Cattle market
		2.3 Hotel	This UMT includes Hotel, Restaurant, Bar, Lodge, Resort Hotels
		2.4 Fuel station	This UMT includes shops selling fuel
3. Administrative	The different types of administrative building constitute this class.	3.1 Administrative	This UMT include local area administration, zonal administration, political organization, police station, NGOs, etc.
4. Community Services	This UMT class included institutions that provide educational, medical, religious and financial services to the	4.1 Education	Educational institutions are those that provide elementary, secondary or tertiary education.
		4.2 Health/ Medical	Medical institutions are those providing medical

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
	community.		service for the community.
		4.3 Religion	Religious institutions are churches and mosques for practicing spiritual commitments.
		4.4 Cemeteries	In most cases, cemeteries are associated with churches and contain trees and shrubs.
		4.5 Social and Cultural center	This UMT include multi-purpose hall, Public library, Youth center
		4.6 Financial institutions	This UMT include Bank, Insurance institution, Micro enterprise
5. Industry and Manufacturing	This UMT class consists of manufacturing industry, storage and maintenance machinery workshops	5.1 Heavy industry	This UMT includes heavy manufacturing industry
		5.2 Small scale industry	This UMT includes wood work and Metal workshop, Small scale enterprises
		5.3 Storage	This UMTs are used for merchandise storage and

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
			distribution
		5.4 Garages	This UMT includes workshops for maintaining machines and vehicles
6. Urban Agriculture	This is a UMT class characterized by field crops and vegetables.	6.1 Field crops	This UMT is characterized by cotton, maize and banana production.
		6.2 Vegetable farms	The land cover here is cultivated vegetables, like tomato, potato, cabbage, etc.
7. Recreation	This UMT class consists of green areas which are used for public recreation and conservation of native flora.	7.1 Parks	Parks are open spaces covered with perennial vegetation (tree, shrub and herbs). They serve as places for public recreation.
		7.2 Stadium	This UMT is open spaces used for sport activities and religious, political and recreational public events.
8. Transport	The transport	8.1 Asphalt road	This UMT includes all

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
	UMT is used for public transport, both on foot and car.		existing asphalt roads
		8.2 Coble stone road	This UMT includes both existing and under construction coble stone roads
		8.3 Open soil and Gravel road	This UMT includes existing open soil and gravel roads
		8.4 Bus terminals	This UMT includes bus station
		8.5 Airport	This UMT includes airport with vegetation's and its administrative units with in its boundary
9. Vegetation	This UMT unit is characterized by a permanent land cover of woody and non-woody vegetation.	9.1 Natural forest	This UMT includes forest grown naturally
		9.2 Mixed forest	This UMT includes forest grown naturally and human induced plantation
10. Quarry	This UMT class is a representative of an excavated	10.1 Quarry	This UMT is a site used for production of selected

High level UMT class	Description of the land use class	UMT sub class	Description of key characteristics of UMT
	site used for quarrying.		material, stones.
11. Bare Land	This UMT class represents a land never been occupied by any structure and the land remains bare.	11.1 Bare Land	This UMT class represents a land never been occupied by any structure and the land remains bare.
12. River	This UMT class represents water body	12.1 River	This UMT class represents river body

N.B: The above detailed UMTs are digitized only if the UMTs covers 75% and above area of the polygon.

4.1.2. Mapping Urban Morphology Types

Figure 3 and figure 4 shows both the high level and UMT sub classes that are mapped in this study for Arba Minch town.

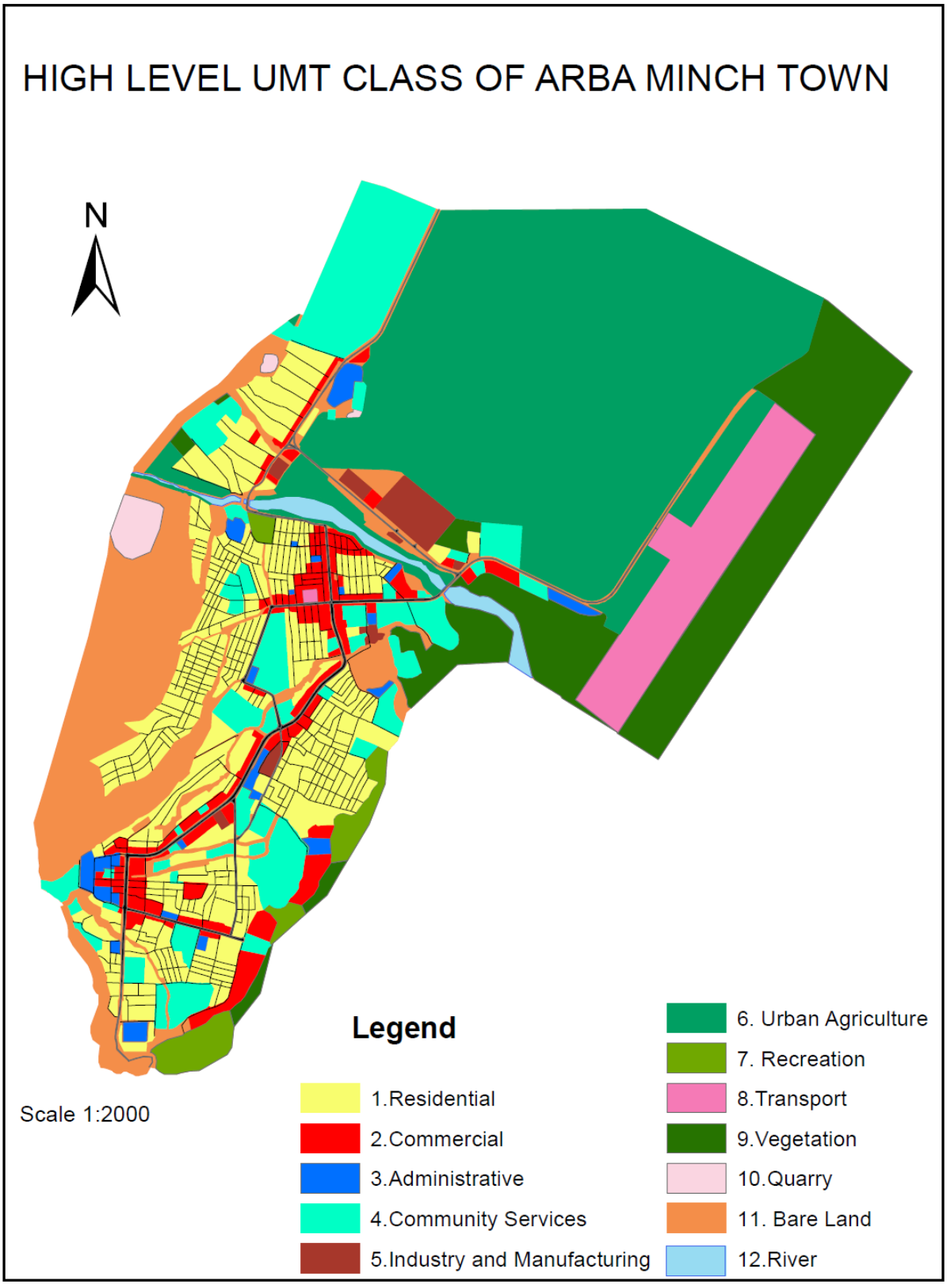

Figure 6 High level UMT map of Arba Minch

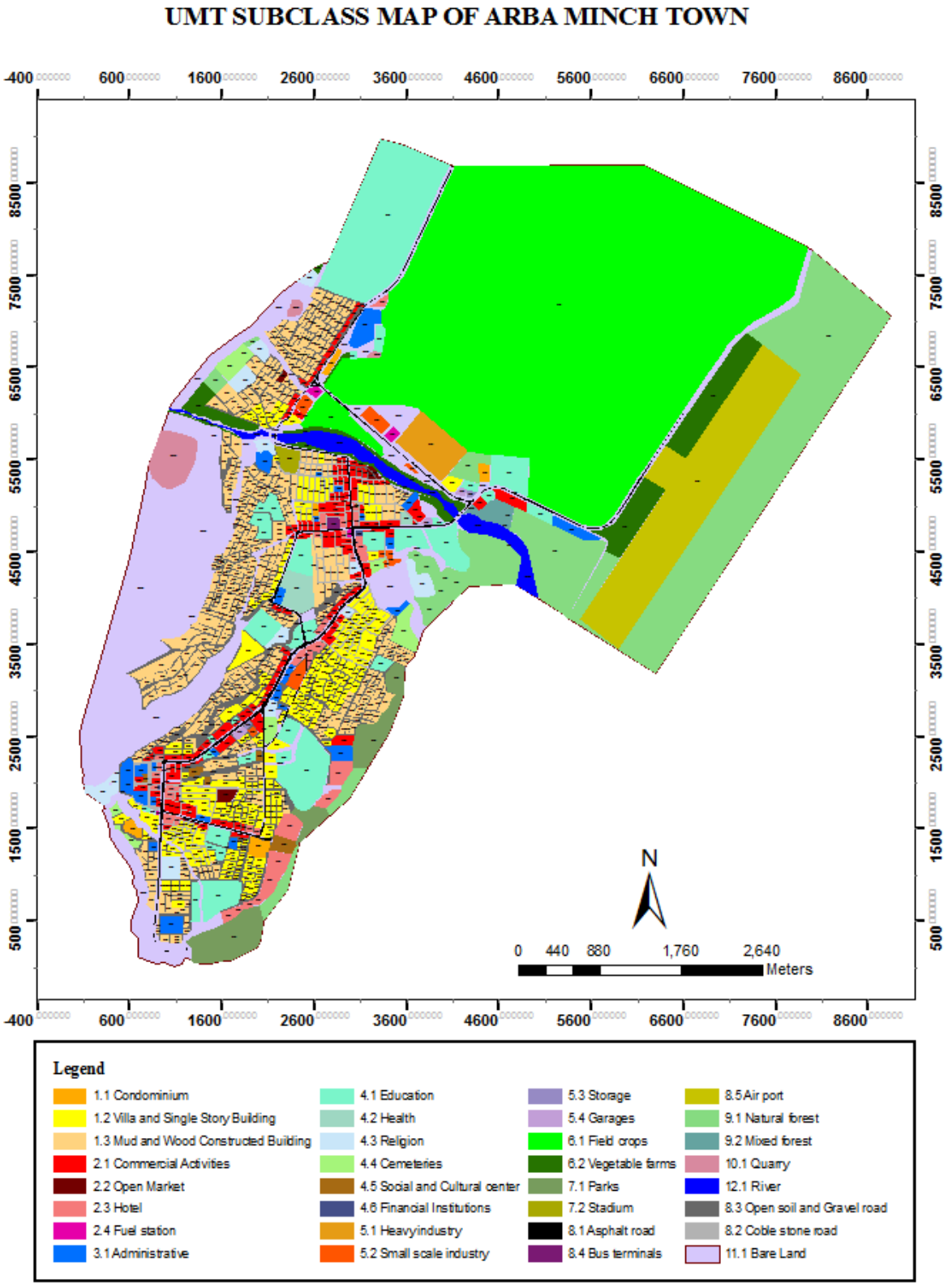

Figure 7 Map of the UMT sub classes for Arba Minch

Table 5 Summary statistics of the UMT sub and main categories

UMTs	No. of UMT units	Min. Area (Ha)	Max. Area (Ha)	Mean Area (Ha)	Sum of Area (Ha)	Percentage Area (%)
1. Residential	762				481.95	12.02
1.1 Condominium	5	0.74	4.19	2.34	11.72	0.29
1.2 Villa and Single Story Building	274	0.25	14.03	0.83	175.78	4.38
1.3 Mud and Wood Constructed Building	483	0.25	5.91	0.61	294.46	7.34
2. Commercial	163				144.50	3.5
2.1 Commercial Activities	126	0.25	3.96	0.64	80.00	1.9
2.2 Open Market	4	0.56	2.67	1.13	4.53	0.11
2.3 Hotel	29	0.32	14.04	1.94	56.37	1.4
2.4 Fuel station	4	0.26	1.64	0.91	3.64	0.09
3. Administrative	26				48.81	1.22
3.1 Administrative	26	0.32	9.21	1.88	48.81	1.22
4. Community Services	67				332.4	8.44
4.1 Education	31	0.35	130.69	7.64	229.28	5.72
4.2 Health/ Medical	6	1.38	14.63	6.00	36.00	0.90
4.3 Religion	15	0.35	7.31	2.66	39.86	0.99
4.4 Cemeteries	7	1.22	8.36	3.61	25.25	0.63
4.5 Social and Cultural center	6	0.25	4.06	5.38	1.24	0.18
4.6 Financial institutions	2	0.25	0.52	0.39	0.77	0.02
5. Industry and Manufacturing	19				47.95	1.19
5.1 Heavy industry	1	29.58	29.58	29.58	29.58	0.74
5.2 Small scale industry	12	0.25	4.54	1.19	14.22	0.35
5.3 Storage	2	0.48	0.75	0.61	1.23	0.03
5.4 Garage	4	0.32	1.23	0.73	2.92	0.07

UMTs	No. of UMT units	Min. Area (Ha)	Max. Area (Ha)	Mean Area (Ha)	Sum of Area (Ha)	Percentage Area (%)
6. Urban Agriculture	11				1,297.21	32.34
6.1 Field crops	2	19.19	1,180.73	599.96	1,199.92	29.91
6.2 Vegetable farms	9	0.51	38.06	10.81	97.29	2.43
7. Recreation	4				12.10	0.31
7.1 Park	3	8.01	30.80	20.80	62.4	1.56
7.2 Stadium	1	5.86	5.86	5.86	5.86	0.15
8. Transport					440.46	10.97
8.1 Asphalt road	-	-	-	-	35.71	0.89
8.2 Coble stone road	-	-	-	-	36.67	0.91
8.3 Open soil and Gravel road		-	-	-	168.23	4.19
8.4 Bus terminal	1	1.51	1.51	1.51	1.51	0.04
8.5 Air port	1	198.34	198.34	198.34	198.34	4.94
9. Vegetation	11				451.54	11.26
9.1 Natural forest	10	0.91	287.57	44.20	441.97	11.02
9.2 Mixed forest	1	9.57	9.57	9.57	9.57	0.24
10. Quarry	3				28.09	0.70
10.1 Quarry	3	0.98	24.44	9.36	28.09	0.70
11. Bare Land	-	-	-	-	651.2	16.01
11.1 Bare Land	-	-	-	-	651.2	16.01
12. River	1				46.68	1.16
12.1 River	1	46.68	46.68	46.68	46.68	1.16

Table 5 above shows the number of UMTs, minimum, maximum, mean area, total area in hector and percentage contribution of each UMT to the total area of the town.

Statistical summary of the UMTs sub and main categories are provided in Table 5 and shows percentage contribution of each UMT category to the total area of Arba Minch town. As shown in Table 5, field crops contributes the largest portion, it contribute 29.91% of the total area of Arba Minch, mainly found on the outskirts of the town. Bare land is the second largest UMT,

contributing 15.54% to the total area of Arba Minch. This UMT is mainly located in the periphery of the town and characterized by hilly (slope) areas and covered by bushes and mostly open. Natural forest is the third largest UMT, contributing 11.02% to the total area of Arba Minch. This UMT is mainly found in the eastern borders of the town. Mud and Wood constructed residential Building contributes 7.34% of the total area of Arba Minch. This UMT is mostly found in planned areas. Educational UMT contributes 5.72% of the total area of Arba Minch. This UMT is mainly composed of university and colleges. Airport UMT contributes 4.94% of the total area of Arba Minch. This UMT is mainly covered by green structure and located in northeastern part of the town. Villa and Single Story residential building UMT contributes 4.38% of the total area of Arba Minch and this UMT is mainly located in the middle of the town. Open soil and Gravel road contributes 4.19% of the total area of Arba Minch. Vegetable farms contribute 2.43% to the total area of the town and located at both sides of river UMT. Commercial activities contributes 1.9% to the total area of Arba Minch and this UMT is mainly found in the sides of asphalt road UMT.

Park, Hotel, Administrative and River UMTs have contributes 1.56, 1.4, 1.22 and 1.16% respectively. River UMT specifically called 'kulffo'[3] river and divides the town in two parts. Religion UMT is around 1% and all other UMTs are less than 1% of the total area of Arba Minch.

The developed UMTs map and its attribute data shows the percentage area of green UMTs in Arba Minch is 45.56% in relation to other UMTs. However, in the future if the proposed structural/ development plan of the town implemented it will consequence decrease in green spaces if no other measure is taken to green spaces.

The current structural (developmental) plan shows a number of UMTs will be changed in the near future. These UMTs include filed crops, mud and wood constructed building, bare land, gravel and open soil road and cemeteries. The structural plan verifies that the major contributor of the UMT i.e. filed crops UMT will be specifically changed to residential and commercial UMTs. This change had planned by the local government and would be implemented according to the structural plan and governments low of Ethiopia in the near future.

[3] Local name of river

4.2. Assessment of Recreational Ecosystem Service

As for any evaluation, when assessing CES, minimum conditions should be met to guarantee indicator quality (Morcilloa et ai, 2013). As the assessment of recreational ecosystem service is conducted based on the indicators of the provision of recreational ecosystem service in the recreational areas. The indicators are developed by onsite observations of ongoing recreational ecosystem service in park UMT.

The developed indicators of the provision of recreational ecosystem service to assess recreational ecosystem service at selected three park UMTs for use by users of recreational area are the following:

- Area accommodation of recreational area for users function
- Topography or landscape of recreational area (appropriate for users)
- Location of recreational area in relation to users residence
- Degree of naturalness (existence of diversity of vegetation or species richness and biodiversity) of recreational area
- Noise from nearby town to recreational area
- Management (by local government) of recreational area
- Presence of other infrastructure (cafeteria, shops) in recreational area
- Aesthetics of recreational area
- Presence of good views in recreational area
- Existence of fresh air in recreational area
- Existence of multiple function (place for ceremonies, ways for waking, sits, children play ground)
- Accessibility due to travel coast, access to transport, multiple entrance and exit
- Security of the recreational area
- Sanitary (neatness) of the recreational area
- Existence of place for physical activities
- Existence of entertainment
- Value of individuals about the benefit of recreational ecosystem service
- Individuals demand for recreational ecosystem service
- Existence of signs, showing entrance, exit, path ways on recreational area

- Existence of parking places in recreational area

The scores given in tables below represent the response obtained from users and concerned government officials, with equal weighting to each of the responses. The response choices for assessment interview questions and questionnaires are based on; not satisfactory at all, satisfactory and very satisfactory; not suitable at all, suitable and very suitable; not good at all, good and very good; not available at all, available and available enough for recreation based on the questions requirement. The tables below are filled based on the above scoring system form the three assessment areas.

Table 6 Response obtained and selected comments of interviews from users at selected three assessment areas

Selected indicators for assess the provision of recreational ecosystem service	**Respondents response scoring**				**Selected respondents comments or recommendation**
	Not available at all	Not Satisfactory at all	Satisfactory	Very satisfactory	
Area accommodation of recreational area for users function	-	3	19	8	Currently the growth of town is reducing the recreational area, due to the provision of settlements, hotels, logs in recreational area
Degree of naturalness (existence of diversity vegetation or species richness and biodiversity)	-	2	17	11	Needs conservation and rehabilitation of some areas
Management (by					

local government) for recreational area	26	4	-	-	
Presence of other infrastructure (cafeteria, shops) in recreational area	30	-	-	-	Available in adjacent UMTs in some cases
Existence of multiple function (place for ceremonies, ways for waking, sits, children play ground)	3	17	10	-	Design needed functions and implementation is required
Security in recreational area	30	-	-	-	Management staffs working on security required
Existence of place for physical activities	14	11	5	-	Design needed functions and implementation is required
Existence of entertainment (by other medias)	30	-	-	-	Provision of other entertainment in recreational area required
Existence of signs, showing entrance, exit, path ways on recreational area	30	-	-	-	Need to be included in the design of recreational area
Existence of parking places in recreational area	28	2	-	-	Need to be included in the design of recreational area

Table 6 above shows the response obtained and selected comments from the users of recreational ecosystem service in the study areas.

Ecosystem services in urban areas are clearly directly related to land use and land cover (MA, 2005). In Arba Minch town, the existing area accommodation (62.4ha.) of recreational area for users' functions for recreation is satisfactory but due to the provision of recreational area to settlements and other commercial activities there will be less recreational area in the future compared to the societies demand for recreation. The majority of the environmental loss in towns is due various constructions, widening of roads, industrialization (Tejashri and Mayur, 2012). The case is same in Arba Minch town and if this action continues the town will face; shortage of urban open spaces and green space in the town, problems by the lack of open green spaces and open spaces. And, shortage of recreational ecosystem services, users of these services (recreational ecosystem service) forced to look for other types of recreational areas outside the town or other recreation types.

About 93% of the respondents responded that the recreational area has satisfactory natural vegetation in the area and around recreational area. A key step is to identify the main sources of uncertainty regarding the protection of ecosystem services, and their importance. Developing methods of quantifying this uncertainty, and incorporating it into flexible policy (Daily, 1997). However, the existing vegetation not well conserved and the area is not rehabilitated due to absence of well-defined management and maintaining concerned officials in the town for the recreational area. 87% of the respondents responded that the recreational area lacks well-defined management and maintaining staffs for the recreational area.

As seen in the recreational area, due to absence of design and implementation in the recreational areas, there are no other infrastructures like cafeteria and shortage/absence of multiple recreational functions like; designed place for ceremonies, ways for walking, sits, children playing areas and well-designed places for physical activities. However, based respondents comments, the existing recreational areas are both satisfactory and suitable for the provision of those recreational functions.

About 100% of the respondents responded the recreational lack assigned security and other concerned government officials in the recreational area. This also resulted in the absence of other entertainment services like TV, radio, music, etc. in the recreational areas. In addition, as

observed in the recreational area and based on responses of respondents the existing recreational area misses the following recreational supporting functions parking places, signs showing directions, entrance and exits and designed walkways.

Table 7 Response obtained and selected comments of interviews from users at selected three assessment areas

Selected indicators for assess the provision of recreational ecosystem service	**Respondents response scoring**			**Selected respondents comments or recommendation**
	Not suitable at all	Suitable	Very suitable	
Topography or landscape (appropriate for users) of recreational area	2	16	12	Landscape design is required
Location of recreational area in relation to users residence	3	19	8	
Aesthetics of recreational area	4	19	7	
Presence of good views from recreational area	-	4	26	
Existence of fresh air in recreational area	1	8	21	
Accessibility due to travel coast, access to transport, multiple entrance and exit	18	9	3	Transportation service (taxi and other means) to recreational area required

Table 7 above shows the response obtained and selected comments from the users of recreational ecosystem service in the study areas.

The 93% of the respondents are responded that, landscape of the recreational areas is suitable for recreational activities like; hiking, walking, birds watching and nature study and also the aesthetic quality of recreational areas are suitable for recreation. Based on the responses of the respondent, the current location of recreational areas in relation to users' residence is suitable for

societies to access. However; it was observed that, the area is not accessible due to access to transport, prevention of some areas by hotels and loge owners in nearby UMTs and absence of well-defined multiple entrance and exit to recreational area.

As observed in the recreational area, the recreational areas have good views to Abaya and Chamo lakes, natural forest of the boarders and Nech-Sar national park, God Bridge[4] and to forty springs. Additionally, the recreational areas access the fresh air from Abaya and Chamo lakes and also from the nearby forest of the borders, that make the recreation area suitable for recreational activities.

Table 8 Response obtained by interviews from users on three assessment areas

Selected indicators for assess the provision of recreational ecosystem service	**Respondents response scoring**				**Selected respondents comments or recommendation**
	Not available at all	Not significant	available	More available	
Noise from nearby town to recreational area	6	21	3	-	

Table 8 above shows Response obtained by interviews from users on three assessment areas.

Based on observation and respondents responses, the recreational areas disturbance level by noise from nearby UMTs is not significant in the recreational area and that makes the UMTs suitable for recreation and recreational activities that enhance the provision recreational ecosystem services.

[4] Natural bridge of landmass between Abaya and Chamo lakes

Table 9 Response obtained and selected comments of interviews from users on three assessment areas

Selected indicators for assess the provision of recreational ecosystem service	**Respondents response scoring**			**Selected respondents comments or recommendation**
	Not good at all	Good	Very good enough	
Sanitary (neatness) of the recreational area	18	10	2	Management staffs working on sanitary required

Table 9 above shows the response obtained and selected comments from the users of recreational ecosystem service in the study areas.

About 60% of the respondents responded that the recreational area had sanitary problem. As observed, some parts of recreational areas are used as disposal of waste for nearby UMTs. This sanitary problem of recreational areas resulted in decrease of the provision of recreational ecosystem services in the recreational areas.

Table 10 Response obtained by interviews from users on three assessment areas

Selected indicators for assess the provision of recreational ecosystem service	**Respondents response scoring**				**Selected respondents comments or recommendation**
	Very low	Low	High	Very high	
Individuals demand for recreational ecosystem service	-	3	9	18	
Stress level reduced by using the existing green UMTs	-	-	7	23	

Table 10 Response obtained by interviews from users on three assessment areas

As majority of respondents in the recreational area mentioned the demand of societies for recreational ecosystem service is good enough and the users' need the provision of recreational ecosystem services. Around 77% of the respondents responded that, the stress level reducing capacity of the current recreational areas are very high, that makes the recreational suitable for the provision of recreational ecosystem services.

The developed indicators of the provision of recreational ecosystem service to assess the provision of recreational ecosystem service at selected park UMTs of Arba Minch town for use by concerned local government officials of the recreational area are the following:

- Economic profitability of recreational ecosystem services in park UMTs
- Regulation (environmental) capability of park UMTs
- Cultural (historical) value of park UMTs
- Habitat and biodiversity conservation capability value of park UMTs
- Capability of providing recreational place for the public of park UMTs
- Quality and quantity of park UMTs
- Number of users or visitors of park UMTs
- Number of enterprises offering tourism related services in park UMTs
- Amount of specific studies (educational value) in park UMTs
- Specious richness of park UMTs
- Number of available recreation facilities in park UMTs
- Amount of annual budget to enhance provision of recreational service in park UMTs

Table 11 Response obtained and selected comments of questioner from government officials for the study area

Benefits of recreational ecosystem service provided for local government	**Response by government officials**				**Selected comments from government officials**
	No value at all	Not Satisfactory at all	Satisfactory	Very satisfactory	
Economic profitability	6	-	-	-	The local government officials of the town mainly focused on the economic benefits from other recreational areas (Nech-sar national park, forty springs, crocodile ranch)

Regulation (environmental) capability	-	1	4	1	But, the respondents mentioned that there is no studies under taken in this area
Cultural (historical value)	1	5	-	-	The local government give no consideration for the cultural value of recreational area
Habitat and biodiversity conservation capability	-	1	3	2	
Providing recreational place for the public	-	3	3	-	Due to management and security problem the area is not accessible for group of people
Amount of annual budget to enhance provision of recreational service in park UMTs of Arba Minch`	-	6	-	-	Currently the local was not allocating annual budget specific to the UMT

Table 11 above shows the response obtained and selected comments from the concerned local government officials of the town about the provision of recreational ecosystem service in the study areas.

In comparison to record-keeping of physical and financial capital, little attention has been paid to the stocks of natural capital (ecosystems, their geophysical structure, and their biodiversity) that supply ecosystem services (Daily, 2000). Almost, 100% of the respondents responded that the

recreational area had no economic value to the local government. However, this is due to, the local government officials of Arba Minch mainly focused on the economic benefit of recreational ecosystem services from other recreation providing units such as Nech-Sar national park, forty springs and crocodile ranch and had less consideration to the economic benefit of parks and other green recreational providing UMTs in the town. More than 67% of the respondent responded, the current recreational areas of the town regulate the urban environment by cooling the urban environment, providing the town fresh air etc. however, there is no specific study conducted in the study area regarding the issue.

About 83% of the respondent responded that cultural and historical value of the recreational areas are not satisfactory at all. However, it is observed that, the capability to provide cultural and historical value of park UMTs of Arba Minch town is good enough, but due to the little consideration by local government to recreational areas of the town the provision of cultural and historic value of the areas are not significant. The recreational areas of the town are habitats for biodiversity in the town and around the town.

About 50% of the response shows the capability of the recreational areas to provided recreational ecosystem service is satisfactory. However, the parks of the town are not well managed and maintained they provide recreational ecosystem service for some group of people (based on economic status mainly for unemployed ones and based on age group mainly for middle age group). According to the concerned local government officials, the amount of annual budget to enhance the provision of recreational ecosystem service in recreational areas of Arba Minch town is not satisfactory to facilitate the provision of service. Moreover, they mentioned there is no annual budget specific to the parks and other recreational areas.

Table 12 Response obtained and selected comments of questioner from government officials for the study area

Benefits of recreational ecosystem service provided for local government	**Response by government officials**				**Selected comments from government officials**
	Not at all	Very low	Low	High	
Number of users or visitors	-	1	-	-	Due to absence of management body and concerned staffs in recreational area they have no documentation regarding number of users of the park UMT
Number of enterprises offering tourism related services	5	1	-	-	Due to absence of announcement and awareness creation by local government there is no enterprises offering tourism related service in the park UMT
Amount of specific studies (educational value)	2	3	1	-	Due to absence of announcement and awareness creation by local government the amount of specific studies in the park UMT is very low

Table 12 above shows the response obtained and selected comments from the concerned local government officials of the town about the provision of recreational ecosystem service in the study areas.

According to the comments obtained, the concerned local government officials do not have data about the number of users or visitors of recreational areas of Arba Minch, since there is no management body in the recreational area and no well-known entrance and exit to the recreational area. According to the concerned local government officials of the town the number

of enterprises, offering tourism related services in recreational areas of Arba Minch town is not significant. Moreover, the respondents mentioned enterprises mainly aimed at Nech-Sar national park, forty springs, and crocodile ranch and have little attention to the parks of the town. This is due to absence of announcement and awareness creation by local government about the recreational area and the benefit recreational ecosystem service in the park UMTs. Around 83% of the respondents responded that, the capability to provide educational value of park UMTs of the town is high currently park UMTs of the town are least used for education.

Table 13 Response obtained and selected comments of questioner from government officials for the study area

Benefits of recreational ecosystem service provided for local government	**Response by government officials**				**Selected comments from government officials**
	Not at all	Not Satisfactory at all	Satisfactory and suitable	Very satisfactory and suitable	
Specious richness	-	1	3	2	Natural the UMT is reach in vegetation, but there is no prevention and rehabilitation program in the recreational area
Number of available recreation facilities	1	4	1	-	Currently the local government is not working on provision of recreational facilities in the park UMT
Quality and quantity of site	-	1	3	2	Natural the park UMT is suitable for recreation

Table 13 above shows the response obtained and selected comments from the concerned local government officials of the town about the provision of recreational ecosystem service in the study areas.

About 83% of the respondents responded that, the quality and quantity of park UMTs of the town are both satisfactory and suitable for provision of recreational ecosystem service to the societies. However, due to exposure of some parts of the recreational areas as waste disposal site by nearby UMTs the recreational area losing its quality. The specious richness of park UMTs of Arba Minch town is satisfactory and suitable to provide recreational ecosystem services.

According to the response of government officials, the number of available recreation facilities in park UMTs of Arba Minch town is not satisfactory and not suitable at all for the provision of expected recreational ecosystem service. Based on comments obtained it is due to absence of development of recreational facilities in the UMTs and less awareness level of local government about the benefit of recreational ecosystem service to the societies.

CHAPTER FIVE

FUTURE PLANNING OPTIONS

5.1. SWOT Analysis of the Study Area

SWOT analysis is the in-depth analysis of the strength and weakness of a particular site and they describe the internal issues of the site while the opportunities and threats are issues that have positive or adverse effect on the site imposed by external issues.

Table 14 SWOT analysis of the study area

Strength	**Opportunities**
• Good topography and landscape of recreational area • Existence of fresh air in the recreational area • Location of recreational area, suitable for users accessibility • Good views in the recreational area • Presence of local construction materials in the recreational area to build other infrastructure in the recreational area • Presence of existing roads to assess the recreational area	• The demand of societies for recreational area • Presence of concerned local government officials in the town • Availability of NGOs working on environmental issues in the town • Presence of diversity of vegetation in the recreational area
Weakness	**Threats**
• The absence of well-defined management and other staffs to enhance the provision of recreational ecosystem service in the area • Disposal of wastes in the recreational area from nearby UMTs • The miss functional uses of recreational area by some group of peoples • Absence of development and maintenance of infrastructures in the recreational area	• The growth of town to the recreational area • Absence of well-defined bounders for the recreational area • The low awareness of some group of people about the functional use of recreational area

Institutional aspect

The concerned institution of the town should improve, maintain and upgrade the recreational areas, by designing convenient places for ceremonies, play grounds, sits, well-defined entrance and exists and other recreational facilities to the recreational area to make the space appropriate for users of the service. The Arba Minch town municipality should not allow the growth of the town (i.e. settlements) to the recreational areas and should define the boundaries of recreational area and should provide additional recreational areas on the structural plan of the town, by considering the location of existing recreational areas. The local government as well as the concerned institution needs to encourage both individuals and private sectors to provide other proper infrastructures like cafeteria, shops for users to increase the amount of users. The concerned institution should provide security, management and maintenance staffs for the recreational area. The concerned institution should teach the society about the necessity of recreational ecosystem service and increase awareness of network opportunities in the four sub cities to facilitate the information flows. Therefore, public support and participation should be mobilized aiming at raising awareness and public participation to bring better recreational ecosystem service.

Legal aspect

The concerned institution of the town should formulate and implement laws and regulations regarding the use of recreational areas, in accordance with the local conditions, so that to manage proper functional use of recreational areas. The town should also gradually introduce a system of entrance fees for the use of recreational areas. The legal frameworks must also put in place along with effective enforcement mechanisms to implement the existing and additional formulated laws and regulations. In this respect, the town should have efficient planning strategy to carry out the desired implementation quickly and effectively to achieve most required recreational ecosystem services with limited available time and funds.

Financial aspect

The local government should supply the necessary budget to the concerned institution to improve the recreational areas, so as, to enhance the proper provision of recreational ecosystem service. The local government as well as the concerned institution should encourage the public and private institution mainly on infrastructure of recreational areas and NGOs to work on

improvement of the provision of recreational ecosystem service. The concerned institution should collect fees for entrance and fees for using other infrastructure in the recreational area, according to the economic level of the society.

Finally, what making it happen?

- Allocate -define well-known bounders for the recreational area
- Provide – concerned management body and other staffs for recreational area
- Integration – incorporate healthy design principles of recreational area
- Partnerships – work with public, private institutions and NGOs
- Implementation – plan, fund and build infrastructures in the recreational area
- Research – understand community, the service and look for other examples
- Education and Training – educated the public on the use and function of green spaces
- Measuring Success – review implementation and improve

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The amount of urban open spaces in the town has been changing through time. Whenever there is a large development, the number of open spaces and green spaces decreased. This shows that the issue of urban open spaces and green space does not have a place in the developments of the town, even though the societies need for recreation is increasing. This is observed in the structural or developmental plan of the town as well. If most of the proposals in the structural or developmental plan had implemented, the urban open spaces and green areas have left out. This shows a serious threat in the future development of urban open spaces and open green areas in the town. Therefore, the local government needs to give attention for the UMTs approach since the approach give wider consideration for the green infrastructure of the town.

The recreational areas have no well-defined management body and other staffs to facilitate the proper provision of recreational ecosystem service. Although the location of parks is good enough (it have good views, fresh air, good landscape etc.) to provide recreational ecosystem service, the low management value and maintenance problem has resulted in fewer people using them.

The general attitude of the public towards the proper usage of urban green spaces is low. The trend of the people in using green spaces depends on their economic status as well, that is people using green spaces are mainly unemployed and uses the area for the purpose of "Chat'' chewing and the like. This is due to the recreational areas of the town have management and security problem and the recreational areas have sanitary, infrastructure problems and associability problem to service like café and other recreational facilities.

Generally, in comparison to local concerned institution recordkeeping and amount of annual budget to enhance the provision of recreational ecosystem service in park UMTs little attention had paid by local government to facilitate recreational ecosystem service at Arba Minch in park UMTs.

The following recreational ecosystem service facilities are missed in the recreational area of the town:-

- Concerned management bodies and other staffs to enhance the provision of recreational ecosystem service
- Space for children's playground and physical activities
- Space for adult and children's entertainment
- Well-designed open space for variety of functions and infrastructure
- Variety of services like shops, bars and restaurants
- Proper planning, maintenance and management of the landscape of recreational area
- Well known entrances and exits to the recreational areas
- Well-known boundary of recreational area

6.2. Recommendation

Based on additional recommendation provided by the respondents on the survey, in combination with interviews and questioners result, observation result, document review and literature review a number of recommendations regarding UMTs and provision of recreational ecosystem service in park UMTs of Arba Minch town have provided as follow:

- The local government of the town should adapt UMTs approach and should use UMTs approach since the approach is more sensitive to green spaces in relation to the current land use and developmental or structural plan of the town.
- The local government should give attention for urban green spaces and open space in the town, which provide recreational ecosystem service to the societies and should develop new management and maintenance approach to the recreational areas.
- The local government as well as concerned local government official should have identify the current supply rate of recreational ecosystem service, the public demand of recreation and the capacity of recreational areas to provide recreational ecosystem service and should work to satisfy the public demand based on the capacity of recreational areas.
- The local government should invest in required infrastructure to improve the provision of recreational ecosystem service for the recreational area.
- The concerned local government institution should allocate regular transportation (taxis and other means) service to the recreational areas for users of recreational areas.

- The local government or private institution should provide community infrastructure and facilities for all ages in the recreational area.
- The local government should ensure community participation in the planning and decision making process for the recreational area.
- Develop and maintain attractive, well-designed and maintained public open green spaces and other infrastructure for recreational services and should have a variety of functions within easy walking distance in the recreational area.
- The local government should locate parks, play areas and public open green spaces so they are easily visible for the users.
- The concerned institution as well as the public should protect and enhance any environmental, cultural and heritage values in the recreational area.
- The public should have informed and properly use the infrastructure and recreational ecosystem service and should conserve the cultural and heritage values in the recreational areas.

Finally, for following up on the implementation and success of policies, monitoring of all of the above should have needed.

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ANNEXES

Annex A: Questionnaires

Profile of the questionnaires

As discussed in the methodology part of this paper, one of data collection approach is to conduct interviews for the users of recreational area and prepare questionnaires and distribute to the concerned government officials in order to assess the provision of recreational ecosystem service. Hence, the interviews and questionnaires are designed to collect data regarding the provision of recreational ecosystem service. The questioners are grouped in to two sections. The section and their area of identification are the following:

Section one: is interview questions for the users of recreational areas to obtain data's' about the provision of recreational ecosystem service in the recreational areas.

Section two: is questioner for the concerned government officials to obtain data's regarding recreational areas and provision of recreational ecosystem service.

Ethiopian Institute of Architecture, Building Construction and City Development (EiABC)

Interview question developed for assessment of recreational ecosystem service at green Urban Morphology Types (UMTs) of Arba Minch town in partial fulfillment of degree in master in Environmental Planning and Landscape Design (for users of recreational areas)

I. General Information of the Respondent

1. Sub city of respondent: secha___ sekela___ nech-sare____ abaya____ other_____
2. Age group: under 16___ b/n 17-19___ 20-29___ 30-39___ 40-49___ 50-59___ 60-74___ Above 75___
3. Gender: Male____ Female____
4. Marital status: Married___ single___ Divorced___

II. Assessment of Recreational Ecosystem Services

1. Area accommodation of the site for users function during recreation

a) Not satisfactory at all for recreation b) Satisfactory for recreation c) Very satisfactory for recreation

2. Topography or landscape of the recreational area (appropriate for users)

a) Not suitable at all for recreation b) Suitable for recreation c) Very suitable for recreation

3. Location of recreational area in relation to users residence

a) Not suitable at all b) Suitable c) Very suitable

4. Degree of naturalness (existence of diversity of vegetation or species richness and biodiversity) of the recreational area

a) Not satisfactory at all for recreation b) Satisfactory for recreation c) Very satisfactory for recreation

5. Noise from nearby town to recreational area

a) Not available at all b) Not significant c) available d) More available

6. Management (by local government) of recreational area

a) Not available at all b) Not satisfactory at all for recreation c) Satisfactory for recreation d) Very satisfactory for recreation

7. Maintenance (by local government) of the recreational area

a) Not available at all b) Not Satisfactory at all for recreational area c)Satisfactory for recreational area d) Very satisfactory for recreational area

8. Presence of other infrastructure (cafeteria, shops) in the recreational area

a) Not available at all b) Not Satisfactory at all for recreation c)Satisfactory for recreation d) Very satisfactory for recreation

9. Aesthetics of the recreational area

a) Not suitable at all for recreation b) Suitable for recreation c) Very suitable for recreation

10. Presence of good views from recreational area

a) Not available at all b) Not suitable at all for recreation c)Suitable for recreation d) Very suitable for recreation

11. Existence of fresh air in recreational area

a) Not available at all b) Not suitable at all for recreation c)Suitable for recreation d) Very suitable for recreation

12. Existence of multiple function (place for ceremonies, ways for waking, sits, children play ground)

a) Not available at all b) Not Satisfactory at all for recreation c)Satisfactory and suitable for recreation d) Very satisfactory and suitable for recreation

13. Accessibility due to travel coast, access to transport, multiple entrance and exit

a) Not available at all b) Not suitable at all c) Suitable d) Very suitable

14. Security of the recreational area

a) Not available at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory

15. Sanitary (neatness)of the recreational area

a) Not good at all b) Good c) Very good enough

16. Existence of place for physical activities in recreational area

a) Not available at all b) Not Satisfactory at all for recreation c)Satisfactory and suitable for recreation d) Very satisfactory and suitable for recreation

17. Existence of entertainment in recreational area

a) Not available at all b) Not Satisfactory at all for recreation c)Satisfactory and suitable for recreation d) Very satisfactory and suitable for recreation

18. Your degree about the benefit of recreational ecosystem service

a) Not good at all b) Good c) Very good enough

19. Your demand for recreational ecosystem service

a) Very low b) Low c) High d) Very high

20. Your degree of stress level reduced by using the existing green UMTs

a) Very low b) Low c) High d) Very high

21. Existence of signs, showing entrance, exit, path ways on recreational area

a) Not available at all b) Not Satisfactory at all c) Satisfactory and suitable d) Very satisfactory and suitable

22. Existence of parking places in recreational area

a) Not available at all b) Not Satisfactory at all c) Satisfactory and suitable d) Very satisfactory and suitable

23. Finally, please share if any comment you would like to make, or insights you want share regarding the provision of recreational ecosystem service at green UMTs of Arba Minch town.

Dear respondent, this questionnaire is designed for the purpose of conducting a study on Assessment of Recreational Ecosystem Service in green Urban Morphology Types (UMTs) of Arba Minch town. The information you will give is used for academic purposes for the partial fulfillment of degree in Master of Science Environmental Planning and Landscape Design, Ethiopian institute of Architecture Building Construction and City Development (EiABCD), Addis Ababa University. The information has a great role for the success of this research. So, you are kindly requested to take a few minutes and provide accurate information as much as possible. Thank you for your cooperation.

I. General information of the respondent

1. Name of organization working _____.
2. Position in the institute _____
3. Year of experience in the institute _____

II. Assessment of recreational ecosystem service

1. Economic profitability from recreational ecosystem services in green UMTs at Arba Minch

a) No economic value at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory
Reason if any: _____

2. Regulation (environmental) capability of green UMTs at Arba Minch

a) No value at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory
Reason if any: _____

3. Cultural (historical) value of green UMTs of Arba Minch

a) No value at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory
Reason if any: _____

4. Habitat conservation value of green UMTs of Arba Minch

a) No value at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory
Reason if any: _____

5. Capability of providing recreational place for the public of green UMTs of Arba Minch

a) No value at all b) Not Satisfactory at all c)Satisfactory d) Very satisfactory
Reason if any: _____

6. Quality and quantity of green UMTs of Arba Minch

a) Not Satisfactory at all for recreation b)Satisfactory and suitable for recreation c) Very satisfactory and suitable for recreation

Reason if any: _____

7. Number of users or visitors of green UMTs of Arba Minch

a) Very low b) Low c) High d) Very high

Reason if any: _____

8. Number of enterprises offering tourism related services in green UMTs of Arba Minch

a) Not at all b) Very low c) Low d) High

Reason if any: _____

9. Amount of specific studies (educational value)in green UMTs of Arba Minch

a) Not at all b) Very low c) Low d) High

Reason if any: _____

10. Specious richness of green UMTs of Arba Minch

a) Not Satisfactory at all for recreation b)Satisfactory and suitable for recreation c) Very satisfactory and suitable for recreation

Reason if any: _____

11. Number of available recreation facilities in green UMTs of Arba Minch

a) Not at all b) Not Satisfactory at all for recreation c)Satisfactory and suitable for recreation d) Very satisfactory and suitable for recreation

Reason if any: _____

12. Amount of annual budget to enhance provision of recreational service in green UMTs of Arba Minch

a) Not at all b) Not Satisfactory at all for recreation c)Satisfactory for recreation d) Very satisfactory for recreation

Reason if any: _____

13. Finally, please share if any comment you would like to make, or insights you want share regarding the provision of recreational ecosystem service at green UMTs of Arba Minch town