

**GREEN SPACE DEVELOPMENT IN URBAN WETLAND FOR THE
HEALTHY INTERACTION OF COMMUNITY THE CASE OF
CHELELEKA LAKE, BISHOFTU TOWN**



Haymanot Firew

A Thesis Submitted to the Department of Architecture

School of Civil Engineering and Architecture

Presented in partial fulfillment of the requirement for the Degree of Masters
in Environmental Architecture

Office of graduate studies

Adama Science and Technology University

Adama, Ethiopia

June, 2022

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APPROVE OF BOARD OF EXAMINERS

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I hereby declare that this Master thesis entitled “**GREEN SPACE DEVELOPMENT IN URBAN WETLAND FOR THE HEALTHY INTERACTION OF COMMUNITY THE CASE OF CHELELEKA LAKE, BISHOFTU TOWN**” is my original work. That is, it has not been submitted for the award of any academic degree, diploma, or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

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I the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled “**GREEN SPACE DEVELOPMENT IN URBAN WETLAND FOR THE HEALTHY INTERACTION OF COMMUNITY THE CASE OF CHELELEKA LAKE, BISHOFTU TOWN**” prepared under my/our guidance by **Haymanot Firew** submitted in partial fulfillment of the requirements for the degree of Master’s of Science in Environmental Architecture. Therefore, I recommend the submission of a revised version of the thesis to the department following the applicable procedures.

Major Advisor

Signature

Date

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LIST OF ACRONYMS AND ABBREVIATIONS

BCAJOFS -	Bishoftu city administration Job opportunity and food security
CBD –	Central Business District
CWA -	Clean Water Act
DNR -	Department of Natural Resources
ESA-	Ecological Society of America
EWNHS-	Ethiopian Wildlife and Natural History Society
IBA-	International Business Administration
IUCN -	International Union for Conservation of Nature
MRC -	Mekong River Commission
NEPA-	National Environmental Policy Act
NGO -	Non Governmental Office
NRB -	Natural Resources Board
SDGs -	Sustainable Development Goals
UNEP-	United Nations Environment Program

Abstract

Ethiopia owns different types of wetlands which provide enormous socio-economic and environmental values. Despite all those and other indispensable values, these wetlands are under severe pressure and degradation. Due to improper extraction of uses and misconceptions forwarded to wetlands, the health of the wetlands is continuously decreasing from time to time that in doubt their existence in the near future. Traditional and modern agricultural expansions, continuous land degradations, urbanizations and industrializations, lack of policies and institutional arrangements, lack of capacities, natural and ecological problems are the most dominant challenging factors of wetlands in the country. Hence, this thesis aimed is to assess the existing condition of wetlands of Lake Cheleleqa and to design a green space that can integrate community activities and wetland ecosystems without harming one another. The study has collected data from residents around the wetland by using questionnaire and interview to assessing the existing condition of wetlands and identifying factors that affecting the wetlands. Accordingly, wetland preservation and development of Green space as primary criteria, Based on the analysis result, the paper proposed a wetland park with different access like additional roads for vehicle as well as for pedestrians, proposed zoning of uses like playing areas central and walkway plazas road access plan, parking lots, footpath alongside water body, artificial ponds, organized public open space, storm water collection mechanisms to the lake and agricultural lands.

Keywords: *Cheleleqa Lake, Green Space, Green Infrastructures, Urban Green Space, Wetland*

CHAPTER -1 INTRODUCTION

1.1. Background of the study

Today most of natural ecosystems are affected by different factors which is developed by the process of urbanization. In relation to water bodies one of the major example of ecosystem is Wetlands. In the process of urbanization 64% of the world's wetlands have disappeared since 1900. Typically, wetlands have water near or above the ground surface for all or some time of the year. As a result, the soils develop differently in wetlands and the plants and animals that live in wetlands are adapted to changing water levels. So it is considered one of the most productive environments in the world (Dubeau et al., 2017). They are also places for wide range of biodiversity including concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species (Commonwealth of Australia, 2016; Babu, 2015; Johnson, 2013). Due to their vast biological diversity and ecosystem features, wetlands are destinations for recreational and ecotourism opportunities (Chance, 2006; IWMI, 2006; Jafari, 2009; Brooks et al., 2011).

Urban wetlands are those that have survived historical development around which urbanization gradually took place or that are newly constructed in an urban setting. Urban wetlands are essential to making cities livable. During storms urban wetlands absorb excess rainfall, reduce flooding and minimize subsequent infrastructure and economic damage. Urban wetlands also act as a filter for pollution improving water and air quality, and help moderate extreme city temperatures (Terando, Adam J., et al, 2014).

The potentiality of the wetlands to rural communities by creating employment (Secretariat of the Ramsar Convention, 2013; World Bank, 2013; become an active recreation facility such as an ecotourism park also brings necessary benefits for the wetland itself (Chakravarty, 2016).

But now a day, over half of the world's population lives in urban areas and this is expected to increase in the future with over 60% living in cities by 2050. As more and more people move to cities and as populations grow there will be an increased challenge to make our urban areas sustainable and healthy places to live.

At present development of human settlements is a major concern for wetland conservation and wise use. As cities grow and demand for land increases, there is a tendency to

encroach on wetlands or cause direct or indirect impacts on nearby wetlands. Water and other natural resources associated with wetlands also attract the human settlements and economic activities, which result in the degradation of those wetlands (Ramsar, 2013)

Wetlands have been facing maximum exploitation in the post-industrialization era with recent estimates suggesting an 87% decline in global wetland area since pre-industrial times (Walpole and Davidson 2018). Infrastructure construction led wetland conversion and industrial waste disposal in the wetlands were identified as important proximate causes of global wetland degradation (Van Asselen et al. 2013; Gardner and Finlayson 2018), particularly in the developing countries. Over 80% of untreated wastewater is released into wetlands globally (WWAP 2012; UN-Water 2015) with lower middle-class countries treating 28% and low-income countries treating 8% of their wetlands (Sato et al. 2013). Although wetland loss in developing countries was historically lower than the developed countries, the loss is projected to be much higher in future in the former, particularly in Asia, with a predicted increase of urban population by 1.4 billion by 2050 (United Nations 2008; Hettiarachchi et al. 2015), thereby leading to increased risk of environmental disasters and livelihood loss (Smardon 2009; Azarath et al. 1988; Ghosh and Sen 1987). Water pollution is also increasingly worsening the conditions of all Asian rivers (Davidson 2014; WWAP 2017).

Ethiopia is often referred to as the water tower of Africa mainly because of its wide variety of landforms and climatic conditions, creating an extensive wetland system throughout the country. The indirect uses of wetlands are their hydrological and ecological functions, which support various economic activities, life support systems and human welfare. This includes ground water recharge, flood control, nutrient cycling, erosion control and sediment traps, climate regulation, habitats for migratory wildlife and pest control (Dugan, 1990).

As such, wetlands produce an ecological equilibrium in the environment by maintaining the integrity of life support systems for sustainable socio-economic development. Yet, many wetland ecosystems – particularly floodplains and swamps are regarded as wastelands and continue to be depleted at an alarming rate throughout Ethiopia. Moreover, national economic policies that prioritize crop production, severely affects sensitive ecosystems including wetlands through extensive land development schemes that have no concern for environmental costs. (Geheb and Yilma D. Abebe., 2003)

The causes of wetland degradation include the conversion of wetlands for intensive irrigation agriculture, the expansion of human settlement, industrial pollution, pesticides and fertilizers and water diversion for drainage and the construction of dams. Wetland conversion often results in water depletion, the displacement of populations, the destruction of traditional production systems, habitat degradation, salinization, increases of waterborne diseases and other adverse ecological impacts (WCED, 1987).

Lake Awassa is one of many Ethiopian wetland resources. It lies near the town of Awassa in the middle of a series of rift valley lakes at an altitude of 1680 m and 275 km south of Addis Ababa (Makin et al., 1976). The community of Awassa and its environs has utilized the resources of these wetlands as a livelihood source for a very long time. The water of the lake is used for irrigation, bathing, recreation and as drinking water for domestic use and wildlife. The fishery of the lake supplies vital fish protein and incomes for the people of the area and beyond. The wetland yields grasses and other vegetation on which cattle may be grazed, boats constructed ('tankua'), mattresses, mats and agricultural implements created and houses built. The lake, the river and the swamp are presently faced with serious ecological problems due to deleterious anthropogenic activities in the catchment. The construction of irrigation and drainage systems, clearing of forest, building of factories and use of fertilizers, herbicides and pesticides all contribute towards the damage of these indispensable but fragile systems. (Geheb and Yilma D. Abebe., 2003)

As a wetland development challenge Awash Valley Wetlands and Development was an example of wetland transformation and poverty creation. During the 1960s, seasonal wetlands along the lower Awash River were developed for cotton production. This development was based on the state's land tenure system, which refused to recognize the rights of the Afar to pastoral land, including wetlands. As a result, the state alienated some of these wetlands from the Afar community and rented them out to international companies. Agricultural development in Illubabor Zone: a micro-scale is also another example. (Geheb and Yilma D. Abebe., 2003)

A green space can include recreational fields, urban agriculture, and natural play space for children, community, rooftop and balcony gardens, community compost sites, community orchards, and cycling routes.

Urban green space is a component of "green infrastructure". It is an important part of public open spaces and common services provided by a city and can serve as a health-promoting setting for all members of the urban community. It is therefore necessary to

ensure that public green spaces are easily accessible for all population groups and distributed equitably within the city.

Environmental benefits provided by green spaces include ecosystem services and ecological systems that provide a countless of services to human societies and in terms of enhanced biodiversity. It relates to storm water management and providing habitats for wild plants and animals. Various studies have been conducted internationally, focusing on street tree costs (tree planting, irrigation and other maintenance) versus calculated benefits (energy savings, reduced atmospheric carbon dioxide, improved air quality, and reduced storm water runoff), to estimate net benefits of green spaces. Green spaces contribute to reducing pollution and enhancing air quality, microclimate and heat island effects and noise reduction. Green areas can reduce noise pollution and the visual intrusion from traffic. The greatest environmental benefit of green spaces is the impact on biodiversity and providing refuge to species that are disappearing from urban areas (Elizelle Juaneé, 2015).

1.2. Problem Statement

Ethiopia has a wide variety of wetlands that are spread across the country. These wetlands support the human being in terms of economics, ecology, societal benefits, and recreation. However, the wetlands in the country are impacted by a combination of social, economic, development related and climatic factors that lead to their destruction. The pattern of natural terrain of Bishoftu town is mostly the result of volcanic eruption. Some of the present lakes are the results of these geological formations. There are many hills and mountains in the town concentrated at the central part. Most mountains in the town are barren and exposed for natural hazard. Since Bishoftu town is located in the Great Rift Valley the temperature is hostile, if mountains, and unusable land are not covered with forest in the near future it may require artificial energy to cool the environment. On the contrary significant green area cover is observed in private compounds and big institutions. Churches, government institutions, and private ownership could be example for this. However this cannot guarantee the green area will be there forever. It may mislead the perception they could be converted to other land use anytime soon. Urban agriculture is one of the major land uses Bishoftu specializes. Cattle fattening, flower farming, and related horticulture are a typical activities observed in the town. Though the flower farm included under this category,

it has its own separate zone. Different from other urban agriculture activities the flower farming uses extensive chemicals for fertilizer and coloring the flower. Even though the impact is not assessed in detail, it is obvious the waste could potentially pollutes rivers, ground water etc.

Because of the occupancy of the largest space and comfortable topography of Cheleleqa Lake and wetlands a number of forces continue to seriously affect the natural resources and ecosystems of the wetland. Many of these are primarily the result of human actions and include ecosystem and landscape changes, sedimentation, and agricultural activity during dry season, unrestricted access to the wetland, pollution, over-abstraction and climate change. The removal, destruction or impairment of natural ecosystems is among the greatest causes of critical impacts on the sustainability of the wetland.



Figure 1.1. Pumping of lake water using engine pump for agricultural purpose

Sediments occur in the Cheleleqa Lake as a result of various human actions including land-use changes and agricultural practices and infrastructures development like Highway road and railway lines have the major factor in changing dramatically the volume of water resources of the wetland. And also most of the surrounding of the wetland is occupied by urban agriculture like mass vegetable and flower cultivation, community activities like vehicle washing, waste disposal (According to NAMA of Bishoftu City Solid Waste Management (2017) proved that the solid waste management practice of Bishoftu city is poor. Waste disposal at open fields and at lake shores have caused environmental pollution, public health problems and aesthetic impacts in the town) and unhealthy recreation facilities for youths which the major cause of the land use change.



Figure 1.2. The lake is polluted by solid waste agricultural

But the lake and its wetland not getting adequate attention from concerning body and there is no adequate research conducted yet, Therefore, it is crucial and appropriate to take measures by developing green space that can have appropriate architectural solution which integrate the activities of the communities and the ecosystems of the wetland without harming each other.

1.3. Objective of the Study

1.3.1. General objective

The general objective of this research is to assess the existing environmental condition of Wetlands of Lake Cheleleqa and develop a green space design and plan that can creative healthy interaction of community with the urban Wetlands of Lake Cheleleqa, Bishoftu town.

1.3.2. Specific objective

The specific objective of the study:

- To assess the existing condition of wetland of Lake Cheleleqa.
- To identify factors which affect the wetlands of Lake Cheleleqa.
- To develop a healthy green space design and plan in and around the wetland of Lake Cheleleqa

1.4. Research Questions

1. What does the existing condition the wetland of Cheleleqa looks like?
2. What are the factors that affect the wetland?
3. How does Green Space Development create a healthy interaction between community and urban wetland?

1.5. Significance of the Study

This research paper has aimed on the developments of green space on the wetland with new facilities depending on the needs of the community for sustainable utilization of the wetland environment. Moreover, the study would also create interest for the researcher to study and do further studies on related issues.

1.6. Scope and limitation of the Study

The scope of the study is delimited in the Lake Cheleleqa, Bishoftu town that study the development of green space in the interaction of the wetlands of seasonal lake to the community without harming each other. This can be done considering only environmental sustainability perspectives on highly damaged areas of the wetland through development of urban Green space that has eco-friendly activities on and around the wetlands of Lake Cheleleqa, Bishoftu town.

1.7. Organization of the paper

This research paper is organized into five chapters. The first chapter is the introductory part where background of the study, statement of the problem, objectives, significance and finally scope and limitation of the study are presented. The second chapter is the literature review or theoretical background part. The third chapter covers the methods and materials of the study which is used to collect data using different techniques. Under this case studies are presented. In the fourth chapter results and discussions are presented and data analysis and findings of the case area will be covered and the proposals also presented. Finally the last chapter is conclusion and recommendation part.

CHAPTER -2 RELATED LITERATURE REVIEW

2.1. Wetland

Wetlands are defined by the Ramsar Convention as:

“...areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.”

Wetlands occur everywhere, from the poles to the tropics. There are only broad estimates of how much of the earth's surface is presently made up of wetlands. The UNEP-World Conservation Monitoring Centre, for example, estimates that about 570 million hectares (5.7 million km²), or roughly 6% of the Earth's land surface, is composed of wetlands (Ramsar Convention website: www.ramsar.org). Wetland extent can be difficult to assess, particularly for those wetlands that are composed mainly of wet soils and covered with vegetation (where open water is not a good measure of extent), and seasonal wetlands which can vary greatly in extent according to hydrological conditions (e.g. flood versus dry season extents). (Note, 2019)

2.1.1. Wetland Types

As above, the Ramsar Convention uses a broad definition of wetlands. This includes lakes and rivers, swamps and marshes, wet grasslands and peat lands, oases, estuaries, deltas and tidal flats, mangroves and coral reefs, and human-made wetlands such as fish ponds, rice paddies, reservoirs, and salt pans. The MRC has developed a comprehensive Wetland Classification System, accepted by MRC Member Countries, with wetland types grouped into nine broad categories, including marine/coastal wetlands, riverine wetlands, lakes, ponds and freshwater wetlands. (Note, 2019)

2.1.2. Wetland Ecosystem Services and their value

The multiple roles of wetland ecosystems and their value to human populations have been increasingly understood and documented in recent years. The various ecosystem services can be grouped as provisioning services (*products obtained from the wetland (e.g. food)*), regulating services (*benefits obtained from the regulation of ecosystem processes such as climate, water, and natural hazard regulation*), supporting services (*services necessary for the production of all other ecosystem services such as primary production, water cycling, nutrient cycling and habitat for biota;*) and cultural services (*the non-material benefits*

people obtain from ecosystems such as through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences)

Wetlands are inherently diverse and include lakes and rivers, swamps and marshes, wet grasslands and peat lands, oases, estuaries, deltas and tidal flats, near shore marine areas, mangroves and coral reefs, and human made sites such as fish ponds, rice paddies, reservoirs, and salt pans. The main threats to urban wetlands are draining and infilling for housing or other developments, loss of biodiversity by conversion to open public parks and recreational lakes, solid waste and wastewater pollution, channelization of rivers and streams, hydrological disconnection of the wetlands from watercourses, the use of hard infrastructure solutions rather than green infrastructure and invasive species resulting in the loss of native species

2.1.3. Specific Wetlands Project Considerations and Parameters

Historic and Existing Location Conditions: a. For ventures where it is wanted to recreate earlier conditions, it is essential to decide the noteworthy time and conditions that are craved and attainable to recreate. b. Old maps. c. Interviews with inhabitants. d. Old photos of the wetlands zone. e. Existing wetlands location and range vegetation: (i) Narrative depiction of existing location vegetation. (ii) Dominant plant affiliations (gather of plants that are common and developing on the location). (iii) Describe imperiled plant species developing on the location counting where they are located. (iv) A brief posting of the area's local tree, bush, forb (a blossoming plant, with a non-woody stem, that's not grass), and grass species developing locally. (v) Identify trees/vegetation which may or may not be expelled. (vi) Habitat study: • Community type • Surface cover. f. Wildlife employments of the site: (i) Include the creatures focused on for utilize and their particular needs and employments for the location, counting nourishing, cover, loafing, settling, etc. Incorporate the particular predator-prey connections and how that impacts plan prerequisites such as the required for islands or particular landform types. (ii) Is the location basic territory for any imperiled species? In case so when and how do the imperiled species utilize the site? g. Land utilize study of upland ranges, regions adjoining to the wetlands location, and the wetlands site. h. Soils: (i) Provide distributed soil studies by district, state, National Assets Preservation Benefit or others. Overviews may demonstrate soil sorts (sand, soil, clay, etc.), surface, and utilize (rangeland, farming, etc.). (ii) Discuss the accessibility of topsoil either at the location or locally. (iii) Discuss the

dampness holding capacity, saltiness, herbicides, plant illness life forms, or other issues with the soils. (iv) If the wetland will be built from dry arrive, what is the accessibility of topsoil, either on location or locally? Ordinarily the best six inches of soil over an zone that will be cut or filled would be stripped, stockpiled, and spread back over modern forms to make the ultimate grade. (v) Soil chemical properties related to plant development for re vegetation purposes: Results of a schedule soil investigation performed by a proficient soils testing research facility, counting proposals for correcting the soil for craved plant sorts to be developed. The investigation report giving values for soil surface, pH, solvent salts, natural matter, sum of accessible supplements, lime. Supplement levels detailed in parts per million of the basic supplement. Extra tests for gypsum and sodium adsorption proportion may be run. Presence of soil contaminants that may be harmful in tall sufficient concentration, such as petroleum items or herbicides. Levels of overwhelming metals on arrive that has been mined. (vi) Presence of plant or creature malady life forms.

Environmental Considerations. Implementation of design features should be consistent with environmental commitments listed in the NEPA compliance document and should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies. (Designs, 2007)

Plan information ought to incorporate, as a least, a brief portrayal of the natural assets that may well be influenced by the proposed advancement. The accentuation ought to be on those regions inside the run of choices open to the creators in creating a design. The taking after things ought to too be included within the plan information: a. Cultural (verifiable, archeological, structural, and paleontological) assets within the range of the development. b. The require for mixing structures with the environment. c. Comments on biological, stylish, or other natural viewpoints unconventional to this area which would influence format or conceptual plan. d. Problems with existing bank disintegration. e. Erosion and dregs control necessities. f. Environmental allow necessities (Clean Water Act). g. Special natural necessities for transmission lines or underground transmission frameworks. h. Location, volume, and defilement levels or any strong squander or dangerous squander offices inside the development zone. i. Provide information on the method(s) of brush and tree transfer allowed by neighborhood and State contamination administrative offices. j. Biological data prerequisites: (i) Disease vector control contemplations. Infections may be carried by a few creatures most commonly mosquitoes. Examine which malady vectors may be display and potential control measures such as: • Water administration –

anticipation of stagnant water • Excavation profundities • Use of bug sprays • Timing of development • other control measures (ii) Potential obtrusive species which may harm the wetlands and or adjoining ranges. (iii) State expected impacts to debilitated and imperiled species and relief measures which can be taken to avoid/and or minimize these impacts. Accentuation ought to be set on gathering, or arranging for the collection of any information which can afterward be required to back fundamental allow applications (counting Environmental Society of America (ESA) interviews (iv) Disease vector control contemplations. Illnesses may be carried by a few creatures most commonly mosquitoes. Examine which malady vectors may be display and potential control measures such as: (v) Water administration – avoidance of stagnant water (vi) Excavation profundities (vii) Use of bug sprays (viii) Timing of development (ix) Other control measures (x) Potential obtrusive species which may harm the wetlands and or adjoining zones. (xi) State expected impacts to undermined and imperiled species and relief measures which can be taken to avoid/and or minimize these impacts. Accentuation ought to be set on gathering, or arranging for the collection of any information which is able afterward be required to bolster vital allow applications (counting Environmental Society of America (ESA) meetings Clean Water Act (CWA) area 404 licenses).

Water Supply and Water Quality Components: (Plans, 2007)

Source of water for wetlands: (i) Describe the source of water (stream, store, and ground water). (ii) Is the source of water ceaseless or discontinuous? (iii) Will precipitation, waterway streams, or store enough supply water or will supplemental water be required?

Rivers/streams – hydrologic information: (i) Design surges and surge hydrographs. Ordinarily a likelihood bend of surge top releases up to 100-year repeat period will be adequate. (ii) Flood hydrographs for frequencies of 2, 5, 10, and 25 a long time for utilize amid development. (iii) Monthly hydrographs for past 10 to 100 a long time. (iv) Historical month to month stream midpoints. Incorporate periods of anticipated no-flow or aquifer estimate and revive rate month to month averages.

River morphology: (i) Water surface rise bends, sedimentation considers, debasement and aggradation considers ought to be included. Water surface heights ought to be decided for surges of 100-, 50-, 10-, 5-, and 2-year frequencies. (ii) Potential impacts of the venture that require plan contemplations, e.g., expanded channel scour, and downstream channel assurance, etc. (iii) Anticipated future waterway channel advancement or other

development (upstream and downstream within the stream) which might alter regimen. (iv) Data on upstream and downstream dams, redirections, pumping plants and reservoirs.

Reservoirs: (v) Maximum and least working water surfaces. (vi) Operating procedures. (vii) Anticipated events and sums of sediment, silt, biomass, ice (thickness) and float (trash).

Ground water: (i) Describe and give foundation information on ground water heights over time period, counting regular and over a long period of time. (ii) Chemical composition (See table 1 for water quality checking parameters). (iii) Recharge and permeation rates.

Water quality: (i) Existing water quality (ii) Results of water quality considers carried out at or close the site. (iii) Potential changes to arrive utilize which may influence water quality: mechanical, private, logging, mining, and agricultural. (iv) Product water quality necessities (water treatment wetlands): Water quality necessities or benchmarks which need to be met. Desired saltiness of item water and limits on particular particle levels, in case applicable. Consider potential impacts to the wetlands location, which may happen from surface water runoff starting frame off-site sources, containing salts, fertilizers, oils, or any other non-point source of pollution. Screening necessities for potential contaminants which may affect the capacity of the venture to meet plan and working criteria, or posture potential dangers to natural life or human wellbeing and safety.

Climate: (Plans, 2007) a. Climatic conditions that will influence development and operation and upkeep methods such as: sum, rate, and dissemination of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; and likelihood of intemperate tidy or sand. b. Number of days of ice within the range of the venture location. c. Evaporation - Yearly net vanishing rates and month to month dissemination. Incorporate normal month to month wind speeds, extraordinary wind speeds and winning headings.

2.2. Empirical Experience

2.2.1. Sustainable development

Research and Development

It is estimated that Zimbabwe is endowed with 1.28 million hectares of wetland areas and 20% of these are in the communal areas. Prior to colonization and the enactment of the Land Apportionment Act, indigenous farmers cultivated wetlands and were successfully producing crops as rice, maize, cleus esculentus and vegetables. Evidence of wetland

cultivation is available from notes by early travelers, folklore and remnants of ridge and furrow landforms.

The utilization of these ecosystems is now governed by the Natural Resources Act and the Water Act, which seek to protect them from degradation particularly through cultivation. The enactment of these restrictive pieces of legislation was a reaction of the Government to the mismanagement of these ecosystems by settler farmers who sought to cultivate wetlands conventionally for purposes of growing crops as maize, wheat and tobacco. Since these crops do not grow well in areas with high water tables, drainage lines were installed, which caused the drying up of wetlands, soil erosion and the siltation of rivers and dams. Wetlands were then classified as being unsuitable for cultivation and are currently designated as grazing areas. Only in very special but rare cases is permission granted for a farmer to cultivate wetlands by the Natural Resources Board which is the authority with the responsibility to administer the legislation.

Currently wetlands and their related catchments continue to degrade at an alarming rate and the cultivation of wetlands is increasing without the granted permission from the Board. Such encroachment through cultivation, in the absence of technical guidance or traditional experience which has since been forgotten by many, can only result in increased damage.

Research has trailed behind mainly because of the misconceptions, ignorance, fear to destroy wetlands and the restrictive legislation imposed by the administrators. Very limited research was done on wetlands in the past and the need for gathering information on the management of these ecosystems is obvious and long overdue. It must be realized that, whilst the pieces of legislation are restrictive, their relaxation in the absence of appropriate utilization guidelines based on sound and proven scientific principles would be an act of irresponsibility which could worsen the current situation.

Current researchers have the task to develop an understanding of the processes that operate within the ecosystems (catchment-wetland-stream) and thereby formulate management techniques that enhance the conservation and utilization of these natural resources for the benefit of communities. It is imperative to conduct these studies in a systems approach with the full participation of farmers wherever possible or appropriate.

Results from recent/current research have shown the following:

- Dambos in Zimbabwe are derived from two main parent materials: granite and dolerite. Those derived from granite are less fertile than those from doleritic material;
- most wetlands associated with the basement complex have two water tables: perched and temporary, deep and permanent;
- For most wetlands the condition of the catchment area determines the wetness of the wetland into which it feeds its run-off and seepage. Improving infiltration in the catchment area increases the wetness and its duration in the wetlands;
- wetlands can be cultivated safely using the Ngwarati Cultivation System which consists of broad-ridges and broad-furrows where upland crops are grown on ridges whilst rice or other crops tolerant to waterlogged conditions are grown in the furrows;
- the Ngwarati system ensures high crop yields, controls erosion, raises the water table in the wetlands, traps nutrients and removes debris from the water that passes through the system into the drainage system (reduces siltation of the drainage system);
- the majority of wetland soils are acidic and do respond to liming;
- It has been observed from pilot schemes that farmers are very keen to participate and contribute to wetland research. Adding value to wetlands through cultivation raises the interest of farmers in natural resource management.

Researchers on wetlands

Research on wetlands is being carried out by a number of institutions and individuals in Zimbabwe. Some of these institutions include the Lowveld Research Stations, the Agronomy Institute, the Horticultural Research Institute and the Chemistry and Soil Research Institute in the Department of Research and Specialist Services. Others include the Department of Natural Resources, several departments at the University of Zimbabwe and IUCN.

Research in the Department of Research and Specialist Services is coordinated by the Lowveld Research Stations and is focused on developing an understanding of the processes in the wetland ecosystems and on formulating management options for the conservation

and utilization of wetlands on a sustainable basis. Current research is being carried out on-station at Makoholi Experiment Station and The Horticultural Research Centre and on-farm at pilot sites in Seke and Guru Communal areas. Monitoring is being carried out on a wide range of physical, chemical, biological and socioeconomic factors that are relevant to the management of wetlands.

Research in the Department of Natural Resources is carried out by the Research and Technology Branch (RTB). There are two main researches that have been carried out by RTB: inventorying / mapping of wetlands and the application of environmental economics. Research in the area of the application of satellite remotely sensed data for inventorying and mapping was carried out in Mashonaland East Province, while research in the application of the environmental economics in management of natural resources was carried out in the Mashonaland Central Province. The research focused on the application of natural resources valuing technique to enhance policies that affect the management of wetlands.

Currently research is being carried out in the area of soil moisture regimes and spectral variations in the wetlands. The research is expected to enhance inventorying and mapping capabilities of the wetlands as well as the vegetation that is associated with them. Landsat TM satellite imagery, a spectroradiometer and global position systems are being used in the research.

It is expected that results from these and other studies will be useful in the review of the current legislation.

Constraints

Some of the constraints in the research of wetlands in Zimbabwe are:

- inadequate funding for operations
- lack of appropriate equipment
- lack of appropriate infrastructure/support services for field research
- limited trained personnel for long term multi-disciplinary research

Research needs

Future research is being directed at analyzing appropriate methodologies of utilizing dambos with the aim of assisting the Natural Resources Board (NRB) and Department of Natural Resources (DNR) in the process of exempting the communities and or individuals who might want to utilize wetlands. Currently the NRB under the Natural Resource Act can allow individuals or communities to utilize the wetlands after the DNR officers have conducted field analysis of the wetland to be utilized. The capacity for this analysis needs to be sharpened and supported with scientific and technical information generated through research.

Some of the research needs are:

- funding
- equipment (field, computer and software)
- transport
- technical expertise as backup
- increased capacity for analytical laboratories

2.2.2. Empirical experience in Fadamas Seasonally flooded depressions of Northern Nigeria

In northern Nigeria, for example, seasonally flooded depressions known as ‘Fadamas’ have supported the livelihoods of hundreds of thousands of smallholder farmers for generations (Tarhule and Woo 1997; Dan-Azumi 2010; Tanko 2013), while similarly across central and southern Africa ‘dambos’ continue to support water provision, fishing, grazing, seasonal agriculture and wild plant collection (Whitlow 1983; Bell et al. 1987; Roberts 1988; Wood and Thawe 2013).

A critical prerequisite to resilience is adaptive capacity, which in ecological systems is linked to biodiversity and the heterogeneity of landscapes, while in social systems it is enhanced through knowledge diversity, social networks and institutions (Berkes et al. 2003).

Within this context the key challenge for Africa’s critically important smaller wetlands becomes arguably less about how to conserve and protect them from people, and more

about how to ensure their ecosystem services and livelihood benefits can be sustained for the future in the face of numerous shocks and pressures. Rapid population growth, socio-economic change, and the prevalence of government policies that uncouple economic growth and poverty reduction from environmental concerns present such challenges to which local wetland users must adapt. Indeed, with wetlands in Africa already becoming a ‘new agricultural frontier’ (Dixon and Wood 2003; Maconachie et al. 2009) wetland use has itself emerged as an adaptive strategy to land shortages, land degradation and a decline in the quality and quantity of rain-fed harvests in upland farmland.

At Applied Resource Management, one of our areas of expertise is wetlands delineation. This is process during which we determine whether and where wetlands are located on a property and, if the answer is “yes,” make recommendations about how to continue with your project in a safe and environmentally responsible way. (Curious about what wetlands are and why they’re important? You’re in luck—we covered this in a previous blog post!)

If you have wetlands on your property, it’s important not to view them as a problem. In reality, your wetlands are an opportunity to help preserve the fragile ecosystems that support certain plants and animals. Below are five ways to help your wetlands survive and thrive, and to become a steward of the environment in the process.

1. Maintain a buffer strip of native plants along streams and wetlands.

A buffer will stabilize the stream bank, prevent erosion, and improve the health of the wetlands. Native plants are also more resistant to disease, which means you don’t need to use pesticides or fertilizers to help them thrive—in general, they have everything they need!

2. Use pesticides and fertilizers sparingly.

Speaking of lawn care aids, try to avoid them whenever possible. The chemicals these products contain can harm wildlife and aquatic life, and negatively impact water quality, especially downstream. If you have pest problem, opt for natural products such as soap or plant-based insecticides. You can also mulch using lawn clippings and leaves instead of fertilizer. Not only are they better for your wetlands, they’re also free!

3. Avoid non-native and invasive species of plants.

Non-native plants have had a devastating effect on wetlands worldwide. They can quickly become invasive, choking out the native species and altering the way the wetlands function. If you see non-native plants moving in, remove them immediately. And if you're thinking about planting something exotic because it looks cool, don't. There are plenty of beautiful native species to celebrate and embrace—nurture those instead, and enjoy a healthier environment as a bonus.

4. Avoid storm water run-off and don't pollute.

Wetlands need plenty of water to thrive, and much of that is supplied by storm water—especially in urban areas. If you live near or on wetlands, your storm water feeds into it. This is why it's so important to keep storm water clean, not just for the wetlands on your property, but for any wetlands that might be located downstream from where you live or work. Basically, if you wouldn't want to swim in it, then don't throw it down a storm drain!

5. Keep your pets under control.

We love animals and understand that dogs and cats are more than just pets—for many of us, they're a part of our families. That said, animals can wreak havoc on wetlands and the wildlife populations that live there. The only way to keep all lives—animals and otherwise—safe is to make sure dogs and cats don't have access to your wetlands. Keep dogs leashed or fenced in, and make sure your cats stay indoors as much as possible.

2.2.3. How can recreational values save wetlands in urban areas in Kampala city, Uganda?

Recreational opportunities and amenities are important human-use services generated by urban open spaces. However, empirical evidence on the magnitude of monetary values of these services is hardly available, in fact, anecdotal if any, in developing countries. Historically the Nakivubo wetland has provided a valuable natural service of filtering polluted water from Kampala City before the water reached Murchison Bay (part of Lake Victoria). With rapid urbanization around the city center, the construction of a railway line through the wetland, and the development of informal settlements in the wetland, the amount of waste entering the wetland is now exceeding its capacity to process polluted water, causing severe degradation. Thus there is a need for rehabilitation. However, the

benefits of rehabilitated open green spaces and the demand for these spaces as recreational areas are poorly understood by the government, especially considering the potential services an open green space can provide in developing countries.

In a recent study, *Bayesian analysis of demand for urban green space: A contingent valuation of developing a new urban park*, led by EfD researcher Jane Turpie the recreational value of developing a new urban park from the currently degraded Nakivubo Wetland in Kampala City, Uganda was investigated. This research comes from a larger World Bank-funded study carried out by Anchor Environmental, which focused on investigating green urban development in Africa and highlights the potential costs and benefits of restoring and maintaining green open space areas in Kampala, Dar es Salaam and Durban. In Kampala, the study focused on rehabilitating the Nakivubo wetland located between the city center and Lake Victoria's Inner Murchison Bay. Using contingent valuation methods (CVM) the researchers could more precisely estimate urban dwellers' willingness to pay (WTP) to access and utilize the recreational services the restored wetland would provide.

“One of the key messages of the study was that, although justifiable in economic terms, fixing the mess made of this urban wetland will be very costly, and so Kampala needs to put very strong measures in place to prevent its other major wetlands from going the same way,” says Jane Turpie.

Providing benefits to urban residents

The researchers found that Kampala residents are willing to pay on average USH14184.538 (\$4.728) per household as an entry fee to use the rehabilitated wetland for outdoor recreation. More importantly, the study found that the majority of residents surveyed thought they would use the proposed urban open space regularly. Residents saw an urban park would improve their health and wellness through outdoor recreation as well as the opportunity for socialization. Overall the proposed urban park would improve urban resident's welfare.

“Kampalan residents have very few options for outdoor recreation, and so people have to spend hours in the traffic to get to locations that are on the outskirts of the city. If healthy,

Nakivubo wetland could offer a wonderful opportunity for the development of an outdoor recreation area close to the city center,” Jane Turpie explains.

Informing decision-makers

Positive willingness to pay estimates provide valuable information to the local government showing that urban dwellers value and appreciate open green spaces. Additionally, positive WTP justifies the potential cost of rehabilitating Nakivubo Wetland, especially when in competition with other city demands.

According to the researchers, this study helps highlight the benefits of urban open space(s) and prioritize conservation efforts from a public perspective. The studies’ estimate of WTP acts as an instrument to inform policymakers of the potential in urban parks.

“This will hopefully push local government to prioritize preventing the decline, and/or the rehabilitation, of open green spaces,” says Jane Turpie.

2.3.Green space

2.3.1. Definition of green space

Green spaces are an area of grass, trees, or other vegetation set apart for recreational or esthetic purposes in an otherwise urban environment. Green spaces are the ‘green lungs’ of our towns and cities which contribute to improving people’s physical and mental health by providing places for informal recreation walking, cycling, sitting, socializing and children’s play and ‘breathing spaces’ to take time out from the stresses of modern life. They include not only areas to which the public have physical access, but also visual access, for example, in the way green spaces provide setting for building, communities, and everyday activities.

European context, the green space definition includes the function, user category, accessibility and its impact on quality of life.(Access, n.d.)

United Kingdom context elaborates green spaces in terms of its physical characteristics, function performed, perceived benefits availed and about physical and visual accessibility.(Access, n.d.)

Indian context green space is considered for provision in the terms of accessibility and connectivity. According to above discussion the green space might be understood as.

Green spaces are those planned open spatial layouts with visual and physical. Accessibility in a residential community, which are committed to guarantee services including passive and active recreation. As an impact interface they can enhance social cohesion, feelings of safety security as also other perceived benefits to all users.(Access, n.d.)

the term ‘green space’ also used ‘blue space’, ‘green area’, ‘greenery’, ‘green belt’, ‘green environment’, ‘green network’, ‘green infrastructure’, ‘green roof’, ‘urban green’, ‘nature’, ‘parkland’, ‘urban forest’, ‘urban parks’, ‘urban gar-den’, ‘urban farm’, ‘walkable area’, and ‘woodland’.(Taylor & Hochuli, 2017)

2.3.2. **Types of green spaces**(England, 2020)

- Public parks and gardens – including urban and country parks, and formal gardens
- Private gardens or grounds – private gardens and school and institutional grounds
- Amenity green space – residential, business and transport amenity space, including communal recreation spaces, domestic gardens, informal recreation space, green space around housing, town and village greens
- Play space for children and teenagers
- Sports areas – playing fields, golf courses, tennis courts, bowling greens and other sports areas
- Green corridors – green access routes including green cycle ways, and routes along canals and rivers
- Natural and semi-natural green space – woodland, open semi-natural, open water, beach, foreshore or manmade
- Allotments and community growing spaces
- Burial grounds – churchyards and cemeteries
- Other functional green space camping and caravan parks, and areas undergoing land use change

2.3.3. **Benefits of green space**

Green Space symbolize peace, minimal stress and a cleaner environment for many people, which are considered as important factors in making a city livable, pleasant and attractive for its citizens and guests.

The significant benefits obtained through urban green space, are categorized under two perspectives tangible and intangible. Tangible benefits include ecological benefits (absorbing pollutants, clean air, improve the urban climate, etc.), planning benefits (network linking, improving accessibility, noise barrier, visual screening and safe walking and recreational) and economic benefits (Comparing with other landscape elements, neighborhood parks induced the heaviest investment intention in the home buying behavior).(Access, n.d.)

Likewise, the intangible benefits include social benefits (Opportunities for people of all age groups to interact, encourages volunteerism, promotes stewardship, help individuals with disabilities, enhance cultural life by providing venues for local festivals, civic celebrations, and theatrical performances, reduces crime, strengthens community by reflecting the different communities they serve and meeting their varying needs) (Access, n.d.)

Social Benefits of Green Spaces

Social benefits of green spaces are related to leisure and recreation, the facilitation of social contact and communication, access to and experience of nature, issues influencing human physical and psychological health and well-being and overall sustainability. These social benefits are measured in terms of aesthetic value, qualitative living environments, and the positive perception of residents with regard to urban green-space-values, enhanced community cohesion and common interest as a result of green public spaces. Human health and mental health are also part of the social benefits of green-spaces and research in environmental psychology suggested that contact with nature serves psychological restoration. The proximity and accessibility of green spaces in relation to residential areas appears to affect the overall levels of physical activity. Research furthermore proofed the restorative effects of green spaces in terms of stress relief, happiness versus aggression and especially the positive social impact on children. Green spaces also contributes to enhanced community cohesion, social interaction, lowers levels of fear, less aggressive behavior, and better neighbor relationships.(Cilliers, 2017)

Recreation and Wellbeing

People satisfy most of their recreational needs within the locality where they live. Findings by Nicol and Blake (2000) show that over 80% of the UK's population live in urban areas, and thus green spaces within urban areas provide a sustainable proportion of the total

outdoor leisure opportunities. A study conducted in Helsinki, Finland, indicated that nearly all (97%) city residents participate in some outdoor recreation during the year. Half of the residents make outdoor visits on a daily basis or every second day. Urban green spaces serve as a near resource for relaxation; provide emotional warmth. In Mexico City, the centrally located Chapultepec Park draws up to three million visitors a week who enjoy a wide variety of activities. (JEP, 2011, 2, 601-608)

Human Health

People who were exposed to natural environment, the level of stress decreased rapidly as compared to people who were exposed to urban environment, their stress level remained high. In the same review, patients in hospital whose rooms were facing a park had a 10% faster recovery and needed 50% less strong pain relieving medication as compared to patients whose rooms were facing a building wall. This is a clear indication that urban green spaces can increase the physical and psychological wellbeing of urban citizens. In another re-search conducted in Swedish cities showed that the more time people spend outdoors in urban green spaces, the less they are affected by stress. Certainly, improvements in air quality due to vegetation have a positive impact on physical health with such obvious benefits as decrease in respiratory illnesses. The connection between people and nature is important for everyday enjoyment, work productivity and general mental health. (JEP, 2011, 2, 601-608)

Environmental Benefits of Green Spaces

Environmental benefits provided by green spaces include ecosystem services and ecological systems that provide a myriad of services to human societies and in terms of enhanced biodiversity. It relates to storm water management and providing habitats for wild plants and animals. Various studies have been conducted internationally, focusing on street tree costs (tree planting, irrigation and other maintenance) versus calculated benefits (energy savings, reduced atmospheric carbon dioxide, improved air quality, and reduced storm water runoff), to estimate net benefits of green spaces. Green spaces contributes to reducing pollution and enhancing air quality, microclimate and heat island effects and noise reduction. Green areas can reduce noise pollution and the visual intrusion from traffic. The greatest environmental benefit of green spaces is the impact on biodiversity and providing refuge to species that are disappearing from urban areas.(Cilliers, 2017)

Ecological Benefits

Urban green spaces supply to cities with ecosystem services ranging from maintenance of biodiversity to the regulation of urban climate. Comparing with rural areas, differences in solar input, rainfall pattern and temperature are usual in urban areas. Solar radiation, air temperature, wind speed and relative humidity vary significantly due to the built environment in cities. Urban heat island effect is caused by the large areas of heat absorbing surfaces, in combination of high energy use in cities. Urban heat island effect can increase urban temperatures by 5°C. Therefore, adequate forest plantation, vegetation around urban dweller's house, management of water bodies by authorities can help to mitigate the situation. (JEP, 2011, 2, 601-608)

Pollution Control

Pollution in cities as a form of pollutants includes chemicals, particulate matter and biological materials, which occur in the form of solid particles, liquid droplets or gases. Air and noise pollution is common phenomenon in urban areas. The presence of many motor vehicles in urban areas produces noise and air pollutants such as carbon dioxide and carbon monoxide. Emissions from factories such as sulphurdioxide and nitrogen oxides are very toxic to both human beings and environment. The most affected by such detrimental contaminants are children, the elderly and people with respiratory problems .Urban greening can reduce air pollutants directly when dust and smoke particles are trapped by vegetation. Re-search has shown that in average, 85% of air pollution in a park can be filtered.

Noise pollution from traffic and other sources can be stressful and creates health problems for people in urban areas. The overall costs of noise have been estimated to be in the range of 0.2% - 2% of European Union gross domestic product. Urban green spaces in over crowded cities can largely reduce the levels of noise de-pending on their quantity, quality and the distance from the source of noise pollution. In the contemporary studies on urban green spaces consider the complex urban eco-system, conservation of the urban green spaces to maintain natural ecological network for environmental sustainability in cities. For the cities in fast urbanizing and growing economy, country like China should consider the dynamic form of urban expanding to manage effective urban green spaces which will contribute to reduce the overall CO₂ by maintaining or even increasing the ability of CO₂ absorption via natural eco-system. (JEP, 2011, 2, 601-608)

Biodiversity and Nature Conservation

Green spaces do functions as protection center for re-production of species and conservation of plants, soil and water quality. Urban green spaces provide the linkage of the urban and rural areas. They provide visual relief, seasonal change and link with natural world. A functional network of green spaces is important for the maintenance of ecological aspects of sustainable urban landscape, with greenways and use of plant species adapted to the local condition with low maintenance cost, self-sufficient and sustainable. (JEP, 2011, 2, 601-608)

Economic Benefits of Green Spaces

The economic benefits of green spaces relates to the economic and financial gain as a direct result of the provided green space, including aspects such as a favorable image for a place, the boost retail sales, increased tourism, enhance inward investment in the area, and encouraged employment (emphasizing the impact on production values). Economic benefits furthermore relate to the positive impact on property values, the value of open spaces and proximity of neighborhoods to natural areas. Research proofed that proximity to large protected natural areas have a positive influence on housing values. Research conducted on the outdoor environmental quality that contributes to house-buyers preferences were linked to the findings of that concluded that natural parks have the largest statistically significant effect on home sale prices. Proximity to open-space was found to have a statistically, significant effect (positive) on a home's sale price and houses that were within one half-block of any type of open space were estimated, on average, to experience the largest positive effect on their sale price . In addition the value of proximity to open space was higher in neighborhoods that were dense, near the CBD, high-crime or home to many children.(Cilliers, 2017)

Energy Savings

Using vegetation to reduce the energy costs of cooling buildings has been increasingly recognized as a cost effective reason for increasing green space and tree planting in temperate climate cities. Plants improve air circulation, provide shade and they evapo transpire. This pro-vides a cooling effect and help to lower air temperatures. A park of 1.2 km by 1.0 km can produce an air temperature between the park and the surrounding city that is detectable up to 4 km away. A study in Chicago has shown that increasing tree cover in the city by 10% may reduce the total energy for heating and cooling by 5 to 10%. (JEP, 2011, 2, 601-608)

Property Value

Areas of the city with enough greenery are aesthetically pleasing and attractive to both residents and investors. The beautification of Singapore and Kuala Lumpur, Malaysia, was one of the factors that attracted significant foreign investments that assisted rapid economic growth. Still, indicators are very strong that green spaces and landscaping increase property values and financial re-turns for land developers, of between 5% and 15% depending on the type of project. (JEP, 2011, 2, 601-608)

2.3.4. Planning concepts of green space

Depending on the benefits of green space for wellbeing there should be deep attention on the potential of natural environments which provide opportunities to enhance wellbeing in different ways: these are;

- Physical wellbeing through physical activity and fresh air.
- Mental wellbeing through stress reduction and attention restoration.
- Social wellbeing through social integration, engagement and participation.

2.4. Green infrastructures

Green infrastructure is a network of connected, high-quality, multi-functional open spaces, corridors and the links in between that provides environmental services and multiple benefits for people and wildlife. It is a network providing the ingredients in both rural and urban areas for solving urban and climatic challenges by building with nature, which underpins the sustainability and increases quality of life with its natural and ecological processes. The main components of this approach include storm water management, climate adaptation, less heat stress, more biodiversity, food production, better air quality, sustainable energy production, clean water and healthy soils, as well as the more anthropocentric functions such as increased quality of life through recreation and providing shade and shelter in and around towns and cities. This is usually divided into areas (parks, gardens, squares, etc.) and paths (streets, walkways, canals, etc.), which may surround the built environment.

CHAPTER -3 MATERIALS AND METHODS

This chapter presents different methodologies which are applied to gather relevant information about the study area which is finally help to organize and analyze the collected data in order to answer the research questions developed in chapter 1 and also to reach to conclusion and propose specific projects and present a final output. So the chapter covers the Data types and sources, materials as well as the methods.

3.1. Study Area Location and Description

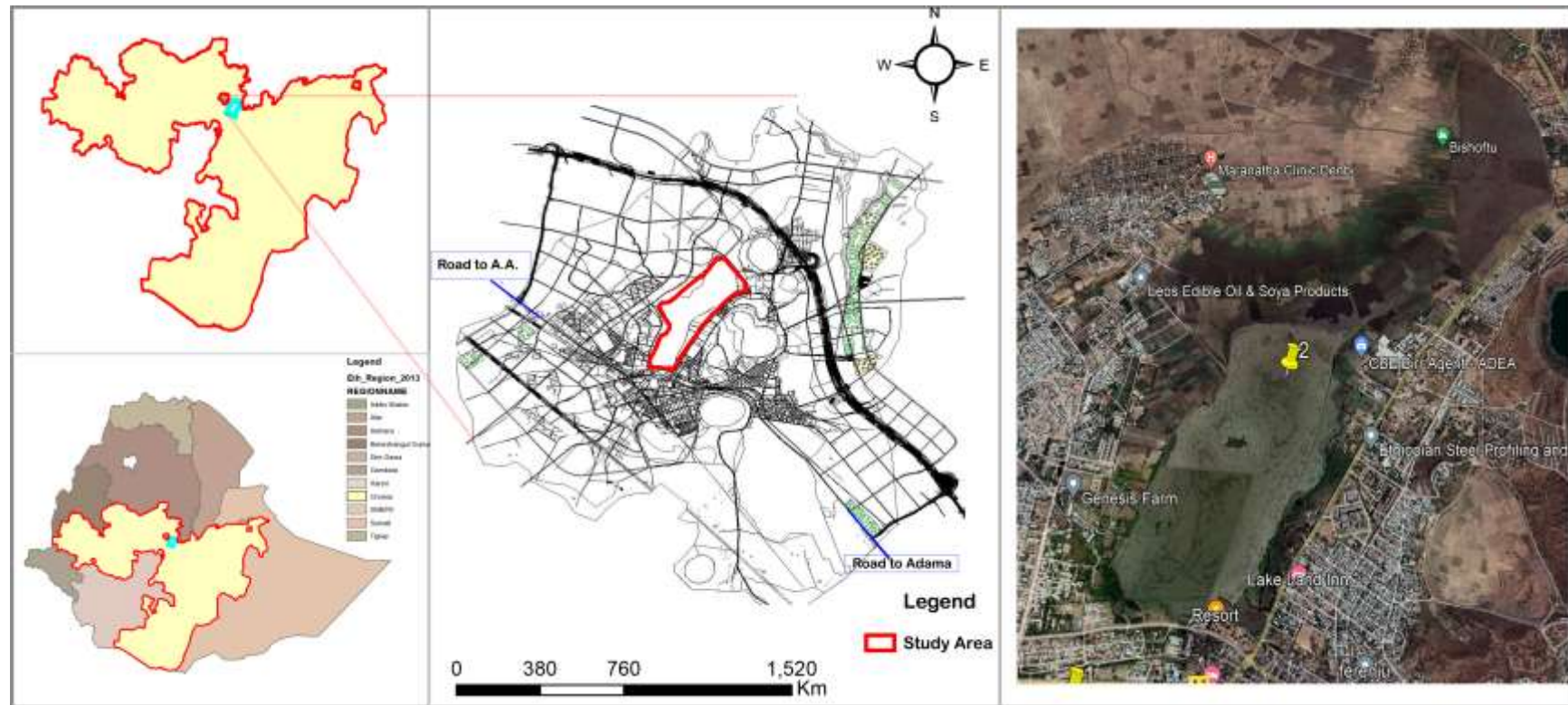


Figure 3.1. Study Area Location Map

Bishoftu is one of the worth note towns in the history of early urbanization process of the country in general and Oromiya in particular. It is one the pre-Italian town of the country. It is also one of the rail-way towns whose history is so fascinating. The town's topographical attraction and natural beauty such as the attractive lakes makes the area one of the top tourist attraction areas.

The town is located in area where there are a great number of cultural and historical sites. Important Gada sites that are essential in Oromo history and tradition are located in this area. It is currently its significance is realized by the government and **the town is listed as a number one tourist destination city** (Temesgen Gudina, 2009 G.C).

This is because, the town is located 47 km to the south from the capital Addis Ababa. In spite of its location the town is preferred for **different urban functions and spaces**. The analyses of the existing land use and town structure are divided in to: Street network and transport, Town centers, Social and municipal services, Environment, **Housing** and Manufacturing and storage.

Recreational functions, manufacturing functions and **urban agriculture** are the dominant preference apart from its healthy and attractive residential area.

The other figure of Bishoftu city is it is one of the most water bounded town. Most of the water bodies are the result of volcanic eruption. Some of the present lakes (Lake Babogaya, kuriftu, Bishoftu, Hora arsadi, Green Lake, Lake Hora Kilole and Lake Ziquala) are the results of these geological formations.

3.1.1. Topography

The topography of Bishoftu area is characterized by gently sloping off smooth topography which is often interrupted by rocky hills. As depicted in the figure below, the elevation of Bishoftu city varies from 2050 to 1879 meter above sea level (m.a.s.l). Generally the elevation of the mapped area decreases from Northern to Southern peaks towards East. With regard to wetlands of Cheleleqa elevation gently decreases from Northwestern to Southwestern parts of project area towards the lake. So Elevation varies from 1910 M.a.s.l at Southwestern periphery of the lake to 1888 m.a.s.l at

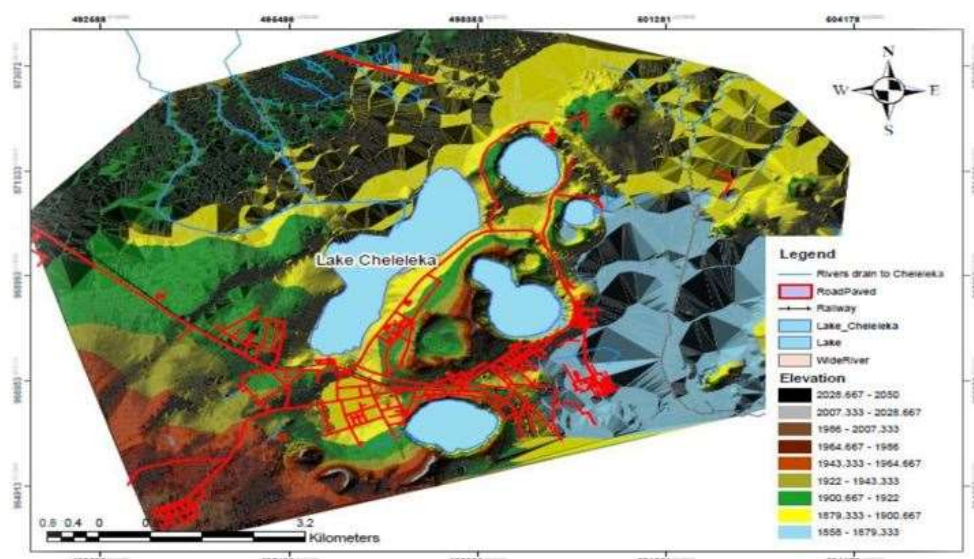


Figure 3.1.1. Topographic map of Bishoftu Town

3.1.2. Demographic Information

Population

The population of the city is rapidly mounting from year to year at an average growth rate of more than 2.9 % per annum. In urban environment, migration (rural to urban) / urban to urban/ has predominant role in changing the population characteristics and reflects the urbanization rate. Much of the population growth has been the result of internal migration and expansion of different pulling factors. The city has economically independent population accounts for about 70% and only 3.3% of the total population is above 65 years of age.

Table 3.1.2. Population in each kebele by sex

Kebele	Total Number of residence			Kebele	Total Number of residence		
	<i>Male</i>	<i>Female</i>	<i>Total</i>		<i>Male</i>	<i>Female</i>	<i>Total</i>
Genda Gorba	3,564	6,486	10,050	Hora Bishoftu	4,429	4,547	8,482
Gerbicha	5,790	5,309	11,099	Debaso	2,836	3036	4,193
Kajima and Dhibayu	2,511	2,273	4,784	Chaleleka	9,619	10,387	19,212

Kurkura and Dembi	5,601	5,360	10,961	Filtu	5,809	6,804	12,119
Kaliti	3,216	1,234	4,450	Biftu	9,970	9,734	19,210
Dire jitu	19,259	20,619	39,631	Keta	5,867	6,506	11,879
Kudada	11,159	12,672	23,338	Birbirs Foka	11,269	11,226	22,000
Total population					100,898	104,959	205,858

3.1.3. Socio Economic profile of Bishoftu Town

Social Services

Educational facilities available in the city

The existing data shows that 58 KGs, 31 first cycle (1-4), 36 second cycle (5-8), 10 secondary (9-10) and 2 preparatory schools (11-12) are available in the city. In addition to these facilities three universities (one governmental and two private), five colleges (four government and one NGO) are operating in the city. In the city, the provision of educational facilities is within the required diameters; especially the provision of elementary schools is at a very short distance from residences. The participation of private sectors on education service is very high and the significant number of educational institutions in the city are owned by NGOs and private owners. There are also one Poly Technique School and one TVET in Bishoftu. In 2007 a total of 47,704 students (22,558 males and 25,146 females) have attended school in the range of KG to Grade 12. The number of teachers in the indicated year was 5,645.

Health service

Different health facilities are currently, giving service in the city at 13 kebeles. When we see the distribution of these facilities, one government zonal hospital, one defense hospital, three government health centers, four government health posts, 24 private pharmacies, 26 private clinics, and one rural drug venders are available in the city. Because of the above health service facilities the health coverage of the city is 69.8 percent.

According to the information obtained from the Bishoftu city administration health office (2007 E.C) 326 health personnel with different level of education and fields of specialization are giving service in different government and private health organizations respectively.

Housing service

The existing houses are also below standard and with low quality that damages the social health and reduces aesthetic view and beautification of the city. The majority of the houses exist at old residential areas and center of the city are a shanty and slam houses because majority of them are kebele houses those which have been very aged and dilapidated that necessitate maintenance and upgrading services.

The existing data indicates that 2228 condominium houses were constructed and transferred for beneficiaries. In addition to these houses, 7078 kebele houses and 665 are those managed under housing department with different standards are available in the city.

Economic sector development

Trade

In Bishoftu city, trade is the most dominant source of economy in terms of people engaged in. That means the city economy is mainly depended on trade and other business activities. Increasing population size, growing investment activities and high flow of tourists have created the favorable conditions for business to flourish in Bishoftu. Furthermore, the city administration has given due attention for the expansion of modern market centers and the upgrading of the existing market centers to create favorable environment for trading activities. The data obtained from Bishoftu city trade office reveals that 21 whole sellers, 6,704 retailers, 2,439 service trades, 314 industries and 146 other types of trades exist in the city.

Investment activities

The existing data indicates that 175 local and 40 foreign operational investments with a total investment capital of 4,025,728,924.3ETB are currently operating in the city. These investments have created employment opportunity to 25,296 people, of which 17,635 are permanent and 7661 are temporary.

Moreover, 134 local and 9 foreign investment projects are under construction with a capital of 1,801,659,221 ETB and expected to be implemented in the near future. In these ongoing projects, 13,494 people have obtained job opportunity permanently and temporarily.

Urban agriculture

Bishoftu city and the surrounding areas have favorable climatic condition and agro ecological soil type for the development of agricultural sector as the urban economic activity. Because of these facts, urban agriculture is widely practiced in the city as a major occupational activity for many dwellers and even by different organizations as investment intervention.

The major crops produced in surrounding kebeles of the city cereals such as maize, sorghum, teff, barley, wheat, maize. Moreover, fruit and vegetable are mostly produced in and around the city. Regarding irrigation, the land under local irrigation is about 397 Hectare and 684 male and 110 female farmers utilized it during the year 2007. From this, around 133,690 quintals of various types of vegetables were produced. The major types of vegetable produced are cabbage, tomato, pepper, red root, onion, potato, and other.

As summarized in the following table, the city had a total of 38,895 lives stock's in 2007. Moreover, there were about 15,583 poultry (12,365 improved breed and local breed 3,218 local breed) in the city in 2007.

Table 3.1.3. Summary of active MSE's in the city administration (2010)

Sector of enterprise	Members by sex			Total No. of association	Capital
	Male	Female	Total		
Manufacturing	593	427	1020	229	25,290,847
Urban Agriculture	195	165	360	85	10,392,511
Fattening and animal husbandry	364	254	618	120	3,678,845
Quarry /Mine	280	168	448	17	168,211
Services	744	667	1411	317	6,326,041
Trade	327	331	658	195	10,176,938
Construction	445	140	585	159	108,174,847
Total	3624	2472	6096	1122	164,208, 239

Source BCAJOFS office

3.1.4. Biological Environment of Wetlands of lake Cheleleka

Cheleleka is a wetland of importance to both the surrounding people and wildlife. It is a seasonally inundated pan which often attracts large numbers of water birds. The lake was well known for being seasonal home for thousands of birds and flamingos from September to March which are known for their recycling migration in eastern Africa. Flamingoes were often seen here, and in the European Winter there are Common Crane and many palearctic ducks and waders. Birds seem to use it as a staging post in their journey south during the autumn migration when the lake is at its fullest. The water level is high from September to February and the lake and swamp used to accommodate large numbers of both resident and Palearctic birds. The practice of capturing wildfowl, especially Egyptian Geese, to sell to non-Ethiopians was going on for many years. There is also information that a few people come and hunt coot and ducks from this swamp and from Lake Hora. However, the majority of Ethiopians follow the Orthodox Christian or Muslim faiths which prohibit the eating of water birds.

Because of its shallow nature, the shoreline is wide, unlike most of the crater lakes. At the end of the rainy season, one can see Widow Birds and Weavers displaying over the vegetation where they make use of these plants to build their nests in the few trees remaining around Cheleleka Lake.

According to EWNHS IBA Survey (1996) Cheleleka Lake and its wet land is recognized as an IBA under categories 1(Globally threatened species) and 4 (Congregations). The area is estimated to hold more than 20,000 water- birds seasonally. The site also supports substantial populations of a number of other water bird species. An EWNHS IBA Survey in February 1996 recorded substantial numbers of Little Grebe (150 +), Cattle Egret (1,800 +), Lesser Flamingo (3,000 +), Egyptian Goose (1,000+), Spur-winged Goose (250 +), Red-knobbed Coot (300 +), Ruff (500+), Pintail (300+), Garganey (200 +), Northern Shoveler (500 +), Southern Pochard (150 +), as well as smaller numbers of Pygmy Goose and White - backed Duck. There is also one record of White-tailed Plover. Imperial Eagle and Lesser Spotted Eagle have been reported during autumn migration. Other Palearctic migrant species include Sedge Warbler and European Marsh Harrier.

3.2. Research Design

The study is project based research, which needs a design-based solution. As mentioned in the previous session the research is to develop Green space which create a healthy interaction of society to the urban wetland. The study analyzed different journals which is recently published in order to adopt different strategies for sustainable development of green space on natural wetlands especially wetlands which is created by a seasonally flooded lake. After analysis, the study proposes different programs regarding the principles of Green space.

Therefore, in order to achieve the objectives of the study the following research design has implemented.

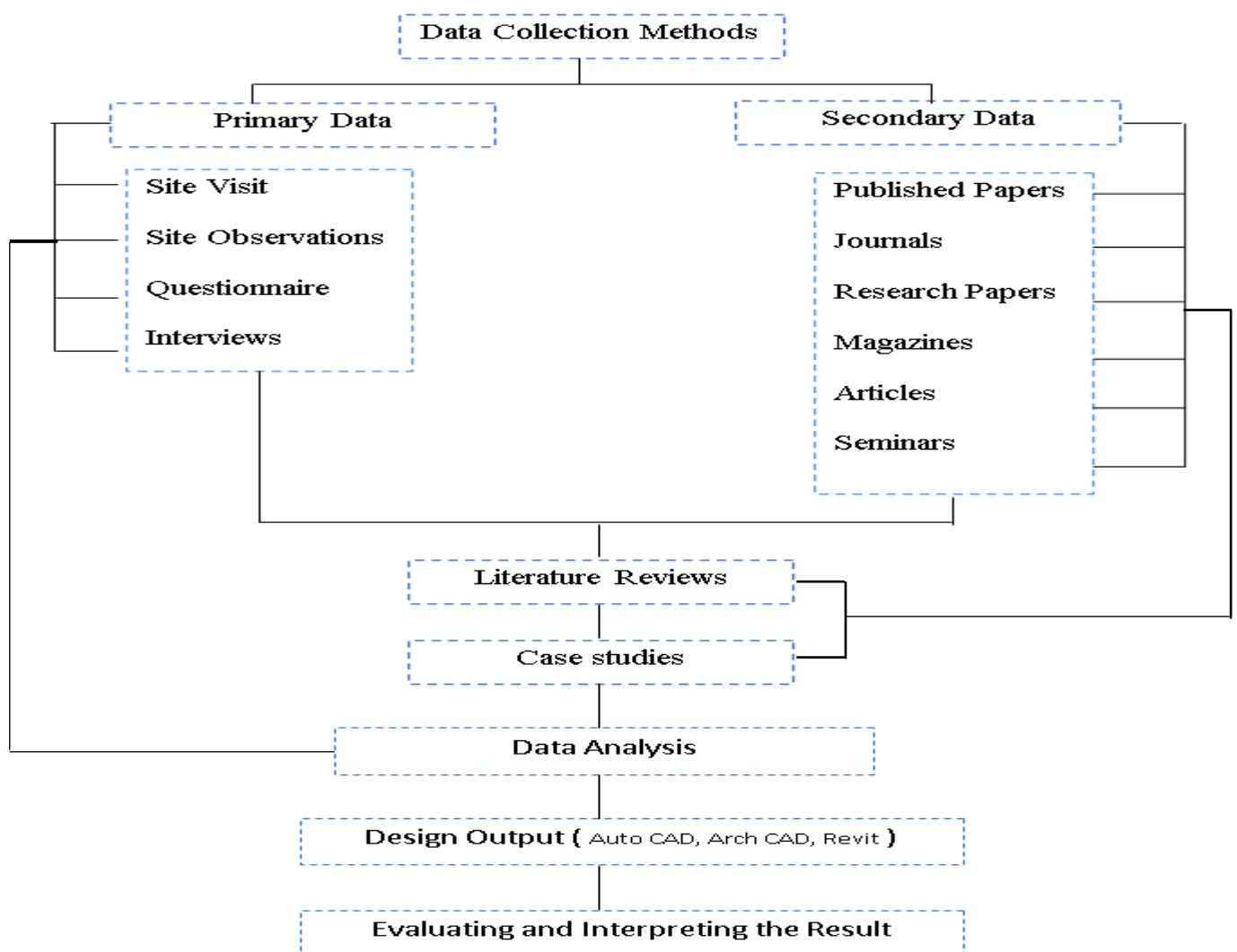


Figure 3.4. Illustration of the fieldwork structure and data collection

3.3. Data collection and sources of data

The source of the data for this study is from two data sources which is; primary and secondary. The primary data is collected from site observation, questionnaire and interview. The second data source is from Bishoftu Town administration office and Bishoftu town urban water supply and sanitation project office. These Data are; Land use map of Bishoftu Town, different studies on Cheleleka Lake, Structural Map of Bishoftu town and Bishoftu Drainage Base map.

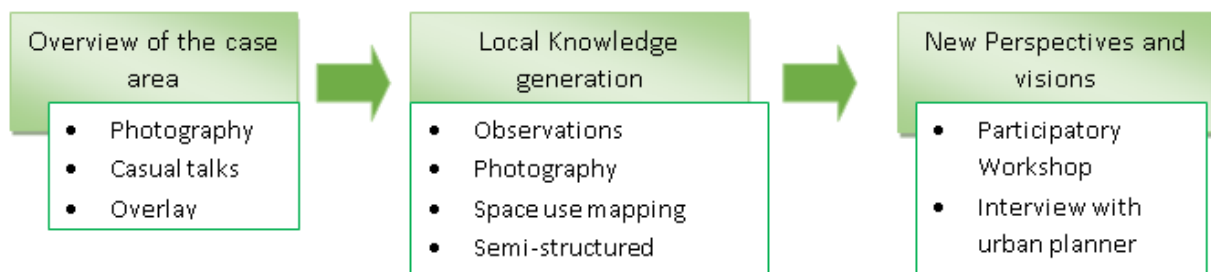


Table 3.2.1. Data used to achieve the intended objectives

Data type		Purpose	Source
Secondary	Land use map Structural plan	Helps to determine the current and future development of the town	Bishoftu Town Administration
	Drainage base map	To differentiate the basic source of storm water of the town to the project area	Bishoftu town urban water supply and sanitation project office
	Satellite Images	For site map, for previous and current status of urban development, Vegetation coverage and Wetland status of the site.	USGS Satellite Imagary
Primary	Photograph	Shows the current condition of the site	Observation
	Questionnaire and Interview	Asses the basic activities of the society and site	Society

3.4. Sampling size and techniques

Due to undefined population size and nature the study has used random sampling method to collect reliable data. Therefore during the field survey 50 participants who were permanent and temporary user of the wetland were selected. Permanent user was the land owners who perform different activities on the buffer line of the wetland, and the temporary users were the people who used to stay at the site for different activities from different Kebeles.

And the study area sample is taken within 700 m from the wetland including its buffer zone to the surrounding neighborhood areas which includes infrastructures like Existing Roads, residential areas and surrounding activities within the radius.

3.5. Data analysis and method

The method used to analysis the data collected from both primary and secondary sources should be clearly stated. To assess the existing condition of the wetland is analysis is made as followed

The environmental analysis of the study area was analyzed from areal satellite image of the study area.

The data which is collected from the structural plan and Satellite image from Google Earth and USGS satellite imagery basically the physical analysis which is taken from the Google earth (from Year 2005-2021) like the change of urban development, vegetation coverage, the wetland coverage and existing roads were identified and visually characterized and thereby mapped using AutoCAD software .

The land use of the study area for each period (2000,2005,20015 and 2021) which is obtained from USGS satellite imagery were dereference using GIS to the coordinate system of the study area. Each land use type for each year was digitized using Arc GIS to calculate the area of each land use type.

The different time serious image were classified using supervised classification with maximum like hood classifier algorithm; land use and land cover is analyzed using

ERDAS-2015 software and then classified to land use (Farmland, Forestland, Urban land, Water body and Grassland).

The data which obtained from the questioners conducted were analyzed and interpreted quantitatively using graphs and charts. The wetland cover change is analyzed from satellite image which is taken from Google Earth converted to the AutoCAD software with the exact measurement in order to show the expansion of the built up spaces. The area is analyzed from the Google earth. The time interval which is from the year 2005 to 2021 is chosen because of lots of infrastructural developments around the wetland is constructed the major ones are Ethio-Djibouti railway line, and Addis Ababa to Adama highway road.

Identification of Negative factors of wetlands of Lake Cheleleqa which is adopted from questioner and interview survey was collected from 50 respondents which is selected randomly from the site. This is done in and around the wetland from those people who has owned a land around the wetland and who have used the wetland directly or indirectly. And then the data was analyzed in excel format.

So that recommendations can be developed from interpreted results and used as inputs for the Green space developments.

Finally the proposed design is interpreted using different Software like AutoCAD, ArchiCAD, Sketch up.....and others.

CHAPTER -4 RESULTS AND DISCUSSION

4.1. Background of the Respondents

This section focuses on the presentation and analysis of fundamental characteristics of the sample respondents. These include the principal demographic variables such as Age, Gender, educational background, marital status, Religion and occupation.

The survey had a total of 50 respondents from the field survey. Most of the respondents were male (84% or n=42) and 16% or n=8 were female. So these shows unhealthy use of wetland depending on gender. These is because of different reasons maybe the comfort, safety and accessibility of the area.

Out of the 50 respondents 48% which is 24 respondents were between the ages of 21–30 years and most of them 70% are not married. These shows the primary user of the wetland area are teens. These also shows there is no compromised access to the adults, kids and also aged people. Almost all the respondents lives in the town but they came from different Kebeles like 20% from Kebele 01,16% from kebele 02, 12% from kebele 03, 8 % from kebele 04,20% from kebele 05, 10% from kebele 06, 6% from kebele 07, 4% from kebele 08 and 2% from kebele 09.

The education status of the respondents were 86% of the respondents attend formal school.20% of the respondents came to the wetland to work ,50% came to enjoy and relax, 20% to visit and 10% to take photographs for different purposes like doing researches, for photo contest and for brochure and magazine preparation.

Out of the 50 respondents 10% were farmers (wetland based), 10% government employees, 30% students and 50% who owned a private job. Most of the respondents (66%) who came to relax or enjoy the view they choose the afternoon time, but when we come to the farmers and the shepherds they stay on the place all day long from 3:00 – 11:00 O'clock. Figure shows survey analysis of respondent's information and participation by charts.

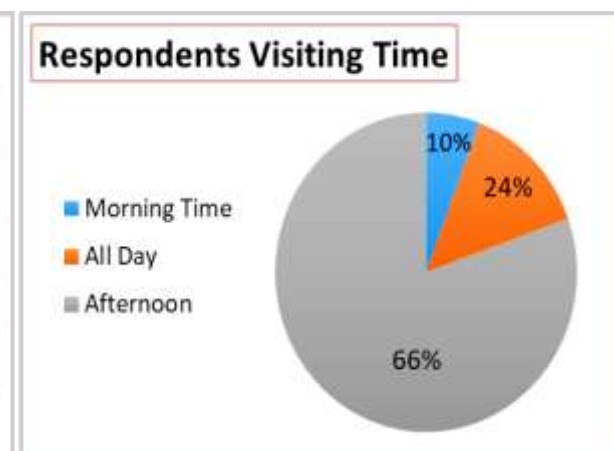
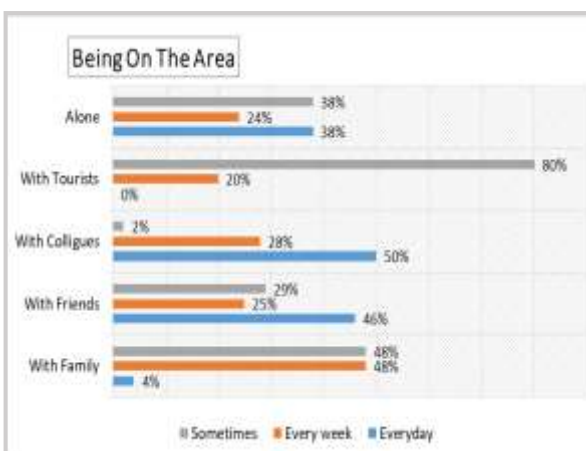
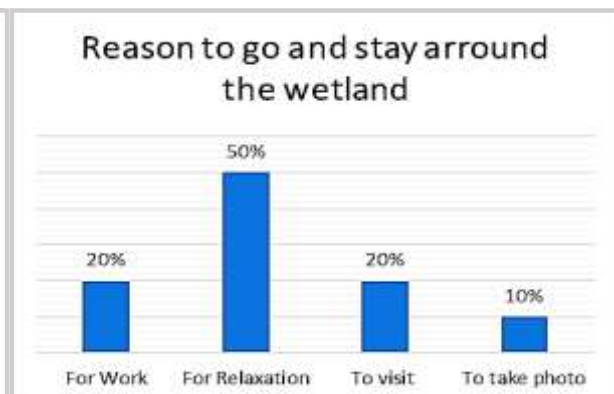
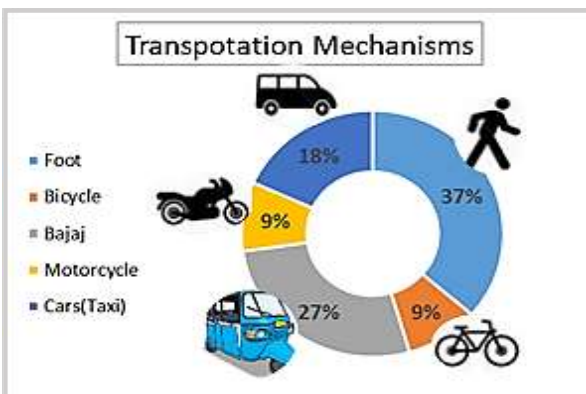
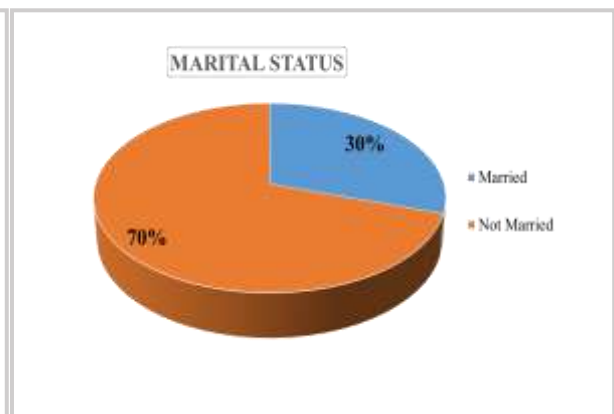
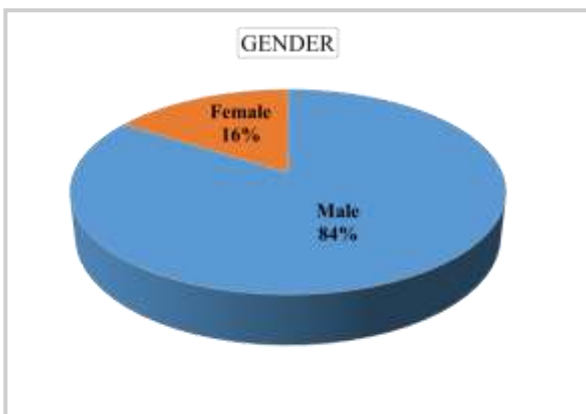
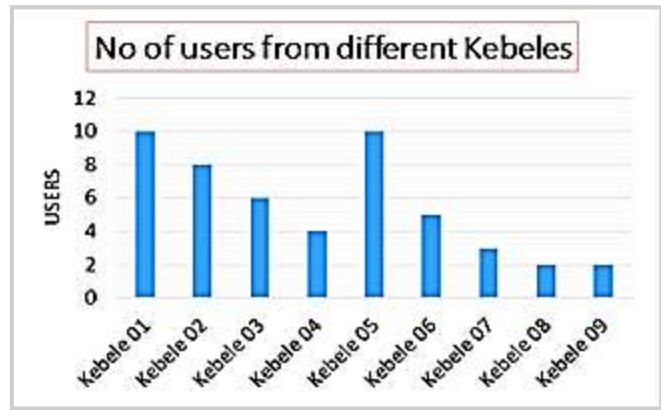
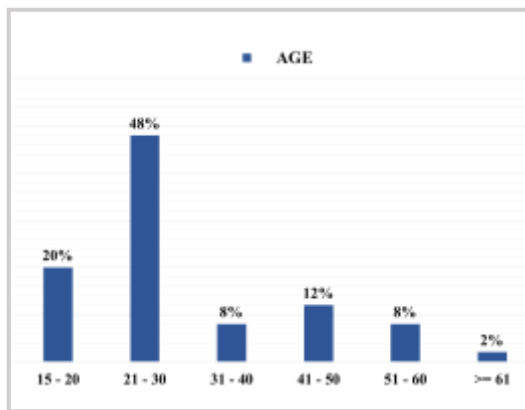


Figure 4.1.1. Survey Participation

Respondent's perception about the wetland

On this section the respondents were asked if they face any problems or a threat on their time of staying at the wetland area. After that the respondents listed different problems and types of threats. So from the listed responses four major points will be selected; these are quality of Road which is accessibility, an unexpected flood which is listed as a major threat, theft and unpleasant smell.

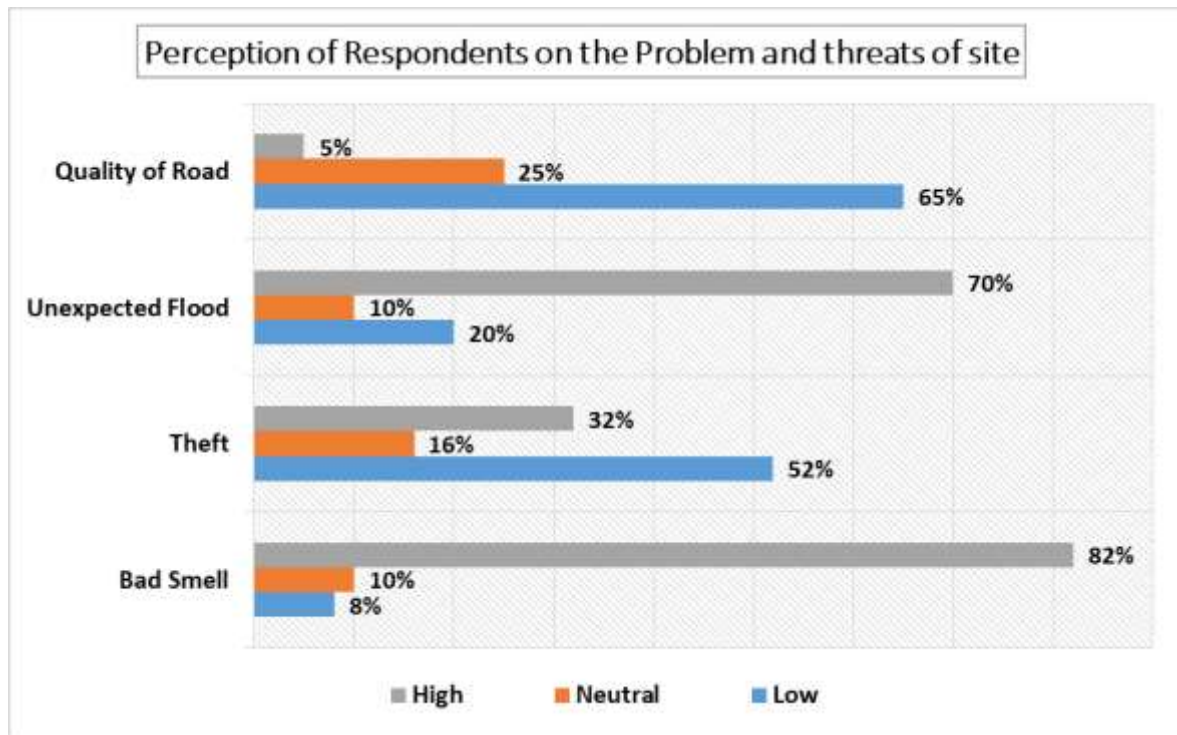


Figure 4.1.2. Respondent's perception on the problems and threats seen on the site

Existing Infrastructures Status

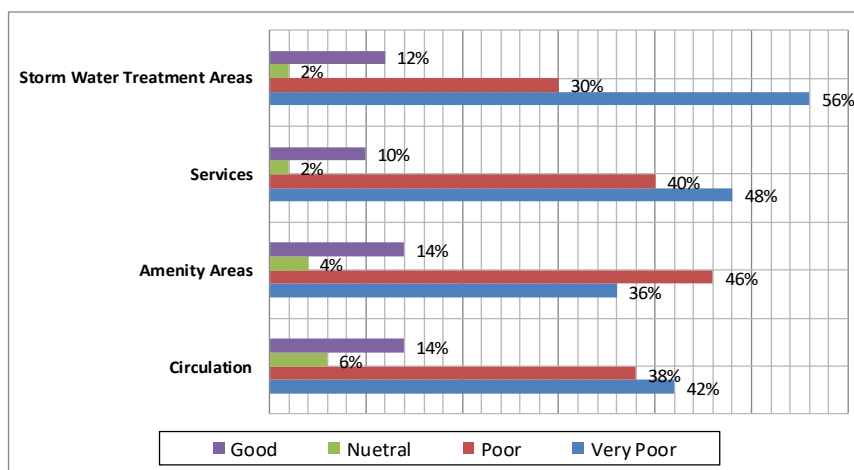


Figure 4.1.3. Existing Infrastructures around the Wetland

The above chart analyze that storm water treatment areas found at worst status than the other infrastructures. These is because the existing drainage lines of the town are poor standard; there is no any mechanisms to control the waste so it is flooded to the wetland. So the main concern is proper management of storm water the study proposed different mechanisms. The other is different services; almost all the services are very poor. So as a resonant replies the accessibility of the area is decreasing time to time.

Level of Waste Management

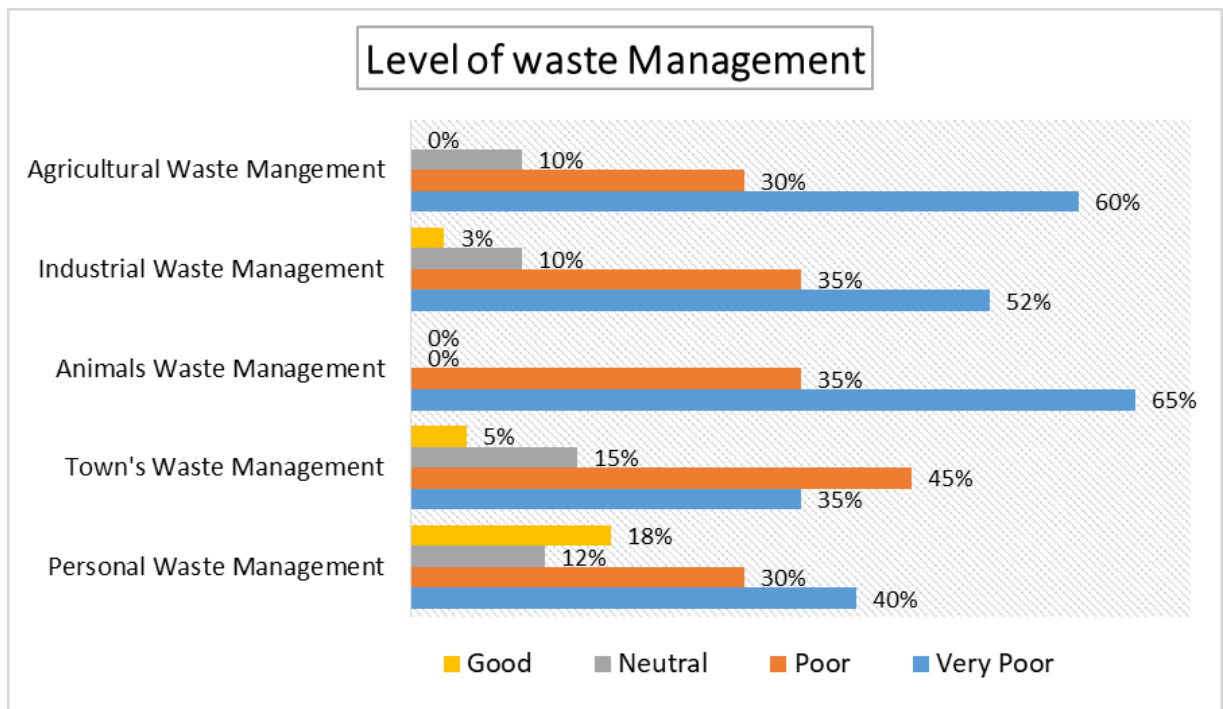


Figure 4.1.4. Level of Waste Management

The above chart (Figure 4.1.4.) analyzes the level of waste management on the site are weak. These shows Agricultural waste, animal waste, industrial waste and towns waste have the worst management systems. So these need a major solution in order to create a comfortable area to the society as well as to protect the wetland and its eco systems.

Responsible actors towards the status of the wetland

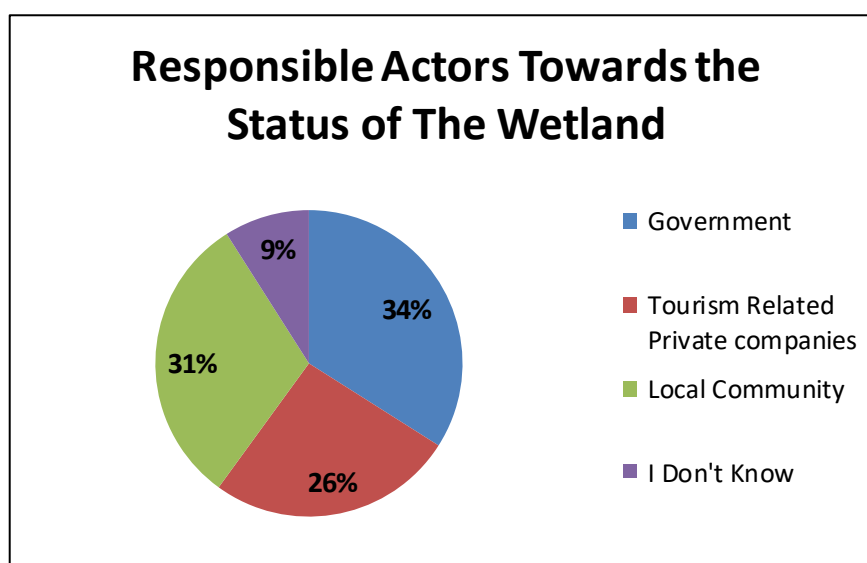


Figure 4.1.5. Actor responsibility towards the status and sustainability of the Wetland

Table 4.1. Expected shared responsibilities of Government actors

No	Respective government institutions/actors towards sustainable wetland and lakes	Shared responsibilities
1	Bishoftu city environmental protection forest and climate change authority	Environment protection and conservation (i.e.buffer zone).greening the city, eia conduct regular follow up the illegal waste disposal activities etc.
2	Health office	Particularly, hygiene of hotels/resorts, health, safety and security of society
3	Bishoftu city culture & tourism office	Monitoring and evaluation, arranging trainings for hotel/resorts, evaluating, approving or disapproving competencies of hotels/resorts are depending upon the rule and regulations. Providing correct “qubee” writing for hotels/resorts etc.
4	Bishoftu city municipality	Making the city clean, green and attractive.

	greenery sub-section.	
5	Bishoftu city municipality greenery sub-section.	Making the city clean, green and attractive.
6	Bishoftu town office of finance and economic development	Providing fund, ensure that all implementing agencies have submitted the quarterly and annual financial report timely.

Source: BCEPFCCA,2017

4.2. Existing Condition of Wetlands of Lake Cheleleqa

4.2.1. Environmental analysis

The study has identified the aerial satellite image of the study area which is used to review the existing vegetation cover, the wetland cover and features within the study area.

Photos of key features – within the study area were taken during a series of site visits as part of the study. Those photos provide further information of infrastructures, vegetation and ecosystems within the site.

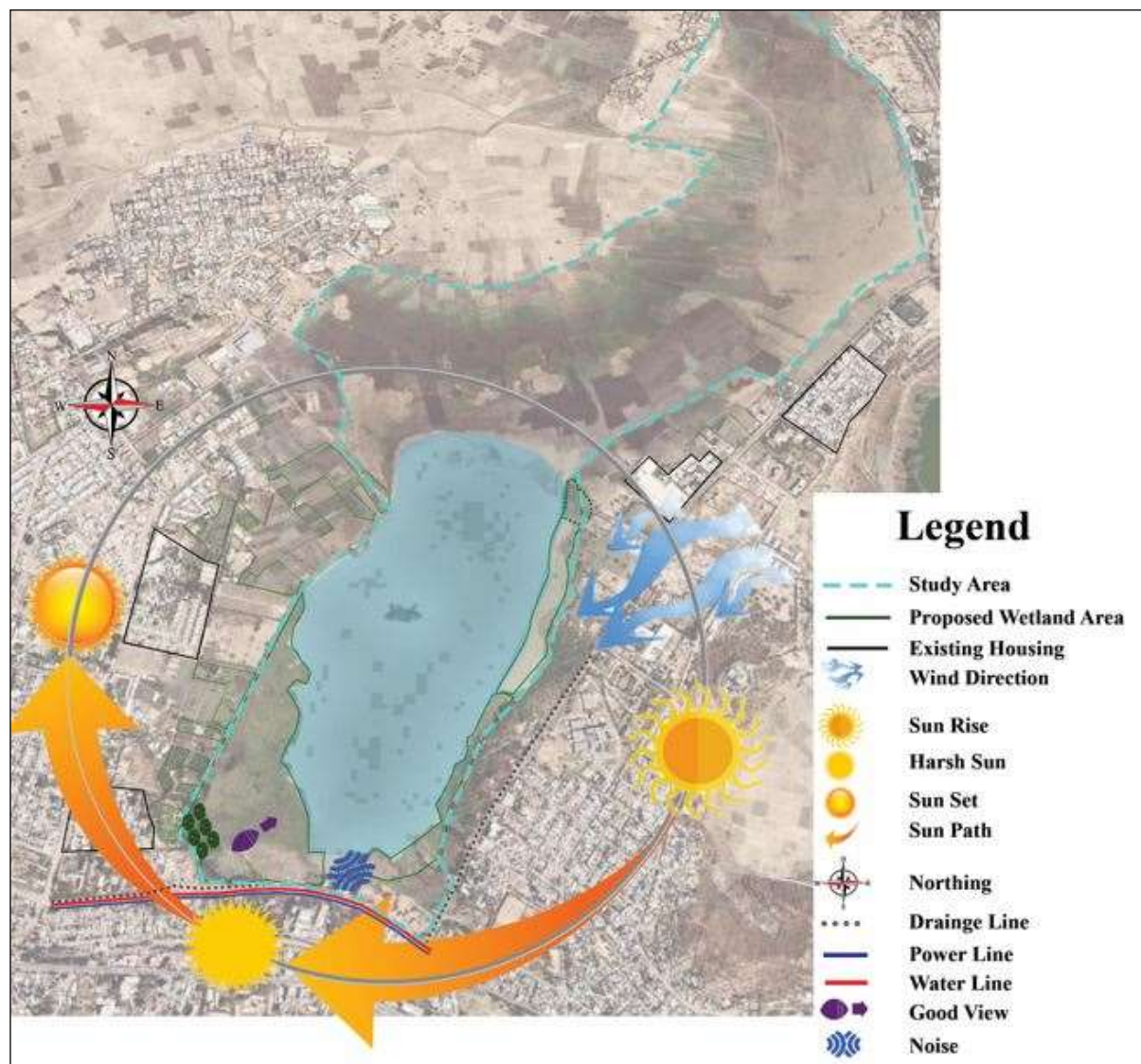


Figure 4.2.1. Existing environmental analysis

As the respondent's response whom have known the past experience of the site it has been used as a food source both for animals and human and water source for vegetation. Cheleleqa is a seasonally flooded shallow pan in to which fresh water seeps and flows from surrounding cultivated slopes and townscapes. Water fills the muddy depression during the rainy season and persists well in to the dry season. The high land ranges of the surrounding on the western, northern and eastern of the swamp, are the main catchments for Cheleleqa. Because of its shallow nature, the lakes shoreline is wide. The size of in undated area varies dramatically from year to year. It seems that, the amount of channeling run off entering to the lake is reduced and catchment area is filled with sediment resulting on total reduction of volume of water. The area around the lake is intensively used as the waters retreat.

4.2.2. Existing road networks

Lake Cheleleqa is situated at the gate of the town from Addis Ababa. It covered large hectare of land and can be accessed both on foot and by vehicles easily.

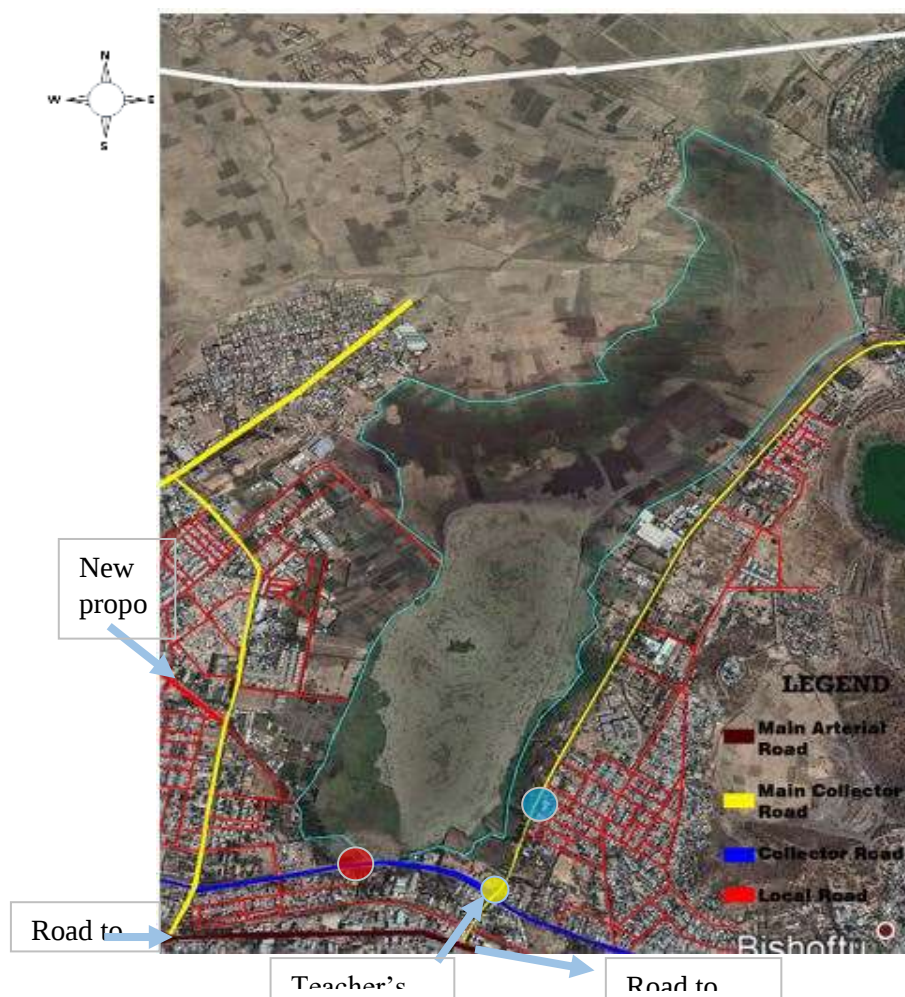


Figure 4.2.2. Surrounding road network of wetlands of Cheleleqa Lake

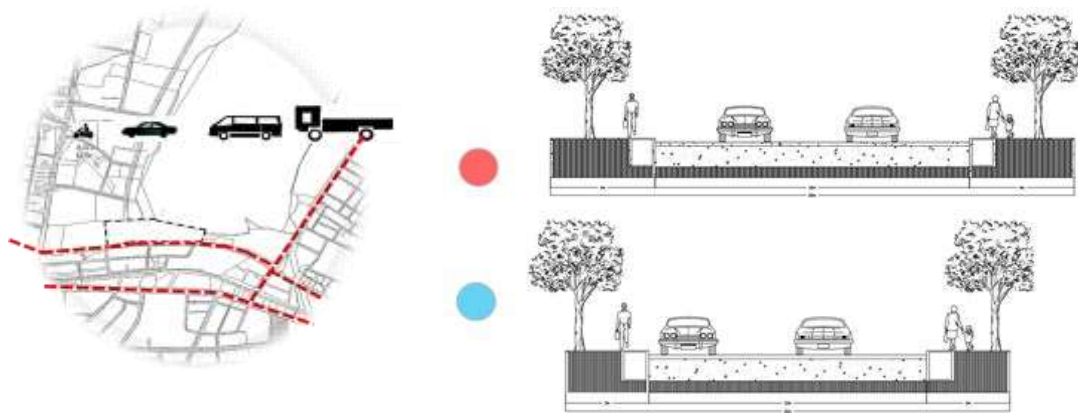


Figure 4.2.3. Traffic flow and existing road section

4.2.3. Land Use around the Lakes

In Bishoftu, different types of land use occupy the sites around the lakes. But land uses around lakes are characterized by specialization. In this regard, **urban agriculture is dominant around Lake Cheleleka occupying 28.2%**. Social service around Lake Kuriftu, Real estate around Lake Hora Arsede (55.1%), residence around lake Bishoftu (55.9%) and resort/recreation around Lake Babogaya (19.9%). If the area of two government institutes (ILCA and Ethiopian Shipping Lines Maritime Institute) are to be excluded. These land uses were categorized into 11. From these Real estate's occupy the largest proportion of all surveyed land uses.

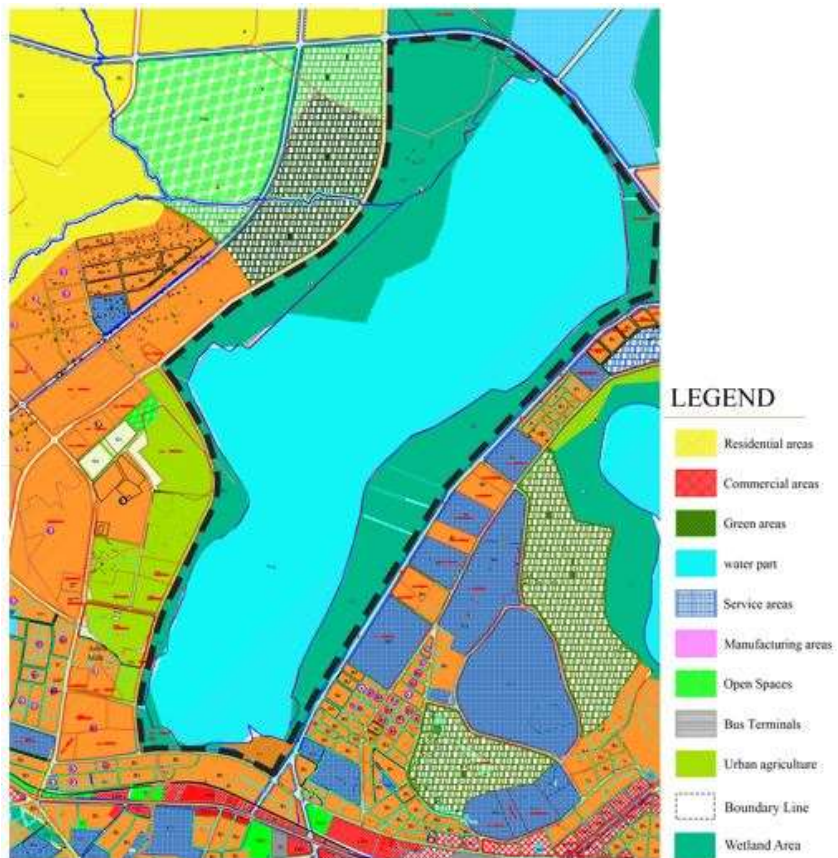


Figure 4.2.4. Land use Map around Lake Cheleleka

4.2.4. Topography of The Site

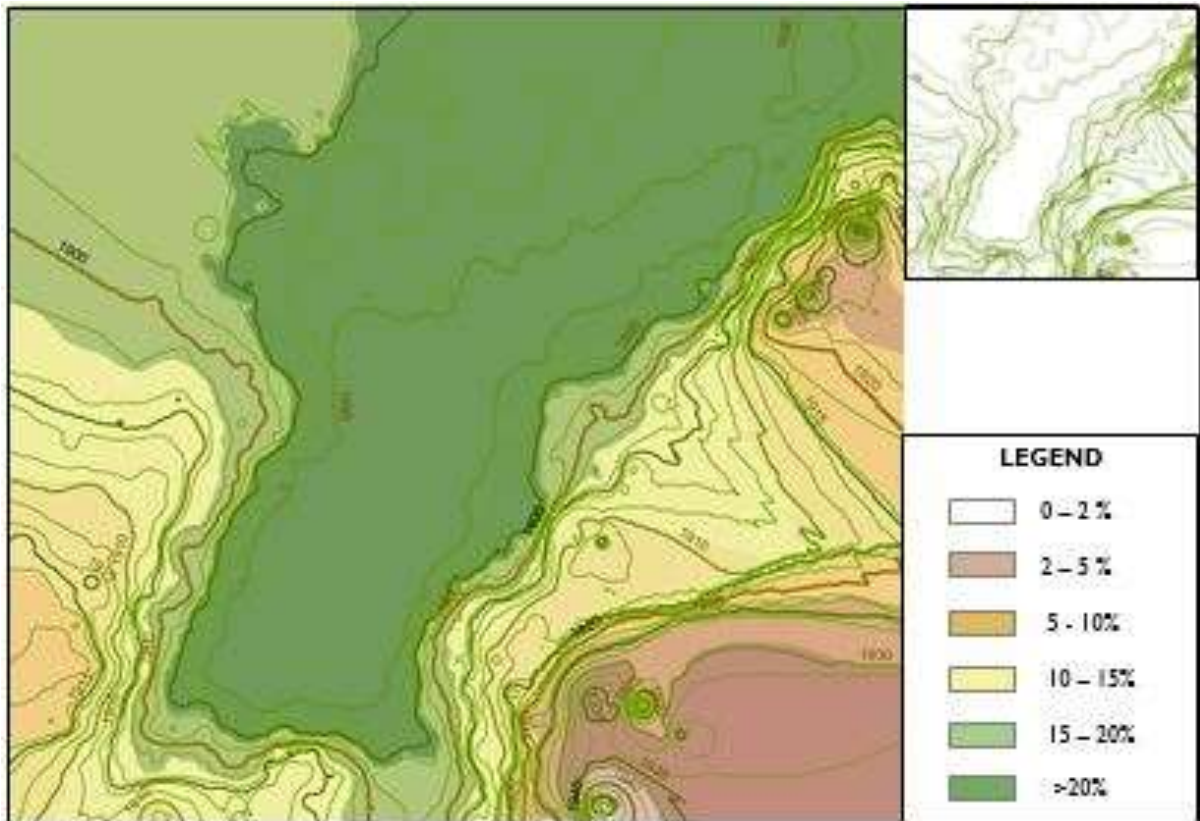


Figure 4.2.5. Land use map around lake

The above figure shows that the topography of the selected site and its surrounding these shows the largest span of the site relies on the same slope which is flat area including the lake's top surface. So on these project the selected area is more comfortable to apply any projects.

4.3. Surrounding Physical Analysis of Wetlands of Lake Cheleleqa

4.3.1. Land use Land cover Description

The land uses of the study area for each period (2000, 2005, 2015 and 2021) which were obtained from USGS stellate imagery were georeference using GIS to the coordinate system of the study area. Each land use type for each year was digitized using Arc GIS (Figure 4.3.) to calculate the area of each land use type and to prepare land cover of the study area.

Four different time series images were classified using supervised classification with maximum likelihood classifier algorithm. The obtained classified results used for analyzing land use and land cover. The software used for this purpose was ERDAS-2015. The classes which were considered for classification are Farm land (cultivated land), Urban (Scattered settlement within the cultivated land and dense settlement in the town), Grassland including urban green areas, Forest (The sparse vegetation of juniper and eucalyptus trees) and Water body.

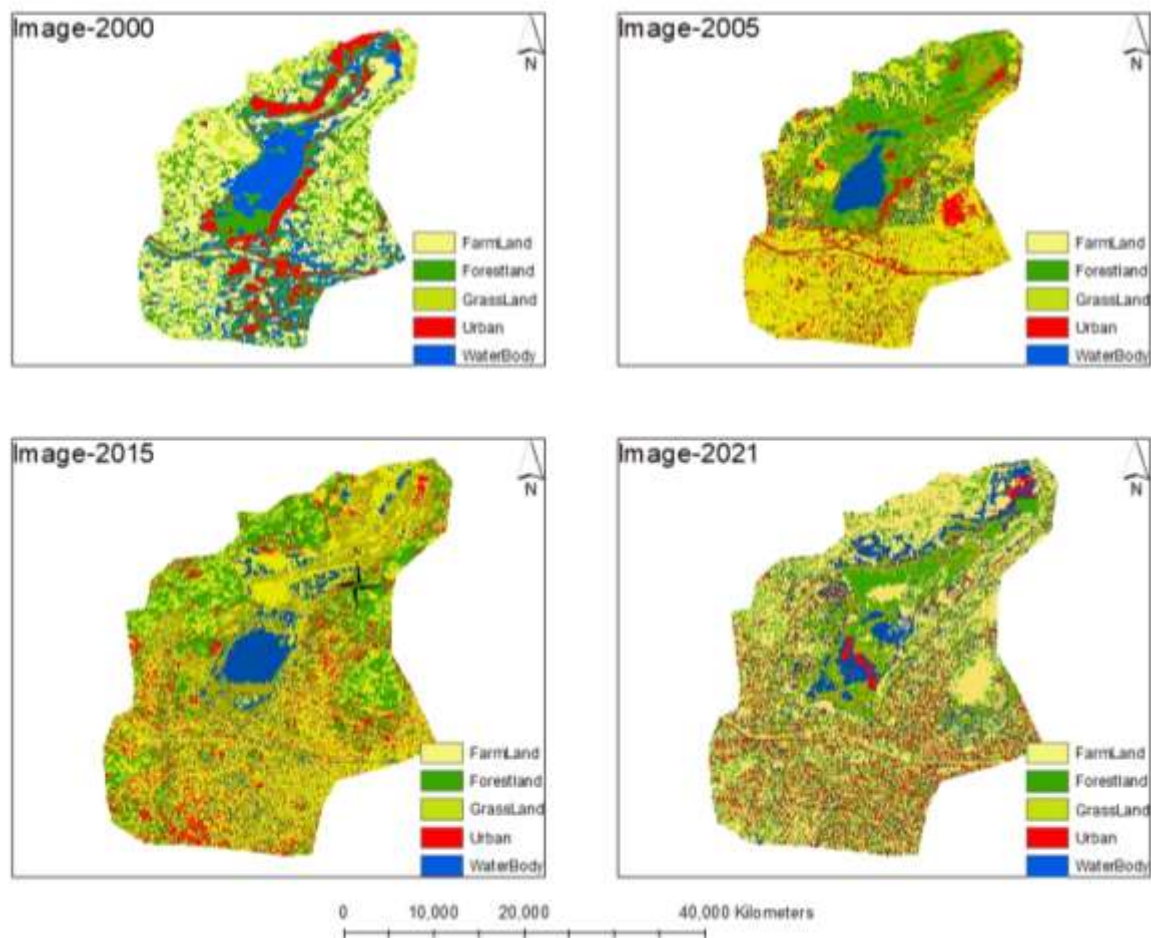


Figure 4. 3. Classified land use for 2000, 2005, 2015 and 2021

Table 4.3. Summary table in Land use change

SN	2000			2015		
1	Forestland	8.894	26 %	Forestland	7.0875	21 %
2	Grassland	0.8026	2 %	Grassland	7.8216	23 %
3	Water Body	6.7391	20 %	Water Body	2.9279	9 %
4	Farmland	14.4407	42 %	Farmland	12.6892	37 %
5	Urban	3.206	9 %	Urban	3.5562	10 %
	Total coverage	34.0824	100%	Total coverage	34.0824	100%
SN	2005			2021		
1	Forestland	7.2528	21 %	Forestland	8.2098	24 %
2	Grassland	4.5345	13 %	Grassland	4.9178	14 %
3	Water Body	4.8927	14 %	Water Body	2.6935	8 %
4	Farmland	14.0091	41 %	Farmland	14.6303	43 %
5	Urban	3.3933	10 %	Urban	3.631	11 %
	Total coverage	34.0824	100 %	Total coverage	34.0824	100%

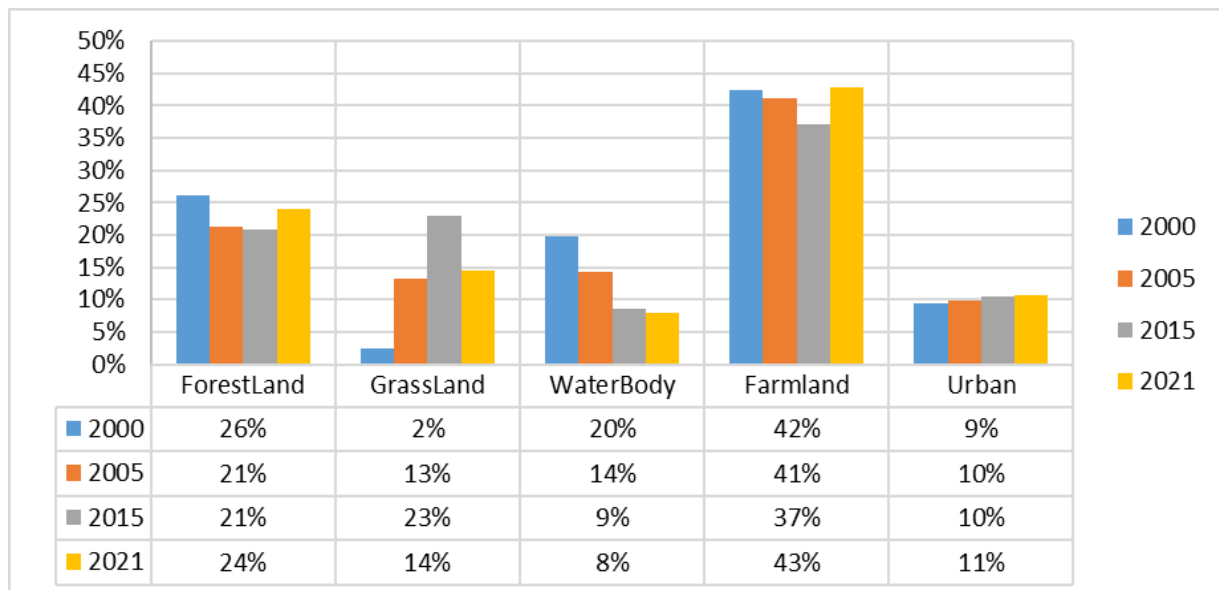


Figure 4.3.1. Summary graph in Land use change

4.3.2. Urban development around the wetland

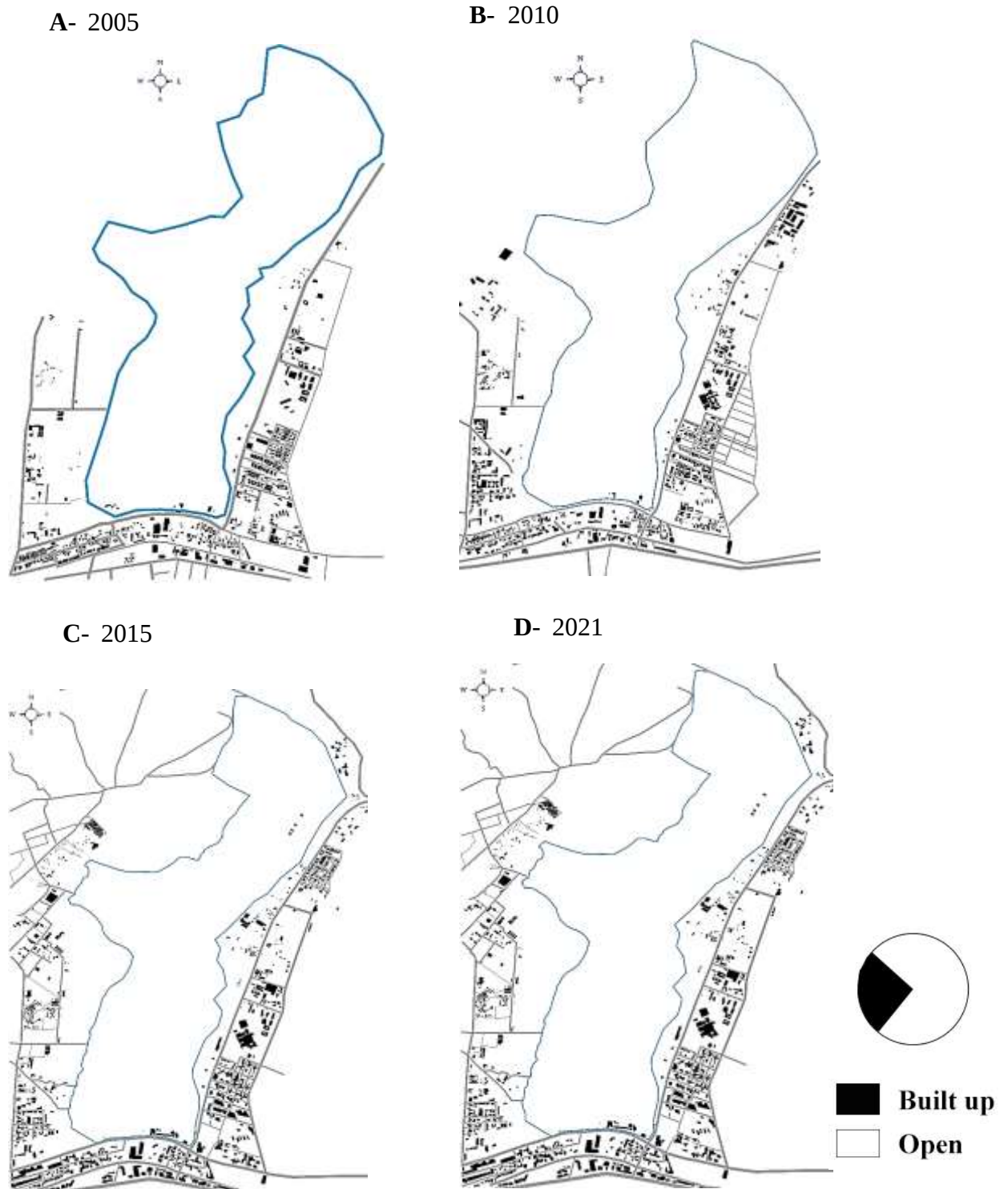


Figure 4.3.2.

Urban Development around the Wetlands of lake Cheleleqa through time: A. 2005, B. 2010, C. 2015, and D. 2021. The site boundary is marked by light blue line while the changes around the wetland are marked by black dots.

The above figure which shows the expansion of urban development map which is studied from 2005 to 2021; therefore the study analyzes the expansion is very rapid within the interval of 5 years around the wetland. So these rapid urbanization is also the main reason for the loss of the wetland because there will be more land conversion and more infrastructure development.

4.3.3. Vegetation coverage change

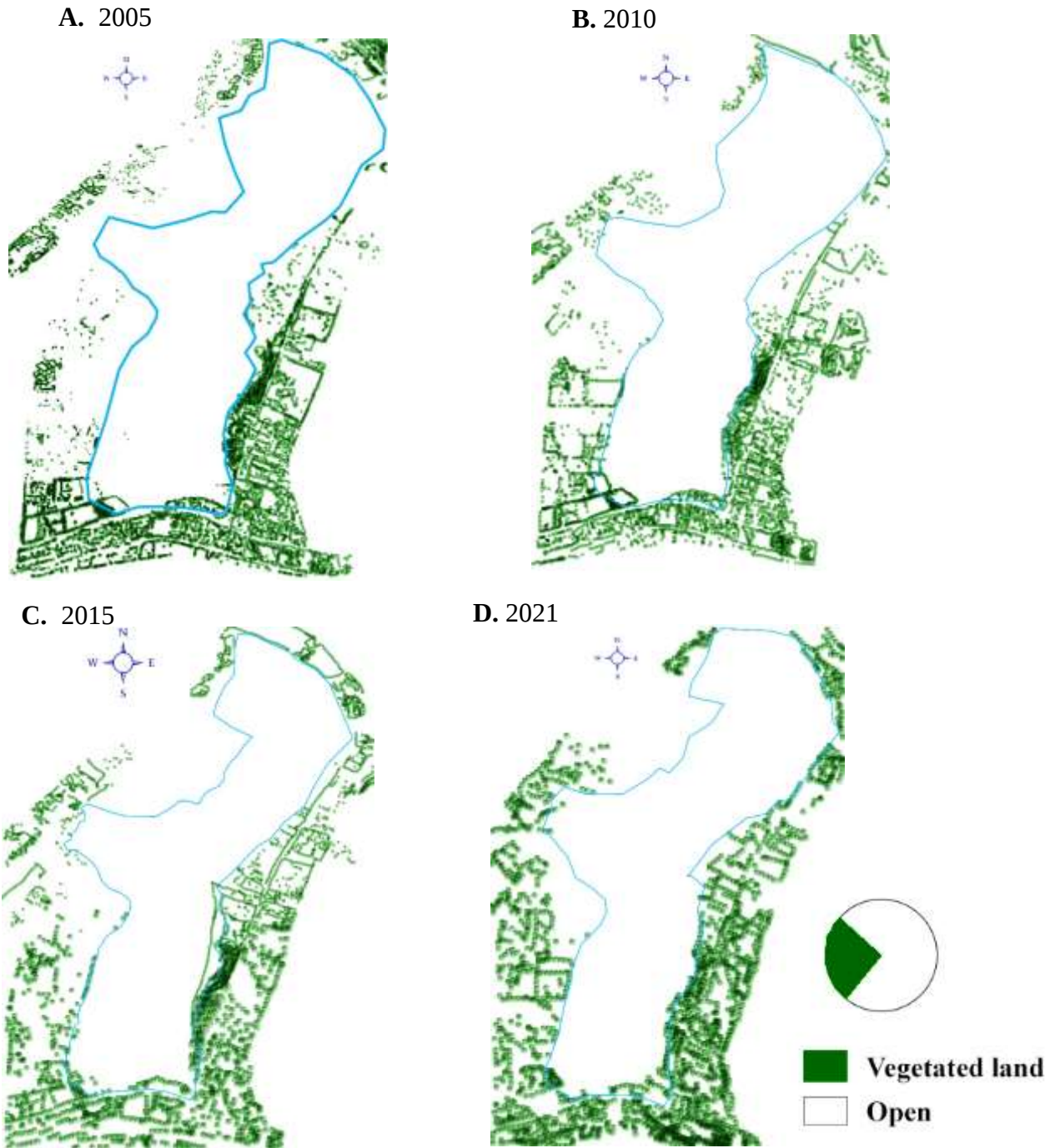


Figure 4.3.3. Vegetation Coverage around the Wetlands of lake Cheleleqa through time: A. 2005, B. 2010, C. 2015, and D. 2021. The site boundary is marked by light blue line while the changes around the wetland are marked by dark green.

The above figure shows map of vegetation coverage expansion which is analyzed from 2005 to 2021; therefore the study shows different types of vegetation coverage like from large trees to shrubs and grasses. So the map shows all vegetation but within the interval of 5 years the largest trees are decreasing because of the need of the space by the societies.

4.3.4. Wetland Coverage Change

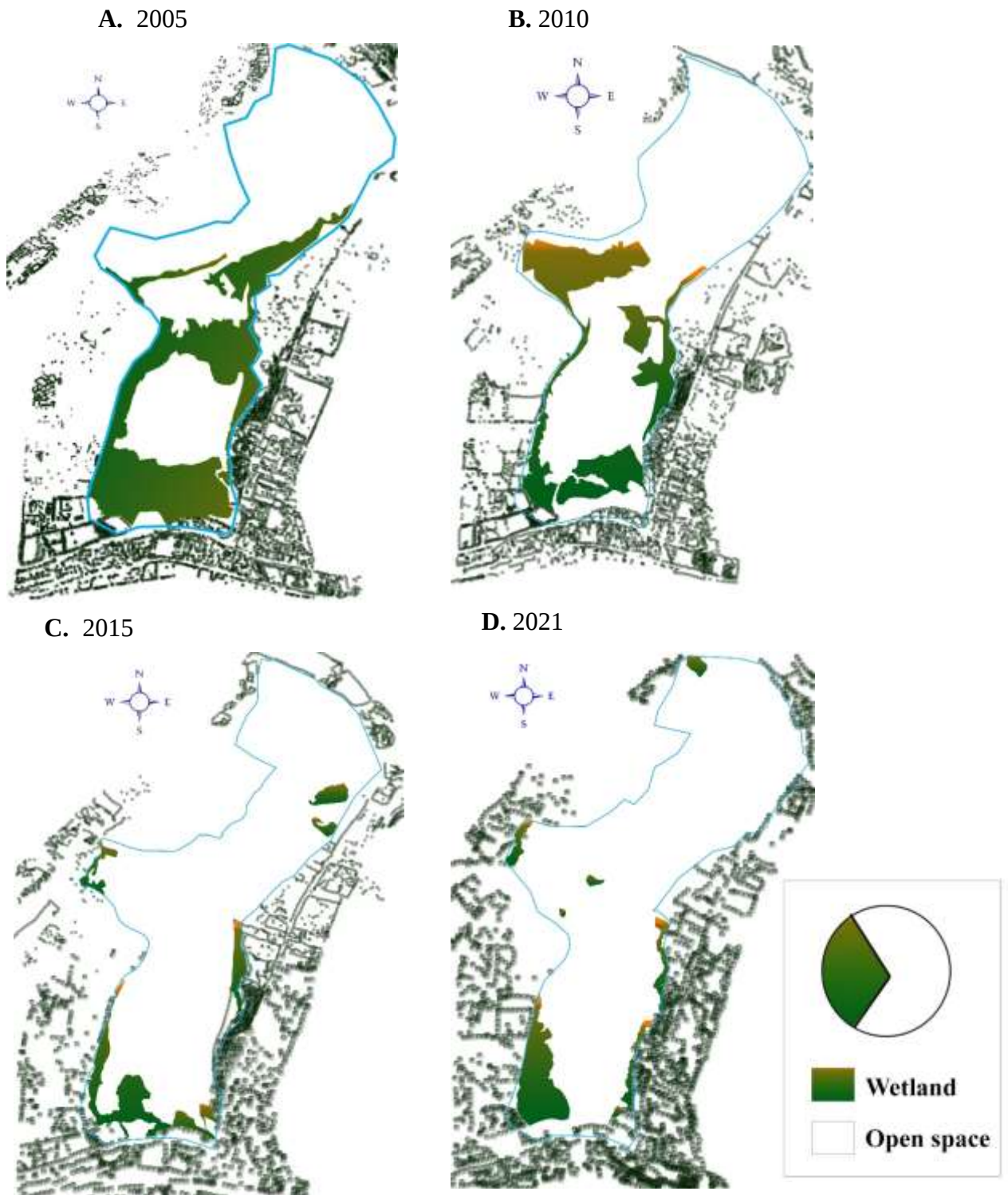


Figure 4.3.4. Shows changes of Wetland coverage around the Wetlands of lake Cheleleqa through time: A. 2005(the wetland covers 7.7 Hectares), B. 2010(the wetland covers 6.8 Hectares), C. 2015(the wetland covers 2.6 Hectares), and D. 2021(the wetland covers 2.1 Hectares).

The above figure shows map of wetland coverage which is analyzed from 2005 to 2021; therefore the map shows the coverage of the wetland is decreasing within the interval of 5 years which is; so the area of the wetland decreases from 7.7 hectares to 2.1 hectares which is (5.6 hectare difference) or these shows the loss of the wetland space is decreased by 72.44% which is very high.

Table 4.3.4. Wetland Cover Change

No	Year(G.C.)	Wetland coverage Change (hec)
1	2005	7.7 hectares
2	2010	6.8 hectares
3	2015	2.6 hectares
4	2021	2.1 hectares

Based on the above figure there is almost 9 inlets which are properly constructed as well as not constructed. And also there is no waste treatment on the inlet as a chamber so these creates not only overflow of storm water it also brought overflow of liquid and solid wastes. Therefore, these affect the two ecosystem services of wetland that are source of freshwater and capture fisheries dependent on the natural reproduction.



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4.3.6. Current Zoning of the Site



Figure 4.3.7. Current Zoning of Uses

4.3.7. Current Activities of the Site



Figure 4.3.8. Current Activities on the Site

Table 4.3.7. List of activities observed on the field survey

List of activities	Description	Related images taken from the survey
Agriculture	- Most of the edges off the wetland covered by agricultural activities. - Cultivated plants like vegetables, fruits, seasonal crops like chickpeas and flowers. - Source off water – most of the water is pumped out from the lake.	   
Cattle grazing	- On the site there are plenty of cattle like cows, sheep and goats spreads in order to graze the wetland's grass and to drink the water from the lake. - But besides the cattle animals like dogs, donkeys and horses were there.	  

People activity	- Hanging out on the lake – this includes washing their bodies and clothes - People look their cattle lying on the grass - Doing researches on the ecosystem of the lake especially on the migratory birds. - Collecting grasses - Children plays on the field - Farmers taking care their vegetated land. - Others use the place to apply different drug like chewing chat in their vehicles.	
As a waste dumping site	- On the site different construction wastes like deconstruction wastes, cart away wastes are dumped on the site. - Agricultural wastes like cultivating plastic bags, pesticide bottles, and unwanted plants are speeded on the wetland. - And manures waste also the major waste on the place. - Other are different plastic bottles which is mainly brought by the people that were hanging there is the source.	

	- Industrial wastes and wastes brought by floods from unprotected drainage lines are also the other source.	
Ecosystems	- On off the main benefits of the wetland is it is a home of different migratory birds. - And also it has big opportunity for tourism activities.	
Existing plant types	- the area has different grass typologies which is related to wetland types of grasses like cyperus latifolius, (cheffe), cyperus brevifolius, anagallis serpens and fuirena stricta were found. - on the other hand besides the wetland there is a forest mainly covered by equilyptus tree.	

4.4. Factors negatively affect the wetlands of Lake Cheleleqa and its environment

Lake Cheleleqa which naturally lies at the lowest elevation in north-western part of the city is the natural drain for most of the city and areas of upland catchment outside northern city boundary. It plays as significant role as a major drain to the city and the surrounding area. another visually obvious indication of possible pollutant/nutrient ingress and enrichment of the lake system from the catchment is the increasing encroachment of aquatic plants in to the inner margin of the lake that these days the entire lake surface is covered by wetland or marshland vegetation; and it is practically the lake is transformed to wetland. Owing to the importance of the lake in the city's overall eco-system and economic profile, and the importance of maintaining a very clear shore line, the indiscriminate discharge of storm

water to the lake/wetland system is not appropriate. More alarming so is the uncontrolled farming activities that agricultural activities that are incubated around the lake shoreline.

Several factors, mostly human activities that don't consider the safety of the wetland have been blamed for the environmental damage sustained by Cheleleqa. Enormous volume of silt generated by intensive agricultural activities in the upstream rural areas and solid wastes from Bishoftu city is deposited in and around the wetlands of Lake Cheleleqa each year propelled by heavy runoffs. moreover, some stakeholders and community representatives have mentioned their serious concern that untreated sewage, toxic wastes released by different producers and agricultural chemicals are all washed in to the lake have a potential to pollute the water and cause human and animal illnesses.

Urban agriculture around the lake

Irrigation farming has increased rapidly around the catchments of the lake and around Cheleleqa wetland. These activities are conducted without the control of a responsible body for a sustainable use of the water by protecting it from pollution, over utilization and avoiding any disturbance of the ecosystem. The common irrigation method practiced around the area is furrow irrigation with two to three harvests in a year. so in order to be productive they use fertilizers and also pesticides. Crops cultivated by irrigation include cereals- maize, pulses- haricot bean and vegetables like tomato, onion, green/red paper, cabbage, carrot, and beetroot, and fruit- papaya.



Figure 4.4.1. Agricultural practices in the buffer zone

The actual total irrigated land area is not identified in any study so far. However, individual commercial farmers, private investors and others are using the water from

Cheleleqa Lake through pumping. This farming practice, which has greatly decreased the lake water and even the ground water around the Cheleleqa, is the prime factor for increased sediment transportation to the lake, hence increasing its level and devastating the beauty of the wetland as well as the lake.

Solid waste & runoff waste

The Cheleleqa wetland is under serious threat of pollution by all sorts of contaminants and waste that are carried by storm water to the shoreline. In addition, direct discharge of waste of all kind to the shoreline is also a serious concern or at least should have been unlawful.

Thus, both regulatory requirement and storm water management to minimize waste carried to the Cheleleqa shoreline should be triggered, to save the lake/wetland system if it is not too late.



Figure 4.4.2. Solid and runoff waste

The type of vegetation in the outlets shoreline is clear indications for the threat caused by raw sewage and other wastes with nitrogen content. These will further deteriorate with the ongoing dairy farming and horticulture farming along the shoreline, if proper care is not taken.

Current storm water management system

Uncontrolled storm water runoff has markedly damaged roads, drainage system, private and public property and different infrastructure developments, which has been established with a huge investment cost. Equally, the pollutant discharged with storm water considerably affects public health particularly those of poor people. The problem is highly

aggravated in overcrowded urban settlements and around Cheleleqa Lake. Design, construction and maintenance of public infrastructure including roads and drainage facilities are the responsibilities of infrastructure development work's process of Bishoftu city administration; however these works are often outsourced to consultants and contractors.

Existing storm drainage facilities

The existing drainage system covers most of the developed areas consists of a considerable length of open masonry, gutters and non-lined ditches, and cross-drainage structures. Most open drainage ditches are adequately designed but slopes are not adequately provided in flatter areas and drops at highly steep areas where excessive velocity is observed to cause damage on the channel.



Figure 4.4.3. Existing storm drainage facilities

Most of the drainage ditches are filled with solid waste and sewerage resulting in formation of sewage ponds in the channel as well as on the road.

During the field visit indiscriminate dumping of solid waste in to storm lines is observed to be a major problem that compromises the functionality of the drainage facilities and seriously endanger the eco-system of the Cheleleqa wetland system.

In addition, the main highway side drains are only planned to safely discharge the surface drain from the road surface. And, these drains are unable to accommodate arterial drainage lines connected to it at different locations. The side drains were totally blocked at some points and surface runoff overflows on the road surface.

4.5. Summary

The main problems and their schematic possible solution is mentioned below

GREEN SPACE DEVELOPMENT	PROBLEMS	POSSIBLE SOLUTION
Elements ➤ Natural Fabric ➤ Urban Fabric ➤ Development	Problems that can be prevented by the green space development ➤ Lack of Buffer Zone ➤ Very poor waste water management ➤ Lack of public space ➤ Lack of accommodation	Propose a suitable type Green space development that aims at creating a healthy interaction of community and urban wetland ➤ Wetland Park

4.6. Proposed green space development on the wetlands of Lake Cheleleqa

In this study, it was found that the wetland and its ecosystem have changed in both time and spatial situation. Based on the aim of the study; creation of healthy interaction of community and urban wetland which triggered to upgrade and rehabilitate the wetland and its ecosystem. So that it can be accessible to the surrounding community which will provide different opportunities and act as a catalyst for the regeneration of the area and its' surrounds.

4.7. The proposed green space development

Proposed green space development which can be suitable in the prevention of the listed problems on the analysis and which is a best fit which encourage the aim of the study which is creating a healthy interaction of community and wetland is wetland park.

4.7.1. Description of proposed wetland park

A wetland park is an active park which is full of activity and which is highly connected with the natural environment as well as the urban fabrics. And as a green space development the land that is partly or completely covered with grass, trees, shrubs, or other vegetation.

4.7.2. Purpose of the wetland park

The purpose of the proposed wetland park connecting the two major elements of green space development which is the natural and the urban fabric of the wetland.

Improve community's wellbeing – is one of the major purpose of the wetland park because improved vegetation and water quality, walkways, leisure activity areas, recreational areas are integrated so these enhance the interaction of the wetland to the community.

Enhance biodiversity and nature conservation – a wetland park is mainly proposed because of creation of a buffered space will

Reduction of pollution – the other importance of Wetland Park is pollution reduction which is avoiding solid and liquid wastes and creating attractive spaces with best waste management. So, this will also improve the air quality of the surrounding environment.

Reduction of noise – at the site noise is highly created by vehicle traffic flows so adding buffer lines is also one program on the proposed wetland park which is used as a noise barrier.

Increase tourism- the proposed wetland park is also a habitat of different birds

Energy saving- adding of different water storing mechanism is one part of mitigation mechanisms which can allow saving the energy wasted while storing and purifying water.

4.7.3. Location of the proposed wetland park

Location – Oromia, Bishoftu town, Southern and Eastern side of Cheleleqa Lake, 496009.37 m E, 967972.64 m N and 496927.82 m E, 968360.47 m N

Area –34 hectares (340,000 sq. m.)

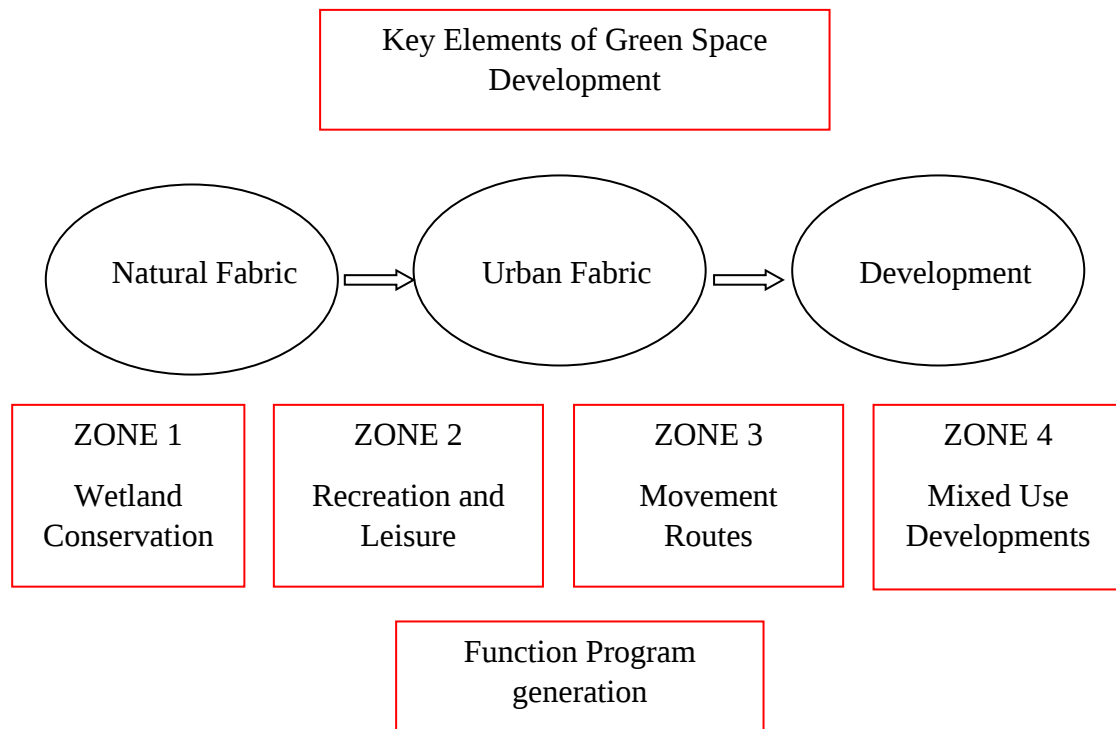
4.7.4. Concept development

In the concept development there is 3 basic elements which must be considered in the proposed green space development. Those are the natural fabric of the site, the urban fabric of the site and the types of green space development by itself.

- Natural fabric – which includes existing vegetation, water body, biodiversity, wetland and ecosystems of wetland.

- Urban fabric – which includes streetscapes, buildings, soft and hard landscaping, lighting, signage, roads and other infrastructures.
- Developments – wetland park as a green space development

These basic elements will lead the project to develop various zoning of uses and different plan of action which must be considered in the creation of the wetland park.



4.8. Design intervention

4.8.1. Design statement

The aim of the development is creation of healthy interaction of urban wetland and the community which provides different initiative facility to the space according to the need of the wetland and the community. The design include recreational , retail center, public green spaces, entertainment spaces, cultural centers, waste water treatment areas, accessible paths and agricultural areas based on the natural and urban fabric.

4.8.2. Proposed program outline

The proposed wetland park programs are developed from those factors which are listed as green space development elements which will then help to sort out the zoning of uses. These will integrate different programs based on the proposed zoning of uses.

4.8.3. Basic Program Lists

Zone 1

1. Wetland Consecration
2. Vegetated land
3. Waste water treatment area
4. Vegetated Buffer lines
5. Biodiversity protection pond
6. Biodiversity protection area
7. Fishing deck
8. Nursery gardens

Zone 2

1. Recreation and leisure Zone
2. Play grounds
3. Outdoor picnic areas
4. Children's play ground
5. Outdoor exercise area
6. Outdoor swimming pool
7. Public plazas
8. Parking lots
9. Viewing platform

Zone 3

1. Movement routes
2. Cyclist path
3. Vehicle path
4. Viewing and walking decks
5. Jogging tracks
6. Entrance plazas

Zone 4

1. Mixed-use Developments
2. Café and Restaurants
3. Indoor Game zones
4. Indoor Gymnasiums
5. Communal spaces like toilet and shower services
6. Cinema and theater halls
7. Retail shopping areas

Figure 4.8.1. Proposed zone of uses of Wetland Park



4.8.4. Proposed Master Plan of wetland Park



Figure 4.8.2. Proposed master plan of Wetland Park

4.9. Projects main plan of action

A. **Recover** – in the process of recovery; places are historically transformed without concern of the ecosystem, and the aim is to recover its identity, articulate them with the contemporary needs and aspirations. Therefore, in order to meet the two basic actions of 1. naturally restoration of hydraulic structures and continuous change of the wetland ecosystems. 2. Culturally make visible and protect the lake; there are some items which must be done

- **Connaturalization of urban spaces**- this action consists on the withdrawal of hard and impervious built surfaces to recover the soil infiltration qualities. Using the previous concrete and palmphitic trails the natural infiltration of rainwater and the changes of tides will be allowed and benefited the wetland ecosystem.

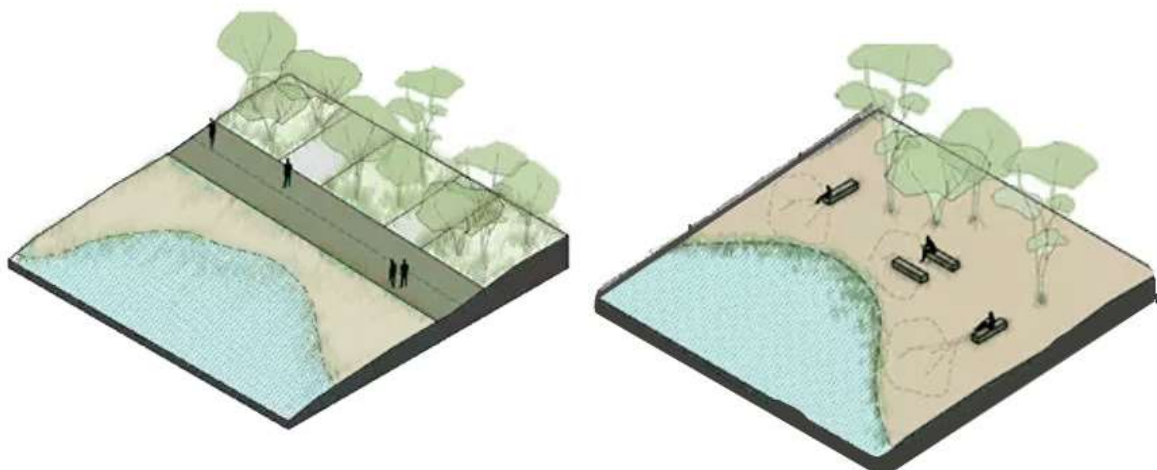


Figure 4.9.1. Connaturalization of urban spaces

- **Urban transitions and connections**- this action is directly related to the articulation of the project with the city and the different projects for the development of the area. So this is made with strategies of physical and visual approach and allows the inhabitants of the surroundings to benefit and enjoy the wetland. And also native vegetation is also used to conform permanence spaces and visual orientation towards the wetland.
- **opening towards the wetland**- this action aims to recover the original geomorphological configuration of the border and restore the eco systematic

functions based on actions like reshaping the border which includes making simple earthworks with the same land of the place to recover the area and cleaning the body of water and controlling the growth of floating plants to prevent water eutrophication.

B. **Strengthening** – this action will enhance the existing conditions and needs of the local ecosystem, as well as spatial and cultural needs.

- **Seed forest-** there are some small remains of native forest around the wetland, in this area the aim is to stimulate and allow the natural succession and control foreign vegetation. This small forests can be used as tree nurseries for the communities around the wetland helping local economies.

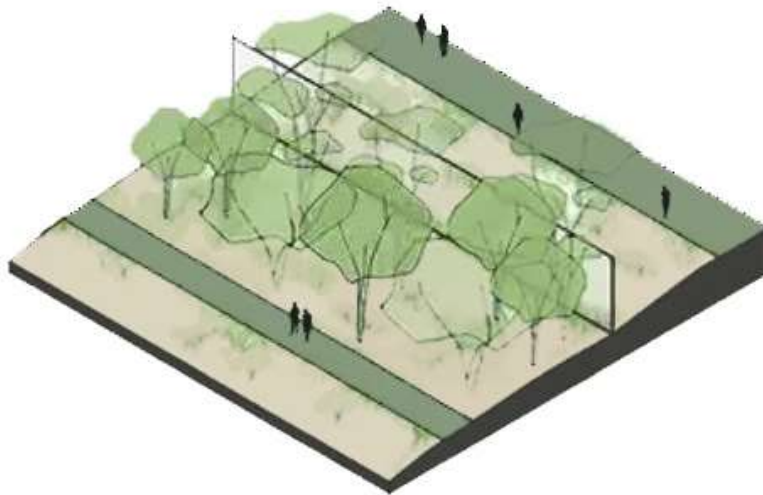


Figure 4.9.2 ‘Seed forest’ entrance control which allow ecological succession

- **Reconnection of water ponds-** actually the body of the water is fragmented because of the activities of the society and the unknown depth of the water body, reconnect this parts its crucial for the restoration of the hydrological system and strengthening of the ecosystem.

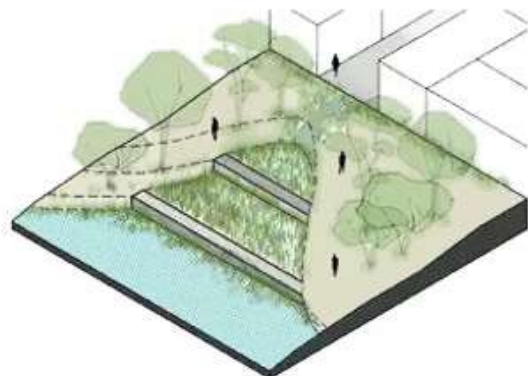


Figure 4.9.3. Bioremediation ponds used for water treatment

- **Gradually foreign vegetation replacement-** some of the trees planted on the past years are not the indicated for the ecosystem and it can be dangerous and not useful for the ecosystem in terms of biodiversity and hydrological systems as well as to the society. The gradually replacement of this vegetation with native trees and plants it's proposed, reducing the visual impact on the community, restoring the wetland identity and eco systematic functions.

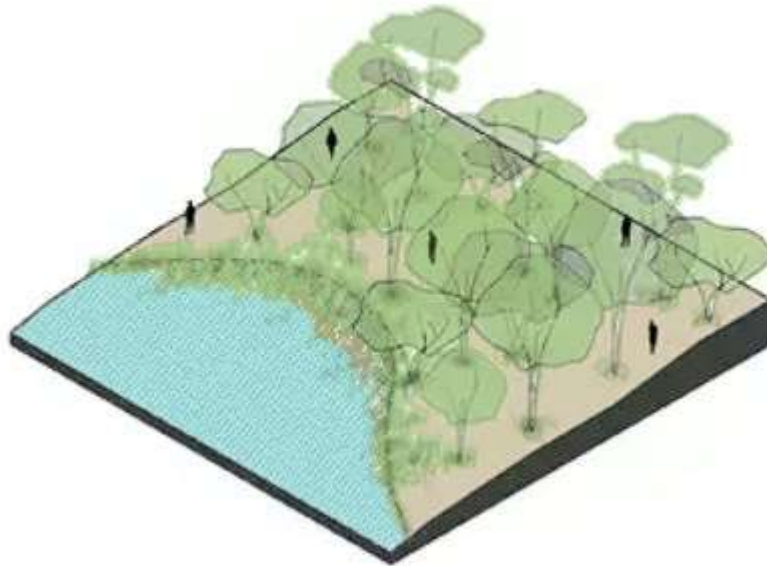


Figure 4.9.4. Gradually foreign vegetation replacement

C. **Permanence Space Conformation-** as a linear park it's very important to configure pauses on the trail, that permanence spaces allow visitors to experience nature, learn about the ecosystem and enhance the their health as well as the wellbeing of the wetland.

- **Open air classroom, aquatic, dry lands and forestry-** the purpose of this space is to strengthen conservation and restoration process. This spaces can be used as an open air classroom to learn about the local ecosystem.
- **Wetlands path penetrations**
- **Playgrounds-** the main criteria of the project it's the preservation of the ecosystem the area surrounding the wetland can't be used for sports, simple earthworks, using the same land of the place, will provide a scenario for passive recreation and other practices of low impact on the ecosystem.
- **Entrance-** the main action which is done on the project is separation of vehicular entrance and pedestrian entrance. So these will enhance the access and mobility of space.

- **Compost area-** the purpose of this space in reduction of wastes which is generated from the surrounding agricultural activities and encourage natural fertilizer usage for the proposed nursery garden.
 - **Nursery garden-** is a place of cultivation of different vegetation which will allow free participation by the community. It is also agricultural lecture areas for children.
 - **Recycling spaces –**
- D. Path Conformation - the configuration of the trails it's beyond quality of materials, indeed its course allows the visitors to recognize the landscape. Learn about the ecosystem and the culture.

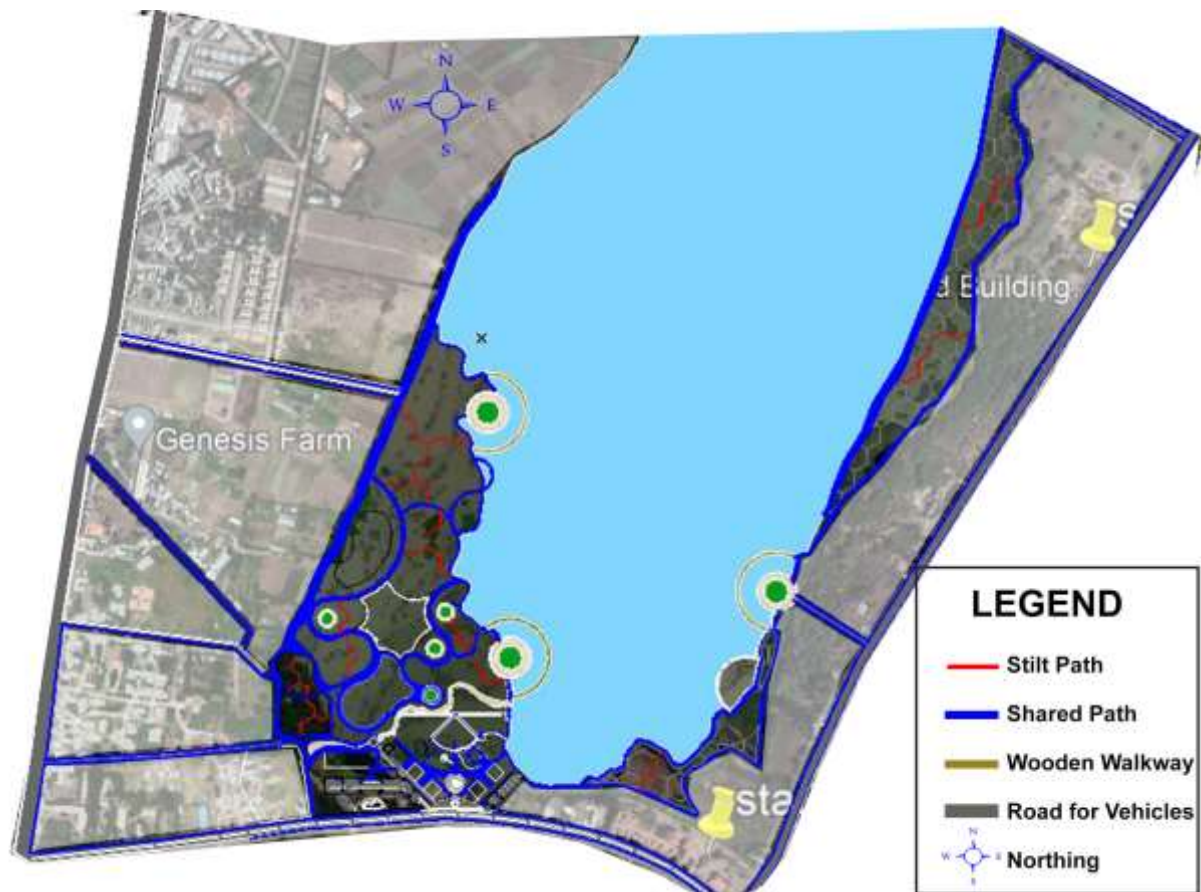


Figure 4.9.5. Proposed movement routs of Wetland Park

- **Shared path** – it's the main axis of the park, establish the relationship between the wetlands and the city. It can be used by pedestrian, cyclist and handicapped people.

The shared path articulates all the interventions and the landscape. The path develops a unique wetland landscape experience and establishes a relationship with the environment. This can be built with previous concrete; these trails run along the edge of the wetland respecting its natural structure, allowing the enjoyment and understanding of the ecosystem while establishing a clear limit that will control further expansion of the urban landscape.

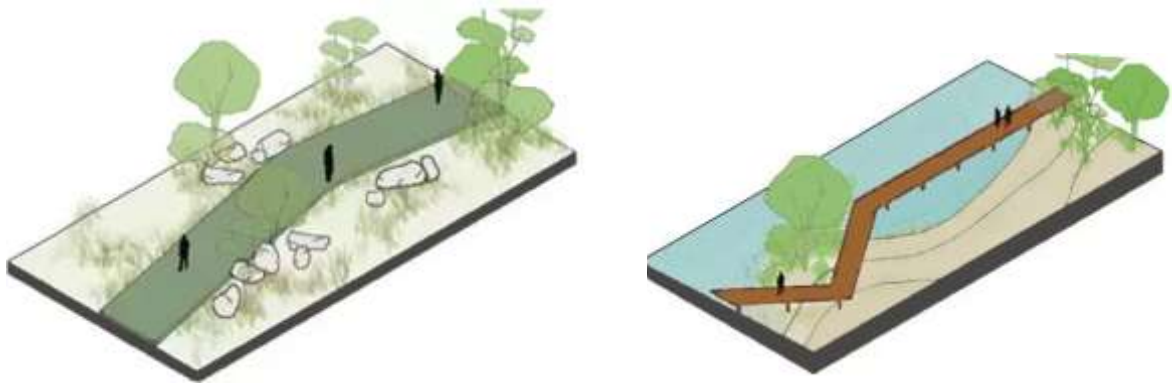


Figure 4.9.6. Propose shared and stilt path features

- **Stilt path-** this path allows visitors a closer relationship with nature and wetland.
- **Bike parking-** most of the park's movement routes are for pedestrian cyclist and disabled so this space is basic program in order to initiate the community health as

Proposed wetland area coverage

The result analyzes that the current wetland coverage of Cheleleqa wetland decreases from time to time; this means the wetland coverage is decreased by 72.44% within 16 years. So the proposed green space development will boost the liability of the wetland using different natural as well as artificial mechanisms. So based on the proposed master plan, the wetland park will raise the coverage area of the wetland to 16.6 hectares.

Figure 4.9.7. Proposed area coverage of Wetland Park and proposed ponds

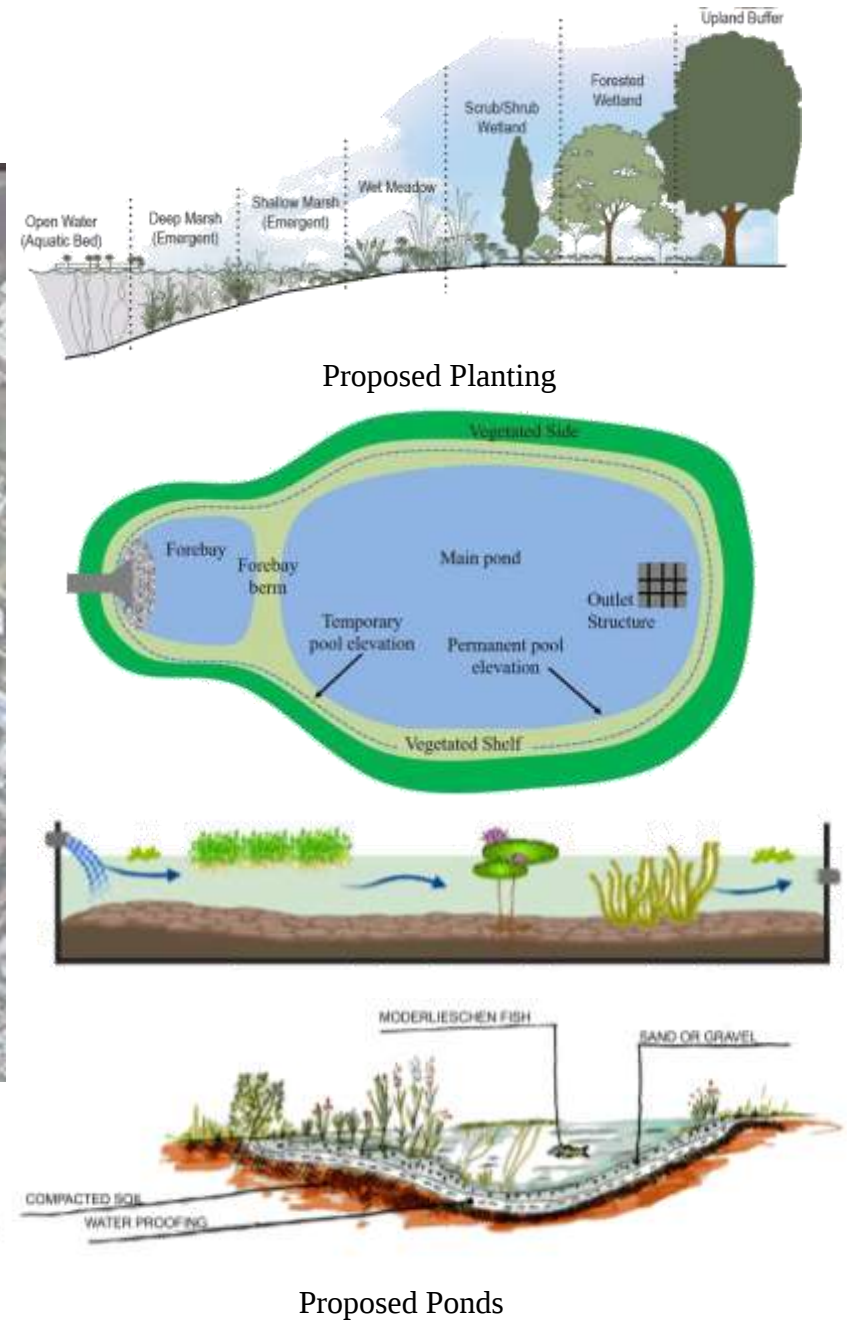
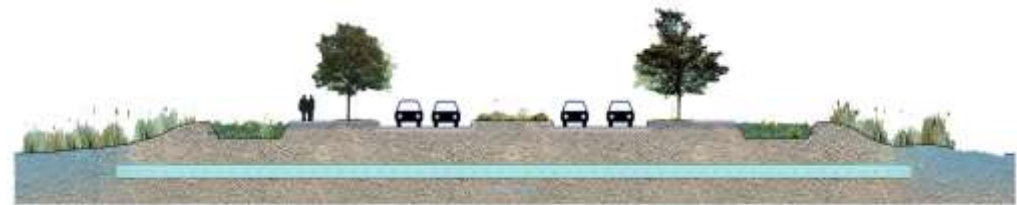


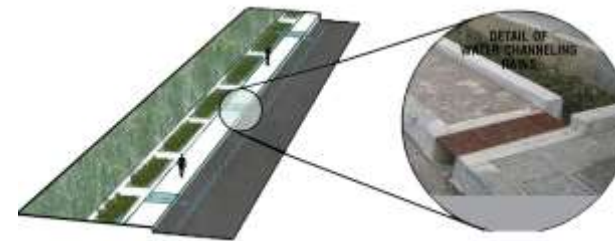
Figure 4.9.8. 3D Features of the Wetland Park



Figure 4.9.9. 3D features of the proposed Road Storm water Prevention Mechanism



Rain Water treatment



Water Channeling Trench

- On the proposed road in order to prevent storm water runoff addition of green infrastructures beside the roads which is water channeling trench to control waste, adding bio swales or vegetated swales besides Main Roads, creating visual comfort to the users by opening side of the park, addition of median strip channel to enhance mobility is the main activities.



Road with visual comfort



Road with visual comfort



Median strip Channel

CHAPTER -5 CONCLUSION and RECOMMENDATION

5.1. Conclusions

Cheleleqa is a seasonally flooded shallow pan in to which fresh water seeps and flows from surrounding cultivated slopes and townscapes. Water fills the muddy depression during the rainy season and persists well in to the dry season.

The land use land cover change which is taken from the years 2000 to 2021 shows the coverage of forest land (the spares vegetation of eucalyptus and juniper trees)decreases 26 to 24%, Water Body decreases 20 to 8% , farmland (all cultivated areas) increases 42 to 43% and Urban settlement increases 9 to 11% from within 21 years.

The wetland coverage during the dry season is decreased due to the increasing demand of water and wetland by the society and other mismanagement problem. The wetland coverage of the lake was 7.7 hectare during 2005 and it decreased to 2.1 hectare on 2021, this means the wetland coverage is decreased by 72.44% within 16 years.

There are different types of vegetation coverage from large trees to shrubs and grasses around the lake. But the vegetation coverage dramatically decreased through time due to expansion in need of the space by the societies.

Currently the society uses the wetland for different purposes which are agriculture, cattle grazing, recreation and other people activity and as a waste damping site.

Bad smell, unexpected flood, theft and low road coverage are top factors that the societies responded as a problem of the wetland.

The existing infrastructure condition on the wetland is barely poor. There are no available storm water treatment facilities, services infrastructures, amenity spots and access and feeder roads.

The waste management of the wetland from agriculture, industrial, animals, town and personal waste is very poor also much concerned.

Currently the lake has suffered greatly from increasing silt deposit during rainy that significantly reduced its water reservation capacity for the dry season these damage the wetland too. The following are major factors that negatively affect the lake and its wetland

✚ Intensive urban agriculture on the wetland during the dry season

- ✚ Solid waste & runoff waste from the storm water during rainy season
- ✚ Poor storm water management system
- ✚ Existing storm drainage facilities

As the lake and the wetland gives multiple services for the society, adequate attention and management not given due to this the lake is facing different problems those leads to decreasing of water reservation capacity for dry season. Therefore, the study strongly believes that healthy and ecofriendly green space development is recommended.

The proposed green space has consider the following main plan of action

- ✚ Recover- naturally restoration of hydraulic structures and continuous change of the wetland ecosystems. It includes co-naturalization of urban spaces urban transitions and connections and opening towards the wetland.
- ✚ Strengthening-improving its existing nature including seed forest, reconnection of water ponds and gradually foreign vegetation replacement
- ✚ Permanence space conformation- ecosystem and enhance their health as well as the wellbeing of the wetland. it includes open air classroom, aquatic, dry lands and forestry, wetlands path penetrations, playgrounds, entrance, compost area, nursery garden and recycling spaces
- ✚ Path conformation- the circulation of the visitor and accessibility of the green space and it includes shared path, stilt path and bike parking.

5.2. Recommendations

The government and city administration should give adequate attention for the lake and its wet land.

The government should assign a concerned body with full power and adequate budget to safeguard the health of the wetland and the lake.

Workable guideline and standards should be develop and implement with a tight monitoring and evaluation by assigned government organ or city administration.

Sustainable awareness creation and capacity development including different trainings for all stakeholders especially for the society have a direct business and day to day interaction with the lake.

The amount of water demanded from the lake during the dry season for the irrigation purpose should be limited. But application of different kinds of water management tools that are basically nature based for example vegetated swale/ bio swale, surface

detention/bio retention basin, cleansing biotope, constructed wetland, rainwater detention, green roof, controlled outflow to channels, riparian landscape and surface conveyance will improve not also the wetland ecosystem it also improve the lake and its biodiversity as long term urban planning.

Promote alternative fertilizer like organic compost usage for agriculture on the wetland by giving proper trainings and supports for urban farmers who engaged themselves on the agricultural business on the wetland. Because the current chemical fertilizer usage is heavily damaged the ecosystem of the lake and put in danger the future ecosystem of the lake.

Adequate waste management should be implemented including construction of different storm water drainage with solid filtration facility like silt and solid waste trap.

The concerned body should be allocating adequate budget and manpower to clean and to keep cleaned the wetland, blocked drainage and visitor residue.

Adequate facilities like toilets, seats and information signs should be constructed around recreational areas and frequently accessed areas by visitors and local residents.

The healthy interaction of hotels and resorts around the lake should be assess and regulate periodically.

To improve the circulation and limit the unrestricted interaction of the society with the wetland, access and feeder roads and access barrier should be constructed.

It is well known that prevention is better than cure and by taking lesson from similar lakes in Ethiopia like Haromaya, stakeholders should be devote with their unlimited effort on prevention actions before the death of the lake. Because, the cost for prevention is less than the cost of desperate restoration action

Universities and other concerned NGOs and government organizations should be conducting similar researches by allocating adequate budget and capable professionals from all concerned sectors.

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Appendixes

Questionnaire paper for data collection distributed to Bishoftu town society.



GREEN SPACE DEVELOPMENT IN URBAN WETLAND FOR THE HEALTHY INTERACTION OF COMMUNITY THE CASE OF CHELELEKA LAKE, BISHOFTU TOWN

Adama Science and Technology University

School Of Civil Engineering and Architecture

Master of Science in Environmental Architecture

Survey Questionnaire

Dear Respondents,

The questionnaire is prepared to conduct study on “**GREEN SPACE DEVELOPMENT IN URBAN WETLAND FOR THE HEALTHY INTERACTION OF COMMUNITY THE CASE OF CHELELEKA LAKE, BISHOFTU TOWN**” for the partial fulfillment of MSc degree in Environmental Architecture that is given by Adama Science and Technology University. So, you are selected to give your answer and opinion for the questions.

Please, note that the information you provided is only used for the academic purpose and confidential. Besides, no reference will be made to you in particular. Therefore, feel free to respond to the questions to the best of your knowledge so as to realize the objective of this study.

Thank you in advance for your cooperation

Haymanot Firew

MSc Candidate in Environmental Architecture

Adama Science and Technology University, Adama, Ethiopia

1. Date _____

2. Name of interviewer _____
3. Name of Respondent _____
4. Age?
- A. 15-20 B. 21-30 C. 31-40 D.41-50 E. 51-60 F. 61 and above
5. Gender ☐ Male ☐ Female
6. Kebele _____
7. Marital status ☐ Married ☐ Single ☐ Widowed ☐
Divorced ☐
8. Did you attend formal school Yes ☐ No ☐
9. Educational level University College ☐ ☐ Secondary
 Primary ☐ Never attended School ☐
10. Economic activity done for a living
- A. Farmer B. Employed (Private, Government, NGO) C. Other
(specify)

If your answer is other

11. What kind of transportation did you use to arrive /reach here?
- A. By foot B. By bicycle C. By car D. Bajaj E. Motor Bicycle F. Other
(Specify)

12. Did you come alone to the wetland of Cheleleqa Lake?
- A. With families B. With friends C. Alone D. With tourists
13. Why do you come to the wetland of Cheleleqa Lake?
- A. Work B. To relax C. To visit D. to take pictures

14. How often do you come to the wetland?
- A. Everyday B. Every weekend C. Sometimes D. Never
15. What time did you use a lot to spend around the wetland? And for how long?
- A. Morning B. Afternoon C. After 11 O'clock D. to take pictures

16. What problems did you see while you staying around the wetland?

17. Is it safe for you to stay to stay around the wetland?

Yes ☐ No ☐

If your answer is Yes How?

18. Did you face any problem at the time of staying around the wetland?

Yes ☐ No ☐

If Yes; what kinds?

19. How do you use the wetland?

20. How do you manage your waste (Solid, Liquid / Both)?

21. How do you see the status of infrastructure (Road, Surrounding facilities) before and now?

A. Very Good B. Good C. Fair D. Poor

22. Who do you think is responsible for the present status of the wetland? (Government, NGO, Other)

USE OF WETLAND

23. How have you been using this wetland?

Rank 3 of the uses in order of preference:-

Wetland use	(a) 10 years ago	(b) Now
a. Grazing fields		
b. Cutting grass for sell		
c. Water collection		
d. For farming		
e. For fishing		
f. Other (specify)		

24. Do you have a monthly generating income activity?

Yes ☐

No ☐

A. Interview Guide For Farmers

1. What is the brief history of the wetland?
2. How do you use the wetland?
3. Size of your farming land?
4. What is the source of water for the farm?
5. How have you contributed to the quality of the wetland as well as the Lake abundance?
6. Do you have your own pond?
7. What can you comment about the Environment and related infrastructures?
8. What challenges have you encountered? If any how have you gone about them?
9. In your own views, what is the future of the wetland of Cheleleka Lake?
10. Any general comments regarding the wetland?

B. Interview Guide for Bishoftu Town councils

1. How did the council use and manage the wetlands of Cheleleka Lake?
2. What can you comment about the activities around the Lake Cheleleka regarding the wetland?
3. What kinds of measures are conducted on the wellbeing off the Wetland of cheleleka Lake?
4. How do you benefit the society regarding the use of the wetland?
5. What do you think about Green Space development as a new strategy for the urban wetland?
6. What can you comment about the Environment and related infrastructures?
7. What do you feel for the future of the Cheleleka Lake with reference the Wetland, people and the environment?
8. What are your general comments regarding the issues to do with the Wetland of Cheleleka Lake?

C. Interview Guide For Individual Interviews

1. What do you do for living?

2. How do you use the Wetland?
3. What are your views regarding the activities of the wetland. How has it contribute to the living standards of the society?
4. Who do you feel is responsible for the present state of affairs in this area?
5. What do you feel for the future of the Cheleleka Lake with reference the Wetland, people and the environment?
6. Comment on the general environment and societies trends in this area?

D. Focus Group Discussions Guide

Questions

1. Land Uses (Land use change, previous History and current activities etc...)
2. Water source and flood Management (History, and current activates)
3. Seasonal Calendar (Agriculture, Rainfall etc...)

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