ECO-TOURISM DEVELOPMENT PRAPOSAL FOR ANSUPA LAKE, ODISHA

Submitted
In partial fulfilment of the requirements for
The award of the degree of

MASTER OF ARCHITECTURE
(LANDSCAPE)

By
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Declaration

I **Sagar Sanjay Kamble**, Scholar No: 2017MLA018 hereby declare that the thesis entitled Landscape Development Plan for Ansupa Lake, Odisha, submitted by me in partial fulfilment for the award of Master of Architecture (Landscape), in School of Planning and Architecture, Bhopal, India, is a record of bona fide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

20th April 2019 Sagar Sanjay Kamble

Certificate

This is to certify that the declaration of Sagar Sanjay Kamble is true to the best of my knowledge and that the student has worked under the guidance of the following panel.

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Sagar Sanjay Kamble

TABLE OF CONTENT :

LIST OF FIGERS

1. INTRODUCTION

1.1. Background- Importance of Water

Water is an essential component of human existence. The oldest philosopher knew that water was life's origin. Thales (6th century B.C.) was the earliest Greek scholar to speculate in regard to the main material component or origin of all humans and natural events, which he recognized as water. Asian philosophy described water as the "start and base of all development." Thales ' opinion that water is the divine cause of all the living stuff caused him to indicate that it is water, since its strength is essentially kinetic, that the true material of soul and nature. The flow of water enables to keep equilibrium on the planet and within all species. Since the beginning of life; civilizations have witnessed growth along water bodies, establishing the significance of water as a driving force in the process of development. Different alternatives have existed throughout the centuries to ensure sufficient water supplies for human colonies. In drawing their water, indigenous individuals were very clever. They regarded water as a very important and often sacred component. A large or sufficient supply of water has been one of the key variables in the growth of a community–towns and societies over the lengthy term. Water is a financial and social advantage rather than just a product. This positions government accountability for its administration and supervision. For the future it is important to balance objectives of water utilization, water amount and water quality. While the water supply will remain of the greatest concern, problems in water quality are comparatively even more crucial than amount. It is increasingly crucial that water is used wisely and that this significant natural asset is not wasted. Thus the wise use of water and the safe use of water bodies is a primary objective and a duty for everyone. Without water, life just can't happen.

Nature has endowed us multiple natural water resources such as ocean, seas and rivers, lakes, streams etc. Humans, also where necessary have created manmade reservoirs for various purposes to sustain life. Since water holds so much importance it is essential to conserve and preserve these water resources to continue to use them for human existence, environment sustainability and retain urban nature link. To retain this balance lakes play a significant role with varied services it can provide to its surrounding setting and ecosystem.

Lakes provide many of our inhabitants not only with water and subsistence, but also promote a big part of biodiversity. The forests, the flaky peripheries of big rivers and a big number of animals, many of whom move to various parts of India, are breeding and nesting grounds. But lake and wetland degradation has been due in particular to the anthropogenic pressures in their catchment fields during last few centuries. The human waste and land erosion that resulted led to our ponds being silted and eutrophic.

1.2. Information about Odisha

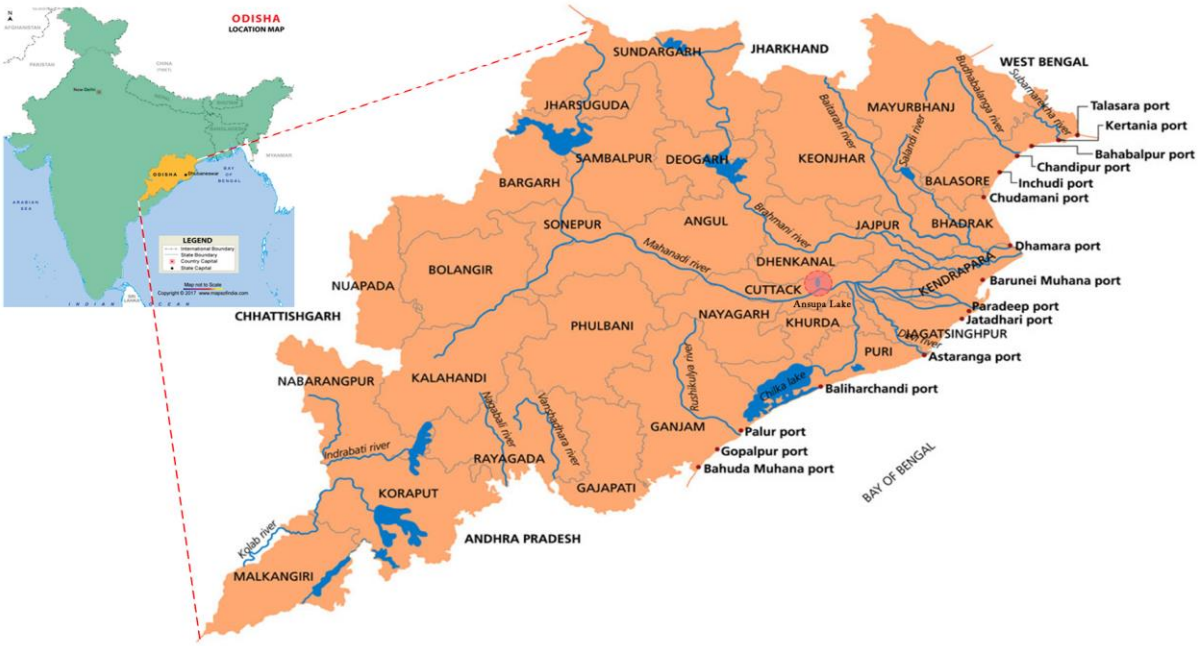


Figure 1 - Location map of Odisha

The waters of the Bay of Bengal spiralling along the east and south-east borders of Orissa are on the East shore of India. In the north, the Bay of Bengal is covered by 300 miles (482 km) of smooth sea, whereas the elevated hills and mountains of the East Ghats are bordering the west. In the meantime, there is a tranquil, rural landscape of 96,000 miles (156,000 sq kms). To tens of the holiest pilgrimage sites of India and to hundreds of thousands of traditional little towns with a surface region of approximately 1 55,707 km2. Modern Orissa is one of today's most famous tourist destinations with many decades of history.

1.3. Lakes and Reservoir in Odisha

Odisha is bestowed with abundant water resources with pristine water and siren landscape, the pristine yet popular lakes in Odisha are known to be major crowed-pleasers. The most important water resources are wetlands like lakes and reservoirs. Apart from being sources of water, Lakes are highly productive eco systems. A large number of people depend upon the lake resources for irrigation, drinking, fishery, energy production etc. for their sustenance. It has unique bio diversity character. It harbors a large number of aquatic fauna and flora. Sometimes the productivity is more than agriculture resources. Orissa has many Lakes which is very important water resources and very famous Natural Heritage sites.

Figure 2 - Ansupa Lake (Inland Lake)

Figure 3 - Chilika Lake (Costal Lake)

Figure 4 - Kanjia Lake (Inland Lake)

Figure 5 - Sara Lake (Inland Lake)

Figure 6 - Bhitarkanika (Costal Wetland)

Figure 7 - Balimela Reservoir

But due to improper management coupled with excessive exploitation, most of the water bodies are severely stressed and depleting. In time to come, water demand and supply gap will grow wider, leading to bigger equity issues in socioeconomic development and environmental sustainability. Lakes, the preservation of the economic health of metropolitan regions plays a crucial part, whether man-made or fresh water or brackish. These waters conduct important environmental, cultural and financial tasks, from a source of drinking water, to ground-water recovery and to flood control, wildlife support and livelihoods. These water bodies conduct important tasks. They have, however, become today's greatest loss of urbanization.

1.4. Why Ansupa Lake? (Importance and Need)

- Ansupa lake and wetland surrounded by protected areas in the vicinity it become a safe place for birds and animals to breed and feed, because of Chilika and other wetlands in Odisha it attracts many migratory birds coming from Siberian region, for them Ansupa wetland acts like major stepping stone in the coerce of their migration.

- The Ansupa Lake has a great scenic beauty surrounded by Saranda and Bishnupur hills and river Mahanadi in its vicinity which attracts many tourist.

- Ansupa wetland provides various resources for the livelihood of the communities staying nearby villages.

- The place holds historical significance also because of Saranda Fort.

- As this lake has great potential for Eco-Tourism development but due to the negligence the lake is at the verge condition of degradation.

Figure 8 – Panoramic Top view of Ansupa Lake and Wetland

Figure 9 - View of Ansupa Lake

2. AIM, OBJECTIVE AND SCOPE

2.1. Aim

To rejuvenate the Ansupa Lake in Odisha by restoring its biodiversity through a holistic landscape design approach while promoting the site as an Eco-tourism destination.

2.2. Objectives

Ansupa Lake and Wetland has huge potential to become an Eco-tourism Site.

- To understand the physiographic of delineated site in micro and macro level.
- To understand the landscape values and significance of Ansupa lake.
- To study cause and evolution of lake (Socio cultural significance).
- To understand the landscape characteristics spaces around the region.
- To understand the ecology of the wetland.
- To determine the ecological boundary of the Ansupa lake wetland system.
- To identify the reason which lead to degradation of Ansupa Lake and wetland.
- To prepare a landscape integrated master plan for Eco-tourism.
- To create a network of tourist and cultural spaces.
- To study and propose planting strategies which enhance bird population in the Ansupa wetland and surrounding areas.

2.3. Methodology

The methodology to be adopted will be to follow the following list in order:

- Collection of available data of the site- history, government tender document, water quality reports, etc.
- Literature study – about lakes, management and conservation of lakes, treatment of lakes, case studies, cultural and historic value of lakes and lake revival as a measure for the development of a city
- Prepare a research paper of all the above data
- Site visit- record observations
- Site analysis- topography, vegetation, climate, surface hydrology, geography, history, land use water quality and soil test, etc.
- Landscape Character analysis, activity mapping, spatial analysis, etc.
- Community needs and demand study
- Site constraints/Issue identification- detail key issues of the site needed to be resolved for the revival of the lake
- Prepare an outline map for integrated landscape proposal of Ansupa Lake - catchment area, sustainability, tourism and visitors, and water treatment methods
- Develop a conceptual plan for site opportunities.

3. LITERATURE STUDY

3.1.0. LAKES

3.1.1. What is Lake?

- A pond is a big, land-circumcising body of water. Fresher, sour (like the Great Salt Lake), the water of the lake can scarcely be. A lake is usually considered to be larger than the' pond.' — A vast region of water is rounded by soil and not linked to the ocean except rivers or lakes.

- Lake is a vast region of land-circled water. They are very much appreciated for their recreational, aesthetic and panoramic landscape characteristics and provide significant habitat, a fuel source for a varied range of fish, water life and fauna.

  Lakes behave almost like a living creature, constantly sensitive to what goes on around it. Lakes do not end their shores and cannot be isolated from land around them. They are profoundly affected by the changes taking place on land, even at great distance from the lake itself. Being complex, dynamic systems, doing things to them is bound to have effects and they need protection from abuse.

  Lakes all over the world are under the adverse effects of rapid environmental changes. Some of them have shown significant declines and deterioration in the water quality and are being subjected to change through time. Human activities are further accelerating the rate of change. Thus, there is a great need to adopt the preventive measures for controlling the detrimental changes.

  The increase trend of global warming is imposing a serious threat to the environment and the fast depletion of various natural resources due to human consumption is making the future of the world uncertain. The availability of clean, fresh water which happens to be the basis of human existence is also facing worldwide crisis.

  Hence, lakes being fragile in nature, it is imperative to understand and preserve the value of this precious resource.

3.1.2. Formation of Lakes

The features of the physico-chemical and biological occurrences occurring in a pond depend both on their shapes, magnitude and drainage basin features. The source of the pond is a significant factor in these features. The forces that create a pond are generally: 1. In geological terms, disastrous or sudden, 2. In national nature, several comparable lakes often emerge, forming a "neighbourhood of the lakes" and three. The ponds will then be transient characteristics of the scenery, accompanied by erosion (inlet), and sedimentation in the reservoir.

There are lakes in a variety of forms and sizes that add to their beauty and singularity. The way it was created often results immediately in the form of a lake.

Important natural force for the formation of lakes include glacial activity, tectonic motion, volcanic activity, erosion of the channel and other processes in the Earth's surfaces. Many lakes, including basins most deliberately established, are also formed by human operation.

Glacial Activity:
The weight and pressures of penetrating and recuperating ice layers have sculpted several depressions in the Earth's ground. The rock may divide and tighten the basin of' Glacial Scour Lakes' if the ice layers move over the flat stone ground with broken regions of cracks.

Tectonic Movement:
Tectonic depressions happen because of the disturbance, decay, folding and fracturing of the earth's soil. These depressions lead to ponds of enormous dimensions and profundities. Typically, those lakes shape at fault lines where flats encounter and more frequent earthquakes. The high, tight distance between the teams can lead to garben development when the adjective layers are separately on fault lines.

Volcanic Activit:
The top of the tower may be swept away during a volcanic eruption leaving behind a natural void known as a cave. This can be extended into a caldera by subsidence. These depressions are usually moist, tight and curved in form. Rain drops directly into a cave and caldera in dormant or extinct mountains that has no shallow outlet and forms the pond or pond of a caldera.

River Erosion:
Many lakes result from river movement of sediments that slowly creates lakes over time.

River Deposition:
During a flood a stream may shorten its course by crossing its meandering loops and leave a horseshoe-shaped canal like an ox-bow pond behind.

Manmade Lakes:
Reservoirs and rubble ponds are created by man by deliberate and unintentional damming or other procedures that contribute to water pooling in one place. In addition to the natural ponds, people have now built artificial lakes by erecting a concrete bridge across an open stream. Valley to reserve the waters of the stream.

Figure 10 - Types of Lakes

3.1.3. WETLANDS

3.1.4. Definition of Wetland

- A wetland is a territory whose soil is permanently or seasonally saturated with moisture. Such regions may also be partly or fully coated by shallow water pools. Among other wetlands, there are lakes, swamps and bogs. Water can be saltwater, freshwater or brackish in forests.

- Wetlands are areas that cover the soil, or are present at or near the soil surface all year round or for a variety of periods, including during the cultivation season. Water (hydrology) saturation mainly affects the way in which soils develop and the kinds of plants and animals in and on the land. Both marine and terrestrial animals can be supported by wetlands.

- Towards Wetlands in fields which cross bodies of water and soil can be discovered all over the globe. The water they obtain is their defining feature. There may be several shapes in a pond. Some grasslands include ponds, fens, bogs, river basins, swamps and estuaries. Wetlands outside the ocean are ground watered and planned; coastal habitats are precipitated by rainfall and soil waters but are also influenced by seawater and wind. The water table is situated on or near the ground of the earth in marshes and the region is usually covered by shallow water. A substratum of moist soil and materials, which do not consist of soil but are inundated by rain in increasing season, may also be other features of forests. Freshwater, saltwater, brackish water or running water are available in wetland habitats. Wetlands comprise moist soils and typically anaerobic environments and rooted crops or other life types. The features of wetlands can mix natural and marine habitats, although they remain distinctive.

3.1.5. Ramsar Convention definition

Under the Ramsar international wetland conservation treaty, wetlands are defined as follows:

Article 1.1 : " Wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that static or flowing, fresh, brackish, or salt, including areas of marine water the depth of which at low tide does not exceed six meters".

Article 2.1 : " Wetlands may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands".

3.1.6. Formation of Wetlands

Wetlands are a type wherever ground water is costly. All communicate to produce a hydraulic model for wetland creation by climate, internal land moisture and topography. Special wetland features (such as crop group structure and efficiency) are affected by other variables (such as ground history, groundwater features, and hydrologic structures). The abiotic characteristics of wetlands reveal an association of hydrological variables.
Wetlands may develop also when its banks overflow or shifts in ocean level become overwhelmed by dry regions. Furthermore, weather can influence the development of wetlands as elevated precipitation causes the soil to get wet in usually dry regions with bad drainage.

They change continuously once wetland shape. Like increasing sediments and debris, which shape wetlands, they can make the lake shallower, in conjunction with roots and deceased plants, and ultimately the bottom parts grow over the water table and drain out. Terrestrial animals and plants may colonize the territory when this occurs.

3.1.7. Characteristics of Wetlands

Characteristics of wetlands adjacent to lakes and their ability to retain Non-Point source pollutants (UNEP/IETC, 1999).

Types of Wetland	Characteristics	Ability to retain non-point source pollutants
Wet meadows	Grasslands with waterlogged soil; standing water for part of the year.	Denitrification only in standing water, removal of nitrogen and phosphorus by harvest.
Fresh water marshes	Reed-grass dominated, often with peat accumulation.	High potential for denitrification, which is limited by the hydraulic conductivity.
Forested Wetlands	Dominated by trees, shrubs; standing water, but not always for the entire year.	High potential for denitrification and accumulation of pollutants, provided that standing water is present.
Salt water marshes	Herbaceous vegetation, usually with mineral soil	Medium potential for denitrification; harvest possible.
Bogs	A peat-accumulating wetland with minor flows.	High potential for denitrification but limited by small hydraulic conductivity.
Shoreline Wetlands	Littoral vegetation of significant importance for lakes and reservoirs.	High potential for denitrification and accumulation of pollutants, but limited coverage.

3.1.8. Importance of Wetlands

- Wetlands are natural water purifier. Bacteria, plants and animals present in the wetland are natural filters. They absorb the minerals and gases dissolved in the water.

- Wetlands are habitat spaces for many species. Birds, animals, fishes, plan tons, plants and sometimes humans are largely dependent on wetland and its resources.

- Wetlands acts as sponge during floods and can absorb huge amounts of flood water reducing the damage caused by the floods. Riverine wetlands plays a vital role in absorbing the floods.

- Wetlands are a recreational spots. It is an open up space for the people. Activities like hiking, camping, bird watching, fishing, boating are some major activities that happen in these water bodies.

- Wetlands tends to absorb large amount of phosphorus which tends to pollute lakes and underground water systems. Phosphorus causes algal bloom in water bodies.

- Wetlands provide many educational activities as it is a major site for various research works, birders, aquaculture, water management etc.

- Wetlands have their own micro watershed. It even stores water in saviour dry seasons and feeds the nearby areas by releasing the stored water.

- Wetlands checks soil erosion as it enhances the vegetation quality of the area.it reinforces the soil. Wetlands also provides us with many medicinal plants.

- Wetlands absorbs large amount of carbon and other greenhouse gases. It plays an important role in checking climate change.

3.1.9. Functions of Wetland

- The association of man and wetland is ancient. Development of water resources is the backbone of any economic activity. Wetland systems directly and indirectly support millions of people, by providing goods and services to them.

- These standing water bodies not only serves as source for fresh water, but also act as units for recharging ground water which in terms act as a channel of distributing or providing access to all living biota and thus help in maintaining the fragile ecological balance.

- Indirect benefits from functions occurring within the eco-system such as, flood control, Wetland have the capacity to retain excess floodwater during heavy rainfall that would otherwise cause flooding. By retaining flood flows, they maintain a constant flow regime downstream, preserving water quality and increasing

biological productivity for both aquatic life as well as human communities of the region.

- Wetland vegetation plays a major role in erosion control, which in turn contributes to shoreline stabilization and storm protection. Coastal wetlands in particular mangrove forests play a major role in shoreline stabilization and storm protection by helping dissipates the force and protect the coast by reducing the damage of wind and wave action.

- Wetland supports indigenous people as part of their cultural heritage.

- Wetland retain nutrients by storing eutrophic parameters like nitrogen and phosphorus flooding waters in vegetation or accumulation them in the sub-soil.

- Wetland also helps in absorbing sewage and purifying water supplies.

Apart from the Socio-economic values of wetlands like water supply, fisheries, fuel wood, medicinal herbs and plants, livestock grazing, agricultural energy resources, wildlife resources, transport, recreation and tourism etc…

- It moderates temperature and affect the climate of the surrounding area. By storing water they help in regulating stream flow, recharge ground water aquifers and moderate droughts.

- They contribute to important process, which include the movement of water through the wetlands into streams or the ocean.

- They provide habitat to aquatic and semi aquatic plants and animals and thus supports the biodiversity of the landscape. Thus clearly demonstrates it role in maintaining ecological balance by supporting all forms of life and perform useful function like interfacing both land and water systems which are highly productive and biologically rich ecosystem.

3.1.10. Wetland Ecosystem Functions Primary production and the food web

Green plants use the sun's energy to convert inorganic (non-living) minerals to organic (living) plant tissue. This process is known as photosynthesis. At the first level of production of organic material the process is called primary production and is accomplished only by those microorganisms that contain chlorophyll. Plant species common to wetlands have high levels of primary production. Estimates of the primary production of wetlands are as high as 4-6 tons per acre per year. Wetlands productivity rivals or surpasses the most productive farmlands (Tiner, 1984). Animals that feed directly on plant material are called primary consumers. However, few animals eat wetland vegetation and most of the plant material becomes detritus. Detritus is partially decomposed plant material. In wetlands systems, some or most, of the material is exported to the estuary. Many types of microorganisms grow on the detritus. The tiny plants and animals which populate the detritus increase the value of the detritus as food for estuarine organisms. The detritus is consumed by many animals including

crabs, fish and shellfish. The consumers digest the microorganisms growing on the detritus. However, the detritus is only partially broken-down and passes through mostly undigested. The detritus is repopulated with microorganisms and the process is repeated. The higher level consumers in the process are those that feed on the detrital consumers. Examples of higher level consumers are shorebirds, finfish and mammals including humans.

3.1.11. Threats to wetlands

Wetland values are increasingly facing several anthropogenic pressures. The rapidly expanding human population, large scale changes in land use / land cover and burgeoning development projects and improper use of watersheds has all caused a substantial decline of wetland resources of the country. Absence of reliable and updates information and data on extent of wetlands, their conservation values and socioeconomic importance has greatly hampered development of policies, legislation administrative interventions by the state.

3.1.12. Causes of Deterioration of Wetlands

Dense human population in catchments, urbanisation, and various activities has resulted in over exploitation of wetland resources, loading to degradation in their quality and quantity. Now, there is increasing concern to conserve and restore perishing wetlands and endangered habitats to achieve ecological sustainability. As per one of the studies, wetlands in our country are disappearing at a rate of 2% to 3% every year. Some of the major threats to wetlands are as given below:

- Urbanization- increasing developmental pressure for residential, industrial and commercial Facilities.
- Anthropogenic activities- unplanned urban and agricultural development, industries, road construction, impoundment, resource extraction and dredge disposal.
- Agricultural Activities- conversion of wetlands for paddy fields; construction of a large number of reservoirs, canals and dams; diversion of streams and rivers to provide for irrigation.
- Deforestation- removal of vegetation in the catchment leading to soil erosion and siltation.
- Pollution-unrestricted dumping of sewage, solid wastes and toxic chemicals from industries and households.
- Salinization- over withdrawal of groundwater has led to salinization.
- Aquaculture- pisciculture and aquaculture ponds.
- Introduced Species- exotic introduced plant species such as Water Hyacinth and Salvinia clog waterways and compete with native vegetation.
- Climate change- increased air temperature; shifts in precipitation; increased frequency of storms, droughts, and floods; increased atmospheric carbon dioxide concentration; and sea level rise.
- Draining and land filling
- Over- exploitation of fish resources
- Pollution
- Agricultural production and residues, industrial wastes reach wetlands

- More than 1/2 of the world's remaining wetlands have been destroyed in the 20th century, especially in developing countries by the demands of industrialisation.
- 1/3rd of Indian wetlands has already been wiped out or has been severely degraded.

3.1.13. Ramsar Wetlands conservation and management

'Value' is an anthropocentric concept as it depends upon the perception or judgment of the human society about the usefulness of something. The goods and services provided by an ecosystem are then considered as values. All values are derived from the functions performed by an ecosystem. All wetlands perform certain functions and hence, have some values. Sometimes, these functions and values are considered interchangeably. It must be stressed however that all kinds of wetlands do not perform all possible functions, and therefore do not have similar values. The functions depend upon the location, size and various ecosystem, characteristics of the wetland, and also upon the nature and degree of human intervention. Functions of an ecosystem are ecological attributes resulting from the interaction between its physical, chemical and biological components. These interactions result in the creation of a variety of niches, which are occupied by various organisms thus providing a habitat to plants, animals and microorganism, is an ecosystem function. Besides the foregoing quantifiable and consumptive values, wetlands also have an important non-consumptive value.

Wetlands that are on the Ramsar list of International importance often provide habitat for wild life whose value is not expressed in monetary terms but whose aesthetic and biological diversity value is nonetheless recognized world -wide.

In view of understanding the utility of wetlands, the attempt made by the Ramsar authority as well as the strategy evolved by the scientists and other agencies are covered in this chapter. The legal, scientific, economical and cultural values of wetlands are the central issues being addressed.

The Ramsar Convention preamble recognizes the "fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna, especially Water fowl". The ambitious aim of the Convention is "to stem the progressive encroachment on and loss of wetlands now and future" and to support wetland conservation "by combining far-sighted national policies with coordinated international action". The Contracting Parties are bound by three main groups of obligations which, consistently with Ramsar's very broad definition of wetlands, apply equally to inland and coastal wetlands and water systems. They are as follows;

- **Site-specific measures:** To designate one or more suitable wetlands of international importance for inclusion in the list of wetlands of importance.(Art.2), to promote the conservation of listed wetlands(Art.3.1) and to establish nature reserves on wetlands and provide adequately for their widening. (Art.4.1);

- **Non-Site -Specific:** To formulate and implement their planning so as to promote, as far as possible, the "wise use" of wetlands in their territory (Art.3.1);

- **International cooperation:** To consult with other parties about implementing obligations arising under the convention in respect of trans boundary wetlands,

Shared watercourses and coordinated conservation of wetland flora and fauna (Art.5); Article.4 generally requires parties to encourage wetland research, to endeavour to increase water fowl populations on wetlands and to promote the training of personnel. The combination of localized, general and international measures is of particular interest. Whereas area-based conservation mechanisms were already well established in international and national law, the open-ended concepts of wise use and multifaceted trans boundary cooperation were more pioneering.3 The National policy and practice towards the conservation of wetlands varies from one Country to the other. Some Countries, which have ratified the Ramsar

Convention, have no legally backed definition of wetlands, whilst the Countries like Spain and Uganda have incorporated the Ramsar definition into national legislation without any modification. Costa Rica has recently modified the Ramsar definition to reflect the predominance of coastal wetlands and mangrove ecosystem. The Ramsar Convention's Strategic Plan 1997-2002, adopted by the COP in 1996, provides a clear conceptual frame work and ordered structure for the next phase of implementation. Its Mission statement for the convention-"the conservation and the wise use of wetlands by National and International co-operation as a means to achieving Sustainable Development throughout the World '-is intended to anchor Ramsar firmly with in the body of more modern environmental instruments founded on the concept of Sustainable Development. Under the Ramsar Convention on Wetlands, the two concepts of wise use and site designation are fully compatible and mutually reinforcing. The Contracting Parties are expected to designate sites for the List of Wetlands of International Importance, "on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" (Article 2.2). The Contracting Parties to "formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory" (Article 3.1) Ramsar COP3 (1987) defined wise use of wetlands as "their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem".4 The Strategic Plan (at COP6 (1996) and COP8 (2002) equate) adopted "wise use" with sustainable use. Contracting Parties to the Convention also recognize that wetlands, through their ecological and hydrological functions, provide invaluable services, products and benefits enjoyed by, and sustaining, human populations. Therefore, the Convention promotes practices that will ensure that all wetlands, and especially those designated for the Ramsar List, will continue to provide these functions and values for future generations as well as for the conservation of biological diversity.

3.1.14. Guidelines for management planning for Ramsar sites

Designed to complement the Ramsar management planning guidelines adopted by Resolution, this guide has been developed by WWF in association with Ramsar's Scientific & Technical Review Panel (STRP) in response to a request by Ramsar COP8 for the preparation of a simple "field guide" to wetland management planning. **Wetland management planning:** a guide for site managers provides those responsible for on-the-ground management of Ramsar sites and other wetlands with

a simple aide memoire summary of key issues and activities to remember and apply in the various different stages of the management planning process. The guide is arranged in a series of colour-coded sections designed to facilitate easy look-up when a manager is dealing with a particular aspect of the process. The guide is organized in the following sections:

i. Introduction
ii. The need for management planning,
iii. Essentials of management planning
iv. Successful wetland management planning,
v. Knowing the wetland and its values
vi. Setting management objectives,
vii. Achieving management objectives and
viii. Closing the planning loop.

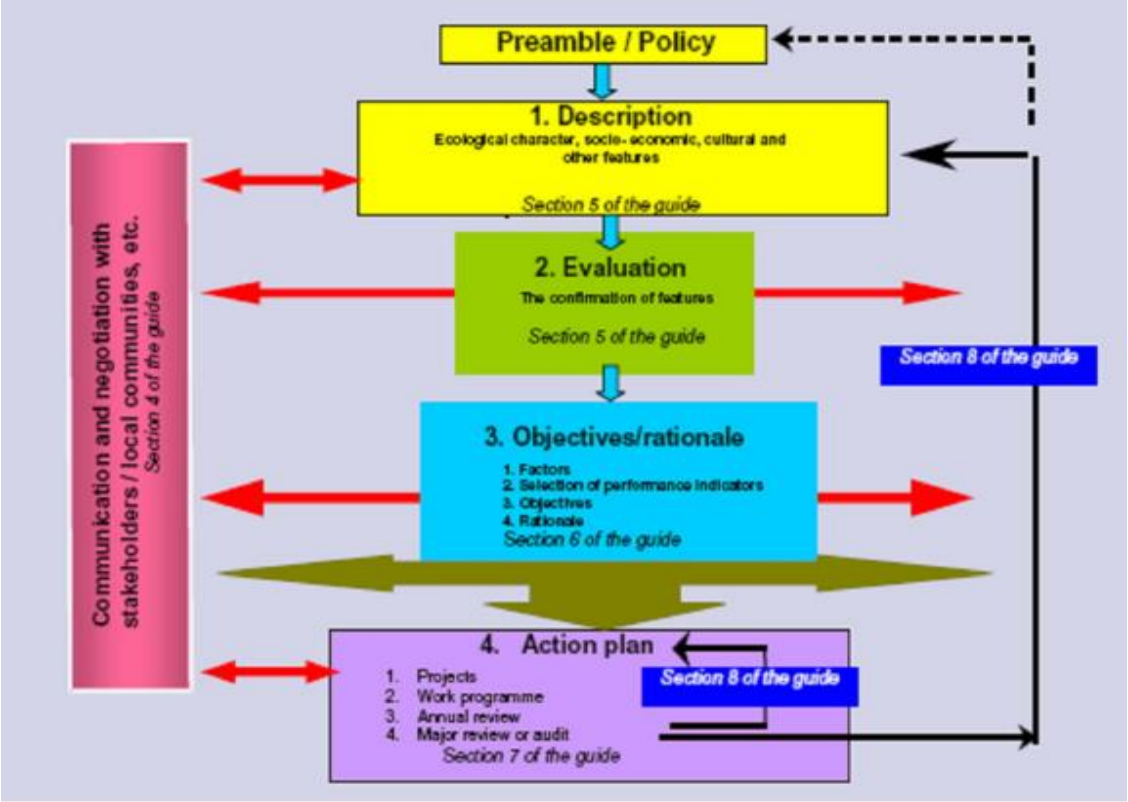


Figure 11 - (Source: Ramsar Hand books16: Managing wetlands)

General Guidelines

- Wetlands are dynamic areas, open to influence from natural and human factors. In order to maintain their biological diversity and productivity (i.e., their 'ecological character' as defined by the Convention), and to permit the wise use of their resources by people, an overall agreement is essential between the various managers, owners, occupiers and other stakeholders. The management planning process provides the mechanism to achieve this agreement.

- The management plan itself should be a technical document, though it may be appropriate for it to be supported by legislation and in some circumstances to be adopted as a legal document.
- The management plan is part of a dynamic and continuing management planning process. The plan should be kept under review and adjusted to take into account the monitoring process, changing priorities, and emerging issues.

- An authority should be appointed to implement the management planning process, and this authority should be clearly identified to all stakeholders. This is particularly important on a large site where there is a need to take account of all interests, users, and pressures on the wetland, in a complex ownership and management situation.

- Although conditions vary at individual wetlands, these guidelines may be applied worldwide. The guidelines provide a conceptual background to, and framework for, wetland management planning and an outline of the main sections of a management plan. It is emphasized that the guidelines do not provide a prescription for the detailed contents of a complete management plan itself, which will be a much more detailed document and should be prepared at regional or local level. ["Ecological character is the combination of the ecosystem components, processes and benefits/services that characterize the wetland at a given point in time." (Resolution IX.1 Annex A).]

- A management plan, and the management planning process, should only be as large or complex as the site requires. The production of a large, elaborate and expensive plan will not be possible, and certainly not justifiable, for many sites. The size of a plan, and (perhaps more importantly) the resources made available for its production, must be in proportion to the size and complexity of the site, and also to the total resources available for the safeguarding and/or management of the site. Thus for small uncomplicated sites, brief,

3.1.15. The components of the Total Value of a wetland

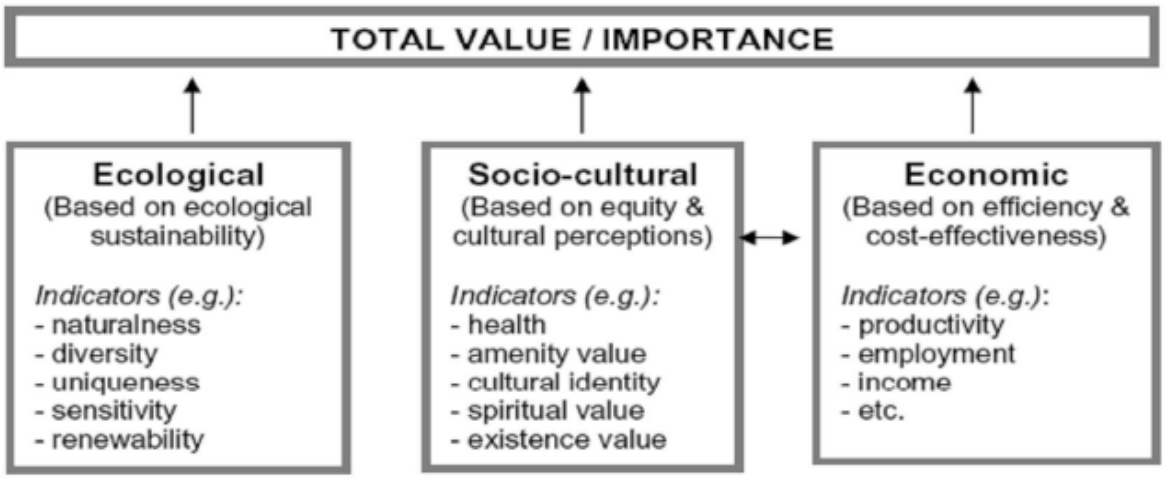


Figure 12 - (Source: Ramsar Technical Report No.3 CBD Technical Series No.27)

3.1.16. ECO-TOURISM

According to the World Conservation Union (IUCN), the Ecotourism is defined as:

"Environmentally responsible travel to natural areas, in order to enjoy and appreciate nature (and accompanying cultural features, both past and present) that promote conservation, have a low visitor impact and provide for beneficially active socio-economic involvement of local peoples.

Ecotourism is maintaining the tourism in natural areas without compromising the need of conserving the environment and making it more sustainable.

As per The International Ecotourism Society,
“Ecotourism is now defined as “responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education” Education is meant to be inclusive of both staff and guests.”

3.1.17. Principles of eco-tourism

(Jacobus Franciscus koenscarel Dieperink, 08 October 2009)

- It is about uniting the communities in order to minimize the negative impacts on environment and make the tourism sustainable.
- Ecotourism should be environmental friendly and socially and culturally responsible.
- Providing economic benefits for the local communities involved, by introducing the alternative employment and other direct income opportunities.
- Creating public awareness about the need to protect and conserve the environment and respecting the local culture.
- Introducing the alternative, low impact and environment friendly facilities.

3.1.18. Importance of Ecotourism in India

India being a reserve country of natural beauty like mountains, oceans, natural forests, valleys, architectural monuments and archaeological sites offers various tourism options all across the country. Tourism is India due to its varied geography is classified into four major part:

a) North Indian Tourism
b) West India Tourism
c) South Indian Tourism
d) East Indian Tourism

Each part offers several different tourist destinations to enjoy the nature in the most pristine way.

Presently, tourism is one of the largest service industry in India. The GDP of the country is expected to grow at the rate of approximately 8.0 percent yearly in the period of 2013-2023.

The WTO and UNEP (United Nations Environment Program) recognize five key challenges for sustainable tourism and they are

- Managing the progressive increase in the growth rate of international tourist arrivals by 2020.
- Climate change, as increase in tourism will contribute more towards the global warming.
- Poverty abatement mainly in rural areas where tourism can provide only a small number of augmentation options.
- Support from tourists regarding conserving and protecting the environment; and
- Issues regarding health and safety of tourists.

4. CASET STUDY – CHILIKA LAKE, ODISHA

4.1. Location, Geology and Geomorphology

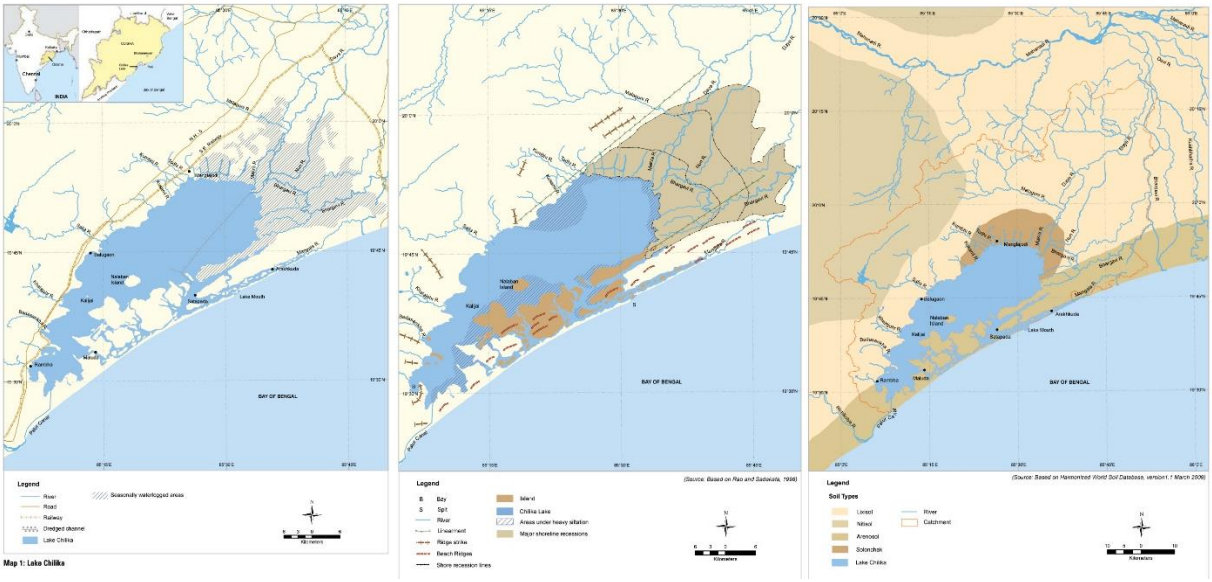


Figure 13 - Location, Change in Chilika Lake Shoreline and Soil Type

The origins of Lake Chilika are due to a complicated geological method concerning deposition of sand hills and troughs surrounding the water body. Chilika was component of the Bay of Bengal 6000 years ago and during Pleistocene supplied its Gulf. Chilika has been given a crisis of shoreline over the last 6000-7000 years, which was supported by sea and river dynamics (Flegar, 1969).

The region of Chilika is characterized by several erosion and depositional forms. Khondalites, unclassified granites, Laterites, Carbnockites, Anorthosites are the primary form of stone in the area around Chilika

Figure 14 - Opening of mouth to the sea in September 2000 helped to rejuvenate the Chilika Lake, Views of Chilika Lake

Chilika lake fluctuates within the region of a peak of 1165 Sq.km of Monsoon, with an average length of 20,2 km and a 906 Sq.km of the wedge formed watershed axis of 63,4 km. There are 24 islands at its southern edge, spanning an area of 18.4 km2. Chilika has a 32-kilometer channel connecting to the ocean, leading towards the Bengal Bay opposite Sipakuda, with a wide area of marshy alluvial land stretching to

about 400 sq.km in the west through the Palura Canal connecting Chilika. Eight blocks from 3 counties, Puri, Khurda and Ganjam, cover the bay borders.

4.2. Mahanadi River and Chilika Lake Basin

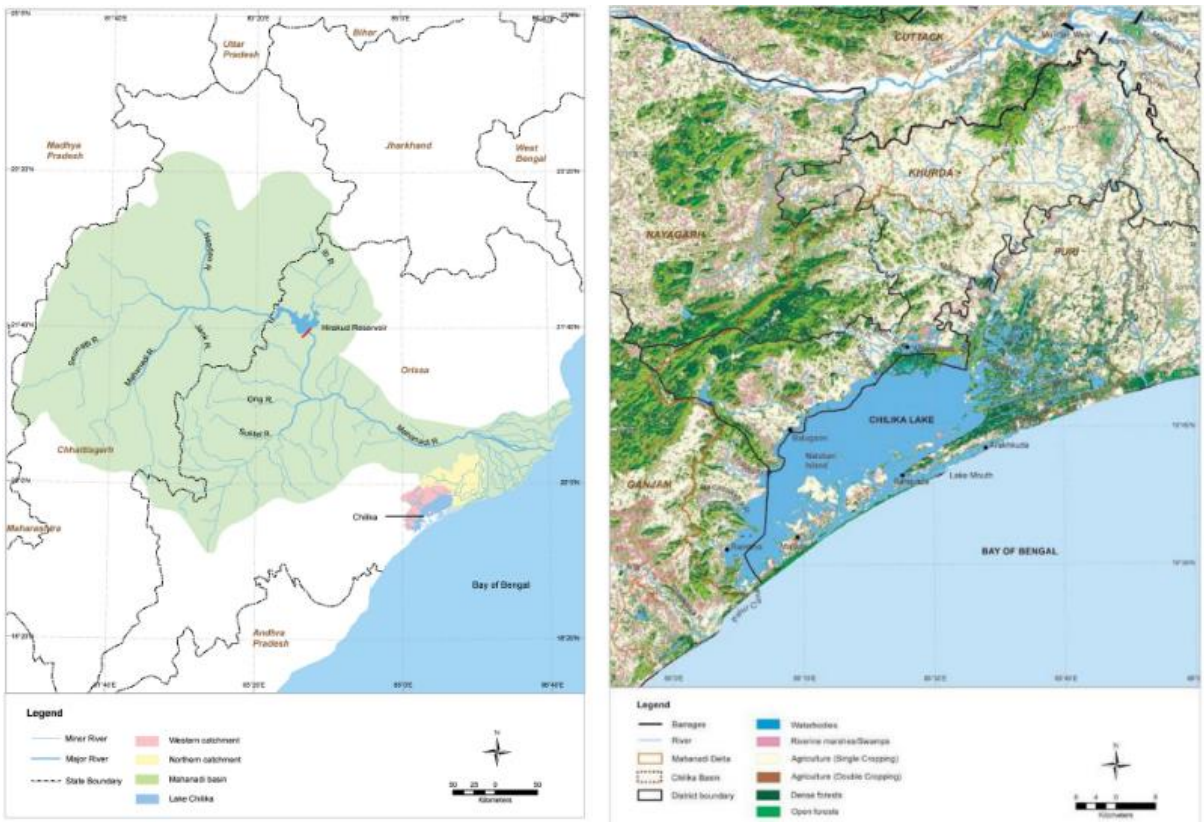


Figure 15 - Mahanadi and Chilika Basin

Chilika Lake is component of the catchment of the Mahanadi River Basin. It stretches from the Chhattisgarh hills Bastar and flows from 141589 m2 in Madhya Pradesh, Chhattisgarh and Odisha. The river is 858 km long. The canal produces a complicated, Naraj baraj arcuate delta which is divided into three distributors, Kuakhai, Kathjodi and Birupa. The delta itself is made up of the Brahmani-Baitarni sub-delta in the north, the Mahanadi River in the centre and the Devi in the west.

On the basis of drying, 6 watercourses, 56 mini-watercourses and 218 micro watersheds have been divided up into the river basin. The evaluation of land use with 2011 distant imaging imagery shows that agriculture accounts for 36.5% of the watershed region as the most dominant group. The next component of 26.1 percent of land use will be dense and open woods.




4.3. Hydrology

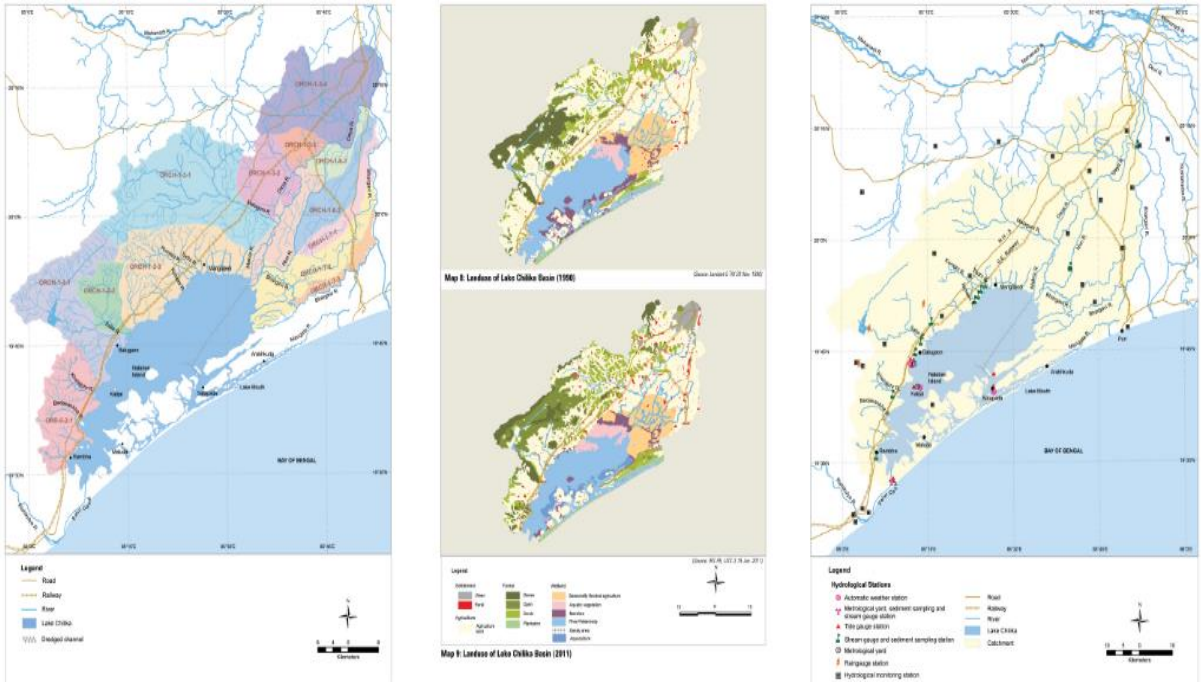


Figure 16 - Watersheds in Chilika Lake Catchment

Influenced by riparian basin as well as coastal processes, hydro-logical regimes in the Chilika area have, since 1999, been monitored through a network of 47 stations and another 30 monitoring stations. Chilika water supply includes Mahanadi and West drainage systems of freshwater, mouth water and Palur Canal at the south end of the pond. The water supplies to Chilika. A major source of fresh water to Chilika Lake is the river Mahanadi.

4.4. Important Issues with the Lake Chilika

- **Sedimentation:**

Lake Chilika is subject to sedimentation from its extensive catchment as well as from the sea Bay of Bengal.

- **Water Quality:**

Water quality of Chilika Lake in general is warm, alkaline, well oxygenated, turbid, brackish and nutrient rich. The lake water quality is conductive for aquatic life. However, seasonal and sectorial fluctuations are observed owing to connectivity with catchment and sea, evaporation and wind action.

- **Transparency:**

Chilika Lake is a shallow, well-mixed water body that is generally turbid.

4.5. Biodiversity and Floral diversity of Lake Chilika

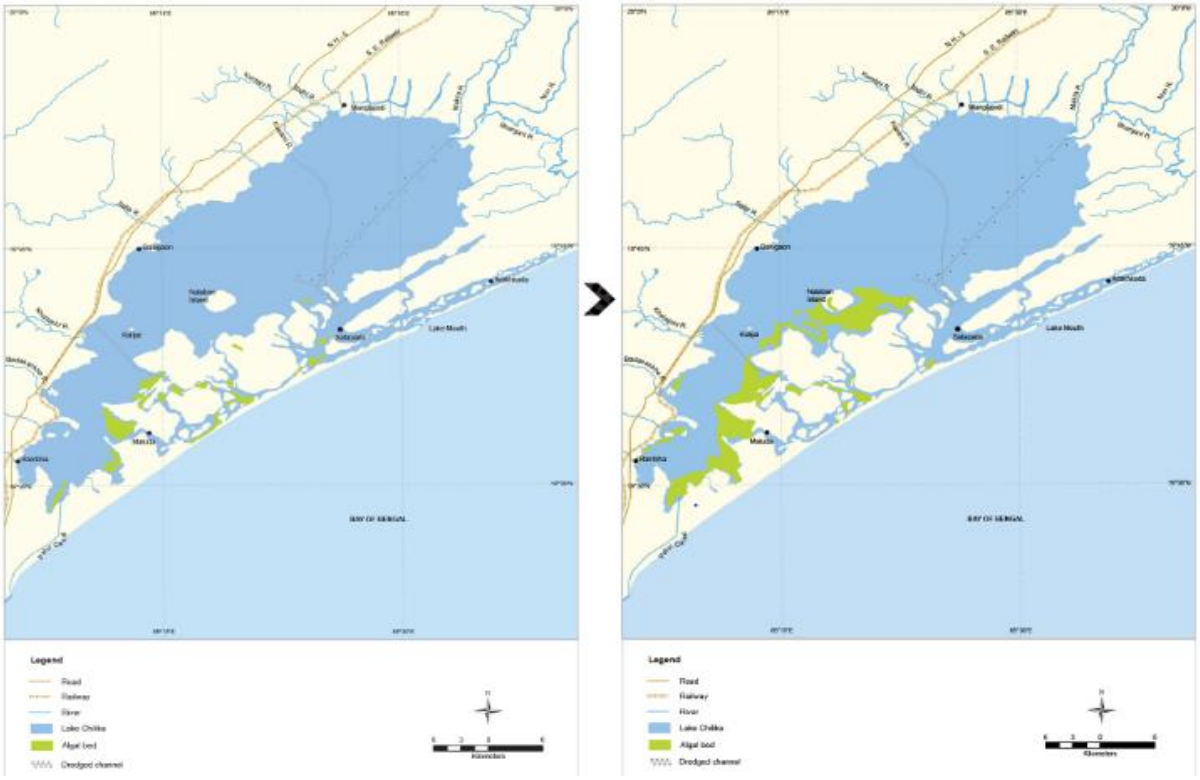


Figure 17 - Algal bed extent in Lake Chilika

Habits 399 phytoplankton, 14 bacteria, 729 trees, 37 zooplankton, 6 porifera, 7 coelenterate, 29 Platyhelminthes and 36 nematodes, 314 insects, 7 amphibians, 30 invertebrates, 224 birds and 19 animals are the islands. Chilika is the location of 379 phytoplankton fields and islands. A few scarce and threatened animals also live in the pond.

Biodiversity Group		No. of species	Record data	Status						
				CR	EN	VN	NT	DD	LC	NE
Flora	Phytoplankton	399	2003-04							
	Algae	14	2003							
	Plants	729	2008							
Fauna	Zooplankton	37	2003-04							
	Protozoa	61	1985-87							
	Porifera	6	1985-87							
	Coelenterates	7	1985-87							
	Platyhelminthes	29	1985-87				Not evaluated			
	Nematodes	36	1985-87							
	Annelids	31	1985-87							
	Mollusca	136	1985-87							
	Crustacea	31	1985-87							
	Decapoda	31	1985-87							
	Echinodermata	5	1985-87							
	Protochordata	1	1985-87							
	Fish	314	20011	2	2	4	17	15	61	213
	Amphibian	7	1985-87	0	0	0	0	0	7	0
	Reptile	30	1985-87					1	8	21
	Birds	224	2009	1	0	5	12	0	206	0
	Mammals	19	1985-87	0	1	1	1	0	16	0

CR - Critically Endangered • EN - Endangered • VN - Vulnerable • NT - Near Threatened • DD - Data Deficient • LC - Least Concern • NE - Not Evaluated
(Source: IUCN Red List of Threatened Species accessed in July 2011)

Figure 18 - Conservation status of Flora and Fauna in Lake Chilika

4.6. Vegetation of Lake Chilika

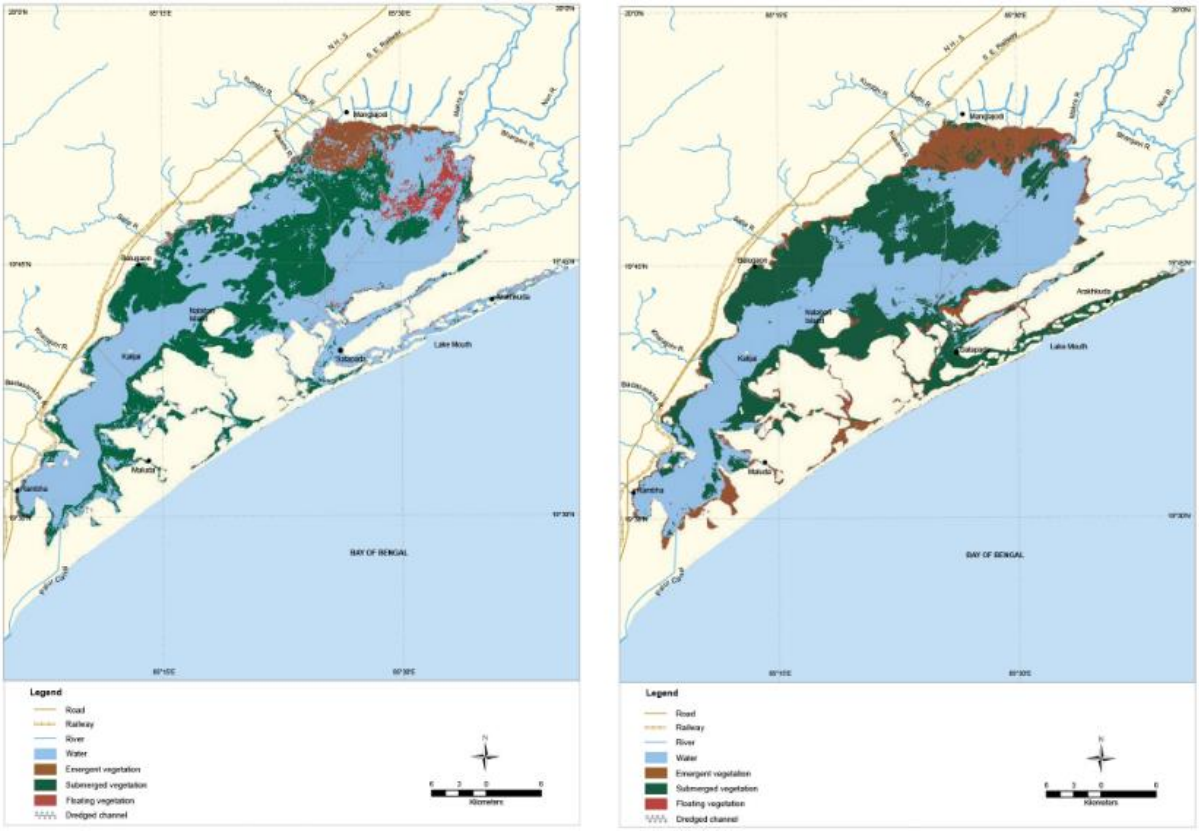


Figure 19 - Chilika Lake vegetation in 2002 and in 2010

In the southern area, the existence of Phragmites karka will have an effect on the sediment accumulation and preservation. The northern industry acts as the breeding floor for various economically significant fish species from an ecological view that would be impacted both by stress for youth and by the obstruction of the migratory route. Phragmites also tended to colonize areas of submerged soil in former times. Phragmites are considered to be a cause variable, especially for long phases of hydrology in cultivation in peripheral societies. Phramites ' dense stands also cause mosquitoes to grow and thus a health risk. Substantially silted regions generate conductive circumstances for soil invasion.

Mangroves planted considering their role in supporting nursery grounds for fish, prawns and crabs and ability to buffer storms.

Figure 20 - Phragmites Grass and Mangrove

4.7. Management Strategies and Framework

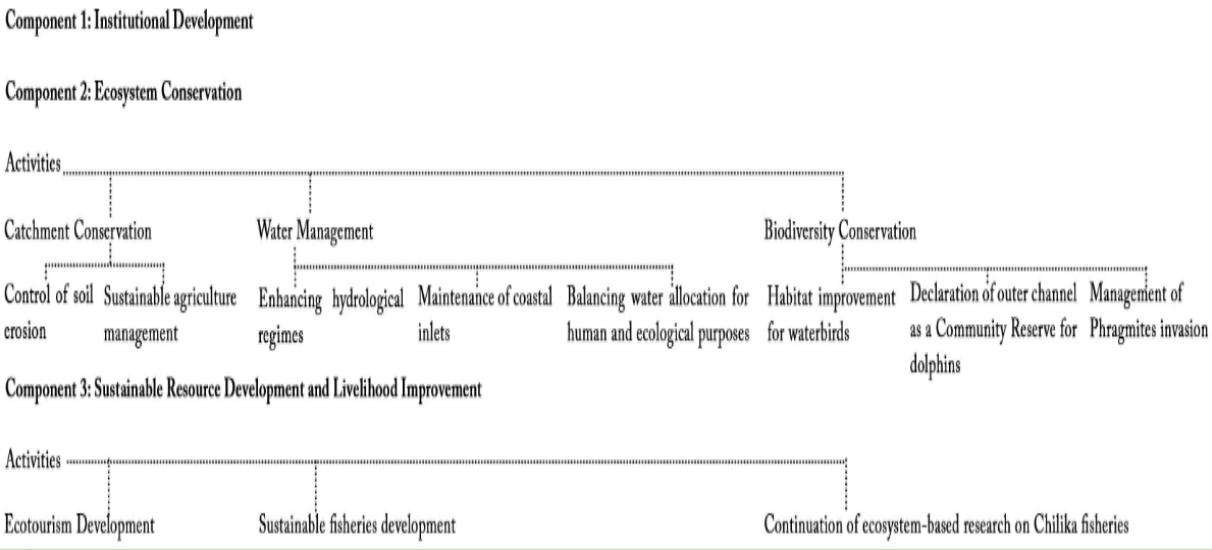
The management planning framework presented outlines a response strategy to the threats identified to ecological character and the gaps within the current institutional arrangements.

Management Strategies

Key management strategies to be adopted include:

- **Ensuring hydrological connectivity** of Chilika with freshwater and coastal processes at basin level
- **Establishing hierarchical and multiscalar inventory** of hydrological, ecological, socioeconomic and institutional features and ecosystem services to support management planning and decision making.
- **Promoting sustainable catchment management practices** to manage inflow of silt and nutrients into the wetland ecosystem.
- **Environmental flows as basis for water allocation** for conservation and developmental activities
- **Biodiversity conservation** through habitat improvement of endangered and indigenous species.
- **Ecotourism development** for enhancing awareness, income generation and livelihood diversification.
- **Promoting sustainable fisheries** for maintaining nutritional security while ensuring maintenance of biodiversity and equitable sharing of benefits.
- **Poverty reduction** through sustainable resource development and utilization and livelihood diversification.
- **Promoting institutional arrangements** enabling integration of wetland management planning and river basin and coastal zone management
- **Strengthening CDA** with adequate legal and administrative powers to regulate detrimental activities
- **Capacity building** at all levels for technical and managerial skills for implementation of integrated management planning.
- **Communication, education, participation and awareness** at multiple levels and stakeholders to support management planning
- **Result oriented monitoring and evaluation** at activity, outcome and impact levels.

4.8. Action plan (Performance Indicators, Research Needs, Activities)



5. INTRODUCTION TO SITE

5.1. About Ansupa lake

- Ansupa Lake is the largest, very old fresh water wetland in Cuttack, Odisha. It is situated 70km away from the Cuttack city near river Mahanadi, the biggest river of Odisha. The lake Ansupa is surrounded by two hills, one is Saranda hill on western side and Bishnupur hill on its north-eastern side. The land use, land cover includes forest land, agriculture land, lake area, and human habitation etc. because of this the lake has its own scenic beauty.

- The lake is directly linked with Mahanadi by a channel Mayuree nala, through which flood water of river Mahanadi enters the lake. There is another channel Kabula nala and Hulluhula nala, which has also an opening to Mahanadi acts as the outlet. The length of the lake is approximately 3km and breadth varies from 250m to 500m. Water spread area varies from 375 acres. Average depth was about 15 to 20 meters, has considerably reduced 8 to 10 meters now. Catchment area is 2810 ha.

- It comes under territorial jurisdiction of Athagarh Forest division. Apart from this original existence as lake, it is declared as “Wetland of national importance”. Due to its unique bio-diversity character having varied aquatic fauna and flora and is a famous natural heritage of Odisha.

- It has large number of fishes, aquatic plants; different types of domestic and migratory birds visit the lake in winter time, retracting large number of tourists. Peripheral villages depend very much on the lake resources mainly fishery and water for agriculture for their livelihood.

- The site has great potential for Eco-tourism development plan, this will create a positive outcome towards the ecological importance of the place and act as a recreational area for the people visiting the Nature. It will act as a cultural public space combined with a self-sustaining, productive and naturalized. It will create a good Eco-tourism development plan for the city in terms of economic development, sustainable development, and landscape aspects and fulfil needs and requirements of the people.

Figure 21 - View of Ansupa Lake

5.2. Origin

The literature survey revealed that Ansupa was known as Ainspa pat (Ansa-pata) as it is a water source (Pata) formed out of a part (Ansa) of river Mahanadi. It was als known as Hansa-Pata as it is a water source (Pata) and had attracts the hordes of wild swans (Hansa) in the past. In course of time, be that as it may be, lake is known as Ansupa Lake.

5.3. Ansupa lake and its mysterious history

Saranda hill or the area called Sarandagada is famous in the history because of the ruling of the king having a fort at Saranda hill top. It is believed that during Ganga dynasty, the king Subarnakeshari was overwhelmed with the natural beauty and panoramic view of Ansupa. Subsequently, the king established the village Subarnapur on the bank of the Ansupa and Saranda hill. According to the legend, one of the brothers of Dhala Dynasty of Banki had established his kingdom on the top of the Saranda hill which was popularly known as Sarandagada. As per the history, the king of Saranda had married one of the daughters of nearby king of Tigiriagada, which is 15km away from Saranda. The king of Saranda preferred and had chosen this place to develop his fort for his safety and protection. There was an entrance gate constructed by stones connected with footsteps built on stones starting from Ansupa lake. The king had also built a house made up of stones for storing arms and ammunition which is known as magazine house (Baruda Ghara). This structure is still existing without any damage. The king had fixed a heavy metal door made up of bronze metal (cupper + tin) at the entrance of the fort which was producing an intense sound. This sound was indicating the king's arrival and departure to his fort. At present, the entrance gate of the fort, magazine house, a twin well at the top of the hill locally called Brother-Daughter-in Law well or Bhai-Bhou Kua) and another big well like hole made up of stone are still existing showing the King's creation. After independence in 1970, the Government of Odisha declared 160.93 ha of Saranda hill area as proposed "Reserved Forest". After being declared as a reserved forest, the forest growth and development in this area is dense which is evidenced from the view taken from the watch tower of the hill. The entire horse shoe shaped area of the lake appears to be surrounded by greenery or large trees.

Figure 22 - View Of Existing Saranda fort Structure

5.4. Site Plan of Ansupa lake

Figure 23 - Site Plan of Ansupa Lake

Ansupa Lake is a topographic depression surrounded by small hillocks such as Saranda (124 m) on the west, Bishnupur (65 m) on the east Dhangarh (160m) on the north and Betla pahad (105 m) on the north-west. The surroundings region is broadly undulating plain with isolated hill ranges and dissected valleys. The lake is connected with Mahanadi through the channel “Kabula nala” in the southern site and Huluhula nala on the south estern site through which flood water from Mahanadi enters to the lake. The catchment area of Ansupa is spread over 5231.0 ha. The land use, land cover includes forest land, agriculture land, lake area and human habitation etc.

5.5. Site Area of Ansupa lake

The total catchment area of Ansupa Lake is 5231 ha. Out of the above catchment 4 numbers of micro watersheds having 2809 ha of area encompassing the lake from 4 sides are highly fragile in nature. Details of the 4 number of Micro-watersheds are as under;

Detailed information of the most vulnerable micro-watersheds

- Location : 85°-35’-0” to 85°-37’-30”E longitude and 20°-25’-30” to 20°-30’-0”N latitude
- District : Cuttack
- Revenue sub-division : Athagarh & Banki
- Block : Athagarh & Banki
- No. of Micro Watersheds : 4
- Agro climatic zone : Mid. Central table land zone (084)
- Total No. of villages : 12
- Name of the village : Maidharpur, Radhadarsanpur, Podapada Kadalibadi, Baidehipur, Ostia, Anandpur, Santrapur, Bishnupur, Sarandagarh, Kantapanhara, Gholapur
- Total Catchment area : 2809.08
- Treatable area : 2394.07 ha
- Non treatable area : 415.01 ha
- Ansupa lake area : 182.0 ha (rainy season),141.0 ha.(Summer)
- Total Agricultural land : 1836.99 ha
- Upland : 791.13 ha
- Medium land : 509.75 ha
- Low land : 536.11 ha
- Total non-Agricultural land : 972.09 ha
- Average Annual Rainfall : 1406.44mm
- Total population : 16757
- SC : 3039
- ST : 1084
- OTHER : 12634

5.6. Satellite images showing evolution (degradation) of Ansupa lake:

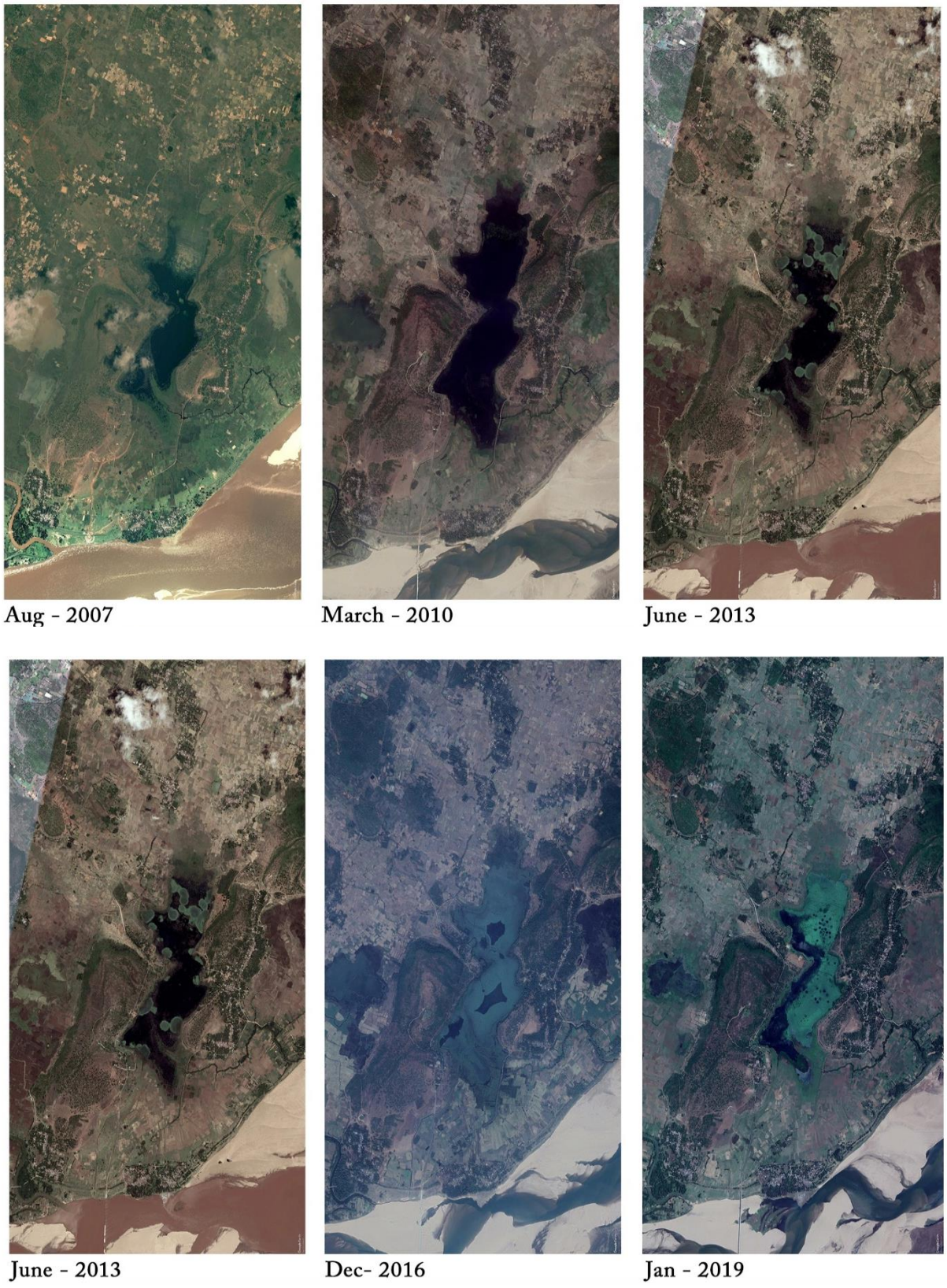
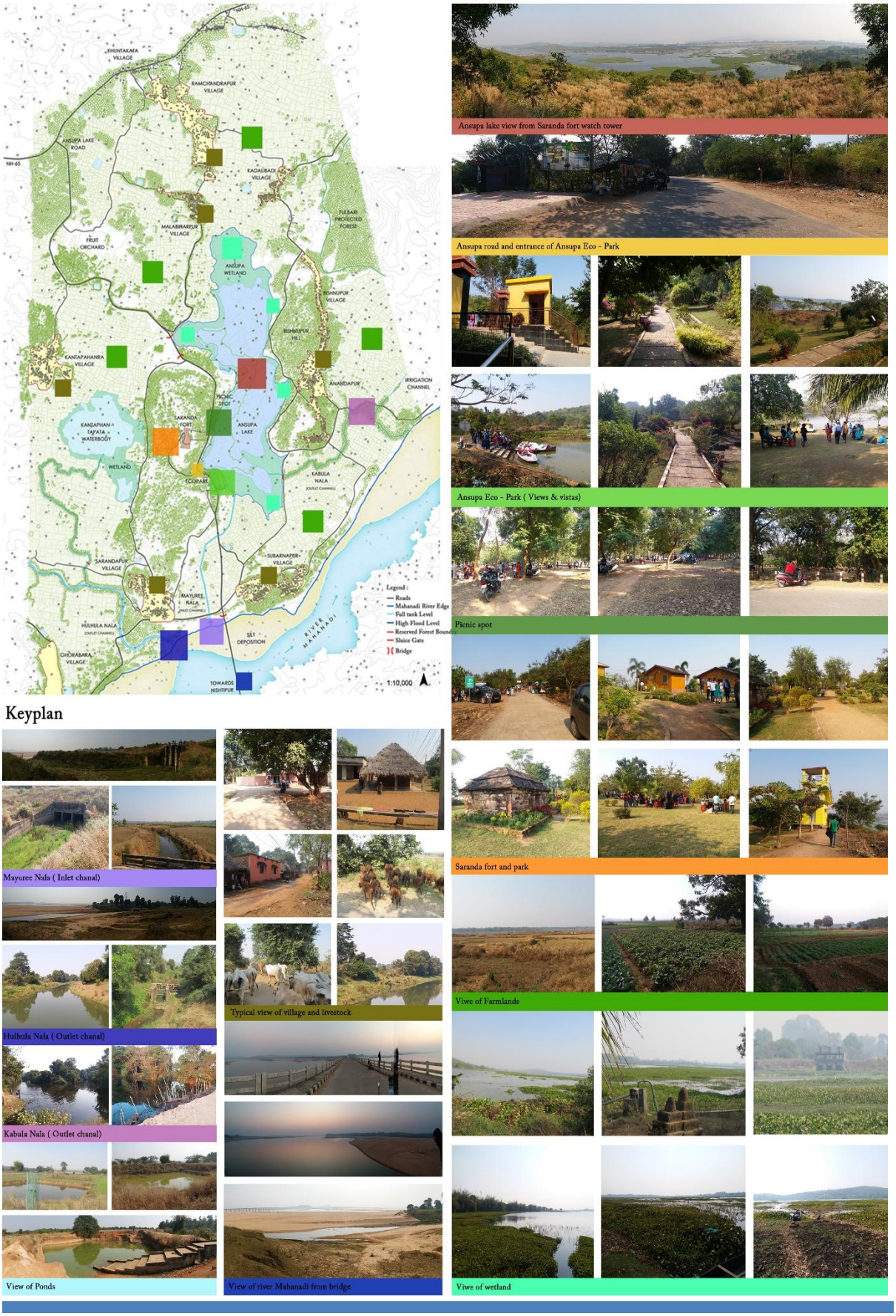


Figure 24 - Satellite Images of Ansupa Lake

5.7. Site and surroundings of Ansupa Lake



5.8. The Important Issues of the Lake and Wetland

Siltation:

There is heavy siltation, the quality of the silt is mainly clay and sand and about 1 lakh metric ton of silt enter the lake during rainy season ever year.

Weed infestation:

There is rapid proliferation of freshwater weeds in the lake like submerged, emergent and floating which is due to heavy nutrients loading from the peripheral paddy fields and also due to the use of detergent by the people resulting high eutrophic condition.

Water quality degradation:

Due to heavy nutrient flow and due to human intervention, the water quality of the lake has considerably degraded and polluted.

Decrease in water circulation:

The closure of the inlet and outlet mechanism of flow water from river Mahanadi resulting in water circulation and increase in sedimentation process.

Decrease in fishery potential:

There were a number of freshwater fishes, about 24 types in the lake. There is considerable decrease in the fishery potential because of the wetland and water quality degradation.

Decrease in Avifauna:

There is major reduction in the number of migratory and resident birds due to improper condition of the lake habitat and wetland degradation.

Tourism Potential:

Due to its unique bio-diversity character having varied aquatic fauna and flora and is a famous natural heritage of Odisha.

Figure 25 - Images showing existing conditions of Ansupa Lake

6. SITE DOCUMENTATION AND ANALYSIS

6.1. The administrative map of Ansupa lake catchment

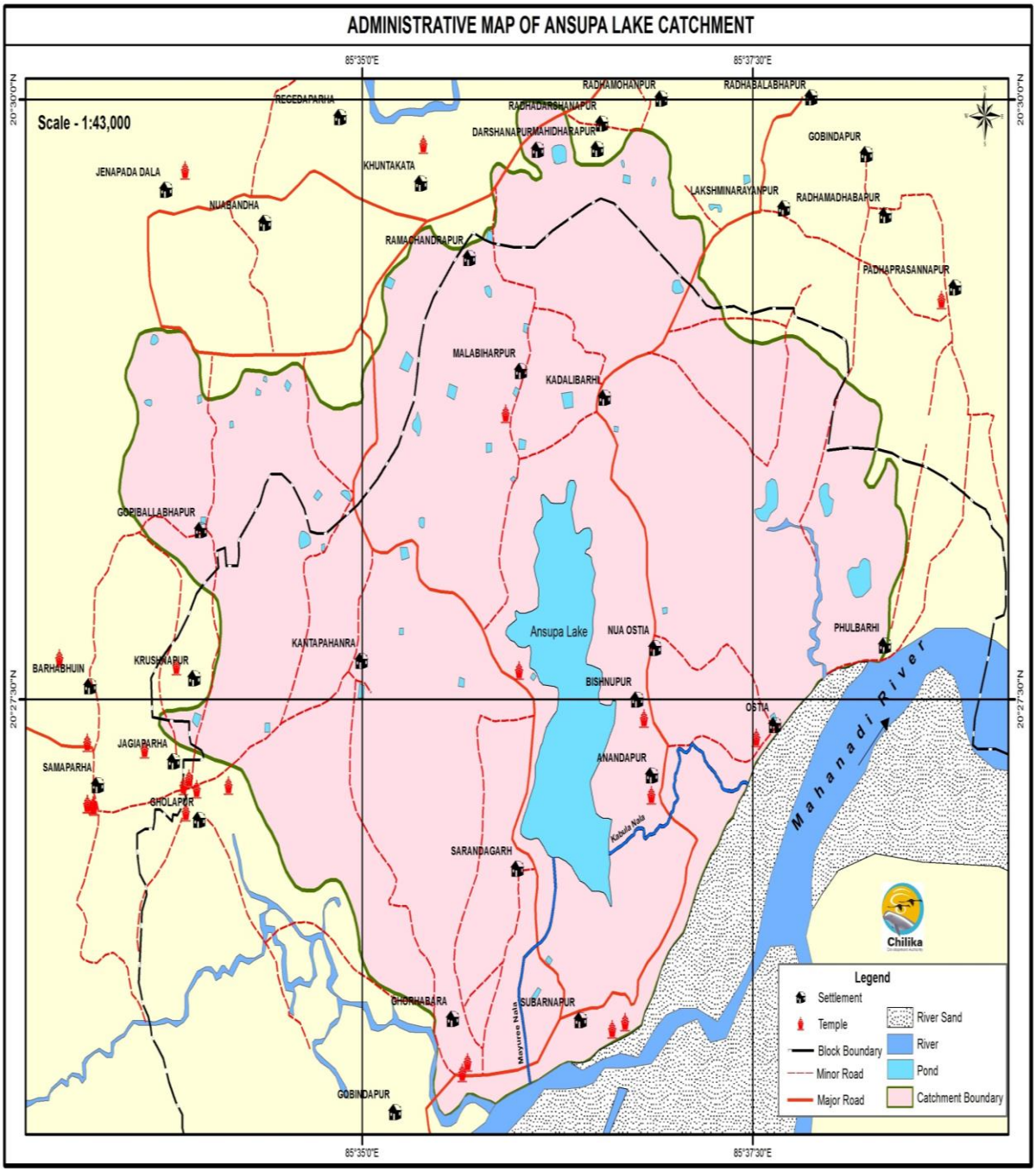


Figure 26 - Administrative Map of Ansupa Lake Catchment

Map showing important administrative boundaries of catchment area and Road networks, settlements, Water bodies etc…

6.2. THE NATURAL FORCES ON SITE:

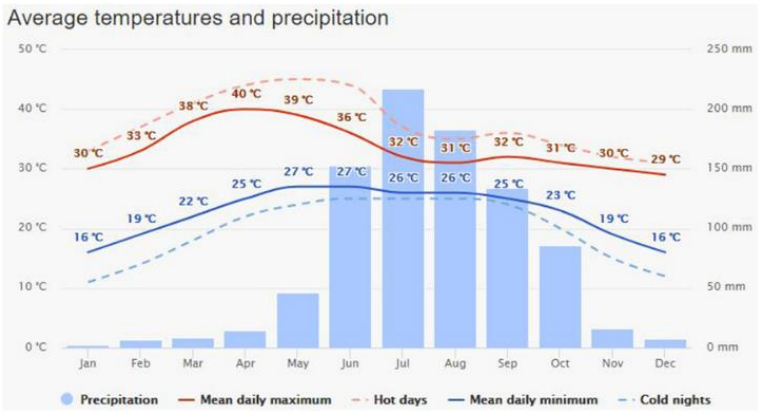
6.3. Climate

The area under study falls under hot and humid, subtropical region characterized by warm humid climate with heavy rainfall and relatively cools winter, with rather scanty rainfall. Seasons can be categorized as humid, tropical monsoon climate with a prolonged monsoon season from May to September, a relatively cool, dry winter from October to February and a pre-monsoon period in March to May with occasional founder storms. Temperature ranges from 10.60°C to 40.0°C.

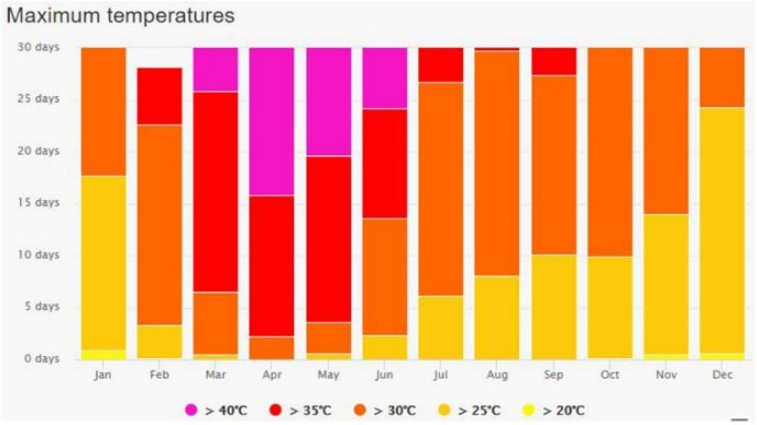
Winters:
The winter season from November to February is characterized by mild temperatures and occasional showers. Temperatures may fall below 10°C in winter.

Summers:
Summers in Cuttack are hot and humid. It starts in March and lasts till June with an average maximum temperature of 40°C and a minimum of 22°C. Cuttack is also prone to thunderstorms during this period.

Monsoons:
The monsoon months are from July to October when the city receives most of its rainfall from the South West Monsoon. The annual rainfall is around 144 cm which means it gets really wet.



(Source: Meteoblue)



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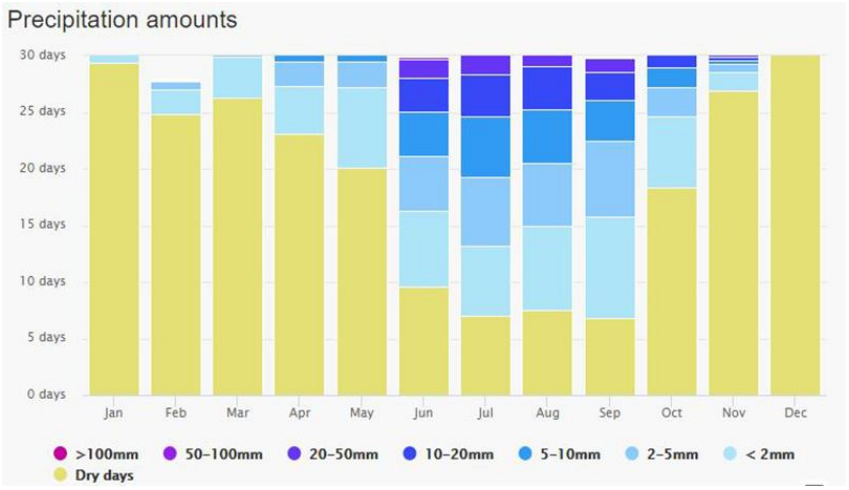

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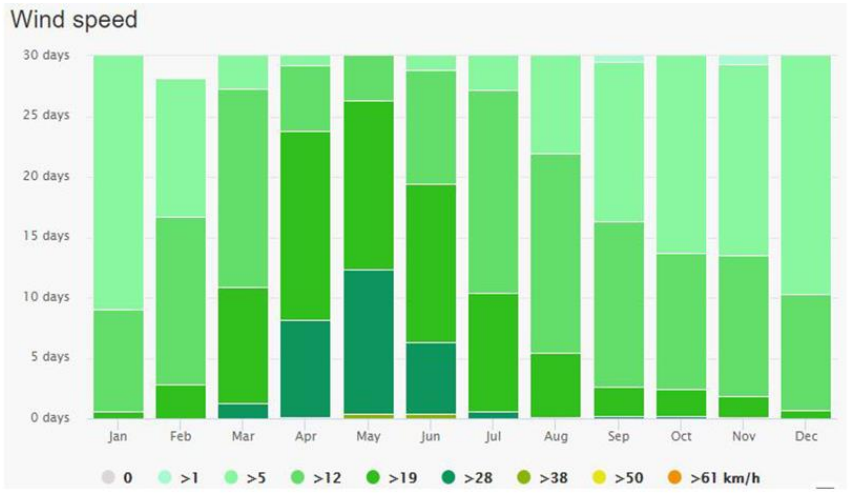

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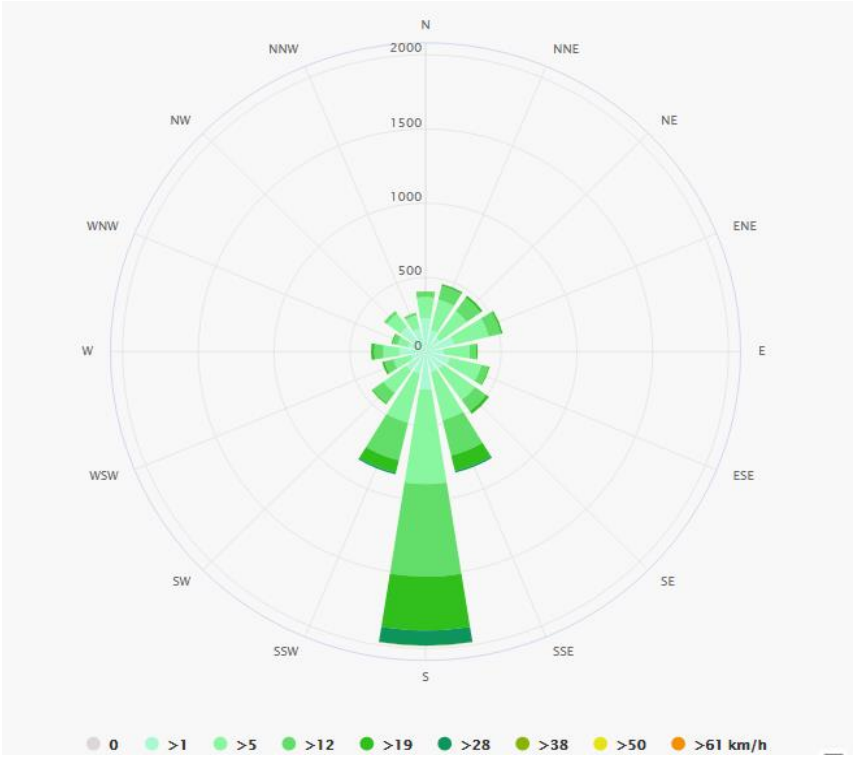


(Source: Meteoblue)

6.4. Catchment area map of Ansupa Lake

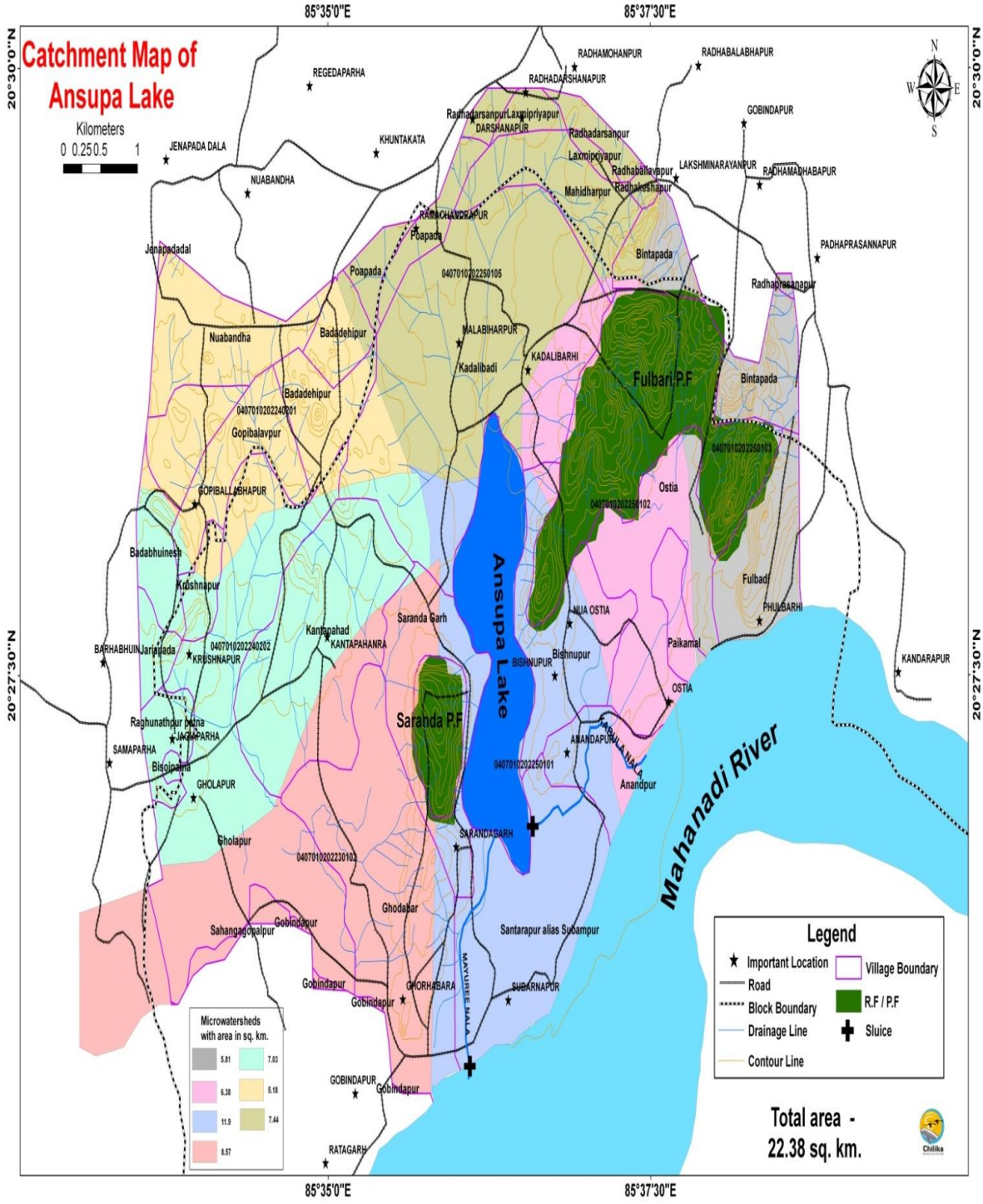
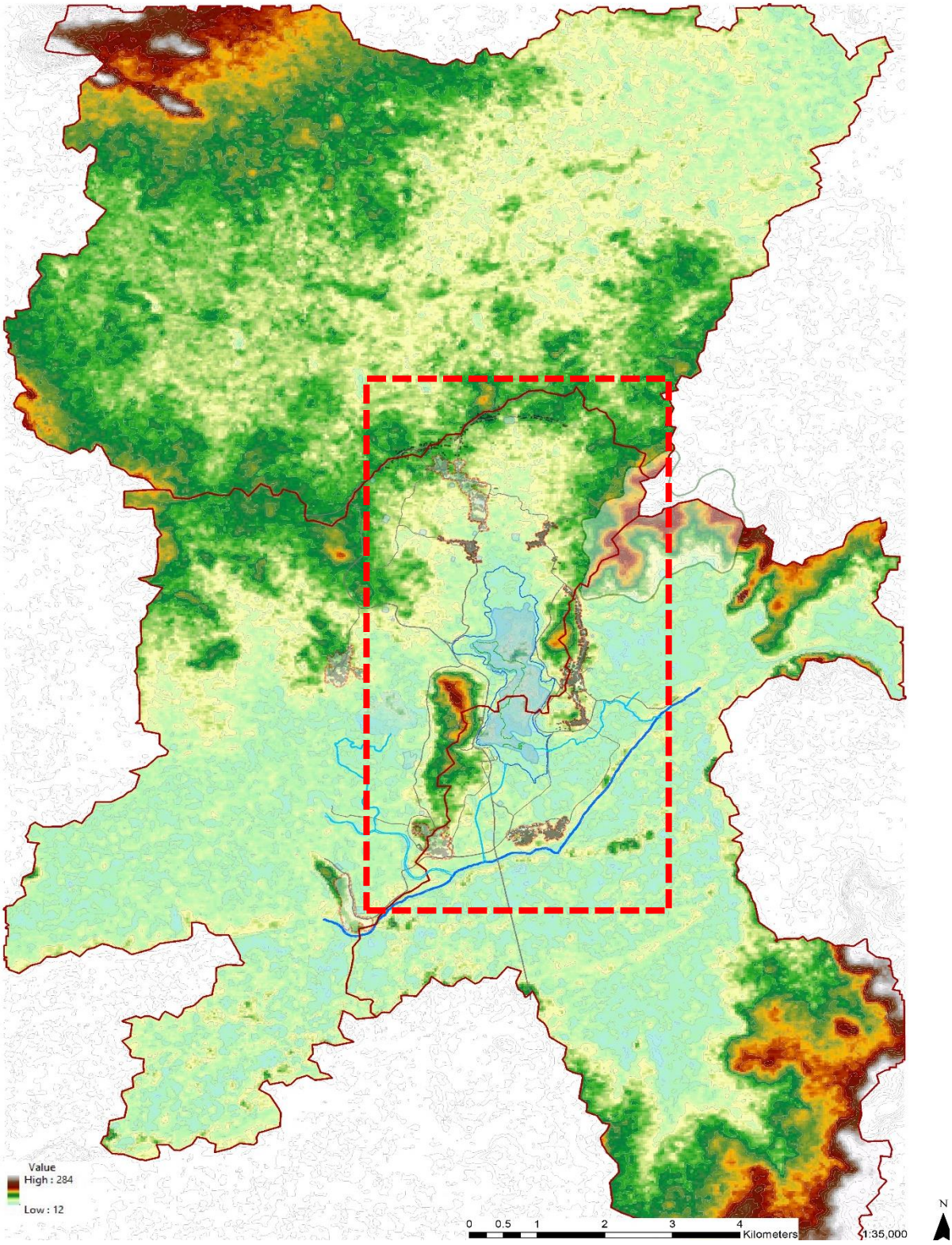


Figure 27 - Map of Catchment Area of Ansupa Lake

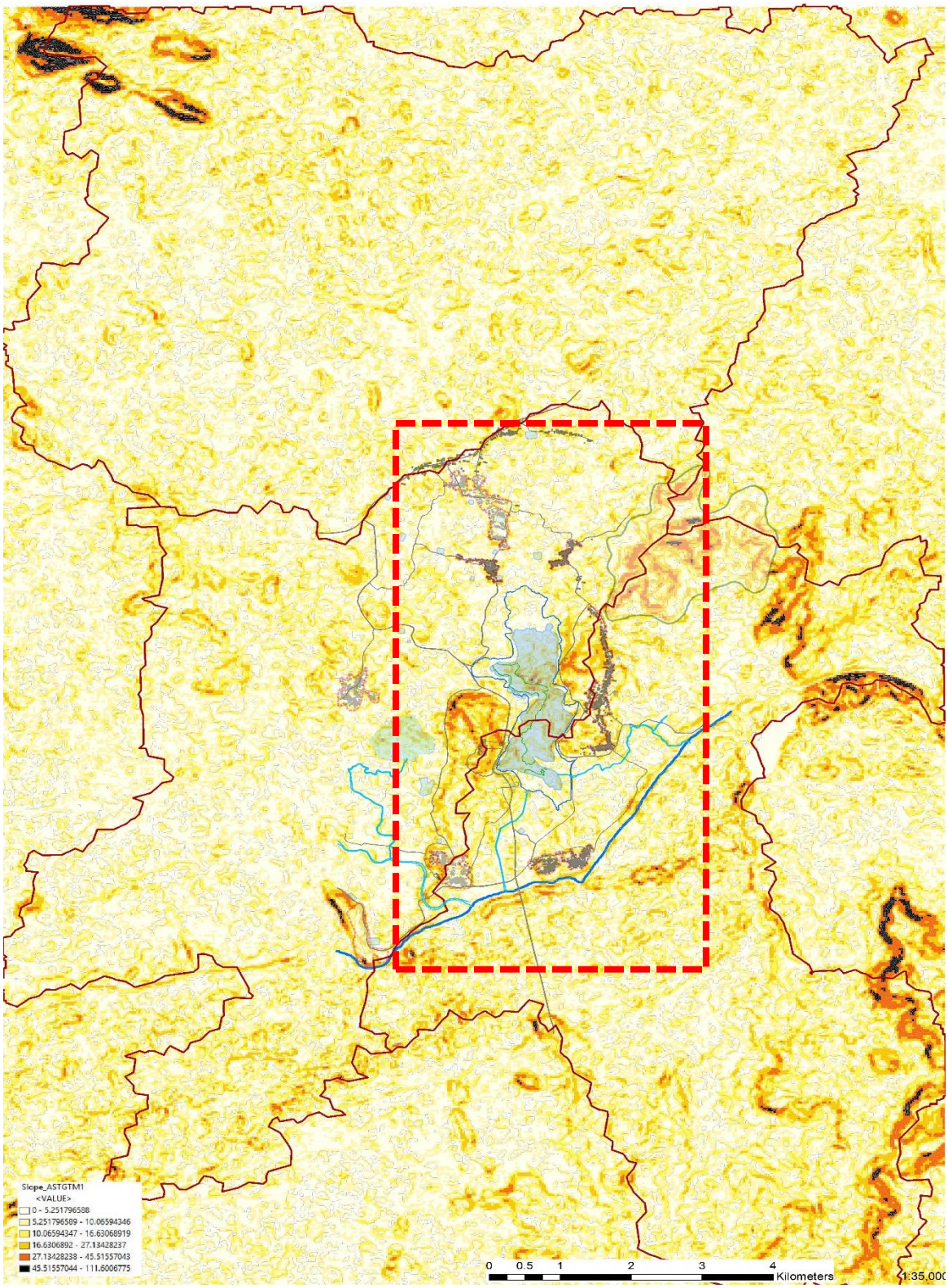
Map showing important administrative boundaries of catchment area and Road networks, Water bodies etc… (Source – Chilika Development Authority)

6.4.1. Delineation of catchment area of Ansupa Lake



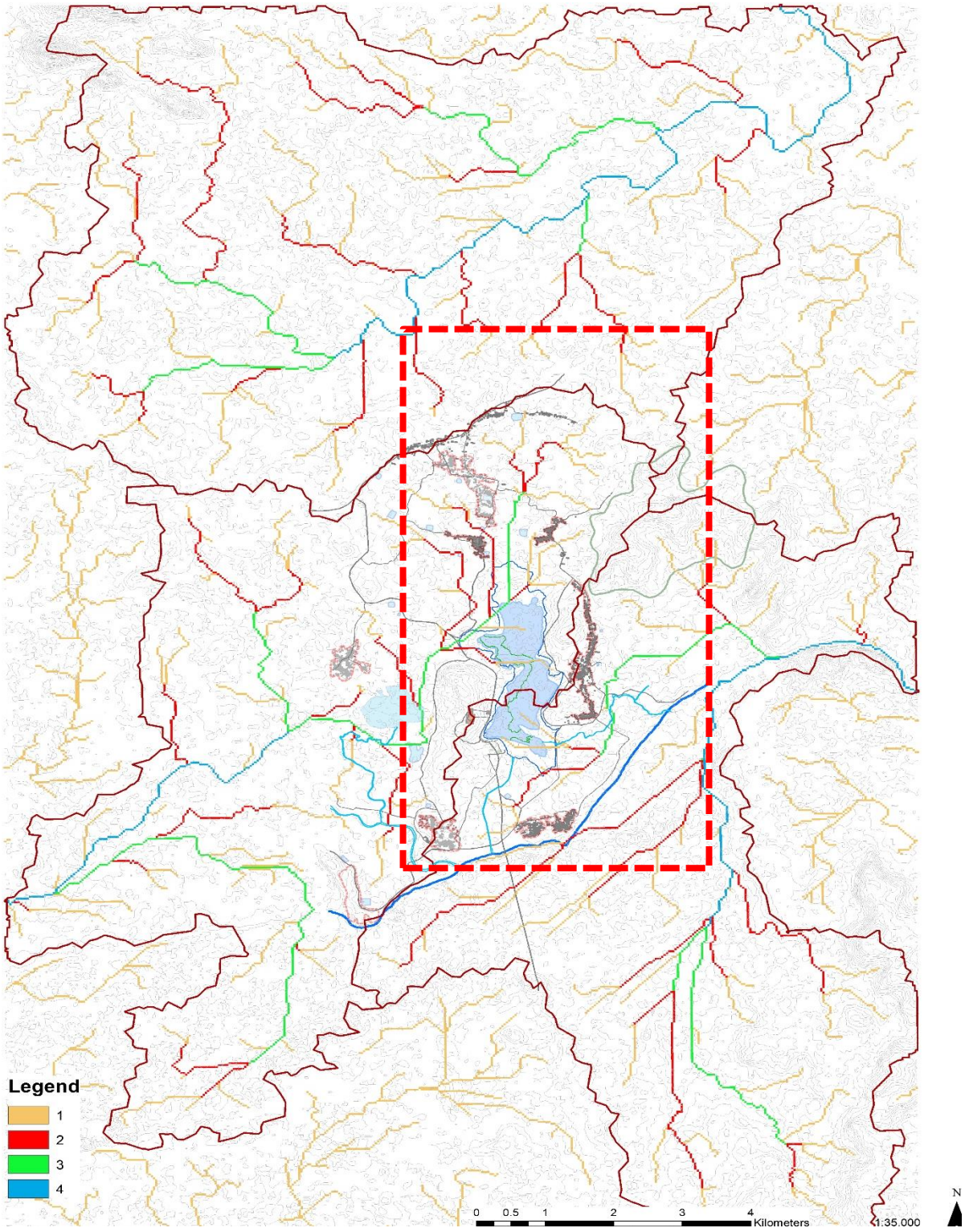
Map showing water basin and the 3 main water shade area with relief (topography of the water basin) and the context of Ansupa Lake.
Map generated on GIS (Geographic Information System) Software.

6.4.2. Slope map of delineated catchment area of Ansupa Lake



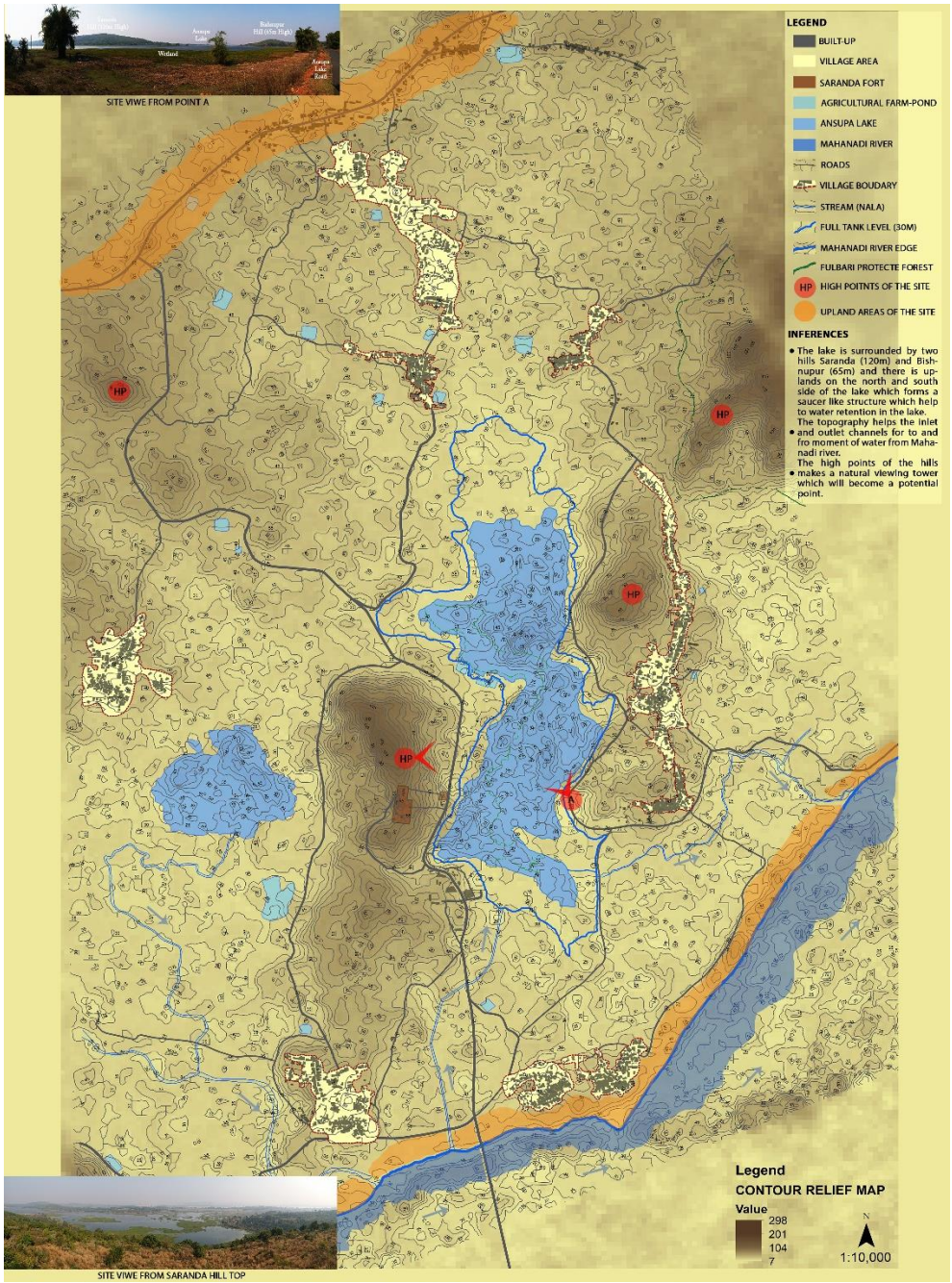
Map showing water shade area and slopes on the delineated water shades with context of Ansupa Lake.
Map generated on GIS (Geographic Information System) Software.

6.4.3. Hydrology map of delineated catchment area of Ansupa Lake



Map showing water shade area and Stream Order on the delineated water shades with context of Ansupa Lake.
Map generated on GIS (Geographic Information System) Software.

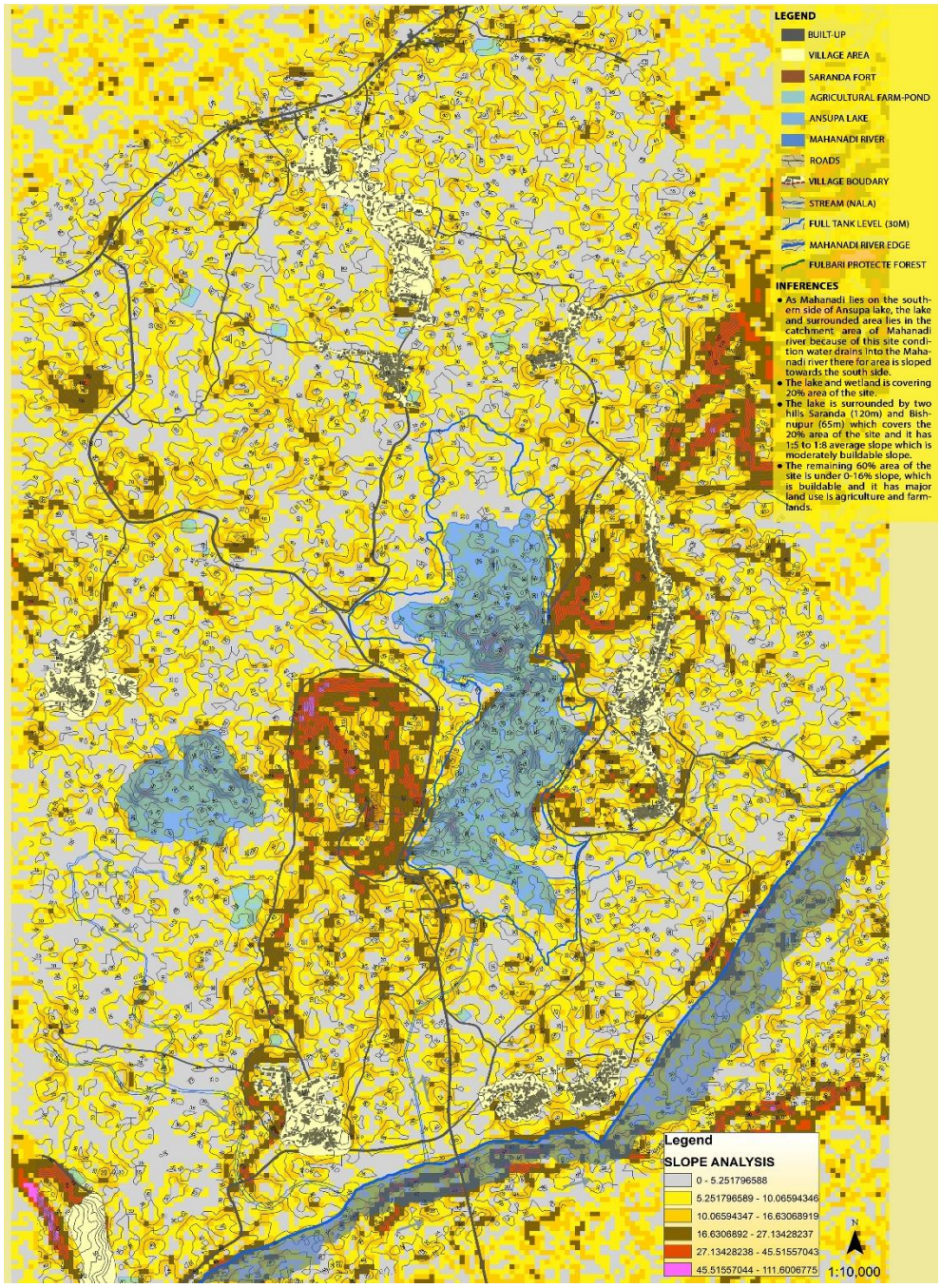
6.4.4. Relief map (showing elevation of site)



Elevation map of the study area with the context
Map generated on GIS (Geographic Information System) Software.

The lake is surrounded by two hills Saranda (120m) and Bishnupur (65m) and there is uplands on the north and south side of the lake which forms a saucer like structure which help to water retention in the lake.
The topography helps the inlet and outlet channels for to and fro moment of water from Mahanadi river. The high points of the hills makes a natural viewing tower which will become a potential point.

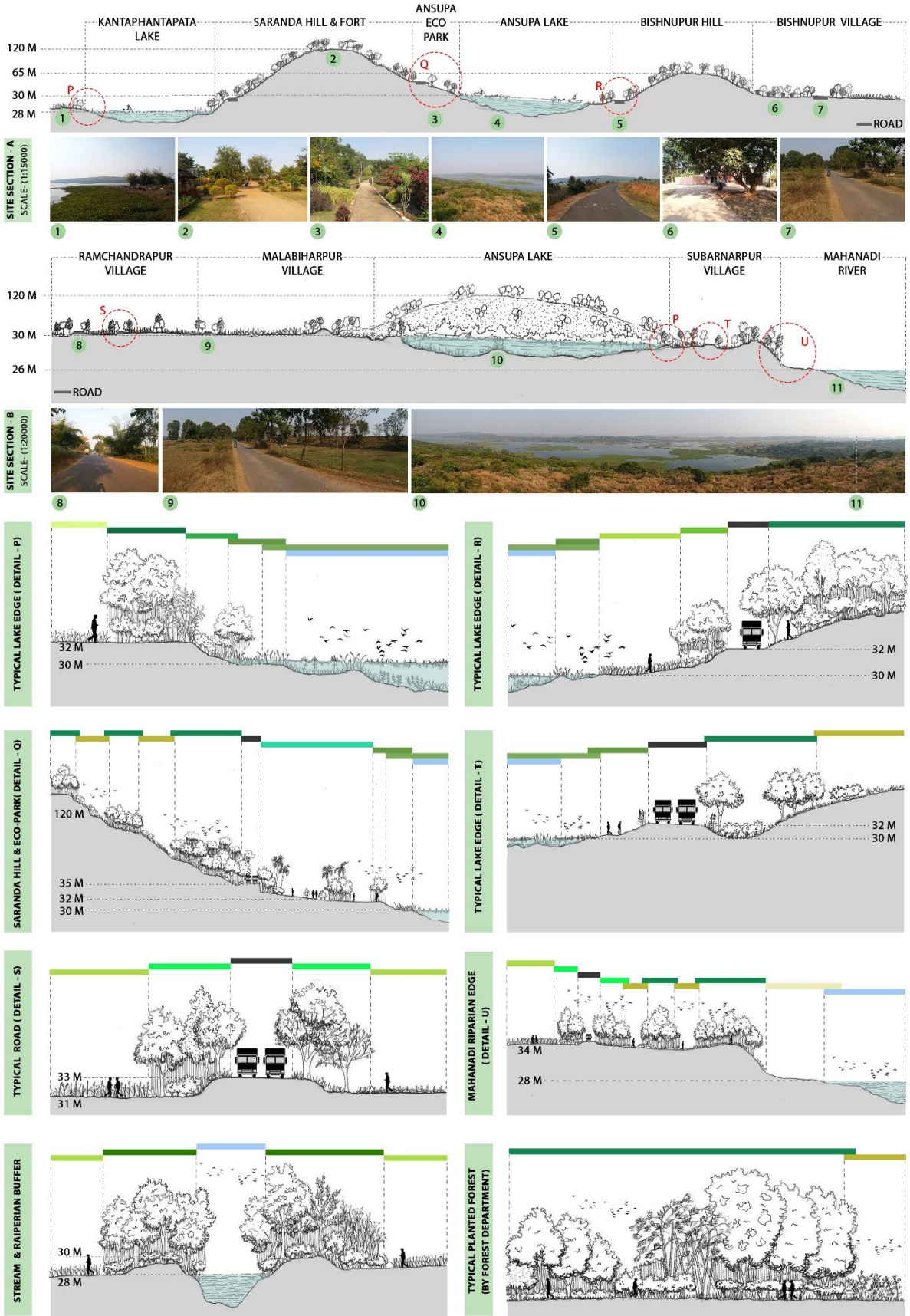
6.4.5. Slope map (showing elevation of site)



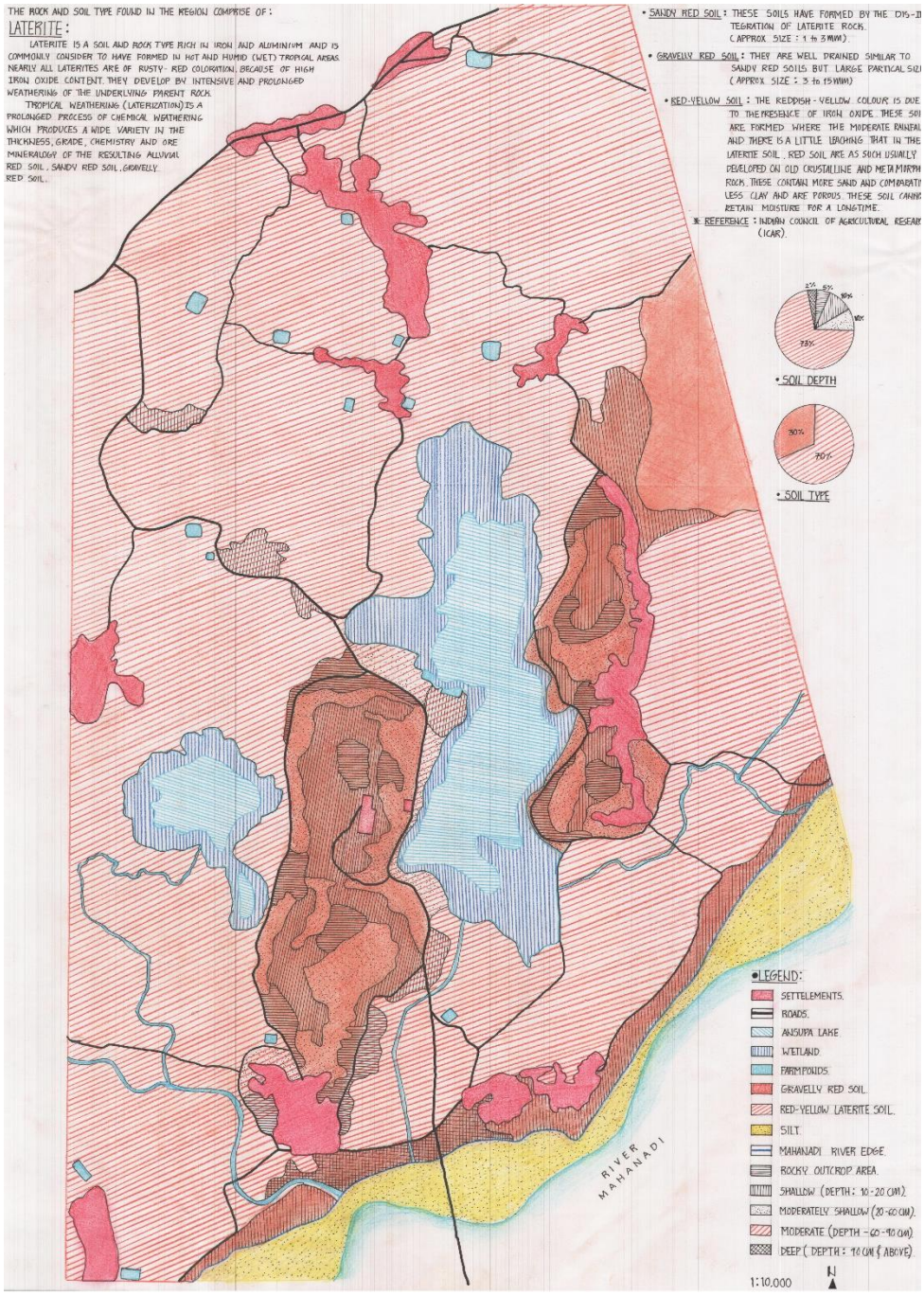
Elevation map of the study area with the context
Map generated on GIS (Geographic Information System) Software.

As Mahanadi River lies on the southern side the lake and surrounded area lies in the catchment area of River because of this site condition water drains into the River there for area is sloped towards the south side. The lake and wetland is covering 20% area of the site. The lake is surrounded by two hills Saranda (120m) and Bishnupur (65m) which covers the 20% area of the site and it has 1:5 to 1:8 average slope which is moderately buildable slope. The remaining 60% area of the site is under0-16% slope, which is buildable and it has major land use is agriculture and farmlands.

6.4.6. Illustrative sections showing elevation gradients



6.4.7. Geology and soils



The Rock and Soil type found in the study area region comprises of:

Laterite Stone:

Laterite is a soil and rock type rich in Iron and Aluminium and is commonly consider to have formed in hot and humid (Wet) tropical areas. Nearly all laterites are of rusty-red coloration, because of high iron content. They develop by intensive and prolonged weathering of the underlying parent rock. Tropical weathering (Laterization) is a prolonged process of chemical weathering which produces a wide variety in the

thickness, grade, chemistry and mineralogy of the resulting, Alluvial red soil, Sandy red soil, Gravelly red soil.

Sandy Red Soil:

These soils have formed by the dis-integration of laterite rock (Approx Size– 1 to 3mm)

Gravelly Red Soil:

They are well drained similar to Red Sandy Soil but large in particle size (Approx Size – 3 to 15mm)

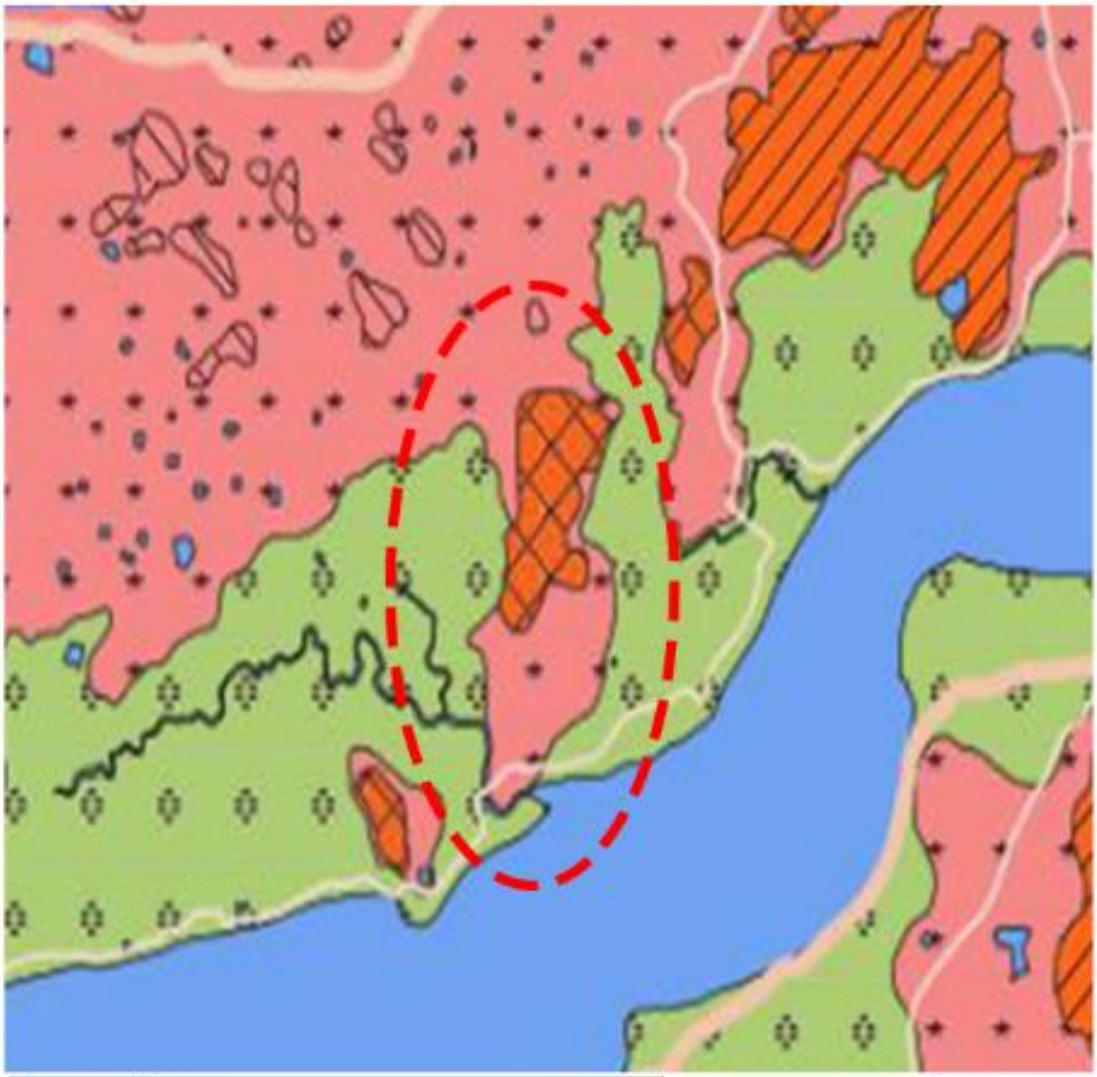
Red – Yellow Soil:

The reddish yellow colour is due to the presence of Iron Oxide. These soils are formed where the moderate rainfall and there is a little leaching that in the laterite soil. Red soil are as such usually developed on old crystalline and metamorphic rock. These contain more sand and comparatively less clay and are porous. These soil cannot retain moisture for long time.

- **Images showing Existing Soil Condition:**



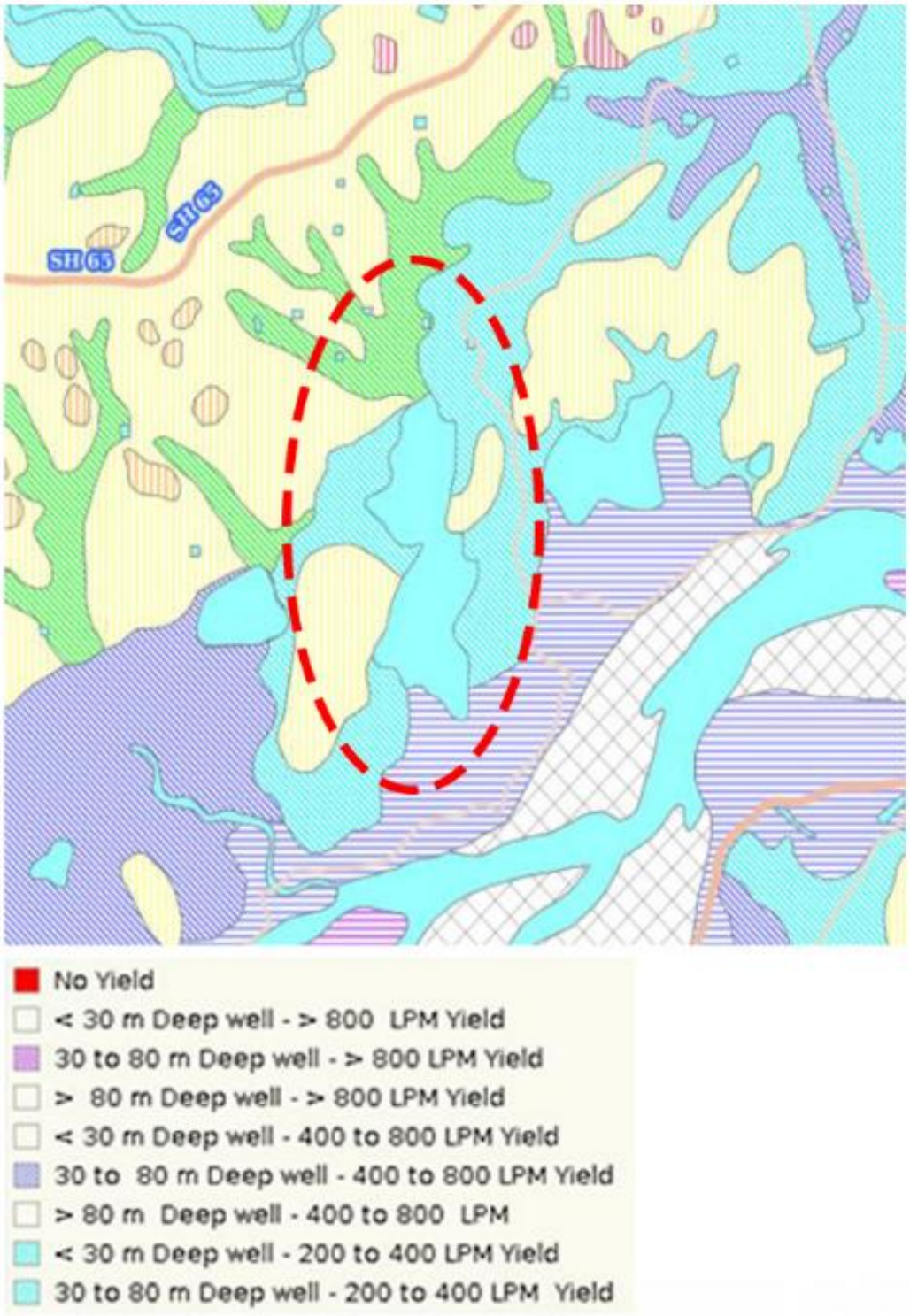

6.4.8. Geomorphology



Map showing Geomorphology - Structural origin-highly dissected hills and valleys and Denudational Origin – Pediment – Pedi plain complex and fluvial origin – younger Alluvial plain on study area.

(Source: Bhuvan website, **Developed by:** Indian Space Research Organisation (ISRO)

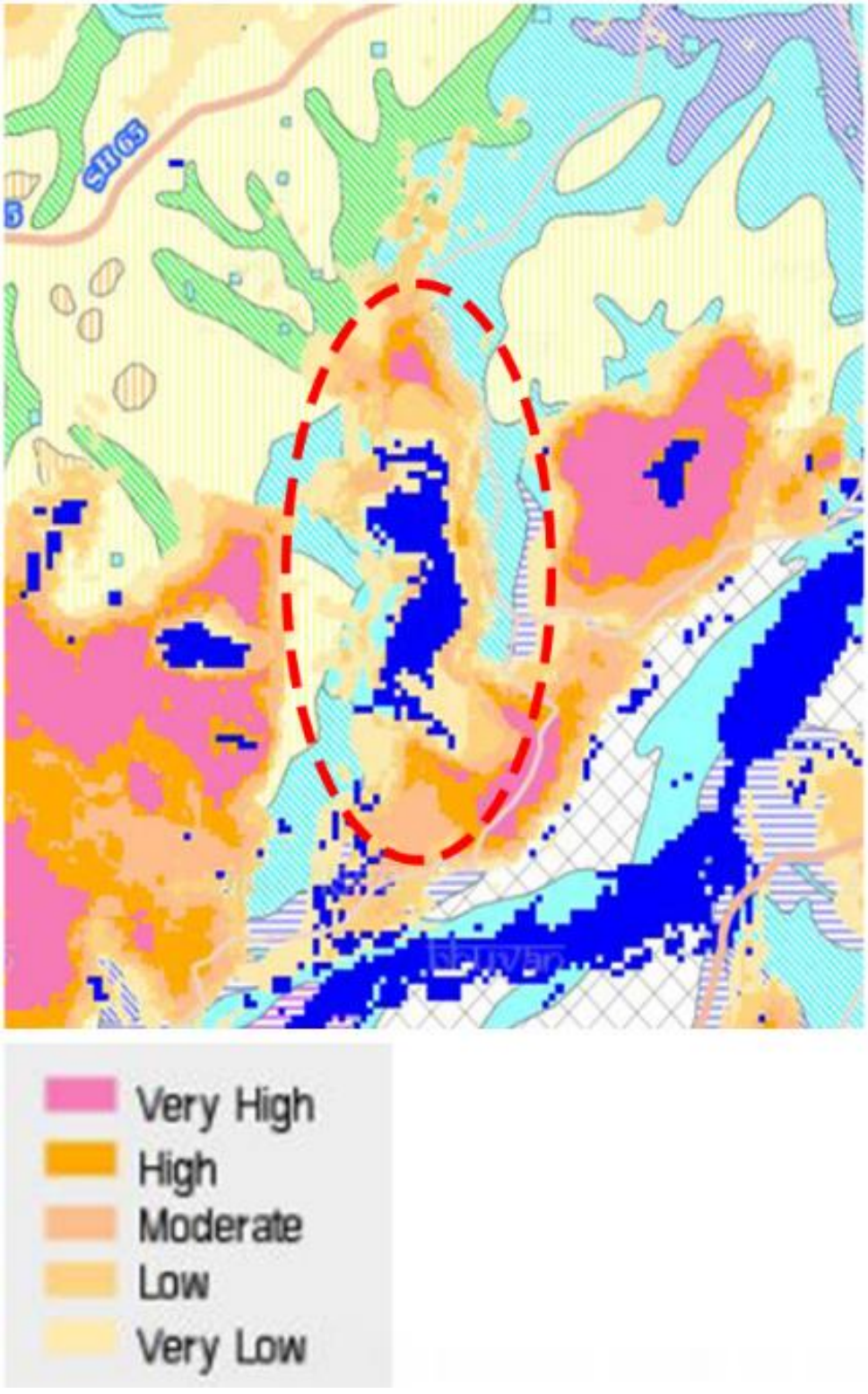
6.4.9. Ground water prospect map



Map showing potential areas of high groundwater yield and depth of available which helps in to find tentative locations for constructing recharge structures.

(Source: Bhuvan website, **Developed by:** Indian Space Research Organisation (ISRO)

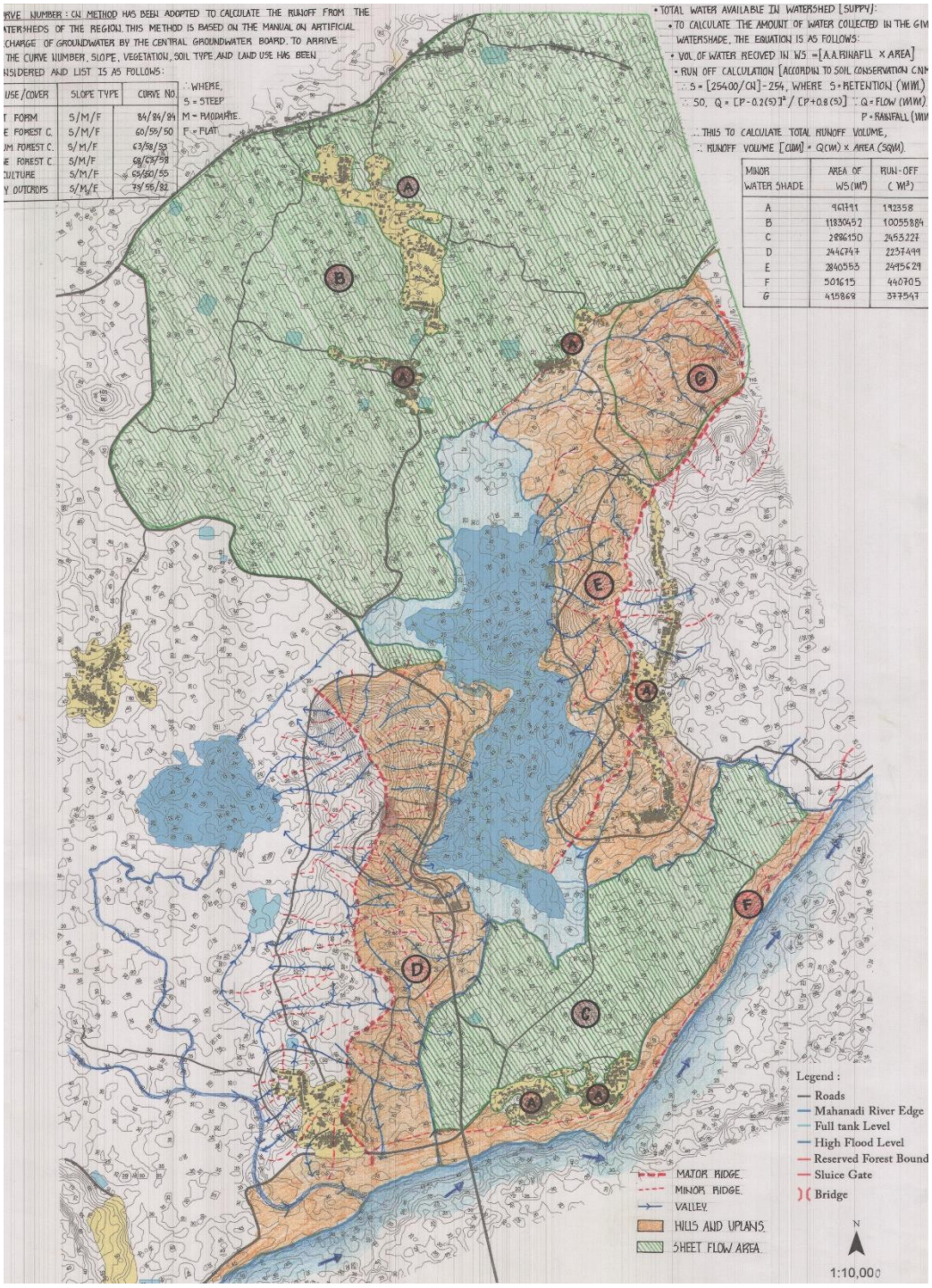
6.4.10. Flood map



Map showing tentative location of food areas which help while designing.

(Source: Bhuvan website, **Developed by:** Indian Space Research Organisation (ISRO)

6.4.11. Hydrology map



Map showing the Micro water shades, Ridges and valleys, and Run-off water calculation in the study area region.

The region falls under the Mahanadi River basin.

Mahanadi is one of the largest river in India which originates from Chhattisgarh and travel through the state of Odisha to meet the Bay of Bengal.

The average ground water level of the region ranges between 35m to 90m depth.

The region has average run-off of 60% due to moderate and steep slopes, rocky outcrops and shallow soil depth.

- **To calculate the run-off water from the micro watersheds of the region by using CN (Curve Number) Method.**

Curve number method is based on the manual on artificial recharge of ground water board. To arrive at the curve number, slopes, vegetation, soil type and land use has been considered and the list is as follows:

Land use / cover	Slope type	Curve no.(CN)
Built form	Steep	84
	Moderate	84
	Flat	84
Dense forest cover	Steep	60
	Moderate	55
	Flat	50
Medium forest cover	Steep	63
	Moderate	58
	Flat	53
Sparse forest cover	Steep	68
	Moderate	63
	Flat	58
Agriculture	Steep	65
	Moderate	60
	Flat	55
Rocky outcrops	-	82

Table shows the CN Values for different land use and slopes.

Total Water Available in Watershed (Supply)

To calculate the amount of water collected in a given watershed, the equation is as follows:

VOLUME OF WATER RECEVIED IN WATERSHED (M^3) = AVERAGE ANNUAL RAINFALL (M) X AREA (M^2)

Run-off Calculation:
According to SCS (Soil Conservation Services of US) for Run-off Calculation,

S = (25400 / CN) – 254

Where,
S = Retention (mm), CN = it ranges from 0 to 100, CN = 0, means Complete Retention, CN = 100, means Zero Retention.

Now,

$Q = [P – 0.2 (S)]^2 / [P + 0.8 (S)]$

Where,
Q = River Flow (mm), P = Precipitation / Rainfall (mm)

Thus, to calculate total Run-off volume,

Run-Off Volume (M^3) = Q (M) X Area (M^2)

MINOR WATESHED	AREA OF WATERSHED (M^2)	RUN-OFF WATER (M^3)
A	961791	192358
B	11830452	10055884
C	2886150	2453227
D	2446747	2237499
E	2840553	2495629
F	501615	440705
G	415868	377547

Table shows Volume of Run-off water in Watershed of Ansupa Lake Region.

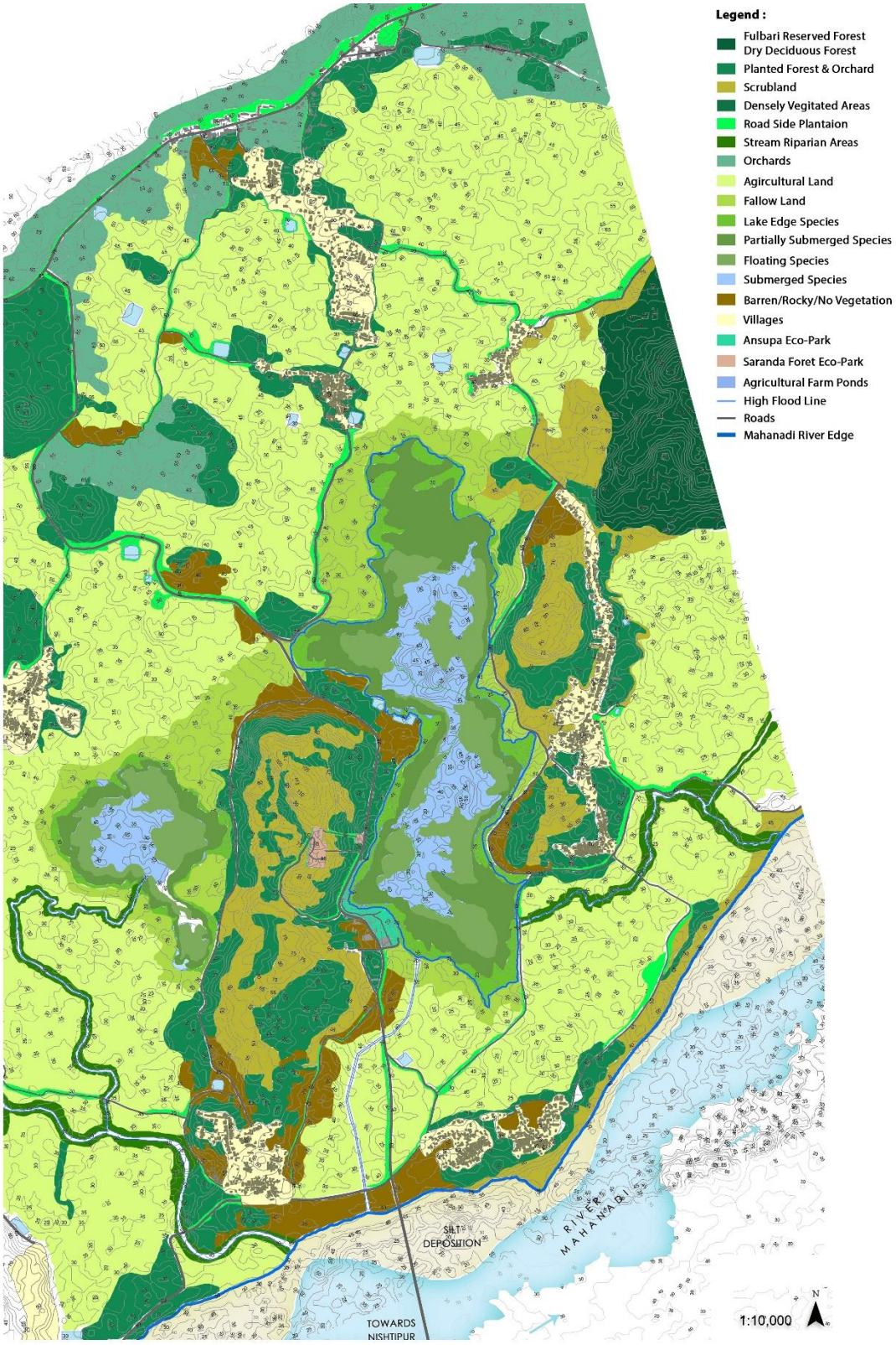
Existing Water quality parameters of Ansupa Lake:

Water quality variables	Northern Ansupa Lake	Central Ansupa lake	Southern Ansupa Lake
Secchi disc depth in mm	Depth of water	1.96 – 2.85	0.73
Chlorophyllug / l	4.58	3.22 – 7.51	8.99 – 51.73
Epilimentic Oxygen % of saturation	28.54	89.7 – 127.73	51.32 – 54.78
Trophic Status	Eutrophic	Mesotrophic	Eutrophic

Other water quality parameters:

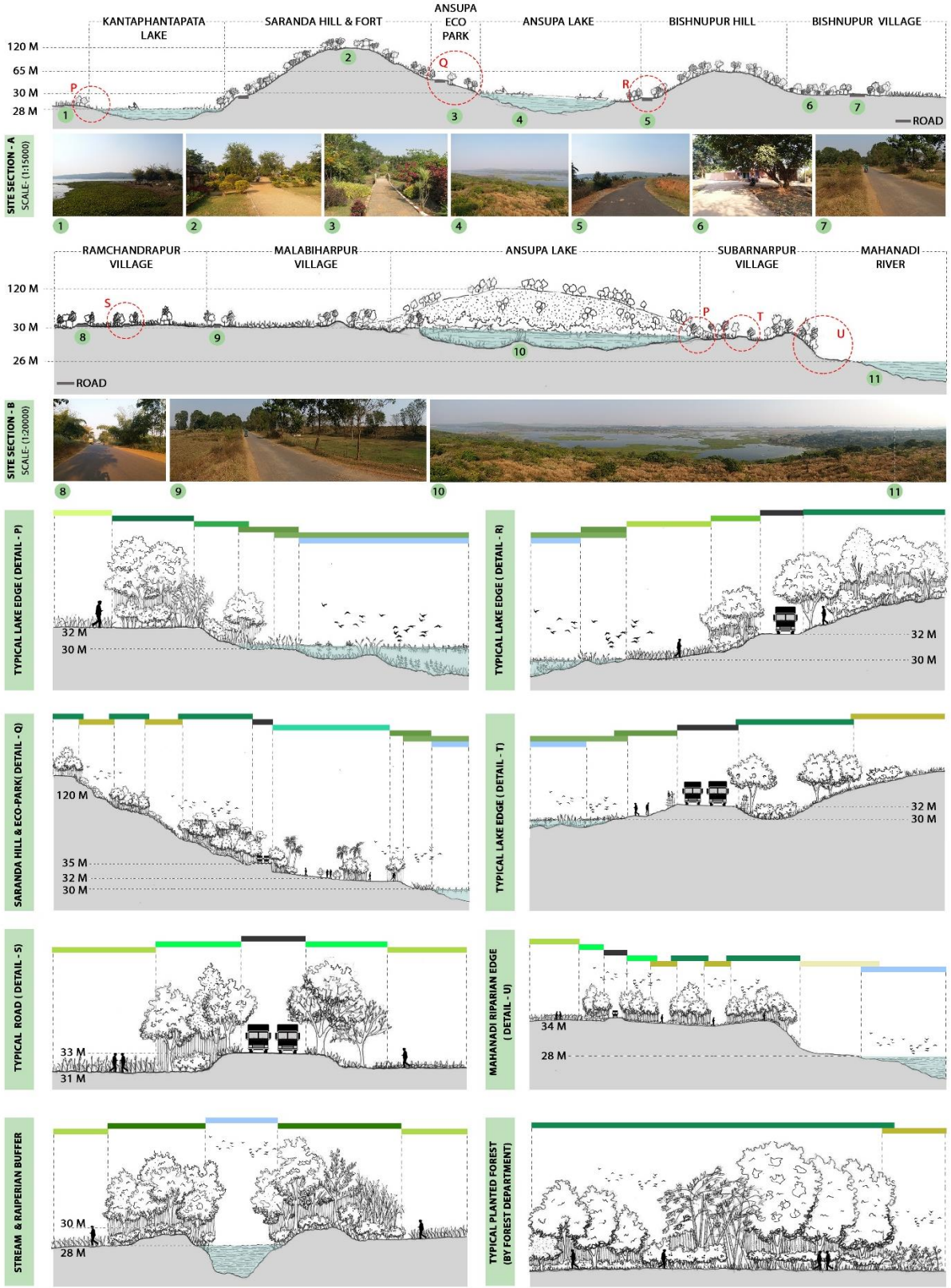
pH – 6.10, Chloride – 14ppm(mg/L), Nitrate – 15ppm, Sodium – 2.3ppm, Calcium – 10ppm, Magnesium – 3.6ppm, Potassium – 0.12ppm, Total Hardness – 40ppm (Source – Chilika Development Authority).

6.4.12. Existing vegetation typology map



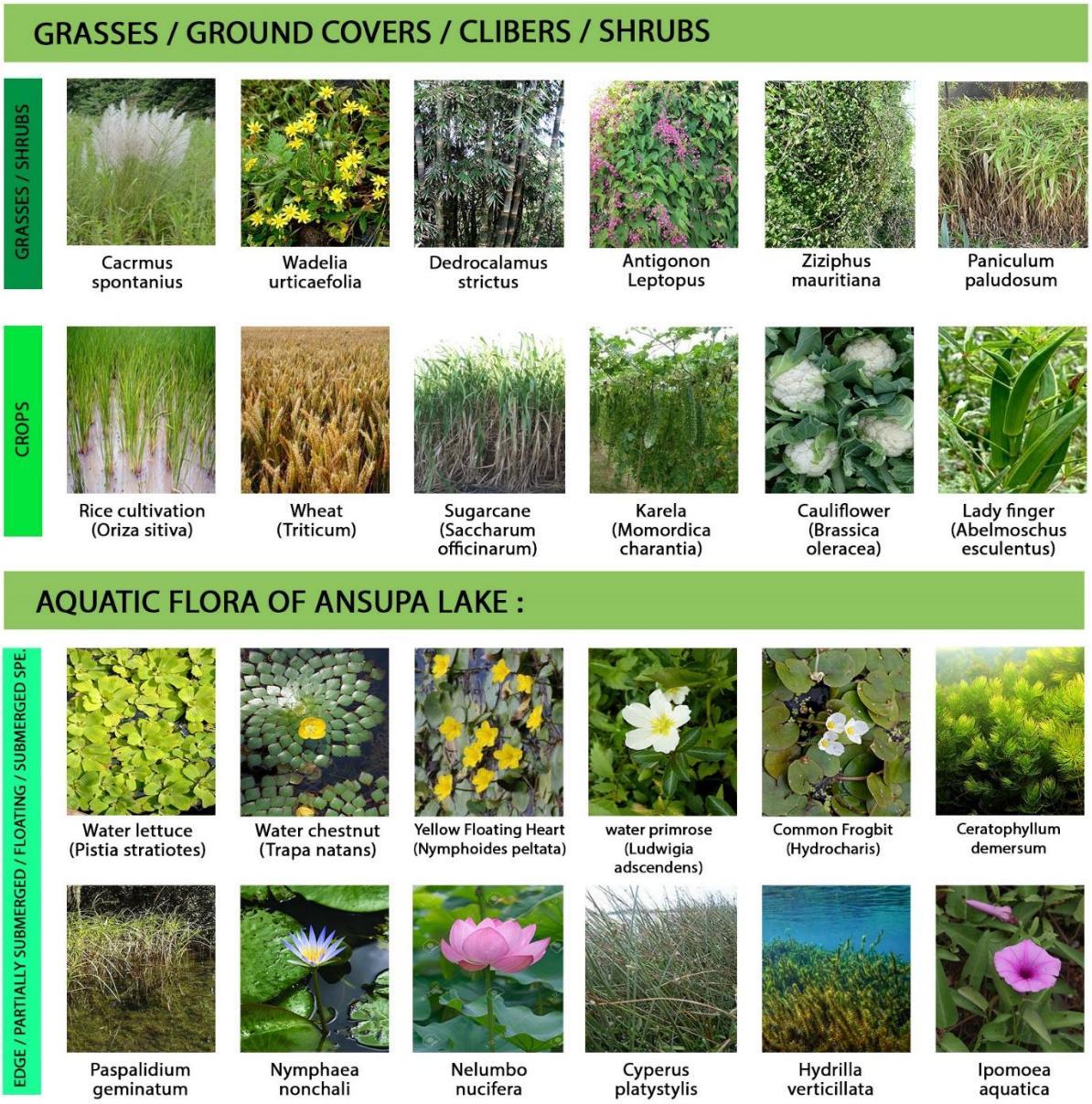
Map showing existing vegetation pattern.

6.4.13. Illustrative sections showing existing vegetation typology



Section showing vegetation typology with highlighted bands as per vegetation colour coding shown in vegetation typology map

6.4.14. List of existing vegetation species: as per colour coding in map



Inferences

- Forest department has taken step to for Afforestation on the hills and surrounded areas along the lake to control the erosion. The trees which has been planted are of commercial values which government leases out to improve the socio-economic conditions in the villages around the lake.

- Planted species are not of much varieties which affects the biodiversity of the area, also it affects the soil nutrition by absorbing same type of nutrient leaving the soil nutrition deficit.

- Due to deforestation wild life corridor has been disturbed and making their approach to the lake difficult.

- Due to less vegetation around the roads and barren rocky areas has led to heat island effect affecting the microclimate of the area which in turn affect the wetland ecosystem.

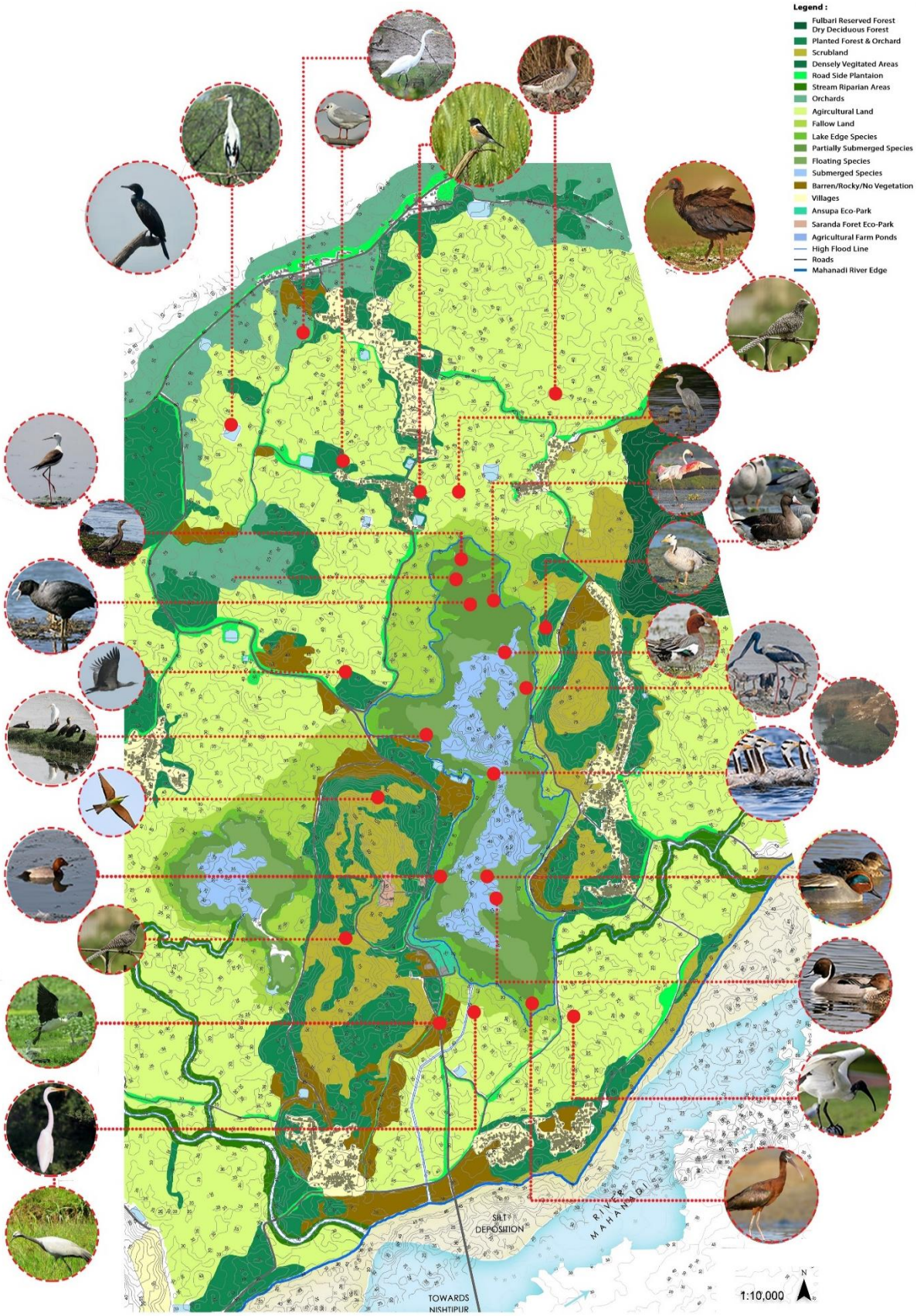
- Due to faulty agricultural practices and excessive use of fertilizers and pesticides the soil quality has degraded these fertilizers and pesticides gets deposited on the soil which is carried to the lake with the runoff during rains, this causes eutrophication of the lake.

- The eutrophicated water is used for irrigation and the cycle continues.

- These has let to degradation for the aquaculture of the lake which affects fishing and wetland ecosystem.

- Due to all these factors productivity of the wetland is degrading and it is adversely affecting the socio economic condition of the area.

6.4.15. Avifauna habitat mapping with reference to existing vegetation



6.4.16. Bird checklist with IUCN red-list nomenclature status

BIRD CHECKLIST WITH IUCN REDLIST NOMENCLATURE, RESIDENTIAL STATUS, GEOGRAPHICAL RANGE & HABITAT

Sl no	SCIENTIFIC NAME	COMMON NAME	IUCN	RESIDENTIAL STATUS	GEOGRAPHICAL RANGE IN SITE	HABITAT
1	*Anas acuta*	Northern Pintail	LC	WM		5.1, 5.4, 5.5, 5.8, 5.14, 9, 13
2	*Anas crecca*	Common Teal	LC	WM		5.1, 5.5, 5.7, 5.8, 5.16
3	*Anas platyrhynchos*	Mallard	LC	R/WM		5.1, 5.4, 5.5, 5.7, 5.14, 5.17, 15
4	*Anhinga melanogaster*	Oriental Darter	NT	R/LM		1, 5.1, 5.4, 5.5, 5.14, 9, 13
5	*Anser albifrons*	Greater White-fronted Goose	LC	WM		4, 5.4, 5.10, 9, 13, 14
6	*Anser anser*	Greylag Goose	LC	WM		4, 5.4, 5.10, 14
7	*Anser indicus*	Bar-headed Goose	LC	R/WM		5.1, 6, 14, 15
8	*Anthropoides virgo*	Demoiselle Crane	LC	WM		2, 3, 4, 5.1, 5.2, 5.4, 5.5, 5.15, 6, 8, 14, 15
9	*Antigone antigone*	Sarus Crane	VU	R/LM		4, 5.4, 5.5, 5.7, 14, 15
10	*Aquila nipalensis*	Steppe Eagle	EN	WM		2, 4, 6
11	*Ardea alba*	Great White Egret	LC	R/LM		4, 5.4, 5.5, 12, 15
12	*Ardea cinerea*	Grey Heron	LC	R/WM		1, 4, 5.1, 5.4, 5.5, 5.6, 5.7, 5.8, 5.13, 5.14, 5.15, 5.16, 5.17, 9, 12, 15
13	*Ardea purpurea*	Purple Heron	LC	R/LM		1, 3, 5.4, 12
14	*Ardeola grayii*	Indian Pond-heron	LC	R/LM		1, 5.1, 5.4, 5.5, 12, 15
15	*Aythya ferina*	Common Pochard	VU	WM		5.1, 5.4, 5.5, 5.7, 5.14, 5.16, 9, 13, 15
16	*Aythya nyroca*	Ferruginous Duck	NT	R/WM		5.5, 5.7, 13, 15
17	*Bubulcus ibis*	Cattle Egret	LC	R/AM		1, 5.1, 5.5, 14
18	*Calidris pugnax*	Ruff	LC	WM/PM		4, 5.5, 5.6, 5.7, 5.8, 9, 12, 14, 15
19	*Calidris pygmaea*	Spoon-billed Sandpiper	CR	NE		4, 12
20	*Chrysomma sinense*	Yellow-eyed Babbler	LC	NE		3, 4, 5.1, 5.4, 14, 15
21	*Ciconia episcopus*	White necked stork	VU	R		1, 4, 5.1, 5.7, 5.8, 9, 12, 14, 15
22	*Circaetus gallicus*	Short-toed Snake-eagle	LC	NE		1, 2, 3, 4, 8
23	*Clamator jacobinus*	Jacobin Cuckoo	LC	NE		2, 4
24	*Dendrocygna javanica*	Lesser Whistling-duck	LC	R/LM		1, 4, 5.4, 13, 14 ,15
25	*Dicrurus macrocercus*	Black Drongo	LC	NE		2, 3, 4, 14
26	*Egretta garzetta*	Little Egret	LC	R/LM		1, 4, 5.1, 5.5, 5.8, 5.14, 5.15, 9, 12, 13, 15
27	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT	R		1, 4, 5.4, 5.7, 9, 12, 13, 15
28	*Eudynamys scolopaceus*	Western Koel	LC	NE		1, 3, 14
29	*Francolinus pondicerianus*	Grey Francolin	LC	NE		2, 3, 4, 14
30	*Fulica atra*	Common Coot	LC	R/WM		4, 5.1, 5.4, 5.5, 5.6, 5.7, 5.8, 9, 13, 15
31	*Gallinago gallinago*	Common Snipe	LC	R/WM		1, 4, 5.1, 5.4, 5.5, 5.7, 5.10, 9, 15
32	*Grus grus*	Common Crane	LC	WM		2, 4, 5.1, 5.4, 5.5, 5.7, 12, 14, 15
33	*Halcyon smyrnensis*	White-breasted Kingfisher	LC	R/LM		1, 5.4, 12, 14, 15
34	*Himantopus himantopus*	Black-winged Stilt	LC	R/LM		4, 5.1, 5.5, 5.6, 5.7, 5.8, 5.14, 5.15, 9, 12, 13, 15
35	*Hirundo rustica*	Barn Swallow	LC	WM		2, 3, 4, 5.1, 5.4, 5.5, 5.6, 5.7, 14, 15
36	*Lanius schach*	Long-tailed Shrike	LC	NE		1, 3, 4, 5.4, 8, 14
37	*Larus ridibundus*	Black-headed Gull	LC	WM		4, 5.1, 5.5, 5.7, 5.8, 9, 12, 13, 14, 15
38	*Limosa limosa*	Black-tailed Godwit	NT	WM		4, 5.4, 5.6, 5.8, 9, 12, 14
39	*Mareca penelope*	Eurasian Wigeon	LC	WM		4, 5.4, 5.5, 5.6, 5.7, 5.8, 5.16, 9, 12, 13
40	*Mareca strepera*	Gadwall	LC	WM		5.4, 5.5
41	*Merops orientalis*	Asian Green Bee-eater	LC	NE		1, 2, 3, 5.9, 8, 14,
42	*Microcarbo niger*	Little Cormorant	LC	R/LM		1, 5.1, 5.4, 5.5, 5.7, 15
43	*Mycteria leucocephala*	Painted Stork	NT	R/LM		5.1, 5.4, 5.5, 13, 15
44	*Numenius arquata*	Eurasian Curlew	NT	WM		1, 3, 4, 5.1, 5.4, 5.5, 5.6, 12, 13, 14, 15
45	*Ocyceros birostris*	Indian Grey Hornbill	LC	NE		1, 2, 14
46	*Phalacrocorax carbo*	Great Cormorant	LC	R/WM		1, 5.4, 5.5, 5.14, 9, 13
47	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	R/LM		1, 5.1, 5.5, 9
48	*Phoenicopterus roseus*	Greater Flamingo	LC	R/WM/LM		5.14, 9
49	*Platalea leucorodia*	Eurasian Spoonbill	LC	R		1, 5.7, 9, 13, 15
50	*Plegadis falcinellus*	Glossy Ibis	LC	R/WM/LM		5.1, 5.4, 5.7, 13
51	*Ploceus benghalensis*	Black-breasted Weaver	LC	R/LM		4, 5.4, 15
52	*Ploceus philippinus*	Baya Weaver	LC	R/LM		1, 3, 4, 14, 15
53	*Pseudibis papillosa*	Red-naped Ibis	LC	R/WM/LM		4, 5.1, 14
54	*Recurvirostra avosetta*	Pied Avocet	LC	WM/R		4, 5.6, 5.13, 5.14, 5.15, 12, 13
55	*Spatula clypeata*	Northern Shoveler	LC	WM		4, 5.5, 5.7, 9, 12, 13, 15
56	*Spatula querquedula*	Garganey	LC	WM		4, 5.5, 5.7, 5.8, 5.13, 9, 12, 13, 15
57	*Tachybaptus ruficollis*	Little Grebe	LC	R/LM		5.1, 5.5, 5.9, 5.14, 9, 13, 15
58	*Tadorna ferruginea*	Ruddy Shelduck	LC	WM		4, 5.1, 5.5, 5.7, 5.14, 14, 15
59	*Tadorna tadorna*	Common Shelduck	LC	WM		5.5, 9, 12
60	*Threskiornis melanocephalus*	Black-headed Ibis	NT	R/WM/LM		1, 4, 5.1, 5.4, 5.5, 12, 13, 15

IUCN Red List Categories	
EX	Extinct
EW	Extinct in the Wild
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient

RESIDENTIAL STATUS	
R	Resident
R/LM	Resident with local movements
R/AM	Resident with altitudinal movements
R/WM	Resident with winter influx
R/WM/LM	Resident with winter influx as well as local movements
WM	Winter Migrant
WM/R	Largely winter migrant and partly resident
WM/PM	Winter migrant as well as passage migrant

The above table shows 60 of the well known and on site observed species of lake area. the recent bird count data by The Asian Waterbird Census (AWC) 2018 and Bird Count India shows that the lake is home of 264 species in which 51 are migratory birds.

Bird details and habitat as well as the category source: http://www.iucnredlist.org/
Photo credits for the chart : facebook family of Birds of Ansupa Lake group page
Residential status source : Ministry of Environment and Forestry, Govt. of India

IUCN Habitat Classification	
Habitat 1	Forest and Woodland
Habitat 2	Savanna
Habitat 3	Shrubland
Habitat 4	Native Grassland
Habitat 5	Wetlands (Inland)
Habitat 6	Inland Rocky Areas
Habitat 7	Caves and Subterranean
Habitat 8	Desert
Habitat 9	Marine - Neritic
Habitat 10	Marine - Oceanic
Habitat 11	Marine – Deep Ocean Floor
Habitat 12	Marine - Intertidal
Habitat 13	Marine – Coastal/Supratidal
Habitat 14	Artificial - Terrestrial
Habitat 15	Artificial - Aquatic
Habitat 16	Introduced Vegetation
Habitat 17	Other
Habitat 18	Unknown

Subclassification of Habitat 5 - Wetland	
Habitat 5.1	Permanent Rivers, Streams, Creeks
Habitat 5.2	Seasonal Rivers, Streams, Creeks
Habitat 5.3	Shrub Dominated Wetlands
Habitat 5.4	Bogs, Marshes, Swamps, Fens, Peatlands
Habitat 5.5	Permanent Freshwater Lakes
Habitat 5.6	Seasonal Freshwater Lakes
Habitat 5.7	Permanent Freshwater Marshes/Pools
Habitat 5.8	Seasonal Freshwater Marshes/Pools
Habitat 5.9	Freshwater Springs and Oasis
Habitat 5.10	Tundra Wetlands
Habitat 5.11	Alpine Wetlands
Habitat 5.12	Geothermal Wetlands
Habitat 5.13	Permanent Inland Deltas
Habitat 5.14	Permanent Saline, Brackish or Alkaline Lakes
Habitat 5.15	Seasonal Saline, Brackish or Alkaline Lakes
Habitat 5.16	Permanent Saline, Brackish or Alkaline Marshes
Habitat 5.17	Seasonal Saline, Brackish or Alkaline Marshes
Habitat 5.18	Karst and other subterranean inland aquatic

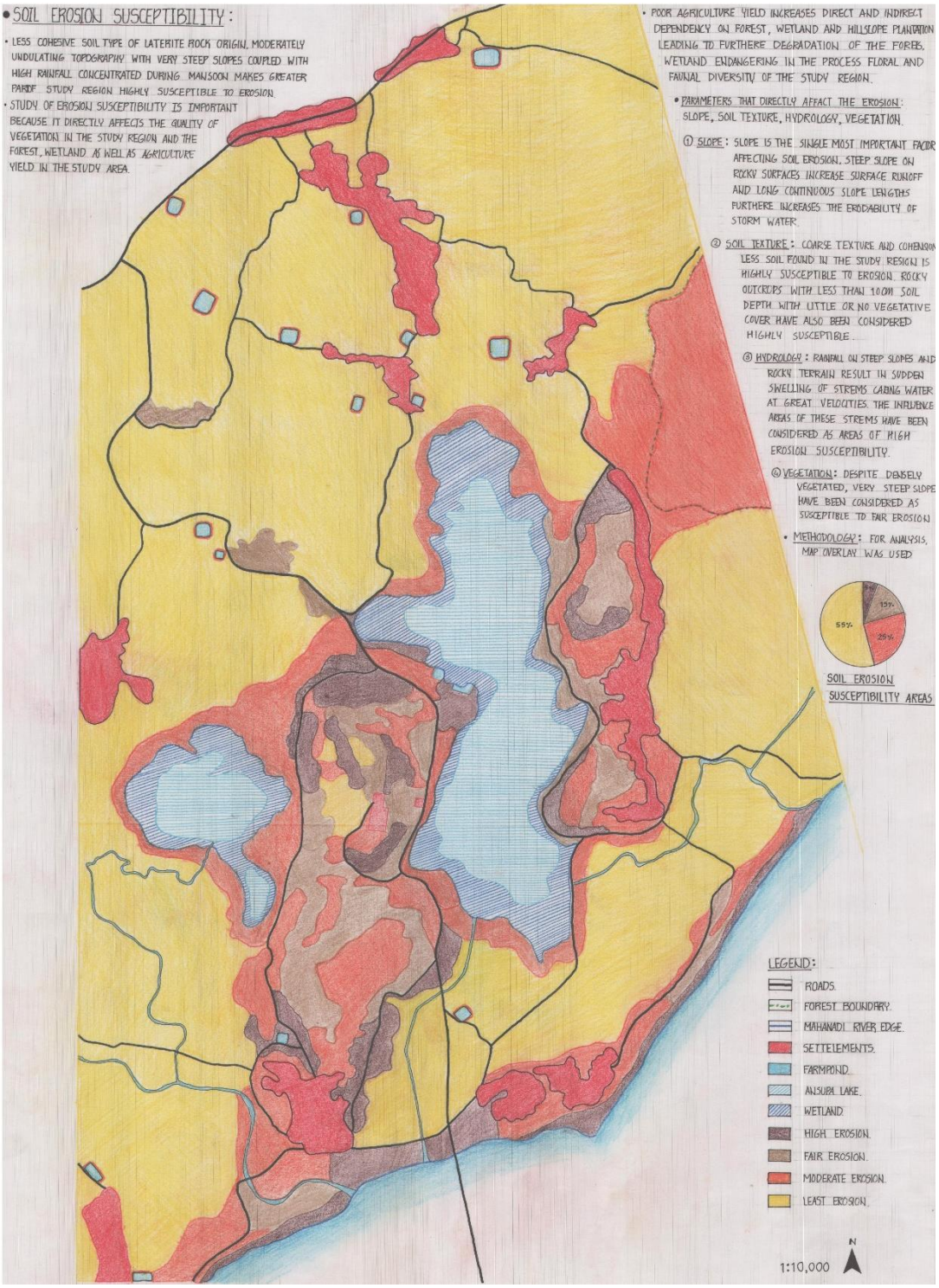
ıri Reserved Forest
)eciduous Forest
ed Forest & Orchard
)land
Edge Species

The main category pattern that follows in this area is observed by birds that come to indian subcontinent during the winters, birds from central asian region of Kazakhistan, Mongolia and Russia and from the Tibetan region make wetlands, rivers, streams, lakes,coastalareas, farmlands in this subcontinent as their home during winter period. While some just visit and go back after winters but some of them even breeds in the wintering region.

At Ansupa lake these birds visit during novemeber to march. Most of them are snail eating and some of them thrive on planktons, fishes and weed

Due to change in weather conditions and major anthropogenic activities these birds are diverting and the number has gone down in recent years.

6.4.17. Soil erosion susceptibility map



- Less cohesive soil type of Laterite Rock origin, moderately undulating topography with high very steep slopes coupled with high rainfall concentrated during monsoon makes greater part of study region highly susceptible to erosion.

- Study of erosion susceptibility is important because it directly affect the quality of vegetation in the forest as forest leading to further degradation of the forest, wetland, hill slope vegetation, Agriculture.

- Poor agriculture yield increases direct and indirect dependency on forest, wetland, hill slope plantation leading to further degradation of the forest, wetland endangering in the process floral and faunal diversity of the study region.

Parameters that directly affect the erosion potential are:

Slope, Soil type, Soil texture, hydrology, vegetation

- **Slope:**

Slope is the single most important factor affecting soil erosion, Steep slopes on rocky surfaces increase surface run-off and long continuous slope length further increase the erodability of storm water.

- **Soil Texture:**

Coarse textured and cohesion less soil found in the study region is highly susceptible to erosion, Rocky outcrops with less than 10cm soil depth with little or no vegetation cover have also been considered highly susceptible.

- **Hydrology:**

Rainfall on steep slopes and rocky terrain result in sudden swelling of streams carrying water at greater velocities. The influence areas of these streams have been considered as areas of high erosion susceptibility.

- **Vegetation:**

Despite densely vegetated, very steep slope have been considered as susceptible to erosion.

Methodology: For analysis, map overlay was used.

- The first step involves making criticality of various slope ranges with respect to erosion susceptibility.

Sr. No.	Slope Ranges	Erosion Susceptibility
1.	> 25%	High
2.	10% - 25%	Moderate
3.	0% - 10%	Low

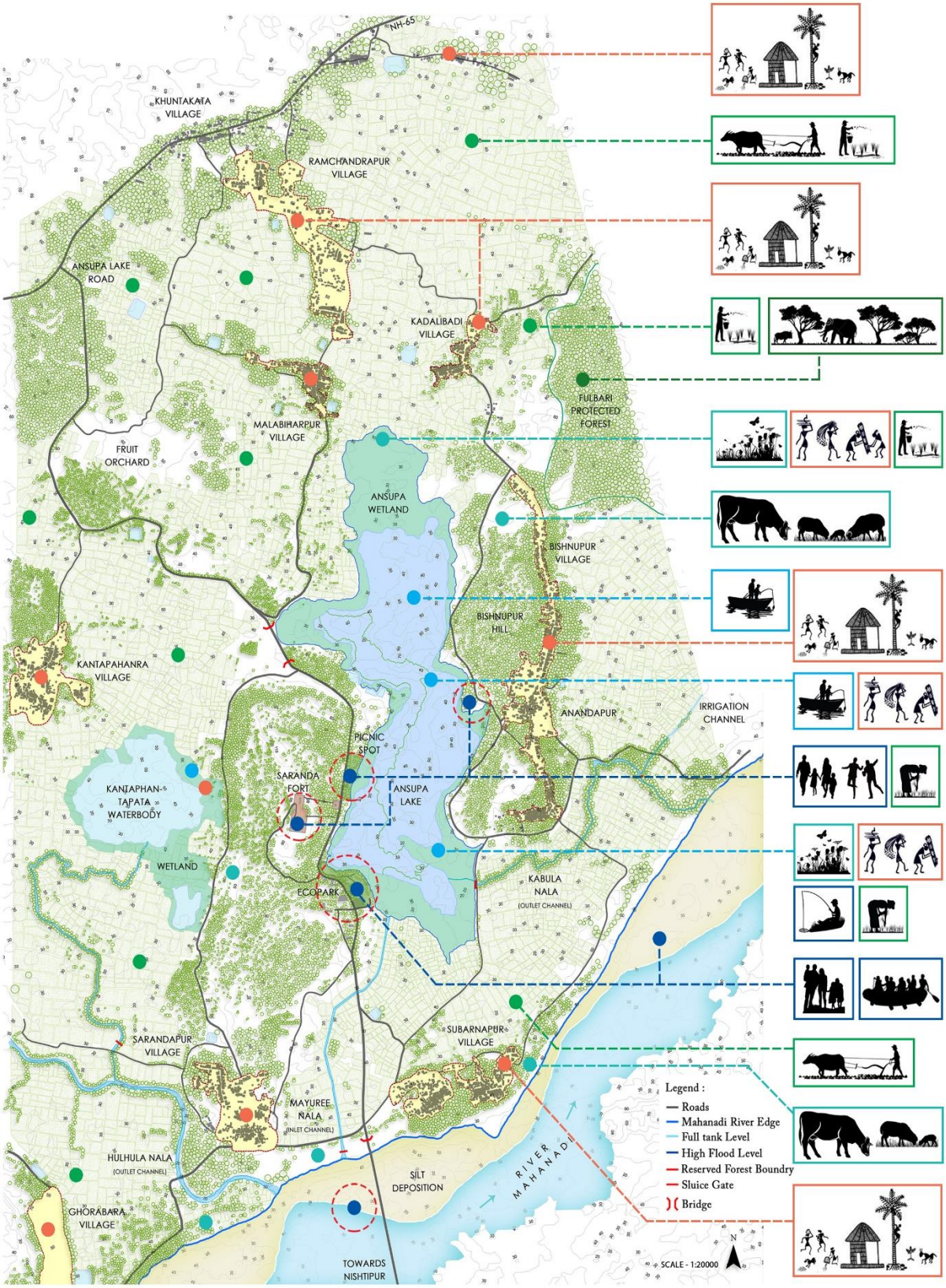
- Making influence areas of streams based on stream orders in meters.

Stream Order - Slope	Steep Slope (> 25%)	Moderate (10% - 25%)	Gentle (0% - 10%)
First Order	5	10	16
Second Order	10	20	30
Third Order	20	40	60

- Erosion susceptibility with respect to soil – Red Sandy Soil – Coarse - High

– Gravelly Red Soil – Coarse – High

6.5. Activity mapping



Map showing the day today lives activities around the lake with colour code.

The area surrounding the lake like, Saranda fort and garden, Ansupa Eco-park, Picnic Spot, Mahanadi River and its scenic beauty attracts many tourists every day, these sites also offers other activities like boating, play area, nursery, hospitality (Saranda Resort) and small vending zones. Due to these activities the landscape is getting degraded because of littering done by them. Due to no strict rules and regulations people are used to play loud music which creates noise pollution which is major threat to avifauna.

Peoples are mostly indulge in agriculture, households, cattle raring and another domestic avidities. Major occupation of people around the lake is fishing and farming like major crops Paddy, Wheat, Sugarcane, and other vegetables.

The Fulbari dry-deciduous reserved forest lies in the vicinity of the lake and it has a rich biodiversity. The local people are dependent on forest for fodder, food and fuel. But, now the forest is under threat due to extensive extraction of its resources.

Fulbari Dry-Deciduous Reserved Forest

Cattle raring is one of the major activity is around the lake area but due to extensive grazing these has laid to deterioration nearby grasslands leaving open soil areas susceptible to erosion.

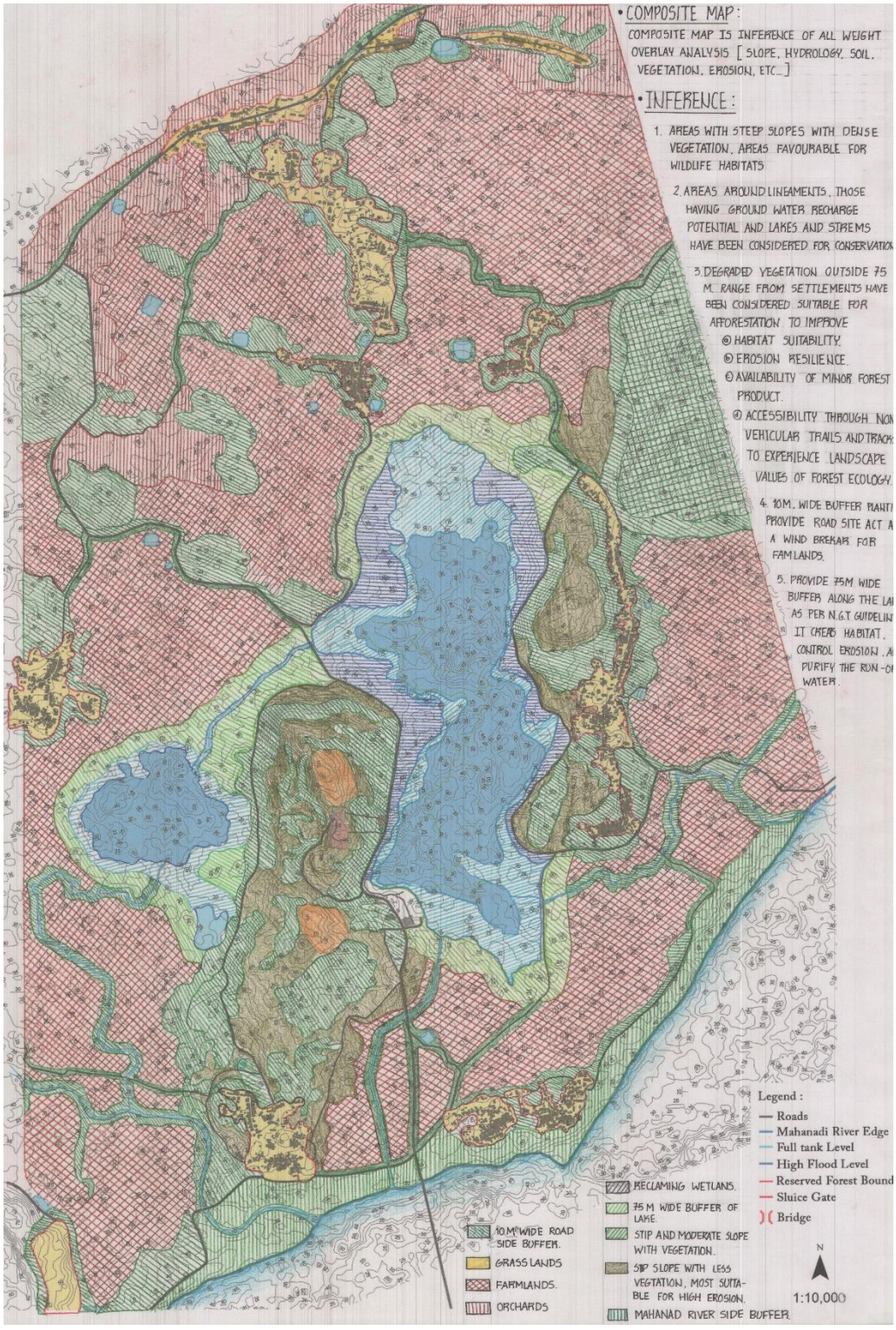
Wetland and Water Activties

Fishing is one of the major activity in the area but extensive eutrophication and siltation are two major threats for the aquatic fauna of the intron affect fishing and fishermen economic condition. For other day todays activities people go to these waterfront. The activities include bathing, washing clothes and animals, vegetables and to extract other wetland resources like grasses, lotus, medicinal herbs etc…

Ethanobotany around the site :

Images showing the local handicraft work, for this handicraft work resources taken from wetland and the forest.

6.6. Composite map



Composite map is inference of all Physical, Ecological, and Cultural analysis

(By using Method - weighted overlay analysis)

(Map Use: Slope, Soil, Hydrology, vegetation, Erosion, Habitat, Cultural, etc…)

6.7. Inference

Area with steep slopes with dense vegetation, areas favourable for wildlife habitats, areas around lineaments, those having ground water recharge potential and lakes and streams have been considered for conservation.

Degraded vegetation outside 75m range from the settlements have been considered suitable for afforestation to improve: Habitat suitability, Erosion resilience, Availability of minor forest product, Accessibility through non-vehicular trails and tracks to experience landscape values of forest ecology.

Reclaiming the wetland area to improve wetland condition and create more resourceful wetland which also provide habitat for avifauna.

Provide 75m wide buffer plantation area around the lake as per National Green tribunal (NGT guidelines), which creates habitat for avifauna and wildlife, it also provide help to control erosion and purify the run-off water.

Provide 10m wide buffer plantation with vertical stratification along the roads which act as a windbreakers and prove shade also to control heat island effect.

Provide bioswale bellow the steep slopes to catch the run-off water which helps to control the siltation issue as well as purify the water before it is going to the lake.

Improvement of water inflow and outflow mechanism from Mahanadi River to Ansupa Lake by restoring the existing streams and with the sluice gate through engineering intervention which help to retain the water level of Ansupa Lake and Aquatic culture of lake.

Provide different landscape character experience trails like Eco-trail, Cultural trail, Forest trail, Fruit and Flowering trail, Trekking routs with the habitat plantation which attracts the tourist.

Provide spaces for Eco-park, Fare grounds, Maidan, Playground, Picnic, House stay, Handcraft workshops…etc... Which attracts the tourist and provide employment for nearby villagers.

Provide activities like boating by using the local boats which also attracts the tourist.

All these above mentioned activities are being implemented in phased manner and in an integrated manner with community mobilization and participation to make it sustainable.

This famous fresh water wetland, Ansupa Lake would become the site as an Eco-tourism destination with international importance which would not only attracts the attention of national but international tourist and agencies.

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8. DESIGN PROPOSAL AND RECOMMENDATIONS