# Biodiversity Intregrated Landscape Level Land Use Plan For Kala Oya Basin

Prepared by

**Land Use Policy Planning Department**

**Enhancing Biodiversity Conservation and Sustenance of Ecosystem Services in Environmentally Sensitive Areas Project**

Implemented by

Ministry of Environment

LUPD GUIDING FOR BETTER LAND USE

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# 2020

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# Message of Director General

Conservation of biological diversity in Sri Lanka is crucial in present day context. It seems to be a big challenge with increasing demand for land resource for various development activities and with diverse land use patterns. At present, conservation of biological diversity go beyond the protected area boundaries by introducing landscape level conservation which is widely accepted concept for bio-diversity conservation.

"Enhancing Biodiversity Conservation and Sustenance of Ecosystem Services in Environmental Sensitive Areas" is a GEF funded project, implemented by the Ministry of Environment (MoE). Land Use Policy Planning Department (LUPPD) had been entrusted by the project to prepare a landscape level land use plan for Kala Oya Basin by mainstreaming biodiversity conservation. The project focuses integrating biodiversity conservation into the mix of diverse land use patterns in Environmentally Sensitive Areas (ESAs).

Land use planning may be one of the strategies that can be used to facilitate the decision making process in allocating the land resource among competing demands while conserving bio-diversity. However, during the past, Land Use Policy Planning Department (LUPPD) has mainly engaged in preparing land use plans at various levels mainly to enhance the productivity of the lands by considering administrative units as the planning area. Preparation of landscape level land use plans by mainstreaming bio-diversity conservation is a new thought to our staff. This challenge was faced by providing training to the staff particularly on the incorporation of bio-diversity conservation into planning process. Through this capacity building process, we were able to complete the planning exercise successfully. This output is a collective effort of all, including our staff, experts, representatives of stakeholder agencies and land users. This exercise can be replicated in other river basins in order to conserve the biodiversity of the entire country.

The recommendations given in this plan are multidisciplinary in nature. Hence, different agencies are given responsibilities to implement these recommendations depending on their expertise. Biodiversity of the identified ESAs in the river basin should be conserved mainly by implementing the recommendations while land use of the rest of the areas should also be regulated according to the plan with the participation of all stakeholders. Further, it is advisable to develop a mechanism to disseminate the information of the plan among the people who are living in the river basin in order to guide the biodiversity conservation. I hope this plan will facilitate the decision making process of all stakeholder agencies and finally it helps to conserve the biodiversity of the entire basin.

A.S. Ilangamge

Director General

Land Use Policy Planning Department

## Message of Project Director

Sri Lanka is a small island with rich biological diversity and high level of endemism. Biodiversity of the country is unique and hence it has a universal value and significance. However, our biodiversity is currently under the threat from ever increasing human interferences. Due to the high endemism and high level of threat to the existing biodiversity, Sri Lanka is considered as one of the global biodiversity hotspots.

Sri Lanka signed the "**Convention on Biological Diversity"** in 1992, ratified it in 1994, and is obliged to implement the relevant provisions of the Convention. As per the Article 6 of the CBD, This Ministry developed the National Biodiversity Strategic Action Plan (NBSAP) to mainstream biodiversity into national development, strategies and actions. The Strategic Action Plan has proposed working solutions and actions having taken into account in-depth studies on causes of biodiversity degradation in our country.

Many of the globally important ecosystems and habitats of globally significant species will continue to remain outside the protected areas and will face accelerating pressures of development. Unless strong measures are undertaken to put development on a more conservation friendly trajectory by mainstreaming biodiversity into production activities, biodiversity outside protected areas cannot be safeguarded, especially under the current context of rapid urbanization and high rate of economic development in the country. Enhancing Biodiversity Conservation and Sustenance of Ecosystem Services in Environmentally Sensitive Areas Project, which is funded by Global Environmental Facility (GEF), implemented by Ministry of Environment (MoE) and supported by UNDP has been developed to introduce a new land use governance frame work for Sri Lanka to safeguard biodiversity in the multiple land use areas with high biodiversity value.

It has been prepared landscape level land use plan for the Kala Oya Basin in order to conserve the biodiversity by identifying ESAs in the region. Project activities, impacts and lessons learnt are recorded and disseminated widely within the country to generate a bottom-up demand for similar activities throughout the country. Hence, the recommendations of this plan should also be disseminated among all stakeholders including the people living in the basin. Further, this exercise should also be replicated with certain modifications in other basins to ensure the biodiversity conservation.

ESA project being implemented under the Ministry of Environment has supported LUPPD to develop this biodiversity integrated landscape level land use plan to provide guidance to the land use planners, especially at the sub-national level to integrate biodiversity priorities into land-use plans. I wish these tools will be instrumental to regulate development activities in production landscapes with high biodiversity and conservation values

Kulani H.W. Karunarathne
Project Director (Enhancing Biodiversity Conservation
and Sustenance of Ecosystem Services in Environmentally Sensitive Areas Project)
Ministry of Environment

## Acknowledgement

*Land use plan for the Kala Oya river basin is an output of an effort of LUPPD along with the support of many institutions and individuals. First of all it is necessary to acknowledge Dr. Sevavndi Jayakody, Senior Lecture, Wayamba University of Sri Lanka, for her continuous guidance given throughout the process of the preparation of the plan. Acknowledgement also goes to the Government Agents/District Secretaries in Anuradhapura and Puttalam Districts, Divisional Secretaries in Palagala, Galnewa, Ipalogama, Kekirawa, Vanathavillu and Karuwalagaswewa divisions, National, District and Divisional level staff of relevant stakeholder institutions who supported in numerous ways to complete this exercise successfully. Further, Project Director of ESA Project, project staff and biodiversity expert team appointed by the project are also acknowledged for their continuous support in the planning process.Support given by Mrs. Sugandhi Samarasingha, Technical Coordinator, UNDP and UNDP Field Coordinators are also greatly acknowledged. At last but not least, generous support of the people during the field work is highly appreciated.*

## ABBREVIATIONS

| | |
|---|---|
| BDS | - Bio Diversity Secretariat |
| BRMS | - Bar Reef Marine Sanctuary |
| BZ | - Buffer Zone |
| CBO | - Community Based Organization |
| DCS | - Department of Census and Statistics |
| DFC | - Department of Forest Conservation |
| DSD | - Divisional Secretary Division |
| DWLC | - Department of Wildlife Conservation |
| EPA | - Environmental Protection Area |
| ESA | - Environment Sensitive Area/Ecologically Sensitive Area |
| F&FPO | - Fauna & Flora Protection Ordinance |
| FAO | - Food and Agriculture Organization |
| FO | - Forest Ordinance |
| GAP | - Good Agricultural Practices |
| GDP | - Gross Domestic Production |
| GEF | - Global Environment Facility |
| GND | - Grama Niladari Division |
| IAS | - Invasive Alien Species |
| IPM | - Integrated Pest Management |
| IUCN | - International Union for Conservation of Nature |
| KOB | - Kala Oya River Basin |
| LUPPD | - Land Use Policy Planning Department |
| MASL | - Mahaweli Authority of Sri Lanka |
| MER | - Managed Elephant Reserve |
| MoL | - Ministry of Lands |
| MoE | - Ministry of Environment |
| NBSAP | - National Biodiversity Strategic Action Plan |
| NEA | - National Environmental Act |
| NEP | - National Environmental Policy |
| NLUP | - National Land Use Policy |
| NPPD | - National Physical Planning Department |
| PA | - Protected Area |
| SLM | - Sustainable Land Management |
| UDA | - Urban Development Authority |
| UNDP | - United Nations Development Programme |
| USDA | - United States Department of Agriculture |

## MEMBERS OF THE FIELD TEAM

### Anuradhapura District

| | |
|---|---|
| Late Mr. R.E.W.M.S. Bandara | Assistant Director (District Land Use) |
| Mr. P.R.U. Aberathna | Land Use Planning Officer |
| Mrs. S.S.K. Dissanayaka | Development Officer of LUPPD |
| Mrs. C.R.M. Devika Priyadarshani | Development Officer of LUPPD |
| Mrs. R.B.R.N. Kumari | Development Officer of LUPPD |

### Puttalam District

| | |
|---|---|
| Mr. H.M. Mahinda Pemasiri | Assistant Director (District Land Use) |
| Mrs. W.U.S. Silva | Land Use Planning Officer |
| Mr. I.M.A. Premalal | Land Use Planning Officer |
| Mr. S.P.N.C. Aberathna | Development Officer of LUPPD |

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# 1. INTRODUCTION OF THE PROJECT

The Project "Enhancing Biodiversity Conservation and Sustenance of Ecosystems services in Environmentally Sensitive Areas" is a GEF funded project, implemented by the Ministry of Environment (MoE) and supported by UNDP. The Project would contribute to safeguarding globally significant biodiversity on production lands of high interest for conservation. This phase of project will greatly strengthen the country's ability to safeguard biodiversity outside of the protected areas in special Environmentally Sensitive Areas, through a new land use governance framework. Project activities will provide a vehicle for safeguarding globally significant biodiversity on multiple-use lands of high conservation values.

The primary objective of this project is "To operationalize Environmentally Sensitive Areas (ESA), as a mechanism for mainstreaming biodiversity management into development in areas of high conservation significance, outside Protected Area network. To achieve this objective, the project has two major outcomes; (1) national enabling framework strengthened to designate and manage ESAs and (2) biodiversity-friendly ESA management for long term integrity and resilience ensured at sites identified in the Kala Oya basin.

The Project adopts Environmentally Sensitive Areas (ESA) as a tool to manage a landscape or seascape from an ecological perspective. ESA is an area outside a formal Protected Area that is vital for the long-term maintenance of biodiversity and/or the productivity of water, soil and other natural resources to provide ecological, environmental, economic and cultural benefits to the local community involved as well as to the nation and global community as a whole."

In the beginning as per cumulative scores against ecological criteria and eco system services derived from scorecard of baseline survey conducted in Kala Oya Basin; it was identified 13 ESAs in the Kala Oya Basin. Five ESAs were prioritized as (1) Villu ESA, (2) Gangevadiya ESA, (3) Vevelkele ESA within Wanathawilluwa Divisional Secretariat Division (DSD), (4) Manewekanda ESA within Ipalogama DSD and (5) 4km long reservation of Kala Oya.

The Project proposes to use land use planning and management frame work as the key entry point to optimize land management in ESAs in order to ensure conservation of biodiversity and other natural resources while allowing the ESAs for sustainable economic activities under proper management. Preparation of Land Use Plans by mainstreaming biodiversity conservation had been mainly entrusted to Land Use Policy Planning Department (LUPPD) and developed the biodiversity integrated land use plan for Kala Oya Basin during 2018.

## 1.1 Scope for ESAs; Current policies and policy needs

### Scope for ESAs

Generally, ESA is an area that is vital for long-term conservation and maintenance of biodiversity and productivity of water, soil and other natural resources that provides ecological, environmental, economic and cultural benefits to a local community.

The origins of the ESA lie in the UK, where the ESA scheme was introduced in 1987. The rationale for developing such schemes is based on ´agriculture can have a major influence on the conservation and enhancement of the countryside, wildlife and historical features´[1]. ESAs were introduced with the purpose of offering incentives to encourage farmers to adopt agricultural practices safeguarding and enhancing parts of the country of particularly high landscape, wildlife or historic value[2].The ESA scheme encourages farmers to help protecting such areas. In the UK, the ESAs were particular parts of the countryside where the landscape, wildlife and historic interest are of national importance´, including many features of the countryside (e.g. hedges, walls, hay meadows, river valley grasslands) that were highly valued for their scenic beauty and for the habitats they provide for plants and wildlife[3]. Each ESA is unique and having its own particular environmental features and therefore land management requirements which farmers must comply differ from one site to another[4]. In the UK, the scheme has always been voluntary, encouraging farmers within an ESA ´to maintain or adopt farming practices that will protect the special environmental features´[5].There are various definitions and applications of the term ESAs across countries as per their context.

ESA is broadly defined[6] for this project as;

An area outside a formal Protected Area that is vital for the long-term maintenance of biodiversity and/or the productivity of water, soil and other natural resources to provide ecological, environmental, economic and cultural benefits to the local community involved as well as to the nation and global community as a whole."

Sri Lanka has already established a network of protected areas (PAs) under the Fauna and Flora Protection and Forest Ordinances partly to conserve its critical biodiversity, including genes, species and ecosystems. Practically, biodiversity is not only confined to the protected area within a landscape. There are various land uses/land covers that forms various ecosystems outside the PAs are also provide important biodiversity rich

[1] Website Department for Environment Food and Rural Affairs (DEFRA), available at: http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZW.0A75HQWNML25Y9Z.
[2]Naturenet, available at: http://naturenet.net/status/esa.html
[3]Ibid.
[4] Website Department for Environment Food and Rural Affairs (DEFRA), available at: http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZW.0A75HQWNML25Y9Z.
[5] Website Department for Environment Food and Rural Affairs (DEFRA), available at: http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZW.0A75HQWNML25Y9Z. It is mentioned by DEFRA that in some cases, farmers are offered financial incentives to open their land for public access.
[6]Malcolm.A.J. 2020.Identification, Planning, Management and Monitoring and Evaluation of Environmentally Sensitive Areas on Sri Lanka, Operational Manual.

areas. These areas mainly include conservation areas like buffer zones of the PAs, stream reservations including riverine vegetation, isolated forest patches, tank catchments & related areas and human induced various land uses. Therefore, protected areas alone cannot conserve or protect all genes, species and ecosystems since the country is having an assortment of other forms of land uses/land cover.

Hence, beyond the PAs there are areas of ecological importance that are either affected adversely or likely to be affected adversely by changes mainly as a result of human activity. Improving the condition of these areas of ecological importance requires specific efforts to manage human activity and development threats with the objective to safeguard biodiversity and to ensure the maintained flow of ecosystem services from these areas. The intent is to ensure that these areas of ecological importance that lie outside the PAs network are adequately conserved, using a combination of more environmentally friendly land uses and facilitating a better understanding of trade-offs between conservation, resource use and socio-economic development objectives. Such trade-off can be facilitated by using appropriate decision making tools such as a landscape level land use plan prepared by aiming biodiversity conservation while ensuring the optimum benefits to the society.

Hence, the project suggested a new approach to identify ESAs outside the PAs within the landscape and incorporated into a land use plan in order to protect the biodiversity outside the PAs. This approach emerged as newer and wider management frameworks for conservation at the landscape level, beyond the confines of Protected Areas.

Therefore, an ESA should be viewed as a “concept for management” rather than a definite category of conservation or protected area. The focus is on the conservation of biodiversity in areas with different types of human use (e.g. agriculture, fisheries, irrigation, tourism, etc.) through measures other than exclusive protection.

The term “ESA” is not used in National Environmental Act No. 47 of 1980, National Environmental Act (Amendment) No. 56 of 1988 and National Environmental Act (Amendment) No. 53 of 2000. However, they are having the provision to identify and declare “Environmental Protection Area” (EPA). The relevant Minister for the subject of Environment may by the order published in the Gazette, declare any area which is environmentally important or threatened or with higher necessity of protection to be declared as an Environmental Protection Areas under the provision of 24 (c) and 24 (d) of National Environment Act No.47 of 1980 amended by the Act No. 53 of 2000 and Act No. 56 of 1986.Accordingly, the process of identifying suitable places/areas and declaring them as Environmental Protection Areas is carried out by the Central Environmental Authority (CEA). Areas can be considered as EPAs are; (01) Ecosystems with unique characters (e.g. The areas with high biodiversity, areas consisting of endemic or threatened floral and faunal species), (02) Places with landscape or geologically or geographically important and with aesthetic value (e.g. Waterfalls, hot water spring, caves, including limestone),(03) Hydrologically important places (e.g. Wetlands, catchment areas, important waterways, lakes), (04)Landscapes with tourist

attractions (e.g. Beaches, mountain ranges, rivers, view points), (05) Feckless lands with high risk of accident (e.g. Landslide prone areas, areas which have a high tendency to erode), (06)Areas/ landscapes which are scientifically important, (07) Areas important for flood retention, (08) Buffer Zones of environmentally important areas declared under other Acts and Ordinances, (09) Areas which are identified to be protected/ conserved by Master Plans of other institutes/ areas which have been recommended to be protected by other policies or scientific studies and (10) Areas which have been identified to protect/conserve under other programmes or identified by scientific studies[7]. However, irrespective of the term, the objectives of declaring either ESA or EPA are more or less the same.CEA can enforce regulations and guidelines in EPAs but can't involve in implementation. One law alone also not sufficient in ESA management. There should be mechanism to apply collection of legal instruments (Acts, by-laws, etc),Tools & Guidelines for Partnership driven governance, sustainable financing mechanism and participatory governance systems for identification and management of ESAs

Nevertheless, the existing land uses within the ESAs will not completely be changed by this exercise, but these uses will be improved by various measures in order to make the biodiversity friendly environment while ensuring the sustainability of economic activities. Declaration of such area may help to regulate the land use in favourable manner by restricting inappropriate projects/activities.

**Current Policies, Policy needs for Biodiversity conservation**

Sri Lanka has prioritized biodiversity conservation through several national policies and action plans. The country's constitution has provision to protect, preserve and improve the environment for the benefit of the community. In line with the Constitutional directives there are several sectoral and cross sectoral policies developed and currently available to conserve the biodiversity of the country. The major policy that prominently covers the biodiversity conservation is National Environmental Policy (NEP) of 2003. Under that policy, several outcomes in terms of biodiversity conservation are expected to be achieved. These outcomes are; (1) Degraded ecosystems restored, and further degradation of the country's biodiversity arrested, (2) Adequate areas of forest ecosystems representing the diverse forest communities that are present in the Island and of those ecosystems that contain rare and threatened species are protected for the conservation of biodiversity, (3) Key coastal and marine ecosystems rich in biodiversity are declared as conservation areas and given adequate protection, (4) Adequate protection provided, by in-situ conservation measures to all species of fauna and flora that are threatened, including the wild relatives of cultivated species, (5) Captive breeding/propagation of species that are in demand and that are rare and threatened in the wild are encouraged, (6) Collection of species from natural ecosystems is regulated to within sustainable level

[7]www.cea.lk

sand benefit mainly the local communities, while collection of threatened species is restricted or prohibited, (7) The propagation and cultivation of local cultivars of food species that represent a valuable and threatened agricultural gene pool encouraged, (8) The ex-situ conservation of genetic stocks of agricultural species and their wild relatives is provided for, (9) Effective measures adapted to guard against the entry into Sri Lanka of noxious, invasive species (of plants, animals and micro-organisms) and environmentally harmful genetically modified organisms, (10) Spread within the country of invasive and noxious species of plants, animals and micro-organisms are controlled, (11) The value of biodiversity recognized in national accounting, (12) Research and studies are carried out on aspects of conservation and sustainable use of biodiversity, (13) Sri Lanka's traditional knowledge on biodiversity is protected, and access to indigenous biodiversity by foreign organizations/persons prevented unless equitable benefits to this country are assured.

However, it is rare to see any strong National mechanism to support inter-sectoral approach to achieve the above expected outcomes by managing important biodiversity hotspots outside the protected areas.

There are several National Policies apart from NEP geared towards the environmental protection. Some of them are (1) National Forestry Policy of 1995, (2) National Watershed Management Policy of 2004, (3) National Policy on Wetland Management 2005, (4) National Policy on Elephant Conservation 2006& review in 2017, (5) National Policy on Wild Life Conservation in 2000, (6) National Policy on Conservation and Protection of Water Sources, their Catchments and Reservations in Sri Lanka of 2014) and (7) National Land Use Policy (NLUP) of 2007. All these policies are directly or indirectly covered the biodiversity conservation.

NLUP provides a policy framework to ensure proper land use, food security, economic development and the maintenance of the productivity of the land at the higher level. NLUP is mainly focused on land productivity and biodiversity conservation is also appeared as one of the policy objectives. In NLUP a policy statement was included as “Environmentally Sensitive Areas will be identified and measures will be taken to protect and conserve such areas”. LUPPD has identified additional areas that can be recommended for protection considering the environmental and historical significance and shown in the District and Divisional level land use plans based on the land use policy directives.

One of the main objectives of forest policy is to conserve forests for posterity, with particular regard to biodiversity, soils, water, and historical, cultural, religious, and aesthetic values. Wetland policy (2006) has an objective out of several objectives; to restore and maintain the biological diversity and productivity of wetlands. To minimize the risks of invasive alien species (IAS) on the biodiversity, ecosystems, economy and society thus promoting the sustainable economic development is one of the objectives of the national invasive alien species policy (2016).

There are also several sectoral and cross sectoral actions have been developed for biodiversity conservation. For instance, under the "*Haritha Lanka"* programme*,* several conservation oriented specific actions had been identified. High priority conservation areas were considered by National Biodiversity Strategy and Action Plan in 1999.Further, the National Conservation Strategy, the National Environmental Action Plan, the Forestry Sector Master Plan, the National Coastal Management Plan are some of the policy instruments that have addressed the biodiversity conservation.

There are number of legislations that are relevant to the management of land, water marine resources including biodiversity. For an example the National Environmental Act (NEA) has a provision to declare Environmental Protection Areas (EPAs) which is similar to the ESAs in terms of the objectives of the declaration as mentioned before. The Forest Ordinance No. 16 of 1907, the Fauna and Flora protection ordinance No. 2 of 1937, The felling of trees control Act No. 09 of 1951, the National Heritage and Wilderness Area Act No. 3 of 1988, The Fisheries and Aquatic Resources Act No. 2 of 1996 are some of the ordinance and Acts available to manage the natural resources including biodiversity. Most of these policies and legislations mainly focused on the state lands and not much about on the private lands. Hence it is necessary to develop policies and effective mechanism to protect the biodiversity on private lands too. In such case a mechanism should be developed to obtain peoples' active participation at the planning and implementation stages.

Most of the policies and legislations presently available are mainly address the sectoral issues but hardly having the integrated approach, particularly to ensure the biodiversity conservation. This seems to be one of the drawbacks in available policies. Therefore, the project has a component to support policy and legislation formulation/amendments to minimize the policy gaps regarding the biodiversity conservation.

Provisions of existing ordinance and Acts particularly land development ordinance, Fauna and Flora protection ordinance; Coast Conservation Act etc. were mainly used to develop the decisions in this plan.

## 2. Objectives of the Land Use Plan of Kala Oya Basin

**Main Objective:**

Design and implement biodiversity mainstreamed land use plan as a model for validation of approaches and document lessons learnt.

There are several specific objectives. They are;

1. Identify biodiversity hot spots as ESAs outside the Protected Areas of Kala Oya Basin.

2. Seek opportunities to mainstream biodiversity interests into river basin level land use planning.
3. Identify the opportunities to conserve and enhance biodiversity outside the protected areas of Kala Oya Basin.
4. Develop maps that can be used to plan the land use for biodiversity conservation in Kala Oya Basin
5. Identify potential areas where protected areas can be further connected through strategic land use planning
6. Identify areas for community oriented biodiversity schemes to ensure human, ecological and economic wellbeing of the communities of Kala Oya Basin
7. Apply river continuum approach within the basin connecting the landscape and seascape.

## 3. KALA OYA BASIN

### 3.1 Administrative Divisions

The total land extent of the Kala Oya Basin is approximately 284,691 ha (sq.km. 2847). The basin mainly belongs to two administrative districts namely Anuradhapura and Puttalam. However, small parts of Matale and Kurunegala districts also included within the basin boundary at the South and South East sides (Fig 1).

There are 18 Divisional Secretariat Divisions (DSDs) encompasses by the basin. However, only 03 DSDs are completely included to the basin and remaining divisions are included partly. There are approximately 524 Gram Niladari Divisions (GNDs) available within the basin and some are completely included and some are partly included.

**Planning Area**

There is no argument that Land Use Planning is more effective when planning is based on the natural boundaries. Hence, land use planning exercise for the basin was done considering the natural boundaries rather than considering the administrative boundaries. However, to facilitate the implementation and monitoring of the activities administrative boundaries can be considered.

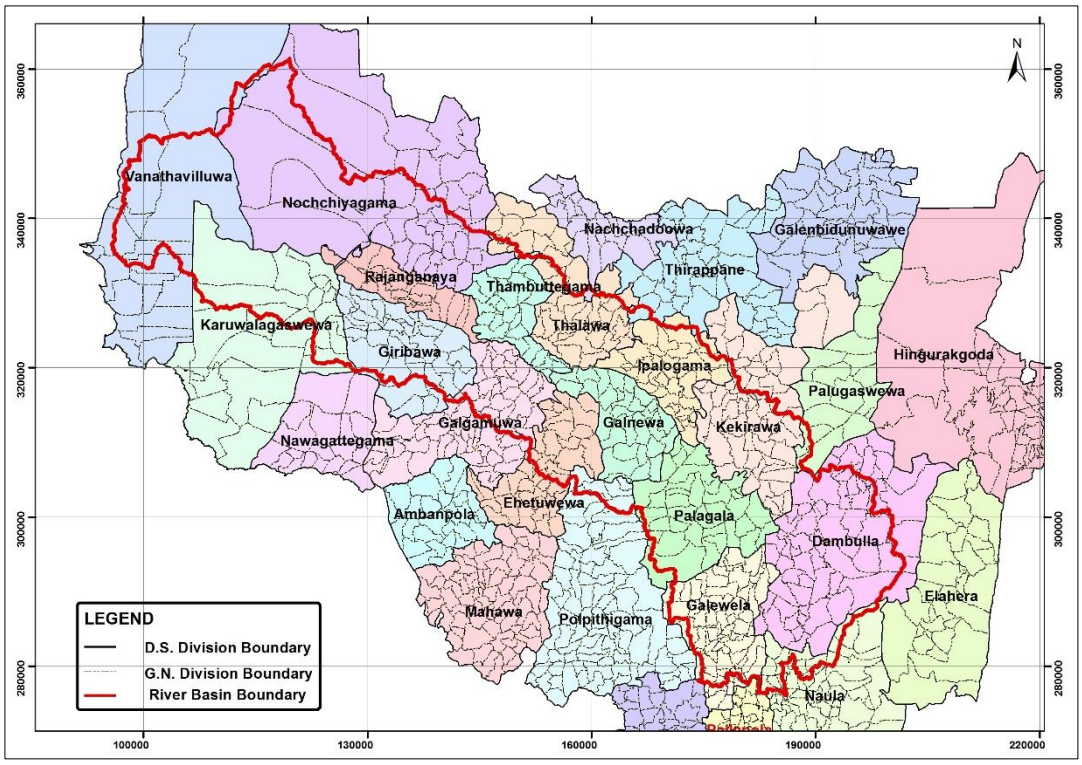


Fig.1. DS and GN Divisions encompassed by Kala Oya Basin

### 3.2 Sub watersheds of Kala Oya Basin

The total extent of the entire basin is about 2847 sq.km. and consisted with 14 sub watersheds. The names of the sub watersheds and their extents are given in the Table 1 and their locations are shown in the Fig. 2.

The Kala Oya Basin is surrounded by six other river basins namely Modayagam Aru, Malwathu Oya and Yan Oya basins from north, Mahaweli River from East, Deduru Oya and Mee Oya from South.

**Table 1 Sub watersheds of Kala Oya Basin and their extents**

| | Name of the sub watershed | Approx. Extent (sq.km.) |
|---|---|---|
| 1 | Havanhela | 261 |
| 2 | DambuluOya | 212 |
| 3 | MirisgoniOya | 282 |
| 4 | Upper Kala Oya | 75 |
| 5 | Upper middle Kala Oya | 183 |
| 6 | Kalankuttiya Ela | 118 |
| 7 | SiyabalangamuwaOya | 325 |
| 8 | Upper Rajanganaya | 196 |
| 9 | Angamuwawewa | 160 |
| 10 | Lower Rajanganya | 153 |
| 11 | Lower Moragahawewa | 211 |
| 12 | Lower middle Kala Oya | 235 |
| 13 | Lower Uththumadu Aru | 234 |
| 14 | Lower Kala Oya | 181 |
| | Total | 2847 |

Source: Vitharana, (2011)[8]

Vitharana,D.D.P.,(2011)Hand Book of Agro-Ecology and Watersheds. Agrarian Services Department, Sri Lanka. 41pp.

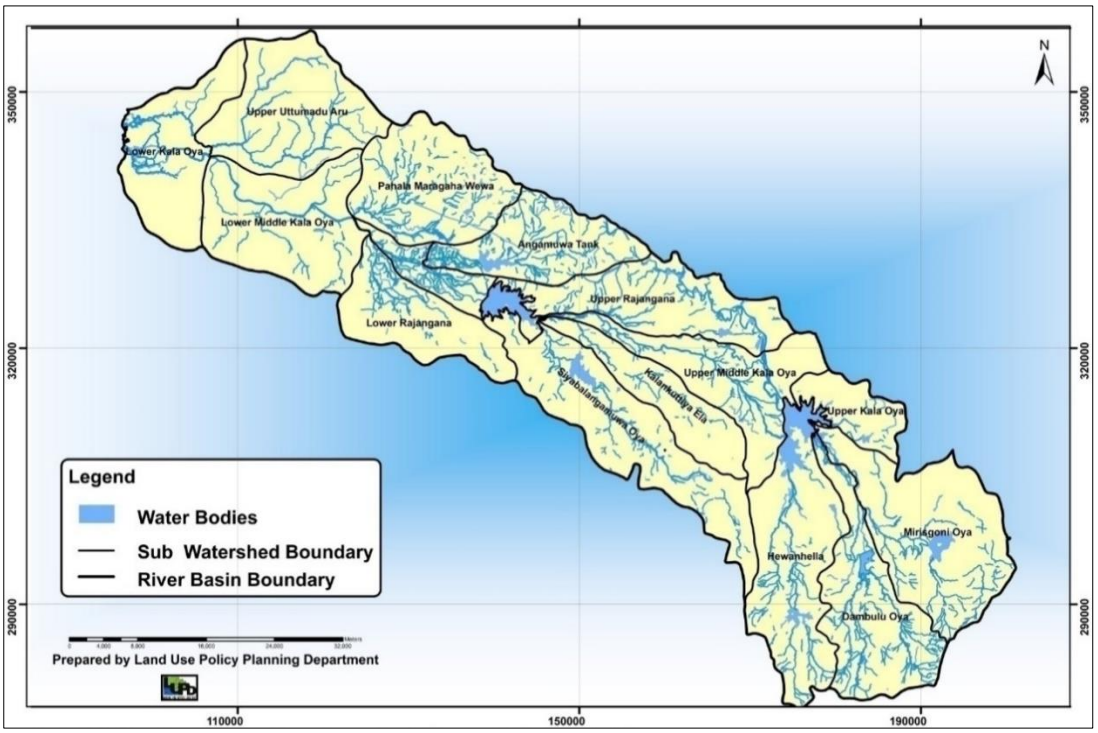


Fig.2. Kala Oya Basin and it's Sub watersheds (Source: Vitharana, 2011)

### 3.3 Physical Environment

#### 3.3.1 Topography

Large extent of the Kala Oya Basin is having undulating to flat landscape especially in the lower part of the basin (Fig. 3 and Table 2). However, there are several erosional remnants which are rise up to about 800 m from MSL (Fig. 4). Large extents of the area are apparently having higher agricultural capability due to its flat to undulating nature in spite of other soil limitations.

**Table 2: Slope categories of the Kala Oya Basin and their extents as a percentage of the total extent of the basin.**

| Slope Category (%) | Percentage of Extent (%) |
|---|---|
| 0-2 | 71 |
| 2-8 | 26 |
| 8-16 | 2.8 |
| 16-30 | 0.5 |
| More than 30 | 0 |

### 3.3.2 Soils

Great soil groups map (Alwis and Panabokke, 1972) prepared for the entire country was used to determine the distribution of soil groups within the basin (Fig.5). Since the scale of this map is large it gives the broad picture about the soils of the area. However, according to the map, majority of the area occupied by Reddish Brown Earth (RBE) and Low Humic Glay (LHG) associations (Table 3) in different terrains which are more suitable for highland crops and paddy cultivation depending on the availability of water.

Based on the series level soil classification (Mapa et.al., 2010) there are about twenty soil series available within the basin (Fig.6). A large extent is occupied by Medawachchiya, Ranorawa, Elayapaththuwa, Hurathgama, Nawagaththegama association (Table 4).

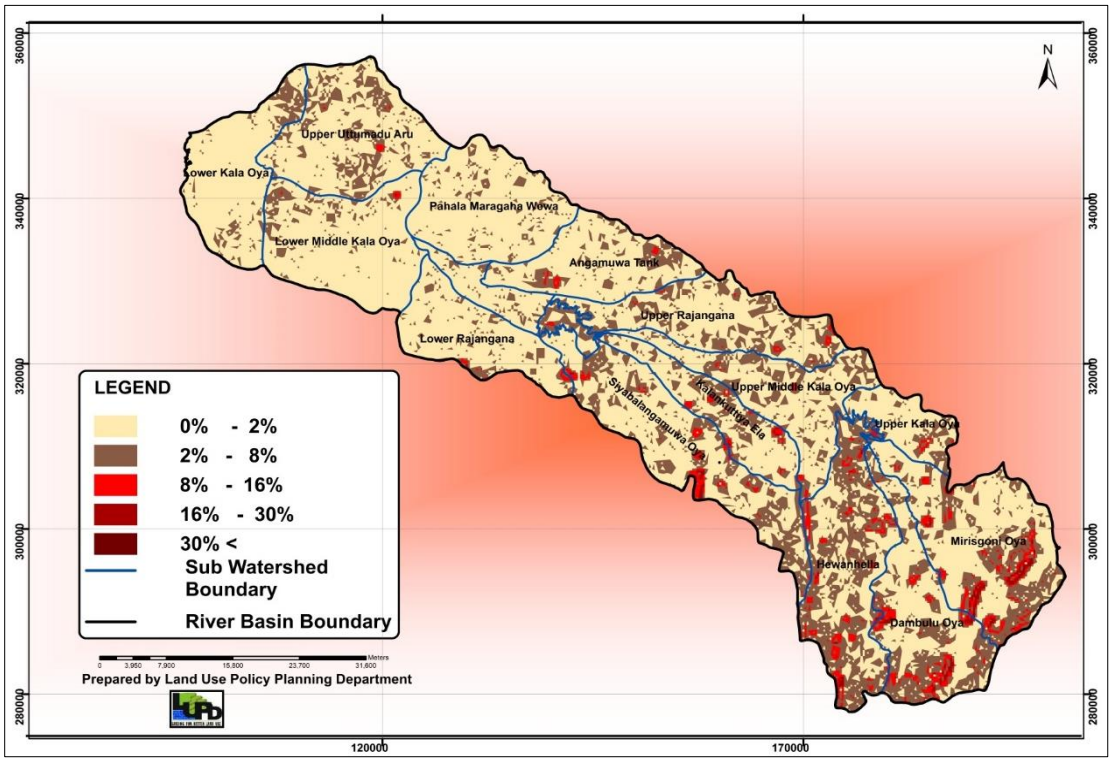


Fig. 3. Slope categories in Kala Oya Basin (Source: LUPPD)

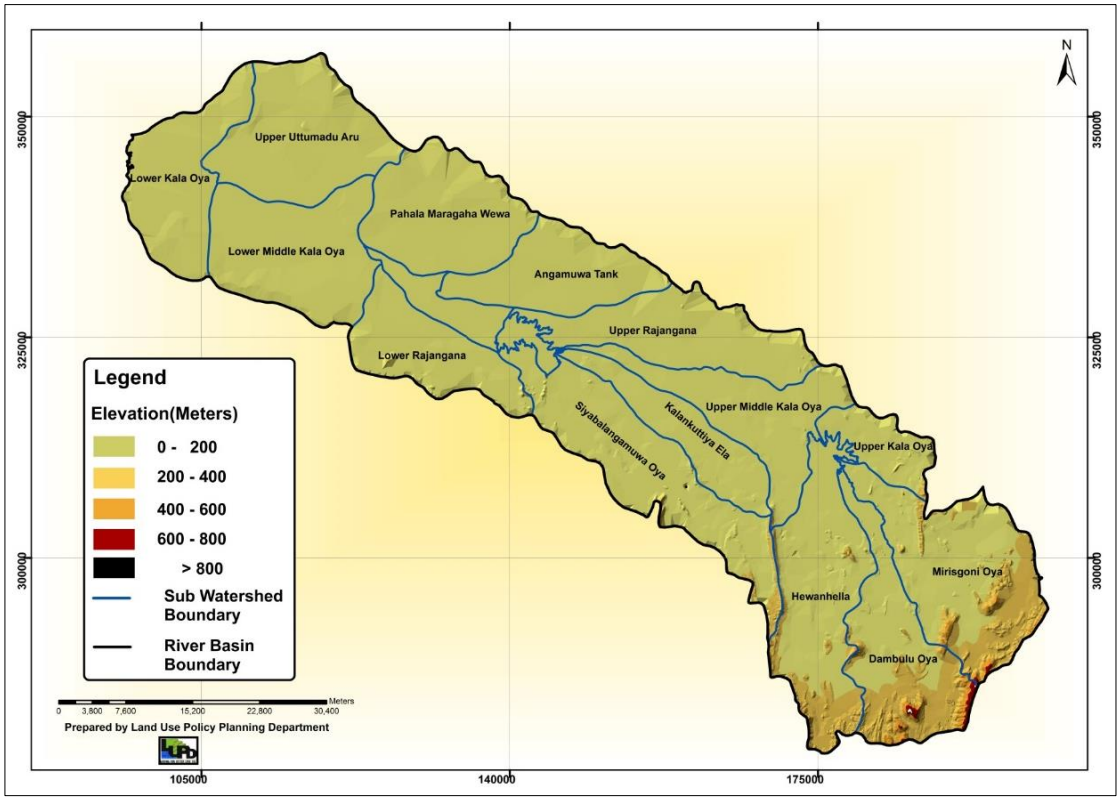


Fig: 4. Elevation variation (m. from MSL) in Kala Oya Basin (Source: LUPPD).

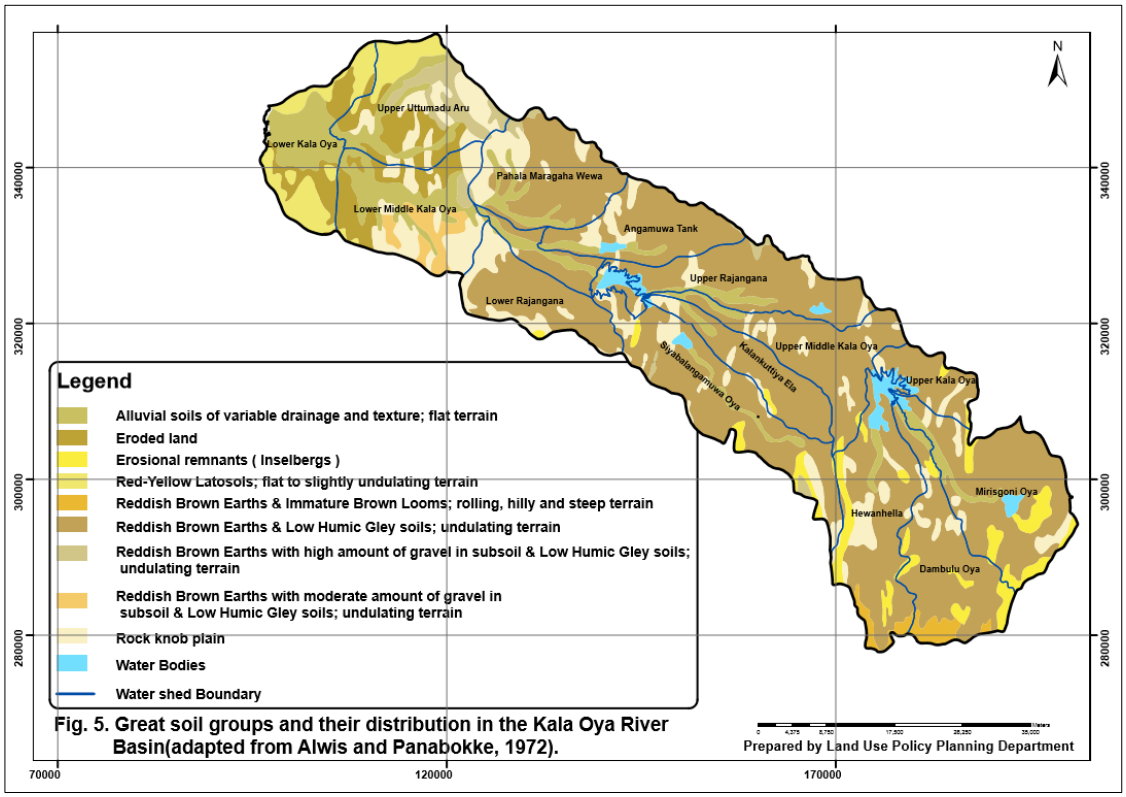


Fig. 5. Great soil groups and their distribution in the Kala Oya River Basin(adapted from Alwis and Panabokke, 1972).

Fig: 5. Great soil groups and their distribution in the Kala Oya basin (adapted from Alwis and Panabokke, 1972)

The soils of the Dry Zone generally have less variation with respect to their morphology and characteristics than those soils of the wet and intermediate zone (Kumaragamge and Kendaragama, 2010)[9]. Due to prolong dry period and less rainfall, moisture limitation for cultivation is more pronounced than other limitations of the soil. Most of the soil series in the dry zone shows the higher agricultural suitability. However, presence of gravel layer in the sub soil in some areas of the dry zone may hinder the root growth. Further, poor aeration due to poor drainage, salinity, soil erosion into certain extent can also be observed as limitations in some areas. Generally, limitation of soil moisture can be observed all over the dry zone except areas where irrigation facilities are provided.

Soil nutrient management particularly the soil organic matter management is crucial in the dry zone. Adding of organic matter, mulching introduction of minimum tillage practices, shade management etc. are needed to enrich the soil nutrient, to conserve the soil moisture and also to prevent the soil erosion.

**Table 3. Great Soil Groups present and their extents as a percentage of the total extent of the Kala Oya Basin**

| Soil Group | Extent as a percentage (%) |
|---|---|
| Reddish Brown Earth & Low Humic Glay Soil; undulating terrain | 56 |
| Reddish Brown Earth with high amount of gravel in sub soil &Low HumicGlay Soil; undulating terrain | 2 |
| Reddish Brown Earth with moderate amount of gravel in sub soil & Low Humic Glay Soil; undulating terrain | 1 |
| Reddish Brown Earth& Immature Brown Loam; rolling hilly and steep terrain | 1 |
| Red Yellow Latosols; flat to slightly undulating terrain | 4 |
| Alluvial soils of variable drainage and texture; flat terrain | 11 |
| Rock knob plain | 14 |
| Eroded land | 5 |
| Erosional remnants | 4 |
| Water area | 2 |
| Total | 100 |

[9]Kumaragamage. D, K.M.A. Kendaragama. 2010. Risks and Limitations of Dry Zone Soils. Soils of the Dry Zone of Sri Lanka.R.B.Mapa, S. Somasiri, A.R.Dasnayaka (Ed.).Morphology, Characterization and Classification.Soil Sci. Soc. Sri Lanka.

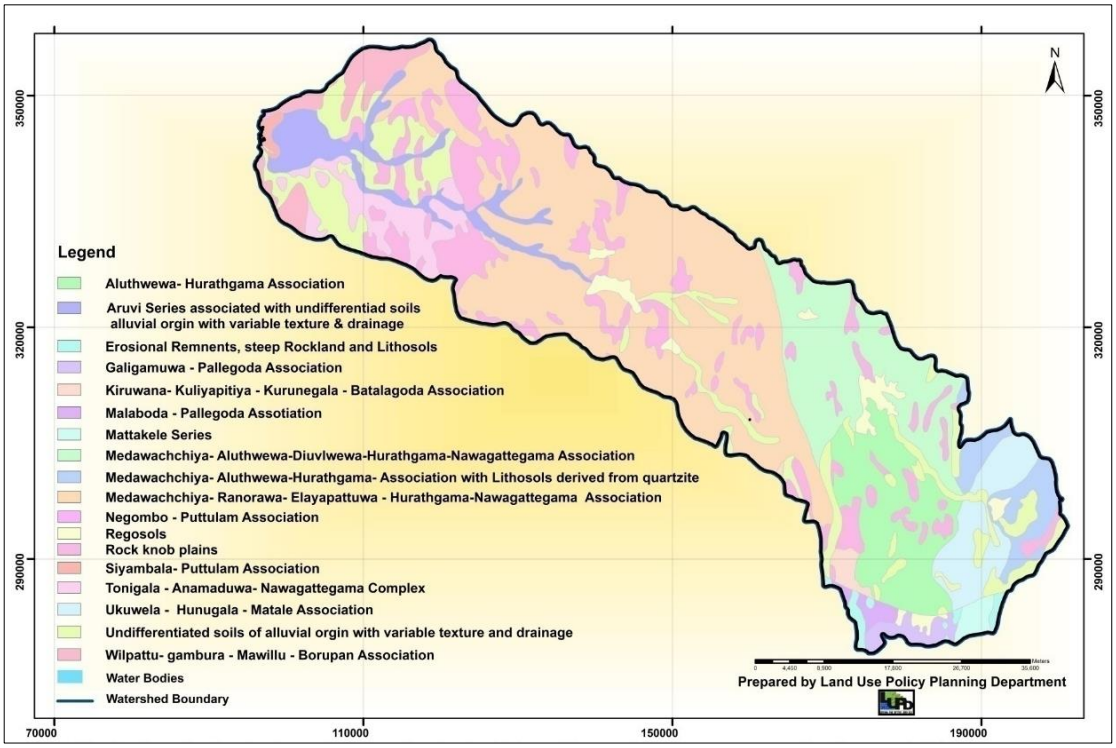


Fig: 6. Distribution of soil series in the Kala Oya Basin (adapted from soil series map prepared by Mapa et al,2010)

**Table 4. Different soil series available in the Kala Oya Basin and their extents as a percentage of the total extent.**

| Soil series | Extent (%) |
|---|---|
| Aluthwewa-Hurathgama association | 8 |
| Aruvi series associated with undifferentiated soils of alluvial origin with variable texture and drainage | 5 |
| Kiruwana –Kuliyapitiya- Kurunegala – Batalagoda Association | 1 |
| Kiruwana _Malsiripura Association | 2 |
| Madawachchiya-Aluthweva-Hurathgama Association with Lithosols derived from quartzite | 3 |
| Medawachchiya-Aluthweva-Divulweva-Hurathgama-Kahatagasdigiliya Association | 10 |
| Medawachchiya-ranorawa-Elayapaththuwa-Hurathgama-Nawagaththegama Association | 32 |
| Negombo, Puttalam Association | 0.3 |
| Regosols | 2 |
| Siyabala, Puttalam Association | 0.4 |
| TonigalaAnamaduwaNawagaththegama Complex | 3 |
| UkuwelaHunugalaMatale Complex | 1 |
| UkuwelaHunugalaMatale Association | 4 |
| Undifferentiated soils of alluvial origin with variable texture and drainage | 2 |
| WillpattuGamburaMavilluBorupana Association | 4 |
| Erosional remnants | 9 |
| Erosional remnants steep Rocklands and lithosols | 1 |
| Rock Knob Plains | 13 |

### 3.3.3 Climate

**Rainfall**

The Kala Oya Basin mainly located in the Dry Zone and its small part at the upper end belongs to intermediate zone. Generally, in the Dry Zone average annual rain fall is less than 1750 mm and having dry period from May to September. There are four rainy seasons in Sri Lanka (Punyawardana, 2010)[10].

- March to April – Rains from first Inter monsoon
- May to September – Rains from South-West monsoon
- October to November – Rains from second inter monsoon
- November to February – Rains from North-East monsoon

Dry zone mainly receives the rains from inter monsoons and North-East monsoon. Based on this rainfall pattern, the crop cultivation traditionally confined to two seasons namely *Yala* (Minor season) and *Maha* (Major season).

**Temperature**

The average annual temperature varies throughout the year and both minimum and maximum temperatures show the minimum value during the period from November to February due to the North-East monsoons. From May to September the temperature rises up to $38^0$C (Punyawardana, 2010).

Types of the existing land use and land cover including natural vegetation are mainly determined by the climate (i.e. rainfall, temperature, sunshine hours, wind, evaporation, relative humidity etc.) of the area. Hence specific environment and associated biodiversity can be observed in the basin.

**Agro-ecology**

The Kala Oya Basin has seven agro-ecological regions (Fig.7). Majority of the area belongs to Low Country Dry Zone (DL1 and DL3). Rest belongs to Low Country Intermediate Zone and Mid Country Intermediate Zone. The dryer part is located at the lower part of the basin and comparatively wetter part is located at the upper part of the basin.

[10]Punyawardana, B.V.R. 2010.Climate of the Dry Zone of Sri Lanka. Soils of the Dry Zone of Sri Lanka.R.B.Mapa, S. Somasiri, A.R.Dasnayaka (Ed.).Morphology, Characterization and Classification.Soil Sci. Soc. Sri Lanka.

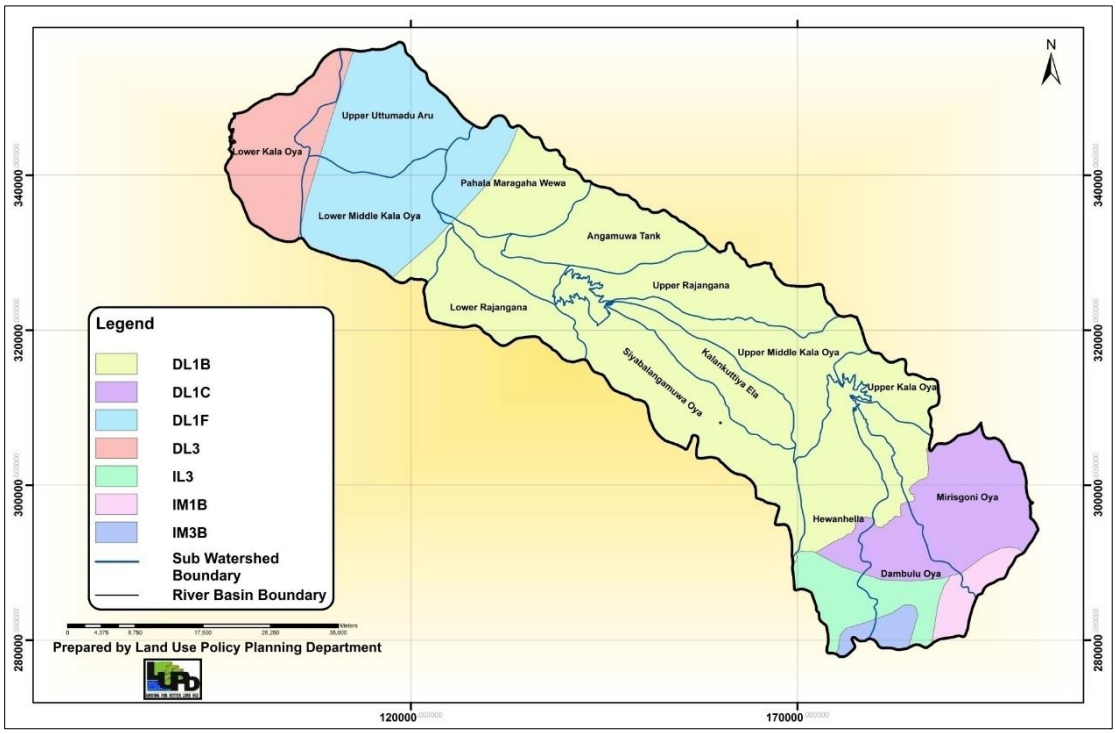


Fig: 7. Agro - Ecological regions of Kala Oya Basin (Adapted from Agro – Ecology Map, 2013

### 3.3.4 Water

There are several water bodies including the Kala Oya and its tributaries, reservoirs, small village tanks located in the basin. Total extent of the water bodies in the basin is about 21766 ha and they are shown in the Fig. 8. There are about 600 minor irrigation tanks including abandoned tanks within the basin, which provide many services to the local communities in addition to providing irrigation water. Some of the tanks are mainly fed by the water from Mahaweli scheme. There are number of small tank cascades which create unique habitats for different floral and faunal species. A larger part (around 50%), of the Kala Oya Basin is in the North Central Province, where 457 tank cascade systems are located[11].

Soils and environmental factors prevailing in the Kala Oya Basin create a unique environment which supports to have specific vegetation with high biodiversity value. However, the original vegetation outside the protected area had largely been destroyed due to various human activities. Therefore, it is crucial to ensure the sustenance of particular environment through ESA concepts.

[11]Panabokke, C.R., Sakthivadivel R., Weerasinghe A.D.(2002), Small Tanks in Sri Lanka: Evolution, Present Status and Issues.

Photo 1. Bird's eye view of Kala Wewa. One of the largest water bodies located in the basin

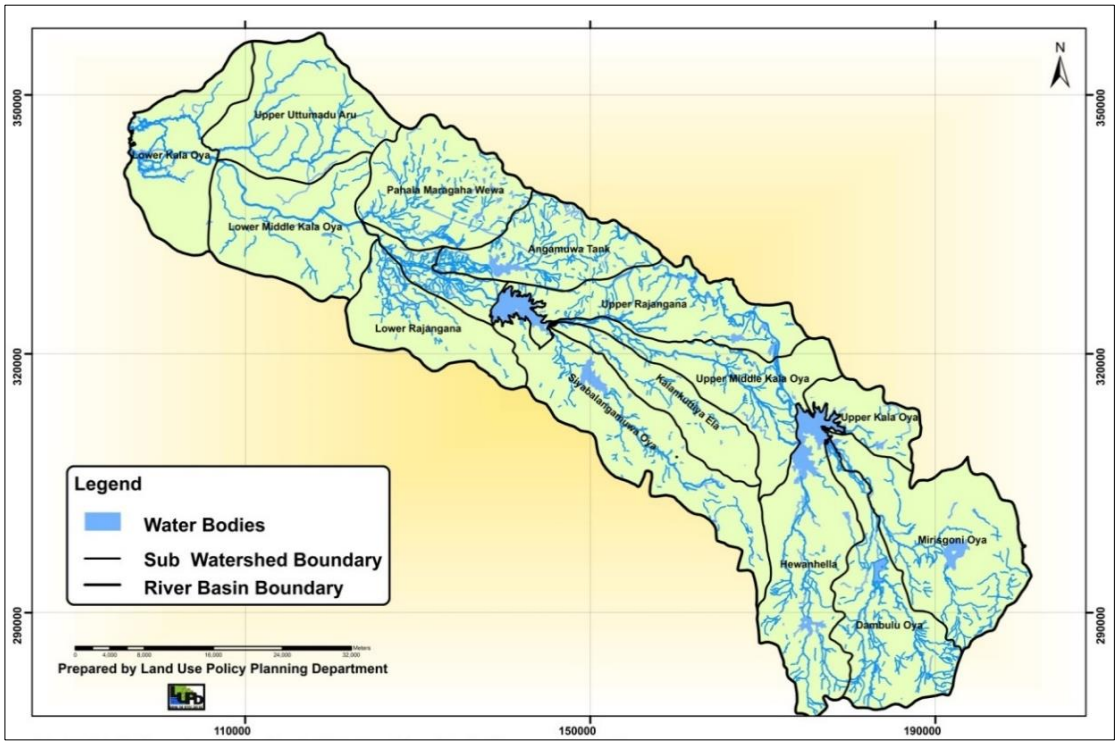


Fig.8. Distribution of water bodies in the Kala Oya basin

### 3.4 Population

Since population figures are available based on the administrative divisions it is difficult to provide the exact figures of population for the basin. However, considering the GND level population, it was able to prepare a population density map which is shown in the Fig.9.

The lowest density has (2-280 people per sq.km.) observed mainly in the upper and lower parts of the basin mainly due to the presence of protected areas. The highest density (4000-9000) has observed in few GNDs which are located in urban areas. GNDs with higher densities mainly located in the middle of the basin where most of the farming activities and residential areas are located.

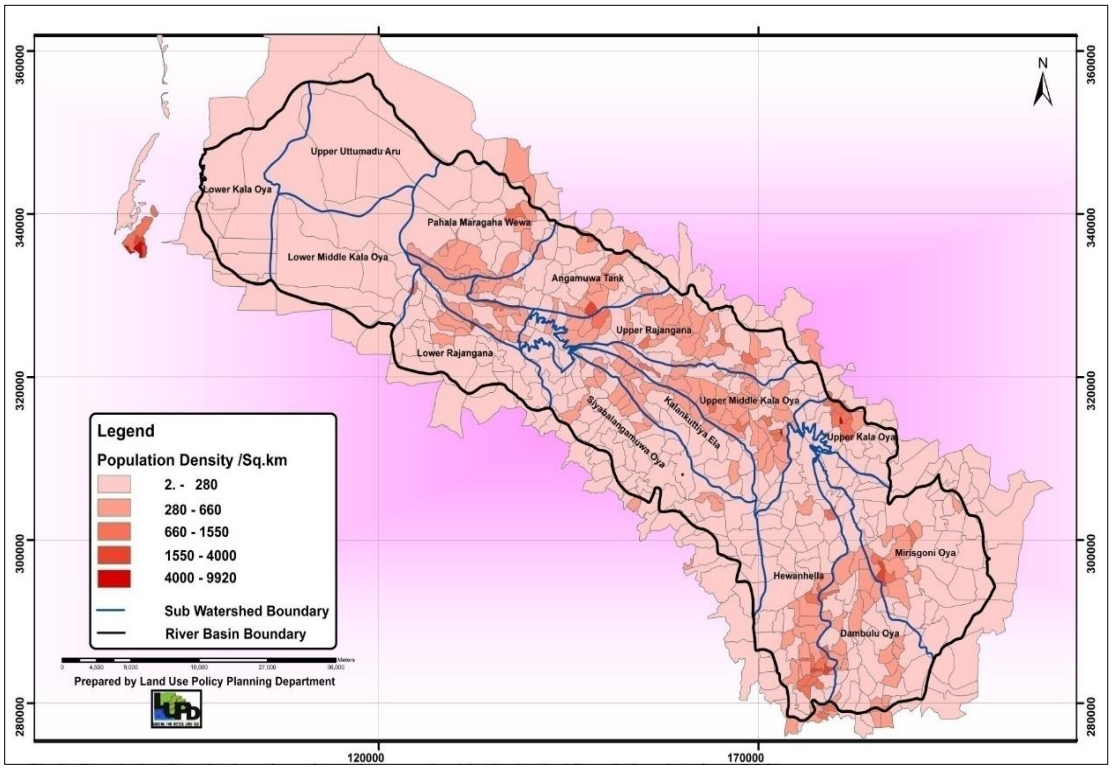


Fig: 9. Population Density (Number of people of per sq.km) in the basin – Population data from DCS

### 3.5 Land Use

#### Land Use (2019)

Land use and land cover (data published in 2019 by LUPPD) is shown in the Fig. 10 and their approximate extents are given in the table 5. Major land cover is the forest which accounts about 107,720 ha and it covers about 38% of the total land area. The agricultural area including home gardens and paddy lands covers about 97282 ha. Built-up area which mainly includes urban and sub urban areas accounts about 53000 ha. Rest of the area is covered by wet lands, sandy areas, rocky areas, water bodies and bare lands.

**Table 5. Major land uses/ land cover and their approximate extents in the Kala Oya basin.**

| Major Land uses/Land cover | Extent (ha) | Percentage (%) |
|---|---|---|
| Agricultural lands including home gardens | 97282.10 | 34.2 |
| Built-up area | 53111.02 | 18.7 |
| Forest | 107720.56 | 37.8 |
| Wet lands | 1733.33 | 0.6 |
| Rocky area | 2335.44 | 0.8 |
| Sandy area | 4.47 | 0.001 |
| Water bodies | 21766.44 | 7.6 |
| Bare lands | 738.96 | 0.3 |
| Total | 284692.33 | 100 |

Previous land use and land cover extents cannot be compared with the present situation mainly due to differences in the map legends and the scales.

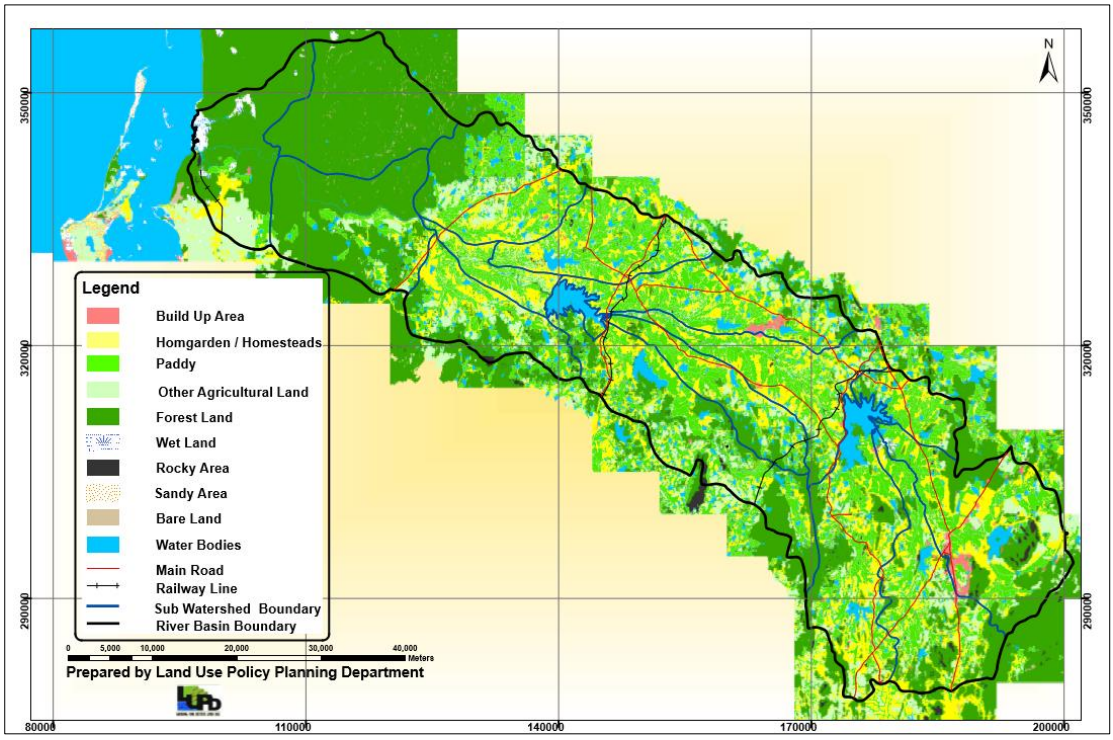


Fig. 10. Land use and Land cover of the Kala Oya Basin (2019)

### 3.6 Ecosystems and Biodiversity of the basin

A simple definition for Biodiversity is the variety of organisms found on the earth. A more explanatory definition is; the variability among living organisms from all sources including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems[12].

[12]The Convention on Biological Diversity. 1992.

There are several natural and manmade ecosystems available in the area. The ecosystems within the basin are shown in the Fig. 11. The major ecosystems are; (1) Agriculture ecosystem, (2) Forest ecosystem, (3) Riverine ecosystem, (4) Wetland ecosystem, (5) Aquatic ecosystem and (6) Coastal ecosystem. These ecosystems provide specific habitats to flora and fauna. However, some ecosystems are more diverse and species-rich, some have a high spatial turnover in species while others have more homogeneity. Certain ecosystems support critical ecosystem processes and services based on their location. Generally, many ecosystems have very high levels of endemism which makes them irreplaceable and even not restorable if they are degraded or converted.

In the forest ecosystem consisted with mostly mixed evergreen forests and in this forest type 136 faunal and 100 floral species have been recorded. Of the floral species 18% were endemic to such forest[13]. Since there are number of water bodies including small tanks available within the basin, different species can be seen associated with these water bodies.

Different ecosystems are having unique features and provide specific ecosystem services. The annual value of the ecosystem services of the Kala Oya Basin is Rs. million 23,500. The highest economic value was resulted from the carbon values (77%). The estimated value represents 1.16% of GDP (of2004) of the country and 7.33%of the agricultural sector GDP which highlights the significance of the potential economic gains of the basin[14].

In addition to the above terrestrial ecosystems, marine ecosystem extended towards to the seascape from the coastal boundary also very important in terms of biodiversity conservation. This ecosystem is crucial since the Bar Reef Marine Sanctuary (BRMS); largest marine protected area in Sri Lanka is located. This sanctuary was declared in 1992 under the Fauna and Flora Protection Ordinance. The BRMS is covering an area of 306 sq km, located west of the Kalpitiya Peninsula in the north-western coastal waters and borders the Puttalam Lagoon. This is the only location in Sri Lanka that has many coastal ecosystems (coral reefs, mangroves, sea grass beds, coastal sand dunes / spits, and a large lagoon) in a single area[15]. The biodiversity of BRMS is linked to the surrounding environment including the Puttalam Lagoon.

Biophysical assessment carried out by National Aquatic Resources Research and Development Agency (NARA) during 2013-2015 period revealed that hard corals were in good condition at the Bar Reef compared to damaged areas but the percentage of live coral cover has been reduced by 10%. Percentage of rubble coral and the physical

[13]Project Inception Report, Enhancing Biodiversity Conservation and Sustenance of Ecosystem Services in ESAs Project.

[14]Gunawardena, U.A.D.P. (2009). Valuation of Ecosystem Services of Kala Oya River Basin: Implications for River Basin Management. Vidyodaya Journal of Humanities and Social Sciences. pp 239 - 266

[15]Jayasiri.H.B. and Hputhanthri.S.S.K. (2015).Template for Submission of Scientific Information to Describe Areas Meeting Scientific Criteria for Ecologically or Biologically Significant Marine Areas. NARA.

damages also have increased from 2014 to 2015[16]. However, this picture may be worse now due to various reasons including operating of harmful fishing gears, non-demarcation of the boundary of the reef, unregulated tourism etc. Anyway, this has now been rectified to a certain extent by demarcating the reef boundary and imposing some restrictions.

A biodiversity (BD) baseline surveys had carried out in the Kala Oya Basin by Mahaweli Authority of Sri Lanka (MASL) and BD secretariat. But the available data was not comprehensive enough and bit out dated.The project conducted an accelerated BD survey in Kala Oya Basin across 23 transects on the request of BDS. However, the survey data from MASL and BDS were also used for the preparation of biodiversity integrated land use plans in the Kala Oya Basin.

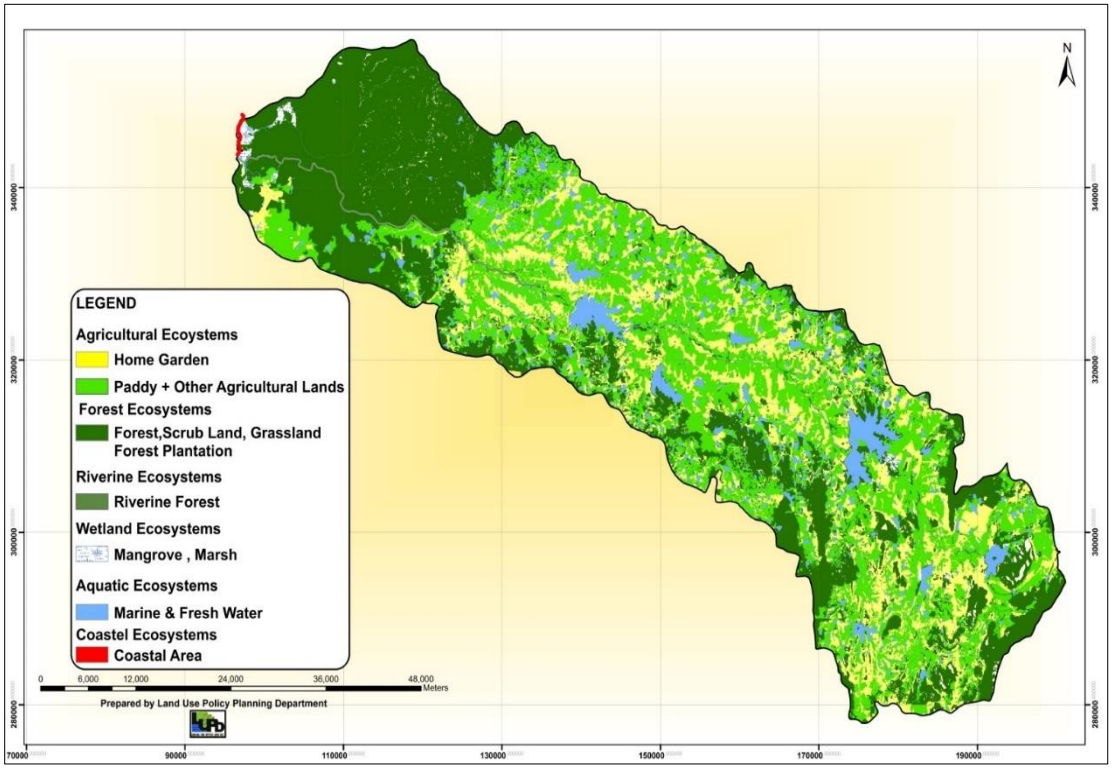


Fig: 11. Natural and man - made eco-systems in Kala Oya River Basin. Some of the ecosystems are not visible due to scale factor.

[16]Anon, 2015, Education, capacity development and monitoring in support of Bar Reef Marine Sanctuary (BRMS) management. National Aquatic Resources Research and Development Agency Colombo, Sri Lanka.

### 3.7 Proposed Development Activities

Information on proposed development activities is not easily available and accessible, partly due to communication gaps between National and District level agencies. It was noted two hotel projects in the Puttalam district (within the basin) have been approved. Solid waste management project at Aruwakkadu in Puttalam district is located outside of the basin boundary and belongs to another river basin (Fig. 12).However, it is better to study the impact of these projects to the existing biodiversity of the area by referring the EIA report of the project. The information regarding the proposed development activities in Anuradhapura is lacking and based on informal sources there were no recently approved development projects within the project area in Anuradhapura district.

### 3.8 Existing Spatial Plans

#### National Level Plans

The National Physical Plan prepared by the National Physical Planning Department (NPPD) is a conceptual plan which provides a broad frame work for the national development of the country. It is also a strategic document that outlines the vision of Sri Lanka in 2050[17]. Its role is to promote and regulate the integrated planning of economic, social physical and environmental aspects of the land and territorial waters of Sri Lanka. The main objective of the National Physical Panning Policy and the plan are to achieve economic development through the use of available resources of the country including agriculture, realizing a higher living standard for the people and the establishment of an independence economic status internationally[18].

The National Physical Plan 2030 is shown in the Fig. 12. This plan has been amended and gazetted. Major themes of the revised draft National Physical Plan – 2050 shown in the Fig. 13. It shows development corridor, coastal environmental sensitive area, central environmental sensitive area, conservation area and area above 1500m MSL. Both of these plans do not adequately pay the attention on biodiversity conservation particularly outside of the protected area. However, the amended physical plan was prepared focusing the environmental sensitivity in addition to other factors.

[17]Anon, 2015.National Physical Plan as the Framework for City of Tomorrow. World cities day 2015. Consultative forum, NPPD, Ministry of Mega Polis and Western Development.
[18] www.nppd.gov.lk

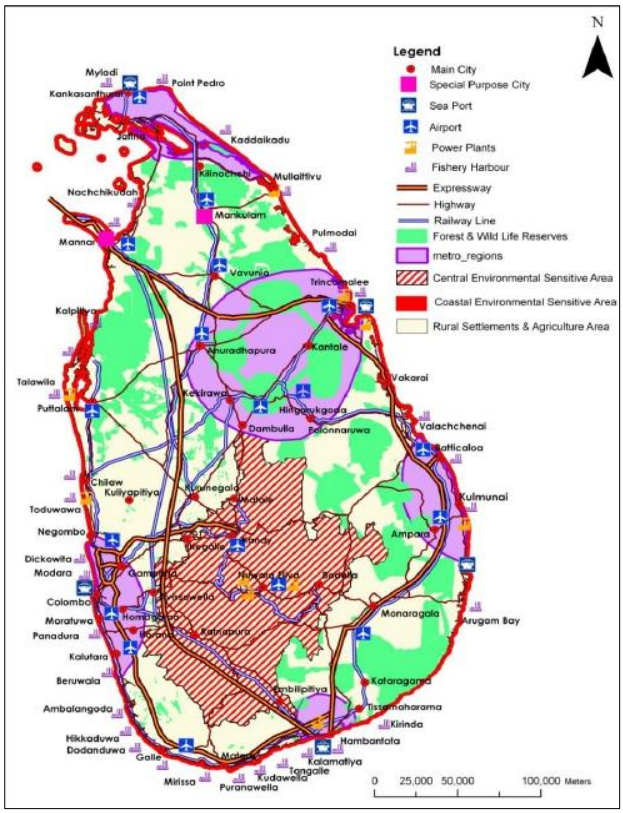


Fig. 12.National Physical Plan 2030 (Source: NPPD)

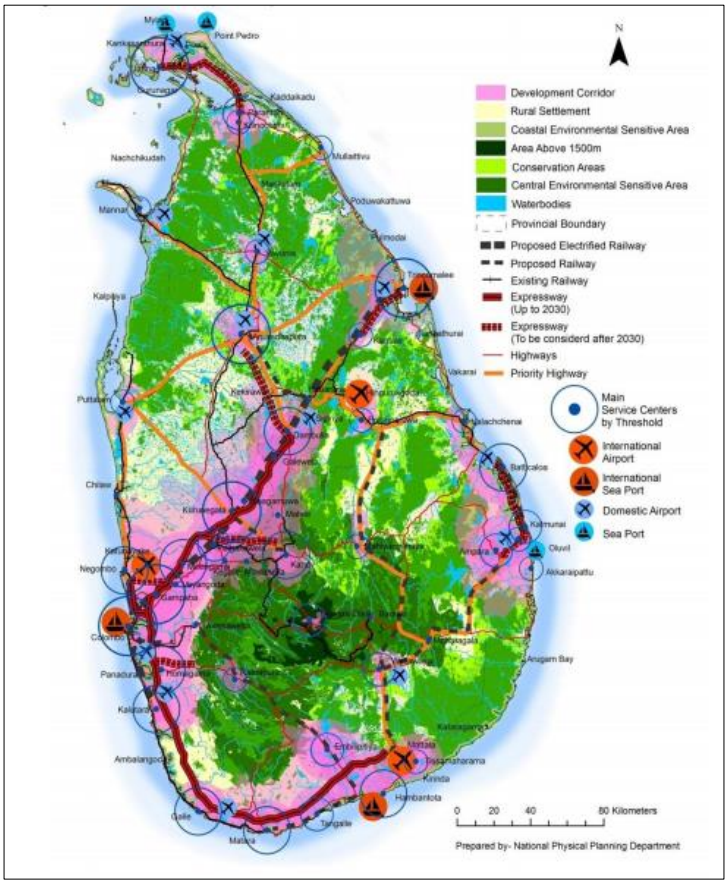


Fig.13. National Physical Plan 2050 (Source: NPPD)

**Regional and Sub Regional Level Plans**

A several regional physical structure plans were prepared by NPPD for Eastern Province, North Central Metropolitan Region, Sabaragamuwa Province, Western Region and Uva Province. In addition, strategic environment assessment had been carried out for the Northern Province with multi stakeholder participation. These plans are not much considered here as they are excluded the area of the Kala Oya Basin.

**Urban Development Plans**

The urban development plans are prepared by the Urban Development Authority (UDA). These plans are confined to the UDA declared urban areas focusing mainly on urban development.

**Divisional Land Use Plans**

Land Use Plans at different levels were prepared by LUPPD. There are about 300 Divisional Land Use Plans have been completed in the year 2016. These plans mainly focused the productivity enhancement of the agricultural lands while ensuring the protection of the protected area. However, the plans provide some recommendations to protect the areas outside of the protected areas due to its environmental and historical/archaeological significance. The all DSDs within the Kala Oya Basin are having divisional land use plans. Updating process of the divisional land use plans have now been started by LUPPD.

**Village level Land Use Plans**

LUPPD has initiated the preparation of village level land use plans since 2017.Land use planning issues at village level were identified with the participation of the people in selected villages. About six village level land use plans have been completed for selected villages in both districts within the basin. Since the recommendations of these plans are directly address the land use issues, they are more practical and can be implemented easily.

### 3.9 Need of a biodiversity integrated Land Use Plan

Information in existing plans revealed that they are sector specific and mainly focused on the infrastructure development, urban development and productivity enhancement. Apparently, an integrated approach is not available in these plans to address the biodiversity issues of the country. Further these plans mainly considered the administrative boundaries and not the natural boundaries for the planning. Hence

these gaps in the existing plans should be bridged by preparing a plan with holistic approach to achieve the optimum level of production while conserving the biodiversity. Further, ESA concept had not been used in the existing plans. This is the first time; the ESA concept has been used for land use planning by mainstreaming biodiversity conservation.

# 4. PROPOSED LAND USE PLAN

## 4.1 Approaches and Methodology used to prepare land use plan.

### Introduction

It was proposed in the Project Inception Report to prepare six landscape level land use plans for the ESA Site 1 and 2 covering the six DSDs in Anuradhapura and Puttalam districts. It was also proposed to prepare two composite plans for two districts. However, this proposal was upgraded to cover the entire basin and prepare a bio diversity integrated land use plan for the entire basin rather than considering the two sites. Hence, the methodology had subsequently been changed to cover the entire landscape.

Approaches to spatial planning vary considerably throughout the world, reflecting historical and cultural developments as well as geographical and economic conditions. There are four major approaches can be identified[19]. They are;

**a) Regional Economic Planning Approach**

In this approach spatial planning is used as a policy tool to pursue wide social and economic objectives, especially in relation to disparities in wealth, employment and social conditions among different regions of the country[20].

**b) Comprehensive integrated approach**

A comprehensive integrated approach, where spatial planning is conducted through a systematic and formal hierarchy of plans. In this approach at lower levels will not contradict with the planning decisions at higher levels.

**c) Land Use Management Approach**

In this approach, planning is a more technical discipline in relation to the control of land use. The recommendations or regulations will ensure the sustainable development.

**d) Urbanism Approach**

In this approach key focus is on the architectural flavour and urban design through rigid zoning and land use codes and a wide range of laws and regulations.

In this pilot project the adopted method was land use management approach, in which biodiversity was mainstreamed with the objective of creating a series of decisions based on the existing biodiversity, its' importance, human needs and economic viability. All models were checked for their actual applicability in the field

[19]EU Commission 1997.The EU Compendium of Spatial Planning Systems and Policies. Brussels: European Union, Office for Official Publications of the European Communities. *http://commin.org/upload/Glossaries/European_Glossary/EU_compendium_No_28_of_1997.pdf*.
[20]Williamson. I., S. Enemark, J. Wallance, A. Rajabifard. 2010. Managing the use of land. Land Administration for Sustainable Development. ESRI Press Academic, California.

with existing policies and legal framework acceptance by communities and long-term impact to ensure biodiversity conservation and wise use. Models that were deemed as nonviable were rejected through a series of stakeholder consultations.

The approaches and the conceptual designs given in the training manual prepared under ESA project were also used in preparing the plans[21]. Additionally, in the preparation of this plan, land use planning guidelines prepared by Food and Agriculture Organization (FAO)[22] and guidelines prepared by LUPPD were also used. Recommendations given for Protected Area peripheries in the strategic management framework of the Protected Area Complex of Wilpattu and management plan of Kahalla Pallekale Protected Area complex were also considered. Further, some of the information in "operational manual for identification, planning, management and monitoring and evaluation of Environmentally Sensitive Areas in Sri Lanka" also used.

The following sub approaches were selected based on the above criteria, they are;

I. Approach to identify significant ESAs in Kala Oya Basin to ensure their sustainable operations as a mechanism for mainstreaming biodiversity management/conservation into development in areas of high conservation value.
II. River continuum approach in Kala Oya Basin by demarcating reservations for the river.
III. A periphery management approach to ensure the human and ecological wellbeing around the PAs.
IV. Zoning approach by demarcating human-elephant co-existence zones considering the habitat suitability and human population density to ensure the sustenance of migratory mega herbivores while managing the economic activities appropriately.
V. Use of selected fauna and flora species as proxy to identify areas that required biodiversity mainstreaming.
VI. Approach to ensure the protection of river mouth based on the seascape and landscape connectivity and ecosystem continuum.
VII. Approach to eradicate the invasive species by identifying areas that need to be sensitive in terms of spreading of invasive species.
VIII. Approach to encourage the in-situ conservation of genetically important wild varieties.
IX. Approach to ensure social and economic wellbeing of the people enhancing the productivity of lands by developing Sustainable Land Management (SLM) practices in areas outside the PAs especially in urban and peri-urban zones.

[21]Training Manual for Integrating Biodiversity Conservation and Sustainable Use into Land Use Panning in Environmental Sensitive Areas, Biodiversity Secretariat, Ministry of Mahaweli Development and Environment.

[22]FAO, 1993.Guidelines for Land Use Planning. Food and Agricultural Organization of the United Nations. Rome.

X. Agricultural land capability classification approach to determine the agriculture land use in the basin.

The land use and land cover maps that cover the basin were updated by using satellite images and images taken from a drone and followed by field verification. All maps were prepared in scale of 1:10,000by using the maps prepared by the Survey General's Department as base maps. As a pilot study 100 sq. km area in Anuradhapura district was covered by photographs taken by low altitude flying Unmanned Aerial Vehicle (UAV alias Drone) to update the land use and land cover layer.

An attempt was taken to identify the land ownerships basically to separate the private and state lands despite the challenges of the lack of information regarding the ownership; and a rough map was prepared using available data sources.

As mentioned earlier Biodiversity information from several sources were used. While the data from the recent study carried out by the project and MASL study was mainly used to take planning decisions, computer software named "MAXENT" was used to extrapolate the available data to fill the gaps.

### 4.2 Planning Decisions

Land use and land cover of the entire basin should be planned in general to ensure the sustainable use of lands for various development activities while conserving the biodiversity. Parallel to this process, particular areas outside the protected areas in the basin should be identified to introduce specific management options at least to maintain the present status or improve them further to protect the biodiversity. These areas may be either ESAs or some other areas (e.g. reservation of the river, peripheral areas of the PAs) that need special attention to avoid the environmental and biodiversity degradation. Proper management of these areas will help to ensure the sustenance of biodiversity of the entire basin while maintaining the production possibilities. Hence, planning decisions were particularly taken, based on the management of ESAs and other areas which needs special land use recommendations. These decisions are elaborated below with the findings.

#### 4.2.1 Decision 01: Land use management and improvements in selected ESAs

Identification and demarcation of ESAs based on the significance of biodiversity is the key activity of the land use planning exercise. Therefore, the main assumption is that protection and conservation of ESAs by regulating land use and land cover is the key to biodiversity conservation. In this section management and improvement of land use within the ESAs have been discussed with more details about ESAs.

In order to determine how ESAs are to be managed, first step is a survey of all remaining natural habitats to determine which have the highest value in their present state and those with the least value if transformed. All other biological and social parameters should also be included in the survey. Criteria for identifying ESAs need to be established on the basis of this information. Four steps were suggested[23]toward a National system of ESAs.

**Step 1**- Evaluate patterns of habitats and vegetation, soils, mineral resources, topography, rivers and other hydrological features, climate, current land use, ethnic groups and population density.

**Step 2** - Establish criteria for identifying ESAs and for providing objective guidelines on appropriate management regimes

**Step 3** - Based on the criteria established, identify especially vulnerable locations, areas of high biological diversity and areas of high economic value in the natural state.

**Step 4** - Prepare a national strategy for conserving ESAs, including establishing national objectives, identifying economic relationships, designing any necessary legislation and assigning institutional responsibility for the ESAs.

In order to prioritize the sensitive areas for conservation, a three-tiered approach is proposed in the ESA Technical paper. The tiers provide a step-wise process as described in the box below:

[23]McNeely.Jeffrey A., Kenton R. Miller, Walter V. Reid, Russell A. Mittermeier and Timothy B. Werner. 1990. Conserving the World's Biological Diversity. IUCN, Gland, Switzerland; WRI, CI,WWF-US and the World Bank, Washington, D.C. 85p.

*Tier 1: Biological criteria: This tier deals with the science-based approach defined in Step 1 to identify the best target elements (species, habitats and ecological processes) that satisfy the sub-criteria of irreplaceability (emphasizing the endemic status of the biota), connectivity and representativeness (represents unique fauna, flora, habitat and ecological process)[24].*

*The outcome of the exercise would be the spatial distribution of the target landscape elements (categorized on the basis of their relevant ecological categories/types). This will provide an overall distribution of the different target elements (and ecological categories) and enable the quantification of the extent and condition of each target element in the landscape. This might require the working from vegetation maps, aerial images, remote sensing imagery or other spatial data sources, supported by ground verification. In undertaking the spatial definition of the target elements, it is also necessary to keep in mind seasonal changes that can occur on which certain target species depend on. For example, if a species depends on a certain kind of habitat maintained by periodic flooding of a river (e.g. Mahaweli Ganga floodplain villus) or a roosting or sleeping area of a particular target species, it is not sufficient to identify those habitat patches during the analysis, but also to include within the conservation area, upstream or floodplain characteristics that determine the flooding regimes. Such extended conservation areas need not necessarily be contiguous with the selected target element's immediate conservation area but must be specific as a requirement for the management of a viable population of the target element, as a whole. The complete extent (either contiguous or dis-contiguous) or area required for maintaining a viable population of the target elements defines the conservation area of a particular target element (or species).*

*Tier 2: Threat criteria: This second tier will provide evidence that the conservation areas within the landscapes are in 'clear and present danger'. It deals with the anthropogenic and natural drivers of land use change and extinction. After the target conservation areas are identified, a new set of environmental layers are added to assess the level and extent of threats to the sites and the species, such as land-use change trends, land use conflicts, institutional and enabling policy environment, institutional capacity and stakeholder participation. In particular, this would entail the use of satellite imageries, other remote sensing tools and socio-economic data (validated by ground truthing) to get an understanding of the social and economic needs and priorities in relation to natural resources. Information on the land ownership and management authority will help make an assessment of the conservation potential of the target areas. The following is a partial list of some of the socio-economic parameters that need to be considered in order to make an assessment of the level of threat orpotential of threat, such as (i) patterns of land and resource use (current land and resource use, proposed development plans, existing and planned infrastructure, etc.); (ii) governance and land*

[24]For further reading see: Margules, C. R., &Pressey, R. L. (2000).Systematic conservation planning. *Nature*, *405*(6783), 243.

*and resource ownership (land tenure, political decision making processes, management responsibilities, etc.); (iii) population trends (density and growth, social characteristics, migration patterns, etc.); (iv) socio-economic conditions (economic growth trends, land price speculation, etc.) and (v) access.*

*Tier 3. Demonstration Potentials Criteria: The third tier will be the final step in the selection process. In this tier, the candidate areas/sites/clusters selected will be subjected to a scenario building exercise to predict probability of success in terms of reducing the conflicts between overlapping high conservation values, threat and potential for success and relative to the constraints of the investment timeframe, resources and institutional capacities. Combining the human and biological landscapes will help identify potential opportunities for conservation enabling the classification of the target conservation areas into (i) priority conservation areas with minimal threats and good opportunities for conservation; (ii) priority areas for both conservation and development, where there are multiple potential conflicting interests, but these can be managed effectively without compromising either the conservation or development needs; (iii) areas with intensive human use and threats, where economic needs take precedence, but these activities can be compatible with conservation; (iv) areas where intensive human is the priority, but a limited number of conservation compatible development activities might be possible; and (v) areas of intensive human use that are likely to expand further, where conservation is likely not possible.*

*The outcome of Step 3 above would be a map (or series of maps) showing prioritized conservation areas (or ESAs) within the landscape characterized by their conservation potential (as discussed in the previous paragraph) based on conservation value, threat and conflict level and demonstration potential.*

**Criteria for designating and managing ESAs**

It is important to develop criteria for designating and managing ESAs. However, these criteria may be slightly varying from one country to another or may be one place to another depending on the availability of information and status of the site. A set of model criteria are given[25]below in descending order of importance. Some of these criteria were used for designating ESAs in Kala Oya Basin.

[25]McNeely.Jeffrey A., Kenton R. Miller, Walter V. Reid, Russell A. Mittermeier and Timothy B. Werner. 1990. Conserving the World's Biological Diversity. IUCN, Gland, Switzerland; WRI, CI,WWF-US and the World Bank, Washington, D.C. 85p.

**1) Criteria that determine the importance of the site to human society;**

**(a)** ***Economic benefit:***
This will be the most important criterion for production-oriented sectors. The site provides long term economic benefits such as watershed protection or tourism.

***(b) Diversity:***
The site has a great variety of species and ecosystems.

***(c) Critical habitat (international and national):***
The site is essential to the survival of one or more threatened species that occur in no other country or threatened in nationally or contains only the example of certain type of ecosystem.

***(d)Cultural diversity:***
The site supports the population of indigenous people who have developed the sustainable living with the ecosystems.

***(e) Urgency:***
Action is required quickly at the site in order to avert an immediate threat.

**2) Criteria to determine additional elements that enhance the value of the site;**

***(a) Demonstration:***
The site demonstrates the benefits, values or methods of protection. It also shows how to resolve conflicts between natural resource values and human activities.

***(b) Representativeness:***
The site is representative of a habitat type, ecological process, biological community, physiographic feature or other natural characteristics.

***(c) Landscape:***
The site has features of outstanding natural beauty. These are usually unique, easily destroyed and attractive to tourists. Any alterations would significantly reduce its amenity value.

***(d) Recreation:***
The site provides local communities with opportunities to use, enjoy and learn about their natural environment.

***(e) Research & monitoring:***
The site can be used for research since it is a non-manipulated area. It can form a basis for assessing any ecological change.

***(d) Awareness:***
Education and training within the site can contribute knowledge and appreciation of regional value.

**3) Criteria to determine the management feasibility of a site;**

***(a) Social acceptance:***
The site is already protected by the local people or official protection by the government would be welcomed.

***(b) Opportunism:***
Existing actions lead to further actions.

***(c) Availability:***
The site can be acquired easily by any legal forms of control.

***(d) Convenience:***
The site is accessible to researches, students for scientific and educational purposes.
All criteria mentioned above could not be applied to designate the ESAs in Kala Oya Basin. But some of the criteria were used to identify the ESAs.

Initially 13 sites (Fig. 14) were tentatively selected by considering several key indicators such as the status of faunal &floral species presence, land use/land cover and its management, qualities of the soil (soil depth, erosion hazard etc.), availability of surface water and population density.Among13 sites, five sites were qualified as ESAs based on the criteria used. All these sites are having some significance in terms of biodiversity but this significance is varying from one site to another. Therefore, a scoring method, developed by a team of experts, was used to select the most significant sites out of thirteen. Five sites namely “Villu ESA”, “Gange Vadiya ESA” & “WevalKele ESA” in Puttalam district and “Manewakanda ESA” & “Kala Oya riverine ESA ” in Anuradhapura district (Fig.14) were qualified as ESAs based on the highest score.

**Proposed process for identification of ESAs**

Under this project a process has been proposed to identify the ESAs[26].It was suggested that ESAs need to be identified by taking into consideration that ESAs are likely to be smaller areas of conservation value that lie outside traditional protected areas (PAs)

[26]Malcolm A. Jansen. 2020.A Decision Support System for Identification of Environmentally Sensitive Areas in Sri Lanka. UNDP.

and likely to be in areas amongst human habitations. The following key characteristics are proposed for the identification.

**I. Size of the ESA**

Area preferably greater than 5 hectares (with specific exceptions defined including areas less than 5 hectares, particularly if the site has very critical aspects of biodiversity and ecology).

**II. Features**

One or more of the following features need to be available in the ESAs

a) Areas containing significant globally, regionally or nationally significant populations of species of conservation importance (endangered, threatened and vulnerable species)
b) Areas containing significant populations of species of specific biological significance (endemic, indigenous, wild crop relatives and/or migratory species)
c) Unique terrestrial, riverine, freshwater, coastal and marine ecosystems (or mixed ecosystems)
d) Significant natural features or landscapes or areas of important geological or cultural features
e) Areas that provide basic ecosystem services in critical situations (e.g. areas critical to water catchments, erosion control and providing barriers to Invasive Alien Species of IAS)
f) Areas critical for ensuring connectivity of important habitats (i.e. to maintain biological integrity) or key biological elements, or to improve ecological viability of existing protected areas.
g) Areas that provides opportunity to demonstrate approaches to sustainable NR development

**III. Management possibilities**

An area that lends itself to manage by one local or regional body or community group or coordination of local bodies or groups. Some examples for such bodies are Divisional Secretariat, Community Development Organization, Forest or Wildlife Department, Fisheries Department.

However, management of ESAs need an integrated approach and community has a big role in planning, decision making, implementation of recommendations and monitoring. Therefore, community participation throughout the entire process is crucial. Selecting a large area as an ESA will make difficulties in obtaining the community participation. To form effective community groups, the area need to be in manageable size. If area is large, it is better to divide the entire area into manageable units then it is easy to form small community groups with those who aware about the area.

Using scoring method five sites were selected as ESAs. However, selection of five sites does not mean that remaining eight sites are not significant in terms of biodiversity. They are also important but priority should be given to these five sites. The experience gain from these five sites can be applied later to the remaining sites as well. The sites that are qualified as ESAs out of thirteen sites are;

1. Villu ESA
2. Gange Vadiya ESA
3. WevelKele ESA
4. Manewakanda ESA
5. Kala Oya riverine ESA

**Boundaries of ESAs**

The boundaries of these areas were approximately demarcated on the map mainly considering the land use and land cover. These boundaries are ideal but may not be practical enough due to the difficulties in identification on the ground. It is therefore necessary to readjust the boundaries by using natural land marks (e.g. streams, roads, forest boundary, mountain crest etc.) to facilitate the identification of ESAs on the ground. This readjustment is compulsory and is a different exercise that can be carried out along with the ESA management planning process with the participation of land users. Further, it is recommended to establish sign boards to identify the ESAs for the local people.

**Land area of selected ESAs**

**Table 6. Extents of selected ESAs.**

| ESAs | Approximate Extent (ha) |
|---|---|
| ESA 1- Viilu | 2187 |
| ESA 2 - Gange Vadiya | 3748 |
| ESA 3 - Weval Kele | 47 |
| ESA 4 - Manevakanda | 856 |
| ESA 5 - Kala Oya riverine | 49 |

Weval kele and Kala Oya buffer ESAs are comparatively smaller than other three. The largest ESA is the Gange Vadiya.

Generally, ESAs could be mnaged efectively with the participation of the people in the area. Therefore, it is recommended to devide these large ESAs into several amaller units to facilitate the participatory management. As mentioned before, if the area is

in managebale size, it is convenient to form community groups to implement the recommendations.

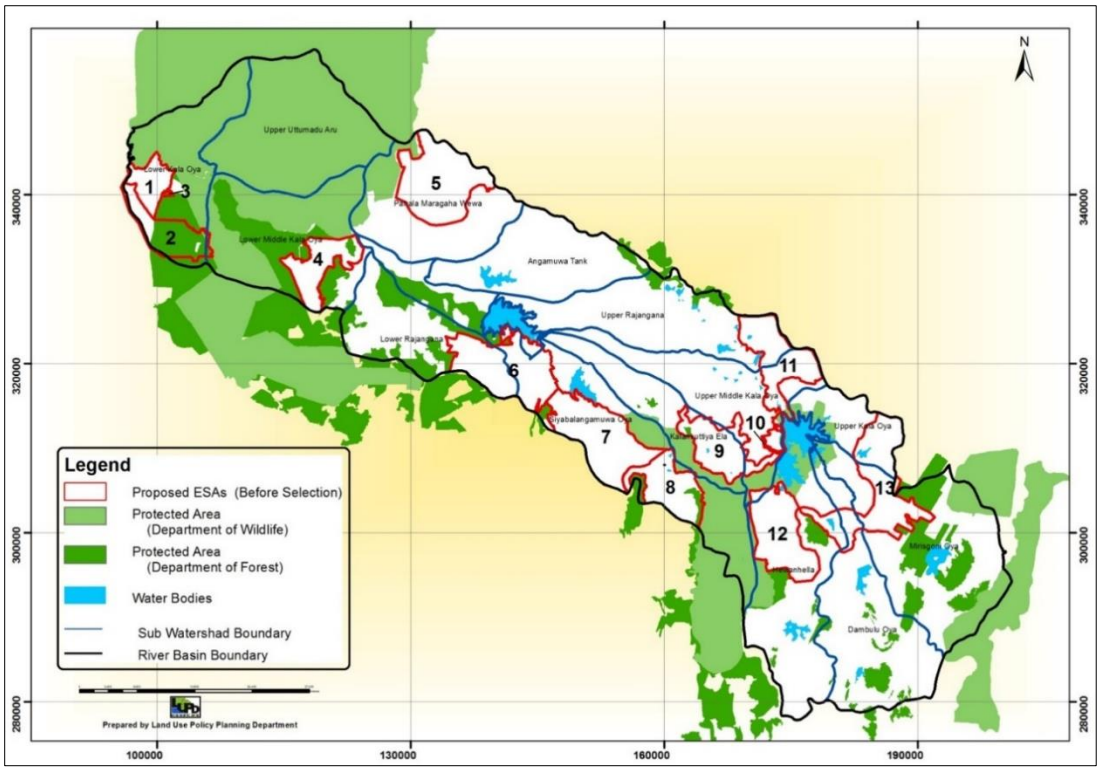


Fig: 14. Proposed sites (marked in red line) that was considered for the selection as ESAs.

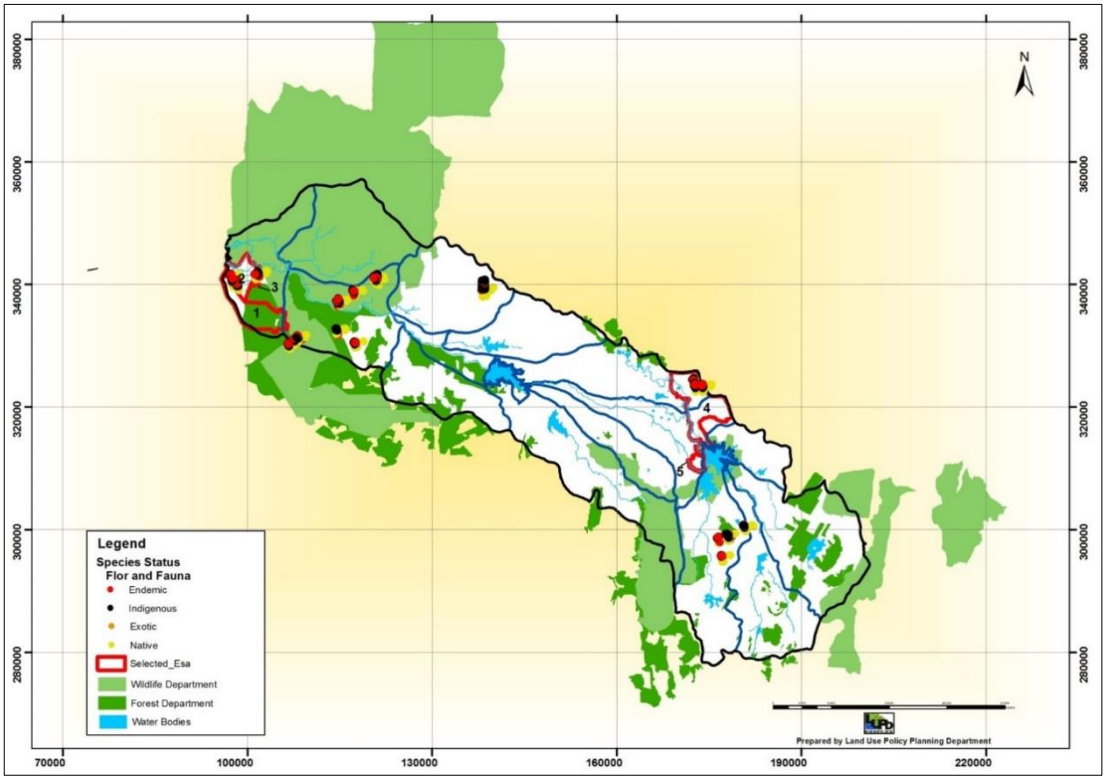


Fig. 15. The five sites that are qualified as ESAs and species status of the basin

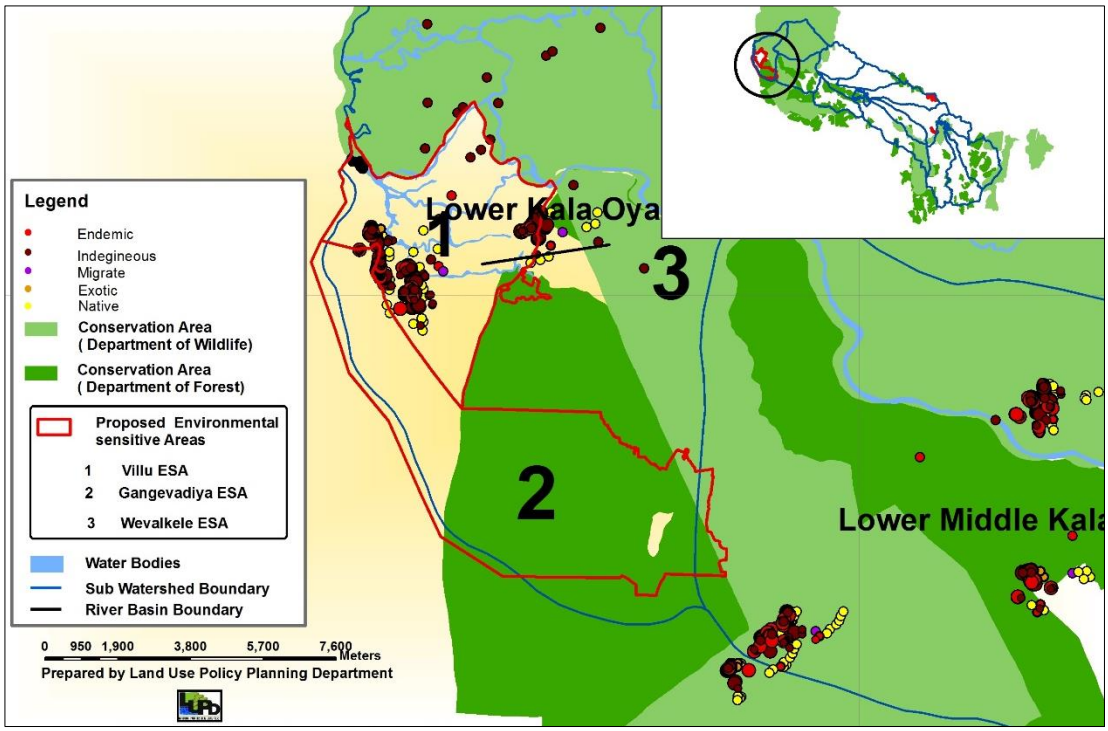


Fig. 15a. Enlarged map showing selected ESAs (Gange Vadiya, Villu and Wevalkele)

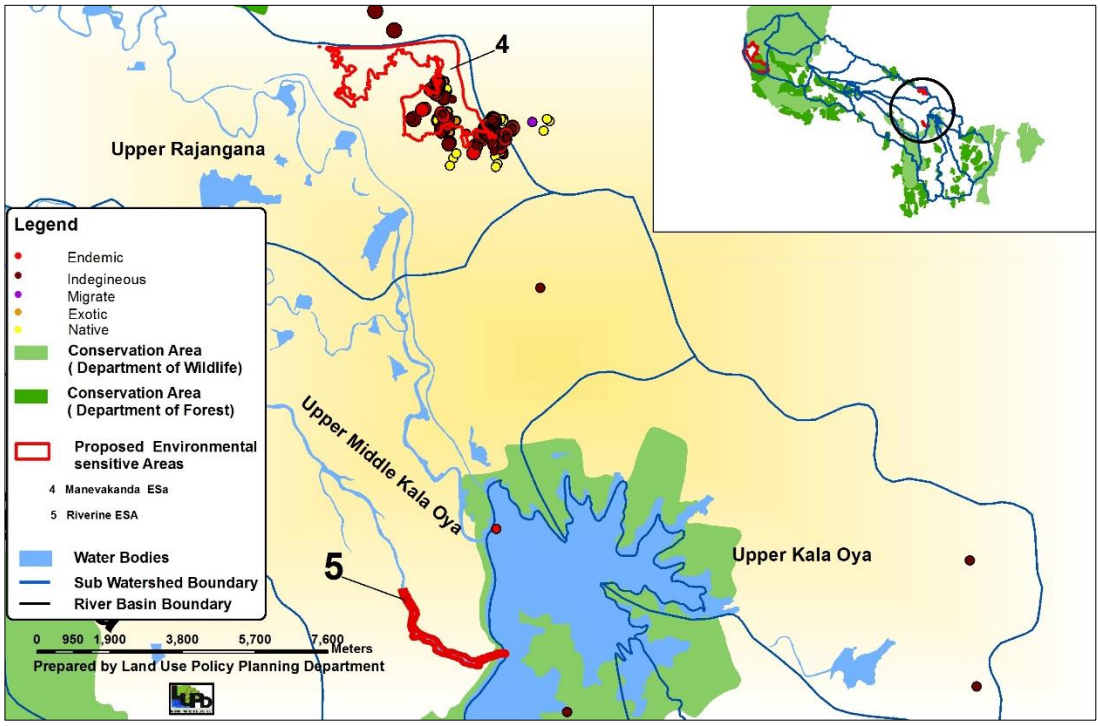


Fig. 15b. Enlarged map showing selected ESAs (Manavakanda and Riverine)

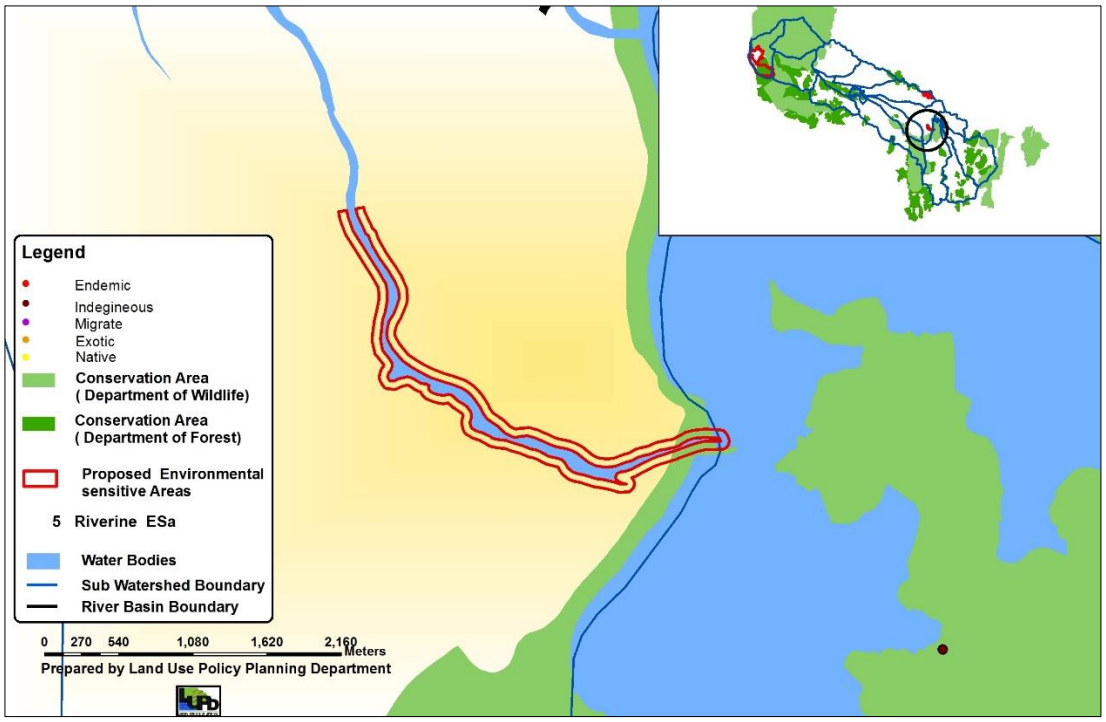


Fig. 15c. Enlarged map showing ESA 5 (Riverine)

### Land Use and Land Cover within the ESAs

Land use and land cover extent as a percentage in the five ESAs is given in Table 7.

**Table 7: Land use and land cover extents as a percentage in ESAs**

| Major Land Use/ Land Cover | Extent as a Percentage (%) | | | | |
|---|---|---|---|---|---|
| | GangeVadiya ESA 01 | Villu ESA 02 | Wevalkele ESA 03 | Manevakanda ESA 04 | Part of the reservation of Kala Oya ESA 05 |
| Settlements and other built-up lands | 7.11 | 14.07 | -- | 1.92 | 20.42 |
| Agricultural uses | 14.18 | 52.64 | -- | 52.98 | 34.04 |
| Forest | 64.23 | 25.74 | 100 | 296.02 | 18.66 |
| Rocks | 2.24 | 0.25 | -- | 14.74 | -- |
| Water | 5.16 | 0.72 | -- | 77.65 | 26.88 |
| Wetlands | 7.06 | 3.30 | -- | -- | -- |
| Bare lands | -- | 3.28 | -- | -- | -- |

Generally, Human interferences are high in settlements and in cultivated areas compared to other land uses/land cover. Percentage of extent of agricultural areas are higher in Manevakanda ESA (ESA 04) (52%) and Villu ESA (52%) than other ESAs. Manevakanda ESA (ESA 01) is having lowest percentage (1.92%) of settlements. Wevalkele ESA (ESA 3) does not have any settlements or built up areas and only having forest. It has been observed that there are settlements (20.4%) in the ESA 05 which was demarcated using the 60m buffer of Kala Oya as a river reservation according to the provisions given in the State Lands Ordinance. However, as per the provisions given in the ordinance, this is applicable only to the state lands and not to the private lands. However, there are about 20% of the total land area has been utilized for settlements and therefore, it is necessary to regulate the land use in appropriate manner with the participation of the people living on it to minimize the negative impacts to the river and ensure the protection of existing biodiversity of the area. Since land uses/land cover are divers in ESAs, land use management options are varying from one area to another.

Generally majority of the home gardens are underutilized in this area mainly due to limitation of soil moisture. Thus, land cover is poor which leads to soil erosion particularly during rainy season. Declining of soil fertility, soil compaction, depletion of organic carbon will reduce the land cover further. This situation is also common to the other cultivated areas excluding paddy. Therefore, it is necessary to improve the land use and land cover in agricultural ecosystems in ESAs by introducing soil and water conservation to cultivated lands. However, these interventions should not be limited to ESAs and they should be introduced to other areas as well but in different intensities depending on the severity of the erosion and moisture limitations.

In cultivated lands particularly in paddy lands, over use (amount more than the recommended amount of DOA) of agro chemicals has been observed in some cases. But it is difficult to prove that due to lack of data. However, trend of importation of agro chemicals has been increased during the past and that can be considered as an indirect indicator. Use of chemical fertilizers sometime exceeds the DOA recommendations and a significant variability of fertilizer usage among districts had been observed[27].

Destruction of pollinators of crop plants leading to poor crop yields. Elimination of natural enemies of pests and consequent loss of natural pest control that keeps the population of pests at higher level. Development of pest resistance to pesticides encouraging further increases in the use of chemical pesticides resulting contamination of the soil and water bodies, pesticide poisoning of farmers and deleterious effects on human health. Loss of bio-diversity in the environment is some of the consequences of the uncontrolled use of agro chemicals.

[27]Weerahewa.J. and Kanthilanka.H. (2016). Do farmers over use fertilizers. Some empirical evidence from paddy cultivation during 2005-2015.Department of Agricultural Economics & Business Management, Faculty of Agriculture, University of Peradeniya.

Introduction of IPM and encourage the use of botanic pesticides are seems to be viable recommendations for agricultural ecosystems within the ESAs to ensure the biodiversity conservation. However, these recommendations can also be adapted to other areas of the basin. Hence, awareness creation and training on IPM, training on making botanic pesticides and making compost are important to popularise these practices among the land users. If possible, establish several demonstration sites to show the impacts of these recommended measures.

**Biodiversity in the ESAs**

The biodiversity data available outside the protected area in the basin particularly within the ESAs are not adequate enough to formulate effective recommendations. However, all data sets available and the output of the modelling using Maxent software were used to elaborate the status of the biodiversity in the ESAs.

Status of the biodiversity within the ESA is high and threatened compared to other areas. Hence it is necessary to give the priority for the conservation of biodiversity in these five ESAs. However, it does not mean that the remaining sites are not significant and conservation is not needed. The remaining sites should also be considered subsequently, may be lessons learnt from selected ESAs can be replicated in these sites later.

**Status of the other physical features and processes within the ESAs**

**Slope and soil erosion**

The slopes of the land within the ESAs are varying and the majority of the lands are flat or almost flat (0-8%)(Table 8). Percentage of land area which is having the slope exceeding 8% is negligible. The available slope categories are not having much influence on soil erosion but erodibility of soils and intensity of rains are having large impact on soil erosion. Therefore, maintaining land cover in the cultivated lands as a live mulch or dead mulch particularly during the monsoon rains is very important to reduce the splash erosion by preventing the rain drop impacts with soil surface. In addition, land cover helps to retain the soil moisture during the dry period and provide organic matter to soil and fix the atmospheric nitrogen when leguminous species are used as live mulch.

**Table 8: Slope categories available in the ESAs and their approximate extents as a percentage.**

| Slope Category | Extent as a % in ESA 1 | Extent as a % in ESA 2 | Extent as a % in ESA 3 | Extent as a % in ESA 4 | Extent as a % in ESA 5 |
|---|---|---|---|---|---|
| 0 % - 2% | 98 | 86 | 100 | 51 | 96 |
| 2 % - 8 % | 2 | 14 | -- | 42 | 4 |
| 8 % - 16% | -- | -- | -- | 5 | -- |
| 16 % - 30% | -- | -- | -- | -- | -- |

**Soils in ESAs**

Different Great soil groups are present in the ESAs. In ESA1 there are about 59% of alluvial soils and 16% of red yellow latosols available (Table 9). In addition there are about 25% of eroded lands available in ESA1. In ESA 2 majority of the soils are red yellow latosols. In ESAs 4 and 5 major soil groups are reddish brown earths and low humicgley associations. Generally, soil groups of RBE and RYL are having high erodibility it is necessary to conserve the soils by maintaining appropriate land cover. Restoration of soils will help to maintain the vegetation/land cover which ultimately creates a favourable environment for biodiversity conservation.

**Table 9: Great soil groups in ESAs and their approximate extents as a percentage**

| Great soil groups | Extent as a percentage (approx.) | | | | |
|---|---|---|---|---|---|
| | ESA 1 | ESA 2 | ESA 3 | ESA 4 | ESA 5 |
| Alluvial soils of variable drainage and texture; flat terrain | 59 | | 85 | | |
| Eroded land | 25 | 20 | 15 | | |
| Red-Yellow Latosols; flat to slightly undulating terrain | 16 | 80 | | | |
| Reddish Brown Earths & Low Humic Gley soils; undulating terrain | | | | 98 | 75 |
| Rock knob plain | | | | 2 | 25 |

**Table 10.Soil series extents as a percentage of the total area of each ESA**

| Soil Series | Extent as a percentage (approx.) | | | | |
|---|---|---|---|---|---|
| | ESA 1 | ESA 2 | ESA 3 | ESA 4 | ESA 5 |
| Aruvi Series associated with undifferentiated soils of alluvial origin with variable texture and drainage | 58 | | 9 | | |
| Siyambala Puttulam Association | 10 | | | | |
| Negambo Putulam Association | 3 | 1 | | | |
| WillpattuGamburaMavilluBorupan Association | 2 | 62 | | | |
| Tonigala Anamaduwa Nawagattegama Complex | 9 | 0 | 91 | | |
| Medawchchiya Aluthwewa Divulwewa Hurathgama kahatagasdigiliya Association | | | | 88 | 100 |
| Rock Knob Plains | | | | 10 | |
| Erosional remnents (Inselberg) | 18 | 37 | | 2 | |

Based on the soil series map (Mapa et.al. 2014) Aruvi Series associated with undifferentiated soils alluvial origin with variable texture & drainage is dominant in

ESA 1 where as Tonigala - Anamaduwa- Nawagattegama Complex is dominant in ESA3. In ESA 4 and ESA 5 Medawachchiya - Aluthwewa - Diuvlwewa – Hurathgama - Nawagattegama Association is dominant (Table 10). Soil properties of these series are varying thus land use and land cover also varying and create different environments.

It is recommended to develop measurable conservation targets mainly for the ESAs considering bio-physical features and other natural & human induced processes. These targets can be achieved by the project interventions carried out by different stakeholders.

**Common threats available in ESAs in terms of biodiversity conservation**

**Threats in Villu ESA**

a) Encroachment of villus area for cultivation of perennial crops (coconut) by the people who are using the surrounding lands.
b) Filling of villus area due to cutting of large drains (to prevent the elephants movements).
c) Use of villus for cultivation by the people who are living in the nearby settlements.
d) Encroachment of the villus for settlements.
e) Some of the villus converted to tanks.
f) Land ownership issues created several threats including encroachments.
g) Destroy the vegetation on villus by fire.
h) Over use of agrochemicals for cultivation have negative impacts on vegetation and biodiversity in villus.
i) Silting of villus due to soil erosion.

**Threats in Gange Vadiya ESA**

a) Frequent climate disasters (Drought and Floods)
b) Various activities carried out by local tourists that have negative impacts to the environment.
c) Over grazing by stray animals.
d) Unmanaged sand mining.
e) Illegal fishing gears.
f) Destruction of mangrove vegetation for various purposes.
g) Solid waste pollution.

**Threats in Weval Kele ESA**

a) Encroachments for settlements, cultivation of perennials (coconuts) and seasonal crops.
b) Unmanaged cutting of cane and setting fire to facilitate the cutting of cane.
c) Hunting and poaching.
d) Make ditches to drain the water and make the area dry to facilitate the cutting of cane
e) Trend to reactivate the extraction of clay.

**Threats in Manevakanda ESA**

a) Encroachments of forest lands
b) Spreading of Invasive Alien Species (IAS)
c) Forest fire
d) Hunting and poaching
e) Drought
f) Mono-cropping with unsustainable use of fertilizer and agro-chemicals.

**Threats in Riverine ESA**

a) Encroachments mostly for seasonal cropping
b) Settling on flooding area
c) Water pollution
d) Hunting and poaching
e) Over use of agro-chemicals

### 4.2.2 Decision 02: Land management along the continuum of Kala Oya

The main assumption is that "uninterrupted river flow is the key to biodiversity conservation and social wellbeing in a river basin". Therefore, manage the reservations along the both sides of the river are very important to ensure the continuum of the river. These reservations can be demarcated using the provision given in the regulations of the State Lands Ordinance (1949) (Table 6). Nevertheless, these regulations can only be used for state lands and not for the private lands.

It is recommended to introduce good land use practices to ensure the sustenance of riverine vegetation and conserve the soil of the state lands. Vegetation of the reserved area should be conserved. Any activities damage to the vegetation and the banks of the river should be stopped in the state lands using current law. These land use recommendations can be implemented by relevant agencies.

It is advisable to review the present management system and develop more effective management system with the assistance of the technical agencies to protect the riverine vegetation in the state lands and also in private lands. Main aim is to conserve the soil and vegetation along the banks of the river to ensure the continuum of the river.

**Table 11. Distance of the reservations that should be kept in the state lands based on the width of the river as given in the land manual.**

| River width (feet) | Reservation from the bank (feet) |
|---|---|
| Less than 15 | 66 (approx. 20 m) |
| 15 - 50 | 132 (approx. 40 m) |
| More than 50 | 198 (approx. 60 m) |

Photo 2. Damaged tree in the reservation of Kala Oya

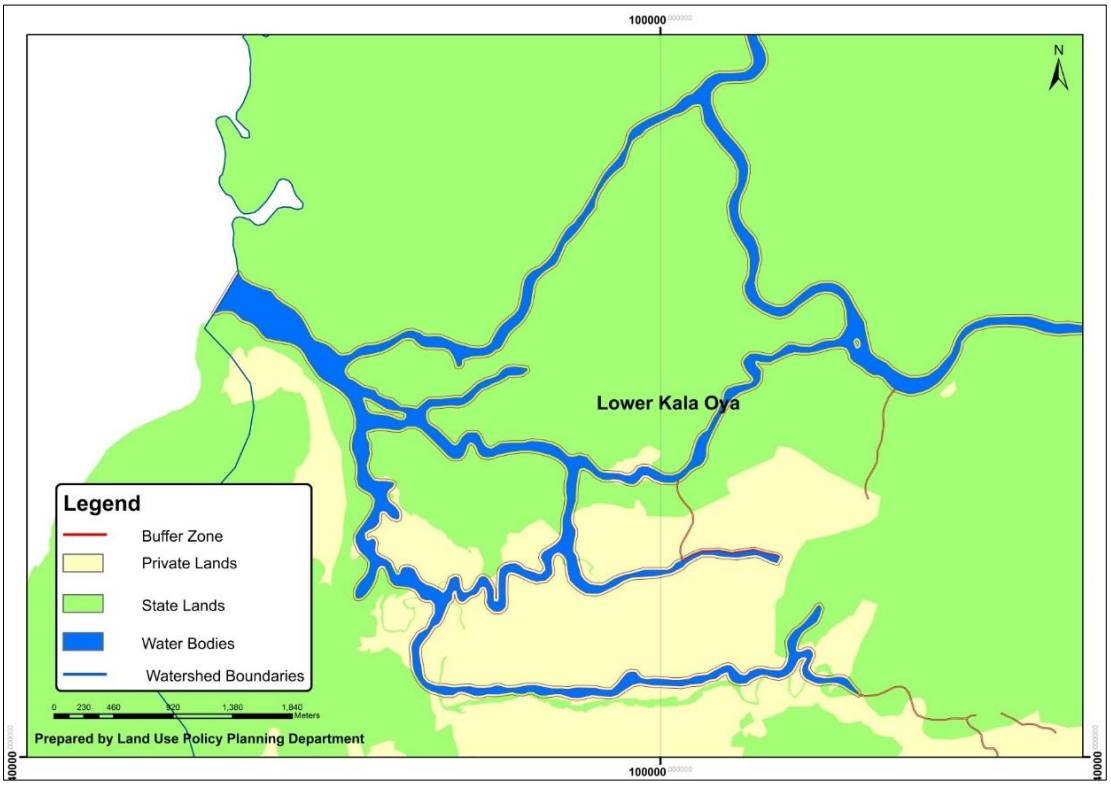


Fig. 16a. River reservation marked along the Kala Oya irrespective of land ownership (close to river mouth).

However, the approach for the private lands along the river should be different. The appropriate land use options should be introduced to the private lands by using participatory approach. It may be incentive driven interventions to encourage the land users to protect the riverine area.

Irrespective of the land ownership a river reservation has been marked on the map based on the provision given by State Land Ordinance and enlarged part of it is shown in the Fig.16a, b and c. Based on the available data approximately, 1264 ha of state lands and 663 ha of private lands are come under the river reservation marked along the Kala Oya. Ownership of some areas cannot be identified due to lack of information. The total area of the buffer along the river and its tributaries is about 4000 ha.

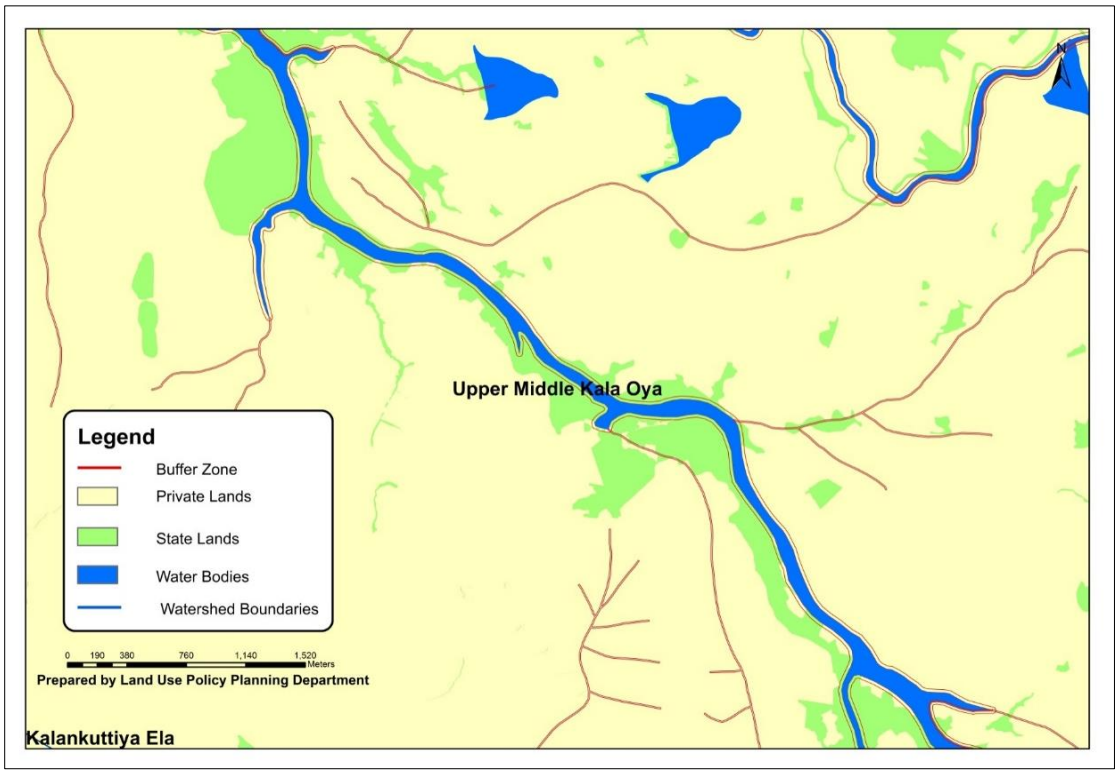


Fig. 16b. River reservation marked along the upper middle Kala Oya irrespective of land ownership

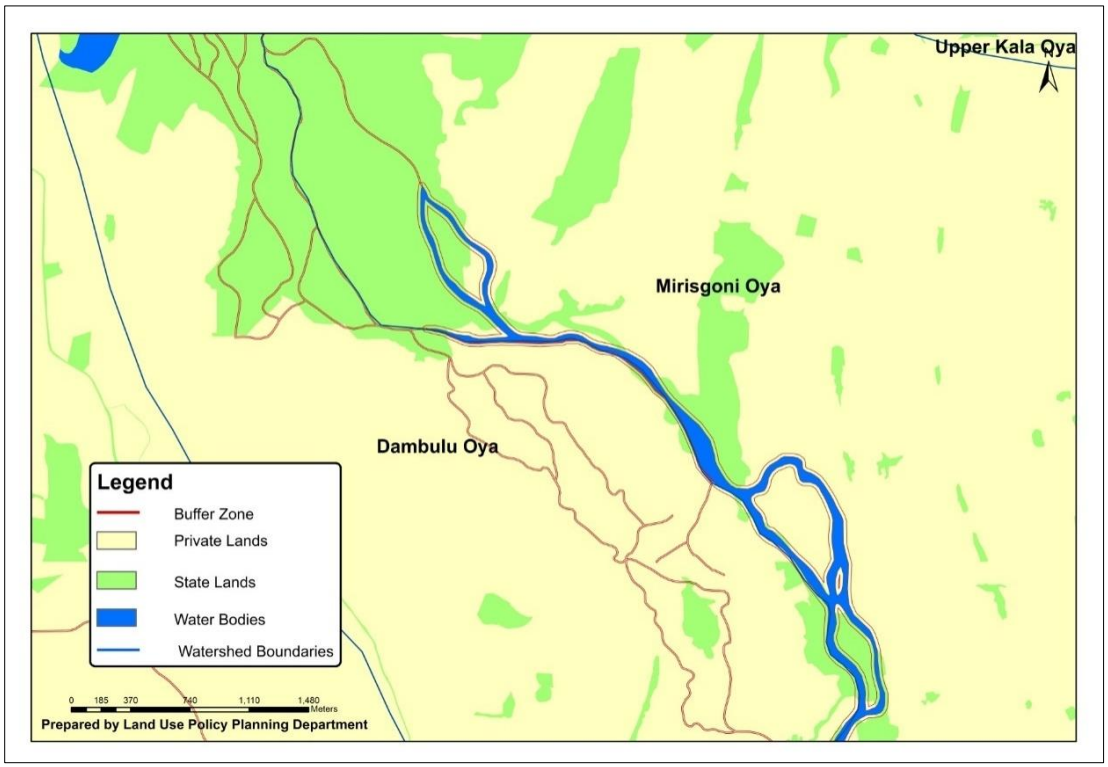


Fig. 16c. River reservation marked along the upper part of Kala Oya irrespective of land ownership

Since the sustainable land use in the basin is the key to ensure the smooth flow of the river, the state lands along the river can be identified as areas of sensitive nature and special plans should be drawn for the conservation of riparian vegetation, soil and elevation gradients. Any developments in the demarcated area should be subjected to environmental assessment. Similarly, responsible authorities should ensure minimal disturbance to river flow. Hence, adequate animal passes such a fish passes are recommended to be constructed where barriers are found in the river (e.g. diversion dams) to ensure the smooth functioning of fluxes along the river.

Where state lands are illegally encroached, attempts must be made to resolve the disputes as per the prevailing law. Further encroachment and effluent discharges should be controlled as per the existing provisions. Sand mining, clearing of vegetation including mangroves and damaging the river bank must be ceased using the provisions of the existing legislations.

Each divisional secretariat should develop special sectoral plans for the private lands in buffer marked herewith. Community forestry programmes and special incentive schemes should be identified to ensure active participation of communities those who are willing to protect the riparian vegetation in their lands.

### 4.2.3 Decision 03: identification of peripheral areas of existing protected areas of Kala Oya and ensuring human and ecological wellbeing in Protected Area (PA) peripheries

The peripheral area (buffer zone) is the PA spill zone (Fig. 17). Fauna as well as flora spills out of PA and the edges of ecosystems can harbour important biodiversity. At the same time this is the conflict zone as edges are mostly farming lands and dwellings of peripheral communities. Due to low income and harsh living conditions, there is a general antipathy towards conservation in most communities. Animal conflicts are a major reason for this. However, the edges of PA are important, hence special sectoral plans and land use management is required.

At present 1mile (1.6km) development restriction is applied only to national reserves declared under Fauna and Flora Protection Ordinance (F&FO). It is proposed to explore the ways and means to identify 1.6 km periphery of all PAs in Kala Oya Basin and developing special plans for these areas. All PAs (including proposed areas by the Department of Forest Conservation) are shown in the Fig. 18. It is recommended to develop community oriented sectoral plans for these peripheral areas to make communities conservation friendly, to maintain integrity of PA, to ensure minimum human animal conflict and to ensure land use practices that are having minimal impact to the surrounding landscape. There is no legal provision to restrict the uses and to demarcate 1mile buffer in the peripheries of the areas other than national reserves. Hence, effective participatory management mechanism should be introduced such areas to regulate the land uses.

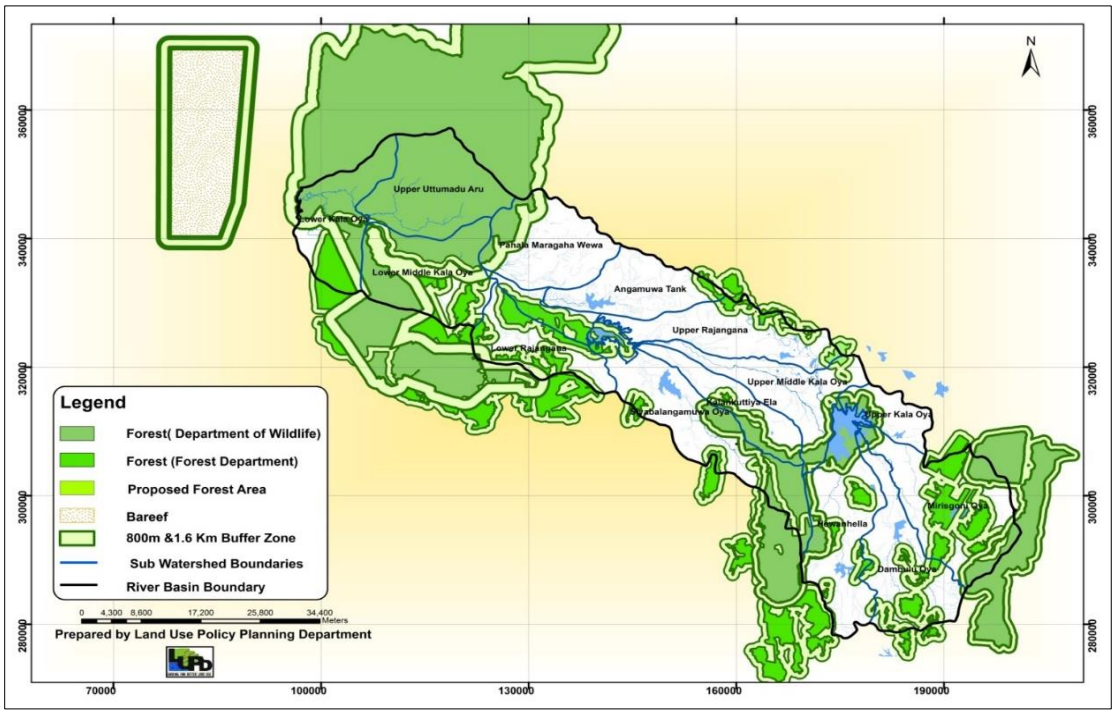


Fig. 17.Bufferdrawn for existing PAs in Kala Oya basin. The square shape polygon appeared in the left-hand side is the protected area declared for Bar Reef. This one mile buffer is only applicable to the national reserves by law.

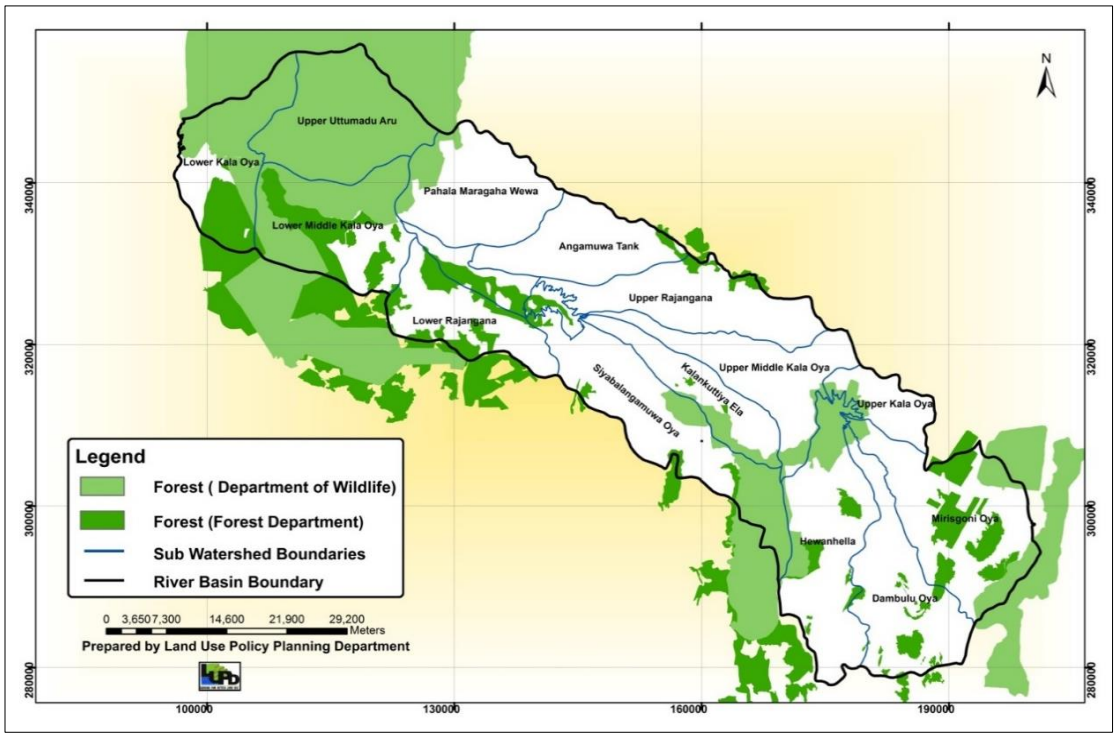


Fig. 18.ProtectedAreas in Kala Oya Basin and associated area, including proposed areas by the Forest Department.

It is important that buffer zone communities are economically rewarded for maintaining the forest cover. Community awareness on ecological farming, effluent management, knowledge on fauna and flora and market linkages for products of such communities with an identity unique to them are some of the activities that can be practiced. Land use in these areas should be managed with community participation. Developments should be monitored closely and where necessary environmental assessments should be conducted. It is needed to avoid major development activities in buffer zones of nature reserves by implementing the provisions given in the Fauna& Flora protection Ordinance.

The three examples given below (Fig. 19, 20 and 21) highlight the necessity.

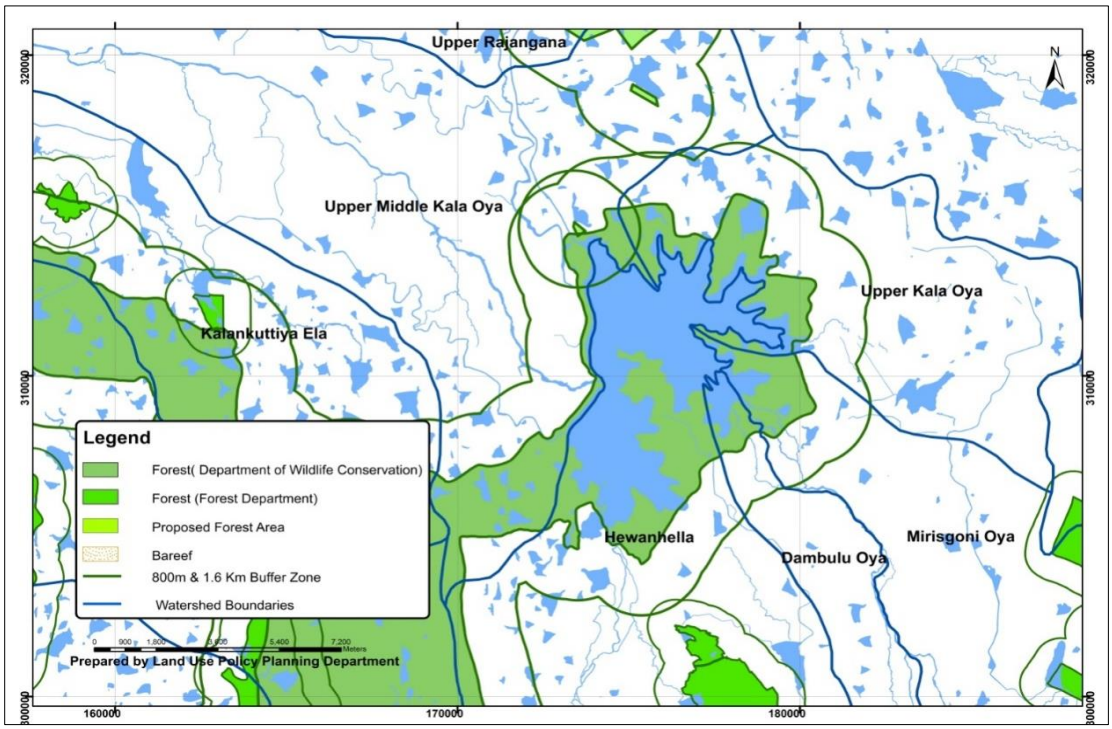


Fig.19: Shows the 1.6 km buffer of Kala wewa and Balaluwewa area.

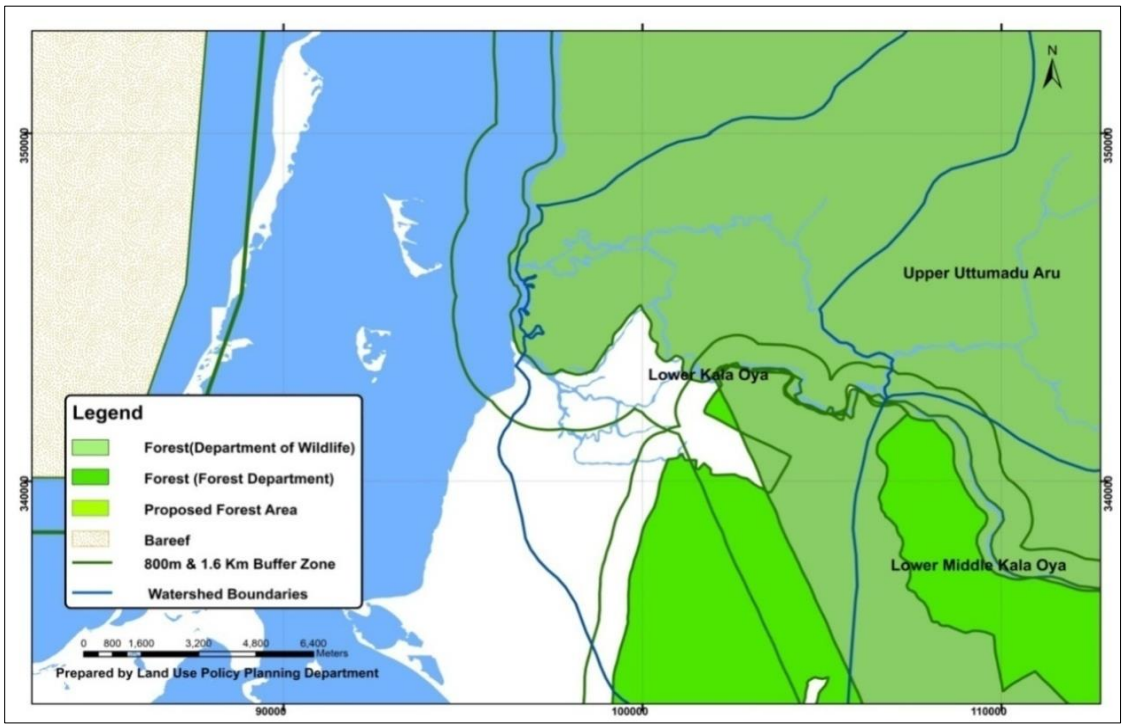


Fig. 20. Shows 1.6 Km buffer of Gange wadiya area. Land use here should ensure river Bank conservation, ensure income of traditional fishing communities, ensure mangrove conservation etc.

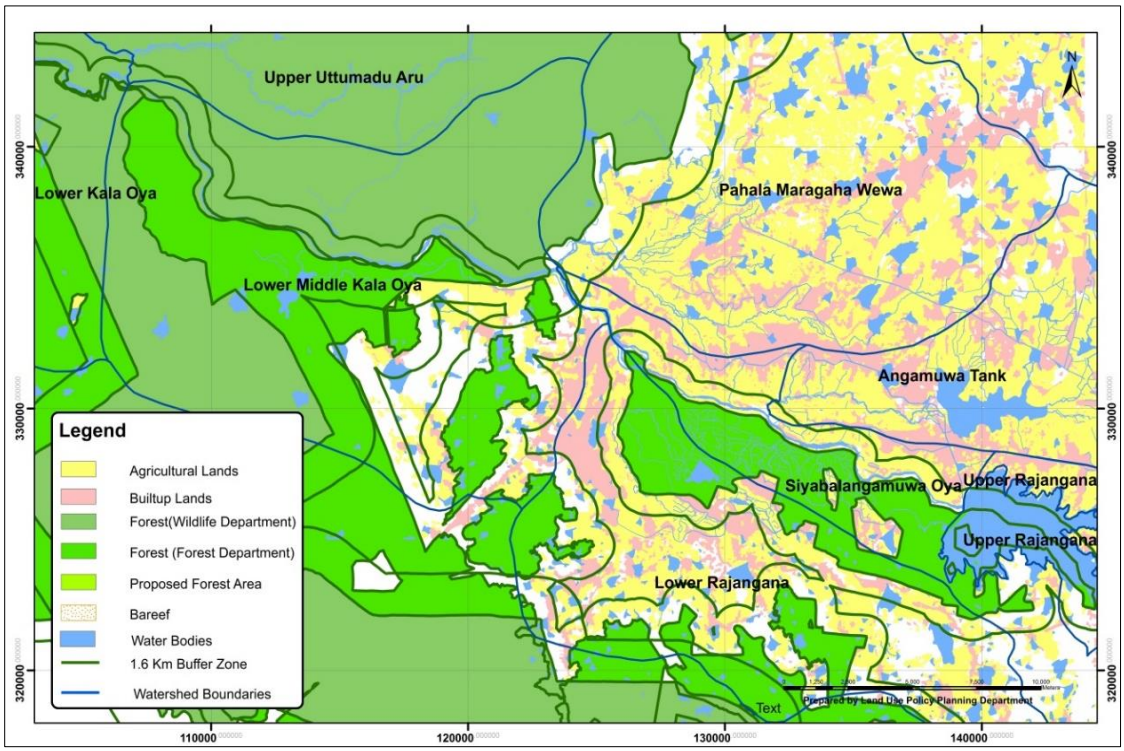


Fig. 21.Shows1.6 km buffer of eastern boarder of Wilpattu National Park.

In these areas need special land use management measures including eco-friendly paddy farming, soil conservation, forestation and human animal conflict management. The area east to Wilpattu National Park is intensively cultivated. A large number of seasonal and perennial reservoirs (minor) both active and abandoned are found in this zone. At present communities in this area have insufficient knowledge on safe use of agro-chemicals, impacts of agro-chemicals on human health and importance of conserving biodiversity at home garden level, eco-friendly farming etc. Also, they have no economic incentives for living beside one of the main PA of the country. Urgent attention should be paid for this region with appropriate awareness on safe and optimum use of agro-chemicals.

**Reservations for the tanks**

In addition to the proposed buffer zones and stream reservations, catchment areas can be demarcated for each and every tank. These areas are varying in size depending on the nature of the topography. These catchment areas should be properly managed to ensure the sustenance of these water bodies. However, land use of tank reservations should be strictly regulated by using existing laws. Unfavourable activities such as clay mining for brick making, seasonal cropping in the immediate catchments (or reservations) of the tanks should be avoided and alternate livelihood options should be identified. These reservations can be demarcated according to the circulars issued by the Department of Irrigation and Dept. of Agrarian Development.

### 4.2.4 Decision 04: Land use planning for human elephant co- existence zones

In Kala Oya, a larger proportion of elephant population are living a considerable period of time outside the protected areas. They also migrate between sub basins and between adjacent, Mee Oya, Deduru Oya, Malwathu Oya and Mahaveli river basins.

In Kala Oya Basin, current Protected Area network is fragmented. Same phenomenon is seen in the adjacent basins. Hence, mega herbivores like elephants frequently use the landscape in between these protected areas for their movements and feeding. As a result, a large population of elephants are encountered in agricultural and other human inhabited areas. The Fig. 8 population density map also shows that the area between two sanctuaries is densely populated and creates a conflict environment between human and elephants. Further, numerous tanks and the small forest patches and shrub lands in catchments of these tanks harbour elephants and lead to the conflict (Fig. 22).

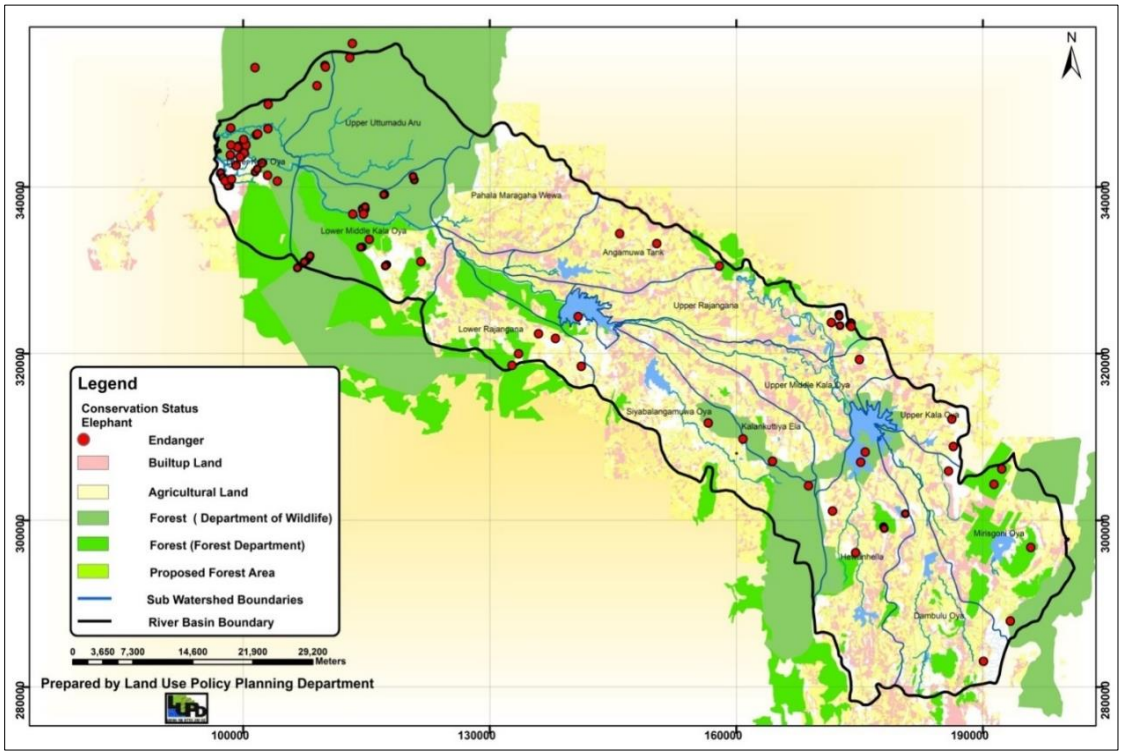


Fig. 22. Elephant distribution in Kala Oya Basin (Source: BD survey data)

The Maxent[28] software is based on the maximum-entropy approach for modelling species niches and distributions. The model shows habitat suitability outside PAs (Fig.22). Since it is difficult to declare as PAs, the zones shown below could be managed as Managed Elephant Reserve (MER).It is proposed to manage these areas as four distinct zones (Fig. 23) using MER concept to ensure human elephant co-existence. The demarcation of zones mainly based on human population density and the habitat suitability for elephants.

It is also suggested to apply development restrictions in elephant corridors which are already declared and identified as corridors.

In this four zones land uses should be focused on human elephant co-existence as well as attempts must be taken to protect existing known migratory corridors without further development. The four zones are;

**Zone A: Right bank of Kala Oya:**
This consists of Pahala Maragahawewa and Upper Rajanganaya. Connect to Malwathuoya sub basin

**Zone B: Left bank of Kalaoya:**
Comprising of lower Rajanganaya sub basin and Siyabalngamuwa sub basin connecting to Meeoya and Deduruoya sub basin

**Zone C:**
Upper catchment of KOB comprise of Dambuluoya, Mirisgonioya and Upper kalaOya connecting to Malwathuoya, Yan oya, Mahaweli river sub basins.

**Zone D:**
Lower catchment of KOBwhich connects to MeeOya basin, also the connection betweenWilpattu NP and Thabbowa sanctuary

[28]http://biodiversityinformatics.amnh.org/open_source/maxent/

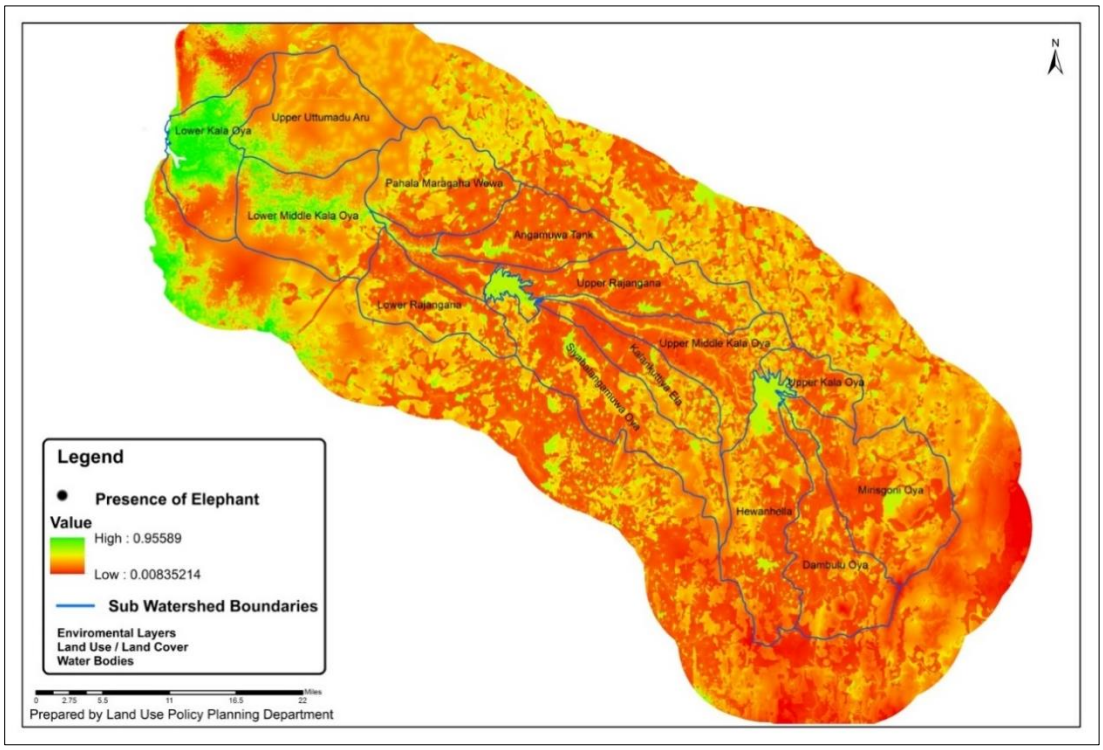


Fig. 23. "Maxent" output showing the suitable habitats for elephants. The areas with green colour indicate high suitability while redareas indicate low suitability. Habitat suitability was evaluated by using layers of land use and water.

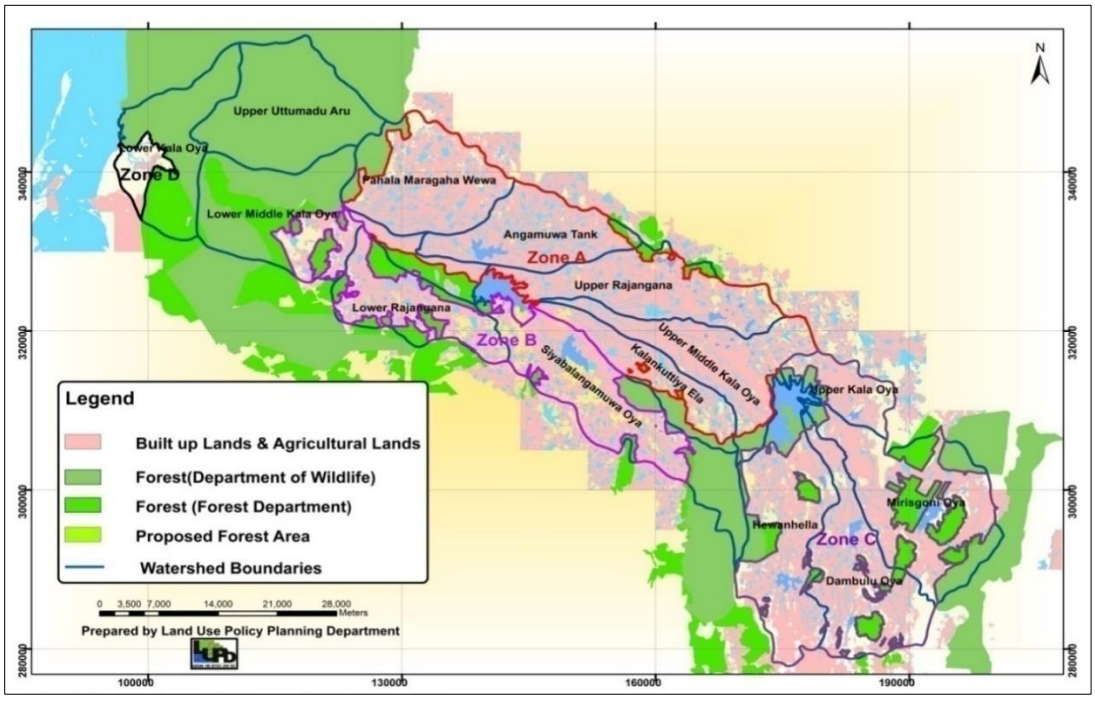


Fig. 24.Proposed zones for human elephant l co-existence areas. (Zone A: Right bank of Kala Oya, Zone B: Left bank of Kala Oya, Zone C: Upper catchment of KOB and Zone D: Lower catchment of KOB)

The approximate extents of these zones are given in the Table 12.

**Table 12.The approximate extents of the demarcated zones.**

| Zones | Approximate Extent (ha.) |
|---|---|
| **Zone A** | 81459 |
| **Zone B** | 34321 |
| **Zone C** | 62841 |
| **Zone D** | 3289 |

Village fencing (electric/ bio-fencing), leaving fallow areas for animals, planning agriculture practices, restriction of developments in known corridors, community forestry, reservoir restoration and management ensuring water for people and animals are key land use practices for these areas.

### 4.2.5 Decision 05: Strategies for the protection of river mouth and the existing environment

River mouth of the Kala Oya and its associated environment is unique and provides a habitat for several aquatic and terrestrial fauna and flora including mangrove vegetation. Therefore, it is crucial to protect the river mouth and its associated environment. Since this area is important in terms of biodiversity conservation it has been identified as an ESA.

Provisions available in the present legislations (State Land Ordinance, Coast Conservation Act, Fauna and Flora Protection Ordinance, Forest Ordinance etc.) can be used to protect this area. Conservation status of the mangrove vegetation is shown in the Fig. 24a and 24b. It shows distribution of mangrove species which are endanger, near threatened and vulnerable in the area. Most of them located close to the river bank.

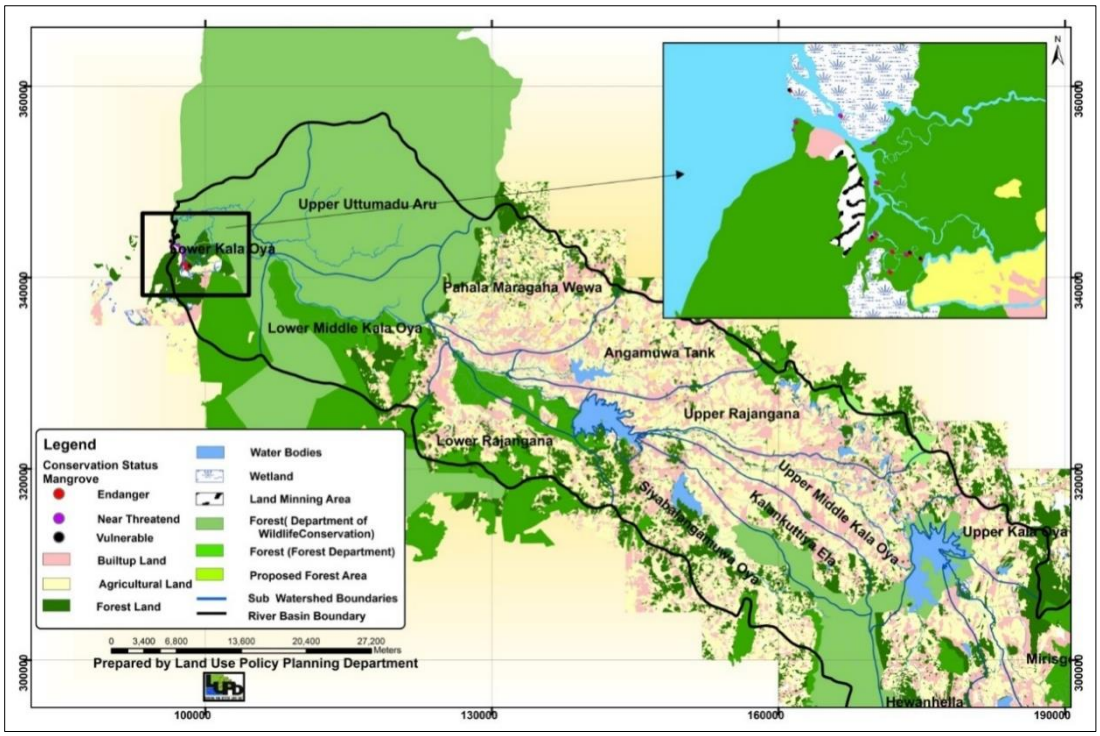


Fig. 25a. Conservation status of the mangroves.

Photo 3. Aerial view of the river mouth at Gange Vadiya


Photo 4. Well grown mangrove vegetation at the lower part of Kala Oya

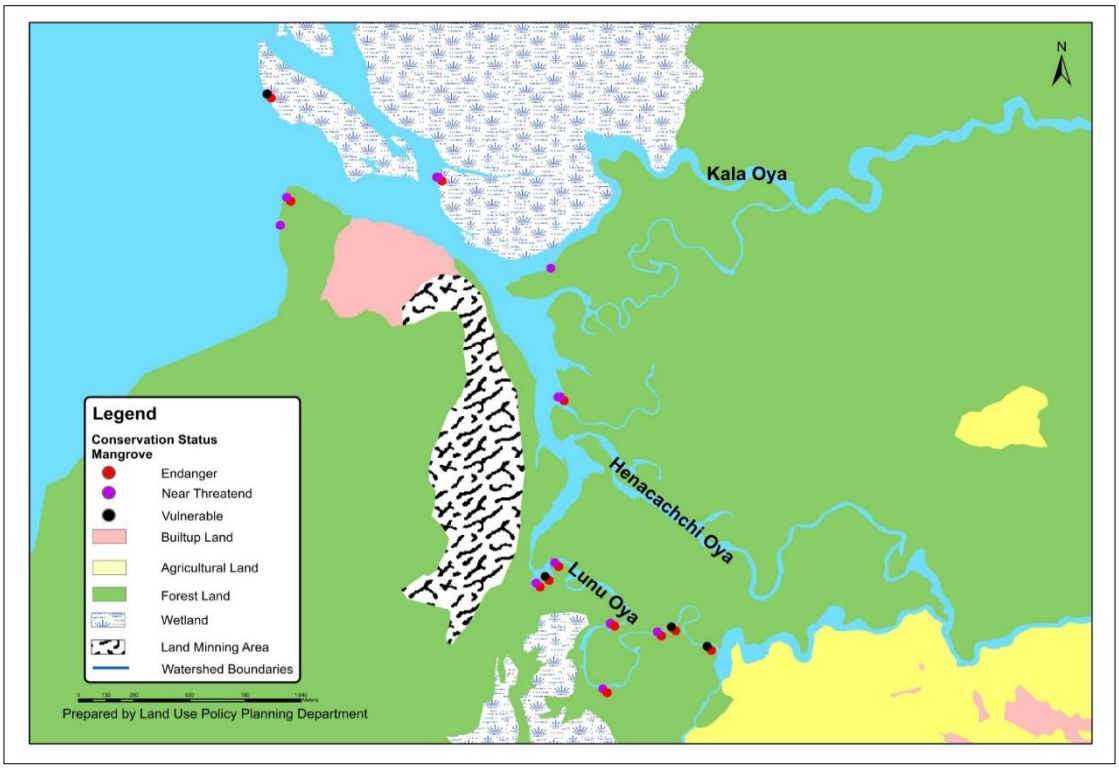


Fig . 25b. Conservation status of the mangroves (enlarged map)

A traditional village is situated close to the river mouth and main livelihood of the villages is fishing in the both river and the sea. It is necessary to get their support to protect the area while ensuring the mutual benefit to them by protecting aquatic and terrestrial environment.

### 4.2.6 Decision 06: Biodiversity Conservation – Conservation status of the flora and fauna

Biodiversity conservation has to be planned by selecting priority conservation areas by using selected species of conservation importance. The species may be endemic or threatened or vulnerable. They may also be act as landscape species or habitat specialist species/ keystone species/migratory species/flagship species. Biodiversity survey provided some information about selected species, their status and distribution. Conservation status of the all selected fauna and flora species are shown in the Fig. 25. Conservation status were identified for fauna (i.e. Amphibians, Birds, Butterflies, Dragon flies, Mammals, Reptiles, Marine and Brackish water fish) and flora including marine Algae and sea grass.

**Amphibians**

The data shows that there are near threatened and vulnerable species available in the basin (Fig. 27). They are mainly confined to the lower part of the basin. The study was initially focused to two project sites of the basin and subsequently considered the other area. This may be a reason for the data concentration at upper and lower part of the basin. However, “Maxent” output (Fig. 28) also shows that highly suitable habitats for amphibians are found in the lower part of the basin. In other areas where water bodies are present also show the high suitability. It is revealed that amphibians present in lower part of the basin are mostly available within the PA and rest are living close to the water bodies. Implementation of the recommendations for designated ESAs, reservations of stream and area close to river mouth will provide a protection to the species. Nevertheless, minimize the use of agro-chemicals, reduce soil erosion to avoid siltation is necessary to ensure the quality of the water bodies since most of suitable habitats for amphibians are found close to water area.

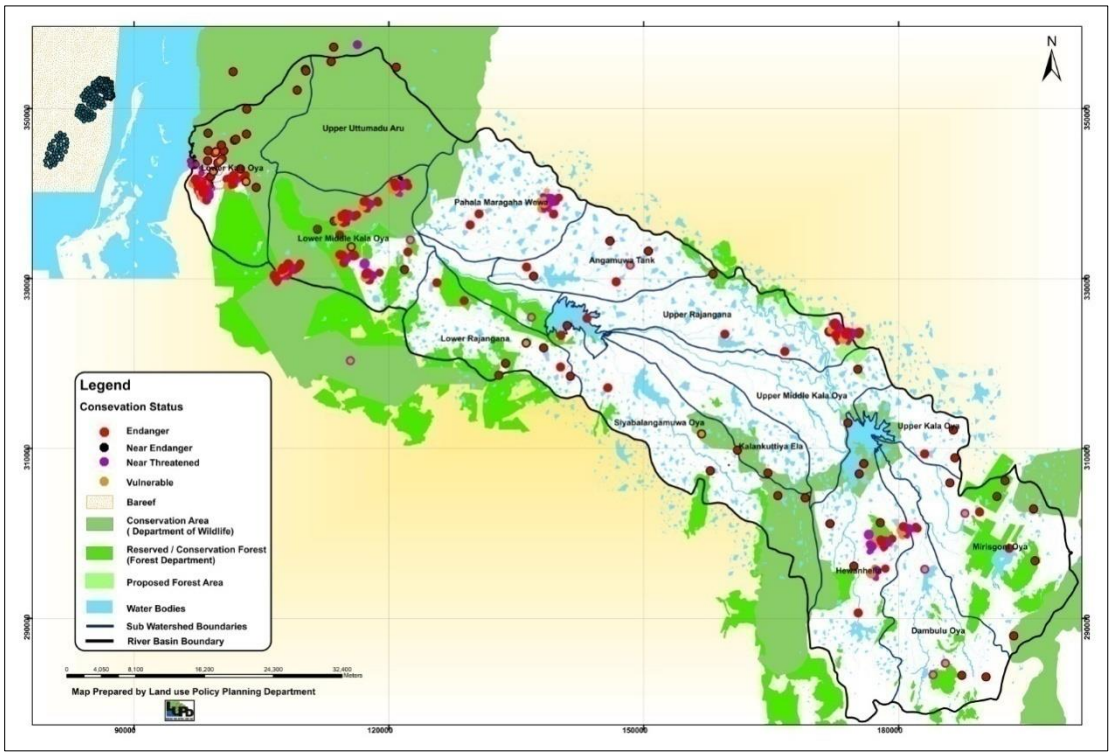


Fig. 26.Conservation status of Flora and Fauna in the Kala Oya basin.
Different coloured dots show the conservation status.

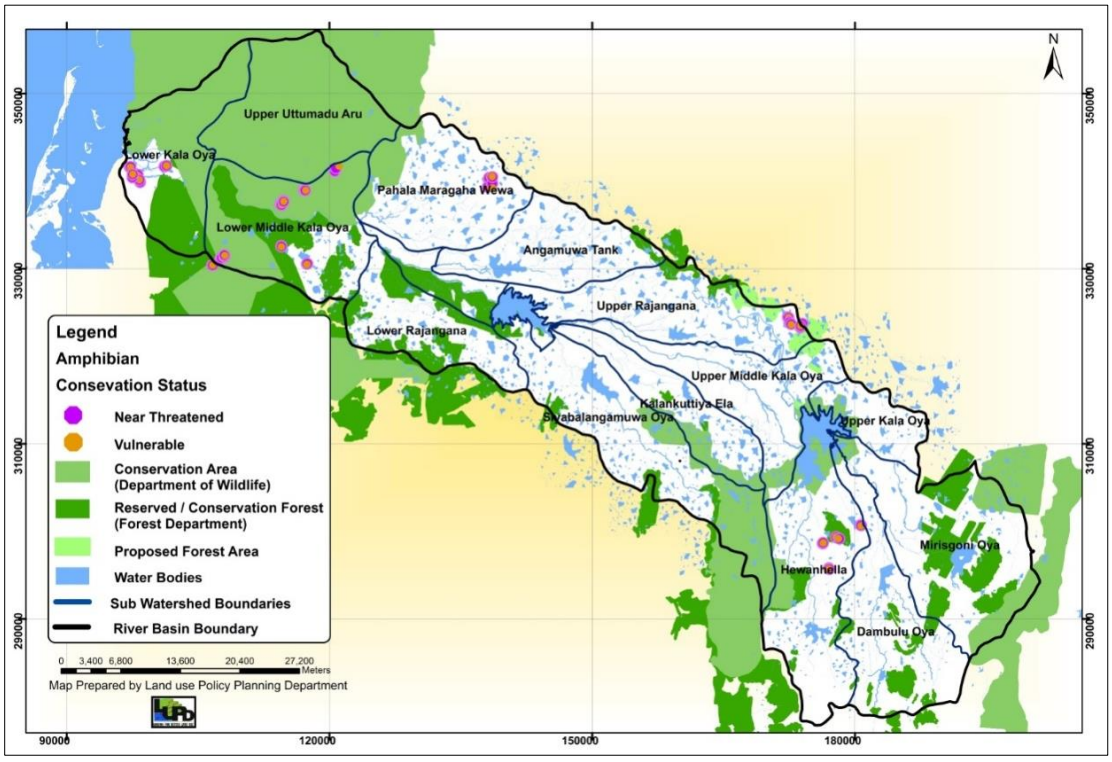


Fig. 27.Conservation status of Amphibians

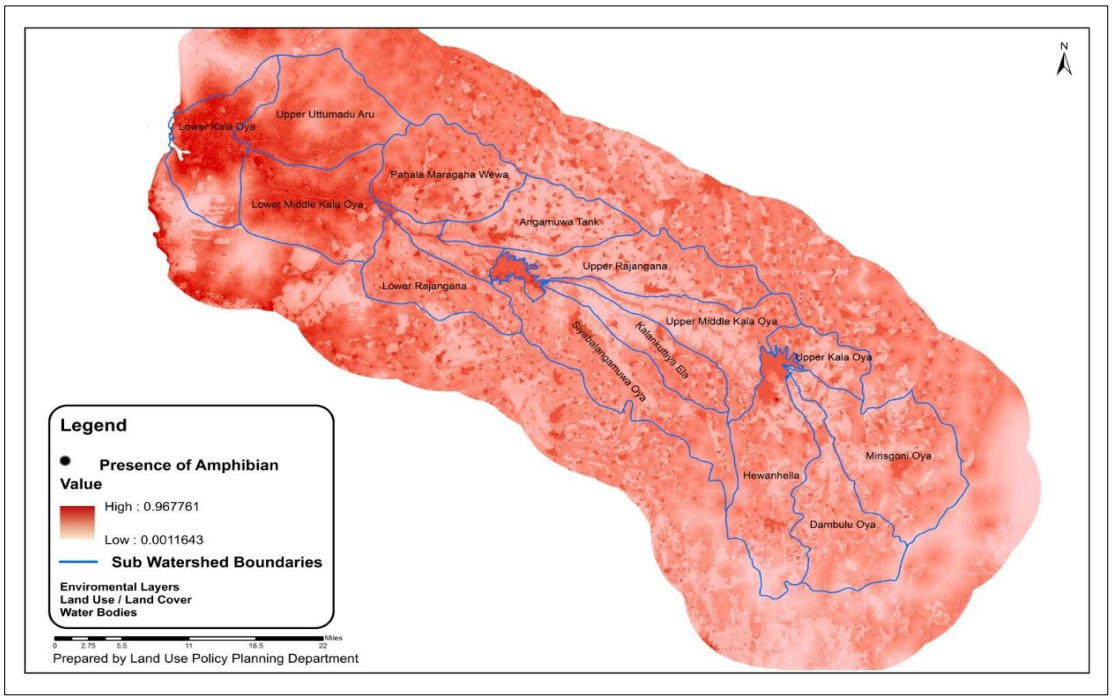


Fig.28. Indicates the habitat suitability for Amphibians derived from "Maxent"

**Birds**

Conservation status of birds in the Kala Oya Basinis shown in the Fig. 29. Majority are in the PAs and rest are close to the basin north boundary. It is necessary to aware the people on the activities that are having negative impact to the avian species and promote the suitable activities to ensure the sustenance of these species in the production lands. For an example manmade bush fire should be minimized to protect the nesting sites of the birds.

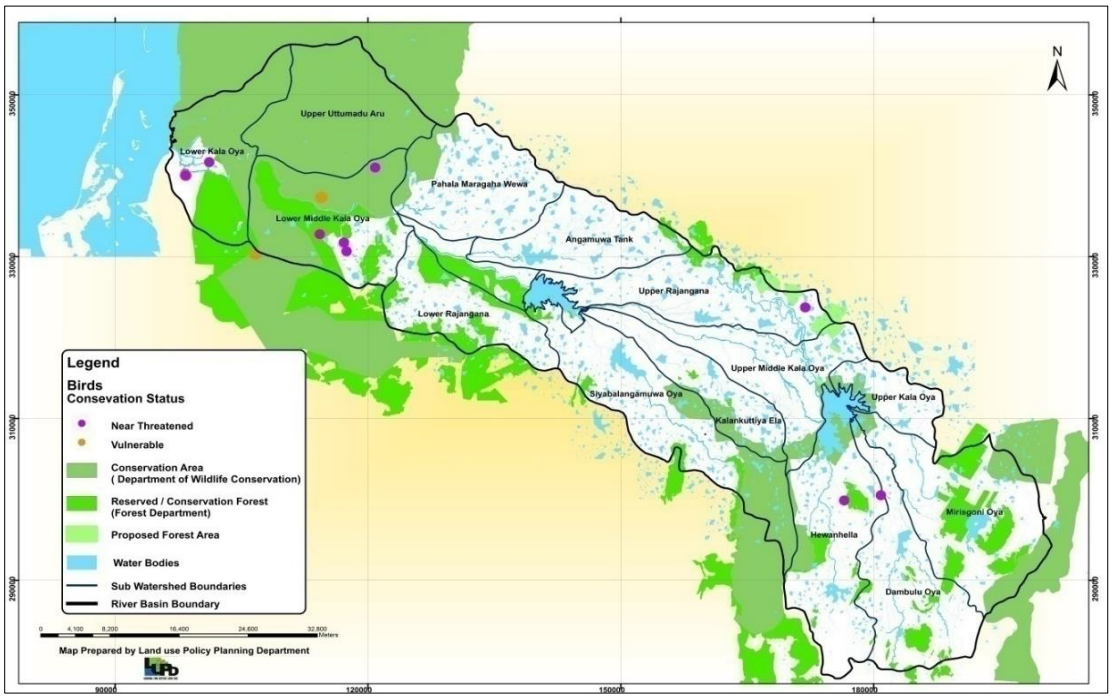


Fig. 29.Conservation status of Birds in Kala Oya basin.

**Butterflies**

Conservation status of butterflies is shown in the Fig. 30. Habitat suitability map (Fig. 31) shows that highly suitable habitats are mainly in the lower part of the basin. According to the habitat suitability map generally the entire basin is suitable for butterflies. Hence, it is needed to aware farmers on Good Agricultural Practices (GAP) to ensure the optimum use of fertilizer and agrochemicals. Further it is recommended to protect the flowering plants in which butterflies depend on their food.

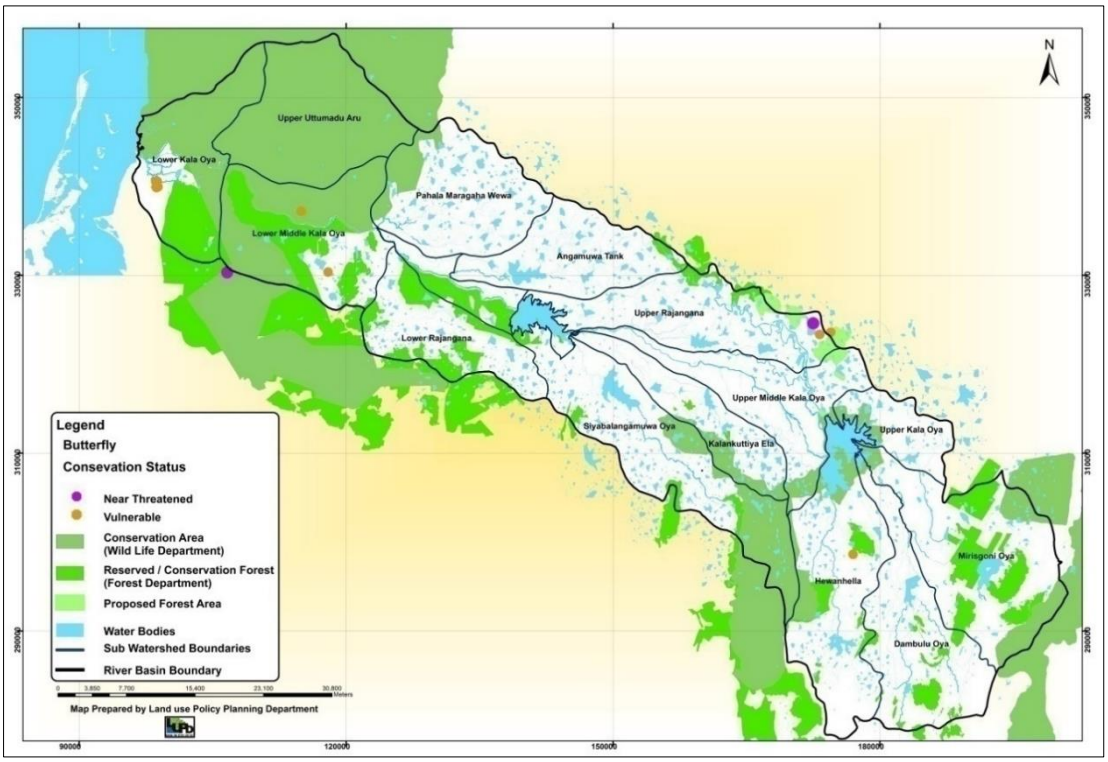


Fig. 30.Conservationstatus of butterflies in Kala Oya Basin.

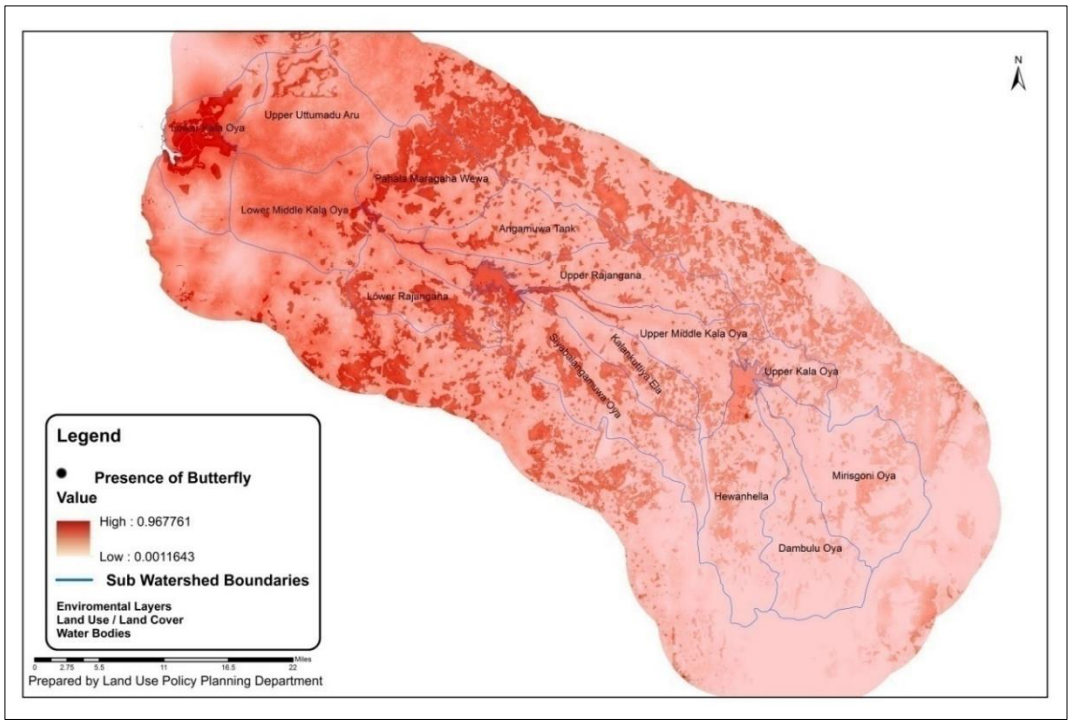


Fig. 31. Habitat suitability for butterflies in the basin

Photo 5. Existing butterfly in the basin. A Butterfly feeling on a flower

**Dragonflies**

Conservation status of the dragonflies is given in the Fig. 32. Near threatened and vulnerable species are mostly confined to the lower part of the basin. Habitat suitability map (Fig. 33) shows that highly suitable areas are located in the lower part of the basin.

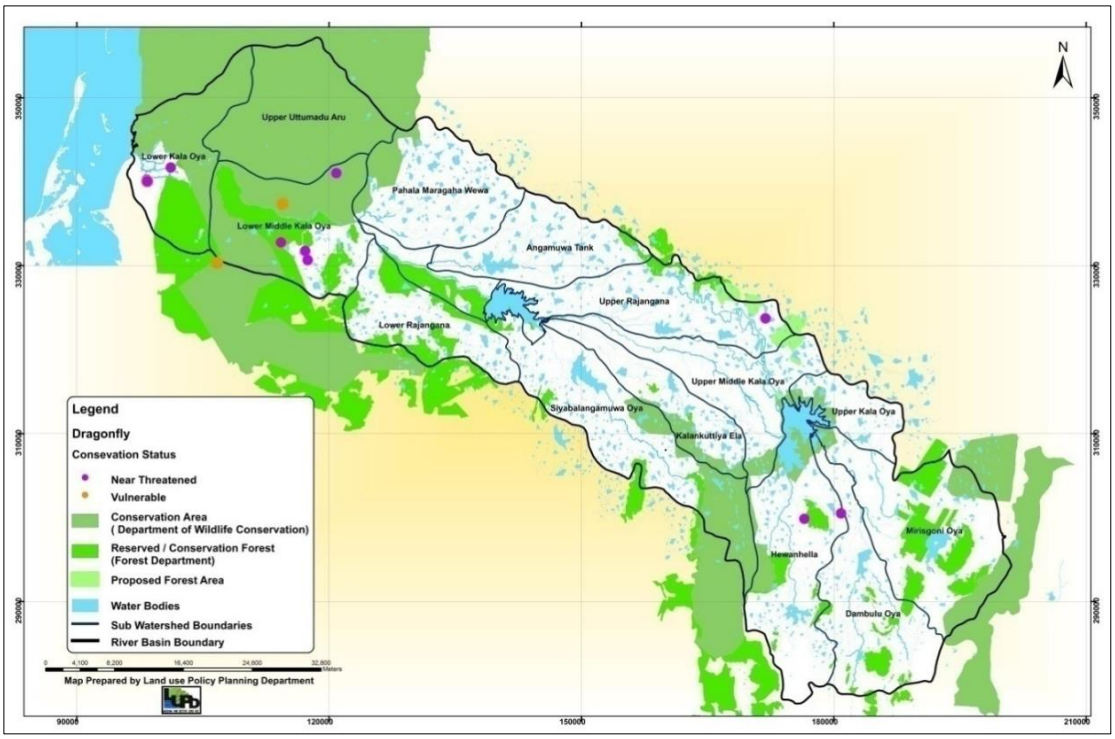


Fig. 32. Conservation status of Dragonflies in the basin

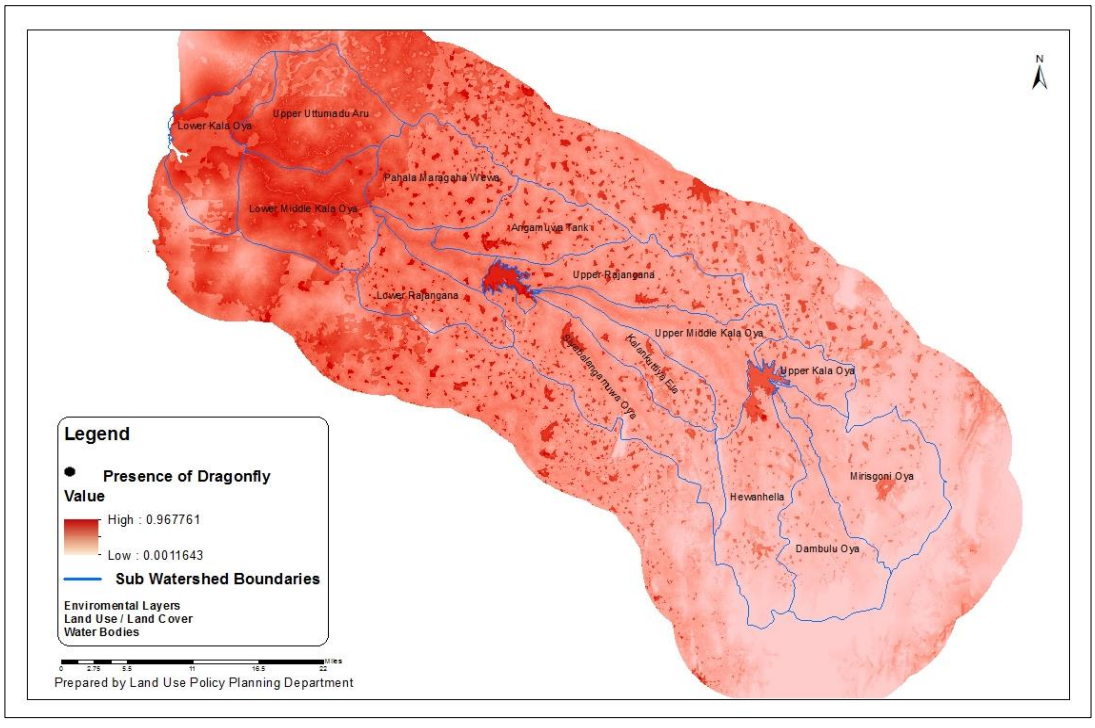


Fig. 33. Habitat suitability for Dragonflies in the basin

**Mammals**

Conservation status map of mammals (elephants, fishing cats, barking deer, jungle cats, pangolins, monkeys, leopards etc....) are shown in Fig. 34. It shows endanger, near endanger, near threatened and vulnerable species. They are available in the entire basin and more concentrated in lower part of the basin particularly within the PAs.

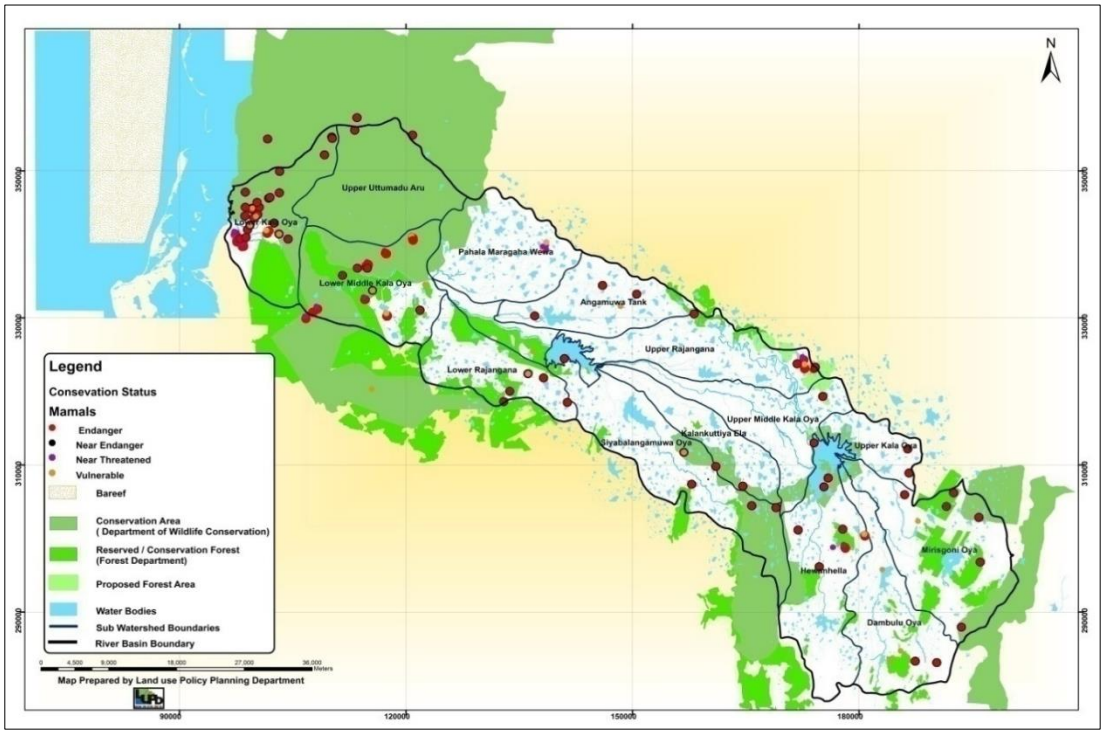


Fig. 34.Conservation status of mammals in Kala Oya basin.

**Reptiles**

Conservation status and habitat suitability of reptiles are shown in the Figures 35 and 36 given below. Habitat suitability map shows that highly suitable habitats are located in the lower part of the basin while other area is generally suitable except the small patches shown in pale red colour.

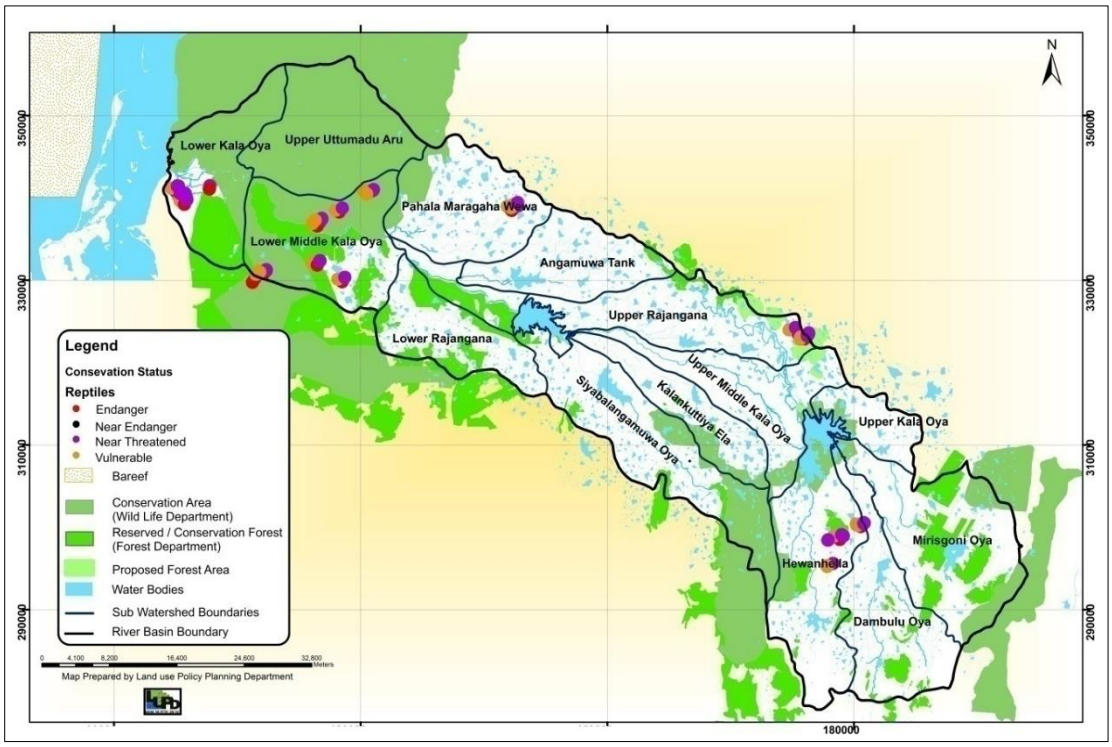


Fig. 35. Conservation status of reptiles in the Kala Oya basin

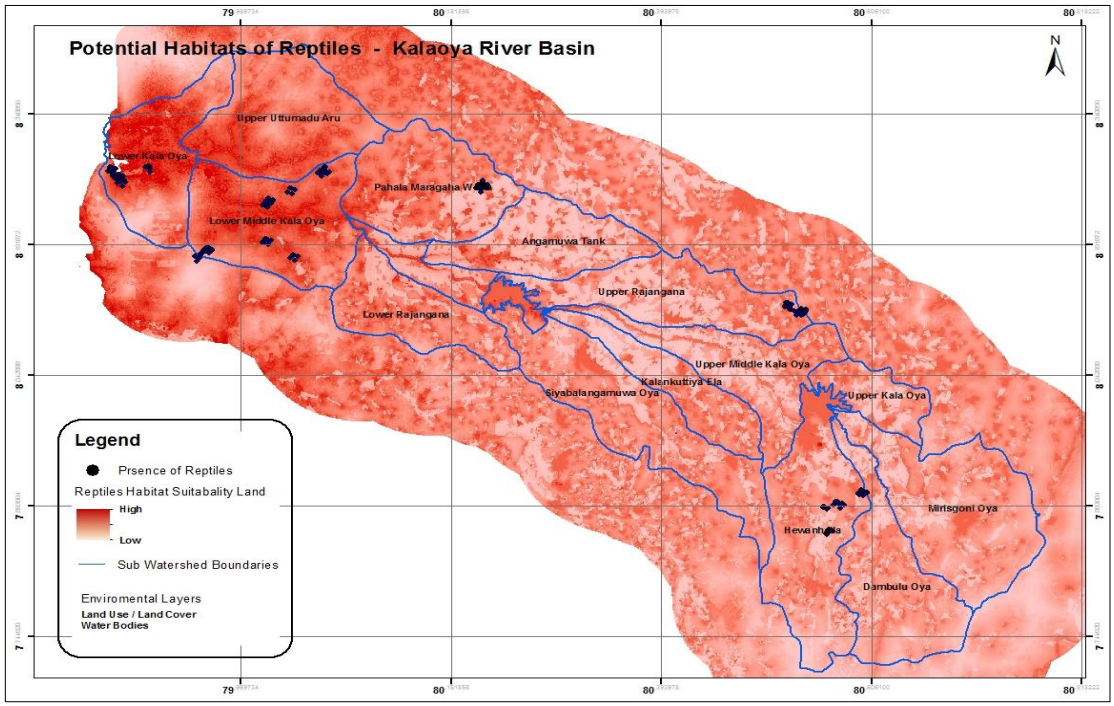


Fig. 36.Habitatsuitability of reptiles within the basin.

### Marine and brackish water fish

Near endanger species of marine and brackish water fish species are shown in Fig. 37. Most of them are found near to the river mouth and some marine fish species are in the bar reef (Fig. 38). Declaration of proposed ESAs with appropriate land use recommendations will help to protect them.

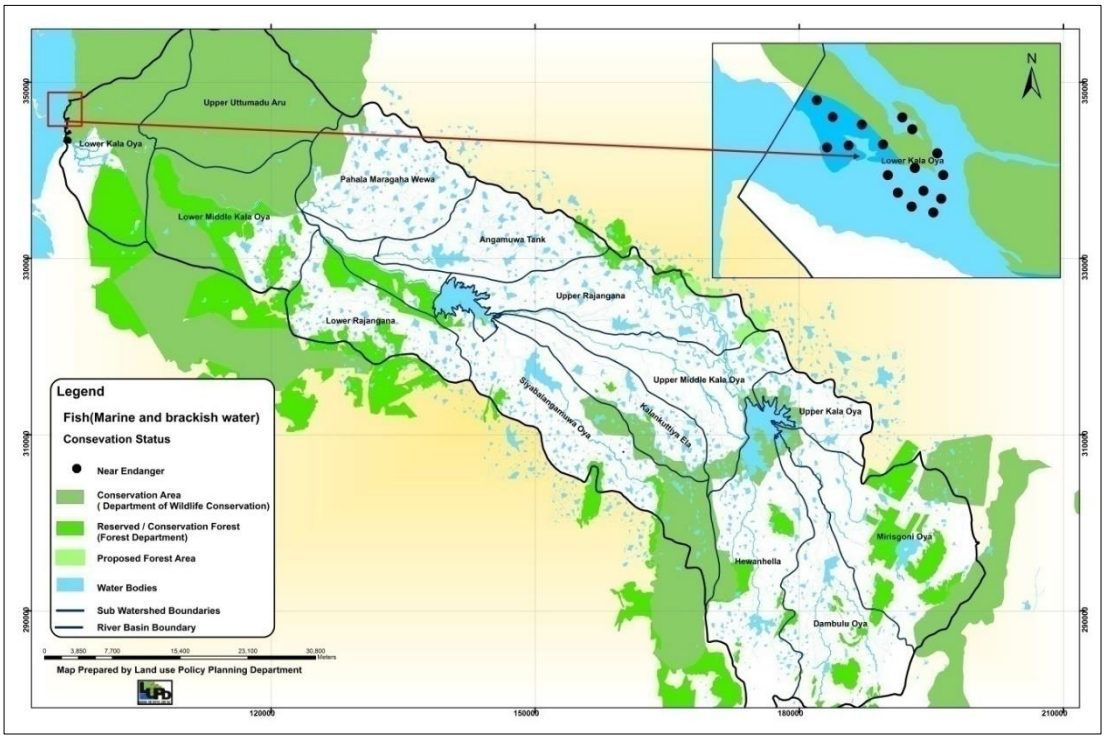

Fig. 37.Conservation status of fish species in Kala Oya basin.

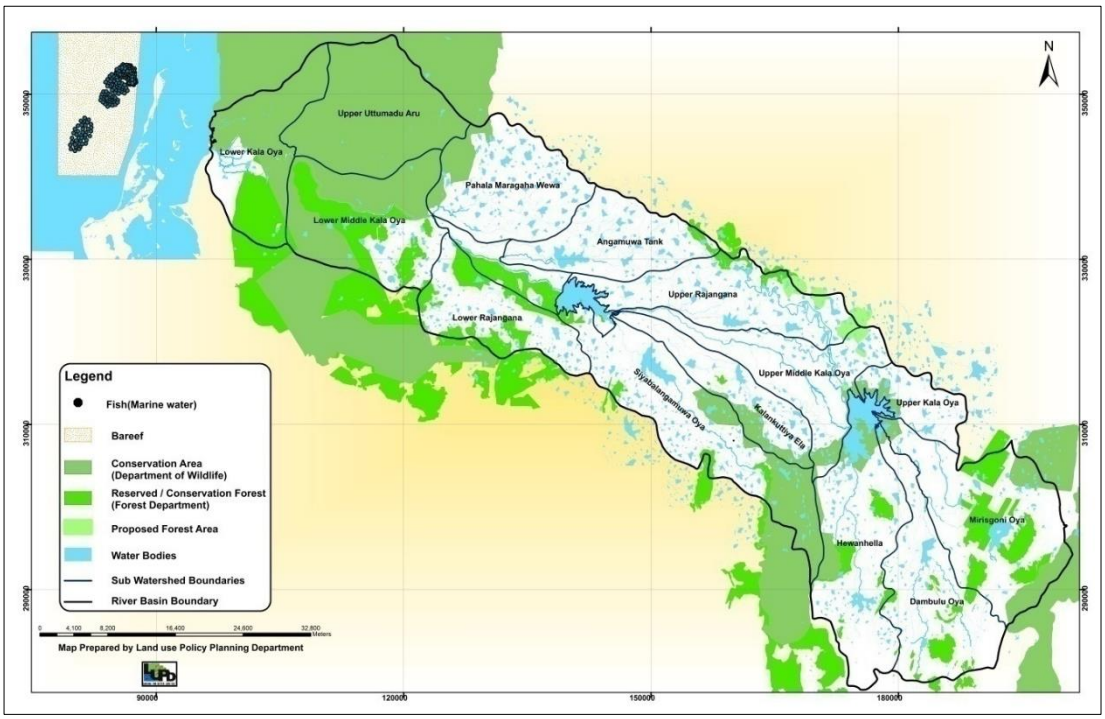

Fig. 38.Distribution of fish species in Bar Reef area.

### 4.2.7 Decision 07: Biodiversity Conservation – Species status of the flora and fauna

Species status of flora and fauna is given in the Fig. 39. Some of the species are endemic, some are indigenous, some are migratory, some are exotic and some are native. These species are generally distributed throughout the basin and as usual many species found within the PAs.

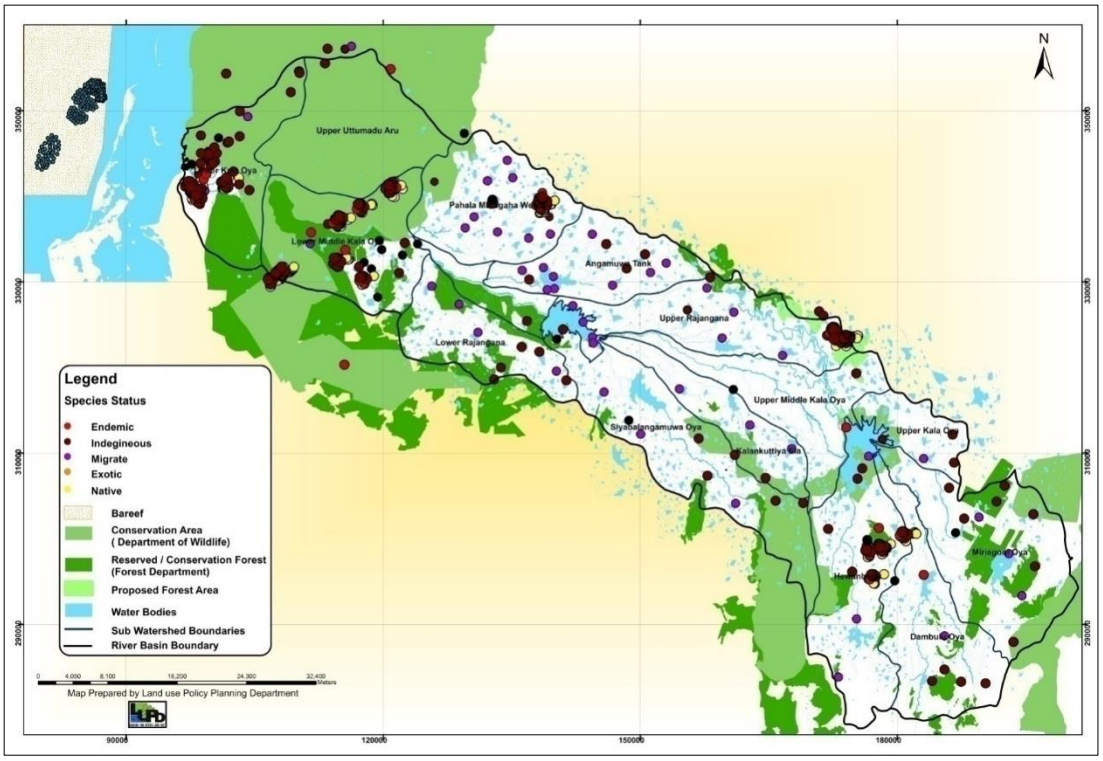


Fig. 39. Species status of flora and fauna in the basin

### 4.2.8 Decision 08: Presence of invasive species in the basin

Spreading of invasive alien species (IAS) is a common threat to the biodiversity of the country. The IAS profile data from Biodiversity secretariat shows distribution density of these species. The data mainly gathered from the area outside of the PAs and species density as high, moderate and low are shown in the Fig. 40.

Each invasion is unique, therefore specific restoration programs are required to be designed at the appropriate level. Restoring degraded areas to their proper ecological function would prevent infestations from IAS or to prevent reoccurrence after their removal. Therefore, adoption of restoration concepts to manage the impacts of IAS on an ecosystem is a critical component of a fully functional invasive species control program. Therefore, implementation of strategies given in the National Invasive Alien Species Policy is important to eradicate IAS from the basin.

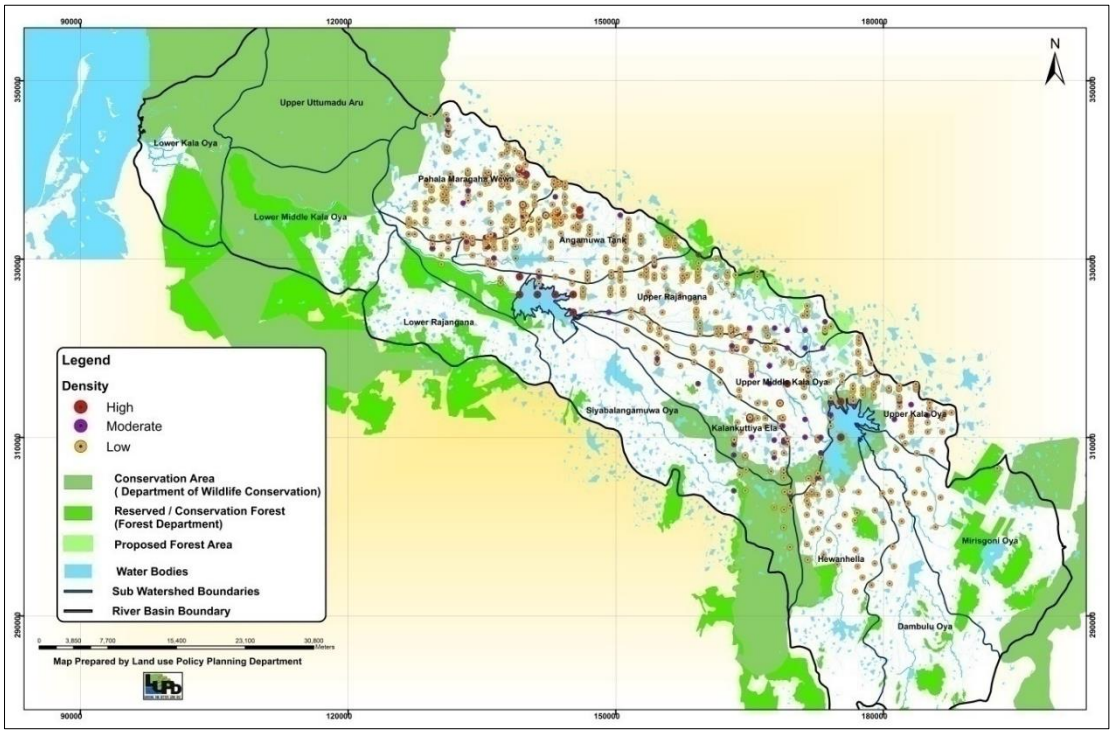


Fig. 40. Density of invasive species within the Kala Oya Basin (Source: Invasive Alien Species profile of the North-Central Province & North Western Province

### 4.2.9 Decision 09: Presence of crop wild relatives in the basin

Genetic erosion of wild relatives of crops in Sri Lanka has been occurring rapidly in natural habitats mainly due to the human interference. These wild species are regarded as actual or potential genetic resources for future use. Hence it is important to develop an *in-situ* conservation programme to conserve this wild species. The data collected under the Crop Wild Relatives Conservation Project were used to prepare a map (Fig. 41) showing their distribution within the Kala Oya basin. According to the data it is revealed that mainly *Oryza*wild relatives are available within the basin and nearby. In addition, some *Vigna* species are also found in the basin. The genus *Oryza* consists of 22 species worldwide out of which only two species are cultivated and rests remain as wild. Five wild rice species and one *Oryza* related genera present in Sri Lanka.[29]In the Kala Oya Basin and adjacent area, three wild rice species were identified. According to the Liyanage, *Oryzanivara* named as "Uru Vee in Sinhala is widely distributed in Sri Lanka while *Oeichingeri* is the species only reported in Asia and Africa. Both these species are found in the basin and the adjacent area.

It is very important to conserve this natural gene pool for future use with the participation of the community in the area. Burning of forest patches, clearing of natural vegetation, use of weedicides may adversely affect these species causing extinction from their habitats. However, people do not have any intension to protect this wild rice species both due to unaware of its genetic significance and due to

[29]Liyanage.A.S.U. 2010.Eco-geographic survey of crop wild relatives. Crop wild relatives conservation project. Department of Agriculture

invasion as a weed in rice fields. Therefore, it is important to aware the community about the significance of this wild relatives of crops. Further, it is necessary to identify the suitable areas where these wild relatives can be conserved *in-situ.*

Since people will not get any benefit by protecting these wild species, an incentive driven mechanism should be introduced to conserve these wild relatives of crops. However, there is a problem of cross pollination with rice cultivars, if these wild species are allowed to spread near to paddy fields. Therefore, it is recommended to confine these wild species to areas which are located adequately away from paddy lands in order to avoid cross pollination. Further development of *ex-situ* conservation of these varieties may solve the above issues in the field.

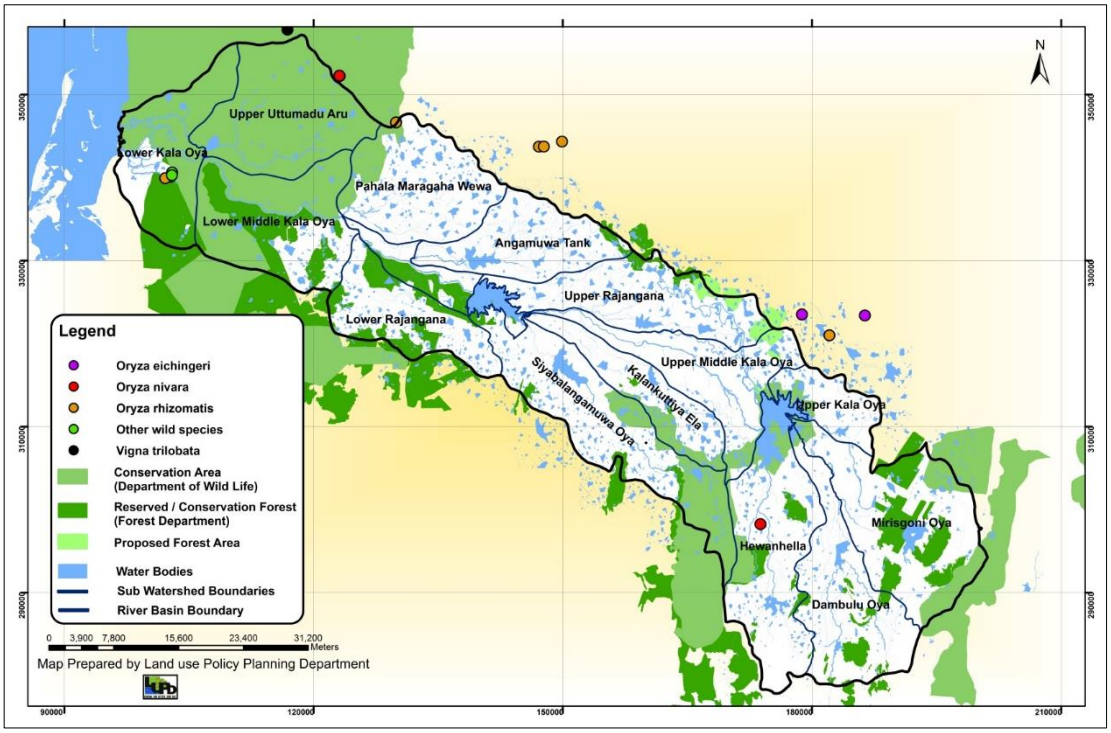


Fig. 41.Presence of crop wild relatives in Kala Oya Basin.

### 4.2.10 Decision 10: Agricultural capability of highlands and land use recommendations

Lands can be classified according to their agricultural capability based on the limitations such as slope, soil depth, rockiness, drainage condition etc..[30] An attempt was taken to classify the area within the basin mainly based on their gradient. Paddy lands were excluded for this classification.

In USDA classification there are eight capability classes were identified based on the severity of the limitations for crop production of the land. In this classification the land Classes from I to IV are having high agricultural capability in decreasing order while classes from V to VIII don't have capability for cropping so they are suitable for other uses such as agro-forestry, grazing, forestry, wildlife conservation etc.

In this exercise only four classes were identified based mainly on the topography which is shown in the Fig. 42. The land units from 1 to 4 are having the agricultural capability in decreasing order. For an example unit 1 shows the higher agricultural capability while unit 4 shows very low capability for cropping. Hence, areas belong to unit 3 and 4 could be used for conservation forestry to ensure the sustainability of the land resource. However, areas belong to unit 1 and 2 also should be used for cultivation with minimum soil disturbances to avoid soil erosion and land degradation.

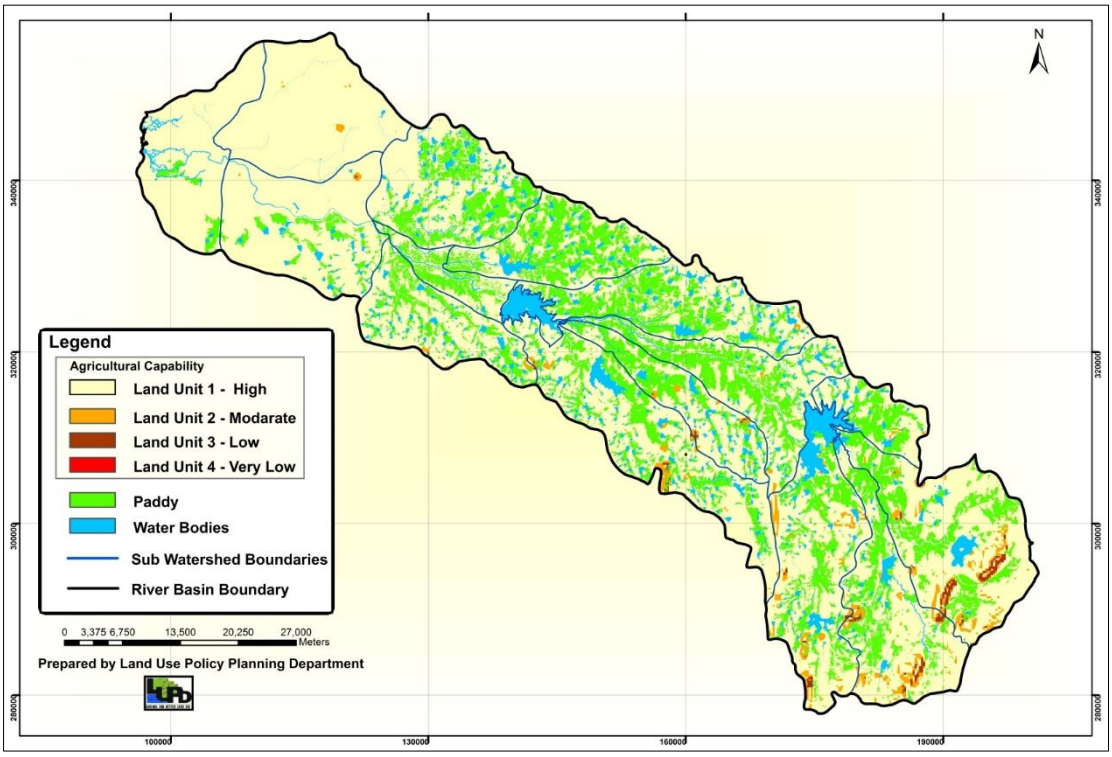


Fig. 42. Agricultural capability of the basin.(Units are not clear enough due to scale factor)

[30]Klingebiel, A.A. and P.H. Montgomery. 1961. Land capability classification. USDA Agricultural Hand Book p.210.

### 4.3 Proposed Land Use Plan for Kala Oya Basin

Based on the above decisions, a land use plan was prepared by demarcating six major areas (Fig. 43). These areas need different land use management options to ensure the sustainability of exiting biodiversity and other natural resources including lands. Protected areas both currently protected and proposed areas should be managed by relevant agencies according to the separate management plan. Identified ESAs need special attention because of their biodiversity significance and existing issues/threats. Therefore, ESAs considered as a separate unit/zone. ESAs include both private and state lands. The recommendations formulated by considering both conservation and production aspects for different land use types in ESAs.

Special Land Use Zone, which needs some land use regulatory mechanism under prevailing law, also identified in the basin. This zone is having both state and privately-owned lands. Hence, it is necessary to draw up an effective mechanism with the community participation to implement proposed activities.

Areas that are situated outside of the ESAs used for cultivation, residential purposes and urban uses are very important in terms of productivity. However, these areas are highly influenced by human activities which may lead to degradation of particular ecosystems. Hence, these areas were identified as a separate zone in the land use plan. It is therefore necessary to implement the given recommendations to ensure the sustainability.

Middle part of the Kala Oya Basin is sandwiched by PAs located at lower and upper part of the basin. These PAs are connected by isolated and scattered forest patches and other land uses. Elephants mainly in the PAs are moving in between PAs by crossing these scattered forest patches and cultivated areas. Hence, human-elephant conflict has significantly increased in the middle part of the basin. Identification of human-elephant coexistence zone is important for land use plan to implement viable measures to reduce this conflict.

**1) Protected Area**

Presently Protected Area

*This area is already protected by law. The area should be managed by respective agencies according to the Protected Area management plan.*

Proposed Area for Protection

*This area has been proposed to declare as PA, by Department of Forest Conservation. Once it declared it will come under PA.*

**2) Environmental Sensitive Area**

*Proposed Environmental Sensitive Area s where special attention is needed to ensure the BD conservation. The existing uses need not to be changed completely, unless there are inappropriate uses are available. However, present uses should be improved to ensure the biodiversity conservation. Existing farming practices should be improved in eco-friendly manner. Any form of deforestation should be avoided. At least, extent of present forest cover should be maintained. All these activities including demarcation of the area boundary need to be carried out with the strong participation of land users within the ESA. Establishment of several ESA management village committees may be a viable option to ensure the proper management. The ecosystem services that are sustained by manging the ESAs should be highlighted and demonstrated to convince the people living in the ESAs.*

**3) Special Land Use Zone**

*Areas where land use restrictions are to be imposed (e.g.Buffer zones and stream reservations). The existing law should be properly imposed to the areas where applicable. For other areas, people participation should be obtained to improve the land uses to ensure the BD conservation. Alternate livelihood options (e.g. eco-tourism and associated livelihood activities) should be identified for the people who are living in this area to minimize /avoid threats to this area.*

**4) Agricultural areas outside of the ESAs that can be continued with eco-friendly manner**

*The extent of this area is comparatively large and contribution for the economy is high. The area includes both paddy cultivation and highland farming. However, the present practices are more erosive form and need to be improved by proper training and awareness creation. An incentive driven mechanism should be identified to promote the ecological farming among the community.*

**5) Urban &Residential areas outside of the ESA**

*Further expansion has to be restricted and vertical expansion of housing should be encouraged where ever possible. Urban area development should be followed the urban area plans prepared by UDA and MASL.*

**6) Human-elephant co-existence zones where special elephant management measures to be introduced**

*This zone must be managed by implementing strategies of the National Policy on Elephant conservation. Main aim of identifying and managing these zones is to minimize the human-elephant conflict that is prevailing in this area. However, more site specific research needs to be carried out in these zones to identify appropriate measures to keep the elephants away from human habitats.*

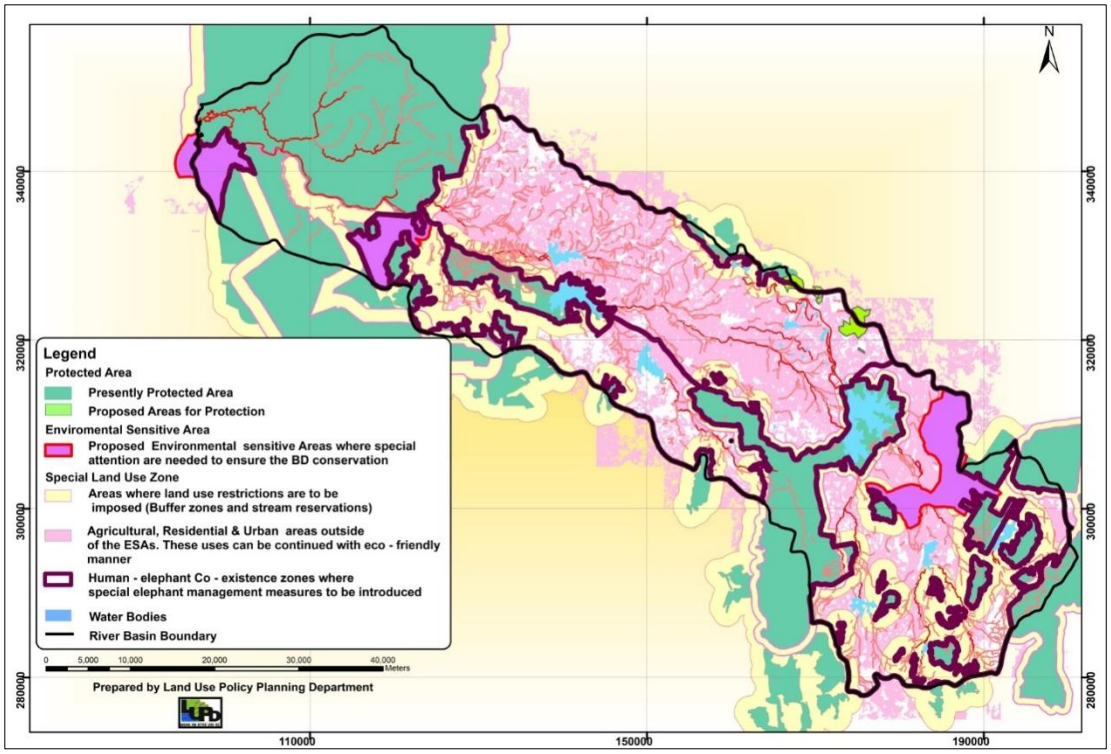

Fig.43: Proposed land use plan for Kala Oya Basin

## 4.4 Land Use Recommendations for proposed ESAs and other Special Land Use Zones (SLUZs)

The ESAs need special management with the participation of the people to ensure the biological diversity conservation particularly outside the PAs. ESAs may have different land uses and land cover at present. Some of the current land use practices may be created negative impact to the sustenance of the biodiversity. It is therefore necessary to implement suitable land use options to protect the biodiversity while ensuring sustainability of economic activities.

The land use recommendations given in the Table 8 are rather wide and general in nature. But it provides a guideline to formulate more specific and practical recommendations with the help of other technical agencies and the land users. Impact of the implemented recommendations should be monitored continuously in order to recommend them for other sites/river basins with similar situation.

**Table.13. Land Use Recommendations for proposed ESAs and other SLUZs**

| Proposed Environmental Sensitive Area, Special land use zones (SLUZs) and other areas | | Major Issues/threats | Recommendations to improve the land use and land cover and minimize the other harmful activities | Responsible Agencies for implementations | Supporting Agencies |
|---|---|---|---|---|---|
| ESAs | ESA01 Villus | a)Encroachment of villus area for cultivation of perennial crops (coconut) by the people who are using the surrounding lands.<br>b) Filling of villus area due to cutting of large drains (to prevent the elephant movements).<br>c) Use of villus for cultivation by the people who are living in the nearby settlements.<br>d) Encroachment of the villus for settlements.<br>e) Some of the villus converted to tanks.<br>f) Land ownership issues created several threats including encroachments.<br><br>g) Destroy the vegetation on villus by fire.<br>h) Over use of agrochemicals for cultivation have negative impacts on vegetation and biodiversity in villus. | Impose the existing laws/regulations to prevent encroachments.<br>Promote income generating activities other than agriculture to reduce the pressure on lands.<br>Design the drain properly to prevent the filling of villus or otherwise explore other possible alternatives to prevent the wild elephant movements towards to settlements/cultivated lands.<br>Awareness creation among the people.<br>Promote conservation-oriented livelihood activities.<br>Introduce alternatives for firewood.<br>Prevent illegal fishing gears and explore the alternative livelihood options<br>Introduce actions to conserve mangrove vegetation.<br>Organize programmes to solve land issues.<br>Establish vigilant groups to prevent bush fire and other harmful activities.<br>Organize programmes to introduce GAP in order to minimize the use of agro-chemicals.<br>Design a programme to reward the people economically by giving guaranteed/better price for their agricultural products as they support to protect the existing environment (e.g. through GAP certification). | Divisional Secretariat<br>Department of Forest Conservation,<br>Department of Wildlife Conservation.<br>Provincial Department of Agriculture.<br>Coconut Cultivation Board<br>Provincial Land Commissioner's Department<br>Department of Agrarian Development. | Natural Resource Management Centre (DOA)<br>LUPPD<br>Small Enterprises Development Division<br>Relevant Private sector organizations |

| | | | | | |
|---|---|---|---|---|---|
| | | i) Silting of villus due to soil erosion. | Introduce soil and water conservation programmes to reduce land degradation.<br>Organize programmes to monitor the status of the soil health and take actions accordingly. | | |
| | ESA02<br>Gage Vadiya | a) Frequent climate disasters (Drought and Floods)<br>b) Various activities carried out by local tourists that have negative impacts to the environment.<br>c) Over grazing by stray animals.<br>d) Unmanaged sand mining.<br>e) Illegal fishing gears.<br>f) Destruction of mangrove vegetation for various purposes.<br>g) Solid waste pollution. | Aware local tourists by various measures the significance of the particular environment (e.g. by erecting sign boards, forming vigilant groups etc.)<br>Impose the existing laws/regulations to prevent<br>- Encroachments.<br>- Use of Illegal fishing gears<br>- Destruction of mangrove vegetation<br>- Hunting and poaching<br><br>Explore possible alternatives for firewood to minimize the destruction of mangroves | Divisional Secretariat<br>Provincial Council<br>Department of Wildlife conservation | |

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|---|---|---|---|---|---|
| | ESA03 Vevalkele | a) Encroachments for settlements, cultivation of perennials (coconuts) and seasonal crops.<br>b) Unmanaged cane cutting and setting fire to facilitate the cutting of cane.<br>c) Hunting and poaching.<br>d) Make the area dry by cutting ditches to facilitate the cane harvesting.<br>e) Trend to reactivate the extraction of clay. | Design a proper program to extract the cane in sustainable manner.<br>. Impose the existing laws/regulations to prevent<br>- Encroachments of forest lands<br>- Hunting and poaching | Provincial Land Commissioner's Department<br>Divisional Secretariat<br>Department of Forest Conservation<br>Community groups<br>CEA | |
| | ESA 04 Manewakanda | a) Encroachments of forest lands<br>b) Spreading of Invasive Alien Species (IAS)<br>c) Forest fire<br>d) Hunting and poaching<br>e) Drought<br>f) Mono-cropping with unsustainable use of fertilizer and agro-chemicals. | Impose the existing laws/regulations to prevent<br>- Encroachments of forest lands<br>- Hunting and poaching<br><br>Organize programmes to introduce GAP in order to minimize the use of agro-chemicals.<br>Establish vigilant groups to protect the area.<br>Make arrangements to eradicate IAS | Department of Forest Conservation<br>Provincial Department of Agriculture<br>Divisional Secretariat<br>Community Groups/Farmer organizations<br>CEA | |
| | ESA 05 Riverine | a) Encroachments mostly for seasonal cropping<br>b) Settling on flooding area<br>c) Water pollution<br>d) Hunting and poaching<br>e) Over use of agro-chemicals | Find out alternate lands to evacuate the people those who are settled in the spill way.<br>Make a program to maintain riverine vegetation with the participation of the people. | Department of Irrigation<br>Provincial Land Commissioner's Department<br>Provincial Agriculture Department<br>MASL | |

| | | | | | |
|---|---|---|---|---|---|
| **SLUZs** | River and stream reservations | Sand mining<br>Encroachments<br>Deforestation | For state lands; Protect the existing vegetation, prevent encroachments and eject existing encroachments.<br>For private lands; Incentive driven activities introduced to protect the river bank using participatory approach. | Divisional secretariat<br>Irrigation Department (Provincial and Central)<br>Forest Department<br>Agriculture Department (Provincial)<br>CEA<br>Farmer Organizations/CBOs/NGOs | |
| | Buffer zones of the PAs including the BZ of Bar reef. | Illegal fishing gears<br>Poaching<br>Deforestation<br>Encroachments<br>Unmanaged tourism | These areas need special provisions to ensure the conservation and social wellbeing of the community.<br>Restrict the development activities.<br>Minimize the use of agro-chemicals and promote agroforestry.<br>Restrict the destructive fishing<br>Manage the tourists<br>Avoid deforestation | Forest Department<br>Dept. of wild life conservation (DWLC)<br>Provincial Dept. of Agriculture.<br>CEA<br>Ministry of fisheries | |
| | River mouth and the associated habitats | Dumping of waste materials<br>Sand mining<br>Destruction of mangroves | Implement the activities based on the provisions given in state land ordinance, coast conservation Act, F&FPO, FO etc. to ensure the biodiversity of the area. | Forest Department<br>Coast Conservation Department.<br>Ministry of fisheries<br>DWLC | |

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| **SLUZs** | Human-elephant coexistence zones | Destruction of forest patches<br>Develop threats to elephants<br>Expansion of cultivation into forest areas | Village fencing, corridor conservation, tank restoration, maintaining fallow vegetation/ grazing fields for animals. | DWLC<br>Provincial Irrigation Department<br>Department of Agrarian Development<br>Provincial Department of Agriculture | |
| | Small tank habitats | Clay extraction<br>Deforestation<br>Encroachments | Minimize the use of agro-chemicals, introduce GAP.<br>Promote alternate livelihoods | Provincial Department of Agriculture<br>Department of Agrarian Development. | |
| Agricultural areas outside of the ESAs | Paddy | Over use of agro-chemicals<br>Over use of inorganic fertilizer.<br>Water management issues | Introduce GAP/IPM<br>Promote use of organic fertilizer and botanic pesticides.<br>Awareness creation | Department of Agrarian Development<br>MASL<br>PDOA | |
| | Highlands | Over use of agro-chemicals<br>Moisture stress<br>Soil erosion | Introduce GAP<br>Promote moisture conservation<br>Introduce soil conservation | PDOA<br>MASL | |
| Settlements & Urban uses outside of the ESAs | | Expansion of these areas into forest areas<br>Pollution due to plastic and other materials<br>Fragmentation of lands into small unproductive units<br>Population pressure on lands | Promote vertical expansion where ever possible.<br>Land suitability evaluation need to be introduced for future expansion. | UDA<br>Housing Development Authority<br>MASL | |

### 4.5 Production and conservation targets

The following production and conservation targets are proposed for Kala Oya Basin to ensure the sustainable use of land resources while conserving biodiversity.

1. Land use in 4000 ha of lands (roughly) located within the reservation of the Kala Oya and its tributaries proposed to be regulated by using participatory approach.

2. Lands located in peripheries of PAs (Buffer zones) proposed to manage with the participation of local communities to ensure the protection of PAs. 70% of the land area of the buffer zones will be managed by participatory approach.

3. GAP has to be introduced to paddy lands and other agricultural land uses to minimize the use of agro chemicals and inorganic fertilizers. GAP will be introduced to 70% of paddy lands and 50% of high lands that are used for cultivation.

4. Fifty percent (50%) of the underutilized home gardens has to be developed to ensure the good vegetative cover and productivity. Other components like bee keeping, rearing livestock need to be introduced.

5. Extent of the mangrove vegetation available at river mouth has to be maintained at least at present level. Natural regeneration of mangroves is to be promoted with appropriate programmes.

6. Invasive alien species have to be eradicated by appropriate programmes, particularly in buffer zones, river reservations and ESAs.

7. Approximately 181,910 ha of lands has to be maintained as human-elephant coexistence zone by introducing appropriate strategies to minimize the human-elephant conflict.

8. Catchment areas of large and small water bodies have to manage to ensure the sustenance of these water bodies. Connectivity of components of the small tank cascades will be ensured and developed.

9. Forest lands located outside of the PAs in scattered manner have to be maintained. These forest patches are in ESAs and outside of the ESAs. Connectivity of these forest patches should be ensured as much as possible.

10. A proper protective mechanism need to be introduced to protect the bar reef and associated ecosystem.

11. Farmers particularly those who are living in the ESAs have to be trained on IPM and GAP.

12. Fifty percent of the farmers will be made aware about the management of ESAs by using effective and people friendly mechanisms.

### 4.6 Implementation mechanism and monitoring

Implementation of the activities recommended in this plan should be done using participatory approach. Committees consisting village people should be established to implement the activities. These committees can develop small projects to ensure BD conservation and economic wellbeing of the people. Progress of the activities can be monitored at DSD level by respective DSs.

### 4.7 Future research needs

It is needed to review the current policies and legislations to identify the gaps in terms of biodiversity conservation. Research should be extended to cover the aquatic habitat both marine and fresh water and terrestrial habitats. Site specific research on corals is needed to make appropriate recommendations to restore the reef.

There is an ample room for agricultural research to ensure the optimum production while conserving the biodiversity. Mainly research on GAP is needed and should be tested in farmer's field to examine their adaptability. Research can be extended to the fields such as soil and moisture conservation, irrigation and water management, IPM, development of botanic pesticides etc. Research can be introduced to modify the participatory approaches to suit the local situation.

Further, socio-economic research is needed to identify the effective mechanisms to encourage the people to protect ESAs. It is necessary, because people who are living within the ESAs may not have much interest in protecting the area, purely based on the biodiversity. Therefore, it is needed to identify reasons other than biodiversity that may link with the environmental services. By identifying those reasons, people can be motivated by briefing the economic and other benefits which will be obtained by them due to the protection of ESAs. Since the benefits are usually obtained in long run, it is better to introduce incentive driven mechanism to protect the ESAs.