Vembanad-Kol Wetland: Integrated Management Plan for Conservation and Wise Use

KSCSTE - CWRDM

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Wetlands International South Asia

Wetlands International South Asia is the South Asia Programme of Wetlands International, a global organization dedicated to conservation and wise use of wetlands. The organization's mission is to sustain and restore wetlands, their resources and biodiversity. Wetlands International South Asia provides scientific and technical support to national governments, wetland authorities, non government organizations, and the private sector for wetland management planning and implementation in South Asia region. It is registered as a non government organization under the Societies Registration Act and steered by eminent conservation planners and wetland experts.

Centre for Water Resources Development and Management

The Centre for Water Resources Development and Management is an autonomous research organization serving as a Centre of Excellence for the Government of Kerala. Established in 1978 under the government's Science and Technology Policy, research undertaken pertains to subjects as ground water, surface water, water management, water quality, isotope hydrology and geomatics. It's Research Council comprises of members from government departments, NGOs and academic institutes.

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PREFACE

The State Wetland Authority Kerala (SWAK) was established under G.O (P) No. 17/2015 dated 30.11.2015, in accordance with the Wetlands (Conservation and Management) Rules of 2010. Subsequently, the Wetlands (Conservation and Management) Rules of 2017 replaced the earlier regulation. As per these directives, SWAK operates with the Minister for Environment (also the Chief Minister in Kerala) as the Chairman, the Chief Secretary as Vice Chairperson, and the Director of Environment and Climate Change as the Member Secretary, functioning as the state's pivotal agency for the management and conservation of wetlands. Its responsibilities encompass policy development, regulatory frameworks, integrated management, planning, action plan implementation, capacity building, research, networking, communication, awareness creation, and fundraising for wetland management within the state.

Initially, the Integrated Management Plan (IMP) for the VKW complex was developed by SWAK in collaboration with Wetlands International South Asia (WISA) and the Centre for Water Resource Development and Management (CWRDM) in 2017. Approved by the Ministry of Environment, Forest and Climate Change, the plan received the first-year installment in 2018 under the Centrally Sponsored Scheme - National Plan for Conservation of Aquatic Ecosystems (NPCA). Significant components included the Wetland Inventory Assessment and Monitoring System (WIAMS), WIAMS Web-portal & Mobile App, alternative livelihoods for clam collectors, and extensive Communication Education Participation and Awareness (CEPA) activities carried out over five years.

Despite approval and an initial fund release of Rs. 140.75 lakhs in March 2018, SWAK encountered impediments in implementing the entire plan due to issues with fund flow mechanisms, staff shortages, and COVID-19 restrictions. However, the Integrated Wetland Inventory, Assessment, and Monitoring System (WIAMS) was successfully implemented through CWRDM, yielding valuable bimonthly water & sediment quality monitoring data. Accompanying this, a national seminar was held in 2023, and the Kerala Agricultural University initiated the annual water bird census in the same year, making progress with monthly field observations. Noteworthy achievements include the development of a mobile app-integrated web portal for wetland monitoring across three Ramsar sites, Sustainable Clam Cultivation in Vembanad Estuary by ATREE-CERC, Wetland Mitra training programs, World Wetlands Day events, and Ramsar Signage installations.

Following the expiration of the previous IMP and guided by the recommendations from the 3rd report of the Amicus Curie at Kerala High Court in the Balakrishnan vs Union of India suit, SWAK has undertaken a plan revision. This updated plan aims to directly benefit the dependent communities of the Wetland by incorporating new guidelines from the NPCA scheme. Given the complexity of the wetland's size and diverse ecosystems, extensive consultations and one-to-one interactions were conducted, forming the backbone of this revised, dynamic plan based on adaptive management principles. SWAK acknowledges and extends gratitude to WISA and CWRDM for their timely completion of the project.

Thiruvananthapuram, Kerala
March, 2024

Member Secretary,
State Wetland Authority, Kerala

Abbreviations

AC	Alappuzha-Changanassery Road
AD	Anno Domini
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
amsl	Above mean Sea level
ATREE	Asoka Trust for Ecology and Environment
AUGES	Ayyankali Urban Employment Guarantee Scheme
BFD	Base Floor Depth
BHC	Benzene hexachloride
BOD	Biological Oxygen Demand
BP	Before Present
BSI	Botanical Survey of India
CaO	Calcium oxide
CARE	Cooperative for Assistance and Relief Everywhere
Cell/l	Cells per litre
CARMC	Centre for Aquatic Resource Management & Conservation
CBO	Community Based Organisation
CDOM	Coloured Dissolved Organic Matter
CERC	Community Environment Resource Centre
CEPA	Communication, Education, Participation, and Awareness
CETP	Common Effluent Treatment Plant
CGWB	Central Ground Water Board
CMFRI	Central Marine Fisheries Research Institute
COD	Chemical Oxygen Demand
CPHEEO	Central Public Health and Environmental Engineering Organisation
CR	Critically Endangered
CRZ	Coastal Regulation Zone
CSO	Civil Society Organisation
Cusec	Cubic feet per second
CWC	Central Water Commission
CUSAT	Cochin University of Science and Technology
CWPRS	Central Water and Power Research Station
CWRA	Central Wetland Regulatory Authority
CWRDM	Centre for Water Resources Development and Management
^{0}C	Degree centigrade
DD	Data Deficient

DDT	Dichlorodiphenyltrichloroethane
DEM	Digital Elevation Model
DPR	Detailed Project Report
DO	Dissolved Oxygen
DTPC	District Tourism Promotion Council
EN	Endangered
ET	Evapotranspiration
ETM	Enhanced Thematic Mapper
ETP	Effluent Treatment Plant
FMC	Fisheries Management Committee
FSTP	Faecal Sludge Treatment Plant
FAO	Food and Agriculture Organization
g/m2	Gram per square meter
gC/m3/day	Gram carbon per cubic meter per day
GHG	Green House Gases
GI	Geographical Indication
GIS	Geographical Information System
GoK	Government of Kerala
GSDP	Gross State Domestic Product
Ha	Hectare
HSW	Hydrographic Survey Wing
IBA	Important Bird Area
ICMAM	Integrated Coastal and Marine Area Management
IDRB	Irrigation Design and Research Board
IFRM	Integrated Fishery Resource Management
IIT	Indian Institute of Technology
IMD	India Meteorological Department
IMP	Integrated Management Plan
IPRD	Integrated Programme for Rice Development
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
K_2O	Potassium oxide
KAU	Kerala Agriculture University
KERI	Kerala Engineering Research Institute
KFRI	Kerala Forest Research Institute
KIIFB	Kerala Infrastructure Investment Fund Board
KILA	Kerala Institute of Land Administration

KIITS	Kerala Institute of Tourism and Travel Studies
KLD	Kilo Litres per Day
KLDC	Kerala Land Development Corporation
kg	Kilogram
km	Kilometer
km/hr	Kilometer per hour
km^2	Square kilometer
km^3	Cubic kilometer
KRWSA	Kerala Rural Water Supply and Sanitation Agency
KSBB	Kerala State Biodiversity Board
KSCSTE	Kerala State Council for Science, Technology and Environment
KSSP	Kerala Sastra Sahitya Parishad
KSWMP	Kerala Solid Waste Management Project
KTDC	Kerala Tourism Development Complex
KCZMA	Kerala Coastal Zone Management Authority
KIDS	Kottappuram Integrated Development Society
KUFOS	Kerala University of Fisheries and Ocean Studies
KVK	Krishi Vigyan Kendra
KSPCB	Kerala State Pollution Control Board
l	Liter
LC	Least Concern
LLMC	Local Level Monitoring Committee
LULC	Land Use and Land Cover
LSG	Local Self Government
m	Meter
m/km	Meter per kilometer
m^3/sec	Cubic meter per second
MAP	Management Action Plan
MCM	Million Cubic Meter
METT	Management Effectiveness Tracking Tool
MGNREGS	Mahatma Gandhi Rural Employment Guarantee Scheme
MoEFCC	Ministry of Environment, Forest and Climate Change
MFF	Mangrove for Future
mg/ kg	Milligram per Kilogram
mg/ l	Milligram per Liter
micromhos/cm	Micromhos per centimeter
mm	Millimeter

MPN/100ml	Most Probable Number per 100 milliliters
msl	Mean Sea level
MT	Metric Tonnes
µg/ l	Microgram per Liter
µS/cm	Micro-Siemens per centimeter
NABARD	National Bank for agriculture and Rural Development
NE	Not Evaluated
NEERI	National Environmental Engineering Research Institute
NERCI	Nansen Environmental Research Centre India
NIH	National Institute of Hydrology
NIO	National Institute of Oceanography
NGO	Non-Governmental Organisation
NGT	National Green Tribunal
NPCA	National Plan for Conservation of Aquatic Ecosystems
no/ l	Number per liter
NT	Near Threatened
NWCP	National Wetland Conservation Programme
NWMP	National Water Quality Monitoring Programme
P_2O_5	Phosphorus pentoxide
pH	Molar concentration of Hydrogen ion
PHC	Primary Health Centre
PM	Particulate Matter
ppm	Parts per million
ppt	Parts per thousand
PRIs	Panchayati Raj Institutions
%	Percent
RIDF	Rural Infrastructure Development Fund
RKI	Rebuild Kerala Initiative
RSIS	Ramsar Site Information Sheet
RT	Responsible Tourism
SHGs	Self Help Groups
SIDA	Swedish International Development Cooperation Agency
SoER	State of Environment Report
SACON	Salim Ali Centre for Ornithology and Natural History
SAPCC	State Action Plan on Climate Change
SAZ	Special Agriculture Zone
SIAD	State Institute for Animal Diseases

SDRF	State Disaster Response Fund
SOP	Standard Operating Procedure
SWAK	State Wetland Authority Kerala
t	Tonnes
t/ha/ya	Tonnes per hectare per Year
TCL	Travancore Cements Limited
TM	Thanneermukom
TSM	Total Suspended Matter
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VKW	Vembanad-Kol Wetland
VKWMU	Vembanad-Kol Wetland Management Unit
VKWAC	Vemband-Kol Wetlands Advisory Committee
UN	United Nations
VN	Vulnerable
WASH	Water, Sanitation and Hygiene
WIAMS	Wetland Inventory Assessment and Monitoring System
WISA	Wetlands International South Asia
WWF	World Wide Fund for Nature
ZSI	Zoological Survey of India

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Executive Summary

Vembanad-Kol is one of the largest coastal wetland complexes of India. Spanning an area of 1,323 km^2, the Ramsar site comprises the Vembanad estuary flanked by river floodplains of Kuttanad and Kol, interspersed by estuaries and mangrove marshes interconnected by an intricate network of natural and human-made channels. These wetlands form a part of the extensive chain of backwaters of Kerala, formed in the lowlands of basins of 10 rivers, and connected to the Lakshadweep Sea through 3 major and 22 minor outlets. The Ministry of Environment, Forest and Climate Change, Government of India designated Vembanad Kol as a Wetland of International Importance (Ramsar Site) under the Ramsar Convention in 2002 thus committing to the maintenance of the wetland's ecological character.

VKW provide a range of valuable ecosystem services and supports rich biodiversity. Vembanad Kol wetlands, with a water holding capacity of ~385 MCM, serve as a critical flood buffer for Kochi, Ernakulum and other towns located around the wetland. Over 0.2 million households derive livelihood sustenance based on backwater tourism, inland navigation, clams, shellfish, and finfish provided by the wetland complex. Agriculture in Kuttanad alone provides sustenance to 90,000 farmers. The wetland complex is also home to an indigenous farming system, Pokkali, which has been accorded Geographical Indication status. Vembanad-Kol is a sought-after destination for backwater tourism. Tourist houseboats or *Kettuvallams* and Snake boat races such as the "Nehru Trophy Boat Race" attract several domestic and international tourists. The rich diversity supported by these wetlands is indicated by the recorded presence of 626 plant and 1071 animal species, including 30 species of high global conservation significance. Each year during winter, Vembanad-Kol is known to harbour one of the highest populations of migratory waterbirds in the Central Asian Flyway within India. In 2013, FAO designated Kuttanad as a Globally Important Agricultural Heritage Site.

Vembanad-Kol is under severe stress from lopsided development which ignores wetland values and functioning. The wetland complex is located in an intensively developed landscape, which includes the Kochi port (the maritime gateway to peninsular India), Kumarakom (center for backwater tourism) and Kuttanad (the Rice Bowl of Kerala). The wetland is fringed by several large urban settlements such as Kochi and Ernakulam, and the state's industrial belt, Udyogmandal. Bouts of food shortage prompted the erstwhile rulers of Travancore to promote the reclamation of marshes as early as 1880. Several spillways, regulators and locks were constructed on the inflowing rivers to regulate inflows and prevent salinity intrusion from the sea. Between 1965 and 1976 two stages of Thanneermukkom Barrier were constructed across Vembanad estuary to prevent saline water intrusion into Kuttanad and control tidal action within its polders. The period since the 1990s has witnessed a rapid increase in the number of houseboats to cater to the increased demand of tourists. The natural banks of the wetland, once covered with thick mangrove stands, have been mostly replaced by coconut plantations and tourism infrastructure.

Lack of consideration of wetland functioning within developmental programming has resulted in shrinkage and transformation of wetland area, reduced water holding capacity, clogging of channels, pollution, growth of invasives, and decline in brackish water fisheries and clam resources. Despite all hydrological interventions, agricultural productivity as well as production in Kuttanad has declined over the years, converting it from the coveted 'rice bowl of Kerala' to a 'den of distress'.

WETLAND STATUS, TRENDS AND THREATS

Shrinkage of wetland regime

The present extent of VKW is a fragment of an extensive regime of estuaries and interconnected river floodplains extending between Thrissur and Arattupuzha which existed till the beginning of the 19th century. Nearly 550 km^2 of Vembanad estuary and floodplain marshes have been converted in the Kuttanad region alone. During 2001-2022 the area under horticulture crops and built-up has increased by 89% and 72% respectively whereas the area under open water and wetland agriculture has declined by 20% and 14% respectively.

Changes in hydrological regimes

Climate induced changes in rainfall patterns and large-scale modifications of the inflowing river basins have considerably altered the hydrological regime of the VKW. The natural salinity gradient prevalent in the wetland complex has been altered to increase freshwater conditions to support agriculture. The circulation and mixing patterns have also been impeded by the operation of Thanneermukkom Barrage. Increased siltation from land use changes in the catchments has led to increased sedimentation of the estuary and a concomitant loss of water holding capacity by 85% between 1930 and 2020. Encroachments and unscientific construction of bridges and roads have affected the free flow of water as evidenced recently by the damages of 2018 Kerala floods.

Pollution

VKW is the ultimate recipient of untreated sewage from the industrial and manufacturing units and settlements that dot the wetland periphery. While the number of houseboats has increased 8 times since 2000 (with several unregistered boats), the commensurate waste management facility is yet to be developed. Intensification of agriculture and the use of high yielding varieties of rice has also led to increased use of fertilizers and pesticides. The incidence of water borne diseases within the farming, fisher and clam collecting communities is high. Coupled with changes in circulation and mixing pattern, excessive loading of nutrients is promoting the growth of freshwater invasives in Kuttanad, clogging the channels and increasing waterlogging. Several stretches of canals in Kol lands are infested with *Salvinia molesta* and *Eichhornia crassipes*.

Increasing anthropogenic pressure on waterbird habitats

The floodplain marshes and the mangroves on the fringes of Vembanad estuary served as important habitats for waterbirds. Clearing of mangroves has affected several of these habitats. Indiscriminate use of pesticides is causing bird mortality. Unregulated fishing along the major breeding and roosting sites is affecting the food resources of waterbirds. Conversion of floodplain marshes for brick kilns and construction purposes are major pressures on waterbird habitats in Kol lands.

Declining wetland resources and increasing stakeholder conflicts

Production of clams as well as wetland agriculture has declined in recent periods stressing livelihoods of dependent communities and creating stakeholder conflicts. The operation of Thanneermukkom Barrage is a perennial conflict between fishers (preferring natural salinity regime) and farmers (preferring freshwater conditions all year round). Clam harvest in the Vembanad estuary has declined by 44 % in the last 2 decades. Pokkali farmlands are increasingly being converted into prawn farms or for coconut cultivation due to reduced availability of labour and high wage rates. Within the Ramsar site, around 1500 ha of Pokkali land has been converted to other land use. The incidence of white spot disease has impacted shrimp production since 2009. Paddy cultivation in Kuttanad is on the decline as the paddy cultivators are relinquishing rice cultivation in favour of less labour-intensive methods such as coconut farming and horticultural systems. Tour operators are in conflicts with environmental groups which have long rallied against increasing tourism operations in biodiversity hotspots such as Kumarakom and Pathiramanal islands.

Local climate change impacts

The surface waters of VKW are progressively becoming warmer. The frequency of high-intensity rainfall events has also increased in recent times. Modelling studies indicate a further increase in such events. Changing rainfall patterns have rendered wetland farming highly vulnerable to floods. Since 2018, recurrent flooding is also triggering an exodus of families from Kuttanad to safer areas and an estimated 6,000 families have left the region in the last two years alone. The floods destroyed several houses and severely damaged infrastructure. Living conditions in the area have deteriorated considerably. Loss to farmers due to rains in October 2021 was estimated by the Department of Agriculture to be Rs 9,608 Crore, encompassing crops over 6,582 ha.

INTEGRATED MANAGEMENT FRAMEWORK

Conservation and wise use of Vembanad-Kol calls for stakeholder-led management balancing the objectives of biodiversity conservation with sustaining livelihoods and well-being of dependent communities in a manner compatible with ecosystem functioning. The goal of the management of VKW is to maintain the Ramsar site's ecological character in a healthy condition to enable the delivery of the wetland's full range of ecosystem services and sustain biological diversity values. The purpose of management is to: (1) Provide a natural flood buffer to Kochi and its surroundings; (2) Strengthen livelihood opportunities of wetland-dependent communities through sustainable fisheries and wetland agriculture, eco-friendly water transport and nature tourism; (3) Maintain habitats for wetland-dependent species, including species migrating in ecological corridors along the Central Asian Flyways and (4) Sustain cultural and relational linkages of people with VKW.

The following twelve management objectives have been identified for VKW to achieve the management goal and purpose.

Objectives	Performance Indicators	Desired Outcomes
Land use and land cover of VKW is maintained in line with regulatory requirements under the Coastal Regulation Zone Notification and Wetlands (Conservation and Management) Rules	LULC with respect to 2002 baseline Number of violations of extant regulatory regimes	No illegal transformation of Land use land cover No instances of violations of extant regulatory regimes
Flood buffering capacity of VKW is maintained	Water holding capacity	Water holding capacity is restored to 2002 levels
Salinity gradient within VKW is maintained in line with ecological requirements of wetland dependent species and below sea level agriculture	Salinity in different parts of the wetland Polderisation and density of linear infrastructure/fragmentation	Brackish conditions in Vembanad estuary and oligohaline conditions towards Kol and Kuttanad polders. Landscape connectivity is restored
Sewage quality and quantity received in the wetland is efficiently treated	Key water quality parameters BOD, COD, Salinity, Micro-plastic, (agri. contaminants), conc. of polyphenols	Desired levels are maintained as per Thresholds/Standards

Objectives	Performance Indicators	Desired Outcomes
Diversity of biota within VKW is maintained and enhanced	Species richness Population of migratory waterbirds Sighting of high conservation value such as Otters Key habitat areas are maintained (Clam beds, Mangrove areas)	No species extirpation Counts are maintained in the range of 20% deviation from average of last five years Preferred habitat is maintained Habitat quality and extent restored to Ramsar Site designation levels in 2002
Species invasion threat to fisheries and wetland agriculture is reduced	Occurrence of invasive species in wetlands and agriculture systems	Occurrence is reduced by at least 80% of the levels as of 2022
Wetland-based agriculture systems in Kuttanad and Kol are sustained in line with ecological character of VKW	Area under wetland agriculture Reduction in use of chemical fertilisers and pesticides	Area of wetland agriculture as in 2022 is maintained At least 50% reduction in use of chemical fertilisers and pesticides against the levels of 2022
Livelihood vulnerability of wetland dependent communities is reduced	Resource productivity (fish-catch, Clam harvest, Rice-Shrimp production from Pokkali, Rice production from Kol-lands and Kuttanad. Instances of water-borne diseases Diversification of income sources of communities	Non-declining harvest (Fish, Clam) Reduce by at least 80% of the incidence level of 2022 Wetlands communities having income in lower 25% quantiles gain additional sources of income
Individual and collective capacity and opportunities for stakeholders to participate in wetlands management and contribute to wetlands wise uses is enhanced	Participation of wetland communities and community-based institutions in wetland management Evidences of affirmative behaviour change within communities living in and around VKW supporting wetlands wise use Evidence of community based collaborative actions for wise use of VKW	Community views, rights and capacities are integrated in management plan integration and monitoring Local action for preventing adverse land use change, encroachment, pollution abatement and over harvesting of biological resources

Objectives	Performance Indicators	Desired Outcomes
Systematic wetlands inventory, assessment and monitoring system is used to inform management decisions and assess effectiveness	Availability of time-series data on wetland ecological character Availability of data on threats leading to adverse changes in ecological character Evidences of use of data generated from WIAMS in decision-making	Time series data on wetlands features is accessible on SWAK WIAMS webportal Data on trend in threats is accessible on SWAK WIAMS webportal Monitoring data is systematically analysed and presented in SWAK meetings and made available to decision makers and stakeholders
Integration of multiple values of wetlands in sectoral development plans, programmes and investments is enhanced	Number of sectoral plans, programmes and investments (which influence VKW) which take into account wetland values Reduction in the number of sectoral plans, programmes and invest which adversely impact VKW ecological health	SWAK meets periodically to review sectoral plans, programmes and investments in terms of their implications for VKW and communicates to the respective departments SWAK establishes sectoral convergence benefitting VKW ecosystem Instances of conflict/s are reduced
Sustainable tourism practices aligned with wetland wise use principles are promoted	Number of houseboats with respect to carrying capacity of the VKW Environmentally sensitive behaviour of tourists, and tour operators Adherence to extant regulatory frameworks with respect to tourism and pollution abatement	Number of houseboats is limited to below carrying capacity of VKW All houseboats are fitted with adequate waste collection and disposal facility and access STP for treatment Tourists are sensitised on significance of the VKW and adhere to do's and don'ts

MANAGEMENT COMPONENTS AND ACTIVITIES

Activities to meet the twelve objectives are clustered under six components: a) Institutions and Governance; b) Water Management; c) Species and Habitat Conservation; d) Community Based Fisheries Management; e) Sustainable Wetland Agriculture Interactions; and f) Nature Tourism.

The management actions are organised at two levels namely (1) Vembanad- Kol basin, and (2) the three ecological zones (Zone I encompassing Thrissur Kol floodplains, Zone II encompassing the Vembanad estuary region north of Thanneermukkom barrage and Zone III encompassing the Kuttanad below-sea-level agricultural wetlands and including the estuary region south of Thanneermukkom barrage).

Proposed actions at Vembanad- Kol basin level

Creation of the VKW Management Unit (VKWMU): It is proposed to create a VKWMU under the aegis of the State Wetland Authority Kerala, for coordinating the implementation of the management plan, maintaining an overview of the status and trends of wetlands and associated catchments and coastal zones, stakeholder engagement, and representing the concerns related to wetlands in sectoral plans and programmes of various government, non-government and private agencies. The institution will be headed by an Executive Director/ Chief Executive Officer and comprise of five divisions (1) Research, monitoring and evaluation, (2) Participation and networking, (3) Communication and outreach, (4) Legal and regulation, and (5) General administration with 13 scientists and subject matter experts and 3 administrative staff. The VKWMU will be responsible for the implementation of the various work programmes. Strategic guidance and technical and scientific inputs to the work programme of VKWMU will be provided by the 'VKW Advisory Committee.

Wetland boundary demarcation: The Ramsar site boundaries and any other important boundary features will be marked on the ground by placing geo-tagged pillars placed at an interval of 100 m along the boundary.

Strengthening the integrated wetland inventory, assessment and monitoring system (WIAMS): The existing WIAMS will be scaled up and strengthened to address overall information needs for wetland management and provide a robust decision support system. A state-of-the-art wetland monitoring and research centre at Alappuzha/Kumarakom housed in the VKWMU and Ramsar Interpretation Centre (RIC) will be established for monitoring the ecological, hydrological and socio-economic features of the VKW (VKW). The WIAMS shall build an interface with existing monitoring systems of different government agencies and research organisations. Two sub centres at Thrissur and at Kochi will cater to the monitoring and research needs of the Kol wetlands and the Vembanad estuary. It is proposed to generate, use and publish annually the Ecosystem Health Report Cards in the WIAMS web portal and the 'Wetlands of India' portal to assess and communicate wetland monitoring information to decision-makers and stakeholders.

Specific studies: It is proposed to commission specific research studies on: a) Environment flows requirements of Vembanad estuary; b) Fish breeding and migration patterns in VKW; c) Ecological character risk and vulnerability assessment; d) Assessments of multiple wetland values for their integration in wetland management decision making; and e) Climate risks assessments and mitigation and adaptation options. The results of these studies will help address existing knowledge gaps on wetland features and will be incorporated into management plan implementation and adaptation and review.

Communication, Education, Participation and Awareness: Regular engagements and continuous dialogue with stakeholders in planning and reviewing specific conservation measures such as water management, catchment treatment measures, pollution abatement measures, sustainable fisheries and other sectoral activities, management effectiveness, is an integral part of management planning. Signages indicating VKW as a Ramsar Site will be placed at all major entry points (Punnamada jetty, Muhamma jetty, Kannankara jetty, Kumarkom and others major boat jetties). These signages will bear information on the international status of the wetland, management authority and Do's and Don'ts. The information on wetland monitoring, research and management plan implementation will be shared with stakeholders through a dedicated web portal. The web portal will also provide a mechanism for Wetland Mitras to enrol and engage in management plan implementation. Stakeholder engagement in wetland management will be encouraged through workshops and public events on conservation and wise use of Vembanad-Kol involving media, research agencies, NGOs and CBOs, observation of World Wetlands Day and other environment related occasions, and publication of newsletter and specific brochures. It is also envisaged that zone wise Community Advisory Groups will be constituted

for targeted stakeholder education, awareness, and behaviour change campaigns to facilitate active participation of Local Self-Governments and communities in wetland management.

Capacity development: The management plan identifies four major actor groups, namely the VKWMU, concerned line departments and agencies of the state government, Local Self Government organisations and civil society and community-based organisations (including resource user groups (Padashekharam committees, coir retting units, clam collector's units). For each of these groups, a capacity and training needs assessment (CTNA) will be conducted in the first year of management plan implementation. The capacity development measures such as training workshops, exposure visits, hands on demonstrations, technology and human resources support, and skill upgradation support will be implemented drawing on the results of the CTNA. A mid-term and end-term evaluation of capacity development will be carried out as a part of review and adaptation measures.

Catchment conservation: Watershed Management Committees are proposed to be constituted in all watersheds of the ten river basins draining into VKW. These committees will be imparted training on watershed planning and identification of interventions to conserve soil and moisture regimes. Within the second year of management plan implementation, the micro watershed level plans will be prepared and will be reviewed as per extant procedures of the Soil Survey and Soil Conservation Department. Implementation of the watershed plan will be ensured through convergence with ongoing watershed development and forest conservation schemes.

Review and Adaptation: R-METT (Ramsar Site Management Effectiveness Tracking Tool) will be used as a basis for assessing management effectiveness. A baseline management effectiveness score will be assessed at the beginning of the management plan implementation. Subsequent assessments will be done at every two-year interval. In addition, a mid-term and end-term review of management plan implementation is proposed to assess the extent to which stipulated objectives have been achieved with a high degree of resource efficiency and in participation with stakeholders.

Proposed actions at the three-zone levels

Component 1: Water Management

- Preparation of zone level Integrated water management strategy based on assessment of water balance, water use for human and ecological purposes, trade off's and assessing climate induces risks. These strategies will support the integration of wetlands within river basin and coastal zone scale water management planning under Rebuild Kerala Initiative
- Rejuvenating hydrological connectivity by unclogging and removal of encroachment along river stretches, canals and, waterways and maintenance of estuaries spillways and estuaries outlets
- Improving the efficiency of Thotapally to design capacity through maintenance of Thottapally spillway mouth, fishing harbour and Andhakaranzhi outlet, and electrification of spillway shutters
- Implementation of ongoing works on construction repair, modification of culverts, sluices
- Removal of water hyacinth from canals and economic utilization as bio-fuel and crafts
- Comprehensive assessments and planning for containment, treatment, and safe disposal of domestic sewage and industrial effluents
- Training and Infrastructure support to Haritha Karmi Sena for integrated waste management in all SHGs
- Plastic waste management through assessments, establishment of integrated waste management facilities, and awareness generation programs

- Support to well-based rooftop rainwater harvesting and recharge system (Mazhapolima) in community institutions and individual households
- Modernisation and automation of Thanneermukkom barrage
- Enhancing storage capacity of irrigation dams of Kol lands (Peechi and Varani)
- DPR preparation of minor outlets to restore natural hydrological connectivity and reduce flood risks
- Electrification of shutters of Thottapally spillway, maintenance of spillway structure, spillway mouth, fishing harbour and Andhakaranzhi outlet

Component 2: Species and Habitat Conservation

- Regular monitoring of Waterbird population in Vembanad estuary, Kuttanad and Kol using Asian Waterbird Census protocols
- Systematic fin fish and shell fish census to assess trends in species richness, populations, habitat conditions and prevalence of diseases
- Monitoring the status of invasive species, mapping of impacted area and preventive measures taken
- Mapping and protection of key habitat areas such as species nesting, spawning and feeding grounds
- Zoonotic disease surveillance to prevent infestation and as well prepare response strategies for proactive zoonotic risk mitigation
- To preserve the mangrove diversity, restoration of native mangrove species to be undertaken in Chettuva estuary, Kodangallur- Azhikode estuary, CRZ I A areas in Aroor, Perumbalam, Palluruthy, Edakochi, Elankunnapuzha, Kayamkulam Kayal and along National Waterway 3

Component 3: Community based Fisheries Management

- Systematic fish and clam catch assessments to be carried out to establish sustainable levels of extraction by adopting a zone-wise calendar
- Establishment and maintenance of fourteen, 2ha protected areas for clams/fishes in Karuvannur-Chettuva Aquatic Ecosystem to preserve and restore native mangrove species diversity and promote Integrated Mangrove Fishery Farming System (IMFFS)
- Annual ranching to replenish depleted stock of commercially important fish species
- Support to establishment of one freshwater prawn hatcheries
- Support to four fisheries management councils (FMC) for active surveillance
- Regular awareness programmes on sustainable fishing practices and promotion of government subsidy schemes for adoption by local fishers

Component 4: Sustainable Wetland Agriculture Interactions

- Support to revival of traditional Pokkali Farming system in Kol lands and Vembanad estuary through incentive programs, organising pokkali harvesting festivals, awareness campaign on best practices and strengthening market linkages
- Improvising, strengthening and reorganising polders in Kuttanad and Kol region through support for restoration of outer bunds, increasing flushing and filteration efficiency
- Revision of cropping calendars in Kuttanad in alignment with Vembanad estuary's ecology and ecosystem functioning
- Promoting adoption of good agricultural practices in Kuttanad and Kol region

Component 5: Nature Tourism

- Design and implementation of an orientation program for houseboat owners, tourism facility owners and tour operators on the extant policies, regulatory regimes, and nature tourism best practices
- Capacity development support to houseboat owners for adherence to prescribed standards for sustainable tourism and waste management
- Surveillance and enforcement of the Kerala Inland Vessels Rules, 2010
- Upgradation of waste management facility for houseboats and tourist facilities through assessment of current waste generation and gaps, operationalization of existing STPs including houseboat sewage collection barges and identifying the need for additional waste treatment infrastructure
- Design and implementation of targeting nature awareness programs for various segments
- Design of Nature tourism program for VKW on the basis of assessment of carrying capacity, key identification of nature tourism zones, potential partners, infrastructural support needed, funding sources and training and capacity development needs. The nature tourism program will serve to convert high volume backwaters tourism into high value nature tourism
- Feasibility assessment for construction of Dry Dock facilities for houseboats to facilitate compliance with safety standards in Vembanad estuary

PHASING AND PRIORITIZATION

Implementation of the integrated management plan for Vembanad-Kol needs to be taken up in phases. The first priority needs to be accorded to putting in place an institutional arrangement for managing Vembanad Kol, securing the wetland boundary and implementing regulatory measures, putting in place the monitoring and evaluation mechanisms and formulating the zonal water management strategies and actions. A process of community engagement for the management of Vembanad-Kol needs to be initiated, along with investment in communication and education on wetland values and functions.

It is envisaged that in the second stage, the focus would be on implementation of the zonal action plans executing actions for improving water regimes, pollution abatement measures, augmenting waste management infrastructure and other sectoral interventions such as sustainable agriculture and fisheries development.

BUDGET

Management plan implementation will require a budget of ₹ 179.88 crores. Of this, the budget allocated for the basin-level actions is ₹ 71.56 crores. The activities proposed for Zone I will require ₹ 25.19 crores; Zone II will require about ₹ 58.77 crores and Zone III will require ₹ 24.36 crores. Of the total budget, ₹ 21.72 crores can be mobilized through convergence with ongoing projects and schemes of various activities.

Introduction

1.1 Vembanad-Kol Wetland

Vembanad-Kol Wetland (hereinafter VKW) constitutes one of the largest wetland regimes on the Malabar coastline. The wetland complex comprises the Vembanad estuary flanked by river floodplains of Kuttanad and Kol, in south and north respectively interspersed by river estuaries and mangrove marshes which are interconnected by an intricate network of natural and humanmade channels extending to over 1323 km^2 (Map 1). Spanning around 145 km along the coastline of Alappuzha, Ernakulam and Thrissur Districts, VKW forms a part of the extensive chain of backwaters which are characteristic features of the state. The rich diversity supported by these wetlands is indicated by the recorded presence of 438 plant and 1071 animal groups, including 30 species of high global conservation significance.[1]*. Each year during winters, VKW harbors one of the highest populations of migrating waterbirds in the Central Asian Flyway within India. The wetland sustains the livelihoods of more than 0.2 million households through backwater tourism, inland navigation, and a range of resources such as clams, shellfish, and finfish. Located at the apex of the basin, VKW also regulates hydrological regimes, providing flood protection to large settlements such as Kochi and Ernakulam as well as water for agriculture in the Kuttanad and Kol regions – the Rice Bowl of Kerala. VKW was designated as a Wetland of International Importance (Ramsar Site) under the Ramsar Convention by the Ministry of Environment and Forests, Government of India in 2002.

Vembanad Estuary and Kol Lands have been also identified as Important Bird Areas (IBA) of Kerala State. Mangalavanam, located on the western fringes of the wetland and a site of large waterbird congregation was declared as a Bird Sanctuary under the Wildlife (Protection) Act 1972 in 2004. In 2013, FAO designated Kuttanad as a Globally Important Agricultural Heritage Site[2].

Vembanad-Kol Wetland

[1] Banerjee D., Bharti D., Kumar S., Mitra A., Joshi R., Gupta D. 2023. Faunal Composition of Ramsar Wetlands from India: An Analysis: Records of Zoological Survey of India 123 (15): 1-15.

* For details on floral and faunal composition please refer section 2.6 Biodiversity

[2] https://www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/kuttanad-below-sea-level-farming-system/en/

Map 1: Location of Vembanad-Kol Ramsar Site

Lack of consideration of wetland ecosystem processes and its full range of ecosystem services and biodiversity values in regional developmental planning has led to the rapid transformation of VKW. Till the turn of the 19th century, there was little anthropogenic pressure on the wetland complex. Establishment of Cochin Port in 1928 catalysed economic activities in the region. An all-weather natural port, it is located strategically close to the busiest international sea routes from the Gulf to Singapore and Europe to the Far East circuits and fastest growing maritime gateway to peninsular India. Large scale reclamation of naturally fertile floodplain marshes for agriculture was encouraged since late 19th century which continued till the 1950s. Shallower wetland regions and marshes in the Kuttanad and Kol region were converted into polders, locally called *padashekharams*, to enable agriculture. A number of spillways, regulators and locks were constructed for regulating inflows and preventing salinity intrusion from the sea. Between 1965 and 1976, Thanneermukom Barrage was constructed across VKW to prevent saline water intrusion into Kuttanad and control tidal action within its polders. Incentives during the 1980s and 90s led to establishment of Udyogmandal, an industrial belt on the shorelines of River Periyar and within the vicinity of wetland complex.

During the 1990s, backwater tourism emerged as one of the prominent features of Kerala tourism industry. There was an explosive surge in the number of tourist houseboats (*Kettuvallams*, originally used as grain barges and presently the most sought-after accommodation in the backwaters). The natural banks of the Vembanad estuary, once covered with thick mangrove forests, were cleared off to construct tourism facilities.

The impacts of these developments on VKW are apparent. The area of the Vembanad Estuary has shrunk (from 365 km^2 in 1834[3] to 206 km^2 in 2022[4]) and water holding capacity drastically reduced (by over 77% during 1834 – 1984[5]). Alteration of natural hydrological regimes has led to clogging of channels in Kuttanad area. Continued discharge of industrial effluents and sewage into the river and the backwaters has led to water quality deterioration and spread of freshwater invasives such as water hyacinth. Diversion of upstream freshwater inflow to the sea for flood control in Kuttanad has led to reduction in water availability within Vembanad impacting flushing patterns. Changes induced in the natural salinity gradients of the Vembanad Estuary due to operation of Thanneermukom Barrage have led to decline in catch of brackish water and marine fisheries and live clams. Despite all hydrological interventions, rice production in Kuttanad has declined over the years, converting it from the coveted 'rice bowl of Kerala' to 'den of distress'.

Changing resource use patterns within the backwaters have made VKW a contested landscape, with wetland values and functions made subservient to economic exploitation. The operation of Thanneermukom Barrage is a perennial conflict between fishers (preferring natural salinity regime) and farmers (preferring freshwater conditions all the year round). Local clam collectors' societies are highly impacted by commercial clam trawling operations (major being Travancore Cements) which led to shifting of beds and reduced natural recruitment. Tour operators are in conflict with environmental groups which have for long rallied against increasing tourism operations in biodiversity hotspots as Kumarakom and Pathiramanal islands. Declining aesthetics due to spread of invasives and degrading water quality put tour operators in conflict with industrial operations in Udyogmandal region.

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[3] Gopalan, U. K., T.V Doyil, P. Udayvarma & M. Krishnankutty 1983. The Shrinking Backwaters of Kerala. Journal of Marine Biological Association India, 25: 131-141.

[4] Sanjeevan et al. (2023)

[5] Gopalan, U. K., T.V Doyil, P. Udayvarma & M. Krishnankutty 1983. The Shrinking Backwaters of Kerala. Journal of Marine Biological Association India, 25: 131-141.

1.2 Overview of management to date

Degradation of VKW has significant implications for ecological and economic security of the entire coastal zone of Kerala State. Yet, coordinated actions for sustainable management of the wetland system are yet to be implemented. Designation of a site as Wetland of International Importance commits the national government to its wise use, and putting in place an integrated management plan for safeguarding wetland features balancing conservation of biodiversity values with livelihoods. Despite implementation of a range of research programmes, notably by Center for Water Resources Development and Management (CWRDM), Cochin University of Science and Technology, Mahatma Gandhi University, Kerala University of Fisheries and Ocean Studies, Kerala Sastra Sahitya Parishad (KSSP), Kerala State Forest and Wildlife Department, local research agencies and civil society, such a plan fails to exist. Meanwhile, sectoral management plans continue to be promoted for agriculture and tourism, without taking into cognizance wetland functioning. several domain-specific studies and recommendations of expert committees like the. E. J. James Committee appointed in 2002 has framed the operational rules for Thanneermukkom barrage. The report of the M. S. Swaminathan Research Foundation (MSSRF) shaped the master plan for the eco-restoration of the Kuttanad region (MSSRF 2007). In 2018, the Government of Kerala launched the Rebuild Kerala Initiative to build social and economic resilience and realize the vision of a Nava Keralam. Several projects are being implemented across 14 different sectors, related to Integrated Water Resource management, improved transportation, water supply systems, urban planning and agriculture, livelihoods and. The process of constitution of a River Basin Authority has also been initiated. While the national and state level regulatory frameworks (Wetlands Conservation and Management Rules, 2017, Coastal Regulation Zone Notification, 2019 and Kerala Conservation of Paddy Land and Wetland Act, 2008) provide legislative basis for regulating activities detrimental to the wetland ecosystem, their enforcement remains a challenge. The management framework of 2013 was subsequently upgraded to an Integrated Management Plan in 2017. In 2017, State Wetlands Authority Kerala (SWAK) was constituted as the nodal State level organisation policy regulation and management of wetlands.

In 2013, a management planning framework for VKW was prepared by WISA and CWRDM with funding from IUCN as part of the Mangroves for the Future (MFF) Programme. The framework included evaluation of wetlands feature and risk of adverse change in ecological character, based on which a management framework (goal, purpose, objectives and key actions) was identified. Approved by the Ministry of Environment, Forest and Climate Change, the plan received the first-year installment in 2018 under the Centrally Sponsored Scheme - National Plan for Conservation of Aquatic Ecosystems (NPCA). Significant components included the Wetland Inventory Assessment and Monitoring System (WIAMS), WIAMS Web-portal & Mobile App, alternative livelihoods for clam collectors, and extensive Communication Education Participation and Awareness (CEPA) activities carried out over five years.

Despite approval and an initial fund release of Rs. 140.75 lakhs in March 2018, SWAK encountered impediments in implementing the entire plan due to issues with fund flow mechanisms, staff shortages, and COVID-19 restrictions. However, the Integrated Wetland Inventory, Assessment, and Monitoring System (WIAMS) was successfully implemented through CWRDM, yielding valuable bimonthly water & sediment quality monitoring data. Accompanying this, a national seminar was held in 2023, and the Kerala Agricultural University initiated the annual water bird census in the same year, making progress with monthly field observations. Noteworthy achievements include the development of a mobile app-integrated web portal for wetland monitoring across three Ramsar sites, sustainable clam cultivation in Vembanad Estuary by ATREE-CERC (Annex XIV), Wetland Mitra training programs, World Wetlands Day events, and Ramsar Signage installations.

In 2001, a writ petition (WP(C) 230/2001), under Article 32 of the Constitution of India, was filed by Shri. M. K. Balakrishnan & others to the Hon'ble Supreme Court of India on the conservation of wetlands in the country. Further in 2017, the Hon'ble Supreme Court in its order dated 8.02.2017 directed that the Wetlands (Conservation and Management) Rules, 2016 should be notified on or before 30.06.2017. It directed Union of India to file an affidavit stating how the funds made available have been utilized towards the protection of the wetlands including their specific details. Since the Wetlands Inventory had already been prepared, the Hon'ble Supreme Court ordered that the already identified 2,01,503 wetlands in the country are subject to the principles of Rule 4 of the Wetlands (Conservation and Management) Rules, 2010. It was also requested that the Hon'ble Chief Justices of the High Courts to treat the affidavit as a *suo motu* public interest petition and if necessary, appoint an *amicus curia* to assist the Court to ensure that Ramsar Convention sites within their jurisdiction are properly maintained. The *amicus curiae* appointed by the Hon'ble High Court of Kerala submitted three reports to the Court, and the third report suggested to revise the existing Integrated Management Plan of VKW with concrete actions and timelines to conserve the wetland. In response, the State Wetlands Authority Kerala, commissioned a joint project to WISA and CWRDM in 2022. This management plan has been prepared under the aegis of the SWAK project.

1.3 Management Planning Purpose and Objectives

VKW is a multi-functional ecosystem supporting rich biodiversity as well as livelihoods of dependent communities. The need for maintaining wetland values and functions, while at the same time delivering services and benefits now and into the future, for human well-being necessitates adoption of management approaches which recognize linkages between livelihoods, wetland functioning and biological diversity. India, as a Contracting Party to Ramsar Convention on Wetlands is committed to ensuring wise use of all wetlands in the territory. The wise use principle encourages stakeholder engagement and transparency in negotiating trade-offs and determining equitable outcomes for wetland conservation while promoting maintenance of environmental, economic and social sustainability. Management planning is an instrument to outline the strategies, mechanisms and actions through which wise use of wetlands is to be achieved.

Wise use of wetlands, defined within the Ramsar Convention text as 'maintenance of their ecological character, achieved through implementation of ecosystem approaches, within the context of sustainable development' forms the overarching principle for management planning. Wise use has been highlighted as the guiding approach for wetland conservation in the National Environment Policy (2006), National Biodiversity Action Plan (2009) and as the primary objective of the National Plan for Conservation of Aquatic Ecosystems (NPCA) of the Ministry of Environment and Forests, Government of India. Mainstreaming wetland wise use within sectoral development strategies forms the foundation of the NPCA, the flagship programme of the Ministry of Environment, Forest and Climate Change for integrated wetland management. Site-based management planning is also recognised as an integral element of a multi-scalar approach to wise use planning and management. The management plan provides a basis for linking with broad-scale landscape and ecosystem planning, particularly at the river basin scales, as policy and planning decisions at these scales affect conservation and wise use outcomes at the site level.

Management planning is aimed at the long-term objective of ensuring conservation and wise use of VKW for securing biodiversity as well as well-being of dependent communities. The purpose is to put in place effective management practices which enable integration of biological diversity and ecosystem service values of VKW in river basin and coastal zone level conservation and development planning. The integrated management plan is specifically aimed at:

- outlining a strategy for identification of site management objectives
- describing the management actions required to achieve objectives
- determining the factors that affect, or may affect, the various site features and functions
- defining monitoring requirements for detecting changes in ecological character
- supporting resource mobilization
- enabling communication within and between sites, organization and stakeholders
- ensuring compliance with local, national and international policies and regulatory frameworks.

1.4 Management Planning Approach and Method

The ecological components, processes and services of VKW are influenced by land and water management practices within the immediate as well as indirect catchments of the wetland complex and the coastal zone. Management planning for VKW therefore calls for an approach which recognizes the interconnectedness of wetland biological diversity and ecosystem services with river basins and coastal zone taking into account the external, natural and induced factors. The approach also needs to address climate change which has direct as well as indirect implications for wetland features and their governing factors. There is an underlying need to maintain ecological character while providing for sustainable utilization of wetland resources for the benefit of stakeholders, particularly local communities.

Wetland ecosystems evolve and function within particular physical templates, the characteristics of which are determined primarily by the interaction between water and sediments. Water apart from being an integral part of an ecosystem, is a natural resource, and social and economic good, whose quantity and quality determines the nature of its use. Considering these interactions, an Integrated Water Resource Management (IWRM) has been adopted as the guiding approach for management planning. The framework brings together stakeholders at all levels considering their needs and aspirations while ensuring conservation of the wetland ecosystem within the river basin (
Figure 1). A critical requirement for IWRM is introduction of land use and water planning and management mechanisms which are aligned with ecological character of wetland complex. IWRM at river basin and coastal zone scale is also underlined in the New Guidelines for Management Planning endorsed by the Eighth Meeting of Contracting Parties to the Ramsar Convention[6]. In order to safeguard site and their features, the planning process recommends adoption of an adaptable management process which allows wetland managers to respond to the legitimate interest of others, adapt to ever-changing political climate, accommodate uncertain and variable resources, and survive the vagaries of the natural resources.

The broad approach for management planning of VKW is characterised by the following:

- Use of wetland ecological character and basin level land and water management interactions as a basis for setting management objectives and targets
- Integrating wetland management within sectoral developmental planning, especially urban development
- Balancing the needs of biodiversity conservation with securing livelihoods of dependent communities
- Promoting cross-sectoral institutional arrangements, the particular involvement of local communities and stakeholders in wetland management

6 Resolution VIII.14 – New Guidelines for management planning for Ramsar sites and other wetlands. Also available as Ramsar Handbook 18, Fourth Edition, 2010

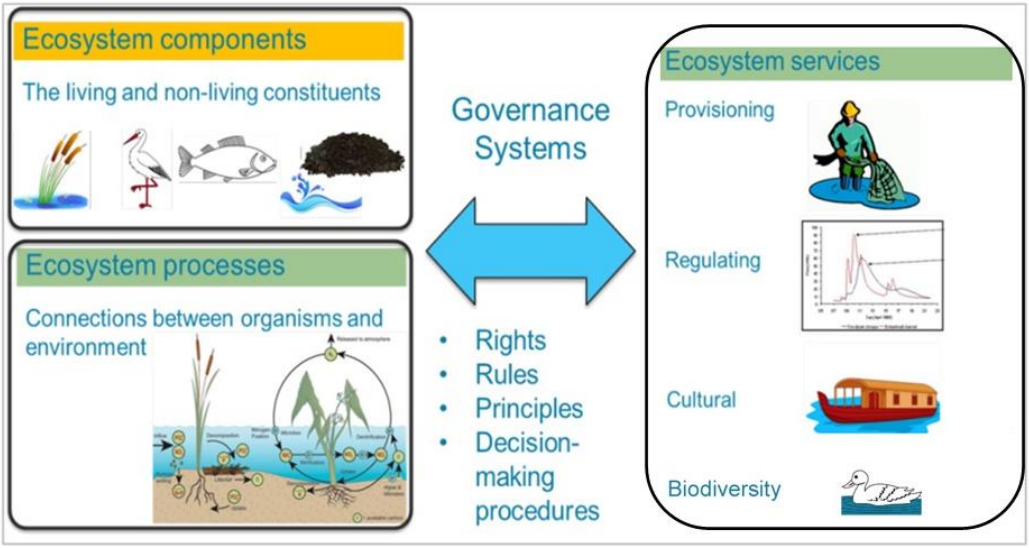

Figure 1: Wetlands wise use framework

- Integrated wetland inventory, assessment and monitoring system (WIAMS) to support decision-making
- Integrating traditional knowledge and practices with assessments and management planning procedures
- Periodic monitoring and evaluation with focus on achieving the goals and objectives rather than merely activities

The Contracting Parties to the Ramsar Convention, in their Tenth Conference of Parties adopted Resolution X.27 on Wetlands and Urbanization, urging all Contracting Parties to pay due attention to the importance of their wetlands in urban and peri-urban environments and to take appropriate measures to conserve and protect these wetlands, while giving due consideration to different national circumstances in each case; In the 11th Conference of Parties meeting, Resolution XI.11- Principles for the planning for management of urban and peri-urban wetlands were adopted. The following 5 policy principles laid down in the guidelines have direct relevance to VKW management:

- Policy principle 1: Wetlands and the range of services they provide are essential elements of the supporting infrastructure of urban and peri-urban settlements
- Policy principle 2: The wise use of wetlands contributes to socially and environmentally sustainable urban and peri-urban areas
- Policy principle 3: Any further degradation or loss of wetlands as a result of urban development or management should be avoided, and where not possible, any impacts should be mitigated, and any residual effects appropriately compensated for by offsets such as wetland restoration
- Policy principle 4: The full participation of indigenous and local communities, municipalities and government sectors involved in urban and peri-urban spatial planning and wetland management decision making is vital to creating sustainable urban and peri-urban settlements
- Policy principle 5: The threat of natural calamities and human-made disasters and their impacts on urban populations and wetlands requires government priority and convergent actions to enhance resilience to disasters.

The Sustainable Development Goals provide a unified framework for achieving societal well-being, including environmental security. The SDGs represent an ambitious agenda to eradicate poverty and achieve sustainable development by 2030. This 2030 Agenda for Sustainable Development provides a comprehensive roadmap for a sustainable future. Seventeen goals,

each with a number of concrete targets, translate this programme into action. The multiple benefits and services provided by wetlands, such as VKW, are essential in achieving the SDGs. The management plan builds-in the role VKW plays in assisting achievement of the SDGs within the context of state and national scale developmental planning.

The process of development and implementation of management plans for wetlands need to be accompanied by governance improvements at basin level. Such an approach underpins Integrated Lake Basin Management framework which calls for achieving 'sustainable management of lakes through gradual, continuous and holistic improvement of basin governance, including sustained efforts for integration of institutional responsibilities, policy directions, stakeholder participation, scientific and traditional knowledge, technological possibilities, and funding prospects and constraints. Achieving close relationship between planning and governance is critical considering multiple stakeholder and sectoral interests which underlie and to a large extent structure wetland biodiversity and ecosystem service values, and the need to secure people's involvement and participation in basin-scale management for considerably long periods of time.

Management planning for VKW imbibes the six governance pillars for Integrated Lake Basin Management[7] namely:

- Institutions: development of effective organisations and governance frameworks
- Policies: setting broad directions and specific rules
- Participation: expanding the circle of involvement
- Technology: possibilities and limitations
- Information: pursuing sources of knowledge and wisdom
- Finance: seeking for sustainable sources at an appropriate level

Methodology for the formulation of Integrated Management Action Plan for VKW has been developed through adaptation of New Guidelines for Management Planning for Ramsar Sites and Other Wetlands as adopted by the Contracting Parties to the Ramsar Convention on Wetlands in 2002. These guidelines also form the basis of the wetlands management planning guidelines of the MoEFCC's National Plan for Conservation of Aquatic Ecosystems (NPCA). In 2022, the Ministry also notified the Sahbhagita Guidelines – wherein a participatory and inclusive framework for wetland management has been outlined clarifying roles and responsibilities at various levels of administration.

The NPCA guidelines recommend following a diagnostic approach – wherein the selection of management interventions is guided by knowledge of wetlands features and factors governing these features, and their relationship with broader societal conservation and development goals that wetland wise use is contributing to. Wetlands features are its ecological, social, and institutional attributes, which collectively characterize a wetland. Wetlands are dynamic systems, and thus their features undergo cyclical and temporal changes. Factors (natural as well as anthropogenic) cause the wetland to move along a specific trajectory. The aforementioned wetland management planning method was implemented during the project phase in the steps indicated in Figure 2.

[7] RCSE and ILEC 2014 Development of ILBM Platform Process: Evolving Guidelines through Participatory Improvement (Shiga, Japan: International Lake Environment Committee Foundation (ILEC), Japan)

Figure 2: Framework for integrated management planning

Several consultations with the members of the government departments, academia, civil society organizations, and local government representatives were undertaken to inform the Integrated management planning processes (Annex XV).

In May 2022, an inception workshop was held in Kumarakom, Kottayam district to sensitize the different stakeholders and to understand their perspectives with regards to VKW Integrated Management Planning. Participants from academia and government departments presented the findings from the various scientific studies conducted on VKW at the workshop and highlighted specific issues.

Three stakeholder consultation workshops were held in Alappuzha, Kochi, and Thrissur in the first week of November 2022 to discuss the current institutional arrangements and future planning for wetland management in different parts of the wetland. The workshops were inaugurated by the sitting Member of Parliaments and Member of Legislative Assembly of the respective legislative and parliamentary constituencies. This enabled mobilizing local bodies to take an active interest and contribute to the management planning. The group works around wetland management themes – Institutions and Governance, Water management, Catchment Conservation, Species and Habitat Conservation, Community based Fisheries Management, Sustainable Wetlands Agriculture Interactions, and Sustainable Wetlands Tourism helped outline: (a) Wetland conditions and drivers of adverse change and the impacts of wetland deterioration on stakeholders (b) Current Institutional set up including information on organizational hierarchy, roles and responsibilities of different line departments towards conservation and sustainable management of VKW with information on challenges and constraints faced in executing the programs, interdepartmental coordination mechanisms, and the schemes, policies, and programs therein, and (c) Broad management actions for the Integrated Management of the VKW.

Subsequently, zone wise draft management action plans were prepared which were further refined and consolidated after seeking inputs from departments through one-to-one meetings with government functionaries and local self-government electives in Thiruvananthapuram, Alappuzha, and Kottayam in the first week of March 2023.

A final stakeholder workshop was held on 20th July 2023 wherein the action plans and budgets were consolidated.

Attendees from the Stakeholder Workshop held in July,2023

1.5 Management Plan Structure

The management plan has eight chapters, in line with the structure recommended by the MoEFCC. The chapter 1 provides the management planning context. The chapter 2 and 3 contain description and evaluation of wetland features and assessment of risk of adverse change. The effectiveness of current institutional arrangements in preventing the adverse change in wetland ecological character is analysed in Chapter 4. The management planning framework is discussed in Chapter 5, and the monitoring plan in Chapter 6. The action plan is in Chapter 7 and budget and financing discussed in Chapter 8 of the plan.

2. Description and evaluation of wetland features

2.1 Location and Extent

The VKW extends between 9°15' to 10°36' latitudes and 76°01' and 76° 34' longitudes in a shallow, and for most parts, below sea level depression along the central Kerala coastline within Alappuzha, Kottayam, Ernakulam and Thrissur districts. Vembanad estuary, Kuttanad and Kol lands are its three major physiographic divisions which are interconnected by an intricate network of natural and man-made channels.

The Ramsar Site comprises of three distinct ecological zones. The Vembanad estuary complex extends to 429 km^2, which includes 272 km^2 open water area and additional 184 km^2 as islands, marshes and coastlines. Wetland areas in Kuttanad are reported to extend 900 km^2[8] and are areas reclaimed from Vembanad estuary and floodplain marshes. The area is characterized by presence of peaty acidic and alluvial soils having elevation at or below sea level, and congested drainage patterns leading to prolonged inundation during post monsoon period.

Vembanad is a bar-built estuary[9] which receives inflows from seven rivers[10] and has four major openings into the Lakshadweep Sea. The mouth at Kochi which houses the Cochin port and harbour is its most prominent connection to the sea. The opening of River Periyar at Azhikode marks the northern tip of the estuary. There is an opening at Thottapally and another one at Chettuva. There are 22 other medium/minor outlets also. The stretch between Vaikom and Cochin is dotted by a number of islands. Wellingdon, located adjacent to Kochi City, has been developed on a natural island by dumping dredged material from the Cochin port and harbor. Vypeen is largest of a series of seven islands between Azhikode – Kochi. Pathiramanal is a 68-ha natural island located between Muhamma and Kumarakom harbouring significant biological diversity, especially of waterbirds. Patches of mangroves exist along the inner shorelines of the estuary, the largest existing chunk being around Kumarakom.

The Vembanad estuary is flanked by river floodplains in north (Kol lands) as well as south (Kuttanad). Kol lands cover an area of 13,632 ha and spread over Thrissur District of Kerala, which extends to northern bank of Chalalakudy river in the south and to Chettuva Estuary in the north. The area lies between 10° 10´ and 10° 36´ N and 76° 01´ and 76° 18´ E. The Kol lands developed from sea lagoons. These gradually developed to shallow lands which could be bunded and dewatered by farmers and turned as rice granary of Kerala[11].Rice cultivation in Kol lands is said to have started way back in the eighteenth century.

Kuttanad is a floodplain of Rivers Achencoil, Pamba, Manimala, Meenachil and parts of Muvattupuzha which have been converted over a period of time into permanent agricultural lands for cultivation of rice and coconut. These include a substantial portion of Vembanad estuary reclaimed through construction of polders (locally called *padashekharam*) and

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[8] The overall area of Kuttanad has been reported to be 900 km^2 of which 550 km^2 is land reclaimed from Vembanad estuary and floodplain marshes of Pamba, Achenkoil, Manimala and Menachil Rivers. The rest is constituted by highlands, which are mainly used for settlements. The reclaimed area is classified into six agro-ecological zones. Land reclaimed from estuary is characterized by polders and is classified as Kayal and Lower Kuttanad, with total extent of 257 km^2. Upper Kuttanad, North Kuttanad, Purrakad Kari and Vaikom Kari are land reclaimed from floodplain marshes and extend to 293 km^2.

[9] An estuary is a semi enclosed coastal body of water which has a free connection with open sea and within which sea-water is measurably diluted with freshwater derived from land drainage (Pritchard, 1967). From a geo-morphological perspective, estuaries can be classified into four categories: (1) drowned river valleys, (2) fjord type estuaries, (3) bar-built estuaries, and (4) estuaries produced by tectonic processes. Bar-built estuaries are formed when offshore barrier sand islands and sand spits build above sea level and extend between headlands in a chain, broken by one or more inlets.

[10] Rivers Pamba, Achencoil, Manimala, Meenachil and Muvattupuzha flow into Vembanad through Kuttanad, whereas Chalkudy and Periyar flow directly into the estuary. Three rivers, namely Keechari, Puzhakkal and Karuvannur flow into Kol lands.

[11] Vineetha, S., Bijoy Nandan, S., and Rakhi Gopalan, K. P. (2015). Composition, abundance and diversity of macrobenthic fauna in Kole paddy fields, Vembanad Kole Wetland, India. International Journal of Current Research, 7(10), 20941-20947.

modification of natural hydrological regimes. Kuttanad is also known as the 'Rice Bowl of Kerala' owing to high agricultural productivity. There are presently around 1,200 polders in this region. The Kol lands are floodplains of Rivers Keecheri, Puzhakkal and Karuvannur, reclaimed for agriculture. Both Kuttanad and Kol lands have major portions located below sea level and are flooded for prolonged periods after monsoon. Brackish marshes around Kochi have traditionally been used for rice-shrimp aquaculture, locally known as *Pokkali*.

The present extent of VKW is a fragment of an extensive wetland regime and interconnected river floodplains extending between Thrissur and Arattupuzha which existed till the beginning of the 19th century. Conversion of wetlands for agriculture, settlements and infrastructure development as ports particularly in the last century has fragmented the entire regime, with several areas losing wetland characteristics.

At the time of Ramsar Site designation in 2002, the area of VKW was indicated to be 1512.50 km^2. However, the maps submitted to the Ramsar Convention Secretariat were not geo-referenced. The Ramsar Site Area also included predominantly built-up areas of Kochi and its surroundings. During the recent RIS updation submitted in 2022, the SWAK has submitted a revised map excluding the built-up areas which has led to a reduction in the Ramsar Site area by 189.7 km^2 leading to a revision in the total area to 1322.8 km^2. A trend analysis of land use and land cover classes within VKW Ramsar Site is presented in Table 1, Figure 3, Figure 4, Map 2, Map 3 and Map 4. The analysis is based on interpretation of post-monsoon LANDSAT 5 and LANDSAT 8 images. The trend analysis indicates a decline in open water area and area under agriculture. There has been a significant increase in built-up area.

Table 1: Land use and land cover classes in VKW Ramsar Site (All figures in km^2)

Land use and land cover classes		**2001**	**2022**
Open Water*		344.1	272.2
Built-up (Including bareground)		42.8	74.2
Agriculture		756.7	651.0
	Paddy (BSL)	496.2	426.0
	Paddy (Other)	201.6	173.5
	Pokkali	56.4	40.4
Vegetation		187.1	327.2
	Mixed Vegetation	176.4	334.6
	Mangroves	0.8	1.5
Sand		4.7	0.7
Total		**1323.0**	**1323.0**

* This includes area under water hyacinth 0.6 km^2 in 2001 and 0.2 km^2 in 2022

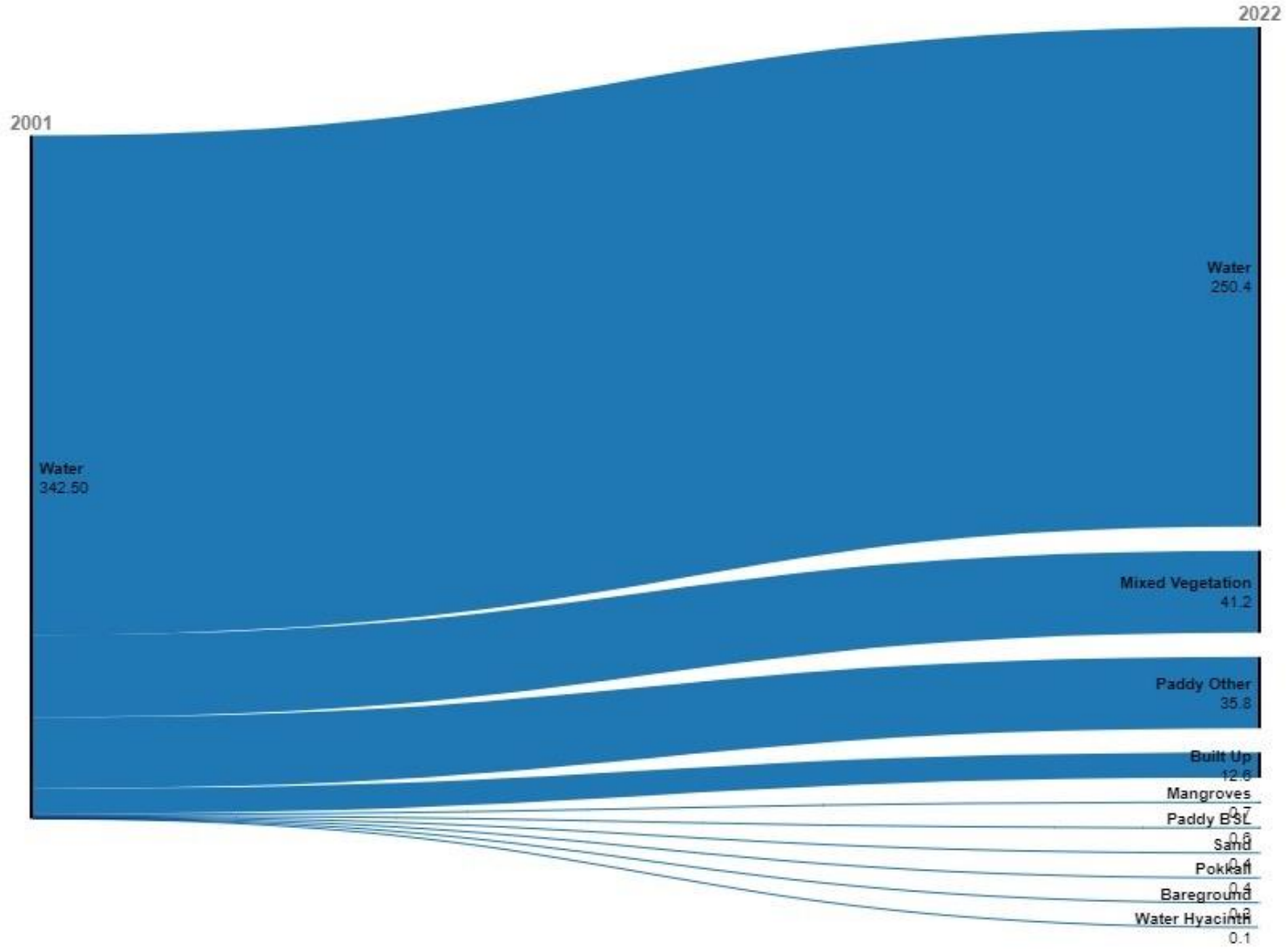


Figure 3: Open water conversion within two decades (2001-2022) to other land use types in VKWs Ramsar site

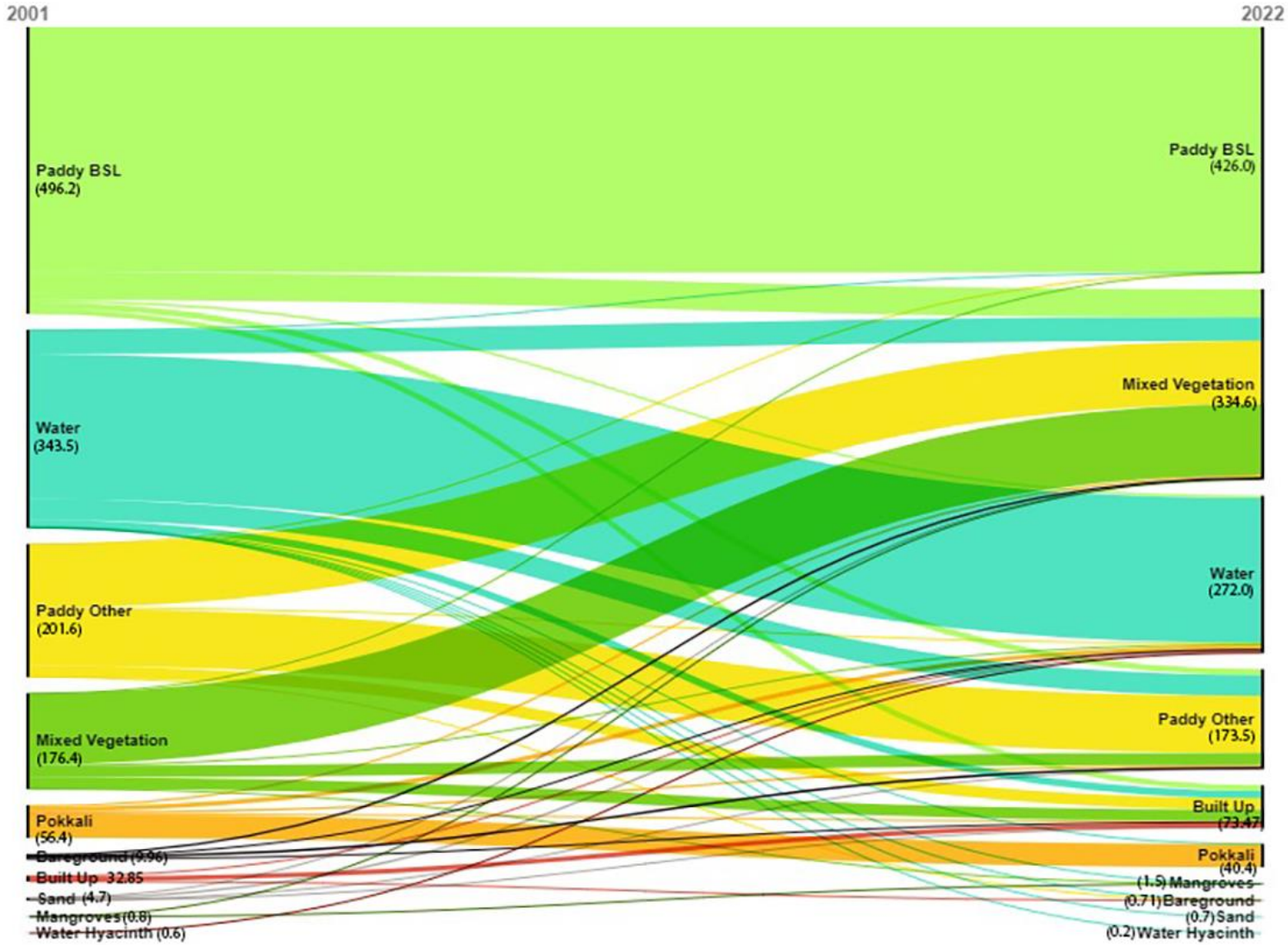
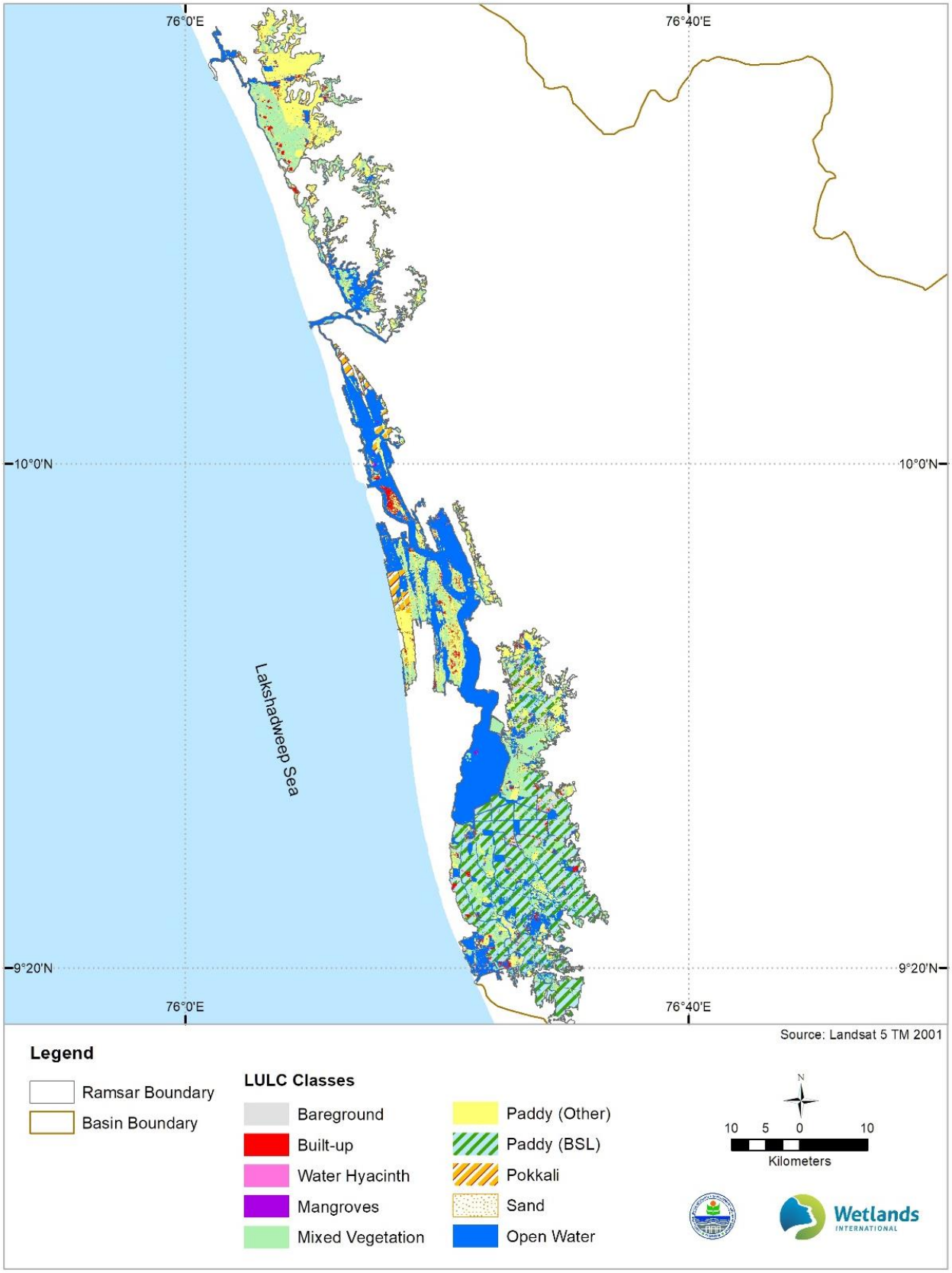
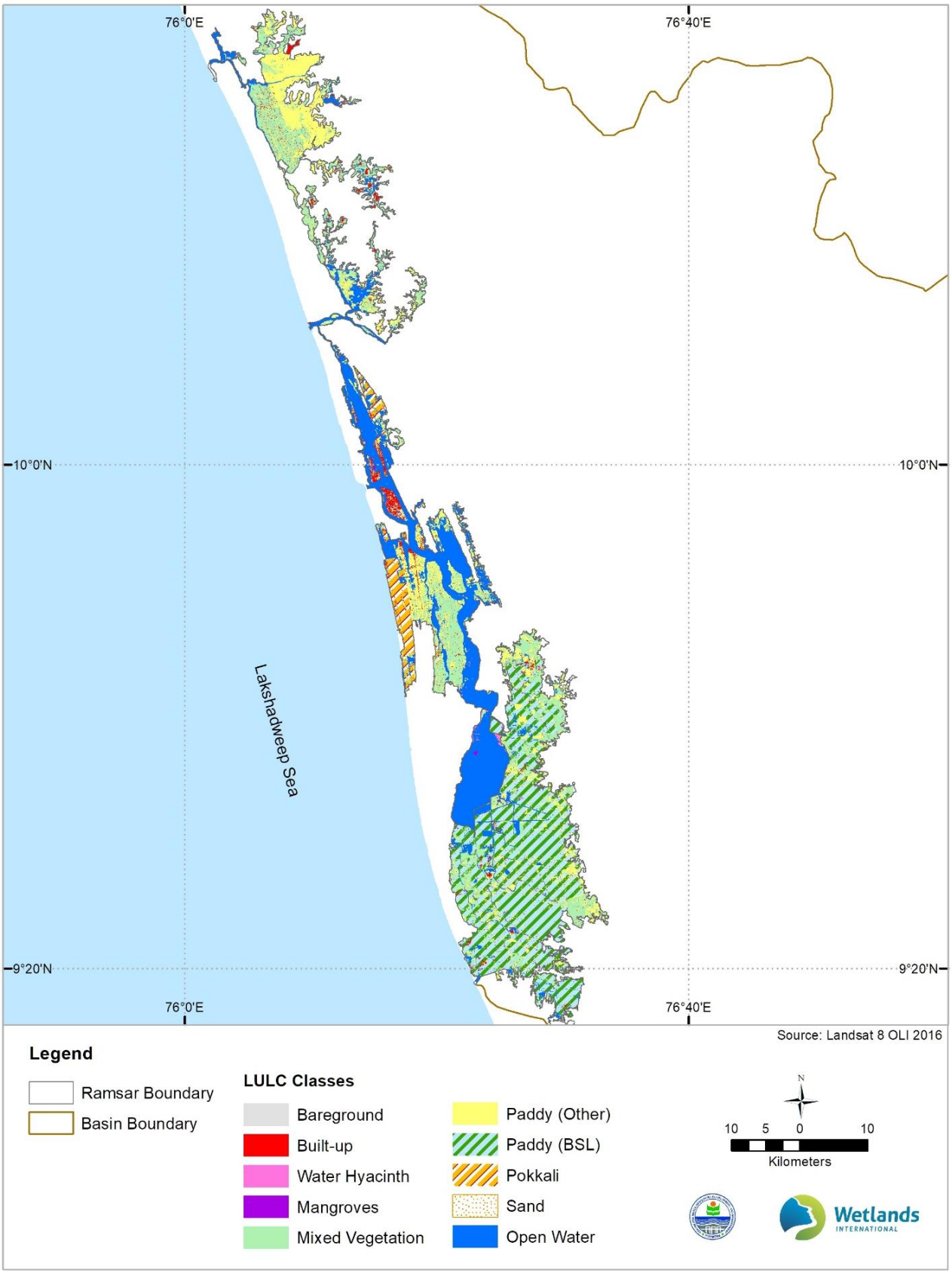


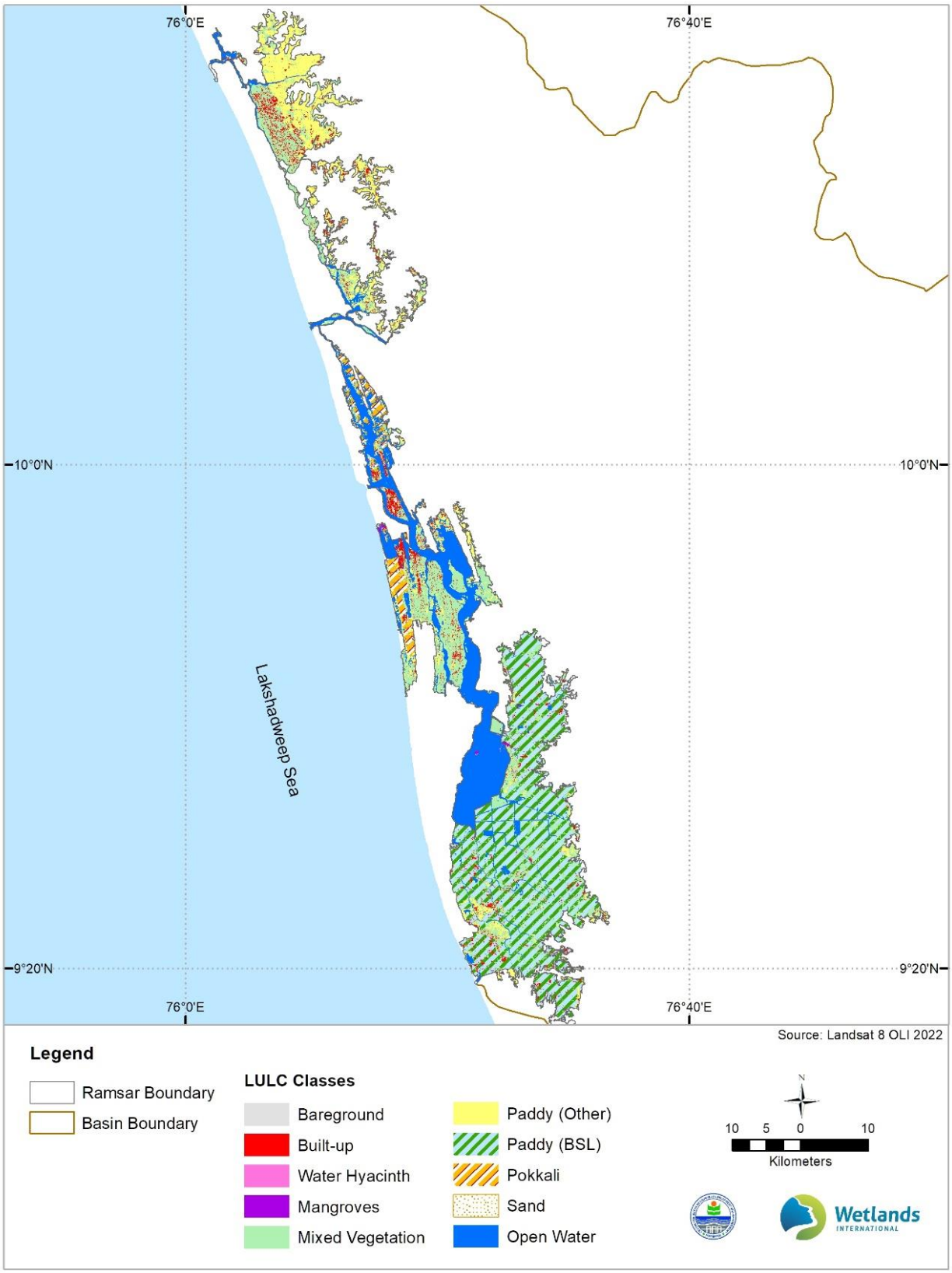
Figure 4: Land Use and Land Cover conversions within two decades (2001-2022) in VKWs Ramsar site



Map 2: LULC of VKW Ramsar boundary for 2001



Map 3: LULC of VKW Ramsar boundary for 2016



Map 4: LULC of VKW Ramsar boundary for 2022

2.2 Geology and Geomorphology

The Kerala coast is characterised by occurrence of tertiary and recent sediments. The rivers and streams flow mostly parallel to the coastal plain and their courses have evolved in response to the depositional history of the lagoon systems that prevailed during the Quaternary. The Alappuzha - Ponnani stretch is composed purely of alluvium of recent deposits with prominent palaeo strandlines. Palaeo beach ridges or regression-transgression features are prominent in the landmass between Kochi mouth to the south. One of these sets of features run parallel to Alappuzha - Kochi coast line and separates the Vembanad- Kuttanad area from the Lakshadweep Sea[12]. The sand in the beach zone of Kerala contains significant quantities of heavy minerals[13].

Vembanad is one of the largest tropical estuaries of India and a major burial ground for Quaternary deposits[14] (Map 5). The wetland complex formed a part of marine environment in the geological past, with an alluvial bar boundary running parallel to the coast and interrupted at places by Arabian Sea. In AD 1341, a catastrophic cyclone is believed to have induced change in course of River Periyar resulting in formation of islands and separating a distinct waterbody that yet maintained connection with the sea[15]. Peat deposits, with a radiocarbon age of 40,000 years BP have been identified at different depths in the boreholes between sandy clay and clayey sand sedimentary facies. Pollen analyses of peat reveal the existence of mangrove vegetation and evergreen forest[13].

Mostly coastal alluvium soils are found within the wetland complex (Map 6). The predominant role of fluvio-estuarine deposition is indicated by the presence of black carbonaceous clay, high organic content, acidic soils and a peaty substratum in major parts. The soils of Kuttanad exhibit the effect of anaerobic decomposition and are acidic in reaction due to microbial oxidation of organic matter.

Soils in Kol land is of piedmont type, silted up with alluvium brought down by Rivers Karuvannur, Puzhakkal and Keechery. Texturally the material ranges from fine to coarse clastic particles derived from the surrounding lateritic hills. Based on textural analysis, soil in the region has been classified into clay, sandy loam, sandy clay loam, and clay loam[16].The presence of organic peat layer in the sub-surface makes soils extremely acidic (pH ranging between 2.6 to 6.3). The total nutrient content of the soil throughout the Kol land is 0.14-0.57% nitrogen, 0.2-0.24 % P_2O_5, and 0.09-0.6 % of K_2O. CaO levels are also reported to be very high[17].

Crystalline and sedimentary rocks of tertiary ages are prominent in the Western Ghats from where the rivers flowing into the wetland complex originate. An intervening narrow stretch of the midlands are lateritised to various depths whereas the recent and sub recent sediments form the low lying and river valley bottoms. Forest loam soils occur in the upper reaches. The middle reaches are characterized by lateritic formations interspersed with brown hydromorphic soils, whilst riverine alluvium is found in the river floodplains.

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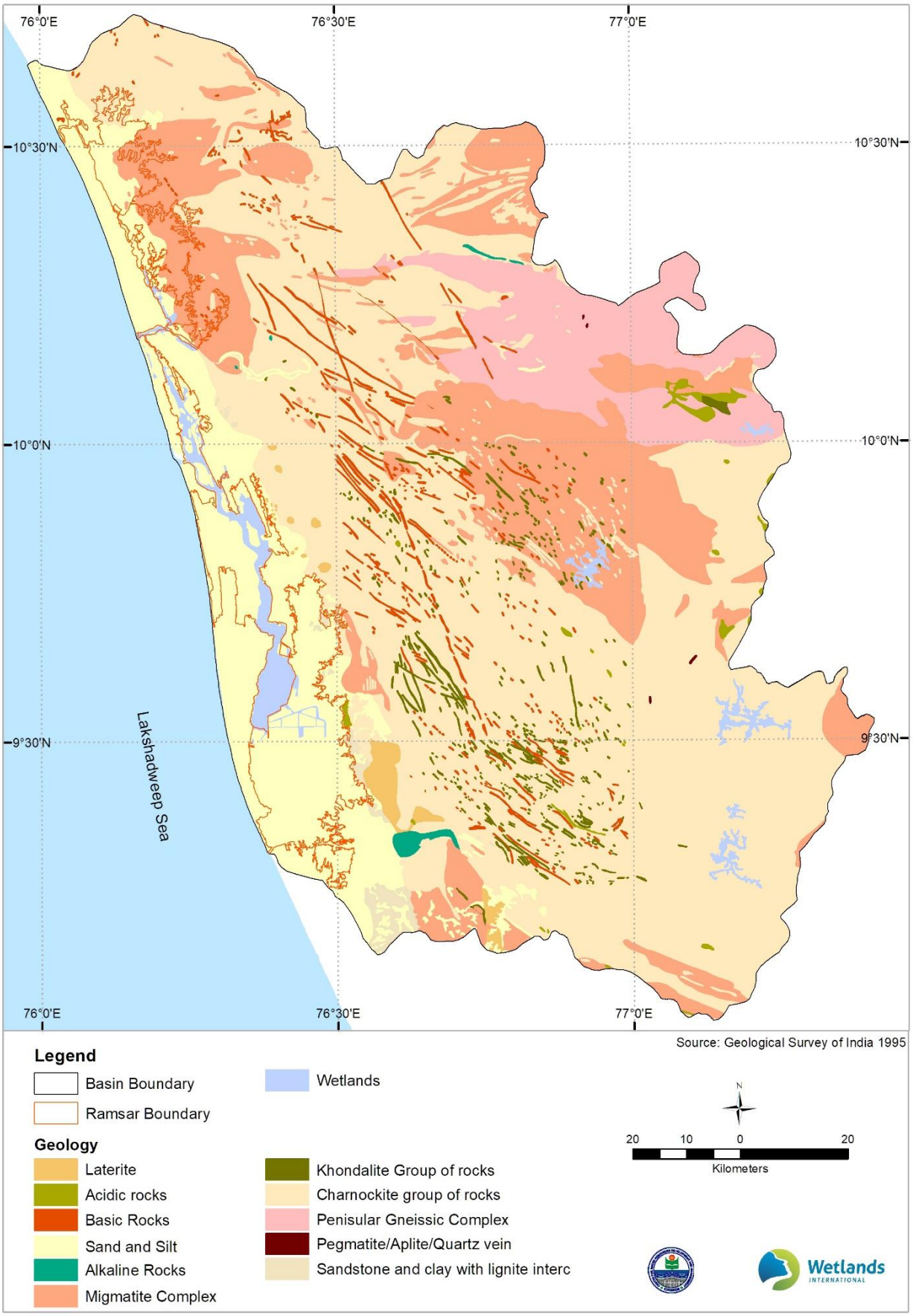
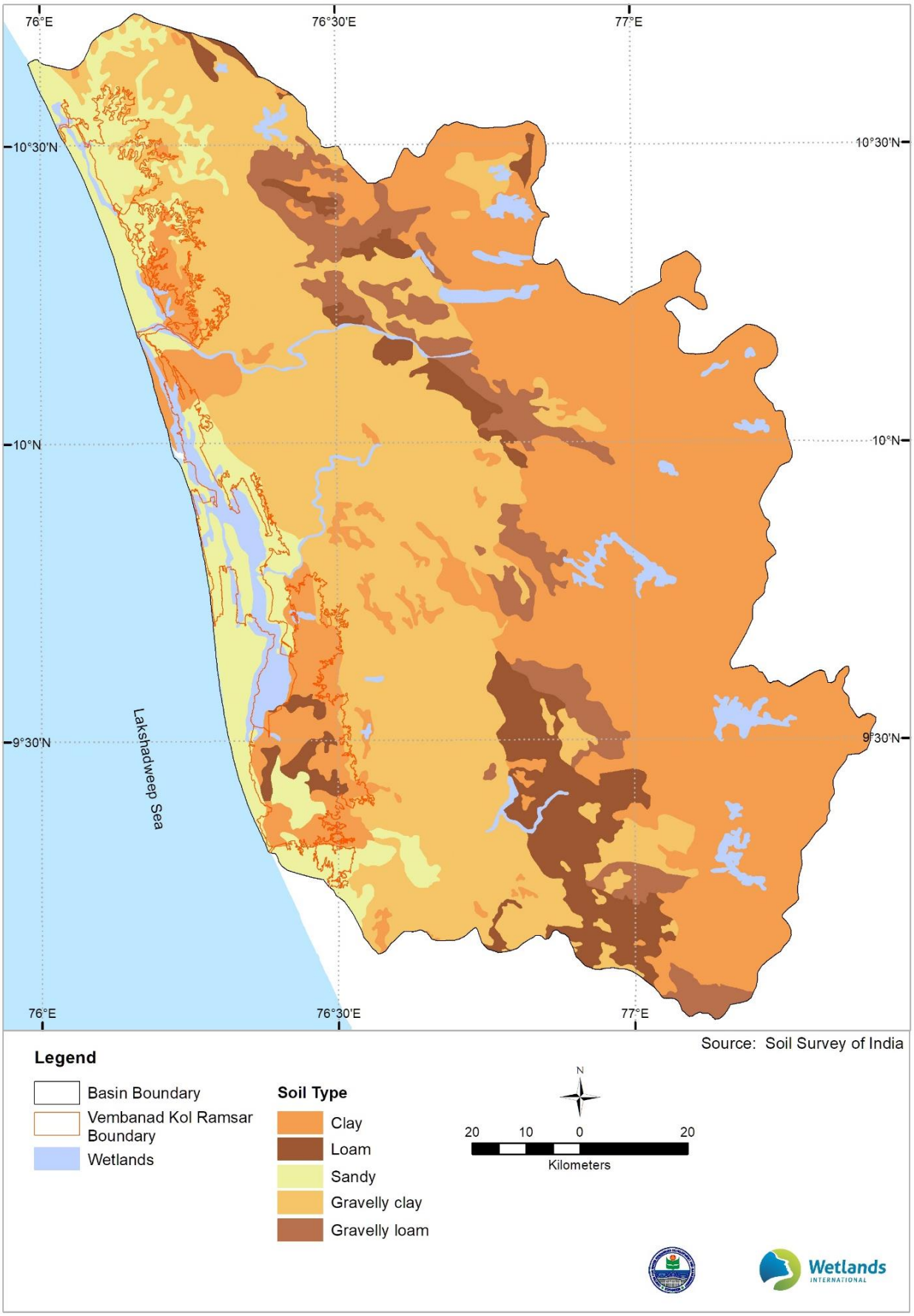


Map 5: Geological formations in Vembanad-Kol catchment



Map 6: Soil types in Vembanad-Kol catchment

2.3 Wetland Catchments

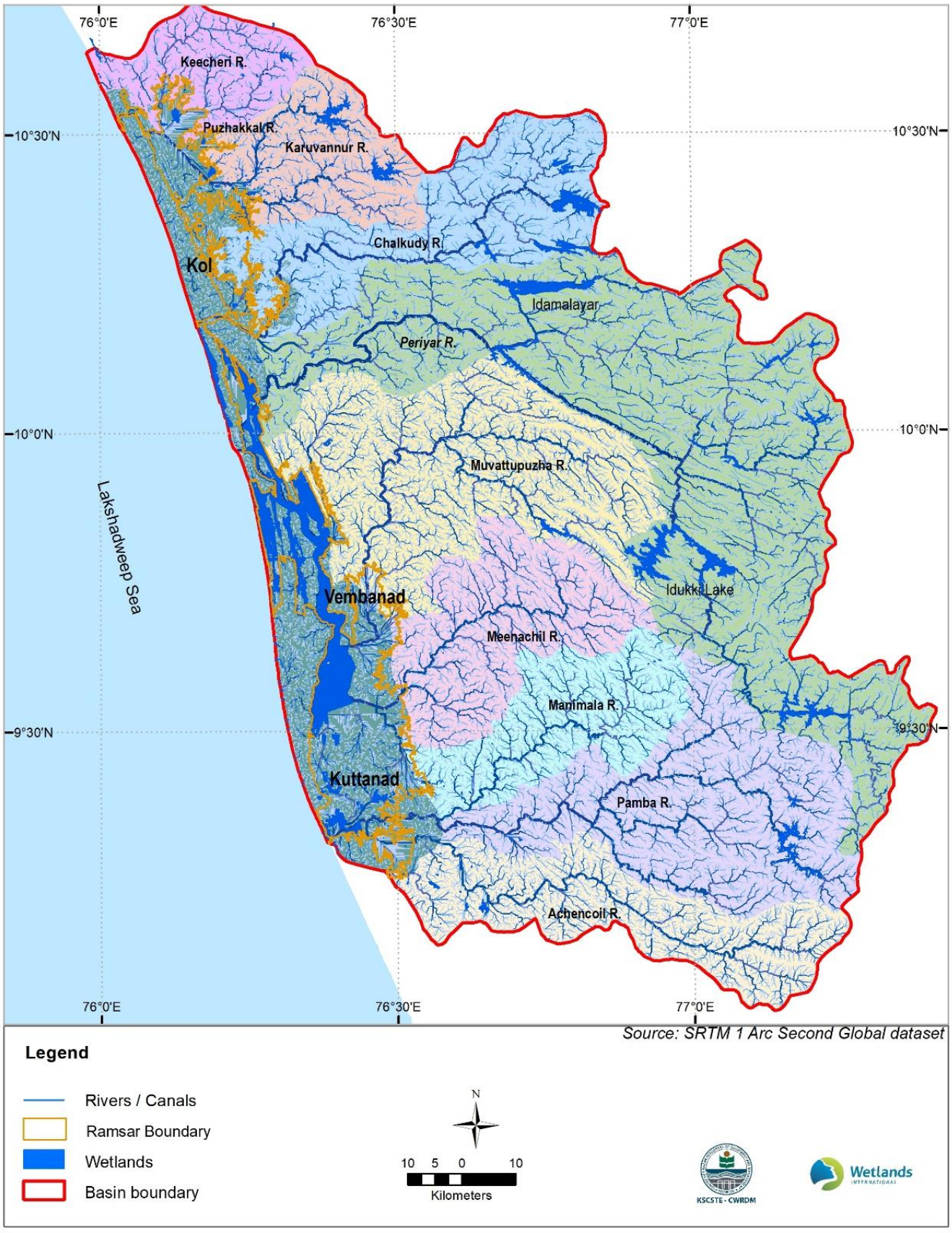
The VKW receive inflows of ten rivers (Keecheri, Puzhakkal, Karuvannur, Chalakudy, Periyar, Muvattupuzha, Meenachil, Manimala, Pamba and Achencoil) all of which originate in Western Ghats. The drainage basins of these rivers span 13,969 km^2 area (between 9° 17' and 10° 43' latitude and 75° 58' and 77° 24' longitude) in seven districts of the state (Alappuzha, Idukki, Ernakulam, and parts of Kottayam, Thrissur, Palakkad, and Pathanamthitta) (Map 7).

The catchment of Vembanad-Kol is dominated by undulating, subdued hills and steep scarp slopes with altitude ranging between below MSL to around 2,700m above MSL (Map 8). Based on topography and elevation profile, the catchment has been classified into three broad categories: highlands, midlands and lowlands. The highland region has elevation ranging between 75 to 2,700m above MSL and is largely covered by forests and plantations. The midlands have altitudes between 7 to 75m amsl and are largely dominated by agriculture and plantation. The lowland region wherein the VKW complex is located is a narrow coastal strip bordering the Arabian Sea marked by presence of wetlands interspersed with agriculture and settlement areas. The highlands and midlands cover 49% and 22% of the basin area respectively.

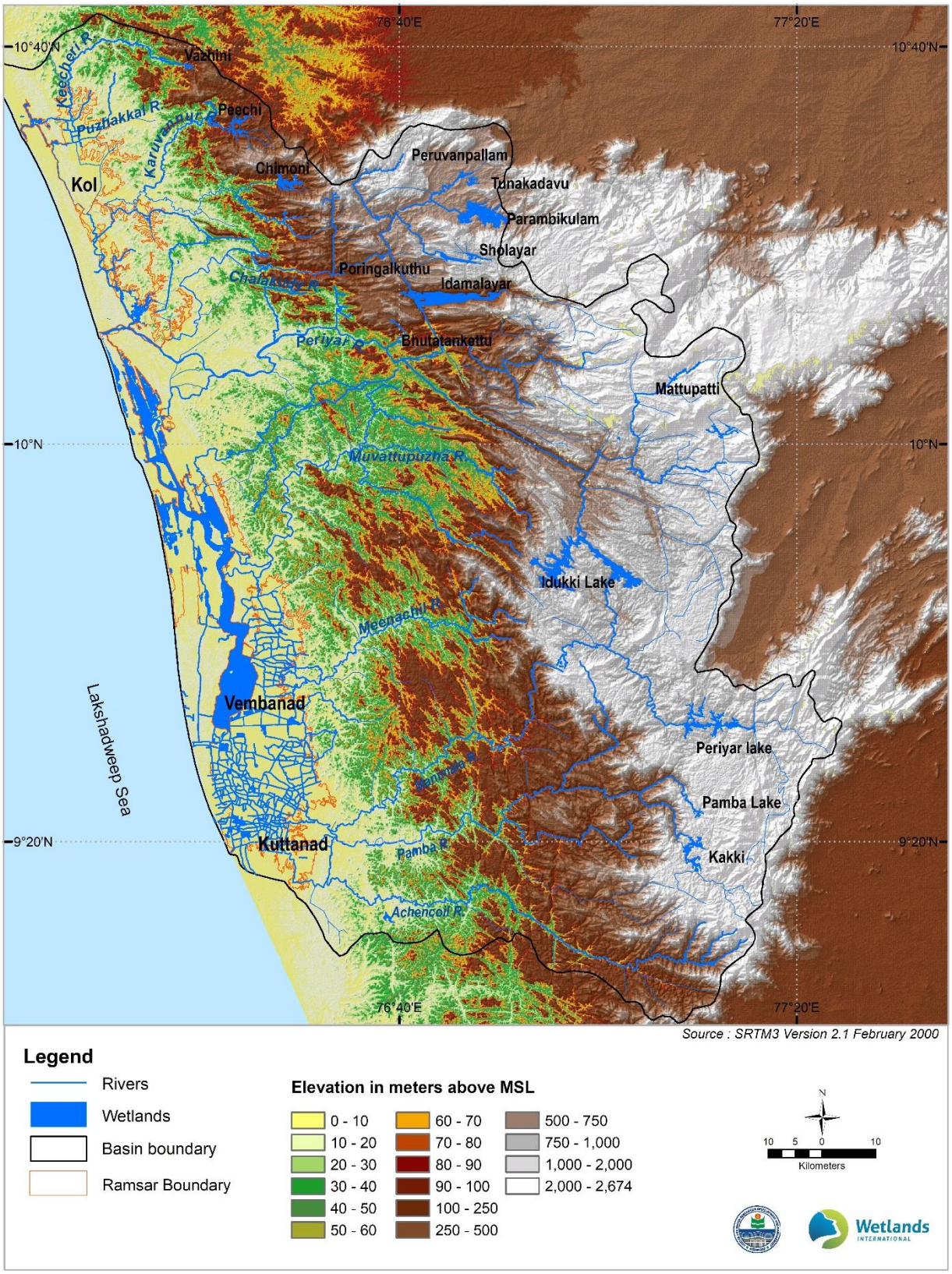
The rivers of the Vembanad-Kol catchment are steep, fast flowing and monsoon fed. The rivers flow down the highlands over steep slopes of almost 60 m/km or more to midland and lowland stretches with much flatter slopes of 1m/km. Periyar with a basin area of 5,284 km^2 is the largest river draining into the wetland complex (Table 2). Assessment of land use and land cover of the basin using satellite imageries of 2005 and 2015 indicate forests to be the predominant category followed by agriculture and plantations (Table 3 and Map 9, Map 10 and Map 11)

Dense forests are present in 3564 km^2 of the catchments mostly restricted within its highlands. Temperate *Shola*[18] forests are found at an altitude of 1800m amsl. These forests are characterized by dense growth of trees in the depressions and folds of the Western Ghats surrounded by extensive areas of grasslands. The forests in the lower reaches belong to moist deciduous category, and wet evergreen forests. The evergreen and semi evergreen forests have generally three-tiered vegetation with *Acrocarpus fraxinifolious, Antiaris toxicaria, Calophyllum* sp., *Cullenia exarillata, Dichopsis elliptica, Dipterocarpus indicus* and other species forming the top canopy. The middle storey comprises *Actinodaphne hookeri, Baccaurea courtallensis, Canarium strictum, Cinnamomum zeylanicum, Elaeocarpus* and the third storey of *Euonymus* sp., *Leea sambucina* etc. The moist deciduous species found within the catchment area include *Tectona grandis, Dalbergia latifolia, Pterocarpus marsupium, Adina* sp. and related species.

[18] Sholas are local names for patches of stunted tropical montane forests found in valleys amid rolling grasslands in the higher montane regions.



Map 7: Drainage basins and stream network within Vembanad-Kol catchment



Map 8: Elevation profile of Vembanad-Kol catchment

Table 2: River Basins of Vembanad-Kol Catchment

Name of the Basin	Area (km^2)[19]	Lowland (km^2)	Midland (km^2)	High land (km^2)
Achancovil	1120.93	93.81	472.09	555.03
Pamba	2180.38	405.69	327.27	1447.41
Manimala	869.11	43.71	336.93	488.46
Meenachil	859.58	16.98	468.91	373.70
Muvattupuzha	2011.16	216.35	1254.44	540.38
Periyar	5411.07	365.41	1304.91	3740.75
Chalakkudi	1217.73	30.97	352.66	834.10
Karuvannur	1052.56	145.09	545.27	362.20
Keecheri & Puzhakkal	673.44	170.49	424.01	78.93
Total	**15395.96**	**1488.49**	**5486.49**	**8420.98**

Table 3: Land use Land cover of Vembanad-Kol Catchment[20] (1985, 2005, 2015)

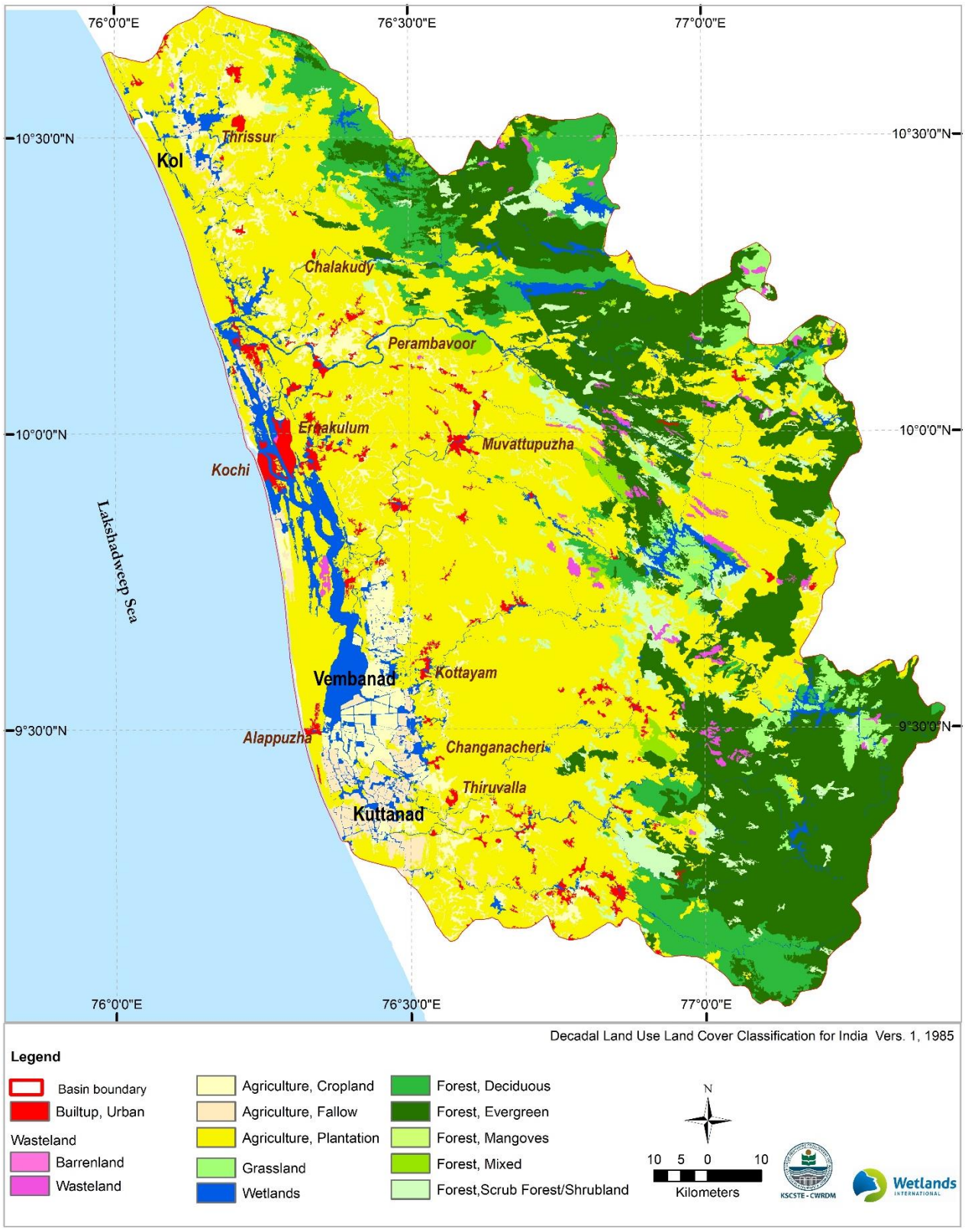
Land use Land cover categories	Area in km^2 1985	Area in km^2 2005	Area in km^2 2015
Built-up, Urban	277.51	501.30	421.26
Built-up, mining	-	-	33.91
Agricultural land	9085.00	8994.00	8930.14
Builtup, Rural	-	-	1123.63
Agricultural Plantation	7898.00	7840.00	6702.41
Agriculture, Crop land (Fallow/Cropland)	1186.93	1153.74	1104.10
Barren/Wasteland	126.31	116.79	628.06
Water bodies	862.83	842.39	792.48
Grass/ Grazing land	346.89	336.80	24.99
Forest, Swamp / Mangroves	0.74	0.76	0.09
Forest (Evergreen/ Deciduous/Mixed)	4928.00	4753.00	3564.00
Forest, Forest Plantation	-	-	884.36
Scrub Forest	592.22	674.38	939.63
Total	**16219.50**	**16219.50**	**16219.50**

[19] This excludes area of Kuttanad 900km^2 below sea level

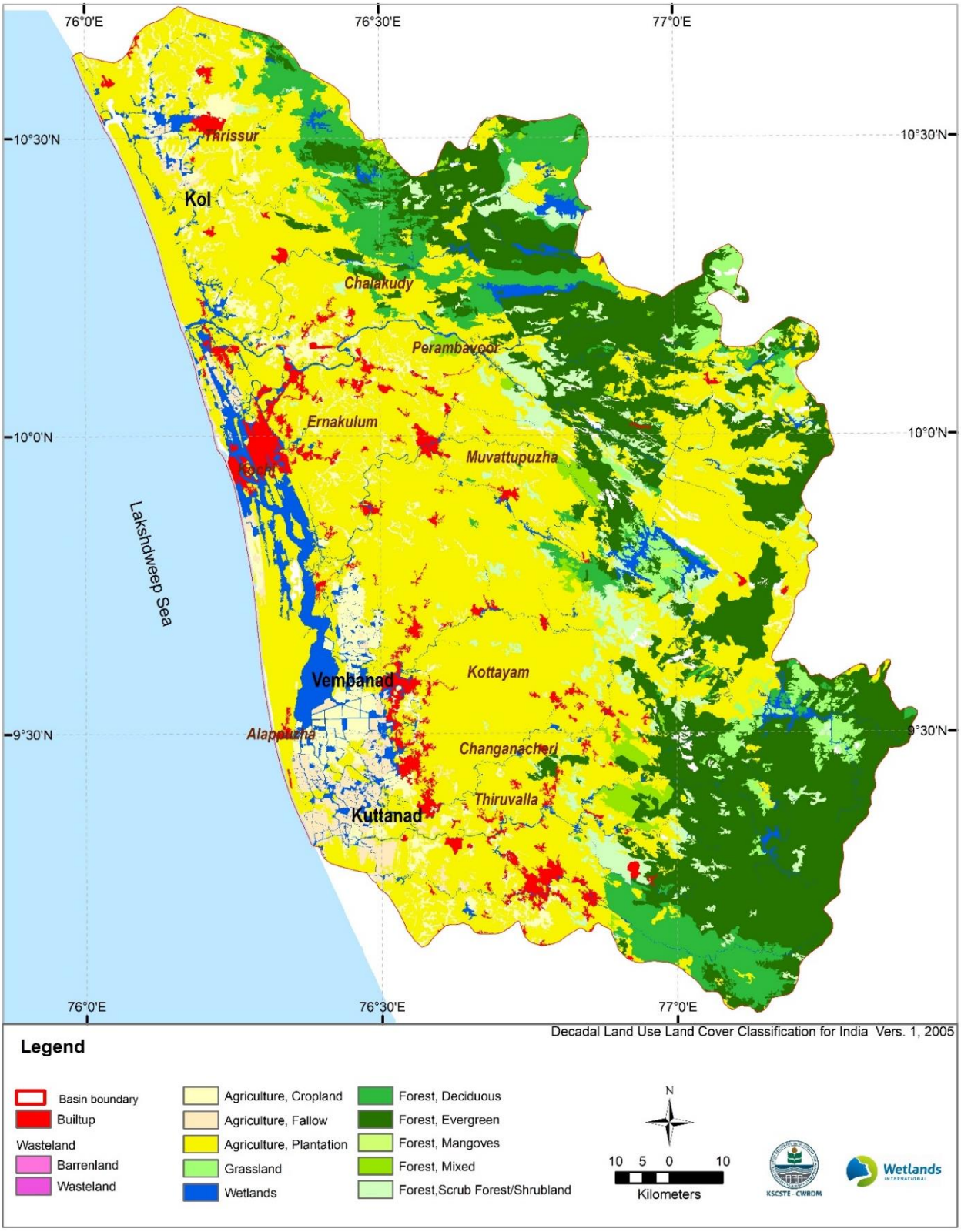
20 The Land Use Land cover statistics for 1985 and 2005 have been sourced from the Decadal Land Use and Land Cover Classifications across India available for the year 1985, 1995, 2005. This data set provides land use and land cover (LULC) classification products at 100-m resolution. The data were derived from Landsat 4 and 5 Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Multispectral (MSS) data, India Remote Sensing satellites (IRS) Resourcesat Linear Imaging Self-Scanning Sensor-1 or III (LISS-I, LISS-III) data, ground truth surveys, and visual interpretation. The data were classified according to the International Geosphere-Biosphere Programme (IGBP) classification scheme and the minimum mapping unit is 2.5 ha (More details can be found at https://daac.ornl.gov/VEGETATION/guides/Decadal_LULC_India.html).

The 2015 Land Use Land cover statistics are sourced from the geo-spatial database on "Land Use/ Land Cover on 1:50,000 scale" prepared using three season Resourcesat-2 ortho rectified LISS-III data of 2015-16 avaialble online. Entire databases are prepared by NRSC, ISRO under the Natural Resources Census (NRC) Project of the National Natural Resources Repository (NRR) Programme. The LULC database is prepared with 54 class LULC Classification Schema and is harmonized to 24 classes for disseminating through Bhuvan, ISRO Geoportal by emphasizing more on Land Cover. (More details can be found at https://bhuvan-app1.nrsc.gov.in/2dresources/thematic/LULC503/lulc.pdf).

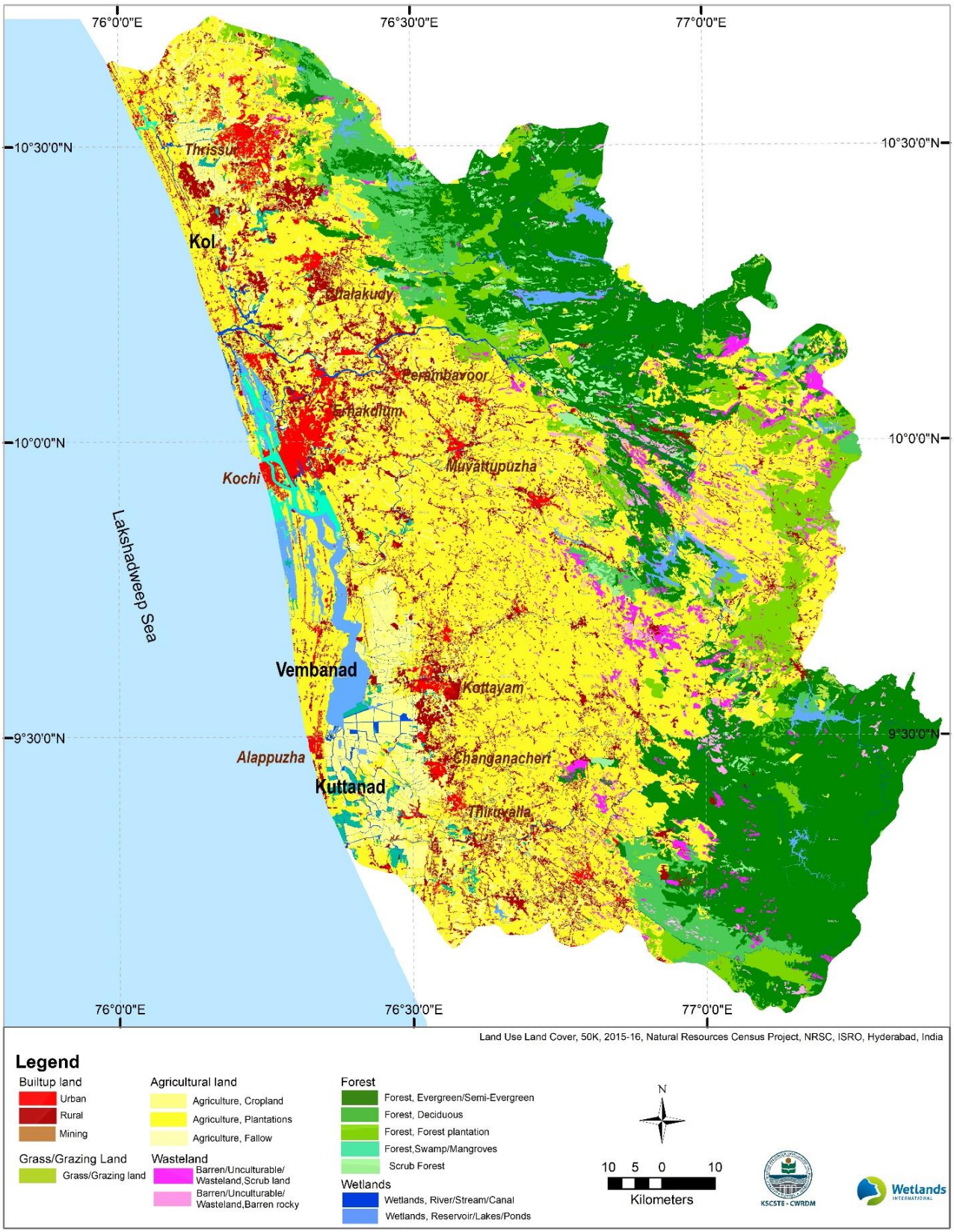
An accurate comparision of Land Use /Land cover statistics is difficult as the data source, classification scheme, and methodology differ. The LULC scheme used by NRSC in 2015 divides built-up into three subcategories of urban, rural, and mining whereas the previous LULC of 1985 and 2005 have a single built-up category. The rural built-up area of 2015 was previously classified as agricultural land. Forest plantations were classified in 2015, however, this class was previously not identified separately. These forest plantations were part of the Forest (Evergreen/ Deciduous/Mixed) category. Hence no trends in forest plantations can be drawn separately. However, total forest cover (inclusive of plantations) is on the decline. Caution is advised while comparing the LULC statistics of the three time periods.



Map 9: Land use land cover of Vembanad-Kol catchment 1985



Map 10: Land use land cover of Vembanad-Kol catchment 2005



Map 11: Land use land cover of Vembanad-Kol catchment 2015

Agriculture plantations account for roughly 41% of the catchment. In 2015 agricultural plantations covered an area of 6702 km^2. In 2015, forest plantations covered an area of 884.36 km^2. These plantations in the highlands have been mostly developed through clearing of the forest. Major crops grown are rubber, tea, coffee and cardamom. Food crops as well as cash crops are cultivated in the mid lands. Rice and tapioca are the main food crops while rubber, coconut and pepper are the main cash crops. Annual crops like plantain and pineapple, seasonal crops like ginger, tubers, vegetables and a wide range of perennial crops like jack fruit, and mango are also grown. Home gardens are the characteristic feature of farming systems in the midlands. The selection and inclusion of crops are influenced by the climate and by household preferences, requirements, and dietary habits. Coconut is the base crop in most of the agro climatic areas, except in the high ranges. The spaces between coconut plants are used to raise an array of intercrops, resulting in a multi-storey cropping pattern with distinct canopy stratification. Perennial crops such as coconut, areca nut, jackfruit, mango, cashew, tamarind, and forest tree species occupy the upper layer; pepper, clove, nutmeg, and cinnamon occupy the second layer; banana, cassava, yam, and the like occupy the third layer; and ginger, turmeric, pineapple, vegetables, and guinea grass occupy the ground layer.

Agriculture in lowlands is mostly concentrated in Kuttanad and Kol lands (Box 1: Rice paddies of Kuttanad). Marshes within Ernakulam and Alappuzha districts are also used for brackish water aquaculture. Rice fields, after harvests are fitted with locally made gates and water from the high tides is allowed to be retained within the fields. This locally evolved technology is called *Pokkali*.

Urban settlements accounted for around 2.6% of the catchment area as per 2015 land use land cover. In addition, 34 km^2 of built-up area is under mining in the wetland catchments. As per 2011 census, the basin is inhabited by 8.8 million people, mostly concentrated in 84 urban centres. Rural settlements spread over 1124 km^2, account for 6.93% of the catchment area. Physiography of the area has distinct influence on the settlement patterns. The coastal lowlands and midlands, which provide congenial grounds for development of transportation networks, commercial activities and access to other social infrastructure, have comparatively higher population densities as compared to the highlands. The catchment is dominated by small, well-distributed urban centres rather than one large megacity.

Box 1: Rice paddies of Kuttanad

Inundated rice field along VKW

Rice based production systems within wetlands have traditionally served as staple source of food worldwide. However, management of wetlands for food production is often at the expense of their regulating services (e.g., ability to influence hydrological regimes, moderate floods etc.), creating policy trade-offs. The Ramsar Convention classification of wetland types include rice fields in the category of human made wetlands. The Contracting Parties of the Convention in their 10th meeting held at Changwon, South Korea adopted a resolution on enhancing biodiversity in rice paddies as wetland systems[21]. The rice paddies of Kuttanad form an integral part of the VKW, and thereby their sustainable management is an important precondition for achieving the goal of 'wise use'.

Rice is the staple food of Kerala. The aim of developmental policy in the state has been to ensure self-sufficiency in rice production so as to reduce dependence on imports and inflows through trade. Till the Second World War, rice was procured by the rulers of Kerala from areas as far as Myanmar. Thereby, the state government looked into mechanism for increasing local production, and developing Kuttanad as 'Rice Bowl of Kerala' formed an integral part of these efforts.

Kuttanad Rice Fields is a floodplain formation of Rivers Achencoil, Pamba, Manimala, Meenachil and parts of Muvattupuzha Rivers at the southern end of Vembanad Estuary. Geological evidences indicate that the region once formed part of an extensive bay of Arabian Sea which gradually filled up with sediments brought in by the inflowing rivers. Its areal extent is around 900 km^2, covering 79 revenue villages within Alappuzha, Pathanamthitta and Kottayam Districts. Barring a small patch in the south-east, the entire Kuttanad was at or below sea level and thereby remained waterlogged and marshy for large parts of the year. This raised portion was known as 'Old Kuttanad' or 'garden land' mostly used for settlements and coconut cultivation.

The erstwhile rulers of Travancore felt the need to develop the waterlogged areas for rice cultivation so as to feed the rice requirement for the growing population. Private entrepreneurs-initiated reclamation of marshes, however, with very limited success. Early 1880s, the state got

[21] Resolution X.31 emphasizes on maintenance and enhancement of ecological and cultural role of rice paddies, and inter alia stresses maintaining connectivity with surrounding natural and semi-natural habitats.

actively engaged into promoting reclamation of marshes, offering loans at concessional rates and exempting land taxes for the first five years of cultivation. However, in 1903, reclamation was temporarily banned on the apprehension that silt was being mobilized on the mouth of Cochin port. In 1912, the ban was again lifted, and Rani, Chithra and Marthandam kayal emerged. Reclamation projects continued till post-independence. In 1942, an agricultural workers' union was formed to improve working conditions of wage labourers. The Land Reforms in the 1970s led to reclaimed land being allocated to cultivators. The reclaimed land was classified under 20 sub-divisions and numbered alphabetically from A to T. 'New Kuttanad' emerged by 1960s including 550 km^2 of land reclaimed from marshes and Vembanad estuary.

Reclamation was usually taken up during summers when river flows were at the leanest. Water wheels were used to drain water from temporary embankments (made from double lined coconut stems filled with sand, clay and garbage). Introduction of mechanical pump sets during the last decade of 19th century greatly enhanced the pace of reclamation. By the early 20th century mechanized pump sets imported from Great Britain and run by kerosene and crude oil started to be used.

These reclaimed lands exist in clusters called polders or *padashekharam*, bound by outer embankments. There are presently over 1200 polders with an area of 593.75 km^2 varying in size from 1 to over 900 ha. Gradually, collectivization of operations took place with *padashekharam* management committees being constituted and dewatering operation schedules streamlined.

Despite Kuttanad being naturally fertile, prolonged inundation and salinity constrained intensification of agriculture. As the flow of rivers dwindled from December, the salinity in surface waters increased, and Kuttanad remained brackish till May. Rice cultivation was possible only once in three years during the Punja season, sown after southwest monsoon and harvested before tidal intrusion of seawater during summer. Crop varieties matured within 100 days with an average productivity of around 1,200 kilogrammes per hectare. A post second World-War food scarcity induced the state government to order annual cropping. Pumping subsidies were announced. Rice Research Station was set up in 1940 to develop crop varieties ideal for Kuttanad. The practice of an additional crop, with a cropping cycle of May to August was promoted in around 10,000 ha.

Rice cultivation in Kuttanad is based on meticulous manoeuvring of water levels. Preparations begin in March-April with ploughing, application of lime to reduce acidity of soil and then letting in waters from the canals to inundate the fields throughout the southwest monsoon period. This suppresses capillary rise of salts from below the soil. In August – September, when water levels decrease to manageable levels, outer bunds encircling the fields are repaired. Second round of ploughing begins as the south-west monsoon subsides. The ploughing is done in waist deep-water. Dewatering commences soon after, following which inner bunds are repaired. Weeding is done prior to sowing. For transplantation, seeds are packed in screw-pine bags and soaked to induce sprouting. The sprouted seeds are transplanted and fertilizers are applied. Twenty-five to thirty days after sowing, the overcrowded portions are thinned out. Harvesting is done by cutting the ear heads, which is then thrashed, paddy separated and transported in storage barns.

As agriculture within the reclaimed lands was not possible without regulation of flooding and salinity, two major hydrological interventions were commissioned. In 1955, Thottapally spillway was constructed to divert the monsoon inflows of Pamba- Achencoil and Meenachil Rivers, through a lead channel from Veeyapuram (Mathirampally,1 km west of Veeyapuram) to Thottapally. It was designed to discharge 64,000 cusecs (cubic feet per second) flow, which was approximately one third of the monsoon flow of the river systems at Veeyapuram. In 1954, construction of Thanneermukom Barrage was initiated across Vembanad estuary to prevent salinity intrusion from the Cochin mouth. The first stage (Vechoor) comprising 31 shutters and 2 navigation lockswas was completed in 1965 and the second stage (Thanneermukkom) was completed in 1975. A road between Alappuzha and Changanassery was constructed to facilitate communication and transport. The Kuttanad Development Project launched by the

government in 1972 projected that with making the bunds permanent using concrete and rubble boulders, it would be possible to ensure double cropping in 520 km^2.

However, the benefits of these hydrological regulations were crowded out within a span of three to four decades. The introduction of high yielding rice crop varieties (having longer maturity period, 120 – 130 days as compared to around 100 days for the traditional variety) led to changes in cropping schedules, forcing closure of the Thanneermukom Barrage for longer period. In actual practice, barrage closure extended from three-month period of December – March to even May and June. Instances of pest and crop diseases led to increased use of chemical pesticides and fungicides. Extended closure of barrage also brought the farmers in conflict with fishers who reported interference in migratory pathways, loss of nursery grounds and decline in catch. Not all the reclaimed polders could be used for agriculture, as waterlogging continued in the blocks adjoining the estuary. Economically, high costs of labour and recurring costs of maintenance of embankments, water pumps and allied infrastructure affected profitability. As per assessments of remote sensing images by the Kerala State Land Use Board, the area under paddy in Kuttanad reduced from 609 km^2 to 376 km^2 during 1963 – 2003, coupled with increase in area left fallow and converted for non-agricultural uses. The canals are choked by invasives mainly Water Hyacinth which further aggravates waterlogging. AC road, constructed across the floodplains has turned out to be a major flow obstruction.

Kuttanad was identified as one of the 31 farm- distressed districts by the Ministry of Agriculture in 2006. An assessment of ecological and livelihood status of Kuttanad wetland was conducted by M S Swaminathan Research Foundation, based on which a Kuttanad Rehabilitation Package amounting to Rs. 1,840 crore was launched in the year 2010. Kuttanad Package Phase II is currently under implementation. Activities under the aegis of the package include reorganizing crop production, improved management of Thanneermukom Barrage, reduction in freshwater invasives and improvement of fisheries.

Since 2018, constant and prolonged flooding has forced people to migrate out of the region. The floods destroyed several houses and severely damaged infrastructure. Living conditions in the area have deteriorated considerably and people are permanently shifting to other places in Alappuzha and Kottayam districts. Punja crop cultivation remains impossible till late November-December, costs of dewatering the fields have gone up significantly. In 2022, instances of leaf blight in rice caused by *Pantoea ananatis* has been reported in the Kuttanad agro-ecosystem.

The current condition of Kuttanad requires a serious examination of ecological and economic viability of intensification of wetland-agriculture. The extent of infrastructure developed in the region is way beyond what a wetland can sustain. The trade offs in terms of impacts on biodiversity and foregone wetland functions as ability of regulating floods are apparent. Agriculture returns too, have diminished due to climate change impacts and adverse impacts of the hydrological interventions. Addressing these issues in a meaningful way is pertinent in order to develop wise use strategies for Vembanad-Kol[22].

[22] Based on information contained in Kuttanad Project Development Report (1971); Report on Measures to Mitigate Agrarian Distress in Alapuzza and Kuttanad Wetland Ecosystem by M. S. Swaminathan Research Foundation (2007), (https://india.mongabay.com/2021/08/why-are-residents-of-low-lying-kuttanad-abandoning-their-homes/)

2.4 Hydrological Regimes

2.4.1 Rivers draining to VKW

The rivers draining to VKW can be considered in two groups, the rivers draining to Vembanad wetland system and rivers draining to Kol lands. Meenachil, Manimala, Pamba and Achenkovil drains to the Vembanad wetland system on the southern side of Thannermukkom barrage Chalakudy, Periyar, Muvattupuzha drains to the northern side of Thannermukkom barrage and Karuvannur, Keechery, Puzhakkal drains to Kol lands. Table 4 shows the details of the river basins draining to VKW.

Table 4: Details of Rivers draining to VKW[23]

River basin	Length (Km)	Originate from	
		Altitude (m above MSL)	Place
Keecheri	51	365	Machadmalai
Puzhakkal	29	525	Machadmalai
Karuvannur	48	1100	Pumalai
Chalakudy	130	1250	Anamalai
Periyar	244	1830	Sivagiri
Muvattupuzha	121	1094	Tharakamkanam Hills
Meenachil	78	1097	Pazhavattimudi
Manimala	90	1156	Tatamala
Pamba	176	1650	Pullichi malai Naga malai Sundara malai
Achenkovil	128	700	Rishi malai Pasikkidamettu

The Rivers Achenkovil, Pamba and Manimala flow westward and discharge waters to both Arabian Sea through the Thottappally spillway and to Vembanad Estuary. The three rivers join and bifurcate into smaller streams at many locations, some of which flow northwards to drain into Vembanad Estuary. Meenachil River also flows westward and joins Vembanad Estuary near Kumarakom. The Muvattupuzha River which is a conglomeration of Muvattupuzha, Thodupuzha and Kaliyar rivers drain into Vembanad Estuary, north of the Thanneermukkom Barrage. Periyar River, the longest River in Kerala is fed by a large number of tributaries like the Mullayar, Cheruthoni, Muthirappuzha, Perinjankutty and Idamalayar. Periyar flows into Arabian Sea through the Kodungallur-Azhikode Estuary and through Vembanad Estuary into Cochin bar mouth. Chalakudy River and a bifurcation from Karuvannur River joins Periyar downstream before joining Arabian Sea. The other branch of Karuvannur River drains through Chettuva, through which Keechery also drains to Arabian Sea. Therefore, the inflow to the VKW system is the discharge from these ten river basins. The outlets to Arabian Sea are at Thottapally in South through which Manimala, Pamba and Achekovil drains, at the northern end of Vembanad Estuary, Periyar drains to Vembanad through Kochi mouth and Munambam. Between Thottapally and Kochi estuary, Vembanad has an outlet at Andhakaranzhi. The three rivers in North, Keechery, Puzhakkal and Karuvannur drains through Chettuva. The VKW system has numerous interconnecting streams and channels, making it a complex hydrological entity. In addition to these outlets of the wetland system, there are 22 minor/medium openings to the sea through smaller channels, most of which are in a degraded state. Thrikkunnapuzha Lock is

[23] (Source: CWRDM, 1995; CWRDM, 2017)

situated at the southern end on Kayamkulam canal connecting to the Kayamkulam estuary (Table 5 and Map 12).

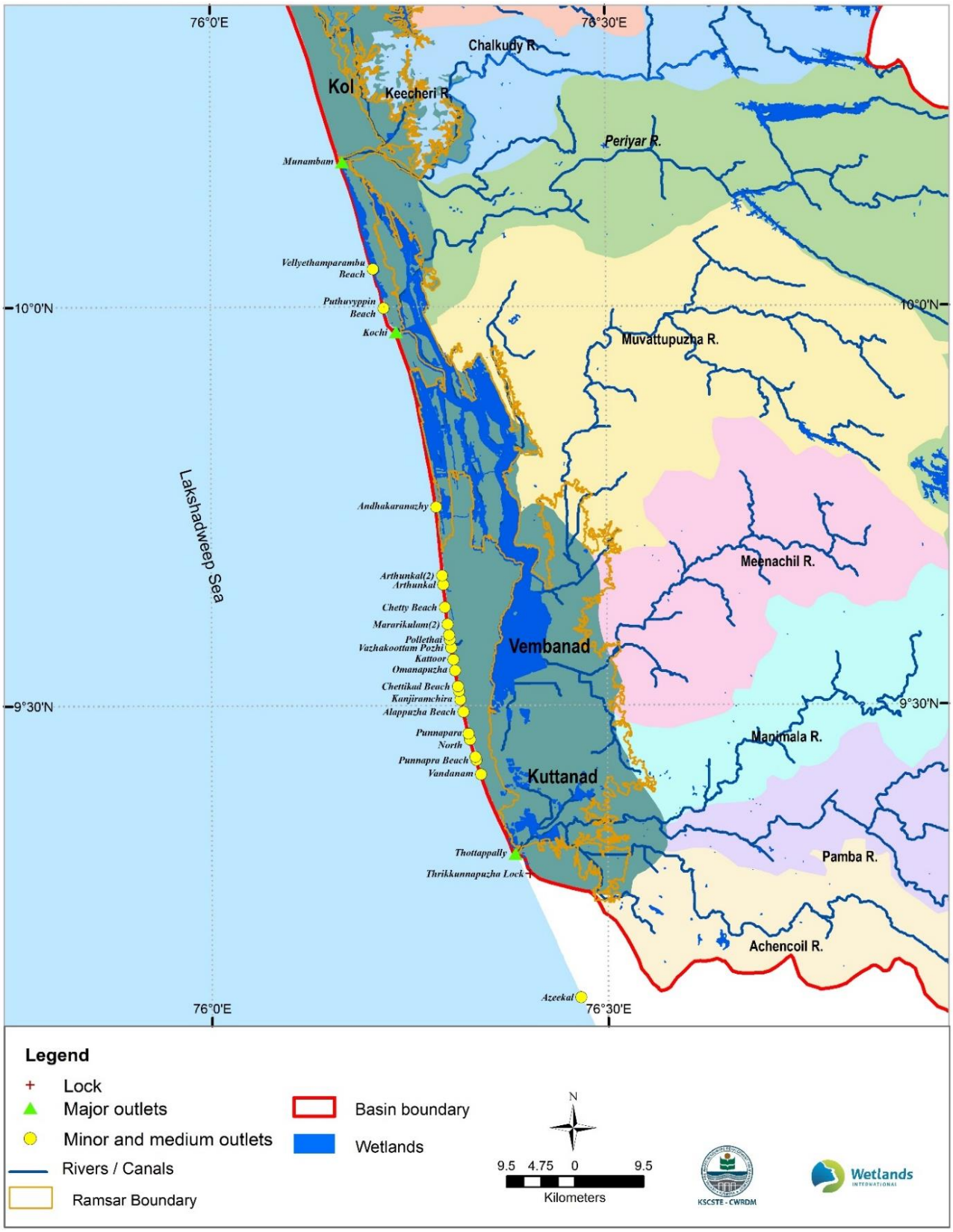
The total area of the ten river basins falling in central Kerala is found to be 16183 km^2 [24,25]of which Periyar River basin is 5398 km^2 (33.36%), Muvattupuzha River basin is 1272 km^2 (7.86%), Pamba River basin is 2235 km^2 (13.81%) Achenkovil River basin is 1484 km^2 (9.17%), Manimala River basin is 847 km^2 (5.23%) and Meenachil River basin is 1554 km^2 (9.60%), Karuvannur is 1054 km^2 (6.51 %), Keechery is 401 km^2 (2.48%) and Puzhakkal is 234 km^2 (1.45%).

Out of the ten river basins, five river basins have dams in the catchment that can act as retention for flood waters, though these dams are not designed for flood control, but for conservation purpose. A total of 17 major and minor dams are located along the Periyar River basin (Mullaperiyar dam, Idukki arch dam, Cheruthoni dam, Kulamavu dam, Kallar dam, Erattayar dam, Anayirangal dam, Mukkudil dam, Mattupetty dam, Ponmudi dam, Kundala dam, RA Headwork, Sengulam dam, Kallarkutty dam, Lower Periyar dam, Idamalayar dam and Bhoothathankettu dam). The Pamba River has dams, the largest being Kakki dam, and Pamba dam, and small dams, Gavi, Kullur etc. The catchment area of Chalakudy river basin has two hydro-electric projects, Porungalkuthu and Sholayar (Map 13). Malankara dam is located in the upstream area of Thodupuzha River in Muvattupuzha river basin. Each tributary of Karuvannur is dammed, by Peechi and Chimoni dam[25].

Table 5: Minor and medium openings to the sea of the VKW[26]

	Opening to the sea (Minor and medium)		
1	Azeekal	12	Kattoor
2	Vandanam	13	Vazhakoottam Pozhi
3	Punnapra Beach	14	Pollethai
4	Naribana Beach	15	Maraikulam
5	Punnapra North	16	Maraikulam (2)
6	Vada Pozhy	17	Chetty Beach
7	Alappuzha Beach	18	Arthunkal
8	Kanjiramchira	19	Arthunkal (2)
9	Thumpoly Beach	20	Anthakaranazhy
10	Chettikad Beach	21	Puthuvyppin Beach
11	Omanapuzha	22	Vellyethamparambu Beach

[24] CWRDM, 1995. Water Atlas, Centre for Water Resources Development and Management, Kozhikode. Kerala.
[25] CWRDM,2017a. Surface Water Information System of Rivers in Kerala, Research Report SWD/N59/II/2017, Centre for Water Resources Development and Management, Kozhikode. Kerala.
[26] Sanjeevan V.N., Thomas K.V., George Abe, K.G. Vimal Kumar and Pillai D.(eds.) 2023. A synthesis report on Vembanad Wetland System. Centre for Aquatic Resource Management and Conservation (CARMC). Kerala University of Fisheries and Ocean Studies, Kochi, Kerala, India.376 pp.



Map 12: Openings to the sea of Vembanad Wetland System

Map 13: Drainage map of Vembanad-Kol lands

2.4.2 Major Interventions in VKW

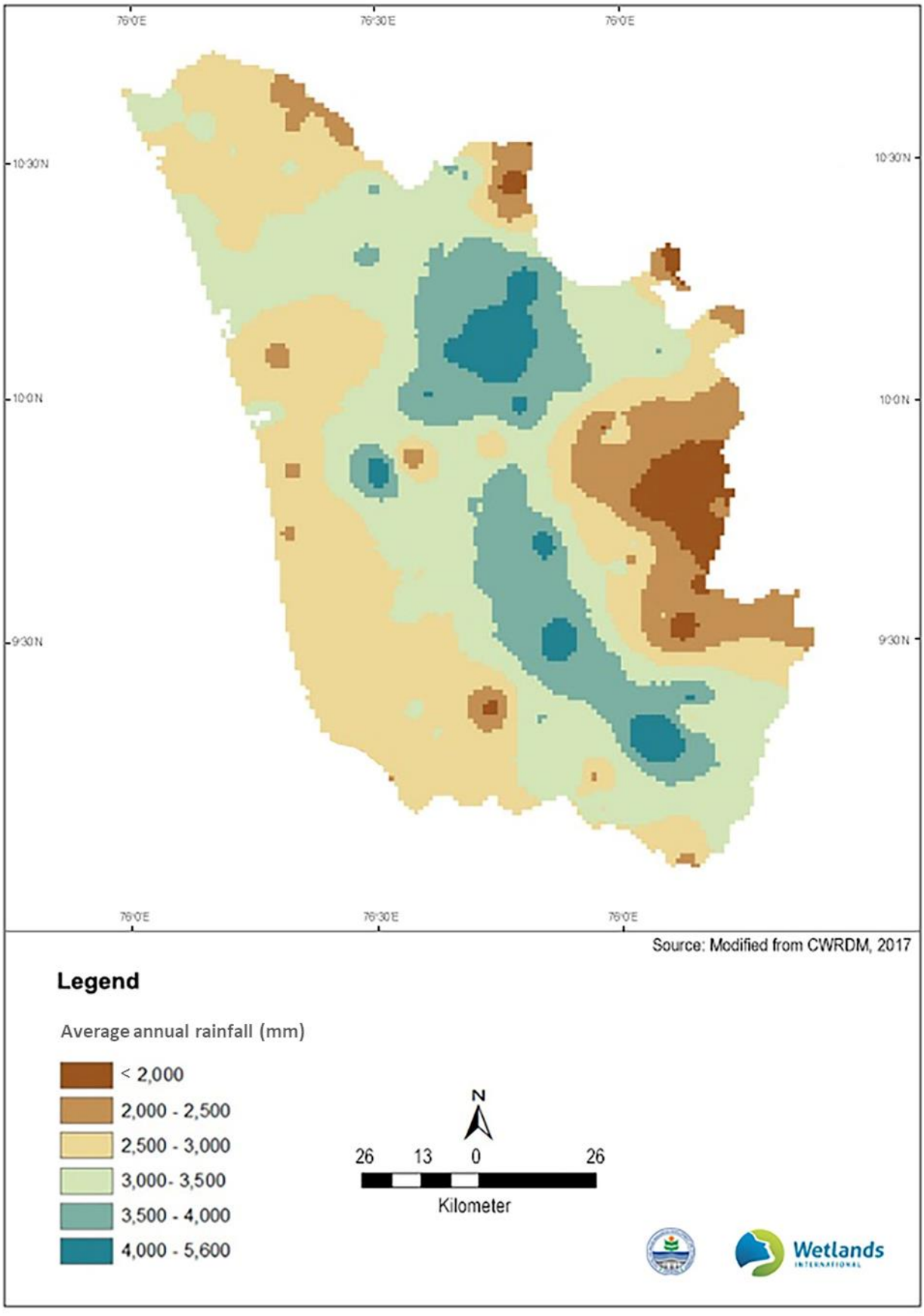
There have been several interventions in the VKW including large scale land reclamation, urbanization, unscientific infrastructure developments from the beginning of the 20th century. One of the first interventions was the construction of Willingdon Island and a shipping channel to the Cochin harbour. It was followed by major land reclamation in Kuttanad region to improve agricultural productivity, which significantly altered the original flow pattern. The Thottappally spillway which was constructed to divert flood waters from Manimala, Pamba and Achenkovil further intervened with the hydrology of the region. The Thanneermukkom barrage was constructed across the Vembanad Estuary to prevent salinity intrusion into the agricultural lands of Kuttanad during lean flow period, thereby aiding agricultural productivity of the region. However, it had significant impacts on the hydrology and ecology of the region. The regulators at Ennamakkal, Idiyanchira and Koothumakkal divert flood waters from the Kol lands into the Arabian Sea. Salinity intrusion to the Kol lands is prevented during dry season by construction of temporary bunds at Munayam, Ennamakkal and Idiyanchira. A permanent bund near Munayam across Karuvannur river is now under progress.

View of the Thanneermukkom barrage

2.4.3 Rainfall analysis

The weighted average annual rainfall calculated using Theisson polygon method for Keecheri is 2920 mm, Puzhakkal 2901 mm, Karuvannur 3024 mm, Chalakudy 2761 mm, Periyar 2884 mm, Muvattupuzha 3190 mm, Meenachil 3193 mm, Manimala 3516mm, Pamba 3771 mm and Achenkovil 2933 mm[27] Within the catchment area of the Vembanad-Kol system, the average annual rainfall varies from 1400mm to 5600mm (Map 14).

[27] CWRDM,2017a. Surface Water Information System of Rivers in Kerala, Research Report SWD/N59/II/2017, Centre for Water Resources Development and Management, Kozhikode. Kerala.



Map 14: Spatial variation of average annual rainfall

The VKW received an average annual rainfall close to 1200 mm in the period between 1951 and 2020, whereas the catchment area draining to the system received an average annual rainfall close to 2500 mm with significant inter-annual variability as seen in Figure 5, Figure 6 and Figure 7. Gridded rainfall data generated by the India Meteorological Department (IMD) based on station data is used to study the variability. The undulating and steep terrain of the basins flowing into the wetland system hence have a significant impact on the hydrology of the system as the high precipitation in the region drains out into Vembanad-Kol estuarine region which should be capable to hold the flow. Seasonal rainfall patterns in both the wetland region and the catchment area (Figure 6 and Figure 7) indicate that majority of the precipitation is contributed by the south-west monsoon followed by the north-east monsoon. The lowest amount of precipitation is observed during January and February, leading to low flow conditions and salinity intrusion; which is being managed by the closure of Thanneermukkom barrage. The rainfall during both monsoon (June to September) & post monsoon (October to December) seasons is very crucial for the region due to the dependency of the crop calendar on the seasonal rainfall pattern. A weak monsoon and post-monsoon rainfall in the region may lead to reduced flow in the streams; thus, affecting the salinity regime. Even though the Thanneermukkom barrage constructed across the Vembanad Estuary is being operated for this purpose, changes in the climate may affect the seasonality of rainfall & subsequent flow in the streams thus altering the extend or period of salinity intrusion. Hence a continuous monitoring of precipitation and subsequent flow in the streams along with real time salinity water levels and tidal water flow monitoring is crucial for automation of the Thanneermukkom barrage operation.

1- day Maximum rainfall

As per the present practice by IMD (IMD forecasting circular, 2015), a 24-hour accumulated rainfall of magnitude greater than 115.6 mm is classified as very heavy rainfall. And a 24-hour accumulated rainfall greater than 204.55, is classified as extremely heavy rainfall. Kerala has been witnessing both extensive and isolated extreme rainfall events for the past few years. The catchments of the study area were severely affected during these extreme rainfall events. It has to be noted that while there is no significant variation observed in the total annual rainfall, the magnitude of the maximum rainfall when averaged over all the catchment areas is showing an increasing trend as shown in Figure 8. The increasing frequency of rainfall of high magnitudes may be attributed to changes in the atmospheric circulations due to the global climate change and other local features. Even though the maximum rainfall when averaged over the basin in the recent years can only be characterised as very heavy rainfall, this was contributed by isolated extremely heavy rainfall in some parts of the catchment area. The study of changes in the rainfall pattern and its impact on the water resources management is crucial for the study region as the VKW system can be considered as a buffer zone for flood management. However, such changes in rainfall pattern can affect the crops in the region and future cropping calendar need to be developed considering these changes as well.

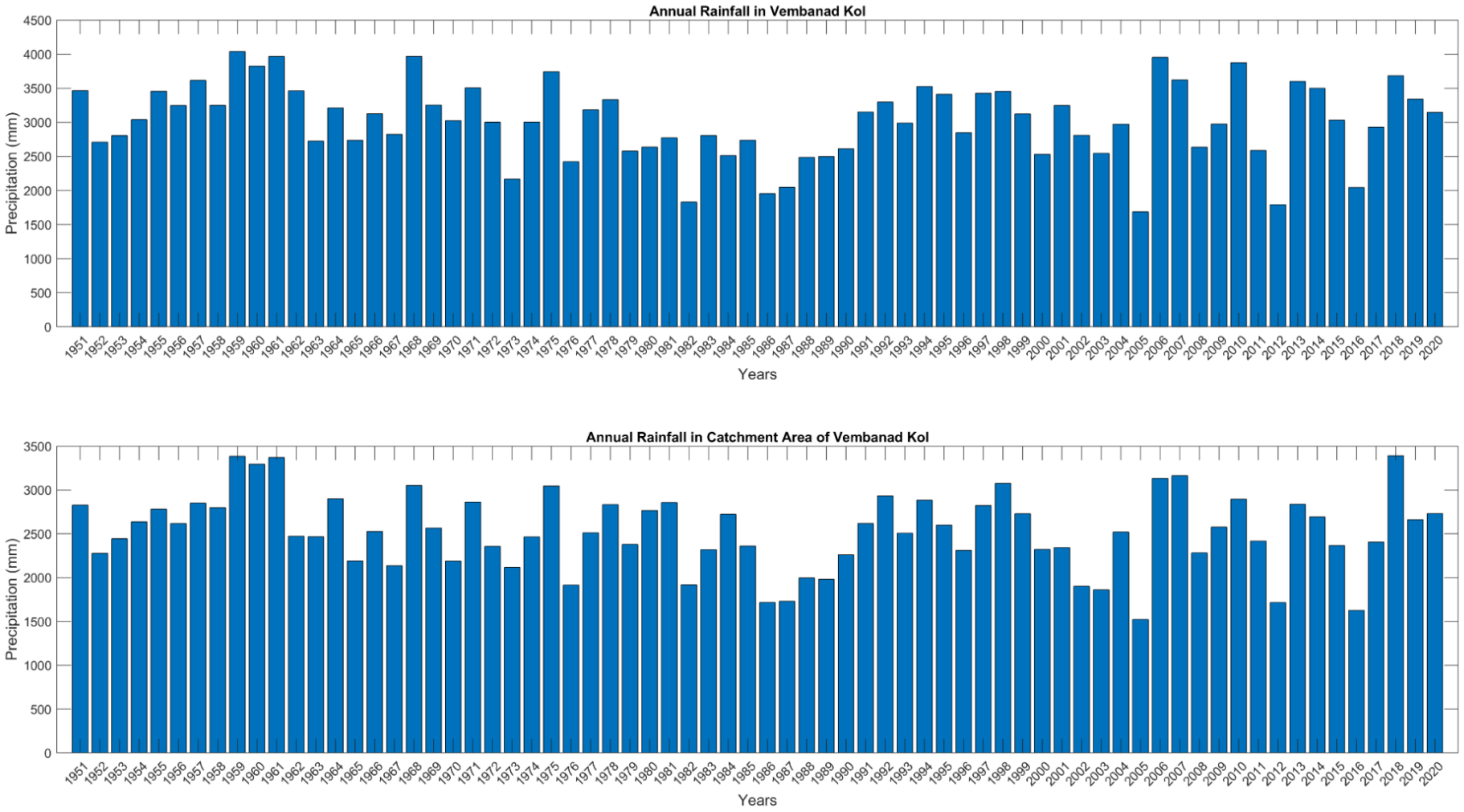


Figure 5: Time series of annual rainfall

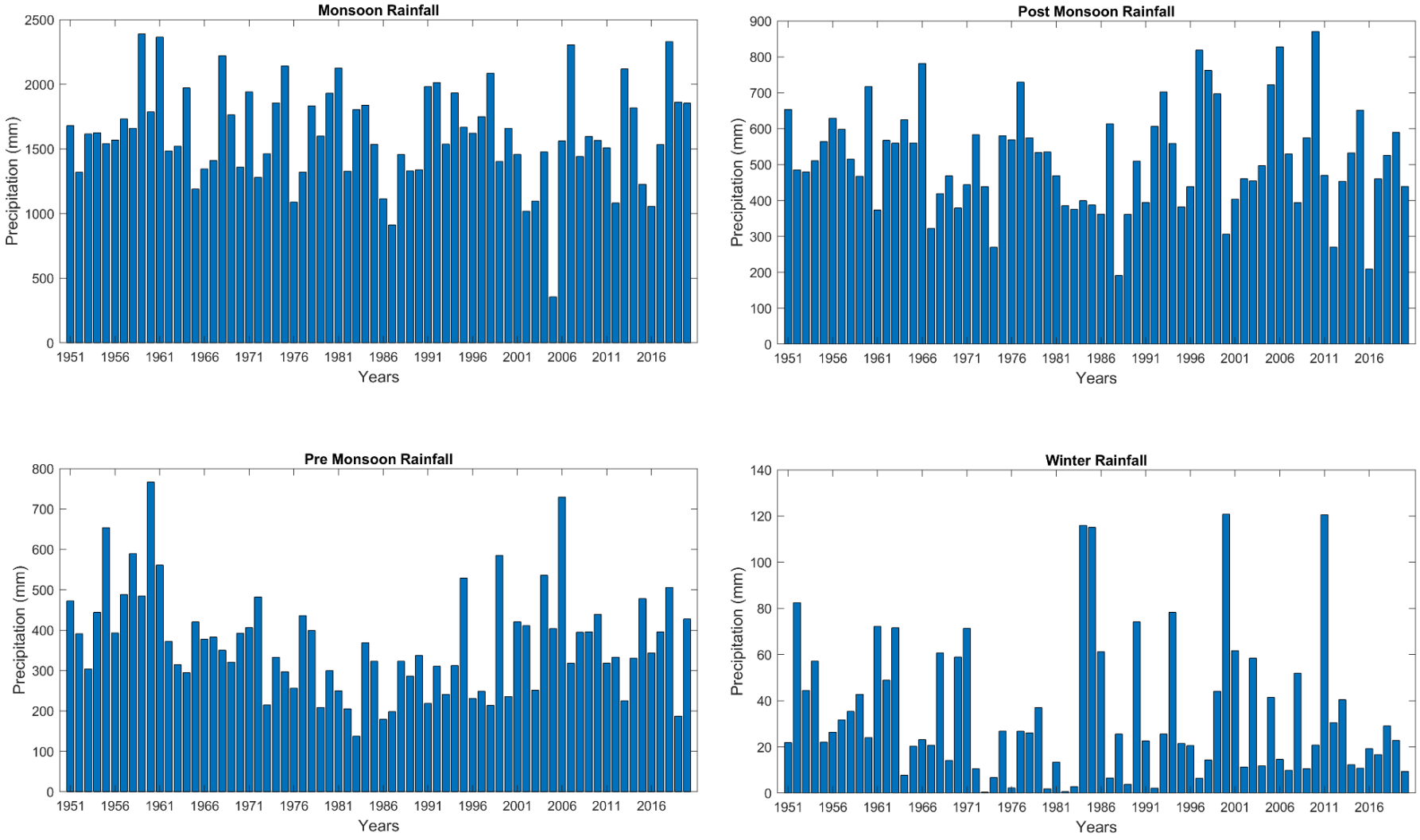


Figure 6: Time series of seasonal rainfall of VKW system

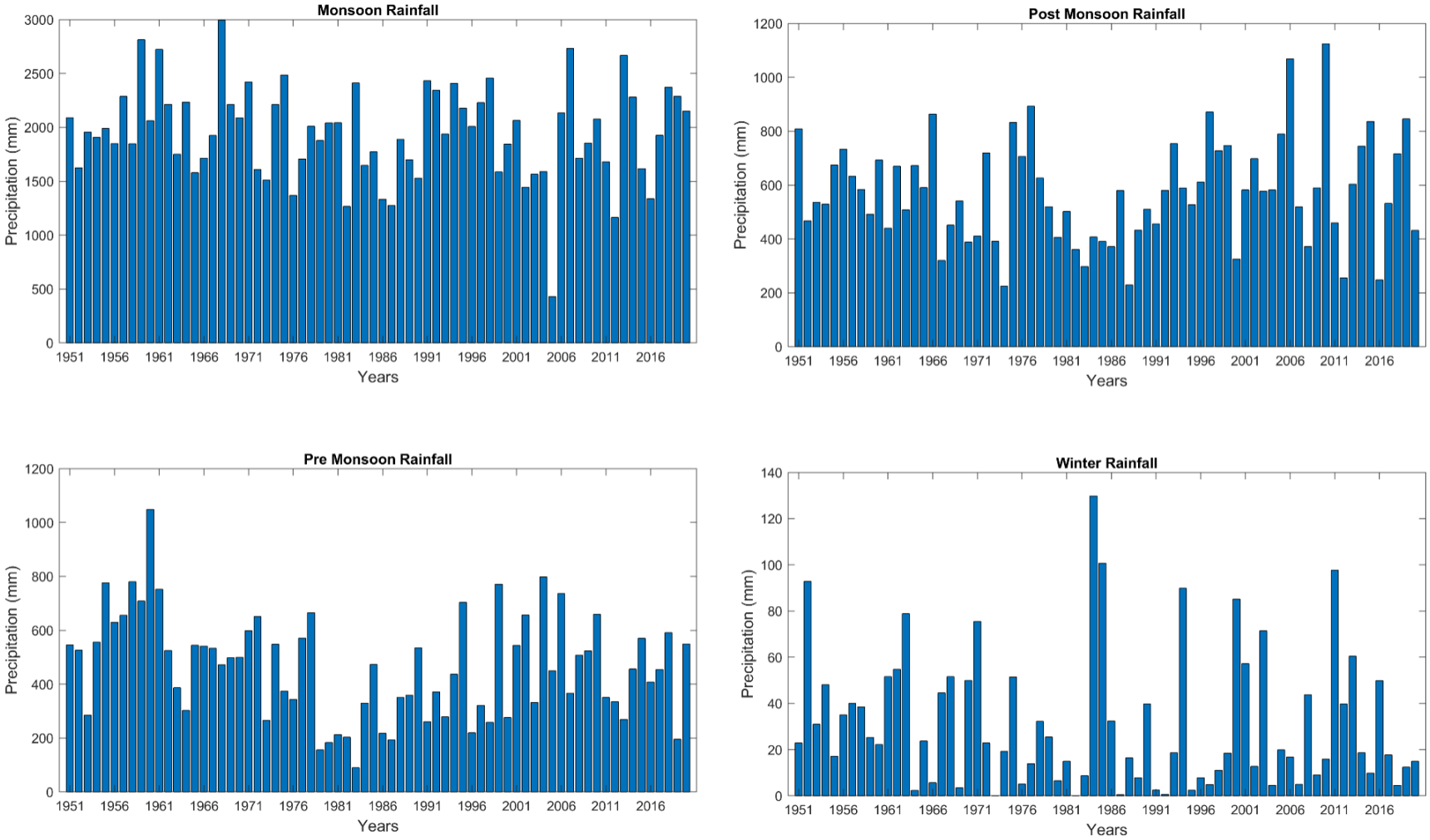


Figure 7: Time series of seasonal rainfall of catchment area draining to VKW system

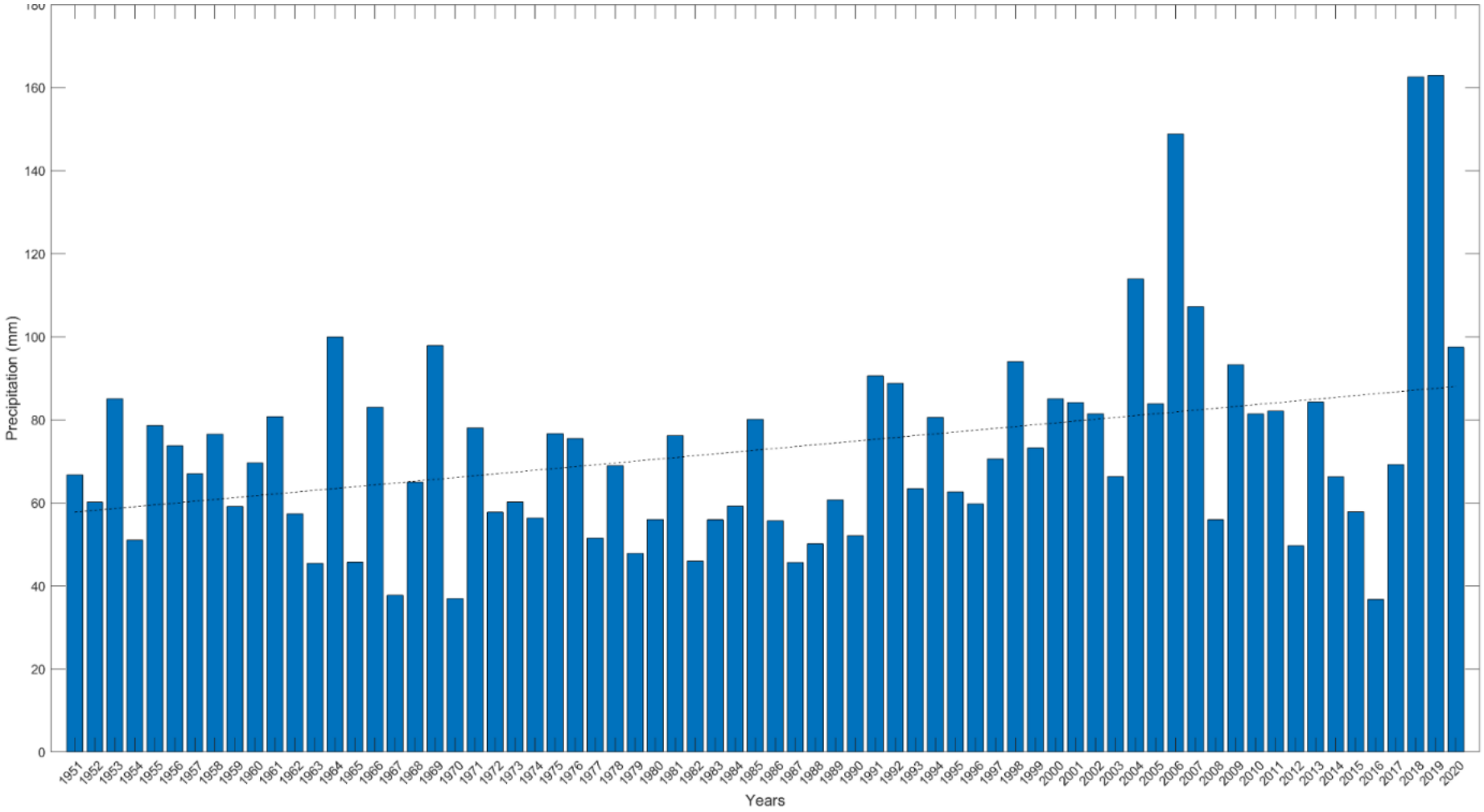


Figure 8: Trend in maximum daily rainfall in catchment Area of Vembanad Kol during 1951 - 2020

2.4.4 Discharge analysis

The stream flow data was monitored by Water Resources Department (WRD), (Government of Kerala) and the Central Water Commission (CWC), (Government of India) in the ten river basins. Table 6 shows the average annual, monsoon and non-monsoon discharge of the river basins, averaged from the CWC data from 1971 to 2012 and the WRD data from 1968 to 2012. The combined annual discharge of the six Rivers draining to Vembanad Estuary, Achenkovil, Pamba, Manimala, Meenachil, Muvattupuzha and Periyar is 21058 MCM (

Table 7) of which monsoon flow (June – November) is 18220 MCM (86.50%) and non-monsoon flow (December to May) is 2378 MCM (11.30%) and the remaining 1977.99 MCM (9.38%). These rivers drain to the Arabian Sea mainly through the Thottappally spillway, the Cochin bar mouth and the Munambam bar mouth. The maximum discharge rate from Thottappally spillway is 630 m^3/s, from Cochin bar-mouth is 1463 m^3/s[28]and from the Munambam bar-mouth is 387 m^3/s[29].

Table 6: Discharge data of ten river basins draining to Vembanad-Kol[30]

River Basin	Stream gauge station	Longitude (E)	Latitude (N)	Stream flow			Agency
				Average Annual (Mm^3)	Monsoon (Mm^3)	Non-Monsoon (Mm^3)	
Keechery	Pazhoor	76°09'30"	10°40'15	280	258	22	WRD
Puzhakkal	Kundukadu	76°16'40"	10°36'17	99	96	3	WRD
Karuvannur	Karuvannur	76°13'30"	10°24'00	1356	1282	74	WRD
Chalakudy	Arangaly	76°17'34"	10°10'43	1860	1731	129	CWC
Periyar	Neeleswaram	75°28'30"	10°10'52	7266	6440	526	CWC
Muvattupuzha	Ramamangalam	76°28'12"	09°56'24	4791	3799	992	CWC
Meenachil	Kidangoor	76°36'55"	09°40'51	1988	1668	160	CWC
Manimala	Kallooppara	76°38'26"	09°23'41	1756	1614	142	CWC
Pamba	Malakkara	76°39'50"	09°19'45	4067	3592	475	CWC
Achencoil	Thumpamon	76°44'42"	09°14'10	1190	1107	83	CWC

Table 7: Monthly average River discharges in MCM[31]

Month	Achankovil	Pamba	Manimala	Meenachil	Muvattupuzha	Periyar	Total
January	9.59	63.56	5.46	5.19	179.49	93.75	357.04
February	4.56	38.57	4.66	1.21	157.36	81.15	287.51
March	3.55	42.65	3.15	5.25	172.50	90.71	317.81
April	13.16	68.87	22.44	34.20	179.06	116.95	434.68
May	31.45	155.40	67.00	48.68	230.23	169.32	702.08
June	199.63	673.09	356.72	273.46	694.65	990.66	3188.21
July	247.06	836.50	400.67	312.30	984.52	1654.09	4435.14
August	203.62	677.47	305.37	286.75	809.34*	1500.37	3782.92
September	152.61	480.64	202.39	169.39	46o.90	814.82	2280.75
October	199.16	563.97	260.44	166.93	540.80	684.87	2416.17
November	158.09	356.79	158.65	172.30	399.60	440.88	1686.31
December	30.13	113.45	29.22	37.31	220.64	157.71	588.46
Total	**1252.61**	**4070.96**	**1816.15**	**1512.97**	**5029.11**	**6795.29**	**20477.09**

[28] Vineetha, S., Bijoy Nandan, S., and Rakhi Gopalan, K. P. (2015). Composition, abundance, and diversity of macrobenthic fauna in Kole paddy fields, Vembanad Kole Wetland, India. International Journal of Current Research, 7(10), 20941-20947.

[29] Revichandran C. and Pylee A. (1998). Mixing and flushing time scales in the Azhikode estuary, southwest coast of India. Indian Journal of Marine Sciences 27,163-166

[30] CWRDM,2017a. Surface Water Information System of Rivers in Kerala, Research Report SWD/N59/II/2017, Centre for Water Resources Development and Management, Kozhikode. Kerala.

[31] Revichandran C., Srinivas K., Muraleedharan K.R., Rafeeq M., Amaravayal S., Vijayakumar K. and Jayalakshmy K. V. 2012. Environmental set-up and tidal propagation in a tropical estuary with dual connection to the sea (SW Coast of India). Environmental Earth Sciences 66(4), 1031-1042, June 2012

2.4.5 Zero flow of rivers draining to VKW system

The summer flow in the rivers draining to the VKW system is reducing. A study on low flows in Periyar and Pamba rivers by NIH, IIT Roorkee, CWRDM, and CWPRS shows that the perennial nature of these rivers changed to intermittent[32]. There is a substantial increase in number of zero flow days, Pamba River was perennial up to 1994-95 and Periyar up to 2007-08. Later, the number of zero flow days increased drastically to even 200 days in Pamba and 120 days in Periyar (ibid) (Figure 9 and Figure 10)[30].

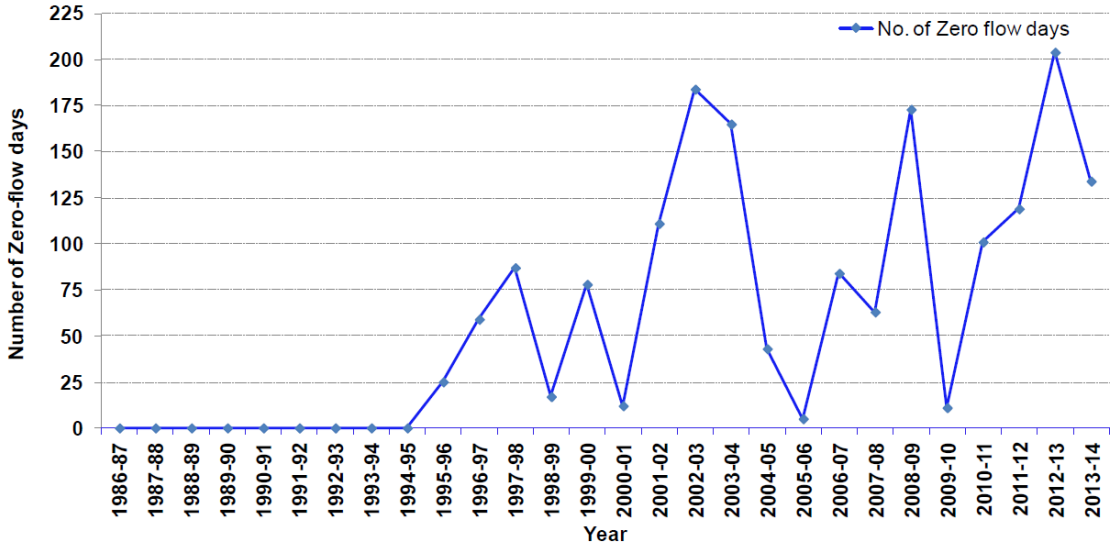


Figure 9: Number of zero flow days in Pamba River

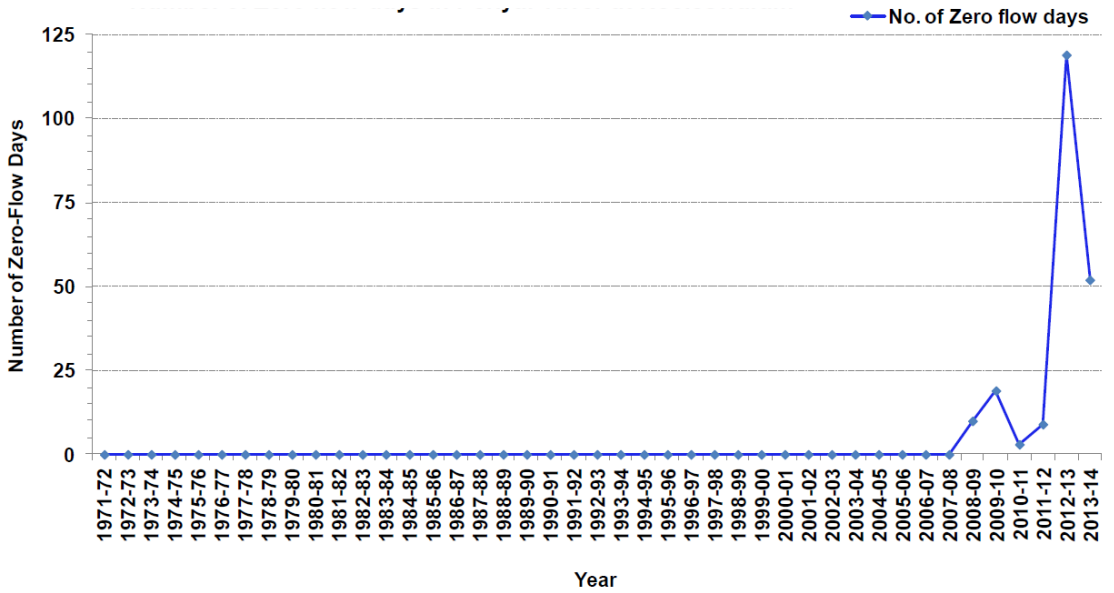


Figure 10: Number of zero flow days in Periyar River

[32] MoWR (2014), Report on the issue of decreasing flows in Pamba and Periyar rivers in Kerala, Ministry of Water Resources. Government of Kerala

The flow duration curve is an important tool to appraise the flow values of various dependability and thus an indispensable simple tool for water availability studies. Figure 11 shows the flow duration curve for the summer months (December to May). Table 8 shows that in Muvattupuzha, Meenachil, Manimala, Pamba and Achekovil, flow is either zero or very minimal 90% of the time during March and April. The above analysis shows that the water availability during summer months is reducing.

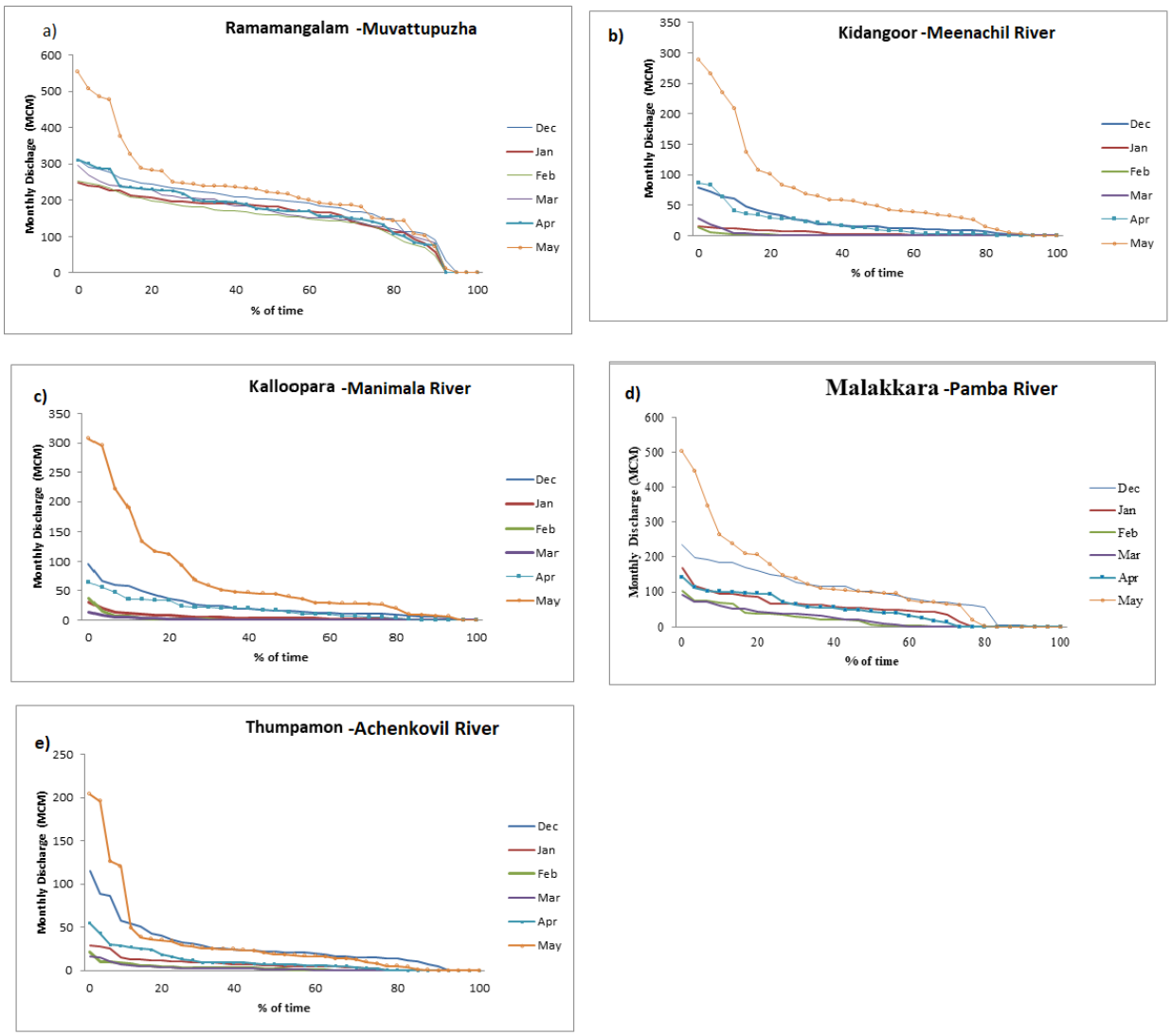


Figure 11: Flow duration curve of a) Muvattupuzha, b) Meenachil, c) Manimala, d) Pamba and e) Achenkovil[33]

[33] CWRDM, 2020. Integrated water resources management plan for rivers draining to Vembanad Lake, Draft report, Centre for Water Resources Development and Management, Kozhikode.

Table 8: Dependable flow (MCM) at 50%, 75% and 90% of five river basins[34]

River Basin		Muvattupuzha	Meenachil	Manimala	Pamba	Achencoil
Dec	50%	204.5	15.2	16.5	102.7	22.1
	75%	168.7	9	11	70.9	15.1
	90%	112.1	3.1	6.4	6.3	10.6
Jan	50%	183.3	1.9	3.5	53.7	6.6
	75%	132.7	0.6	1.1	35.2	3.2
	90%	91.9	0.1	0.1	0	0
Feb	50%	160.9	0	0.1	18.3	1.8
	75%	137.4	0	0	0	0
	90%	78.4	0	0	0	0
Mar	50%	174.7	0	0	21.3	1.7
	75%	137.4	0	0	0	0
	90%	98.9	0	0	0	0
Apr	50%	175.2	12.8	16.3	48.2	7.3
	75%	148.4	3.1	5.1	12.5	3
	90%	83.4	0	0	0	0
May	50%	222.6	51.3	44.4	100.9	19.2
	75%	182.8	32.3	27.6	65.1	9.6
	90%	108.8	9.4	8.7	0	1.2

2.4.6 Groundwater status of VKW

Table 9 shows the groundwater availability and stage of development of blocks in the VKW system. Paravur block is showing semi-critical groundwater development, as per the report of the Central Ground Water Board (CGWB). All other blocks show groundwater development under 'safe' category.

Table 9: Groundwater status in the blocks of VKW system[35,36,37,38]

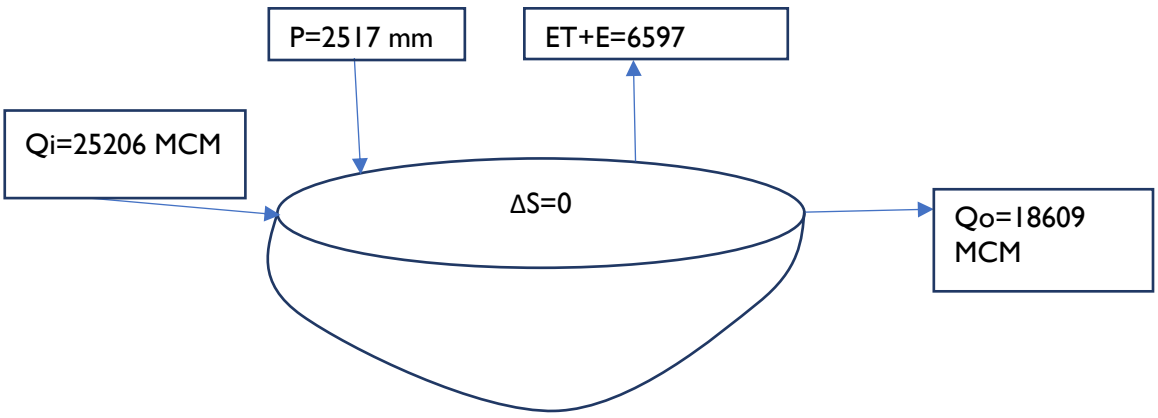
Sl. No.	Block	Total annual ground water recharge (MCM)	Net annual ground water availability (MCM)	Stage of GW development %	Categorization for future GW development
1	Ambalappuzha	24.72	23.48	32.02	Safe
2	Aryad	27.85	26.46	60.35	Safe
3	Champakulam	48.12	43.31	14.02	Safe
4	Kanjikuzhy	32.77	29.49	28.89	Safe

[34] CWRDM, 2020. Integrated water resources management plan for rivers draining to Vembanad Lake, Draft report, Centre for Water Resources Development and Management, Kozhikode.
[35] CGWB, 2013. Ground Water Information Booklet of Ernakulam District, Kerala State, Technical Reports: Series 'D', Central Ground Water Board Kerala Region, Ministry of Water Resources, Government of India.
[36] CGWB, 2013. Ground Water Information Booklet of Alappuzha District, Kerala State, Technical Reports: Series 'D', Central Ground Water Board Kerala Region, Ministry of Water Resources, Government of India.
[37] CGWB, 2013. Ground Water Information Booklet of Kottayam District, Kerala State, Technical Reports: Series 'D', Central Ground Water Board Kerala Region, Ministry of Water Resources, Government of India.
[38] CGWB, 2013. Ground Water Information Booklet of Thrissur District, Kerala State, Technical Reports: Series 'D', Central Ground Water Board Kerala Region, Ministry of Water Resources, Government of India.

Sl. No.	Block	Total annual ground water recharge (MCM)	Net annual ground water availability (MCM)	Stage of GW development %	Categorization for future GW development
5	Pattanakkad	33.98	32.28	34.63	Safe
6	Thykkattussery	37.40	33.66	23.52	Safe
7	Veliyanadu	44.61	42.38	13.46	Safe
8	Edapally	32.36	29.12	34.67	Safe
9	Palluruthy	34.77	31.29	63.10	Safe
10	Paravoor	22.26	20.04	86.10	Semi Critical
11	Vypin	18.45	16.60	62.05	Safe
12	Ettumanoor	34.39	30.95	37.49	Safe
13	Vaikom	78.43	70.59	14.47	Safe
14	Anthikkad	34.01	32.31	45.22	Safe
15	Cherpu	38.63	36.69	47.44	Safe
16	Irinjalakkuda	34.99	31.49	55.17	Safe
17	Kodakara	63.83	57.44	57.71	Safe
18	Mathilakam	22.72	21.59	63.66	Safe
19	Thalikkulam	23.71	22.52	66.73	Safe
	Total	688.04	631.74	Total	

2.4.7 Water Balance of VKW system

The overall balance of the VKW system can be estimated by water balance equation. In the water balance equation, the change in storage is estimated as the difference between inflow and outflow. The inflow from the catchment area to the Vembanad wetland is 24653 MCM, the discharge at the gauging stations in ten river basins Table 4. The downstream area of the gauging station covers 4537.26 km^2, including a lake area of 216.53 km^2. The rainfall directly falling on lake and runoff from the surrounding area is estimated as 545.01 MCM. The total inflow (Qi) to the Vembanad Lake is 25206.16 MCM. The average Evapotranspiration (ET) calculated from the climate data of IMD meteorological station, Alappuzha is 1445.4 mm/year. The evapotranspiration loss from the surrounding area of the Vembanad wetland system is estimated as 6245.18 MCM. The evaporation (E) from the lake area is 352.09 MCM estimated by multiplying average evaporation rate with an average evaporation factor of 1.125 (FAO, 1984; CWRDM, 2010). Assuming change in storage (ΔS) as zero, the outflow (Qo) from the Vembanad wetland system is 18608.89 MCM.



2.4.8 Flood in Vembanad-Kol System

Vembanad Estuary and Kuttanad region is facing floods frequently, when compared with Kol lands due to the peculiarities in the topography. Flood frequency curves having a return period of 2, 5, 10, 25, and 50 years are available for the rivers draining to Vembanad Wetland system. Floods with a return period of 10-year and above are severe, whereas the regular floods with return period of 5-yrs and less are less severe (Figure 12). Floods that occurred in1986 had a return period of 10 years and flooded the entire wetland. The first devastating flood that affected the entire State was in 1924. Afterwards, the year 1961 witnessed heavy floods. Since then, floods were recorded in the years of 1968, 1975, 1981, 1985, 1986, 1989, 1992, and 1994. Limited flood affecting Kuttanad area also occurred in the years of 1964, 1971, 1978, 1996 and 1998. Kuttanad floods are devastating on paddy, fisheries, human lives and property[39].The most recent flood in 2018, 2019 and 2020 caused several casualties in Kuttanad.

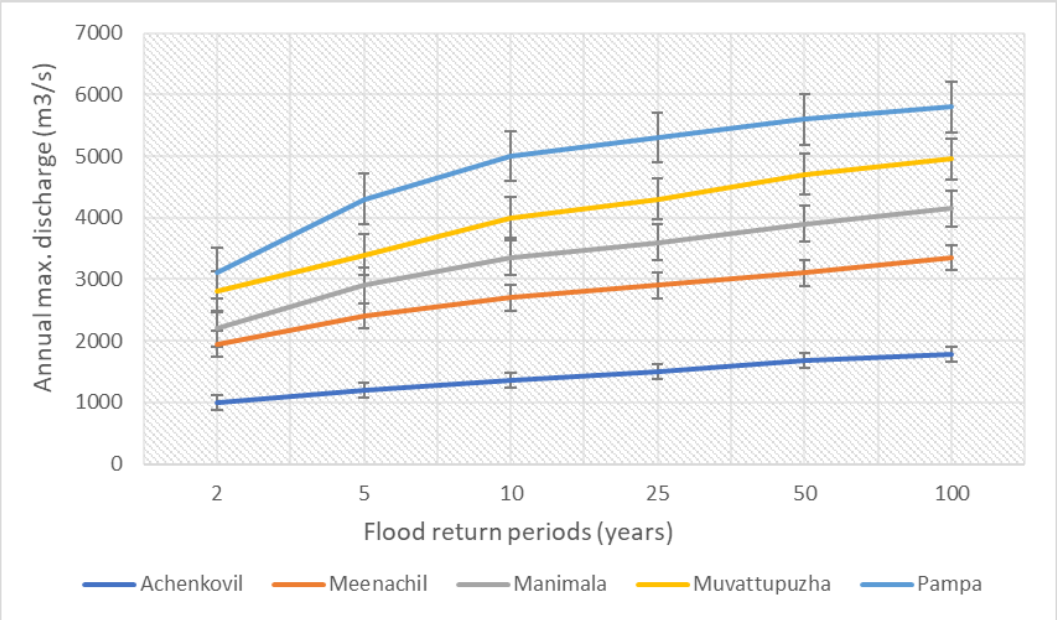


Figure 12: Return period of Floods and their intensity.

Recent flood and flood inundation maps

Recently in 2018, Kerala faced severe flooding, inundating 13 out of 14 districts in Kerala. Before that, it was in 1924, Kerala faced such a catastrophic event. The major cause for the flood is extremely heavy and high intensity rainfall, during 15-17 August 2018. The one day 2 day and 3-day rainfall received in Pamba and Periyar is shown in the Table 10.

Table 10: 1-day, 2-day and 3-day rainfall (mm) in 2018[40]

Name	Area, km2	15 Aug, 2018	16 Aug 2018	15-16 Aug 2018	15-17 Aug 2018
Pamba	1620	176	217	397	538
Periyar	4035	198	248	452	588
Manimala	2477	179		397	537
Chalakudy	1343	140		324	421

[39] CWRDM, 2017b. Mitigation measures for Abating floods in Upper Kuttanad, Submitted to Haritha Keralam Mission, Govt. of Kerala, Centre for Water Resources Development and Management, Kozhikode. Kerala.

[40] CWC, 2018. Study ReportKerala Floods of August 2018, Hydrological Studies Organisation, Hydrology (S) Directorate, Central Water commission, Government of India.

The maximum discharge in Periyar river was 8800 m^3/s on 16th August 2018 at Neeleswaram site, as per the report of CWC. The peak discharge during 2018 flood is nearly 2800 m^3/s for the Malakkara gauging station in Pamba River. In the same way, Kallopara gauging station in Manimala River shows a peak discharge of about 1250 m^3/s, both on 16/08/2018. As per the CWC report (2018), the runoff from the four rivers, Achenkovil, Pamba, Manimala and Meenachil during 2018 flood (15-17 August 2018) was 1630 MCM, which was more than the carrying capacity of Vembanad Estuary (600 MCM). At present the discharge capacity of the Thottapally spillway is only 630 m^3/s against the design dicharge capcity of 1812 m^3/s. Hence, the methods may be adopted to increase the discharge capacity of Thottapally spillway.

Flood inundation map

Flood inundation maps were prepared for the study region using Sentinel-1 data by comparing the areas inundated by water during flooded and dry periods. Maps were generated for 2016, 2018, 2019 and 2020. Here, we have considered only the areas within the Ramsar boundary and the inundated area is provided in Map 15, Map 16, Map 17 and Map 18 and Table 11 below.

Table 11: Flood inundated area

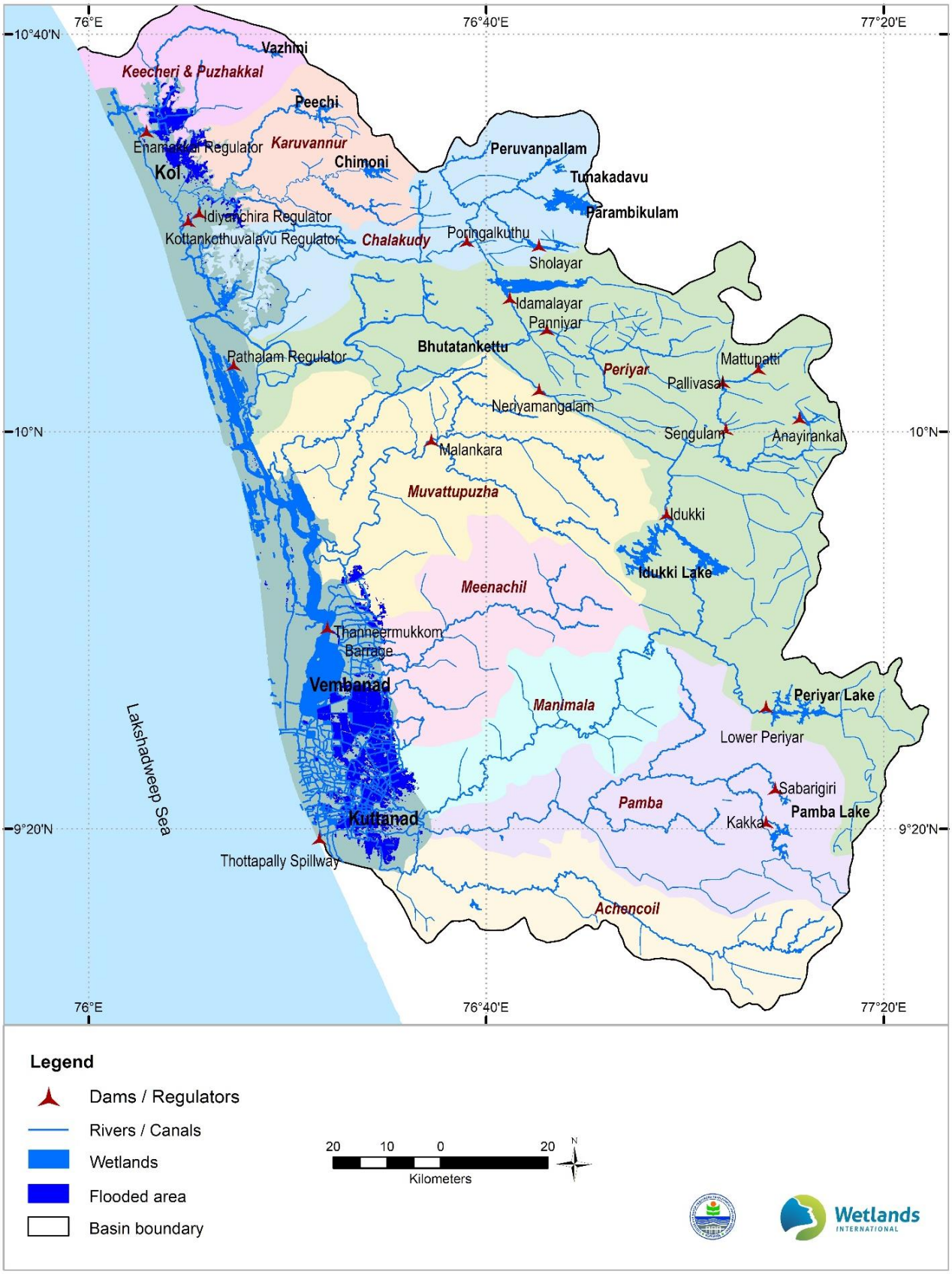
Year	Flood inundated area (km^2)
2016	239.79
2018	498.45
2019	320.68
2021	249.88

Causes of flood in Vembanad system

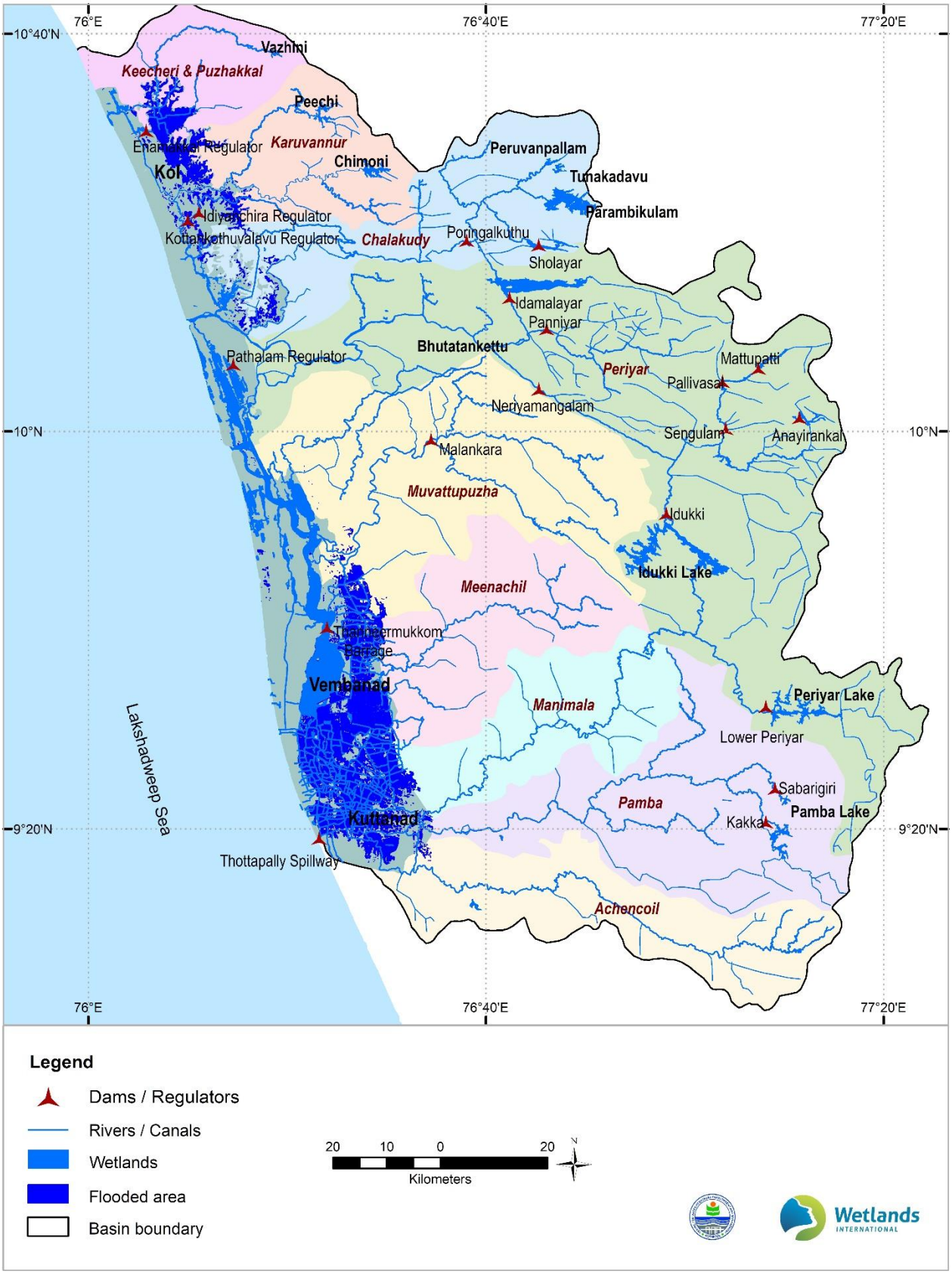
The following points cause flooding in Upper Kuttanad area as reported by[41] which is applicable to the whole Vembanad system.

- The high intensity rainfall in the catchment area of the river basins cause severe flooding in the low-lying area of Kuttanad region. Due to the peculiarities in the topography, the Kuttanad region floods regularly.
- The high discharge from the six rivers causes flooding in the low-lying area for days to week. The discharge through Thottapally spillway is not sufficient to swift away the flood water. The high tidal levels add to the fury.
- One of the major reasons for flooding in the low-lying areas is the inadequate drainage to carry the flood waters in the low-lying land and continuance channel conveyance improvement program has to be done.
- The unscientific construction of bridges and roads reduce the flow path affecting the free flow of water. At few places, canals are either filled completely or blocked to construct roads. All these factors cause flooding in the nearby area.
- The encroachments are another reason that reduce the capacity of the canals, at some stretches, the width of the channel have been reduced from 20m to 10m. The building constructed in the flood plain have been taking the space of the canals, thus reducing the carrying capacity of the canal.
- Another key issue associated with the flooding of Kuttanad is the stratification control on upwelling that leads to elevated sea levels near barmouths. Criss-cross construction of Pullimutts along the coastal belt considerably reduces the velocity of the southflowing (during monsoon season) Western India coastal currents that deter accumulation of river discharges at the barmouths.

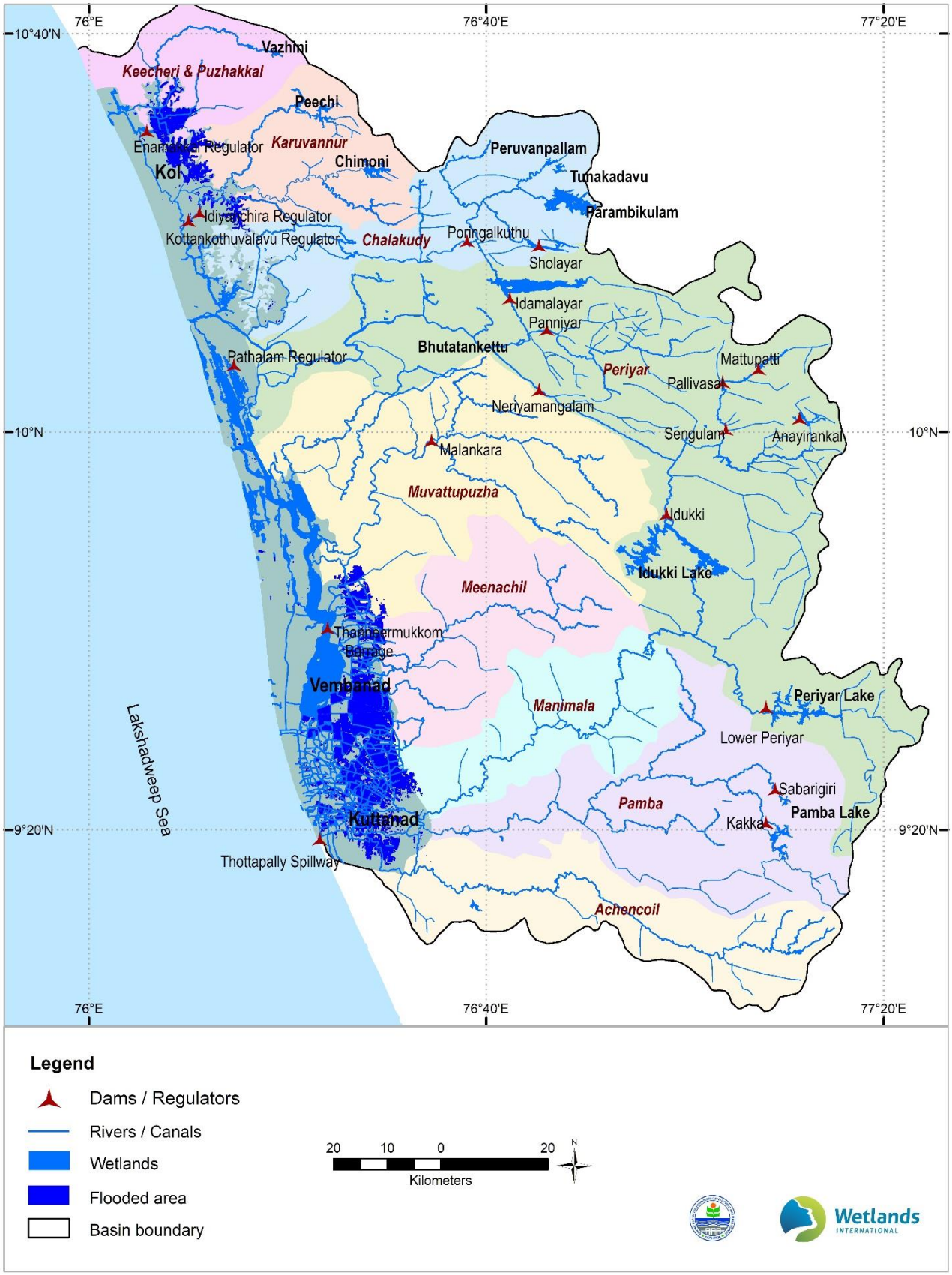
[41] CWRDM, 2017b. Mitigation measures for Abating floods in Upper Kuttanad, Submitted to Haritha Keralam Mission, Govt. of Kerala, Centre for Water Resources Development and Management, Kozhikode. Kerala.



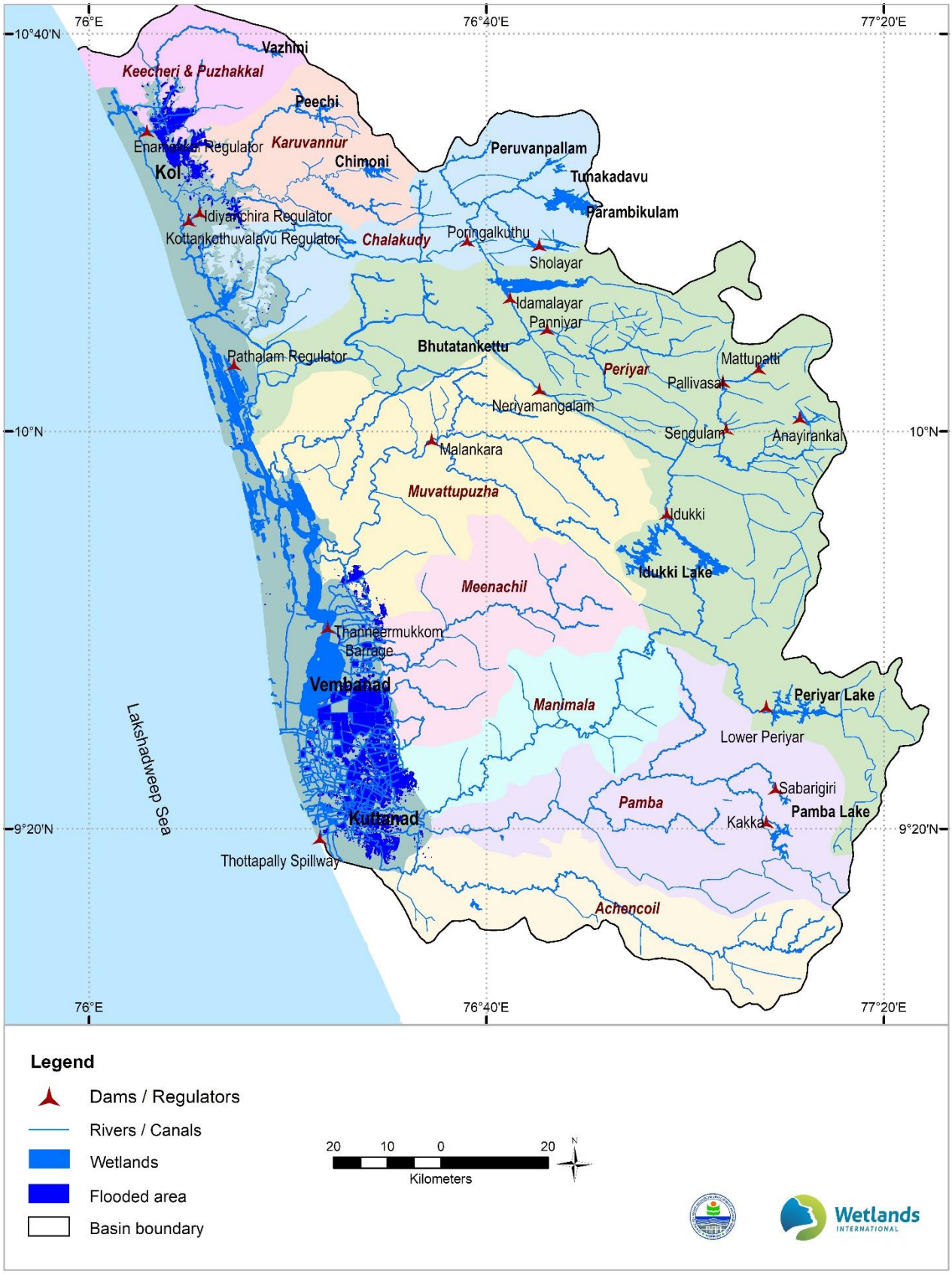
Map 15: Flood inundation map of 2016



Map 16: Flood inundation map of 2018



Map 17: Flood inundation map of 2019



Map 18: Flood inundation map of 2021


(a) Seafood processing unit, Aroor Panchayat, Alappuzha (b) Coir retting, Pallipuram Panchayat[42]


(a) Discharge of effluents (b) Wetland filling in Kuttanad[43]

[42] CWRDM, 2020. Integrated water resources management plan for rivers draining to Vembanad Lake, Draft report, Centre for Water Resources Development and Management, Kozhikode.

[43] Photograph by CWRDM,2021

Dense infestation of water hyacinth[40]

Sand bars formed at the mouth near Thottapally spillway[44]

[44] Photograph by CWRDM,2017


Thanneermukkom Barrage and Thottappally Spillway[45]

- Another problem faced in Kuttanad is the growth of Water Hyacinth in almost all the waterways. This causes hindrance to the flow of water through these channels. Not only that this cause hindrance to the use of water for inland navigation and for other purposes like domestic use.
- The slope in the Vembanad wetland system is almost flat that cause water logging in the area.
- The leading channel to Thottapally spillway is found to be inadequate to carry the design discharge of the spillway during flood period. Study conducted by IIT Madras & CWRDM indicated that deepening of lead channel, which is generally done do not have significant impact on the flood levels. The width of the leading channel needs to be increased for reducing the flood levels in the region.
- The formation of sand bars in non-monsoon season hinders the flow through Thottapally spillway[46]

2.4.9 Sediment load to Vembanad Estuary

CWC monitors the suspended sediment load in the stream gauge stations. Figure 13 shows the average suspended sediment load of Ramanagalam (Muvattupuzha), Kidangoor (Meenachil), Kalloopara (Manimala), Malakkara (Pamba) and Thumpamon (Achenkovil) Rivers from the monsoon months from June to November. The average sediment loads during monsoon months are of 136431 Metric tonnes, 30357.9 Metric tonnes, 51916 Metric tonnes, 108247 Metric tonnes and 56676.4 Metric tonnes for Ramanagalam (Muvattupuzha), Kidangoor (Meenachil), Kalloopara (Manimala), Malakkara (Pamba) and Thumpamon (Achenkovil) Rivers, respectively. Altogether, an average of 383628.2 Metric tonnes of suspended sediment comes to Vembanad Estuary during monsoon months.

[45] Photograph by CWRDM,2021

[46] CWRDM, 2017b. Mitigation measures for Abating floods in Upper Kuttanad, Submitted to Haritha Keralam Mission, Govt. of Kerala, Centre for Water Resources Development and Management, Kozhikode. Kerala.

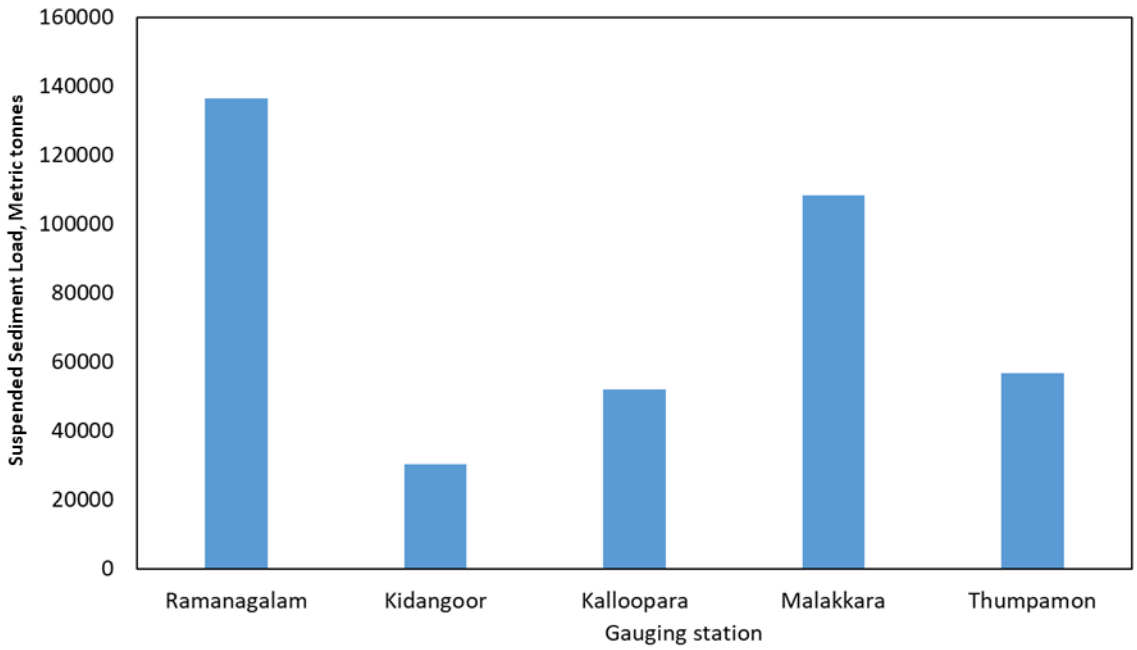


Figure 13: Average Suspended Sediment Load

2.4.10 Water Quality

As part of the WIAMS[47] project seasonal water quality monitoring was conducted across three zones of the VKW complex from 2021 to 2022. Twenty-four stations in Zone 3 (Thanneermukkom – Thottapally), fifteen in Zone 2 (Azhikode – Thanneermukkom), and twenty-four in Zone 1 (Chettuva – Azhikode) were assessed for parameters like physico-chemical and biological characteristics. The findings from WIAMS project and other relevant studies are listed below.

Zone 1: Chettuva – Azhikode

In 2021, Zone 1 displayed a fluctuating pH, with a notable dip during post-monsoon. Dissolved Oxygen (DO) levels peaked at 6.68 mg/l during the monsoon, and Biochemical Oxygen Demand (BOD) showed moderate variation across seasons. Nutrient levels, including Nitrate-Nitrogen and Phosphate-Phosphorus, also fluctuated. The year 2022 saw a slight decrease in pH and increased DO, BOD, and Silicate levels, indicating dynamic water quality changes (Table 12)

Table 12: Water quality of Zone 1 (Chettuva to Azhikode)[48]

	2021			2022	
Parameters	Pre-Monsoon	Monsoon	Post-Monsoon	Pre-Monsoon	Monsoon
pH	7.26	6.97	6.32	7.16	6.70
Dissolved Oxygen (mg/l)	5.41	6.68	6.28	6.78	5.99
Biological Oxygen Demand (mg/l)	2.60	2.08	2.66	4.00	4.25
Nitrate-Nitrogen (mg/l)	0.77	0.93	0.51	0.55	0.76

[47] The WIAMS project, funded by the State Wetland Authority of Kerala, aims to support wetland management through robust decision-making tools. It focuses on the Vembanad-Kol, Ashtamudi, and Sasthamkotta wetlands in Kerala, providing up-to-date, scientifically valid information on their status and trends.

[48] The WIAMS project, funded by the State Wetland Authority of Kerala, aims to support wetland management through robust decision-making tools. It focuses on the Vembanad-Kol, Ashtamudi, and Sasthamkotta wetlands in Kerala, providing up-to-date, scientifically valid information on their status and trends.

	2021			2022	
Parameters	Pre-Monsoon	Monsoon	Post-Monsoon	Pre-Monsoon	Monsoon
Phosphate - Phosphorus (mg/l)	0.04	1.03	0.07	0.04	0.02
Silicate (mg/l)	1.12	1.09	2.96	7.08	6.55
Total Coliforms (MPN/100 ml)	≥2400	1954	2138	2076	2029
E-Coli (MPN/100 ml)	272	259	542	246	85
Fecal Coliform (MPN/100 ml)	1836	659	850	858	192

Zone II: Azhikode – Thanneermukkom

In Zone II, which extends from Azhihode estuary to Thanneemukkom barrage, pH values ranged from 7.81 pre-monsoon to 6.85 in the monsoon during 2021. DO levels remained stable, while BOD was highest post-monsoon. Nutrient concentrations, particularly Silicate, peaked significantly post-monsoon (Table 13). The 2022 data showed a marginal decrease in pH and maintained trends in DO and BOD, with an upward trend for Silicate.

Table 13: Water quality of Zone II (Azhikode – Thanneermukkom)[44]

Parameters	2021			2022	
	Pre-Monsoon	Monsoon	Post-Monsoon	Pre-Monsoon	Monsoon
pH	7.81	6.85	7.72	7.38	7.24
Dissolved Oxygen (mg/l)	6.41	6.01	5.06	5.51	5.56
Biological Oxygen Demand (mg/l)	2.67	2.49	2.76	4.13	3.94
Nitrate-Nitrogen (mg/l)	0.47	0.54	0.81	0.50	0.31
Phosphate-Phosphorus (mg/l)	0.70	0.05	0.07	0.15	0.10
Silicate (mg/l)	4.14	6.52	7.68	7.63	1.64
Total Coliforms (MPN/100 ml)	1796	≥2400	≥2400	2313	1967
E-Coli (MPN/100 ml)	204	295	572	377	389
Fecal Coliform (MPN/100 ml)	344	1057	870	929	887

The region of Vembanad estuary, near confluence of Periyar River is influenced by large influx of chemical and metal processing industries Annex IA and IB. High concentrations of Chromium (0.41-0.62 ppm), Lead (0.07-0.18 ppm), and Zinc (0.38-0.59 ppm) have been reported before the monsoons[49] Increase in accumulation of Copper, Nickel, Cobalt, Zinc and Cadmium have also been reported in lake sediment[50].

Coir retting and associated operations, though small scale, are extensively distributed along the coastal stretches and contribute heavily to the organic pollution load of the open water bodies. Large quantities of polyphenols along with hydrogen sulphide are released from the extracted coconut fibre bundles during the retting process, creating anoxic conditions. Untreated retting effluents which contain high concentrations of biodegradable organic matter along with sulphides, nitrate and phosphates exert heavy BOD and COD stress on the surrounding aquatic environment. The WIAMS data collected during 2021 and 2022, indicate the BOD values in

[49] Chandini, P. K., Shaji, S. H. E. B. I. M. O. L., and Shivalingam, R. (2018). A study on the accumulation of heavy metals on the sediments and shrimps of Cochin estuary. Indian Journal of Scientific Research, 18(2), 92-96.

[50] Priju, C.P. and A.C. Narayan 2007. Heavy and trace metal in Vembanad lake sediments. International Journal of Environment Research 1(4): 280-289.

northern parts of the estuary i.e. Zone II ranged from 2.67 to 4.13 mg/l during pre-monsoon and 2.49 to 3.94 mg/l during the monsoon season.

Intense rainfall coupled with steep topography retards infiltration and causes the mineral products of weathering to flush down through the surface runoff. Consequently, the groundwater is less mineralized and its quality is better. The shallow groundwater in the upper reaches is slightly acidic or near neutral showing that the hydrogen ions have not reacted completely with the minerals of the parent rock. The distribution of electrical conductivity, which is an index of mineralisation, is about 79µmhos/cm to 7426µmhos/cm with a mean of 1977µmhos/cm. The dissolved solids content is also higher in the range of 18600 mg/l (Chandini et al., 2018), as compared to the upper reaches of the basin. Ground water can be classified as C1S1, C2S1 and C3S1 group with higher salinity hazard (ibid).

Zone III: **Thanneermukkom – Thottapally**

Zone III in 2021 experienced pH variations, dropping to 6.71 during the monsoon. DO reached its peak in the monsoon, while BOD was highest pre-monsoon. Nitrate and Phosphate levels showed seasonal variations, and Silicate increased post-monsoon. The 2022 data revealed a stable pH and increased levels of DO, BOD, and Silicate, consistent with water quality changes over time (Table 14).

The presence of higher amounts of total coliforms, fecal coliforms as well as E-coli in all three zones throughout the sampling periods indicate high anthropogenic input, spoiling the overall water quality of the VKW complex drastically.

Table 14: Water quality of Zone III (Thanneermukkom – Thottapally)

Parameters	**2021**			**2022**	
	Pre-Monsoon	Monsoon	Post-Monsoon	Pre-Monsoon	Monsoon
pH	7.66	6.71	7.19	7.14	7.15
Dissolved Oxygen (mg/l)	5.39	6.11	5.28	5.33	6.21
Biological Oxygen Demand (mg/l)	3.10	2.49	2.83	4.33	3.68
Nitrate-Nitrogen (mg/l)	0.34	0.59	0.97	0.48	0.35
Phosphate-Phosphorus (mg/l)	0.31	0.05	0.05	0.05	0.03
Silicate (mg/l)	5.72	6.52	7.21	8.53	1.57
Total Coliforms (MPN/100 ml)	1685	≥2400	2292	1588	1588
E-Coli (MPN/100 ml)	220	242	378	245	213
Fecal Coliform (MPN/100 ml)	133	1074	984	617	638

Salinity gradient is a significant factor directly regulating a range of services in the landscape. While it is the highest at the Kochi Mouth in the range of 23 – 30 ppt, it reduces progressive inwards. Thanneermukom Barrage plays a critical role in checking and influencing salinity. The salinity in the Kol wetland and a part of Vembanad north of Thanneermukom Barrage was observed to range between 10 – 15 ppt during 1990s. Inter basin transfer of water from Periyar to Muvattupuzha and discharge of water from tail races of hydropower projects have changed salinity gradient in the central part of estuary which presently tends towards freshwater conditions. During December to March when barrage gates are closed, salinity towards the north of Thanneermukkom is reported to be higher (10 ppt) which favours integrated prawn farming in *Pokkali* and *Kaipad* areas. Freshwater conditions prevail south of Thanneermukom favour the *Punja* rice crop in Kuttanad areas during this period. The barrage gates are opened from April to December and a gradual increase in salinity is observed in southern part. Lower salinity levels are recorded between June to September in monsoon with a gradual increase during October to January. The entire backwater becomes freshwater

during monsoon barring bar mouths. From November to January partially mixed conditions prevail. High electrical conductivity values have been reported from surface water (167-313 micromhos/cm) and north of Thanneermukkom (14960 micromhos/cm) which is correlated with direct discharge of industrial effluents at these locations[51,52].

Cochin backwater is presently facing serious challenges because of heavy metal contamination (Table 15) Samples were collected from four sites of Ezhikkara region (10°6′0″N, 76°13′0″E) situated close to Cochin township. The concentrations of heavy metals in the water as well as sediment at different locations in the backwater system are consistent with the local industrialization levels. Northern part of the estuary is found to be the most polluted compared to other parts of the estuary.

Table 15: Heavy metals in sediment samples (ND: Not Detected, BDL: Below Detection Level)[53]

PARAMETERS (ppm)	SITE-1	SITE-2	SITE-3	SITE-4
Chromium	0.48	0.5	0.41	0.62
Lead	0.13	0.07	0.11	0.18
Zinc	0.52	0.38	0.42	0.59
Cadmium	ND	BDL	BDL	ND

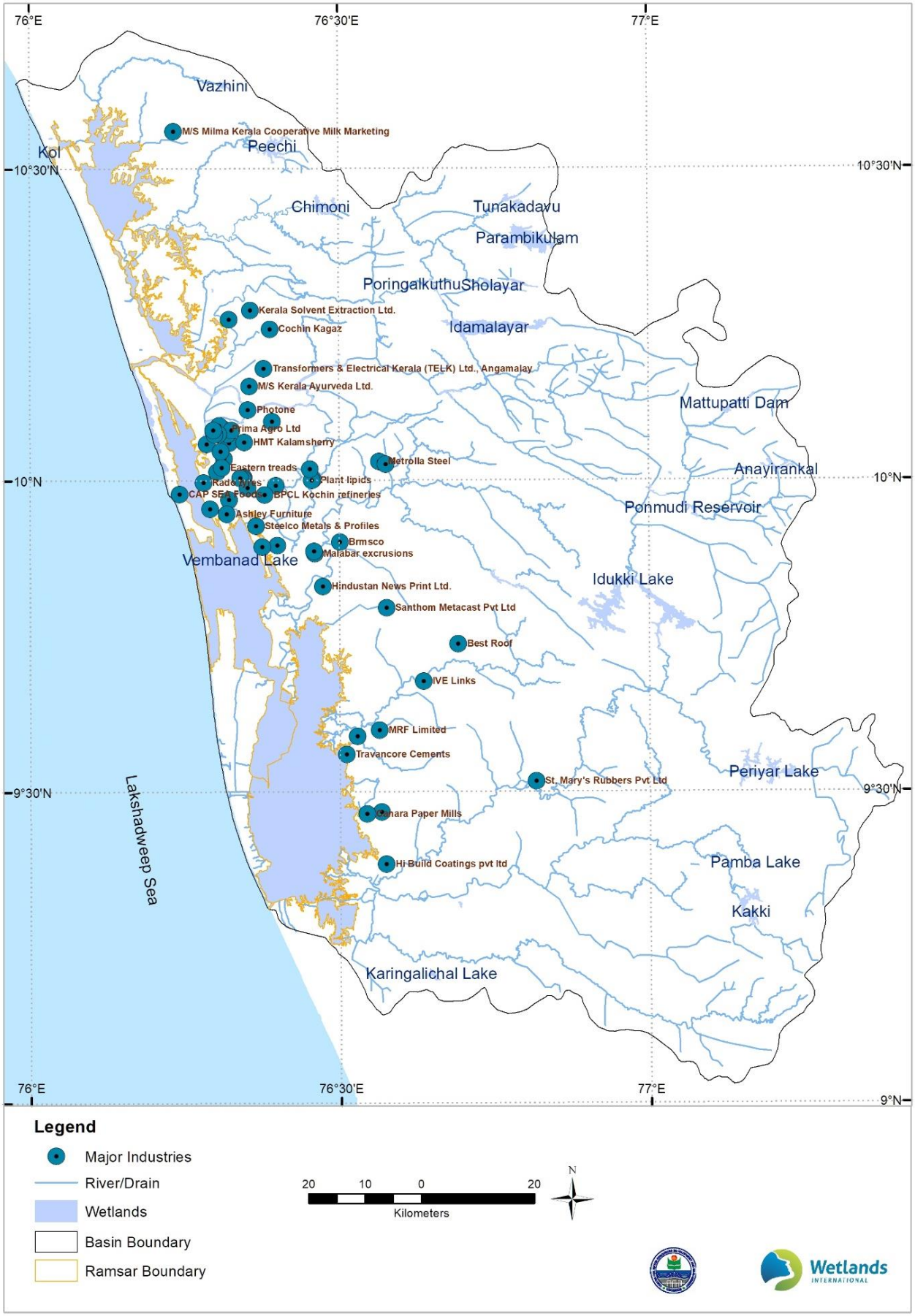
Ernakulum District is the industrial hub of Kerala. It has 28,413 registered industrial units and six industrial areas spanning 339 ha. As in 2019, 64 large scale private industries mainly paint manufacturing, tyre and rubber manufacturing, paper and print industries, fertilizer, food processing, and Aluminium metal industries were present in the district. 19 large-scale Public Sector Units are operational including the Indian Rare Earths Ltd, at Eloor, HMT at Kalamsherry, BPCL, Cochin Refineries at Ambalamugal, FACT at Kunnathunadu and Eloor, Hindalco Industries at Eloor, HIL Ltd. at Udyogamandal, Travancore Cochin Chemicals, Cochin Shipyard and an IOC Bottling Plant at Udayamperoor. Industrial demand for water in the district is high (Map 19).

Carrying Capacity based Development Planning for Greater Cochin Region by National Environmental Engineering Research Institute found that water quality in seven rivers- Chalakkudy, Periyar, Muvattupuzha, Meenachil, Manimala, Pampa and Achenkovil flowing through the region was in general satisfactory falling under B category of CPCB classification. But total coliform was found to be much higher than the permissible limits. Aluva-Eloor and Ambalamedu area have been identified as hotspots due to ground water problems with reference to heavy metals, nitrates and fluoride. The estimate of industrial effluent discharged into the backwaters including industrial and municipal waste is about 1,04,000 m^3/day. Assuming BOD load as 50 mg/l, the total BOD loading is about 5200 kg/day, the estimated assimilative capacity is about 25920 kg/day.

[51] Vincy, M. V., B. Rajan and A. P. Pradeep Kumar 2012. Water Quality Assessment of a Tropical Wetland Ecosystem with special reference to backwater Tourism, Kerala, South India. International Journal of Environmental Science 1(5): 62-68.

[52] IIT and CWRDM, 2011. Report on: Study for modernizing the thannermukkom bund and thotappally spilway for efficient water management in Kuttanad Region, Kerala 207.

[53] Chandini, P. K., Shaji, S. H. E. B. I. M. O. L., and Shivalingam, R. (2018). A study on the accumulation of heavy metals on the sediments and shrimps of Cochin estuary. Indian Journal of Scientific Research, 18(2), 92-96.



Map 19: Major industries within Vembanad-Kol catchment

Similarly, in Alappuzha, 18 industrial areas are notified. 11,809 registered industrial units are present which include 2,293 agro and food-based units, 163 paper and paper products, 307 metal based, 270 rubber, plastic and petro based, 215 soda water and packaged water, 106 cotton textile, and 37 leather-based industries. 31 medium and large industries include major public sector enterprises such as the Malabar cements Ltd., Cement Grinding Unit at Cherthala, Steel Industries Kerala Ltd. At Thuravoor, Travancore Cocotuft Pvt. Ltd at Cherthala.

Thrissur district has six industrial areas spread over an area of 125 ha in Athani, Ayyankunnu, Kunnamkulam, Puzhakkalpadam, Velakode, and Varavoor. Large-scale Public-Sector enterprises produce gelatine, textile and cattle feeds, tyre, textiles, and steel industries. There is a unit of Apollo Tyres at Perambra. The district has 16,272 existing micro and small enterprises and artisan Units (as of 31.03.2019) that employ 90,365 people. This includes several agro-based, paper and paper products, wool, silk, and artificial thread-based industries, leather-based, rubber plastic, and petro-based units, and mineral-based and metal-based industries.

Major minerals present in the catchment districts are clay, sand (Box 2), lime shell, and granite. Kottayam district has lime shell deposits that are exploited by units like Travancore Cements Limited for industrial purposes. Kottayam has 8,223 registered industrial units including 11 registered medium and large units. Three industrial areas are located in Vaikom, Poovanthuruthu, and Athirampuzha. Hindustan News Print and Malayalam Manorama are major Newsprint industries. Tread Rubber, Automobile tubes & Rubber product manufacturing industries such as MRF Limited and Midas Precured Tread(P) Ltd are situated here.

Box 2: Sand Mining along VKW

River sand and gravel are mined extensively from the rivers of the Vembanad catchments. The intensity of the mining is high in the alluvial reaches of the main channels. It has been estimated that around 12.13 million tonnes of sand and gravel are being extracted annually from the seven rivers draining to the Vembanad Estuary[54]. Half of this is from River Periyar which flows through the Kochi city. River Muvattupuzha is also mined for sand owing to its proximity to the city. Apart from instream mining a substantial amount of sand is also being extracted from the floodplain areas of these rivers. Instream mining operations employ about 22300 registered labourers. The number of indirect workers depending on the quarried sand in the construction sector would be over 0.1 million (ibid).

The rate of sand mining is around forty times higher than natural replenishment. As a result, the rivers and associated wetlands are being adversely affected. Indiscriminate sand mining has resulted in the development of pits of various dimensions in river beds. Frequent movement of heavily loaded vehicles across the river banks emitting oil and gasoline pollutes the river and stirs up clouds of fine organic and inorganic particulates, in the overlying waters. Lowering of water table in the wells adjacent to sand mining sites is noticed in the lower reaches of the midlands and lowlands. A study conducted in Manimala River revealed that more than 60% of the wells in its floodplain were affected by water shortages due to river bed lowering consequent to sand mining.

Riparian flora and fauna suffer seriously from riverbank slumping, direct removal of vegetation along the river banks, bank undercutting and channel incision. In several circumstances, resting and nesting grounds of many migratory bird species are affected. The in-stream fish wealth of the rivers is also decreasing due to unabated sand mining[5556]

Mined sand being transported

[54] Padmalal, D., K. Maya, S. Sreebha and R. Sreeja 2008. Environmental effects of river sand mining: a case from the river catchments of Vembanad lake, Southwest coast of India. Environmental Geology 54: 879-889.

[55] Arun, L. K. 1999. Patterns and processes of fish assemblages in Periyar Lake valley system of Southern Western Ghats. *KFRI Research Report* No. 172, Kerala Forest Research Institute, Peechi.

[56] Kurup B. M., K. V. Radhakrishnan and T. G. Manojkumar 2004. Biodiversity status of fishes inhabiting rivers of Kerala (S. India) with special reference to endemism, threats and conservation measures. http//:www.mekonginfo.org/ mrc_en/doclib.nsf/ date of access 12 April, 2013.

2.5. Coastal Processes

Littoral drift[57] plays an important role in shaping and orienting coastal landforms and finally in the evolution of the coast. Information on coastal processes related to VKW is very limited. Gross annual sediment transport rates have been reported to be high in south Kerala (of the order 1.5 to 2 MCM)[58]. The probable volume of sediment transport at 2 m depth has been estimated to be 9 x $10^6/m^3$ towards south between Munambam and Vypeen and 7 x $10^6/m^3$ between Fort Cochin and Andhakaranzhi (ibid). This is one of the factors leading to development of a sandbar at the mouth of the Thottapally spillway, which is currently being maintained by periodic dredging at a significant annual cost.

Tides in the Cochin estuary is of mixed semidiurnal type with an average tidal range of 1m[59].The maximum range of the spring tide was1m while the neap tides did not exceed 0.59 m. According to[60] the relative importance of the semidiurnal and the diurnal components keeps changing throughout the month. Spring phase is dominated by semi-diurnal tides and neap phase by diurnal tides. There is a rapid decay in the amplitudes of the principal tidal constituents as they propagate upstream. However, tidal amplification is observed in the south estuary during pre-monsoon season (March) which is possibly caused by the closure of the hydraulic barrier at Thanneermukom[61].Their model showed that strong currents prevail at the central estuary (from Cochin inlet to 22 km south), whereas weak and slow currents are found in the north and south estuary. Salinity fluctuates at different timescales, including intra tidal, fortnightly of spring and neap tidal cycle, and seasonal wet and dry periods. It was evident that Cochin estuary experiences a transition from partially mixed (neap) or well mixed (spring) in dry season to periodically stratified state during monsoon[62]. The[57] studied the tidal circulation in the Cochin Estuary using a 2D hydrodynamic model (Hydrodyn-FLOSOFT) and found that the tidal excursion is faster in central estuary, but slower in the north and south estuaries; making these two zones more sensitive to environmental pollution.

2.6. Biodiversity

High habitat diversity within Vembanad-Kol enables the wetland ecosystem to support a diverse range of species, several with high conservation significance. Connectivity with riverine and coastal environments leads to development of a salinity gradient within the estuary providing conducive condition for species migration. The wetland catchments form a part of the Western Ghats bio-geographic region which is identified as one of the 25 biodiversity hotspots[63] of the world[64]. The low-lying swamps and tidal creeks with patches of mangroves support juveniles of several economically important fish and prawn species of marine and freshwater origin and act

[57] Littoral transport is the movement of sediments in near shore zones by waves and currents. Transport parallel to the shore is termed as alongshore, whereas perpendicular to the shore is termed as onshore-offshore transport. The material transported is called littoral drift.

[58] Kunte, D. P., B. G Wagle and Y. Sugimori. 2001. Littoral transport studies west coast of India-A review. Indian Journal of MarineScience 30: 57-64.

[59] Qasim S.Z., and Gopinathan C.K. 1969. Tidal cycle and the environmental features of cochin backwater (a tropical estuary). Proceedings of the Indian Academy of Sciences, Bangalore.

[60] Srinivas, K., Revichandran, C., Maheswaran, P.A., Mohammed Ashraf, T.T. and Nuncio, M., 2003. Propagation of tides in the Cochin estuarine system, southwest coast of India. Ind J Mar Sci.,32:14-24.

[61] Balachandran K.K., Reddy G.S., Revichandran C., Srinivas K., Vijayan P.R. and Thottam Tony J. 2008. Modelling of tidal hydrodynamics for a tropical ecosystem with implications for pollutant dispersion (Cochin Estuary, Southwest India). Ocean Dynamics, Vol.58; 259-273.

[62] Shivaprasad A., Vinita J., Revichandran C., Reny P.D., Deepak M.P., Muraleedharan K.R. and Naveen Kumar K.R. 2012. Seasonal stratification and property distributions in a tropical estuary (Cochin estuary, west coast, India). Hydrol. Earth Syst. Sci. Discuss. ,9, 8979–9010, 2012.

[63] Over 4000 species of flowering plants (38% endemic), 289 fish (41% endemic), 135 amphibians (75% endemic), 156 reptiles (62% endemic), 508 birds (4 % endemic) and 120 mammals (12% endemic) have been recorded from Western Ghats (Daniels, 2003; Babu and Nayar, 2004; Dhanukar et al, 2004; Gururaja and Sahyadri, 2004)

[64] Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B da Fonesca, and J. Kent 2000. Biodiversity hotspots for Conservation priorities. Nature 403: 853-858.

as wintering grounds for migrating waterbirds, supporting one of the largest populations within the Central Asian Flyway.

Biodiversity within Vembanad-Kol exists within a highly modified and fragmented landscape. Reclamation of marshes for agriculture, rapid development of tourism infrastructure and increasing area under settlements has adversely affected habitats. The few species-rich pockets as Pathiramanal Islands and Kumarakom need urgent protection to ensure that the biodiversity values of Vembanad-Kol backwaters are not lost in the course of increasing economic development.

While studies on specific groups (mainly waterbirds, fish and mangroves) do provide information on species richness, major component of research is targeted on economically important species, with relatively little information available on the lower order floral and faunal species. Similarly, landscape scale interactions, particularly the impact of landscape fragmentation is yet to be comprehensively assessed. An overview of number of species recorded from the VKW is summarized inTable 16, and the overall status and trends discussed in the following sections.

Table 16: An overview of number of species recorded from the Vembanad-Kol wetlands

Species group	No. of Species	Record Date	Data Source	IUCN Conservation Status						
				CR	EN	VN	NT	DD	LC	NE
Flora										
Phytoplankton	123	1998-99	ICMAM, 2002							123
Algae	188	2005-2006	Tessy and Sreekumar, 2008							188
Vascular plant species	26	2004-2006	John et al., 2009					26		
Shrub	14	2004-2006	John et al., 2009					14		
Herb	237	2004-2006	John et al., 2009							237
Climber	21	2004-2006	John et al., 2009					21		
Mangrove	09	2010	Ram and Shaji, 2013						08	01
Mangrove associates	08	2010	Ram and Shaji, 2013						03	05
Fauna										
Protozoa	67	2009	ZSI, 2023							67
Fish	177	2009	ZSI, 2023			01	03	07	52	114
Crab	19	2012-2013	Mogalekar et. al, 2015						06	13
Clam	6	2004	CMFRI, 2005						02	04
Bivalve	2	2008	Suja and Mohamad, 2010						02	
Mussel	2	2008-2011	Rajan et al., 2011							02
Oyster	1	2008-2011	Rajan et al., 2011							01
Aves	236	2009; 2001-2012	AWC-Narayanan and Sreekumar, 2012; ZSI 2023		02	04	11	01	218	
Mammals	21	2009; 2001-2012	Narayanan and Sreekumar, 2012; ZSI 2023		02	02	01		15	
Reptiles	27	2009; 2001-2012	Narayanan and Sreekumar, 2012; ZSI 2023	01	02	02	01	01	19	01
Amphibia	17	2009; 2001-2012	Narayanan and Sreekumar, 2012; ZSI 2023	01			01	01	13	01
Invertebrates	550	2009; 2001-2012	Narayanan and Sreekumar, 2012; ZSI 2023					02	62	486

Footnote: CR = Critically Endangered, En = Endangered, VN = Vulnerable, NT = Near Threatened, DD = Data Deficient, LC = Least Concerned, NE = Not Evaluated.

Floral diversity

With conversion of marshes of Kuttanad and Kol floodplains into agriculture, aquatic environment is mainly limited to Vembanad estuary and the interconnecting channels. Information on floral diversity pertaining to wetland complex is mostly focused on macrophytes and mangroves, and to a limited extent on terrestrial plant species in the surrounding areas. Information base on Kol and Pokkali areas is further limited.

338 plant species were reported from the VKW[65].There were 40 mangrove and related species, 14 shrub species, 21 climber species, 237 plant species, and 26 tree species. The annual mean Gross Primary Productivity and Net Primary productivity of Cochin backwater is reported to be 0.753 g C/m3/ day and 0.603 g C/m3/day respectively[66].

In the year 2002 presence of 123 phytoplankton species (89 Bacillariophyceae, 31 Dinophyceae, 2 Chlorophyceae, and 1 Cynophyceae) were recorded in assessments conducted by ICMAM[67]. The density of phytoplankton (all groups) ranges between 12,000 – 3,22,000 cells/l in the tidal-zone and 7,000-2,35,000 cells/l in backwaters[62,63]. 64 phytoplankton species were recorded[68] from the Thrissur Kol wetlands, Kerala.

During biodiversity evaluations conducted by CMFRI along the western Kerala coastline, 34 species of benthic marine algae were found[69]. 8 species of seaweeds have also been reported in the coastal zone between Tirumallavaram and Paraparangadi with luxuriant growth of *Enteromorpha compressa* and *Grateloupia filicina*. During 2005 – 2006 a study in the Kol wetlands in Thrissur District, Kerala recorded occurrence of 188 species of algae under 64 genera belonging to six taxonomic groups[64]. Desmidiaceae was the dominant group with 83 species under 19 genera followed by Chlorophyceae with 41 species belonging to 20 genera. Desmids are pollution-tolerant algal species i.e., indicators of pollution level, hence their dominance indicates good water quality of Kol wetlands (Annex II).

Owing to the dense coconut plantations that have grown up around polders, high biomass density (91.2 g/m2 dry weight) was recorded in a few sites[70]. In Kol lands, *Salvinia molesta* and *Eichhornia crassipes* are a plague in some canal segments.

24 species of macrophytes from 12 families and 3 species of pteridophytes (*Lycopodium cernuum, Cyclosorus interruptus,* and *Ceratopteris thalictroides*) were also reported[71] (Annex III). High biomass density (91.2 g/m^2 dry weight) has been observed in few locations[66]. Dense coconut plantations have been developed all around polders.

Large or small free-floating masses of decaying organic matter supporting the growth of various plants over them are quite common in tropical wetlands. Large macrophyte and small woody shrubs colonise on such floating mats called floating islands or sudds[72]. Sudds represents a special habitat different from their surrounding water-spread. The mat is usually composed of dead organic matter, live biomass and mineral sediments held together by network of rhizomes,

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[65] John, C. M., V. P. Sylas, J. Paul and K. S. Unni 2009. Floating island in a tropical wetland of peninsular India. Wetlands Ecology and Management 17: 641-653.

[66] Selvaraj, G. S. D. and V. J. Thomas 2003. Seasonal variation of phytoplankton and productivity in the surf zone and backwater at Cochin. Journal of Marine Biological Association India 45(1): 9-19.

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[68] Tessy, P.P and Sreekumar, R. 2008. A report on the pollution algae from the Thrissur Kol Wetlands (Part of Vembanad Kol, Ramsar Site), Kerala. 2008. Nature Environment and Pollution Technology. Vol. 7. No. 2. 311-314pp.

[69] Krishnamurthy Chennubhotla, V. S B., S. Ramachandrudu, P. Kaladharan and S. K. Dharmaraja 1988. Seaweed resource of Kerala. CMFRI, Aquaculture Biology VII: 69-74.

[70] Sasidharan, N. K., V. Sreekumar, P.S. John and M. S. Nair 1990. Intensity of weeds in the rice ecosystem of Kuttanad. Rice in wetland ecosystem. Proceedings of the National Symposium on Rice in Wetland Ecosystem, Kottayam, Kelala.

[71] Jayan, P. R. and N. Sathyanathan 2010. Overview of farming practices in the water-logged areas of Kerala, India. International Journal of Agricultural and Biological Engineering 3(4): 1-16.

[72] Azza N, Denny P, Koppel JVD, Kanshme F. 2006. Floating mats: their occurrence and influence on shoreline distribution of emergent vegetation. Freshwater Biology 51(7):1286– 1297.

roots and stems. The deltaic region of the Kuttanad-Vembanad wetland environment is home to three different types of floating islands, most of which are found in inland water bodies[73].These were classified based on their origin and development, habitat in which they occur and structural and vegetation characteristics. The floating vegetation mats comprised of 8 to 9 species; mainly fodder grass Ischaemum travancorense (Kadakal), endemic to Kerala. Phragmites karka, Alternanthera philoxeroides (Erect marginal), Eichhornia crassipes, Salvinia molesta (free floating), Cabombo caroliniana (rooted submerged), and Ludwigia adscendens (floating stem), several patches also have Acrostichum aureum, a mangrove associate fern. *Calophyllum sp.* (source of oil), *Oryza sp.* (wild rice), *Aponogeton sp.* (an edible tuber), *Kandelia sp.* (rare mangrove in the state), *Bacopa* (Brahmi a widely used medicinal plant), *Garcinia* and *Morinda* (commercial species known for its fruits), *Pandanus* (leaves harvested for mat weaving) have also been reported from the vicinity of the Kuttanad region.

Mangroves are one of the important constituents of estuarine floral diversity. Assessments[74] have recorded the presence of 09 species of true mangrove and 08 species of mangrove associates (Annex IV). Mangrove patch in Kumarakom forms an important roosting and breeding site of Night heron, Darter, Cormorants, Indian Shags, Egrets, Herons and White Ibis. Dominance of *Avicennia marina, Rhizophora mucronata*and *Acanthus ilicifolius* (species of medicinal importance) from Managalavanam, an 8.4 ha mangrove protected area has also been reprted[75].

Invasive species

Proliferation of invasive species within the channels of Kuttanad and Kol lands is a major concern as it impedes flow and aggravates waterlogging (Kerala State Environment Plan, 2022). Spread of *Eichhornia crassipes* and *Monochoria vaginalis* from the Kuttanad region of the VKW has been reported[76]. Closure of Thanneermukkom Barrage for extended periods has led to significant reduction in tidal flushing in Kuttanad, which was a natural check to proliferation of these species[77].

Faunal Diversity

Recent studies conducted on faunal diversity in Vembanad-Kol complex report presence of 1071 faunal species consisting of 67 Protozoans, 550 Invertebrate species, 177 Fish species, 10 Amphibian species, 23 Reptilian species, 223 Bird species and 21 Mammalian species[78]). (Annex

[73] John, C. M., V. P. Sylas, J. Paul and K. S. Unni 2009. Floating island in a tropical wetland of peninsular India. Wetlands Ecology and Management 17: 641-653.

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[77] Kolathayar, S., U.S. Amala Krishnan., and T. G. Sitharam (2021): Appraisal of Thanneermukkom bund as a coastal reservoir in Kuttanad, Kerala, Journal of Applied Water Engineering and Research. 12pp. DOI: 10.1080/23249676.2021.1884612

[78] Banerjee, D., Bharti, D., Kumar, S., Mitra, A., Joshi, R., & Gupta, D. (2023). Faunal diversity of 75 Ramsar Wetlands from India: 01-581(Zoological Survey of India, Kolkata)

V, VI, VII, VIII, IX, XI).[79,80,81,82,83,84,85,86]. 58 species of butterflies were identified from the Kol wetlands[87] (Annex X). 30 species of high global conservation significance have been recorded (Table 16).

The marsh crocodile *Crocodylus palustris* and Saltwater crocodile *Crocodylus porosus* once present in the estuary are reported locally extinct. Also, the Spinner dolphins *Stenella longirostris* are no longer sighted from the Cochin mouth[88]. Studies are mostly concentrated on specific groups and seasonal patterns. Information on impact of altered hydrological regime on habitat quality and faunal diversity is limited, except reference to changes in migration pattern of Giant Freshwater Prawn (*Macrobrachium rosenbergii).*

In Kol lands rotifers form a major portion of the freshwater zooplankton. 40 species of rotifers belonging to15 genera and 10 families were recorded[80]. Family Brachionidae is the dominating family with 12 species. *Keratella cochlearis* and *Brachionus falcatus* formed the dominant species. Diversity and abundance of rotifers also showed seasonal fluctuations. Highest species richness was found during the pre-monsoon season and lowest during monsoon season.

Comprehensive studies conducted by individual groups are more focussed on fish and water birds, which are discussed in the following sections.

Fish and Fisheries

Connectivity with riverine and marine environments underpins the presence of a high number of freshwaters, brackish as well as marine fish species in Vembanad-Kol. Recorded fish diversity within wetland complex includes 177 species constituting 113 genera and 62 families[89]. 7 species of fish endemic to the rivers of Western Ghats are also found in the estuary viz., *Dayella malabarica, Horabagrus brachysoma, Mastacembelus guentheri, Mystus malabaricus, Mystus oculatus, Puntius filamentosus,* and *Labeo dussumieri*[90].

Fisheries production from Vembanad-Kol is unorganized and data on fishery resources is very scanty. Fish yield from Vembanad area was estimated by Kerala University during Indo-Dutch mission in 1988-1989 and ten fishing zones were identified. A total of 7200 MT of fish yield was reported during the period, of which 93% was from north of Thanneermukom Barrage. In 2000 – 01 the catch was reported to be only 687 MT[91]. Brackish water species are commercially most important. Mullets (*Mugil sp.),* Perches *(Lates calcarifer),* Milkfish (*Chanos chanos),* Catfishes

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[79] Kurup, B. M., J. Sebastian, T. M. Sankaran and P. Rabindranath 1993. Exploited fishery resource of Vembanad lake. Indian Journal of Fisheries 40 (4): 199-206.

[80] ICMAM, 2002. Critical habitat information system for Cochin backwaters-Kerala. Department of Ocean Development, Government of India 1-31.

[81] CMFRI, 2005. State Biodiversity Strategy and Action Plan (SBSAP) for Kerala. Conservation priorities. Nature 403: 853-858.

[82] Krishnakumar, K., R. Raghavan and B. Pereira 2009. Protected on paper, hunted in wetlands: exploitation and trade of freshwater turtles (Melanochelys trijuga coronata and Lissemys punctata punctata) in Punnamada, Kerala, India. Tropical Conservation Science 2(3): 363-373.

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[85] Fathibi, K., Sudhikumar, A.V and Aneesh, E.M. 2020. Species composition and abundance of rotifers (Rotifera: Eurotatoria) in Thrissur Kole wetland, Kerala, India. Egyptian Journal of Aquatic Biology and Fisheries Zoology Department, Faculty of Science, Ain Shams University, Cairo, Egypt. ISSN 1110 – 6131 Vol. 24. No. 6. 439–451pp.

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[90] NBFGR, 1998. Fish chromosome atlas. National Bureau of Fish Genetic Resources Special Publication, No. 1. Lucknow, India, 332 p.

[91] Padmakumar, K. G., A. Keishnan, R. Radhika, P. S. Manu and C. K. Shiny 2002. Open water fishery interventions in Kuttanad, Kerala with reference to fishery decline and ecosystem changes. In: Riverine and Reservoir Fisheries of India. Society of Fishery Technologists (India) Cochin 678.

(Tachysurus maculatus), Halfbeak *(Hyporhamphus sp.),* Elopiformes *(Megalops sp.)* and Pearlspot *(Etroplus suratensis)* are commercially important estuarine finfish species. In earlier periods, the bulk of catch was constituted by Hilsa, Oil Sardines, Mackerel, Herrings, Croakers, Flatfishes and Marine Catfishes. Catch of freshwater fish like *Horobagrus brachysoma, Clarius batrachus* and *Ompak bimaculatus* are also reported to have dwindled[92].

High preference for Pearlspot, particularly by the tourism industry has gradually led to targeted fishing. In 2000 – 2001, pearlspot comprised 29% of catch[85]. The breeding habitat of this species is unique, it utilizes a submerged substratum for egg attachment. A fish sanctuary for Pearlspot has been established at Kumarakom, which is the first of its kind in the country. An area of 10 ha within the open water of Vembanad has been encircled by planting coconut and bamboo piles. Artificial nests and reef substrates have been placed on the sanctuary bed to facilitate natural breeding and egg attachment[93].

Vembanad estuary also serves as nursery ground for penaeid prawns *(Penaeus monodon, P. dobsoni* and *P. monoceros)*. A total of 3500 MT penaeid and 117.69 MT of palaeomonid prawns were recorded from landing centers during 1988-89. Fresh water prawn *Macrobrachium idella* also contributed 6% of the total production followed by *M. rosenbergii* (0.32%). With the commissioning of Thanneermukom Barrage, the upstream and downstream migration of the giant prawns, *M. rosenbergii*, was disrupted leading to near decimation of its fishery in the estuary[94]. The annual catch of this species during the pre-barrage period was 429 tons[95], which has now declined significantly. This decline is primarily attributed to the physical obstruction inflicted by the barrage on the breeding migration of the spawners downstream and the reverse migration of post larvae to their home grounds in Kuttanad (Figure 14).

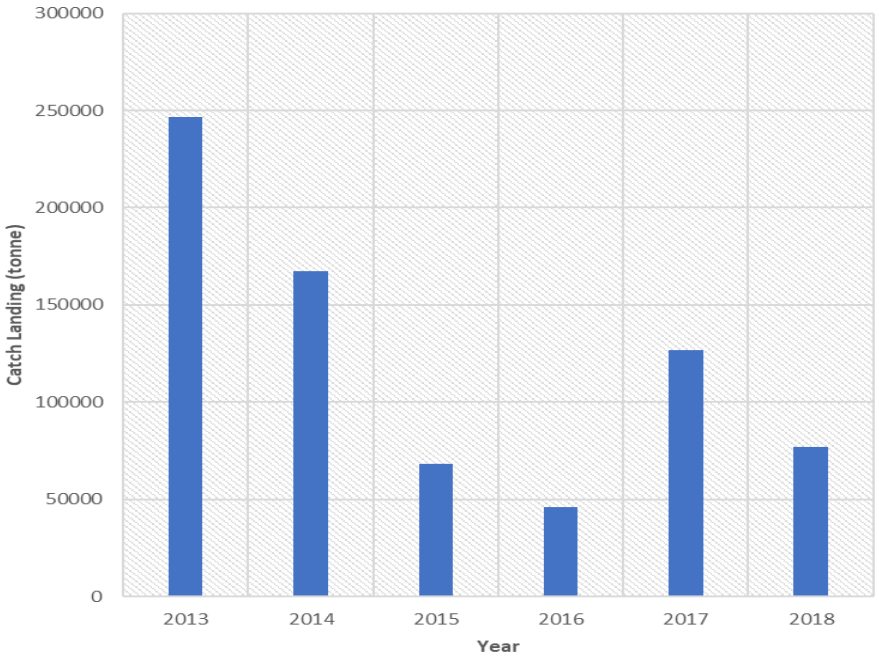

Figure 14: Trend of *M. rosenbergii* landings from 2013 – 2018[92]

[92] Kurup B. M., K. V. Radhakrishnan and T. G. Manojkumar 2004. Biodiversity status of fishes inhabiting rivers of Kerala (S. India) with special reference to endemism, threats and conservation measures. http//:www.mekonginfo.org/ mrc_en/doclib.nsf/ date of access 12 April, 2013.

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Trends in quantity and value of the annual fish productions among the different districts bordering VKW show consistent island production while marine production has dropped across the years. Ernakulam reports the highest yield while Thrissur reports the lowest. Revenue earned in the process also seems to be directly proportional to the increase in production exhibiting marine production peaks in Ernakulam districts during recent years while showing a consistent trend across districts for inland fish production except Ernakulam (Figure 15). The location of major and minor fish landing center is indicated in Map 20 and Annex XVI.

Vembanad estuary is also a rich source of live as well as sub fossil deposit of clam. Six species of clam have been recorded here. A zonation in availability is indicated, which is correlated with salinity regimes. *Sunetta scripta* is found near the bar mouth, *Meretrix casta* and *Paphia malabarica* dominate 2-3 km away from the bar mouth (salinity 15 ppt), whereas *Villorita cyprinoides* are reported from freshwater regions[96]. Main clam fishing methods employed are hand picking and storing in a basket, combing and heaping in low tides with toothed-iron rakes and rakes fitted with bag nets.

The production of black clams has declined drastically from a peak of 75,592 metric tonnes in 2006 to 42,036 metric tonnes in 2019 in the Vembanad Estuary[97]. Low production is owing to multiple reasons ranging from habitat degradation to unsustainable extraction of clams. Significant decline in the fish catch in recent years has led to increasing pressure on harvest of clams as a livelihood resource. Water hyacinth adversely affects the water quality and plastic waste hinders clam collection and transportation of clam collecting canoes. Excessive mat-like growth of weeds is present for more than 8 months a year which results in severe economic loss. Eradication of the weeds are costly and ineffective as they keep coming back (Map 26).

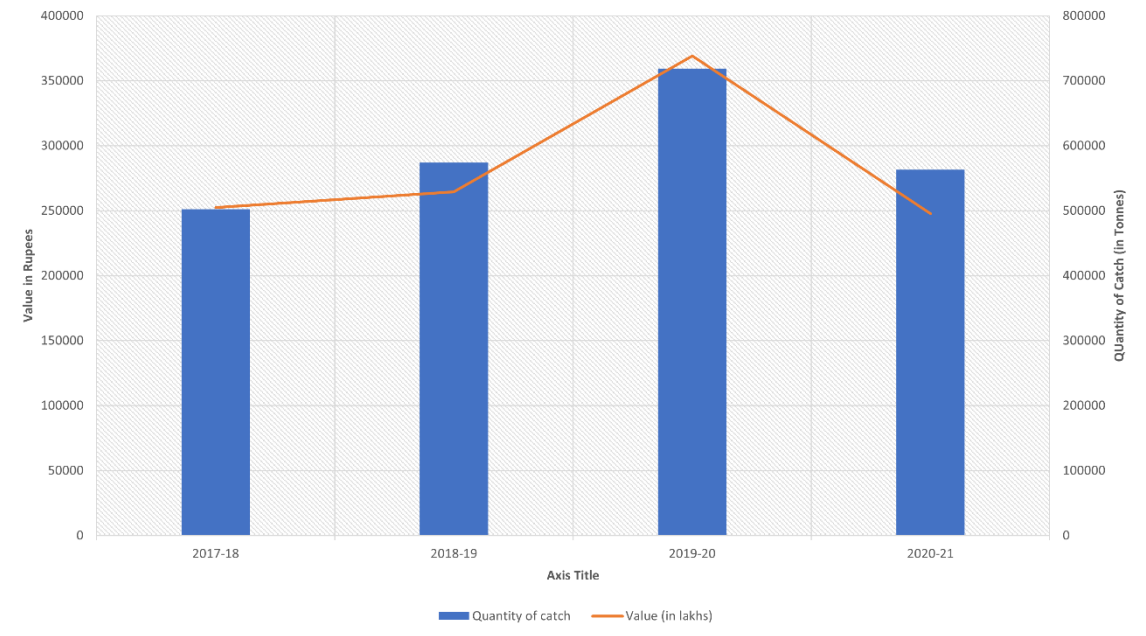
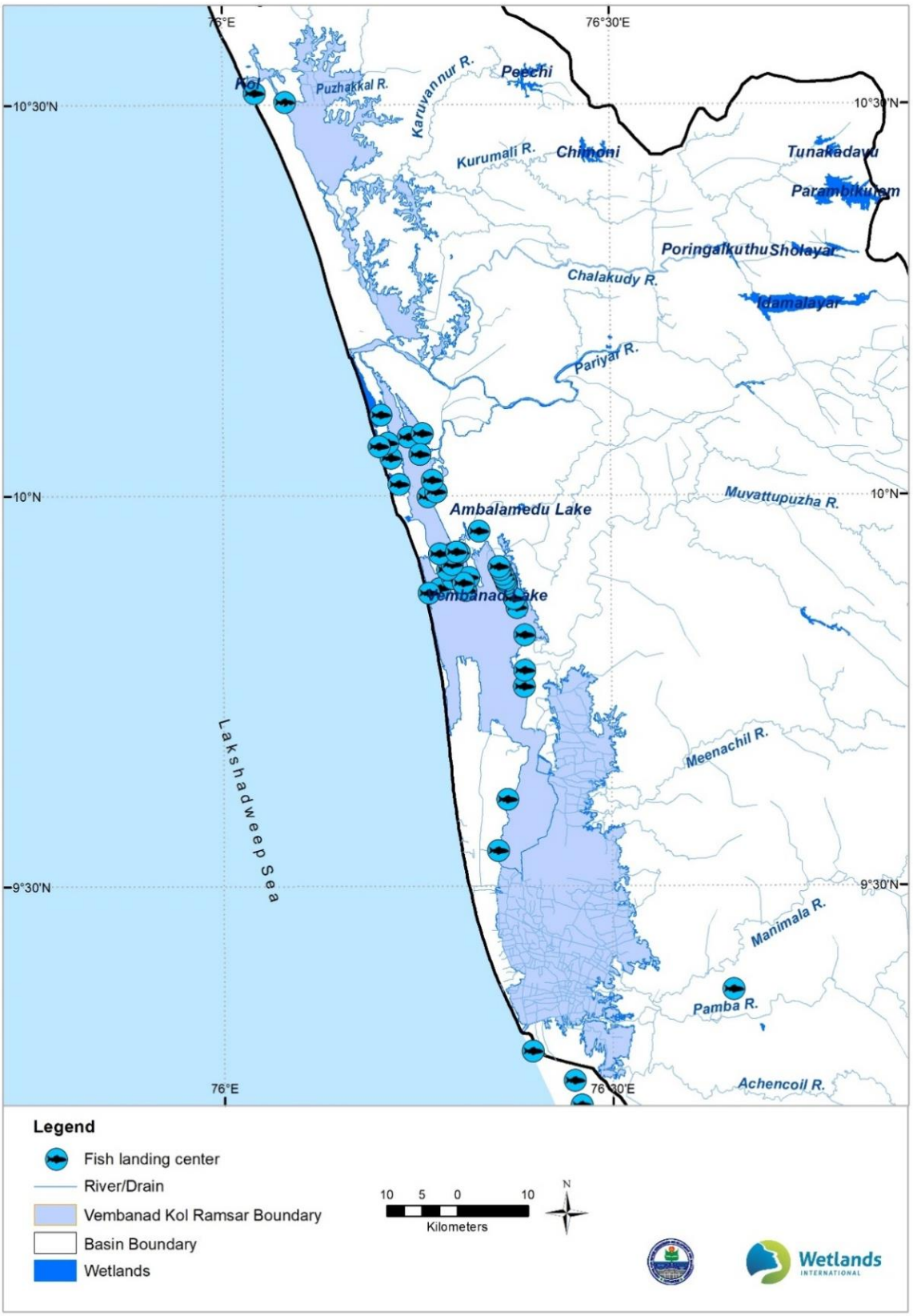


Figure 15: Quantity and value of annual fish production in Vembanad Estuary[98]

[96] KFRI, 2009. The Conservation of Mangroves in Kerala: Economic and Ecological Linkages. Report 487: 47 pp.

[97] Vidya R., Mohamed K. S., Venkatesan V., Sasikumar G., Jenni B., Alloycious P. S., Sajikumar K. K., Jestin Joy K. M., Sheela P. P., Kavitha M., Jasmine F. and Jeena N. S. Fishery and exploitation status of black clam, Villorita cyprinoides from Vembanad Lake, Kerala 2020. In Joshi K. K. et al. Marine Ecosystem Challenges & Opportunities (MECOS 3), International Symposium Marine Ecosystems Challenges & Opportunities 8-10 January 2020, Kochi.

[98] Data taken from the Department of Fisheries, state of Kerala



Map 20: Fish Landing Centres in Vembanad Kol wetlands

The polders of Kuttanad are also used for farming of freshwater prawns. Presently, around 5000 ha area in this region is used for this purpose. In 2002, it was reported that 248 ha of fallow polders were under mono-culture of scampi during January to August, while 4,750 ha was used for polyculture along with major carp during November to July[99]. *Pokkali*, a traditional system of integrated rich shrimp cultivation is also an important source of prawn production (Box 3: *Pokkali* farming system). Some of the polders are reportedly used for trapping fish and prawns during monsoon. The catch from the polders comprises freshwater fishes (93.5%) and palaeomonid prawns (6.5%) (ibid).

A range of fishing gear is used in the wetland complex. Usually, stake nets and Chinese dip nets are used. Marine prawns are captured during the night and fishes, mainly mullets, during day. Baited long lines are used to capture freshwater prawns and crabs. The Chinese dip net (*Cheena Vala* or *Kamba Vala*) is used in the lower stretch of the estuary, particularly in the bar mouth region between of Cochin and Azhikode. A total of 1,428 dip nets are reported operating in the estuary, mostly to the north of Thanneermukom[100]Gill nets used are of two types i.e., set gill nets and drifting gill nets.

Conical-shaped stake net or *Kutti Vala* or *Valu Vala* is used to catch prawns during ebb tides. Presently, 3862 stake nets are operated in the Vembanad estuary of which nearly 30% have very fine mesh sizes (less than 8 mm)[94.]

Seine nets of varying length, width and mesh size are used to catch of fish species. Eight types are commonly used i.e., *Valli Valu, Pattu Kanni Vala, Paithu Vala, Neria Vala, Chemmeen Vala, Mandu Vala, Karimeen Vala and Peru Val*a. More than 90% of pearlspot is caught using *Karimeen Vala* south of the barrage. Fishers use cast nets or *Veechu Vala* in the flat bottom and shallow areas. In northern sector cast nets are used to catch penaeid prawns whereas in southern part it is used for Pearlspot.

Usually small plank-built canoes, 5.8 –9.0 m in length and 0.4-0.9 m in width are used for crab fisheries. *Scylla serrata* is fished by means of baited line with or without hoks, crab traps or hooked iron rods. Crab traps (*Njandu Vala*) are mainly used during January to April. During new moon nights, crab fishing is done using powerful lights and scoop nets (locally called Ball fishing). Crabs are also caught in by-catch with other stationary nets along with other fishes[101]

Fishing activity in Vembanad-Kol

[99] Kurup, B. M and K. Ranjeet 2002. Integration of freshwater prawn culture with rice farming in Kuttanad, India. Naga, Worldfish Center Quarterly 25(3-4):16-19.

[100] Florence, M. A. 2012. Sustainability and livelihood issues of Vembanad ecosystem fish folk communities with special reference to Muhamma and Thanneermukkom villages. Ph.D Thesis submitted to Cochin University of Science and Technology 81-82.

[101] Kurup, B. M. and C. T. Samuel 1985. Fish and fishery resource of Vembanad lake. In: Harvest and post harvest technology of fishes. Proceeding of the symposium on harvest and post harvest technology of fishes, Society of Fisheries Technology (India), Kochi 77-82.

BOX 3: Pokkali farming system

Pokkali is an integrated rice and prawn farming system practiced around Vembanad estuary in Ernakulam, Alappuzha and Thrissur districts since over 3,000 years. The rice variety used in the farming system grows above the water height throughout the monsoon season up to a height of 130-140 cm that can withstand salinity up to 8 ppt and is known as *Pokkali* rice. Pokkali field areas are said to have declined from more than 25,000 hectares two decades ago, to about 5000 hectares with actual cultivation taking place in less than 1000 hectares. 435 ha are cultivated in Ernakulam district.

Rice fields converted to prawn fields. Gates at centre allow the post larvae and juveniles to enter the farm

Pokkali rice is sown immediately after the onset of southwest monsoon in June. About 80-100 kg of seed is required for broadcasting in one ha of paddy field. The crop takes 90-100 days for maturing and is harvested by end of October or early November. Pokkali, Churuttu Pokkali, Chettyviruppu, Anakkondan and Cheruviruppu are the traditional cultivars. Improved varieties developed by the Research Stations, Kerala Agricultural University, Vyttila (VTL-1 to VTL-8) are now popular due to higher yields.

The pinnacles of mature stalk are harvested and the rest is left to decay in the field. Mid-November onwards as salinity tends to increase, prawn / fish farming takes over. Relatively lower salinity in *Pokkali* fields in comparison to sea, trigger movement of prawn post larvae and fish juveniles to these areas. They are guided in the fields by sluice gates. The decaying stalks of *Pokkali* rice form the feed of prawn and fish juveniles. Harvesting of prawn starts from mid January and is done every 3-4 days before and after full moon and new moon. A conical net is fixed at the outer mouth of the sluice gate during low tide to trap the prawn and fish with outflow. Lights are placed at the sluice gate to attract the prawn juveniles from the field. Prawns form about 80% of the catch (*Peneaus monodon, P. indicus, Metapenaeus dobsoni, M. monoceros)* and the rest is contributed by fish (*Etroplus sp., Mugil sp. And Oreochromis mossambicus*). This process of prawns trapping and harvest continues till the end of March when the fields are drained and prepared for next paddy cycle.

Pokkali farming is completely organic. It continues to be profitable even after the increasing cost of inputs and labour. In a typical 1 ha of *Pokkali* rice farm, 1500 kg of rice and 420-900 kg of prawns can be harvested. The net profit form *Pokkali* system is computed to be Rs 47,110 per cycle in comparison to Rs 10,100 from rice monoculture[102]. In 2008, *Pokkali* rice was accorded

[102] Francis, G., U. Focken and K. Becker 1999. A traditional rice-prawn rotation culture system from Kerala State, India. Deutscher Tropentag 1999 in Berlin Session: Sustainable Technology Development in Animal Agriculture 1-7.

Geographical Indication[103] status. Pokkali Land Development Agency was set up in 1996 by the Kerala State Government to promote paddy cultivation in the wetlands.

However, of late, the practice has been stressed due to various reasons. The land is increasingly being converted into prawn farms or for coconut cultivation. Reduced availability of labour and high wage rates is cited as one of the major reasons. This calls for greater mechanization of farm operations. Efficient market linkages are required for marketing of prawns. Unscientific and ill planned constructions at the sea mouth and discharge of effluents from chemical factories have also impacted the arrival of prawn post larvae. With a gradual decline in natural recruitment, farmers have resorted to stocking the farms (0.15 – 0.2 million seeds per acre) resulting in a production of 2 – 3 MT per acre. With stocking, the average farm income has been reported to be around Rs. 3.9 Lakh per hectare. While the net return from Pokkali rice cultivation was estimated to be negative with a loss of Rs 62,864 per ha, the high production of prawns compensates for the losses suffered during paddy cultivation contributing to a net profit of Rs. 3.44 Lakh per ha[104].

Pokkali harvests were unaffected by the 2018 floods. Pokkali resilience to high floods has renewed the interest of climate change and food security experts and policy makers. There have been efforts towards revitalization and advancement of Pokkali agriculture. The *Pokkali Samrakshana Samithi* has leased out Pokkali lands through 'Pokkali bonds' for cultivation. A Pokkali harvest festival was organised in 2022. Value added agriculture mission to market value added products has been launched with world bank support of Rs. 1400 Crore[105]. The National Adaptation Fund on Climate Change (NAFCC) has provided Rs. 250 million towards promotion of Integrated Farming System of 300 ha of *Kaipad* and 300 ha of *Pokkali* lands in 2015-16[106].

Waterbirds

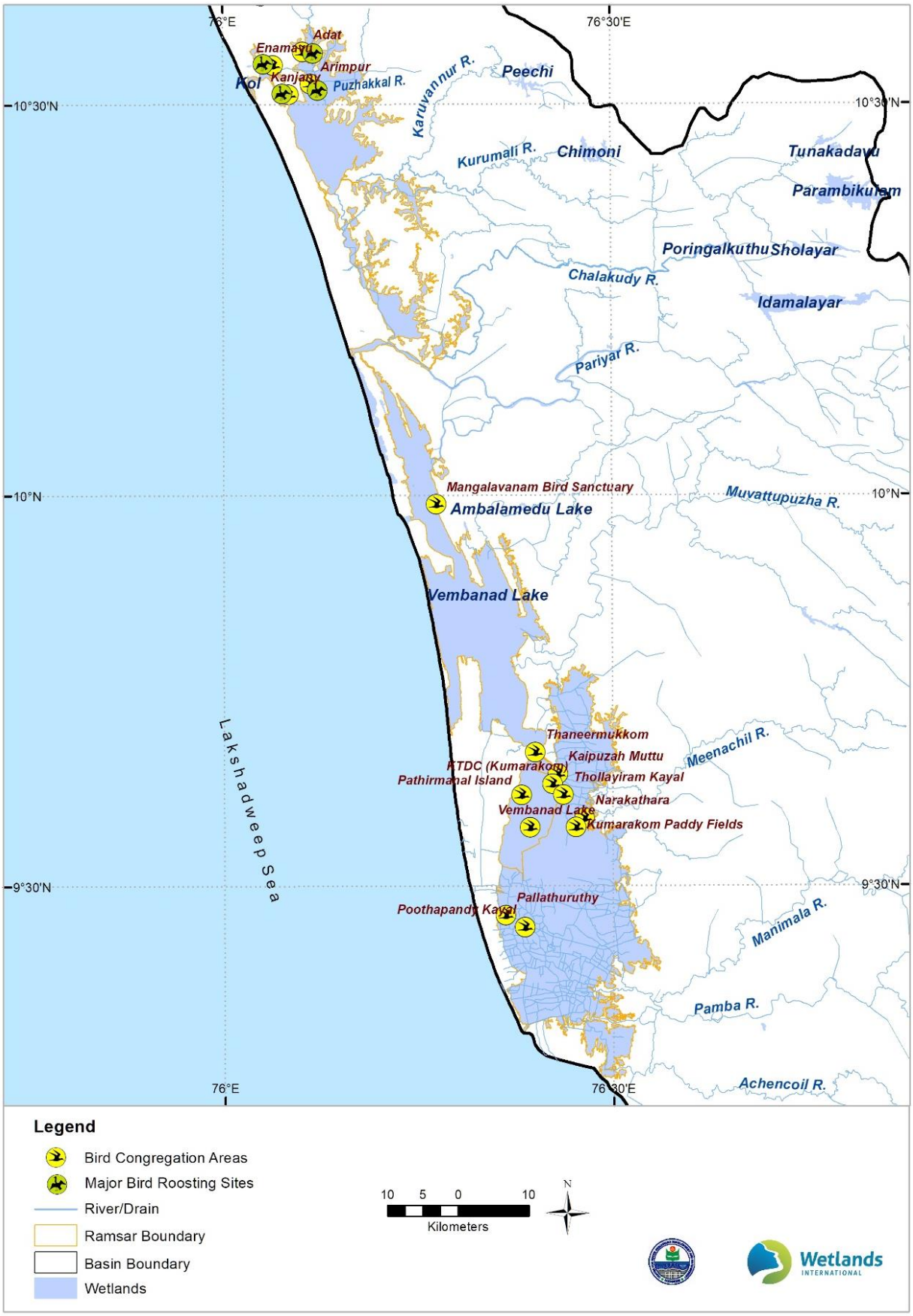
Birds are at the apex of the food chain within wetlands and good indicators of ecosystem health. Vemband-Kol wetlands serve as habitats for a rich diversity of birds including number of migratory species. The wetland is an important stopover in the Central Asian Flyway and has been declared as an important Bird Area. The Annual Waterbird Census (January, 2023) conducted by the Department of Forests and Wildlife, Government of Kerala and the Kottayam Nature Society reported a total of 14178 individuals of wetland and wetland dependant birds belonging to 67 species and 18 families counted from 10 sites surveyed in the Vemband-Kol wetlands. The survey marks a considerable increase of 3881 birds from the numbers recorded last year which was 10247 individuals. Of the total birds counted, Cormorants constituted the largest group, followed by Egrets. The total number of migratory ducks recorded was 1082. This number was higher than the previous year which was 549 migratory ducks. Analysis of Asian Waterbird Count (AWC) and ebird data for 2005-2021 indicates high interannual fluctuation (Figure 16Figure 16). During this period, the total bird count ranged from 5519 to 36240. Overall, 15 congregation sites have been identified (Map 21). Species frequenting the sites mostly include Northern Pintail ducks, Lesser Whistling teals, Little Cormorants, Whiskered Terns, Pond Herons, Cattle Egrets, Common Teals, Medium Egrets and Purple Herons.

[103] A geographical indication (GI) is a name or sign used on certain products which corresponds to a specific geographical location or origin (e.g. a town, region, or country). The use of a GI may act as a certification that the product possesses certain qualities, is made according to traditional methods, or enjoys a certain reputation, due to its geographical origin.

[104] Ranjith, P., Karunakaran, K.R., Avudainayagam S. and Viswasam Samuel A. D. (2019). Pokkali Rice Cultivation System of Kerala: An Economic Analysis. International Multidisciplinary Research Journal - ISSN 2424-7073 Agriculture & Climate Change – (July 2019): Pages 14-19.

[105] http://timesofindia.indiatimes.com/articleshow/95040454.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

[106] https://www.nabard.org/auth/writereaddata/File/Keralanafcc.pdf



Map 21: Bird Congregation areas of VKWs

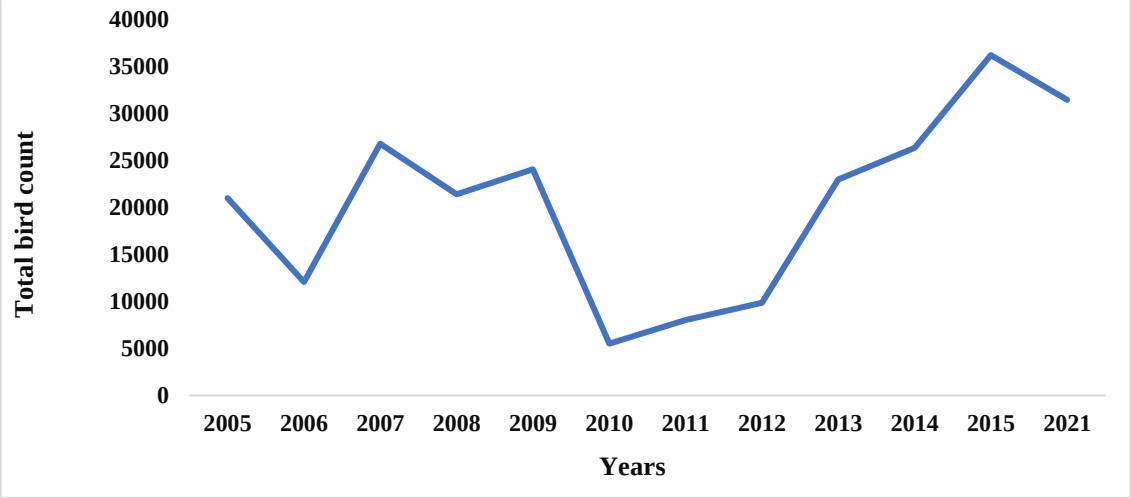


Figure 16: Bird population (Total bird count) trend in Vembanad Estuary (2005 – 2021)[107]

In Kol, 167 species of birds, belonging to 16 orders and 39 families among which 81 species are wetland-dependent birds have been recorded[108]. 53 species are winter visitors and include 9 ducks, 31 waders, 3 gulls and 2 terns. The major roosting sites in the region are Enamavu, Kanjany, Arimpur, and Adat. Little Egret, Cattle Egret, Little Cormorant, Pond Heron, Medium Egret and Whiskered Tern were the most abundant species found in the Kol wetland. Spot-billed Pelican (a near threatened species) and Rufous Babbler (an endemic species of Western Ghats) is also known to frequent the region[109]. Analysis of Asian Waterbird Count data for 2005-2021 indicates high interannual fluctuation (Figure 17). During this period, the total bird count ranged from 27,043 to 55,159. BirdLife International (2022) reports that Kol wetlands have been selected as an Important Bird Area (IBA) based on three criteria: A1: it has many globally Threatened and Near Threatened species; A4i: it has 1% of the biogeographic population of Indian Whiskered Tern, Garganey and Gull-billed Tern, and A4iii: it has 20,000 waterbirds.

Indiscriminate fishing along the major breeding and roosting sites are affecting the food resource of the wetland dependent birds. Mortality of birds due to poaching as well as water high in concentration of pesticides and herbicides is also reported from these areas. Over the years, anthropogenic activities within Vembanad estuary have been on an increase creating stress for habitat.

The area of Kumarakom near Kerala Tourism Development Corporation Complex which once supported the largest heronry and served as an important breeding area for visiting waterbirds has suffered a sharp decline in numbers. Of the ten species found breeding here (Oriental darter, Little Cormorant, Indian Cormorant, Black-crowned Night Heron, Little Egret, Intermediate Egret, Great Egret, Purple Heron, Indian Pond Heron and Black-headed Ibis), the breeding population of Black-crowned Night heron (*Nycticorax nycticorax*) has reduced by over 96%[110]. Reduction in extent of reed beds and mangroves for promoting tourism, discharge of sewage effluents and changes in food availability are presumably the major reasons. The increase in population of Oriental Darter (*Anhinga melanogaster)* may be attributed to altered salinity levels which has favoured freshwater fish population (ibid). In recent years Pathiramanal Island (BOX 4) and Kaippuzha Muttu have emerged as important roosting sites for waterbirds due to the availability of food and negligible human habitation in surrounding areas.

[107] Asian Waterbird Count and eBird data
[108] Sivaperuman, C. and E. A. Jayson 2000. Birds of Kol wetlands, Thrissur, Kerala. Zoo's Print Journal XV (10): 344-349.
[109] Jayson, E. A. and P. S. Easa 2000. Documentation of Vertebrate Fauna in Manglavanam Mangrove Area. KFRI Research Report 183: 42 pp.
[110] Narayanan, S. P. and L. Vijayan 2007. Status of colonial breeding waterbirds in Kumarokom heronry in Kerala, Southern India. Podoces 2(1): 22-29.

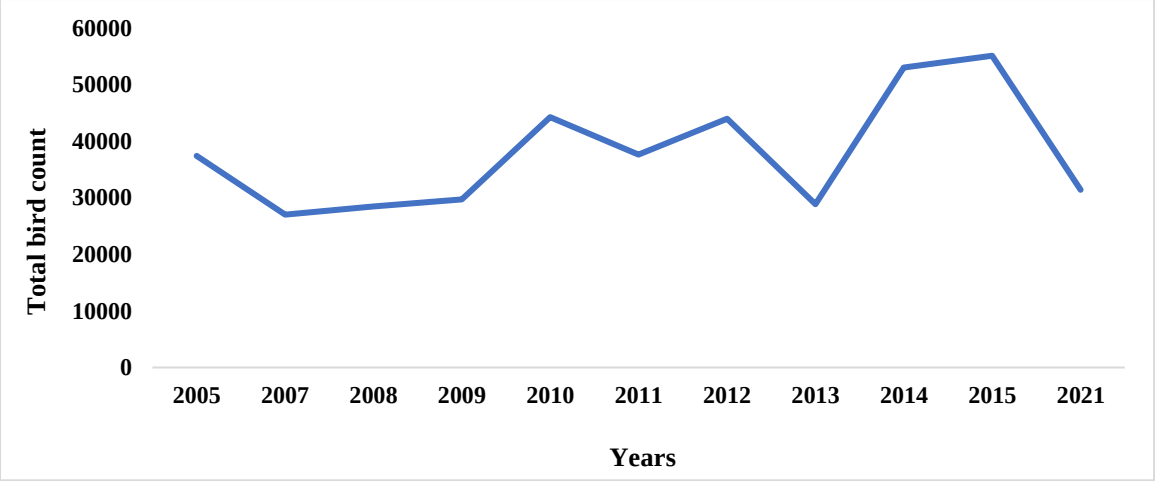


Figure 17: Bird population (Total bird count) trend in Kol wetlands (2005 – 2021)

BOX 4: Pathiramanal Island

Pathiramanal (Sands of the Midnight in Malayalam) is a 68-ha island located in the vicinity of Muhamma Panchayat. The uninhabited island covers an area of 68 ha and till 70s was under coconut and acacia plantation by a private land owner. In 1979, the island was transferred to Kerala Government following the Land Reforms Act, which handed it over to State Department of Tourism for development of tourism facilities.

The island stands out in terms of species diversity. 169 plant species from 64 families have been reported here, including 53 tree, 22 shrubs, 73 herbs and 12 climber species. *Mucuna gigantea* and *Flagellaria indica,* two large climber species with very restricted occurrence in Kerala, are abundant on this island (The Hindu, Aug 05, 2010). Rare plant species viz., *Aponogeton appendiculatus*[111] have also been found here. Pools and puddles have dense macrophytic vegetation. *Calophyllum inophyllum*, *Tylophora indica* and *Senna alata* found here are known to have medicinal properties.

The island is fringed by mangroves and associates. Overall, 16 mangrove species have been recorded. *Ceriops tagal*, *Excoecaria agallocha* and *Cerbera odollam* (mangrove associate) are dominant while *Bruguiera gymnorrhiza*, *Sonneratia apetala* and *Excoecaria agallocha* are less abundant[112].

Pathiramanal Island supports rich floral and faunal diversity

[111] Listed as a threatened species in the Red Data Book of Indian Plants published by the Botanical Survey of India.

[112] Balasubramanian, P. and P. A. Azeez 2012. Floral diversity and vegetation of the Pathiramanal in Vembanad lake, Kerala. Indian Forester 138(9): 804-811.

The diversity of fauna is equally striking. 24 species of dragonflies and damselflies, 23 spiders, 34 butterflies, 88 birds, 58 fishes and 7 reptiles have been recorded. Oriental darter, a near-threatened bird species, is known to breed here. Indian rock python and smooth-coated otter, two globally threatened species, have also been found. Colonies of the *Villorita cyprinoides,* a brackishwater clam, are found in adjoining waters.

2.7. Livelihoods

Socio-economic profile of wetland catchments

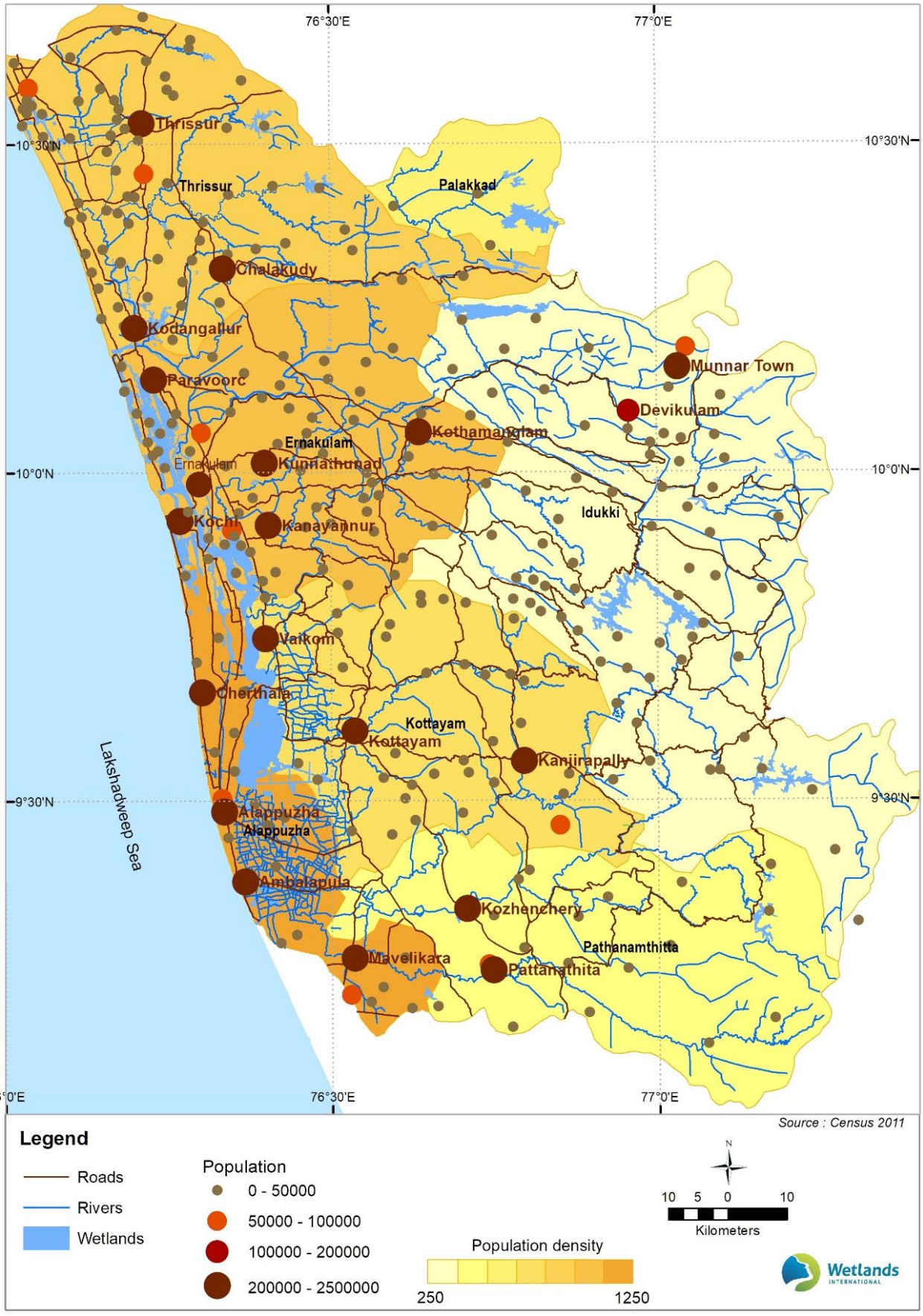
As per the 2011 census, the catchments of VKW are inhabited by 8.98 million people, forming 27% of the population of the entire state. Two-thirds of the population is concentrated in the 84 urban centers within the lowlands. Population density increases significantly from 500 persons / km^2 in the highlands to around 1100 persons / km^2 in the midlands and 1250 persons / km^2 in the lowlands (Map 22).

Of the total catchment population, 38% from the workforce[113]. Of this, one-fourth is dependent on agriculture, with a high proportion (70%) being agricultural laborers.

Fisheries and household industries account for 9% and 3% of the workforce respectively. Within fishers, 60% are employed in the marine fisheries sector. Rest is employed in secondary and service sector industries. Access to social amenities has been higher in Kerala as compared to other parts of the country due to the sizeable investments in the sector under various plans. Safe drinking water and sanitation facilities are available to 65% and 86% of the population respectively. Electrification has also been carried out for 71% of the population living within the region. However, slight variations in access were observed within the highlands and the rest of the region. Access to safe drinking water and electricity is lower in the highlands as compared to the midlands and lowlands. Despite high access to sanitation facilities, the deteriorating water quality of the Vembanad is a severe health hazard for the communities living in and around. High incidence of water borne diseases such as Weil's disease, Diarrhoea, Typhoid, Cholera etc. has been reported from the Kuttanad region. While the state outperforms the entire country in terms of infrastructure indices (for example, the road density of the state is 374.9 km /100 km^2 as compared to national average of 74.9 km/100 km^2), the concentration of roads in floodplains of Kuttanad is way beyond the carrying capacity of the ecologically fragile region.

Economic prosperity of the communities living in the wetland catchments is indicated by high per capita income which has increased over a period of time. Between 1990−91 and 2010−11 the per capita income (GSDP based, at 2004−05 prices) in Kerala has increased from Rs 19,502 to Rs 56,107, an increment of 187 per cent (the national level increase for the period being from Rs 15,865 to Rs 40,752)[114]. The per capita income within the various catchment districts ranged from Rs. 23,014 to Rs. 34,079 (for 2004- 05 at prevailing prices). Districts having larger areas under plantations as well as industries have higher per capita income. The lowland districts, Alappuzha and Thrissur have comparatively lower per capita income. However, in terms of growth rates, the highland districts have recorded almost no increase. The lowland districts have recorded the fastest growth rates, driven mainly by nature-based tourism.

[113] Proportion of the population which forms a part of the primary, secondary, and tertiary sector workforce.
[114] Based on data from http://mospi.nic.in



Map 22: Population density within Vembanad-Kol catchment

The contribution of agriculture and allied services to the overall GSDP has fallen from about 30 per cent in 1990−91 to 10.6 per cent in 2010−11. During the same period, the tertiary sector contribution has increased from 29% to 60%. The per capita agricultural income in Kerala increased only marginally from Rs 4,187 to Rs 4,674, i.e., an increase of only 11.6 per cent between 1990 and 2010. The number of cultivators as a proportion of workforce has reduced from 13.07% in 1981 to 7.20 % in 2011. Similar is the trend for agricultural labourers which decreased from 28.23 % to 16.1 % between 1990 -2010[115]. The economy is highly dependent on remittances of immigrants, which amounts to more than Rs. 15,000 Crore per annum.

Community institutions play an important role in governing resource use patterns within the catchment. Grama panchayats or urban local bodies are the primary units of governance in the region as per the provisions laid under the Kerala Panchayat Raj Act, 1994 and Kerala Municipality Act, 1994. Besides, planning for village development, Panchayati Raj Institutions are also recognized as agencies for regulating tourism under the Kerala Tourism (Conservation and Preservation of Areas) Act, 2005. There are several user groups which function as collectivized production and processing guilds in the region. The region in and around Vembanad Estuary has several coir retting societies, fisheries societies, agriculture farmers societies and boat owners' societies. These societies provide benefits to their members including subsidies in occupation input, protected prices and compensatory allowances for non-employment periods. They also serve as channels of the government for reaching aids / grants under various development schemes.

Wetland ecosystem services – livelihoods interlinkages

The rich biological diversity and associated ecological processes support a range of ecosystem services which form the base of livelihoods of wetland dependent communities. In several circumstances, these services have emerged as a consequence of wetland modification and conversion of habitats. The associated rights and power structures have consequences for wise use of wetland resources. Map 23 provides a generic distribution of stakeholder groups around Vembanad-Kol.

Agriculture Farmers| Wetland agriculture is the predominant resource use around VKW, particularly within the Kuttanad and Kol regions. Agriculture in Kuttanad alone provides sustenance to 90,000 farmers.

Farming in the reclaimed backwaters, floodplains and marshes is highly organized and energy intensive activity. Each cluster of farms, known as *Padashekharam*, has a committee to manage collective dewatering of the fields after monsoon. The committee owns a pump, operation and maintenance of which is financed by the members, and through subsidized electricity from the state government. Rice is the main crop grown in the region. Three cycles of cultivation currently exist, namely Punja (sown during northeast monsoon during October to December and which after construction of Thanneermukom Barrage has been extended to March), *Virruppu* (sown in mid-May and harvested in September). Since this crop has to bear the impact of southwest monsoon, the area planted is restricted to places less vulnerable to flood damage. A third crop *Mundakan* is a short duration crop cultivated during September to December. However, the practice has gradually declined to a large extent as the productivity is affected by monsoon. In areas downstream Kochi till Thanneermukom, an integrated system of rice paddy and prawn farming is practiced locally called Pokkali (Refer Box 3: *Pokkali* farming system).

Of late, the intensity of rice cultivation in Kuttanad has been declining. Rising wage rates has been a key factor affecting profitability of agriculture. There is an acute shortage of agricultural labour leading to high wage rates (Rs. 400 – 900 per day as compared to Rs. 100 – 150 in the

[115] Devi, I. P. 2012. Dynamics of farm labor use-an empirical analysis. Agricultural Economics Research Review 25(2): 317-326.

neighbouring states). This has promoted some of the farmers, especially in the regions around Alappuzha to switch to less labour-intensive coconut farming.

Clam Collector | Vembanad backwaters are a rich source of clam, which forms the basis of livelihoods for around 12,000 households. Black and white clamshells are used in the cement and calcium carbide industries. The meat of clams is a rich source of protein for human consumption and also used as feed for poultry and fishes.

The clam collectors are organized in societies, which have been in existence since 1940s. Presently, there are 13 clam collector's societies in Alappuzha and Kottayam districts, of which 8 are specific to black clams. Clam collectors boil the black clams and remove flesh before selling it to societies while white clam is sold directly to societies after cleaning. The processing of clam is a family endeavour as these needs various stages of processing. While the male members are involved in clam collection, there is large input by the female members into processing.

Trading is done for a set of 20 tins (of 5 kg each) purchased from individual collectors at an average rate of Rs.222/- and subsequently sold for Rs.286/-. The balance is used by the society to pay of tax and royalties, provident fund contributions, and for holiday wages during the period May-August. Nominal loans are also provided to the members @ 12% interest per annum. Average household income from clam collection ranges between Rs. 5,000 – 6,000 per month. Meat from clams is sold @ Rs. 35/kg in the local markets. Declining availability of clams within the estuary has created immense hardships for the clam collectors.

Fishers | Fisheries from VKW provided livelihood support to fishers living in 64 villages. Owing to significant changes in fisheries after construction of Thanneermukom Barrage, the overall importance of this livelihood system has declined, with a sizeable proportion moving out to alternate sources of employment, for example, clam collection. While the total number of fisher households in and around Vembanad was estimated to be 14000 in 1976[116], this reduced to less than 4390 in 202[117] . Fishing is done all year round, barring June and July which are monsoon months. A group of six fishers return with a catch of 7 – 8 kg Karimeen (*Etroplus suratensis*) is the most favoured and prized species for harvest, which is also the state fish of Kerala. The high demand of the species by tourism industry has led to culture of Karimeen in water bodies adjacent to the wetland area particularly in Kuttanad region.

The trends in fisherfolk population from 2016 -17 to 2020-21 show a consistent curve maintaining a downward trend in the number of active fisherfolk in proportion to the total fisherfolk population. It has also been observed that more fishermen are engaged in marine fishery as compared to inland fishery. Among the districts, the maximum number of fisherfolk engagement has been observed in Alappuzha followed by Ernakulam, Thrissur and finally Kottayam. Alappuzha (Marine -30; Inland -24) has the highest number of fishing villages followed by Ernakulam (Marine -21; Inland -15), Thrissur (Marine -15; Inland -8), and Kottayam (Marine -0; Inland -8) (Figure 18).

[116] Rasalam, E. J. and Sebastian, M. J. 1976. The lime-shell fisheries of the Vembanad Lake, Kerala. J. Mar. Biol. Ass. India, 18(2): 323-355.

[117] Kurup, B. M., M.R. Boopendranath, M. Harikrishnan and A.V. Shibu. (2021). Editors: Impact of Climate Change on Hydrological Cycle, Ecosystem, Fisheries and Food Security. 229 Pp. Narendra Publishing House, Delhi, India.

Map 23: Distribution of stakeholder groups around Vembanad-Kol[118]

[118] From Socio-economic Surveys, Present IMP

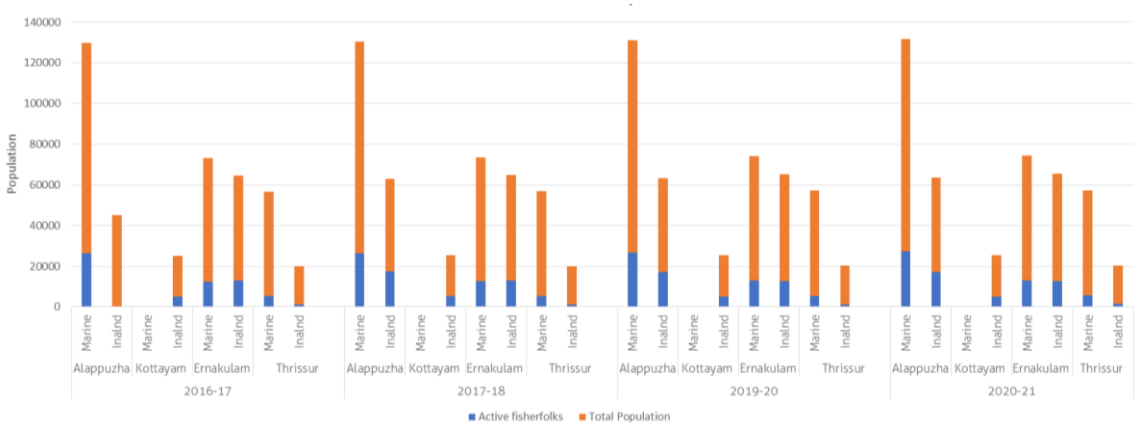


Figure 18: Trends in Fisherfolk Population[119]

Most of the fishers belong to Dheevara and Ezhava communities which are, relative to others, less endowed socially and economically. Traditionally only Dheevara community was engaged in fishing. Ezhava community entered into fishing on the prospects of clam shell collection and processing. Along with the Fisheries Department, agencies like the Kerala Fishermen's Welfare Corporation, Kerala State Co-operative Federation for Fisheries Development commonly known as Matsyafed and the Kerala fishermen's Welfare Fund Board known as Matsya board and the Kerala Fishermen's Welfare Fund provide a range of social security benefits to members. The members of Dheevara community have strong affiliation towards Akhila Kerala Dheevara Sabha which has local units that actively takes up issues that affect their livelihoods and resource use.

The clam sector is organised under the co-operative societies. These societies are the main stakeholders in decision making in the clam sector. They ensure that the members are provided with welfare and livelihood security. Apart from the society members there are around 3000 unregistered clam collectors in the northern side of the barrage.

Protected Sanctuaries - The experiences in the development of a designated 'Fish Sanctuary' for recruitment promotion of the endemic fish *Etroplus suratensis* in the open Vembanad Lake at Kumarakom (Padmakumar *et al*., 2003) indicates one good possibility. The protected sanctuaries were also setup by the lake protection forum with financial and technical aid from ATREE (Asoka Trust for Ecology and Environment) - Community Environment Resource Centre (CERC) at Alappuzha. The fish sanctuaries have been named as '*Matsyathavalam*'.

Houseboat and Tour Operators| Backwaters are the focus of tourism in Kerala. As per a survey carried out by the Kerala Tourism Development Corporation, the wetland accounted for 55% of the total foreigners visiting the state. Kumarakom backwater resort, bird sanctuary, the Pathiramanal islands, and Kuttanad Kayals between Alappuzha & Changanassery are major tourist attractions. The Nehru Trophy Boat Race on the Punnamda, near Alappuzha, held on the second Saturday of August is one of the many popular boats race events held every year.

Analysis of tourism statistics of Alappuzha, Ernakulam, Kottayam, and Thrissur districts from 2004 to 2019 shows a fourfold surge in foreign tourist arrivals whereas domestic tourists increased by two and half times during this period (Figure 19 and Figure 20). The years 2018 and 2019 saw a peak of 6.9 million domestic visitors and 0.7 million foreign visitor arrivals respectively. During 2020 and 2021, visitor arrivals saw a major slump due to the COVID pandemic but it is again expected to pick the pace and regain previous levels with the resumption of normal tourism activities. In Kerala, total tourist arrivals have grown at an

[119] Department of Fisheries, Kerala

average rate of 8 % from 2007 to 2018 with the foreign exchange earnings registering an average increase at 13.67 %.

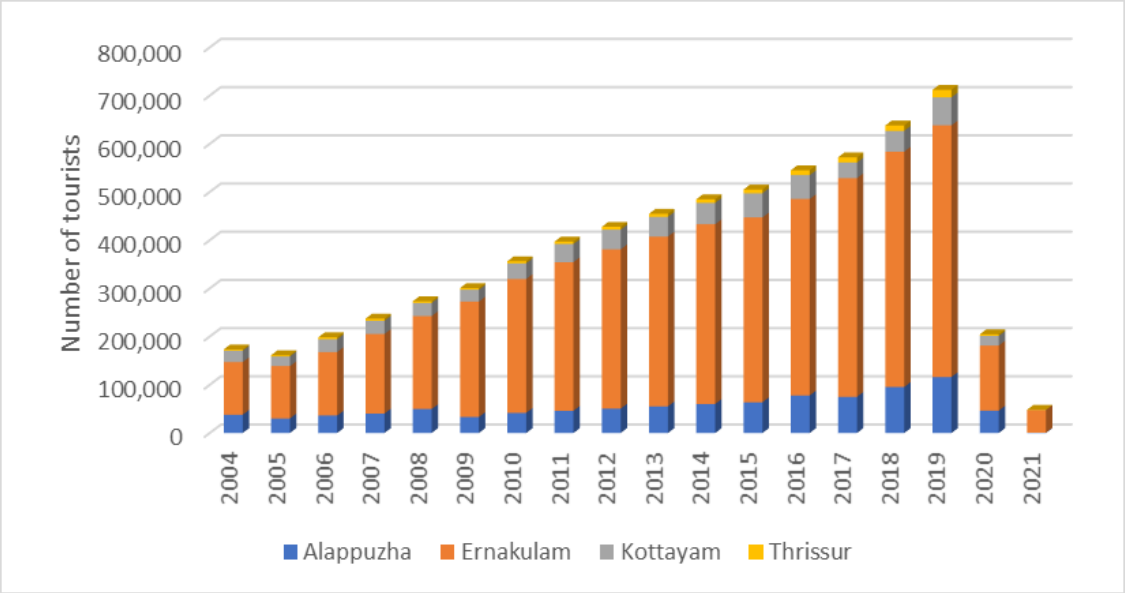


Figure 19: District-wise foreign tourist arrivals during 2004 – 2021 in four districts surrounding VKW[120]

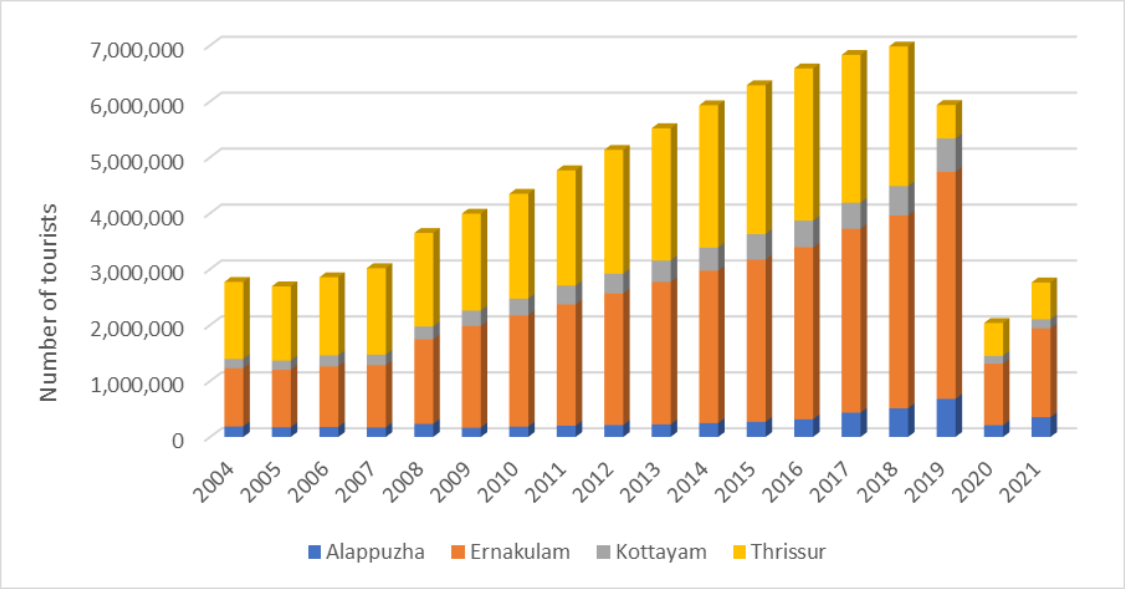


Figure 20: District-wise domestic arrivals during 2004 – 2021 in four districts surrounding VKW[121].

Tourism forms an economic base for many households. Several Ayurvedic centres, Grihasthali, Guest House, Homestays, Hotels, Resorts, Rest houses, and Yatri Nivas operate in these districts are a source of income for people and the state (Figure 21). In the year 2018, tourism accounted for Rs.17,736 Crore of total earnings through direct and indirect linkages in the four districts, which constituted 58 % of the total tourism revenue of Kerala (Table 17).

[120] Kerala Tourism Statistics Reports 2004 till 2021
[121] Kerala Tourism Statistics Reports 2004 till 2021

Table 17: Earnings from tourism in catchment districts of VKW[122]

Year 2018	Earnings - Direct and Indirect (In Crore INR)	% of total foreign exchange earnings for Kerala State	Foreign Exchange Earnings (In Crore INR)	% of total tourism revenue of Kerala (Direct and Indirect)
Alappuzha	1800.02	4.96	763.58	8.71
Ernakulam	10533.78	29.05	3902.37	44.52
Kottayam	1285.26	3.54	346.03	3.95
Thrissur	4117.93	11.36	90.59	1.03
Total	17736.99	48.92	5102.57	58.22

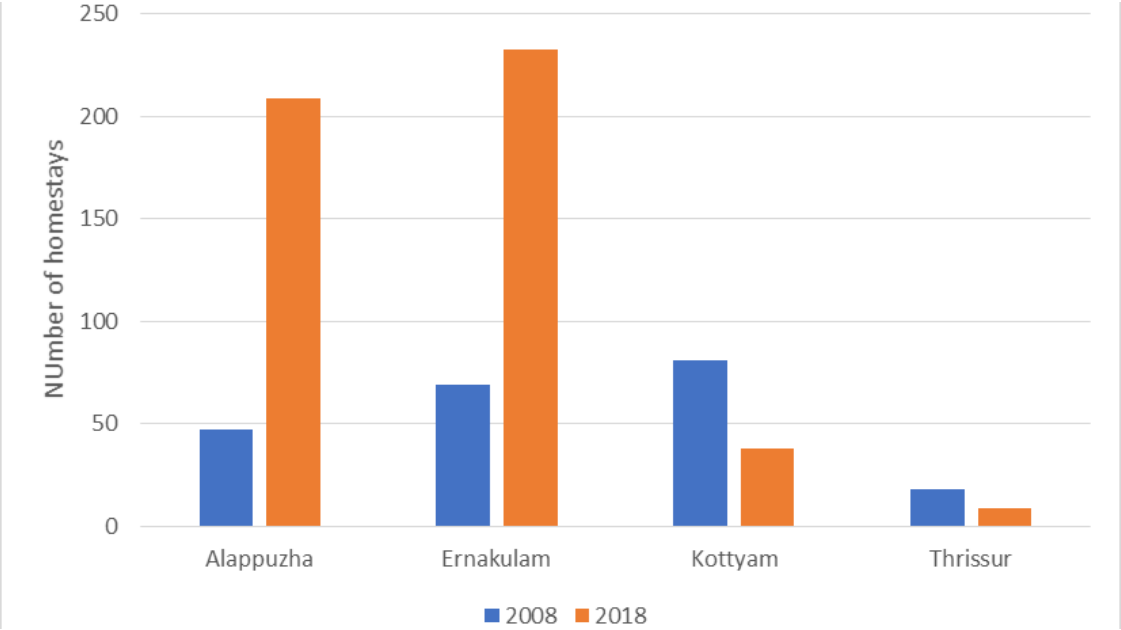


Figure 21: Trends in tourist homestays between 2008 and 2018[123]

As per the records of the Directorate of Ports, 1621 vessels are registered under the Kerala Inland Vessel rules with the Alappuzha Port Registry (covering Alappuzha & Kottayam Districts). They include houseboat boats, motor boats, Shikara, speed boats, barges, ferries, and dredgers. Out of this 821 (more than half) are houseboats. However, the actual number of houseboats plying in the Vembanad Lake in Kottayam & Alappuzha Districts is estimated to be more than 1000 (KSPCB, 2023)[124]. It has been reported that a number of houseboats operate illegally in the Vembanad Estuary without consent from the Pollution Control Board. Of these, around 25% of the unauthorised houseboats allegedly directly discharge their organic waste and sewage into the water body[125]. The extant rules require the pollution control devices for sewage treatment and disposal should be installed and solid waste processing, disposal and noise pollution control measures should be ensured. However, there are challenges in the enforcement of these rules. The Director of Ports issues licenses to houseboats and is responsible for implementation of the Kerala Inland Vessel Rules, 2010. Though stop memos

[122] Kerala Tourism Statistics Reports 2018
[123] Kerala Tourism Statistics Annual Reports 2008 and 2018
[124] KSPCB/34/2023/EE-1, Date:15 /02/2023, Kerala State Pollution Control Board
[125] Writ Petition (Civil) filed by the registered Association of Houseboat Owners in Kerala on 8th, April 2021 in the High Court of Kerala at Ernakulam

are issued to some of the unauthorised houseboats, the memos are not enforced because of staff shortage.

Consent of the Kerala State Pollution Control Board under the Water Act (1974) has been made mandatory for houseboats with condition to provide sewage collection facility and to treat the collected sewage at common treatment plant. The Kottayam District Tourism Promotion Council operates a 0.09 MLD capacity Common Sewage Treatment Plant (STP) for houseboats at Kavanattinkara, Kumarkom. A barge has been purchased to collect sewage directly from houseboats. The houseboats that treat their wastewater at the STP varies from 4 -15. The unregistered boats do not turn up at the STP. Due to less tourist activities in 2019-2022 the capacity of the STP was reported to be not fully utilised. In the STP operated by the DTPC in H block, Alappuzha district, during an inspection and sampling conducted by KSPCB on 26.02.2022 the BOD and COD level of treated water was found to be above the permissible limit. A show cause notice was issued to DTPC and the STP was subsequently closed.

However, the sewage and sullage treatment facilities are inadequate in the wetland catchment districts. The total sewage and sullage generation in urban local bodies in Kerala was 1058 MLD and that in rural area was 2917 MLD as per KSPCB (Ref: KSPCB Monthly progress report submitted to NGT as on June 2022). Presently 19 common STPs/FSTPs (Faecal Sludge Treatment Plant) and three common FSTPs are operational that are able to treat only 129.476 MLD of sewage and 0.21 of septage (Annex XVIII). STPs in individual establishments treat another 69 MLD.

Moreover, the sewage generation estimates are based on the water consumption and wastewater generated are calculated based on the resident population projected for 2020. It does not take in to account the seasonal tourist influx. At present, the state government is in the process of augmenting the treatment capacity with funding from schemes as AMRUT, Suchitwa Mission. Many projects are expected to be completed by the end of 2022 and early 2023.

Common Sewage Treatment Plant (STP) for houseboats at Kavanattinkara, Kumarkom

Barge operated by the DTPC, Kumarakom, Kottayam

In order to incentivize legal and sustainable tourism, the Government of Kerala in 2019 issued an order specifying revised standards for classification and approval of houseboats. The Department of Tourism issues approval for houseboats under a particular category for two years on payment of a fee of Rs. 5000/-. This is in addition to the license/sanctions required to be obtained from the authorities concerned under the existing rules and regulations. Only the houseboats approved by the Department of Tourism under the revised scheme of classification are eligible for various financial benefits sanctioned to the houseboat sector from time to time, including 10% State investment subsidy contemplated in Government Order G.O. (P.) No.14/ 88/GAD dated 12.11.88. Under the classification scheme, necessary conditions for diamond, gold and silver category of houseboats have been prescribed including conditions for waste management and this includes eco-friendly solutions as well.

- Alternative arrangements for discharging solid wastes and sewage, like scientifically designed septic tanks and bio-toilets
- Bio-degradable waste management (such as composting/aero bins/biogas plants etc.)
- Plastic and other non-biodegradable waste management (such as collection agents)
- Septage, liquid waste and sewage management (such as bio toilet/use of septage treatment facilities)
- Use of paper bags, cloth bags and other alternatives instead of polythene bags

Houseboats satisfying the essential conditions and adhering to eco-friendly measures prescribed by the Department of Tourism can be awarded the Green Palm Certificate.

Coir Retters| Coconut husk retting is an important income generating activity carried out in the Vembanad region, particularly in Alappuzha district. Mainly carried out by womenfolk, this activity provides income to 18,000 households living around Vembanad. As per 2012 estimates of Directorate of Coir Development, 3.58 tonnes of coconut fibre are annually retted in the region. There are presently 104 societies engaged in this operation around the wetland, generating around 4,00,000 days of employment to the local communities.

Till late 1980s, Vemaband was a site of active retting. Coir retting involves the defabrication of coconut husk by dipping in the estuary water for six months. The dried fiber is then spun into yarn using threading machines. The society provides a fixed quantity of yarn to its members, usually 3 bundles of 35 kg each, which in a week is converted into 100 yarns of 4 threads, each

yarn being 7m long. The society members are paid Rs. 160 for each consignment of 100 yarns, with the overall quantity being marketed @ Rs. 3,750/quintal. The process is labor intensive with significant health hazards. The incidence of skin diseases and asthma has been reported to be higher in the coir retters.

Coir retting in the Vembanad backwaters has been on the decline since the construction of Thanneermukom Barrage which led to reduced saline water conditions in southern parts of the wetland. Moreover, with the declining productivity of coconuts in Kerala, much of the coir presently used in the industry is imported from Sri Lanka or the neighboring state of Tamil Nadu. The present practice is that bundles of coir fibre is brought from neighboring states and these bundles are retted instead of the coconut husk. The wages of coir retters are low compared to the hard work involved. The living conditions are also comparatively poorer.

Clay Miners | Small number of Clay Miners are also operating in the Estuary and earning their daily livelihood using country boats. The silt is mined from the estuary bottom. Sediment is used as organic manure for horticultural crops in homestead gardens.

Navigation Boat Owners | Vembanad Estuary form a part of the West Coast Canal System extending to an overall length of 546 km, 209 km of which has been declared as a National Waterway 3 by the Government of Kerala. The waterways formed by backwaters, estuaries, lagoons and canals, spreading over 196 km in north south and 29 km in east west directions are an important mode of transport for the communities living in and around the wetland. The Kottapuram – Chettuva waterway supports the inland navigation through the heart of Kol lands. Inland navigation through Vembanad presently supports livelihood of more than 50 boat and 200 houseboat owners.

Vulnerability Contexts

Declining availability of resources| Growth in Kerala's economy has been fueled by secondary and tertiary sectors. The overall contribution of the primary sector in the State GSDP has reduced considerably. The primary sector, which employees 37% of the workforce and includes mostly wetland dependent livelihood has received lesser attention in developmental planning.

Despite a near continuous policy thrust in last five decades for ensuring self-sufficiency in rice production, area and production has been on a decline since late seventies. In the lowlands, diminishing returns and shortage of labour has made paddy cultivation increasingly unviable. Increased cost of inputs, small and uneconomic size of land holdings and excessive fragmentation, high incidence of crop failures, lack of availability of agricultural seeds, lack of proper marketing system, insufficient research and extension services and the trade union activism have also impacted profitability. The labour rates are high because of easy work opportunities in mining and construction sectors. There is high dependence on High Yield Varieties (HYVs), use of pesticides and intensive cropping practices which further increase the cost of production, while at the same time adversely impacting ecological character of the wetland.

The paddy cultivators are relinquishing rice cultivation in favour of less labour intensive such as coconut farming and aquaculture. A sizeable area of the paddy fields is also left fallow during most of the year. An assessment of 2001 indicated that 4000 ha of paddy fields were utilized for prawn/fish culture with or without integration of rice[126]. There were 122 aquaculture ponds farming freshwater prawn of which 67 were within polders.

[126] Ranjeet, K. and B. M. Kurup 2001. Economic analysis of polder based freshwater prawn farming systems in Kuttanad, India. International Journal of Fisheries and Aquaculture 5 (6): 110-121.

Coconut invariably is an important crop contributing to the household income of small and marginal farmers. However, its productivity has been declining for various reasons including widespread damage from root-wilt disease, coconut mite, red-palm and rhinoceros' weevils. The declining price of coconut together with fall in productivity is severely hurting the income of all households in the region.

Fishers are also facing a decline in fish and clam catches. The average fish catch per fisher group (of 6 fishers) has now reduced to 7 – 8 kg per day (for 200 days per annum) as against 20 kg reported in 2000. The number of active fishers has been on a decline in Alappuzha (from 17,417 fishers to 17,251) and Ernakulam districts (from 12,931 to 12,810) between 2016-17 and 2020-21.

Industrial dredging has severely impacted the community collection of clams. The number of black clamshell collectors has increased due to in-migration from fisheries. Engagement in fishing as well as clam collection provides means for stabilizing household income as well as provides opportunities for benefitting from organized marketing structure as is prevalent for clams. Fishers were also observed to diversify into non-fishing options such as coir related occupations. Coconut husk retting operations eliminate prawn and marine fish nurseries. The traditional rice – prawn cultivation system (Pokkali) has also witnessed gradual decline. Incidence of white spot disease has impacted shrimp production since 2009.

Health hazards |Increasing pollution of wetland environment has created several hazards for communities living in and around the wetland. Major towns surrounding Vembanad-Kol do not have a systematic and planned drainage, as a result of which untreated sewage is finally discharged into the wetland. The closure of Thanneermukom Barrage turns Kuttanad into a waste bowl. The sewage treatment plant at Kumarakom has insufficient capacity to treat the entire waste generated by the houseboats.

Pollution due to coir retting units has led to significant local resistance due to impact on surface and ground water quality. Retting is still continued in isolated pockets around Vaikom, the effluents of which are a threat to water quality of Vembanad. Workers in coir retting industry have high incidence of respiratory diseases and skin disorders due to high concentration of lignin, tannin and polyphenols released in the retting process. Filariasis, eye diseases, skin diseases, and oedema of lungs are also common. Shell collectors work up to eight hours underwater and frequently report disruption of ear drums.

Conflicts and marginalisation of stakeholders| While there is a significant degree of collectivization of wetland resource uses, the power structures are in favour of agriculture farmers and tourist boat operators. Operation of Thanneermukom Barrage is a clear demonstration of how the needs of agriculture farmers have prevailed over those of fishers and clam collectors.

More recently, the conversion of rice paddies to dryland farming within Kuttanad has drawn flak from labor unions. The unions vehemently argue that attrition of paddy lands will reduce their job opportunities. On the other hand, landowners are building pressure to amend provisions of The Kerala Conservation of Paddy Land and Wetland Act, 2008, which prohibits any conversion of paddyland and wetland to alternate uses. The Industries Department of the state has already suggested amendments that preclude areas zoned for other purposes in the industrial zone and town planning schemes and notified industrial land including tourism, as service sector projects. The environmentalists, on the other hand, stress that the conversion of wetland and paddy fields are detrimental to ecological balance of the region and should be arrested immediately.

The navigation of house boats through the active fishing zones destroys nets. Fishers claim that the turbines disturb the estuary bed as well as the breeding ground of the fishes. The decline in fish diversity and catch is also attributed to destruction of mangroves. However, the overall development focus on tourism makes these groups hapless spectators. The tour operators claim that increasing pollution from Udyogmandal, Kuttanad and religious tourism in upstream

reaches adversely affects the overall ecology of the backwaters and is a threat to the tourism prospects.

The clam society members mention apathy of the government towards clam resource base. Despite being a part of fisheries, it receives less attention as compared to the latter. The availability of clam shell has declined as a result of indiscriminate dredging by Travancore Cements Limited (TCL). Conflict between TCL industries and fisheries started in 1965 when the government of Kerala leased clam bed mining to minimize input costs. Post this, issues such as pit formation in lake bed as a result of indiscriminate mining and clay depositions in these pits that changed water current and affected overall productivity were raised by fishermen. In 2001, a move to grant mining permit to TCL in northern side of the barrage in Perumbalam region was vehemently opposed by traditional clam collectors. As a result, the clam collectors have resorted to culturing clam in their own waterlogged area, engage in marketing of clams through SHGs and fishing during lean season to meet livelihood needs.

Climate Change and its impacts

The structure and functions of the VKW complex are closely linked with climatic parameters, especially precipitation and temperature, influencing overall freshwater availability and productivity. Long-term (1871-2005) analysis of rainfall patterns in Kerala has indicated a decrease in southwest monsoon rainfall (which normally accounts for nearly two-thirds of the total rainfall) and increases in post-monsoon season rainfall[127]. While the surface water temperature of the Vemaband Estuary has been rising in recent decades, there is an overall increase in freshwater inflow (particularly through events such as the 2018 deluge) and thus reduced salinity[128] Changing rainfall patterns have rendered wetland farming highly vulnerable to floods. Loss to farmers due to rains in October 2021 was estimated by the Department of Agriculture to be Rs 9,608 Crore, encompassing crops over 6,582 ha[129]. Recurrent flooding is also triggering an exodus of families from Kuttanad to safer areas and an estimated 6,000 families have left the region in the last two years alone (Shaji, 2021)[130]. Attribution studies for the 2018 floods have indicated that climate change may have a limited role in the current episode; however, in future scenarios (RCP 8.5), increased tropical humidity would far outweigh the depressions, thus resulting in significantly higher rainfall and flood events in the Vemaband-Kol region[131].The current understanding of the climate vulnerability of the Vembanad-Kol ecosystem is patchy and calls for systematic evaluation involving expert agencies working with local stakeholders, especially local communities and community-based institutions. Frameworks of climate vulnerability assessment of wetlands developed by Ramsar Convention[132] and climate risk assessment protocols suited for Indian conditions[133] can be used for filling up this knowledge gap.

Oceans absorb 93% of the heat liberated due to global warming. This increased heat returned to land as cyclones and torrential rains. Long term Global Ocean temperature increase is 0.85 degrees; where as it is about 1.2 degrees for Arabian Sea. The El-Nino phenomena resulting from western Pacific Ocean resulted in 10-20% reduction in the

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[127] Krishnakumar, K.N., and Prasada Rao, G.S.L.H.V. (2008). Trends and variability in northeast monsoon rainfall over Kerala. Journal of Earth System Science, 121(2), 279-296.

[128] Kurup, B. M., M.R. Boopendranath, M. Harikrishnan and A.V. Shibu. (2021). Editors: Impact of Climate Change on Hydrological Cycle, Ecosystem, Fisheries and Food Security. 229 Pp. Narendra Publishing House, Delhi, India

[129] https://thewire.in/agriculture/kerala-kuttanad-farmers-rainfall-paddy

[130] https://scroll.in/article/1003721/in-keralas-kuttanad-climate-change-is-forcing-residents-to-abandon-their-homes

[131] Hunt, K. and Menon, A. (2020). The 2018 Kerala floods: A climate change perspective. Climate Dynamics. 54. 10.1007/s00382-020-05123-7.

[132] Gitay, H., Finlayson, C. M., and Davidson, N. (2011). A framework for assessing the vulnerability of wetlands to climate change (Ramsar Technical Report No. 5, CBD Technical Series No. 57). Secretariat of the Convention on Biological Diversity and Ramsar Secretariat.

[133] MoEFCC 2021. Mission Document, National Water Mission Under National Action Plan on Climate Change, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India, New Delhi.

monsoon rains in Kerala during 1950-2015 period. At the same time, high intensity rainfall numbers also increased. These contribute to droughts as well as floods, concurrently. Large parts of central Kerala, including parts of Kuttanad region, Vypin and Kochi islands, Vaikom and parts of Thrissur districts, are indicated in the coastal model under high-risk zone of sea-level rise. The projections have been made in the new digital elevation model (DEM) produced by Climate Central, a New Jersey-based science organisation, which has been published in journal 'Nature Communications'. The maximum average sea level rise is about 3mm globally. Kochi experienced 12-14cm sea-level rise in the last 80 years. This would average to about 1-1.2cm per year. This is a serious threat as the population density in coastal areas is about 2,500 persons per km^2.

3. Ecological Character Description and Evaluation

VKW complex is a Wetland of International Importance under Ramsar Convention, designated by the Government of India on August 19, 2002[134]. This commits the Contracting Party of the Convention (Government of India) to ensure its wise use. Wise use of wetlands is defined in the Convention text as 'maintenance of ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development. Ecological character is 'the combination of ecosystem components, processes and services that characterise the wetland at any given point in time.' Changes to the ecological character of wetlands outside natural variation may signal that uses of the site are unsustainable and may lead to the breakdown of its environmental, biological and hydrological functioning[135]. Assessing and responding to risks of human-induced adverse changes in ecological character is therefore fundamental to achieving wise use of the wetland site.

An essential purpose of management is to outline an approach for the maintenance of ecological character and, in doing so, retain those essential ecological functions that underpin the delivery of ecosystem services and maintenance of biodiversity (Table 18).

This management plan chapter contains a description of the ecological characters, an assessment of threats, status, and trends, and an analysis of risks of human-induced adverse changes in ecological character and existing knowledge gaps. This analysis is based on the description of wetland features contained in the present chapter.

3.1. Status and trends in ecological character

The wise use approach calls for 'maintenance of ecological character'. However, a review of the wetland features of VKW contained in Chapter 2 indicates that the wetland complex has been subject to continuous anthropogenic modification, most prominently since the early 18th century. The genesis of the wetland complex is attributed to the geological and geo-morphological processes that led to the formation of a bar-built estuary flanked by river floodplains interconnected with a network of natural and artificial channels. The Vembanad lagoon is believed to have evolved to its present form during the Holocene (approximately in the last 11,700 years of Earth's history) when there existed a broad embayment with rising sea level and north-ward drifting lateral currents, progradation and development of sand barriers transforming the system into a partly closed lagoon with the limited inlet-outlet system by the regressive phase of late-Holocene[136]. Till the early 18th century, the estuarine areas were fringed with extensive mangrove swamps. Marshes were used to cultivate rice paddies, the productivity of which was constrained by inundation and salinity. The development of Cochin port in 1838 triggered rapid urbanization and industrial development around the wetland. Subsequent phases of development were focused on reclaiming marshes and the estuary for permanent agriculture through polderisation. In recent times, the emphasis has been on promoting backwater tourism, inland navigation and enhancing agricultural productivity of the reclaimed marshes through hydrological regulation. The current regime of VKW is a fragment of an extensive wetland regime that once existed in the low-lying coastal plains between Thrissur and Arattupuzha.

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[134] Key qualifying site features included estuarine environment with large live clam and sub-fossil deposits (Criteria 1 – unique example of near-natural wetland type in a given biogeographic region) , habitat for spot-billed pelican (listed as vulnerable and therefore qualifying under Criteria 2 - supports vulnerable, endangered, or critically endangered species or threatened ecological communities), support to large population of waterbirds (Criteria 5 - regularly supports 20,000 or more waterbirds as per Asian Waterbird Census records) and habitat for a range of fish species (Criteria 8).

[135] (Ramsar Convention 1996, Resolution VI.1)

[136] Padmalal, D., Kumaran, K. P. N., Nair, K. M., Limaye, R. B., Vishnu Mohan, S., Baijulal, B., & Anooja, S. (2014). Consequences of sea level and climate changes on the morphodynamics of a tropical coastal lagoon during Holocene: An evolutionary model. *Quaternary International*, *333*, 156–172. https://doi.org/10.1016/j.quaint.2013.12.018

The VKW complex presently exists as three zones namely the Vembanad Estuary, the Kuttanad, and the Kol lands, inter-connected by a network of channels.

The Vembanad lagoon, a tropical estuary, brackish in the Northern part while the southern part is freshwater-dominated[137]. Four significant rivers viz., Manimala, Meenachil, Achankovil and Pamba, discharge fresh water in the southern part, whereas Periyar, Pullot, Chalakudi, Muvattupuzha, Ittupuzha and Kari discharge water in the northern part of the lagoon. Connection to the Arabian Sea is through openings at Kochi and Azhikode influences the estuary regularly through mixed semi-diurnal tides[138]. Vembanad is characterized by conterminous vegetation represented by a variety of plants viz., mangroves, hydrophytes, figs, ferns, etc. Over 20,000 waterbirds, such as spot-billed pelicans and oriental darters, visit the lagoon annually during the winter months[139].The depth of the lagoon varies significantly, with its deepest point at about 8 metres along the Cochin mouth gradually declining towards a depth of about 2 metres in the Kuttanad region[140]. The surface salinity ranges from freshwater in Kuttanad to highly saline conditions near the bar mouth[141]. Connectivity with riverine and marine environments underpins a high number of freshwater, brackish, and marine fish species in the lagoon. The estuary also serves as a nursery ground for penaeid prawns (*Penaeus monodon, P. dobsoni* and *P. monoceros*). Vembanad estuary is also a rich source of live as well as sub-fossil deposits of clam. The scenic beauty of the backwaters has also led to it being developed as a tourist destination. There has been a spectacular rise in the tourism industry in Vembanad lagoon in the past twenty years[142]. The people around the lagoon are profoundly dependent on it for their livelihood. Kumarakom, the premier backwater tourism destination in the region, is listed as part of the Responsible Tourism (RT) initiative of Kerala Tourism. The lagoon performs many functions ranging from flood control to housing biodiversity, agriculture, inland navigation and tourism. The following are the critical values of Vembanad lagoon:

- As a tourist hotspot - Nearly 0.2 million tourists visit the backwaters annually, supporting livelihoods of owners and employees of 821 houseboats. Several spectacular boat races are held in the estuary each year, attracting many spectators.
- Rich source of live and sub-fossil clam deposits – Nearly 50,000 MT of clams is presently harvested from the Vembanad estuary for meat and industrial purposes providing base of livelihoods for 12,000 households.
- Supports productive fisheries - A diverse assemblage of fish and crustacean species support a productive fishery which is the base of livelihoods for nearly 5,000 fisher households.
- As a representative of estuarine floodplain wetland ecosystem, characteristic of Malabar coastal plains.
- As a mode of inland navigation - The Kollam-Kottapuram stretch of the West Coast canal system traversing through the estuary has been declared as National Waterway presently used by over 50 passenger boats and 500 houseboats for navigation.
- As a flood buffer for the coastal region.

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[137] Nath, B. N., Kunzendorf, H. and Plugeer, W. L., (2000). Influence of provenance, weathering and sedimentary processes on the elemental ratios of the fine-grained fractions of bedload sediments from the Vembanad lake and the adjoining continental shelf, southwest coast of India. J. Sedimentary Petrology, 70, 1081-1094.

[138] Revichandran C., Srinivas K., Muraleedharan K.R., Rafeeq M., Amaravayal S., Vijayakumar K. and Jayalakshmy K. V. 2012. Environmental set-up and tidal propagation in a tropical estuary with dual connection to the sea (SW Coast of India). Environmental Earth Sciences 66(4), 1031-1042, June 2012.

[139] Suja, N. and K. S. Mohamed 2010. A model for responsible black clam fisheries at R-Block in Vembanad lake, Kerala. Marine Fisheries Information Service, T and E Ser. 203: 15-17.

[140] Rajan, B., V. M. Varghese and A. P. Pradeepkumar 2011. Recreational Boat Carrying Capacity of Vembanad Lake Ecosystem, Kerala, South India. Environmental Research, Engineering and Management 2 (56).

[141] Verma, A., Subramanian, V., Ramesh, R., 2002. Methane emissions from a coastal lagoon: Vembanad Lake, West Coast, India. Chemosphere 47, 883–889. doi:10.1016/S0045-6535(01)00288-0

[142] Corinne K. and Narayanan N. C. 2012. Governance Challenges in Linking Environmental Sustainability to Tourism: Where is the Houseboat Industry in Kerala, India Headed. Working Paper, No 2013/09 | March 2014. NCCR, Swiss National Centre of Competence in Research, Swiss National Science Foundation.

- As an integral habitat for diverse species of wetland-associated flora and fauna.

The following ecological character elements underpin these values:

- Hydrological connectivity and channel profiles of the canal network and their connections with the rivers and the Arabian Sea.
- Ecological corridors to sustain species migration from the estuarine region towards the low-saline plains.
- Stretches of mangrove patches to sustain the carbon sequestration potential.
- Mild nutrient status to support ecological productivity.
- Depth profiles to sustain inland navigation and the Cochin port activities.
- Cultural values associated with the estuary and its biodiversity.

Kuttanad is a deltaic formation of five river systems viz., Achenkovil, Pamba, Manimala, Meenachil, and Muvattupuzha, located in the fertile low-lying areas in the Southern Zone of the Vembanad-Kol Ramsar Site. The region encompasses vast stretches of backwaters, bordering mangrove formations, and rice fields, the latter mostly reclaimed from the shallow stretches of the wetland. The fringe population is majorly dependent on farming and allied sectors like fishing, animal husbandry, etc for their livelihood. The region is highly fertile with rice being cultivated below sea level and pose great significance in view of the projected sea level rise caused by global warming. The following are the key values of Kuttanad:

- As a source of rice production including 'Pokkali' (registered with the Geographical Indications Registry of the Government of India in 2008).
- As a store for floodwaters and as a flood buffer for the coastal region.
- As a source of livelihood for farmers, who have been cooperatively practising sustainable farming practices.
- As a source of livelihood for fishers, who have been cooperatively practising sustainable fishing practices
- As an integral habitat for diverse species of wetland-associated flora and fauna.

The following ecological character elements underpin these values:

- Land use and land cover, particularly the area under sustainable agricultural practices
- The indigenous knowledge and cultural practices underpinning farming systems
- Nutrient enrichment regime to sustain diversity of life-forms.
- Zonal system of water regime management, wherein water pumped from one zone is collected in other zones and used for irrigation, in line with agricultural operations and habitat needs of other species.

The Kol lands are irrigated rice paddies extending from the bank of Chalakudy River in the south to Thavannur in the north. The region from Velukkara in the south on the Chalakudy river bank in Mukundapuram Taluk to Mullassery of Chavakkad Taluk and Tholur-Kaiparama areas of Thrissur taluk is called as 'Thrissur Kol', whereas the contiguous area from Chavakkad and Choondal to Thavannur, forms the 'Ponnani Kol'. The region existed as shallow lagoons, which have gradually got silted up with floodwaters brought by rivers Kechery, Puzhakkal and Karuvannur. The extensive flat surface, located 0.5 – 1 m below the mean sea level, remains submerged for nearly six months in a year. A network of main and cross canals, separated from rice fields by earthen embankments, connects the different regions of the Kol to the rivers, while also providing external drainage. The Biyyam Dam situated at the downstream end of Kol wetlands, prevents salt water ingress in the rice fields. The following are the key values of Kol lands:

- As a source of livelihood for around 50,000 farmers, who have been cooperatively practising sustainable farming practices
- As a store for floodwaters and flood buffer for the coastal region
- As a habitat for diverse species, notably, 167 species of birds including the ones migrating in the Central Asian Flyway,

The following ecological character elements underpin these values:

- Hydrological connectivity and channel profiles of the canal network and their connections with the rivers and the Arabian Sea
- Land use and land cover, particularly the area under sustainable agricultural practices
- Zonal system of water regime management, wherein water pumped from one zone is collected in other zones and used for irrigation, in line with agricultural operations and habitat needs of species, particularly migratory and resident birds
- The indigenous knowledge and cultural practices underpinning farming systems

Table 18: Status and trends in ecological character

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
Wetland extent											
	Area of Ramsar Site	km²	1323	2022, SWAK	1,512.50	2002, RSIS				The Ramsar Site has been redelineated to exclude Cochin and surrounding urban areas. The proposal is however, yet to be approved by the Ministry.	-
	Open Water	km²	272.0	2022, current report	343.5	2001, current report			Declined		-
	Agricultural area below sea level	km²	426.0	2022, current report	496.2	2001, current report	Paddy field area decline from 400.2 to 299	1973–- 2014, Shreeja et al. 2015	Declined	Area under Paddy is on a decline	±
	Built-up area	km²	74.2	2022, current report	42.8	2001, current report			Increased		-
	Area under Mangroves	Km²	1.5	2022, current report	0.8	2001, current report			Increased		+
	Area under water Hyacinth	Km²	0.2	2022, current report	0.6	2001, current report			Declined		+
	Area under Pokkali	Km²	40.4	2022, current report	56.4	2001, current report			Declined		-
Catchments											
	Total catchment area	km²	16220	2022, Vembanad Kol drainage basin map	16220	2005, Decadal LULC for India	NA		None	NA	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
				prepared based RS and GIS data							
	Area under forest	km²	Evergreen/Deciduous and Mixed Forest–- 3564; Forest plantations–- 884	2015-16, LULC 50K, prepared by NRSC	Evergreen/ Deciduous and Mixed Forest–- 4753; scrub forest–- 674	2005, Decadal LULC for India	Evergreen/Deciduous and Mixed Forest–- 4928; scrub forest–- 592	1985, Decadal LULC for India	Evergreen/Deciduous and Mixed Forest (including forest plantations) decreased by 6.85 % during the period 2005-2015 (from 4753 km2 to 4448 km2). Scrub forest area saw an increase of around 39 % during the period.	Evergreen/Deciduous and Mixed Forest (including forest plantations) decreased by 9.74 % during the period 1985-2015 (from 4928 km2 to 4448 km2). Scrub forest area saw an increase of around 59 % during the period.	-
	Area under built-up	km²	1579	2015-16, LULC 50K, prepared by NRSC	501	2005, Decadal LULC for India	278	1985, Decadal LULC for India	The total built up reported has increased from 278 km2 to 1579 km2 during the period (1985-2015) an almost six folds increase. (Note: The inclusion of rural built up in 2015-16 class makes it difficult to deduce the actual rate of increase in total built up area)	During the period 1985-2005 the urban built up increased by 45 %.	-
	Area under agriculture	km²	8930	2015-16, LULC 50K, prepared by NRSC	8994	2005, Decadal LULC for India	9085	1985, Decadal LULC for India	Agricultural land area has decreased by 0.7 % during 2005-2015. However, within agricultural land a major part is now	Agricultural land area has decreased by 1.7 % during 1985-2005.	No Change

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
									being used for rural built-up purposes constituting 12.6% of the total agricultural land as in 2015.		
	Area under wetlands	km^2	793	2015-16, LULC 50K, prepared by NRSC	842	2005, Decadal LULC for India	863	1985, Decadal LULC for India	The area under wetlands decreased by 5.8 % during 2005-2015.	The area under wetlands decreased by 8.11 % during 1985-2015.	±
Hydrology											
Inflow dynamics	Total annual inflow from the connected rivers	MCM	20477/24653	2020, Sanjeevan et. al. /CWRDM 2017					22,568 (Data based on studies by IIT and CWRDM (2011) and Gopakumar and Takara (2009)		
	Total Rainfall	MCM	545	(CWRDM, 2010)							
	Total annual inflow from the sea	MCM									
	Number of inlets	Number	10 major rivers	2022, current report	10 major rivers	2001, current report					
Outflow dynamics	Total annual outflow into the sea	MCM	18608	2022, current report					24574 (Data based on studies by IIT and CWRDM (2011) and Gopakumar and Takara (2009)		
	Loss to (Evaporation and	MCM	6597	2022, current report							

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
	Evapotranspiration)										
	Number of outlets	Number	4 major openings at Kochi, Azhikode, Thottapally and One at Andhakaranzhi in a degraded state. Kol floodplain rivers drain through Chettuva	(Sanjeevan et al. 2023)	Four major openings for the Vembanad estuary are at Kochi, Azhikode, Thottapally and one at Andhakaranzhi. Kol rivers drain through Chettuva	(2001, current report; Sanjeevan et al. 2023)	22 minor and medium openings existed in addition to the four major openings.	(Sanjeevan et al. 2023)	Reduced	Reduced	-
Water level variation	Max. level	m	1.21 (u/s of TB); 1.10 (d/s of TB)	2010; IIT Madras & CWRDM							
	Min. level	m	0.16 (u/s of TB); 0.17 (d/s of TB)	2010; IIT Madras & CWRDM							
Water holding capacity	Maximum volume	MCM	385	2020, Sanjeevan et. al.	611.47	2009, Gopakumar and Takara	2804	2020, Sanjeevan et. al.		85.63% reduction between 1930 and 2020	-
Sediment inflow	Annual sediment load	MT	383628.2	2012, CWC data							
	Annual sediment yield	MT/Km2	Recent data not available						CWRDM (2006) estimated an annual sediment yield of 0.48 million tonnes based on the sediment data of 1995 – 1999	No historical records / assessments available	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
Climate System											
Rainfall	Annual Rainfall	mm	2940	IMD, 2022	1200 (1951-2022 average)	IMD	1550	IMD			
Temperature	Range	°C	28.7–- 33.1	2021, Kulk et al.	23.3–- 31.0	2002, ICMAM	28.6–- 31.9	1986, Balchand and Nambisan	Increasing trend.	Previous studies indicate higher values of water temperature in the retting zones than non-retting zones.	The global warming issues have resulted in the increasing surface temperature
	Average	°C	30.3	2021, Kulk et al.	29.6	2002, ICMAM	29.4	1986, Balchand and Nambisan			
Water Chemistry											
Salinity	Avg. salinity (Average of pre- and post-monsoon)	ppt	19.94	2020, Krishnan et al.	17.1	2013, Jacob et al.	15.3	1987, Kurup and Samuel	The salinity level has increased in the outer portion of Vembanad Estuary, including the northern side at Vaikom.	Salinity levels in in the 1970s shot up as high as 21 ppt and therefore was reduced drastically thereafter till the 2000s. However, Thanneermukkom bund and the earthen bunds have failed to control saline intrusion as it was found that the salinity level in Thrikkunnapuzha, one of the gateways to the inland waterways of Alappuzha, rose to 19.94 ppt in 2020.	-
	Range	ppt	11.9–- 34.3	2020, Krishnan et al.	N/A		N/A				

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
Dissolved oxygen	Average (Pre-monsoon)	mg/l	3.82 Zone I - 5.41 Zone II - 6.41 Zone III - 5.39	2020, Krishnan et al. WIAMS data 2021, Current report	4.32	2002, ICMAM	6.8	1986, Balchand and Nambisan	Constant increase in area under invasive plant species has brought about a critical decline in dissolved oxygen	Significant reduction over the last three decades primarily due to Increased houseboat tourism, sewage discharge and water hyacinth proliferation.	-
	Range	mg/l	3– 4.1 Zone I - 5.4 - - 6.68 Zone II - 5.06 - 6.41 Zone III - 5.3 -6.1	2020, Krishnan et al. WIAMS data 2021, Current report	3.44–- 5.59	2002, ICMAM	5.9–- 8.1	1986, Balchand and Nambisan			
Nitrate-Nitrogen Concentrations	Range	mg/l	0.35– 0.83 Zone I - 0.55 - 0.71 Zone II - 0.47 - 0.81 Zone III - 0.34 -0.97	2020, Krishnan et al. WIAMS data 2021, Current report	0.01–- 1.16	2009, Sujatha et al.	0.04–- 0.5	1997, James et al.	Significant rise in houseboat number and untreated sewage discharge resulted in an increasing trend.	Untreated sewage from increased industrialization and urbanisation in the 1990s along the shore caused a steady increasing trend. Lack of proper treatment facilities exacerbate the problem.	
	Average	mg/l	0.54	2020, Krishnan et al.	0.49	2009, Sujatha et al.	0.34	1997, James et al.			
Phosphate-Phosphorous Concentrations	Range	mg/l	0.01– 0.03 Zone I - 0.04 – 1.03	2020, Krishnan et al. WIAMS data 2021,	Traces–- 0.45	2009, Sujatha et al.	Traces–- 0.03	1986, Balchand and Nambisan	Significant rise in houseboat number and untreated sewage discharge resulted in an increasing trend.	Untreated sewage from increased industrialization and urbanisation in the 1990s along the shore caused a	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
			Zone II - 0.05 - 0.7 Zone III - 0.05 – 0.31	Current report						steady increasing trend. Lack of proper treatment facilities exacerbate the problem.	
	Average	mg/l	0.02	2020, Krishnan et al.	0.09	2009, Sujatha et al.	0.02	1986, Balchand and Nambisan			
Faecal coliform counts	Max. Value	MPN/100 ml	541 Zone I - 1836 Zone II - 1057 Zone III - 1074	2020, Joy WIAMS data 2021, Current report	2400	1997, James et al.	Unavailable	N/A	Untreated sewage discharge from shore households and houseboats have caused an increasing trend.	Historical records unavailable to discern trends.	
pH	Range	Unitless	6.6–-7.4 Zone I - 6.32-7.26 Zone II – 6.85 -7.81 Zone III – 6.71 – 7.66	2021, KPCB WIAMS data 2021, Current report	6.0–- 8.5	2001, Harikrishnan and Kurup	6.1 to 7.6	1997, James et al.	No change.	No significant changes.	No Change
Temperature	Range	°C	28.7– 33.1	2021, Kulk et al.	23.3–- 31.0	2002, ICMAM	28.6–- 31.9	1986, Balchand and Nambisan	Increasing trend.	Previous studies indicate higher values of water temperature in the retting zones than non-retting zones.	-
	Average	°C	30.3	2021, Kulk et al.	29.6	2002, ICMAM	29.4	1986, Balchand and Nambisan			
Electrical conductivity	Range	µmhos/cm	713 – 44000	2019, KPCB	167–- 313	2010, Nasir	Unavailable	N/A	A significant rise due to increased salinity and temperature.	Historical records unavailable to discern trends.	-
	Average		13604.5	2019, KPCB	246	2010, Nasir	Unavailable	N/A			
Calcium	Range	mg/l	100.2– 120.2	2020, Krishnan et al.	17.6–- 160	2009, Sujatha et al.	Unavailable	N/A	Not much change.	Not much change	No Change

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
	Average	mg/l	104.2	2020, Krishnan et al.	91.2	2009, Sujatha et al.	Unavailable	N/A			
Magnesium	Range	mg/l	280.6– 378.2	2020, Krishnan et al.	4.9–- 413	2010, Nasir	Unavailable	N/A	Not much change to infer trend.	Not much change to infer trend.	No Change
	Average	mg/l	309.88	2020, Krishnan et al.	298.8	2002, ICMAM	Unavailable	N/A			
BOD	Range	mg/l	7– 8.5 Zone I - 2.08 - 2.66 Zone II - 2.49- 2.76 Zone III - 2.49 - 3.10	2018, Chandni et al. WIAMS data 2021, Current report	3.45–- 5.9	2002, ICMAM	0.5–- 3	1986, Balchand and Nambisan	Increase beyond the permissible limits prescribed by WHO, due to the discharge of domestic sewage and anthropogenic activity	An increasing trend due to due to input of organic wastes and enhanced bacterial activity.	-
	Average	mg/l	7.75	2018, Chandni et al.	3.25	2002, ICMAM	2.1	1986, Balchand and Nambisan			
Primary Productivity	Annual Mean Net	g C/m3/day	0.21	2022, Kurup et. al.	0.603	2002, ICMAM	Unavailable	N/A	Declining trend observed post the 2000s.	Historical records unavailable to discern trends.	There is a gradual transition from autotrophy to heterotrophy
Species and Habitats											
Phytoplanktons	Species Richness	Number	22	2021, Kumar et. al.	High diversity of phytoplankton species is reported (WISA/CWRDM 2013)		Assessments of 1998-99 indicate presence of 123 phytoplankton species	ICMAM 2002; Selvaraj and Thomas. 2003	Studies along the coastal zone between Tirumallavaram and Paraparangadi reported 8 species of seaweeds with luxuriant growth of *Enteromorpha*	No long-term assessments to support discerning trend. Coastline of Vembanad estuary is yet to be investigated	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
									compressa and *Grateloupia filicina* (WISA/CWRDM 2013) During monsoon, freshwater species dominate the backwaters and are replaced in post-monsoon by marine forms (WISA/CWRDM 2013)	(WISA/CWRDM 2013)	
Macrophytes	Species Richness	Number	No recent assessment available		No assessments available		Assessments of 2006-2007 recorded 25 species	John et al. (2009); Jayan and Sathyanathan (2012)	No previous assessments to discern trends	No previous assessments to discern trends	
Mangrove	Species Richness	Number	21	2018, Kerala State Biodiversity Board	No assessments available		Assessments of 2005 – 7 period recorded 40 Mangrove and associate species. Another assessment done in 2013 reported 6 species of Mangrove and 17 species of Mangrove associates	Sahu and Ambat (2007); John et al. (2009) and KFRI (2009) Kottayam Nature Society (2013)		Massive reduction in extent of mangroves is reported. Until 1990s, Kerala Tourism Development Complex in Kumarakom (previously known as Baker Estate) had the longest mangrove stretch in the entire Kerala coastline. However, mangroves were subject to rapid	-

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
										felling during 1990-96 to pave way for construction of tourism complex (Gopakumar and Takara 2009).	
Invasive species	Species Richness	Number	2 species–- *Eichhornia crassipes* and *Monochoria vaginalis*	Arunpandi et al. 2022	No assessments available		*Eichhornia crassipes* recorded as the only invasive species	Kuttanad Project Development Report, 1971	Limited data. An increase in number of invasive species has been reported Arunpandi et al. (2022)	No long-term assessments to discern trends	-
Fauna											
Zooplankton	Species Richness	Number	4 species	2021, Kumar et al.	No assessments available		Assessments conducted in 1998-99 indicated presence of 24 species	ICMAM 2002	Sporadic studies have been conducted and data is limited. In the Kol lands; Fathibi, K et. al (2020) recorded 40 species of rotifers belonging to 15 genera and 10 families. Family Brachionidae is the dominating family with 12 species.	No long-term assessments to support discerning trend	
Mammals	Species Richness	Number	No assessments available		No assessments available		No assessments available		Despite information being scanty, occurrence of 21 species reported by ZSI (2009) presents a stable trend	No previous assessments to discern trends	+
Waterbirds	Species Richness	Number	38 species	Narayanan et. al. 2012	225 species	2005, Brief Document of VKW	During 1995-2010 AWC, 225 species recorded	Kottayam Nature Society (2011) and	225 species recorded, presents a stable trend	Narayanan and Sreekumar (2011) report that Kottayam Nature Society in	+

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
								Narayanan et al. (2011)		association with Kerala Forest and Wildlife Department has conducted bird counts at ten representative sites of VKW from 2001-2012. During this period, 236 species have been recorded, which presents a positive trend	
Reptiles	Species Richness	Number	No assessments available		No assessments available		Information is lacking		Narayanan, S.P et. al. (2012) recorded 25 species. Saltwater Crocodile and Mugger Crocodile are reported extinct (Kokkal et al., 2007)	No long-term assessments to support discerning trend	-
Butterfly	Species Richness	Number	No assessments available		No assessments available		No assessments available		34 species recorded at Pathiramanal Bird Sanctuary. Inventory prepared in 2007-2008 by School of Env. Sc. Mahatma Gandhi Univ., Kottayam	Information is lacking	No Change
Fish											
Freshwater fish	Species Richness	Number	43 species	2019, Vembanad.org	No assessments available		No assessments available		ZSI (2009) reported 30 species	No long-term assessments to support discerning trend	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
Estuarine fish	Species Richness	Number	No assessments available		No assessments available		149	1990, Kurup et al.	No assessments available	No long-term assessments to support discerning trend	
Marine fish	Species Richness	Number	50 species	2019, Vembanad.org	No assessments available		No assessments available		ZSI (2009) reported 25 species	No long-term assessments to support discerning trend	
Shell-fish	Species Richness	Number	No assessments available		No assessments available		No assessments available		14 species reported by ZSI (2009) while Kurup et al. (1990; 1993) reported 40 species	No long-term assessments to support discerning trend	
Invasive species	species richness	Number	No assessments available		No assessments available		No assessments available		Knight (2010) reported 9 species	Information available is limited	-
Livelihoods											
Fisheries	Total production	Tonnes	4390	2022, Kurup et. al.	7200	2001, Harikrishnan and Kurup	14000	1976, Rasalam and Sebastian	Declining trend since 2000s observed.	Significant reduction in total fish production.	-
	No: of commercial species	Number	63	2022, Ajay et. al.	73	2002, Padmakumar et. al.	85	1990, Kurup et. al. 1990b	Decline in the population of carnivorous fish species through selective feeding.	Resident fishes like *Clarias dussumieri, Ehirava fluviatilis, Macrognathus guentheri* have gone extinct due to marine exotics. epizootic ulcerative syndrome noted among many other species, recorded historically.	-

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
	Number of active fishers	Number	82467	2022, FIMS	51000	2004, Sathiadhas et al.	Unavailable	N/A	Increasing trend		
	No. of fish co-operatives	Number	304	2022, FIMS	238	2004, Sathiadhas et al.	Unavailable	N/A	Increasing trend	N/A	+
Clam	Total production	Tonnes	42036	2019, CMFRI, 2022	75592	2006, CMFRI, 2022	Unavailable	N/A	Declining trend due to over-fishing.	Decreasing trend due to over-exploitation and unsustainable fishing practices.	-
	Number of active clam collectors	Number	1800	2022, FIMS	6500	2004, Kripa et al.	3780	1976, Rasalam and Sebastian	Declining trend.	Declining trend.	-
	No. of clam co-operatives	Number	14	2022, FIMS	27	2004, Sathiadhas et al.	21	1990, Kurup et. al. 1990b	Declining trend.	Reduction in the number of co-operatives	+
Tourism	Number of visitors (in millions)	Number	6.9 million–- domestic visitors; 0.7 million foreign visitors	Kerala Tourism Statistics 2018, DoT, GoK			No assessments available		Analysis of tourism statistics of Alappuzha, Ernakulam, Kottayam, and Thrissur districts from 2004 to 2019 shows a fourfold surge in foreign tourist arrivals whereas domestic tourists increased by two and half times during this period.	No assessments available	-
	No. of houseboats	Number	1621 vessels are registered. (covering Alappuzha &	KSPCB 2023	100 houseboats		No assessments available		Number of houseboats has increased from less than 100 in 2002 to 821. However, the actual number of	No assessments available	

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
			Kottayam Districts). They include 821 houseboats.						houseboats plying in the Vembanad Lake in Kottayam & Alappuzha Districts is estimated to be more than 1000 (KSPCB, 2023).[143]		
Wetland Agriculture	Area	Km2	483	2022, current report	566 (Paddy Below Sea Level and Pokkali)	2001, current report			Declined	Area under Paddy is on a decline	-
Institutions & Governance											
Implementation of regulatory regimes	Coastal Regulation Zone notification, 2011		KCZMA constituted in 2016. Coastal zone management plans are in place. District level committees headed by the District Magistrate constituted. The KCZMA meets regularly to	2022, KCZMA	Absent				The coastal zone management plans have been prepared as per CRZ 2011 notification in 2018 and CRZ regulations are in force. Cases of violations as well as demands for awarding relaxation in the restrictions are decided by the KCZMA. In 2022, recommendations were given for reclassification of 340.10 km^2 of coastal land, falling under 175		Enforcement of CRZ to support environment-sensitive planning and sustainability requires closer coordination between agencies and individuals to overcome developmental challenges in the densely populated

[143] KSPCB/34/2023/EE-1, Date:15 /02/2023, Kerala State Pollution Control Board

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
			discuss CRZ related issues.						coastal panchayats from CRZ III to CRZ II to allow development works.		coastal landscape.
	Wetlands (Conservation and Management) Rules, 2017		In pursuance of the Wetlands Conservation and Management Rules, 2017 SWAK was constituted in 2017. All the provisions of the rules are in force.	2022, SWAK	Absent						
	Kerala Conservation of Paddy Land & Wetland Act, 2008		The conversion and reclamation of paddy land is prohibited. However, area under paddy cultivation including Paddy BSL, Pokkali and upland Paddy is on decline due to	LULC analysis, This Report	Specific regulation to support wetland conservation did not exist. Water quality, catchments aspects were covered under other sectoral				Despite the promulgation of the act in 2008 during 2001 – 2022, the area under wetlands has reduced by 20 % whereas area under paddy has reduced by 14.3 %. Area mixed vegetation has increased.	A declining trend in area under wetlands and paddy is reported in Kerala since several decades.	Provides a basis for checking wetland conversions. However, this is largely linked to increasing cost of paddy production, lifestyle changes in favour of an urban living. These are difficult to

Ecological Character Element	Indicator	Unit	Current status	Data Year and Source	Status at the time of Ramsar designation (2002)	Data Year and Source	Historical information	Data Year and Source	Trends since Ramsar designation (2002-2022)	Long-term trends based on historical records	Evaluation
			various factors.		acts						manage or reverse.
Management Plan			Approved Management Action Plan, 2017 exists which has validity up to 2022-23	2022, SWAK	Absent						
Monitoring regimes			Continuous operational monitoring through WIAMS project exists now, operating for the last two years.	2022, SWAK, CWRDM	Absent						
Budget			NPCA and State Plan funding	2022, SWAK	No dedicated funding						

3.2. Threats to ecological character

Threat	Risk of adverse change in Ecological Character	Level of Risk (High/Medium/Low)
Direct Threats		
Structural Modification There has been an increase in the built-up area within the Ramsar Site since designation	Leads to overall reduction in wetland regime	High
Alteration of natural hydrological regime There has been a significant shrinkage in open water area in Vembanad estuary The water holding capacity has also significantly reduced with reduction in water depths in the estuary. Historically, Thanneermukkom Barrier and Thottapally Spillway have altered the natural water regime	Hydrological regime buffering capacity is reduced	High
Pollution There has been a significant increase in pollutants in VKW, these include pollutants related with domestic sewage, industrial effluents containing heavy metals, houseboat discharge, pharmacological residues and plastics.	Adverse impact on aquatic life and related processes and health of communities living around the wetland	Medium
Unsustainable harvest The harvest of fish and clams from VKW has been on a consistent decline. The area under Pokkali, a model farming system aligned with wetlands has also been on a decline.	Regenerative capacity of biological resources is adversely impacted; Incomes of wetland-dependent communities are also adversely impacted	High
Invasive species There has been a proliferation of invasive macrophytes (Water Hyacinth, Giant Salvinia, *Monochoria vaginalis*, *Limnocharis flava*, *Ipomea carnea, Cabombo caroliniana*) and invasive fishes (African catfish and Nile tilapia) in the wetland ecosystem	Habitats of native species is adversely affected; Invasive macrophytes choke flows and lead to concentration of pollutants	Medium
Local climate change impacts The surface waters of VKW are progressively becoming warmer. The frequency of high-intensity rainfall events has also increased in the recent times. Modelling studies indicate a further increase in such events.	Warmer waters are more prone to nutrient enrichment and species invasion.	Medium
Indirect Threats		
Urbanisation There is increase in intensification in urban sprawl around the wetland	Leads to an increase in the built-up area causing structural modifications in the wetland	High
Unsustainable tourism There has been a significant increase in unregistered houseboat operations in VKW. Majority of houseboats do not use the prescribed CETP facilities established at two locations within the wetland complex	Pollution from houseboats is one of the significant contributors leading to decline in water quality	High
Agro-practices not aligned with wetland functioning There is considerably high usage of chemical fertilisers and pesticides in the below sea-	Significantly contributes to pollutant concentrations in Kuttanad and Kol wetland systems	Medium

Threat	Risk of adverse change in Ecological Character	Level of Risk (High/Medium/Low)
level wetland agriculture systems. While there has been a reduction in paddy farming area over time in Kuttanad, the intensity of usage remains high		
Insufficient waste treatment infrastructure Due to the absence of sufficient waste treatment infrastructure, majority of households dump their sewage directly into the wetland complex.	Untreated sewage from households is one of the significant contributors in decline in water quality	Medium
Lack of wetland specific institutional mechanism	Still not established, so will affect the effective and efficient implementation of regulatory and management operations	Medium

4. Institutions and Governance Arrangements

Institutions play an important role in governing and coordinating relationships between various wetland stakeholders, and their fit with ecological character has an important influence on wise use outcomes. Institutional requirements for conservation and sustainable management of the wetland complex are defined by the ability to ensure integration of site management within broad-scale environmental management and development plans, programmes and investments, including river basin management, and enabling participatory management, particularly ensuring involvement of local communities whose livelihoods are linked to wetland ecosystem.

This section of the management plan presents an analysis of existing institutions and governance arrangements with the intent of arriving at recommendations for revising these arrangements to achieve conservation and wise use of VKWs. The chapter includes an overview of existing settings, evaluation and recommendations for change in institutional arrangements.

4.1 Existing institutional and governance arrangements

Policy and regulatory frameworks

Wetland conservation draws strength from India's rich legacy of environmental preservation enshrined in various policies, legislation and regulatory regimes. The Indian Constitution encapsulates this spirit, notably in its Article 51–A (g) stating that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."

Within the federal set-up, wetlands conservation and sustainable management are placed within the mandate of the Ministry of Environment, Forest and Climate Change (MoEFCC). Since 2013, the National Plan for Conservation of Aquatic Ecosystems (NPCA) has provided the programmatic guidelines for wetlands conservation, especially those designated as Wetlands of International Importance under the Ramsar Convention.

The National Environment Policy of 2006 lays down specific policy elements for wetlands [144]. Wetlands have been identified as components of 'freshwater resources', and the recommended policy actions for wetlands conservation include integration in developmental planning, management based on prudent use strategies, promotion of ecotourism, and implementation of a regulatory framework. The India's National Wildlife Action Plan (2017-2031) identifies the conservation of inland aquatic ecosystems as one of the 17 priority areas and envisages the development of a national wetlands mission and a national wetlands biodiversity register as key interventions[145] Integration of wetlands in river basin management has been identified as a strategy for the management of river systems[146] .The National Water Policy (2012) recommends adoption of a basin approach for water resources management and identifies conservation of river corridors, waterbodies and associated ecosystems as an essential action area .The National Action Plan for Climate Change includes wetland conservation and sustainable management in the National Water Mission and the Green India Mission[147].

Wetlands receive protection from a number of central enacted rules and regulation. Provisions of the Indian Forest Act, 1927, the Forest (Conservation) Act, 1980 and the Indian Wild Life (Protection) Act, 1972 define the regulatory framework for wetlands located within forests and designated protected areas. In 2017, the Ministry notified the Wetlands (Conservation and Management) Rules under The Environment (Protection) Act, 1986. As per the provisions of

[144] MoEF 2006, National Environment Policy. Ministry of Environment and Forests. Government of India, New Delhi.
[145] MoEFCC 2017. India's National Wildlife Action Plan. Ministry of Environment, Forests and Climate Change, Government of India, New Delhi.
[146] Government of India Ministry of Water Resources, 2014
[147] MoEFCC 2021. Mission Document, National Water Mission Under National Action Plan on Climate Change, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India, New Delhi.

these Rules, State Wetlands Authorities have been constituted as the main policy and regulatory bodies within states and a range of activities listed as being prohibited and regularated. Further, under the EP Act, coastal wetlands are protected under the Coastal Regulation Zone (CRZ) Notification (2019) and its amendments and the Island Protection Zone (IPZ) Notification 2011. The Environment (Protection) Rules, 1986, under the EP Act, empowers the Central government to prohibit or restrict the location of industries and carrying on of processes and operations in different areas, including wetlands. The Indian Fisheries Act, 1897, The Water (Prevention and Control of Pollution) Act, 1974, and The Biological Diversity Act, 2002, provide instruments for regulating various development threats on wetlands. The Coastal Aquaculture Authority Act 2005 prohibits the conversion of natural coastal wetlands such as mangroves, salt pans, estuaries and lagoons for aquaculture. Further, under the Biological Diversity Act, 2002, the Central Government can issue directives to State Governments to take immediate ameliorative measures to conserve any area rich in biological diversity, biological resources and their habitats especially when the area is being threatened by overuse, abuse or neglect. The said Act also gives State Governments the power to notify areas of biodiversity importance as biodiversity heritage sites.

The Kerala State Environment Policy (2009) has a vision of ensuring clean air, water, soil and food to the people of Kerala and its sustainability for healthy living conditions, as well as ensuring the conservation of natural resources, including species, ecosystems and genetic wealth of the State[148] . The Policy aims to create environmental awareness for all sections of society, sensitising all sections on the critical need for sustainability of the ecosystems and environment to meet the growing human development needs and to promote public involvement in all environmental activities. Conservation and sustainable use of wetlands for ensuring water and food security and economic benefit of the people is included as a specific action plan within the State Environment Plan 2022.

The unprecedented floods in 2018 brought back the focus on improved water and river basin management in the state. The Kerala State Water Policy (2008) emphasises upon the maintenance of ecosystem integrity, adopting a watershed approach, ensuring people's participation, and constant upgrading of the water environment through environmental interventions such as salinity regulation, water quality monitoring, and pollution abatement. The policy also prescribes the constitution of a wetland authority for the protection, conservation, development, and management of wetlands in state[149]cand a State Level River Authority for river basin planning and management. The State Government under the Rebuild Kerala agreement with the World Bank, has initiated the process of constitution of a River Basin Authority. A bill to this effect, named the Kerala River Basin Conservation and Management Authority Bill, is currently being reviewed.

The need for rational use of ecological resources for nature-based tourism is highlighted in the State Tourism Policy (2012). The policy strengthens Responsible Tourism by introducing classification systems based on Global Sustainable Tourism Criteria and creating a Task Force for Responsible Tourism at the state level with members drawn from different line departments. The policy also emphasises on implementation of pollution control measures in coordination with the State Pollution Control Board and undertaking measures such as installation of solid and liquid waste management systems in all houseboats and banning the use of disposable plastics around the major tourist destinations. An overview of major regulatory frameworks which set the regulatory boundary for management planning of VKW is in Table 19.

[148] Kerala State Environment Policy 2009 Department of Environment Government of Kerala, 2009
[149]https://www.thehindu.com/news/national/kerala/river-basin-authority-to-be-constituted/article31334177.ece

Table 19: Key regulatory frameworks relevant for VKW

Regulation	Purpose	Scope of Approach	Key implications for management of VKW
Environment Protection Act, 1986	Umbrella law to provide for the protection and improvement of the environment, and for matters connected therewith	National	The Environment Protection Act, 1986 and related Acts such as the Water Act, 1974, the Water Cess Act 1977, the Wetland (Conservation and Management) Rules, 2017 lay the framework of regulatory tools to deal with pollution from industries, towns and settlements located along the wetlands.
Wetlands (Conservation and Management) Rules, 2017 under Environment (Protection) Act, 1986	Provides the regulatory framework for conservation and management of wetlands in the country	All wetlands >2.25 ha except those covered under the Indian Forest Act, 1927, the Wild life (Protection) Act, 1972, the Forest (Conservation) Act, 1980	As per the provisions of the Wetlands Rules: • Wetland boundary and zone of influence needs to be demarcated • Regulation will be as per provisions of the Coastal Regulation Zone Notification and amendments thereof in the case of area of wetlands coming within the CRZ. • A management plan for the wetlands needs to be formulated in line with framework recommended under the Guidelines for implementation of Wetlands Rules be invoked to make new statutes.
Coastal Regulation Zone notification 2011 and its amendments	To ensure livelihood security to the fisher communities and other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural	Extends to the entire country excluding the islands of Andaman and Nicobar and Lakshadweep and the marine areas surrounding these islands	Vembanad backwaters (the estuary region) has been declared as a Critical Vulnerable Coastal Area (CVCA) in consultation with local fisher and dependent communities with the objective of promoting conservation and sustainable use of coastal resources and habitats

Regulation	Purpose	Scope of Approach	Key implications for management of VKW
	hazards in the coastal areas, sea level rise		
The Indian Wildlife (Protection) Act, 1972	Protection of wild animals, birds and plants and for matters connected in addition to that	Applies to all wild habitats, protected areas, wild animals, specified plants, wildlife trade and related matters	Provides the regulatory framework for management of Mangalavanam, designated as a Bird Wildlife Sanctuary in 2004.
The Water (Prevention and Control of Pollution) Act of 1974	Aims to prevent and control water pollution and to maintain/restore wholesomeness of water by establishing central and state pollution control board to monitor and enforce the regulations	National	As per the KSPCB report submitted to the NGT in August 2022, several water quality parameters of Vembanad-Kol did not meet the permissible limits. The Act provides for penal measures for violations.
The Indian Forest Act, 1927	An Act to consolidate the law relating to forests the transit of forest-produce and the duty leviable on timber and other forest produce.	Applicable to whole of India. Wetlands lying within notified forest areas are regulated as per the provisions of the Indian Forest Act of 1927, Forest Conservation Act of 1980	The Act provides for conservation of wetlands within the notified forest areas within the catchments of VKW.
The Biological Diversity Act, 2002	Conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected in addition to that or incidental thereto	National	Prohibits within the VKW, without approval of the National Biodiversity Authority: • Obtaining any biological resource or knowledge associated thereto for research or for commercial utilization or for bio-survey and bio-utilization • Transferring results for monetary consideration • Application for intellectual property rights
The Kerala Conservation of Paddy Land and Wetland Act 2008.	To conserve the paddy land and wetland and to restrict the conversion or reclamation thereof, in order to promote growth in the agricultural sector and	Extends to the entire state of Kerala	This State Act prohibits the conversion and reclamation of paddy lands, except for ten cents in a Panchayat and five cents in a Municipality/Corporation, for the construction of

Regulation	Purpose	Scope of Approach	Key implications for management of VKW
	to sustain the ecological system		residential building for the owner of the paddy land. The act prohibits the reclamation of wetland and removal of sand except for removal of slurry and mud to maintain the ecological condition of wetlands. The act has over riding powers over Kerala Panchayat Raj Act (1994) and The Kerala Municipality Act (1994).
The Kerala Town and Country Planning Act, 2016	To provide for the promotion of planned development and regulation of growth of urban and rural areas with focus on scientific planning and improving livability of ambient spaces for inhabitants	Extends to the state of Kerala	The Act has provisions for preparing a Perspective Plan for the State containing long term policies and strategies for spatial development with a time horizon of twenty years to deal with protection of environmentally and ecologically sensitive areas and conservation of national and state level heritage areas. Similarly, the District Planning Committee and the Metropolitan Planning Committee constituted under section 53 and 54 respectively of the Kerala Municipality Act, 1994 prepares the development plan for the district and metropolitan area with a long-term perspective. Its co-ordinates planning and development activities among the Government departments, Quasi-Government institutions within the district/metropolitan in the context of Plans
The Kerala Inland Fisheries and Aqua Culture Act (2010)	Sustainable development, management, conservation, propagation, protection, exploitation and utilization of the inland fishery sector, promote social fisheries, regulate	Extends to the State of Kerala	Vests the power to develop and manage fisheries in public water bodies (including Vembanad Estuary) with the State Government, including powers to designate aquaculture areas and regulate, prohibit detrimental fishing practices and pollution

Regulation	Purpose	Scope of Approach	Key implications for management of VKW
	aquaculture activities and ensure livelihood of fishers and food security		of water bodies and establishment of Local Fisheries Management Council. The Act also prohibits use of paddy lands that can support one crop for aquaculture purposes.
The Kerala Irrigation and Water Conservation Act, 2003	To consolidate and amend the laws relating to construction of irrigation works, conservation and distribution of water for the purpose of irrigation and levy of water cess and to provide for involvement of farmers in water utilisation system	Extends to the state of Kerala	The Act vest all the water courses with the Government and prohibits acts that divert or diminish the flow of water (including those flowing into the VKW), sand mining in water course or structures maintained by the department, misuse of water from irrigation woks for purposes other than domestic purposes and prescribes development of an irrigation calendar aligned with cropping pattern in consultation with the beneficiaries
The National Waterways Act, 2016	To make provisions for existing national waterways, declaration of certain inland waterways to be national waterways, and to provide for the regulation and development of the said waterways for the purposes of shipping and navigation	Applies to all the existing national waterways 1 to 5 and the new waterways declared under the act	VKWs are part of the National Waterway 3 that extends from Kollam-Kozhikode Stretch of West Coast Canal (168km) and Champakara (14km) and Udyogmandal Canals (23km). Works on improving navigability of different sections of the waterways to improve navigability is being carried out by the Inland Navigation Wing of the Irrigation Department
The Kerala Tourism (Conservation and Preservation of Areas) Act 2005	To make provisions for the conservation and preservation of tourist areas in the State	Extends to the whole of the State of Kerala	Envisages conservation, preservation and integrated development of special tourist zones. Special tourist zones are notified in government gazette, and the act prohibits developmental activities within the notified areas. Till date, Kovalam, Munnar, Kumarakom and Fort Kochi have been brought under the purview of this Act.

4.2 Major organisations and programmes relevant to wetlands conservation

Environment Department
The Directorate of Environment and Climate Change (DoECC) within the Environment Department serves as the nodal agency for the planning, promotion, co-ordination and overseeing the implementation of central and state environmental protection and conservation policies and programmes and for formulating climate change-related schemes, plans, programmes and their execution. It coordinates, inter alea, the programmes for revision and implementation of State Action Plan on Climate Change.

State Wetland Authority Kerala
In pursuance of Section 5(1) of the Wetlands (Conservation and Management) Rules 2017, the Government of Kerala have constituted the State Wetland Authority Kerala (SWAK) vide GO (MS) No. 14/2017/Envt. dated 28.12.2017 with Chief Minister as the Chairman, Chief Secretary to Government as the Vice Chairperson and Director of Environment & Climate Change as the Member Secretary. SWAK is a statutory authority functioning as the State level nodal agency to implement policy development, regulatory frameworks, integrated management, planning, implementation of action plans, capacity building, research, networking, communication, awareness, creation and raising of funds for wetland management.

Kerala Coastal Zone Management Authority
The KCZMA was constituted in 2016 in pursuance of the CRZ notification 2011. The Additional Chief Secretary, Environment Department serves as the Ex officio Chairman. Coastal zone management plan has been prepared for the State of Kerala. District level committees under the chairmanship of the District Magistrate have been constituted for the coastal districts for the enforcement and monitoring of CRZ Notification 2011. The authority meets at regular intervals to hear and dispose cases related to CRZ clearance.

In 2022, an expert committee constituted by the state government to examine and resolve critical issues, has recommended to reclassify 340.10 km^2 of coastal land, falling under 175 coastal panchayats classified under CRZ III to CRZ II to allow development works. The request has been approved for 60 panchayats[150]. Similar recommendations have been given for 72 kms of Pokkali lands and low-lying agricultural lands.[151]

Irrigation Department
The Irrigation Department facilitates sustainable agricultural development and food security in the state and ensures sustainable Management of Water Resources. The department has six wings headed by a Chief Engineer. The Projects - II wing of the Irrigation Department plans, monitors and constructs dams and regulators and undertakes maintenance of completed projects[152]. The wing has been involved in carrying river desiltation works in major river basins in coordination with the District Disaster Management Authorities creating Room for River. Dredging and desilting of dams, reservoirs and barrages, rivers and canals for the maintenance and upkeep and for disaster management has been exempted from the otherwise mandatory environmental clearance for sand mining as per the provisions of section 23 and 24 of the Disaster Management Act 2005. Funds for the carrying river desiltation works have been channelized from the MNREGS, the Ayyankali Urban Employment Guarantee Scheme (AUEGS), the State Disaster Response Fund (SDRF) as well as the departmental funds.

Following the devasting floods of 2018 the CWC revised the Rule curves for various hydel dams in the State Emergency Action Plan of different dams were drawn. Major works in the

[150] https://www.onmanorama.com/news/kerala/2022/09/03/crz-exemption-kerala-panchayats.html
[151] https://www.newindianexpress.com/states/kerala/2022/may/09/keralas-coastal-regulation-zone-panel-report-goes-against-conservation-guidelines-2451342.html
[152] Major Irrigation projects implemented by the department in the wetland catchment includes the Periyar valley irrigation project, Idamalayar Irrigation Project, the Chalakudy River Diversion Scheme, the Meenachil River Valley Projects, the Cheerakuzhy Irrigation Project, the Kole Lands - Peechi irrigation project, the Vazhani Irrigation Project and the Chimoni Irrigation Project.

Kuttanad are undertaken by the Inland Navigation & Kuttanad Package Wing with its head office at Alappuzha. The department is currently implementing Kuttanad Package Phase II, undertaking bund restoration and repair work in different Padasekharams, flood mitigation works, canal desiltation and restoration works, construction of bridge cum regulators across rivers. The following ongoing plan schemes have a total budget allocation for these schemes for the year 2022-23 is Rs 19,606 lakhs:

- Flood Management Programme in Kuttanad
- NABARD-RIDF Assistance for Kuttanad
- Pradhan Manthri Krishi Sinchai Yojana–- Kuttanad Flood management component
- Inland Navigation works
- Investigation of Inland Water Transport schemes
- NABARD-RIDF for Construction of cross structures in National Waterway

The Irrigation Department is also responsible for operating the Thanneermukkom barrage, the Thotapally spillway, and the Andhakaranzhy regulator. The Mechanical Wing of the department is responsible for construction and maintenance of shutters and lock gates, hoisting mechanisms and sluice structures of dams, operating mechanisms of navigation canals, and carrying dredging works in the state. In 2014, the Irrigation department started the modernisation of Thanneermukkom barrage based on the recommendations of the MSSRF report[153]. This involved the replacement of the Coffer dam situated in the middle of the Vembanad Estuary with a RCB structure at a cost of Rs 183 crores. The third stage completed in 2018 has 28 shutters and having a length of 428m[154].

The Thanneermukkom barrage gates are usually shut down in December 15 to facilitate the growing of Punja crop and then reopen it when the Punja harvest is completed by the end of March 15. While the irrigation department physically operates the barrage, a decision on the closure dates is through a committee under the District Collector, Alappuzha with members drawn from padashekharam committees.

The opening of the shutters has been delayed in recent years due to the late harvest of paddy. In 2021 the shutters were opened in May. In the current year the Punja paddy cultivation ran behind schedule with the harvest continuing till May 2022. This led to protests by fishers who contested that the shutter gates be opened by March 15 as the delay will lead to accumulation of pollutants and impact fisheries[155]. An advisory committee constituted by the State government has recommended the opening of shutters of the Thanneermukkom barrage based on the Kuttanad farming calendar from next year. The committee has directed the Padasekharam Samitis to follow the crop calendar and will also seek expert opinion on whether to make changes in the current farming calendar considering the changing rainfall patterns[156].

Kerala Land Development Corporation

KLDC is responsible for developing, implementing, and handing over the quality infrastructure works in the Agriculture and Allied Sector in the State at reasonable cost. In 2017, the Corporation got accreditation from the state government to undertake, execute general civil construction works of any departments or agencies in the State. The KLDC is executing the following projects:

[153] MSSRF 2007. A study reporton: Measures to Mitigate Agrarian Distress in Alappuzha and Kuttanad Wetland Ecosystem. M. S. Swaminathan Research Foundation 219.

[154] https://irrigation.kerala.gov.in/thanneermukkoms

[155] https://www.thehindu.com/news/national/kerala/demand-to-open-shutters-of-thanneermukkom-barrage/article65243676.ece?homepage=true

[156] https://www.thehindu.com/news/national/kerala/panel-suggests-opening-of-thanneermukkom-barrage-shutters/article65326915.ece

- Pokkali Land Development Project with an outlay of Rs. 28 Crore, benefitting an area of 5000 ha and 4000 beneficiaries
- Vaikom Kari Land Project with outlay of Rs.15.36 Crore and benefitting 1837 ha and 4674 beneficiaries
- Kuttanadu and Purakkad Land Development Works with outlay of Rs.7.5 Crore spanning 854 ha and 990 beneficiaries
- NABARD Aided Rural Infrastructural Development Fund (RIDF) Projects including the construction of bunds, infrastructure works in Padasekharams costing a total of Rs.58.69 Crore.
- Rashtriya Krishi Vikas Yojana (RKVY) Projects amounting to Rs.26.1 Crore

Under the Rebuild Kerala Initiative (RKI), the TCR Ponnani Kole Phase IV project is implemented over five years with a project outlay of Rs 298. 38 crores by KLDC, Agriculture Engineering Department and the KAICO. KLDC is undertaking works to improve infrastructure facilities to overcome the flood and droughts in Thrissur-Ponnani Kole lands. The clogged canals and insufficient dewatering systems has been addressed in the project. KLDC has completed the majority works with respect to deepening and desilting of 32 main/leading canals in Thrissur Kole area for flood discharge and storage of irrigation water was carried out (Table 20). List and figure of major canal maintenance works under RKI initiative prepared by KLDC is attached as Annex XII A and XII B.

Within the padashekarams, assistance for infrastructure like farm roads, culvert (kida), ramps, desilting of inner canals are planned for 13,632 hectare of Thrissur Ponnani Kole area with an outlay of Rs 153.56 crores. This will help doubling the paddy output from 3 to 4 t/ha to 7 to 8 t/ha. 33 % of the works with respect to desilting of inner channel has been completed as in March 2023. Besides 93 engine sheds and 8 engine thara are to be constructed which is spread in 24 sites of Thrissur Kole area and 36 sites in Ponnani Kole area with ana outlay of 14.45 crores.

Table 20: KLDC works under Rebuild Kerala Initiative, TCR Ponnani Kole Phase IV project[157]

S. No	Item	Implementing Department/ Agency	Project Cost (INR in Crores)	Completed/ Ongoing
1	Deepening, widening of canals and strengthening of bunds in Kol land	KLDC	66.85	95% completed
2	Construction of Engine Sheds and Engine Thara in Thrissur – Ponnani Kol area	KLDC	14.46	Ongoing
3	Infrastructural assistance in Kole land padashekarams	KLDC	153.57	Ongoing
4.	Others	KLDC	0.25	
Total			**235.12**	

Department of Agriculture Development and Farmers Welfare

Major interventions of the Directorate of Agriculture Development and Farmers Welfare are in Agricultural Planning, Crop Production, Agriculture Extension, Biogas, and Marketing. These

[157] KLDC, Thiruvananthapuram

divisions are headed by an Additional Director. Bund strengthening and Agriculture Engineering related works are being handled by the Agriculture Engineering Wing headed by an Executive Engineer. Each district has a Principal Agriculture Officer's office. Krishi Bhavans and ATMA in the blocks are placed under the PAO office. There is a district soil testing laboratory in each of the districts. Mobile soil testing labs as well as laboratories operated by KVK and institutions are also present. The International Research and Training Centre for Below Sea level Farming at Kuttanad popularizes innovative activities, resolving field problems of the Kuttanad region. In the Kuttanad region, a Punja Special Officer takes care of the dewatering needs, bund repair, and other works in conjunction with the District Collector's office under the provisions of the Kerala Irrigation Works (Execution by Joint Labour) Act, 1967.

Kuttanad, Kol-Thrissur, Kol-Malappuram, Pokkali-Ernakulam, Pokkali – Thrissur have been declared as a Special Agriculture Zone for Rice to ensure greater convergence of programmes and flow of SAZ funds to these zones. The works related to Kuttanad Package Phase II commenced on September 17, 2020. The package emphasizes on operationalisation of a SAZ plan for Kuttanad, preparation of a crop calendar for paddy and other measures such as modernisation of existing dewatering systems, integrated farming systems, integrated pest management amongst others.

The department is currently running 13 central schemes and 38 state schemes in the State. Some of the important schemes relevant to wetland management are listed below.

Central schemes

a) **Krishi UnnathiYojana** is the umbrella scheme under Agriculture with a 60% central share and 40% state share. This includes ongoing centrally sponsored schemes viz. National Food Security Mission (NFSM), Mission on Integrated Development of Horticulture (MIDH), National Mission for Sustainable Agriculture (NMSA), Paramparagath Krishi Vikas Yojana (PKVY), Pradhan Mantri Krishi Sinchayee Yojana (PMSKY), Bharatiya Prakruthik Krishi Padhathi-Subhiksham Surakshitham (BPKP) amongst others. Marketing and GOI-supported Crop Insurance schemes are included under the scheme. An amount of ₹ 15480.00 lakh is provided as the anticipated central share of the scheme.
b) **National Biogas Development Project** with a 100 % central share provides assistance for setting up biogas plants of the normal type and sanitary toilet-linked plants and for the conduct of various training courses for masons, beneficiaries, and other turnkey agents. The subsidy rate is ₹ 12000/plant for the general category and ₹ 13000/- plant for SC/ST category. An amount of ₹ 150.00 lakh is provided during 2022-23.

State schemes

c) Farm plan-based development approach has been introduced in 2022-23 in the state, to promote the adoption of scientific selection of components and suitable agro management practices based on agro-ecological units to minimize risk due to crop loss. The scheme is to be implemented with the help of Krishi Bhavans based on a plan prepared by Agricultural Officer with technical support from the Kerala Agriculture University (KAU) in consultation with the farmers. At least 25 farm units will be developed in each Panchayat. All farming approaches followed by the department in plan schemes are based on scientific knowledge and with the approval of the Kerala Agricultural University. The approach is to be promoted under threes schemes
    - Farm Plan based Production program – Outlay ₹1200 lakhs
    - Scheme on development of production organizations and technology support (₹900 lakhs)
    - Scheme on Supply Chain/Value chain Development and integration under FPD – ₹800 lakhs
d) **Krishi Padhashala** - Krishi Padhshala program will be implemented to create awareness among the farmers on the concept of AEU-based cultivation and popularization of best

traditional technologies and new scientifically proven technologies through field-level demonstrations. The scheme has an outlay of ₹100 lakhs during 2022-23.

e) **Development of the Agriculture sector in Kuttanad** – (a) ₹1200 lakhs have been allocated for the Development of various Padasekharams in Kuttanad and the establishment and replacement of Petti & Para with VAF pumps. Traditional Petti and Para methods of dewatering have only 30-40% efficiency and are being replaced by the low head, high discharge vertical axial flow pump sets (VAF pumps) in both Kuttanad and Thrissur Kol (b) PM KUSUM Top Up subsidy of ₹500 lakhs is being provided to reduce dependence on conventional energy sources. This is being implemented in partnership with ANERT which is the nodal agency for implementation. 30% of the expenditure to set solar pumps will be met from central funds, an equal 30% is to be provided by ANERT, 20% will be met from state plan funds and the beneficiary will contribute 20 %. Roughly, around 4-5 lakh pumps, currently are in use in the agriculture sector in Kerala state. The target is to provide financial assistance for 100,000 pumps. Around 9000 have been replaced so far. However, individuals find it difficult to the initial 20 % of the amount. As of yet, electricity is free for farming works hence farmers are reluctant to shift to the new technology. Preference will be given to the Kuttanad region.
f) **Strengthening Agricultural Extension –** The ATMA model of Agricultural extension with suitable modification integrated as ATMA plus is being implemented in the state for the transfer of scientific and advanced technology to farmer fields and its adoption. An amount of ₹2828 lakhs is earmarked for extension activities during 2022-23. Extension and outreach activities in Kerala state are delivered through 1076 Panchayat level Krishi Bhavans. Agriculture Officer provides technical support on modern agriculture practices. A major focus in the year 2022-23 is to improve the efficiency of the Krishi Bhavans and support of ₹200 lakhs is earmarked for Strengthening Farm Plan Based Development Approach.
g) **State crop insurance schemes** - The state crop insurance scheme has an outlay of ₹3000 lakhs against crop loss due to natural calamity in 2022-23.
h) **Rural Infrastructure Development Fund -** ₹1000.00 lakhs has been earmarked for the implementation of infrastructure works in the agriculture sector for projects approved under the RIDF of NABARD. The new and ongoing projects under tranche XX-XXVIII will be taken up during 2022-23.
i) **Soil and Root Health Management & Productivity Improvement -**₹2200 lakhs is earmarked to provide support to farmers to improve soil health.
j) Agriculture department also uses Sepecial Agriculture Zone funds for infrastructure development and for filling critical gaps in Kol as well the Kuttanad region. Funds of around ₹ 500 lakhs were used for bund strengthening works in 2022-23.[158]

[158] In Kuttanad, bund strengthening works are largely (90% of works) carried out by the Irrigation department by awarding tenders. The main source of funding is the Kuttanad Package - Flood Management Program and NABARD-RIDF assistance funds for Kuttanad. The State Disaster Relief Funds (SDRF) are also used for the purpose, coordinated, and administered through the District Collector's Office. After its formation in 1972, the KLDC was the main agency for agriculture infrastructure works in Kuttanad. At present, KLDC is mainly executing bund and canal maintenance works in Kole floodplains wherein the Irrigation department looks after dam operation and maintenance.

BOX 5: Kuttanad Development Coordination Council[159]

The Kuttanad Development Coordination Council was constituted in consequence of a cabinet decision taken on 13 October 2022 under the chairmanship of the Chief Minister with the objective of overall development of Kuttanad through the coordinated implementation of projects by various departments.

A monitoring and advisory council and an implementation and technical committee are to be formed under the Council. Kuttanad cell under the Planning Department would function as the State-level secretariat of the KDCC whereas the District Development Commissioner's office/District Planning Office would be the district secretariat.

Agriculture Minister is the vice-chairman of the KDCC, the Additional Secretary-Planning is the Convenor/Secretary of the Council while Revenue, Cooperation, Food, Water Resources, Electricity, Fisheries, Local Self Government Department and Tourism Ministers are the council members. The ministers of Revenue, Food, Water Resources, Electricity, Fisheries, Animal Husbandry, Local Self Government, and Tourism are the members of the Council.

Secretaries/Directors/Chief Engineers of various departments, representatives of financing organizations, District Panchayat Presidents of Alappuzha, Kottayam & Pathanamthitta, and the Vice Chancellor of Kerala Agriculture University are members of the 40-member council. The Council is to meet once every six months to meet the following objectives

- The projects under various government agencies in Kuttanad would be brought under one umbrella. Steps will be taken to assess the initiatives of various agencies, ensure that they are mutually beneficial, and avoid the repetition of efforts by various agencies.
- Coordinated planning and implementation of various projects aimed at the overall development of paddy cultivation in Kuttanad
- Implementation of integrated water management in Kuttanad
- Planning and implementation of comprehensive measures to save the paddy cultivation in Kuttanad from floods
- Development and implementation of the appropriate calendar for agriculture and farming methods by untimely rains and floods.
- Adoption and implementation of projects to minimize the crop-loss and destruction of infrastructure
- Mechanisation of agriculture activities and procurement of the required equipment.

Department of Tourism

The Department is responsible for developing and providing direction to tourism in the state. It takes measures to promote and publicize tourism. The Kerala Tourism (Conservation and Preservation of Areas) Act 2005 provides for the conservation, preservation and development of special tourism zones declared by the government. Kumarkom and Fort Kochi are such Special Tourist Zones around Vembanad. Steps have been taken to make tourism environment-friendly.

Local Self-Government Planning Department

The department functions as the nodal agency for ensuring planned development of urban and rural settlements in the state. It grants Statutory Approvals for constructions & land developments, prepares plans at the state, district and local levels and advises the LSGs and

159 https://keralacm.gov.in/2022/10/13/cabinet-decisions-13-10-2022/)

Government on matters related to the planning and development of settlements. It also serves as the technical secretariat for Art and Heritage commission.

The department has been planning interventions in the wetland catchment. Flood risk-informed master plans (with twenty years perspective) have been developed for Chengannur and Cherthala town situated in the coastal stretch. Land use zoning has been prescribed and is supported by zoning regulations. It has been prescribing septage and sewage and soil liquid waste management in adherence to the Kerala Municipality Building Rules 2019 and the Kerala Panchayat Building Rules 2011.

Department of Panchayats
The department strives to create a system of democratic self-reliant Local Self Governments for vibrant and robust decentralised decision making. Some important duties of Panchayats as specified by the Kerala Panchayat Raj Act 1994 are to protect public spaces from encroachment, protect ponds and other water bodies, waterways and canals under the responsibility of Gram Panchayat collect and dispose of solid waste and arrange liquid waste disposal and draining of the flood water. One of its important projects are Green Kerala with three sub missions focusing on water conservation with revival of rivers and streams and claiming of backwaters; sanitation and organic farming. Local Level Monitoring Committee (LLMC) is constituted as per provisions of Kerala Conservation of Paddy lands and wetland Act 2008 to support wetland conservation by Panchayats.

Department of Soil Survey and Soil conservation
The Department's mandate is to process and maintain a database on soil and land resource data, undertake soil surveys of Panchayats and watersheds, prioritisation of watersheds and implementation of soil and water conservation activities basis, enhancement of irrigation potential and infrastructure creation in rural areas for augmenting agricultural production.

Harithakeralam prepares watershed maps with the help of the LSGs and prepares block wise watershed master plan from which priority wise projects are placed for approval at appropriate levels. Implementation is done with the support of local bodies under the supervision of technical committee including line departments and agencies.

Research & Academia
Centre for Water Resources Development and Management (CWRDM), a premiere research and development organization of Government of Kerala, periodically undertakes hydrological investigations in VKW ecosystem and its catchments. CWRDM has also established the Wetland Inventory Assessment and Monitoring System (WIAMS) for the Ramsar Site under a project commissioned by SWAK.

The ICAR – Central Marine Fisheries Research Institute (CMFRI) has been involved with the development of scientific methodologies for estimating the marine fish landings and effort inputs, taxonomy of marine organisms and the biological aspects of the exploited stocks of finfish and shellfish on which fisheries management were to be based. CMFRI maintains databases of annual fish and clam landings of VKW.

Kerala Agricultural University, with its Regional Agricultural Research Station at Kumarakom has been leading agricultural research in special problem zones comprising Kuttanad, Pokkali and Onnatukara tracts. The Krishi Vigyan Kendras are situated in Kottayam and other districts have been promoting scientific and good agricultural practices as avoiding excessive use of pesticides and fertilizers, management of aquatic weeds. Rice Research Centre in Thrissur conducts awareness and outreach activities for paddy cultivators and is currently preparing a revival strategy in the Chalkudy River basin.

The Cochin University of Science and Technology (CUSAT) and Mahatma Gandhi University conduct biogeochemistry and pollution status and mitigation studies on heavy metals, emerging pollutants, microplastics, oil spills, bioremediation in the Vembanad, sediment quality, It is also

involved in remote sensing-based monitoring of Vembanad Kol system and has been continuously monitoring Vembanad water quality.

CANALPY is a collaborative initiative between IIT Bombay and KILA and has been conducting local hazard assessments and mapping at Panchayat level, canal mapping and urban flood zonation and canal rejuvenation works. Foundation for Environmental Research and Innovation (FERI Trust) has been conducting wetland research for exploring commercial uses of wetland resources such as water hyacinth. Nansen Environmental Research Centre India (NERCI) conducts basic and applied research projects in ocean and atmospheric sciences and has been carrying out research studies on Vembanad water quality.

The Centre for Aquatic Resource Management & Conservation (CARMC) of Kerala University of Fisheries and Ocean Studies (KUFOS) have recently completed a comprehensive and high-resolution (300 x 300 m grid resolution) bathymetry for the South and Central sectors of Vembanad Lake with the support of HSW. De-tided depth profiles from echo-soundings were further validated in-situ by CARMC. Detailed bathymetry charts are also available with CARMC. Retention Capacity (carrying capacity) for these sectors have been estimated and long-term changes in retention capacity of the Lake are also captured. Also, the quantum of sediment to be removed (grab collection) and advise on sediment disposal are already given by CARMC. Work on Kol wetland (North VL) bathymetry will commence from April 2023 with the support of HSW. Macroplastic load in the bottom one-meter sediment of SVL & CVL is already documented, and the impact of microplastic on clams and other filter feeders have been worked out on a pilot scale. Through detailed survey's CARMC has documented the trophic structure of SVL & CVL. CARMC has completed an assessment of organic pollutants in these two sectors. Clam abundance and distributional patterns in the said two sectors is completed. The Kol-Wetlands and the land-near coastal interactions will be done by KUFOS between 2023 – 2027.

Civil Society Organisations

ATREE Community Environmental Resource Centre has been advancing wetland conservation in the region, conducting educational programmes in schools as *Jalapaadom* and biodiversity documentation programs as Kerala BioBlitz in collaboration with National Biodiversity Board and annual Vembanad fish counts. A community-based water quality monitoring program named *Jaladarpanam* is also being implemented. The Kerala Centre of WWF has conducted specific studies on clam fisheries of VKW.

The Kerala Sashtra Sahitya Parishad (KSSP) has also been playing a pivotal role in promoting a scientific temper and nature conservation through mobilization of masses. It has undertaken several research studies and awareness activities for Vembanad through the involvement of local self-governments.

Several user guilds such as houseboat associations and coir retting societies and Padasekharam Samitis and Clam collectors' society, are operational and wield significant power in influencing wetland management decisions.

Kole Birder's Community carries out the Annual Waterbird Census and fish surveys in Kole wetlands in collaboration with Kerala Agricultural University and Kerala University of Fisheries and Ocean Studies (KUFOS). It has been conducting awareness programmes in schools and colleges. Similarly, the Kottayam Nature Society conducts the Annual Waterbird Census in Vembanad.

KUFOS has recently completed a comprehensive survey of the southern and central sectors of Vembanad lake covering various aspects such as long-term changes in the geomorphology and water retention capacity, siltation and sediment load above Base Floor Depth (BFD), pulsatile nature and sediment filtration. It has also studied the efficiency of Kuttanad polders, the functional ability of Thottappally spillway, survey of the deltaic canals and their interconnections, flow patterns during monsoon, post-monsoon and pre-monsoon seasons, pollution aspects

(persistent organic pesticides, plastic pollution (macro, meso and microplastic) and biological aspects such as phytoplankton composition and abundance, qualitative and quantitative analysis of macrobenthos, and a detailed analysis of the clam fishery.

4.3 Evaluation of existing institutional arrangements

The institutional regimes and governance arrangements discussed in section 4.1 must be sufficient to address the risk of adverse change in wetland ecological character (section 3.2). An evaluation of existing institutional arrangements is discussed in this section (Table 21).

Table 21: Gap analysis of existing institutional arrangements for managing VKW

Enabling institutional conditions and implications for wetland management	Status of current institutional arrangements	Key gaps
Defined user and resource boundaries		
Presence of well-defined boundaries around VKW is required to ensure that management zones and actions are defined in spatial terms and linked with user access rights, adverse land and water use change is prevented, and communities have incentives for protecting the wetland.	Ramsar site boundary map is available with SWAK. The previous map was revised to exclude major settlement areas and has been submitted to the Ramsar Secretariat for approval. CRZ maps have been prepared for the area. Wetlands and paddy lands have been identified and notified in respective Panchayats and Municipalities under the Kerala Conservation of Paddy Lands and Wetland Act 2008 and there is a ban on their conversion to other uses. The areas marked as paddy lands are mostly under private ownership whereas Vembanad estuary lands are public lands. Despite demarcation of regulatory boundaries, several violations of extant regulations are observed. Encroachments are observed especially on the wetland shorelines.	Ground demarcation of wetland boundary is not yet done. The database on wetlands and paddy lands has not yet been published in a state government gazette. There is an apparent lack of monitoring infrastructure and political will for enforcement of the extant regulations on part of concerned government departments and agencies.
Congruence		
Rules for management of VKW conform to the functioning of biophysical and social systems. The rules also balance the cost of enforcement of management with the	The provisions of Wetlands (Conservation and Management) Rules, 2017 enlists the activities which are prohibited, regulated and permitted within the Ramsar Site and its zone of influence.	While the regulatory regimes are specified, rules for management of Vembanad-Kol Ramsar Site are very weakly articulated and not well communicated all stakeholders. There is absence of mechanisms for ensuring that management of

Enabling institutional conditions and implications for wetland management	Status of current institutional arrangements	Key gaps
benefit derived from wetland ecosystem services and biodiversity.	Regulatory regimes for pollution abatement are also notified. Sector guidelines for tourism, town and country planning, agriculture and industrial development are in place.	developmental activities in the catchment is aligned with ecosystem functioning. There is very limited compliance of most of the environmental safeguards. Increasing costs of agriculture farming, crop failures, low interest of young people and infrastructure development has an impact on land use dynamics in both Kol and Kuttanad paddy lands. Agriculture support and incentives are sometimes delayed and less effective in preventing farmer's distress. Post 2018, river desiltation is being carried out under the River Rejuvenation programme. Construction works and sand mining is said to be impacting domestic freshwater availability particularly in the Kol region. Several infrastructure development activities around wetland have been carried out that violate environmental regulations due to policy incoherence, a lack of clarity on jurisdiction and terms and absence of strict enforcement and command-and-control mechanisms. The metropolitan and urban areas and the Panchayat around Vembanad are not able to capture, contain, treat their sewerage and solid waste despite several policies and regulations. As per KSPCB report all 10 Panchayats and 2 Municipalities sharing boundary with Vembanad lake and the other 62 Panchayats and 4 municipalities in the water shed none had taken Authorisation for Solid waste management or set up scientific waste management facilities. Government is facing issues as lack of space in densely populated areas and public opposition to

Enabling institutional conditions and implications for wetland management	Status of current institutional arrangements	Key gaps
		construction of CETP despite giving clearance to establishment of CETPs. Within sectors there is fund shortage and limited human resources to implement several activities such as regular water quality monitoring.
Conflict resolution mechanism		
Low cost and effective conflict resolution mechanism are available for supporting the implementation of wetland management.	Several cases of conflicts have been reported. These include cases involving corporates and individuals, property developers, Padasekharam samitis and the State of Kerala. Climate change events are causing extended flooding in the Kuttanad area. Cropping cycles are delayed leading to conflicts between fishers and agriculturists. A committee has been constituted to resolve issues. The Directorate of Ports is directed to control unsustainable houseboat tourism in the Estuary The Kerala State Pollution Control Board has been routinely monitoring the estuary with respect to various parameters and submitting its report on environmental quality. As reported in 2022 KSPCB charged an amount of Rs 90,45,400/- as penalty from houseboat owners for not complying with set norms in Alappuzha. Aquaculture operations are impacting traditional fisheries with increased instances of ornamental fishes and fish invasives in wetlands	A calendar on fishing on the lines of crop calendar that could inform irrigation department officials on fish breeding seasons, migration timing and facilitate barrage operation, protect the interest of both fishers and agriculturists and reduce stakeholder conflicts is absent. There is absence of a district level body with administrative powers coordinating various stakeholders including local communities. A designated wetland management agency that promotes greater collaboration and coherence amongst stakeholders, aligns sectoral priorities with wetland management goals and reduces conflicts is absent The monitoring and enforcement agencies lack adequate man power and financial resources to appropriately carry their roles and responsibilities

Enabling institutional conditions and implications for wetland management	Status of current institutional arrangements	Key gaps
	Agricultural infrastructure development works involving construction of bunds, bridges, canal deepening are leading to greater development of linear infrastructure, expansion of settlements and aiding in illegal encroachment of wetlands particularly Kol floodplains and causing pollution. Pollution of wetland waters is impacting fish health (with instances of infectious spleen and kidney necrosy virus in fishes and various parasites.) and continuous presence of E. coli. Water hyacinth is increasing due to freshwater conditions and increasing nutrients status. Cage culture and duck rearing promoted to support small farmers also contributes to the load.	
Minimal recognition of rights to organize		
Rights of communities to define management objectives for VKW are not counter to existing government rules and regulations.	Communities enjoy traditional rights and privileges to access wetland resources. Data suggests over extraction of wetland resources that is adversely impacting the ecological character of the VKW. As reported houseboat tourism, coir retting operations, household water use, discharge of effluents and solid waste dumping from nearby villages, towns, industries, hospitals are polluting the estuary.	Checks and balances to be placed to regulate community rights and privileges in accessing wetland resources subject to the threshold levels and to ensure equitable sharing of benefits and maintaining wetlands ecological character. There is no prescribed monitoring and regulatory tool to guide wetlands wise use and ensure adherence. Local Self Governments have been made responsible for various conservation actions but this is not backed by adequate awareness generation or capacity development actions. LSGs and User guilds exercise considerable power and are politically cognizant. They can

Enabling institutional conditions and implications for wetland management	Status of current institutional arrangements	Key gaps
		positively influence and contribute to wetland conservation but without suitable incentivization and sensitization they are likely to be lured in to economic activities that offer short term gains
Nested enterprises		
Institutional arrangements for management of VKW are linked with wider developmental planning within the river Basins.	River basin authority though prescribed as per Kerala State Water Policy 2008 is yet to be constituted. Planning and protection of river basin falls under the purview of the LSG planning department for town and country planning and the Forests and Wildlife Department.	There is lack of integrated river basin planning and coordinated action for catchment conservation. Significant catchment degradation, river and wetland siltation is observed with reduction in forest areas can be observed. Aligning departmental programmes and priorities that traditionally have a sectoral focus and are antithetical to wetlands conservation is a challenge specifically those related to infrastructure development and tourism. There is a lack of institutional capacities to guide and support integrated management of wetlands. The need was highlighted for all wetlands, during stakeholder consultation workshops. There is also weak coordination between departments and academic Agriculture leading to duplication of activities and wastage of funds. Coordination with research and academic institutions for wetland management needs to be improved by creating a common repository of available knowledge base, involvement of academia and CSOs in decision making and providing appropriate assistance.

4.4 Proposed arrangements for managing VKW

Management of VKW is rendered complex on account of three ecological zones (each having distinct character and values), diverse state agencies implementing their plans and programmes, and a number of primary stakeholders which have their rights and privileges within and around wetland ecosystem, and influencing the wise use outcomes. Based on the experiences of management of Ramsar Sites of similar complexity (such as the Chilika in Odisha, and the East Kolkata Wetlands in West Bengal), it is recommended to constitute a VKW Management Unit under the ambit of SWAK and administrative control of the Environment Department, Government of Kerala (which is also responsible for the management of the wetlands) to coordinate implementation of the management plan and ensure conservation and wise use of the wetlands.

The VKWMU will work towards the mission "to conserve, restore and sustainably manage VKW to maintain and enhance their biodiversity and ensure sustained provision of their full range of ecosystem services to support well-being of dependent communities".

The VKWMU will serve as the nodal planning, management and regulatory body for VKW. Its functions will include outlining integrated management plan, coordinating implementation, enforcing regulation, raising resources for site management, networking and collaboration, capacity building, and communication and outreach. Following are proposed to be the objectives of VKWMU:

- Ensure conservation and wise use of VKW so as to enable the delivery of its full range of ecosystem services and sustenance of diverse species and habitats
- Design an integrated management plan for the conservation and wise use of VKW in consultation with stakeholders and adopting national and international best practices in wetland management
- Coordinate implementation of integrated management plan working collaboratively with various line departments and agencies of the state government, local self governments, academic and research organisations, experts, civil society organisations, and other relevant entities
- Put in place an integrated wetland inventory, assessment, and monitoring system to assess short and long-term changes in wetland ecological character and identify appropriate response mechanisms
- Monitor implementation of extant regulation in VKW and enable enforcement through respective authorities
- Promote long-term multidisciplinary research on various VKW features so as to support integrated management
- Build capability of line State Government departments, agencies and other organisations in integrated management of VKW
- Ensure consideration of VKW ecosystem services and biodiversity values in various plans, programmes, and investments including incorporation of appropriate risk-reduction measures
- Put in place a Communication, Education, Participation, and Awareness (CEPA) programme to promote affirmative behaviour change amongst wetland communities and stakeholders towards conservation and wise use of VKW
- Develop networks and partnerships with local, national and international organisations to support conservation and wise use of VKW
- Mobilise finances from government programmes and private sector for integrated management of VKW

SWAK will be responsible for defining the aims and objectives, governance structure, roles and responsibilities, membership, powers and functions of the VKWMU.

A multistakeholder Vemband-Kol Wetlands Advisory Committee (VKWAC) will be constituted under the chairmanship of the Member Secretary, SWAK with the following members:

- Chief Engineer of Irrigation Department, Directors of different departments such as; Department of Tourism, Local Self-Government Planning Department, Department of Panchayats, Department of Fisheries, Department of Agriculture and Department of Soil Survey and Soil conservation
- Member of Legislative Assemblies of Aluva, Kochi, Vypeen, Vaikom, Ettumanoor, Aroor, Cherthala, Alappuzha, Ambalappuzha and Kuttanad
- District Collectors or their representatives of Alappuzha, Kottayam, Ernakulam and Thrissur districts
- Member Secretary, Kerala State Pollution Control Board or his/her representative
- Representative, Cochin Port Trust
- Representative, Vembanad Houseboat Association
- Representative, Clam collectors' Association, Vembanad
- Representative, Padasekharam Committees, Kuttanad
- Representative, Padasekharam Committees, Kol lands
- Representative, Fisherfolk Association, Vembanad
- Respresentative of KUFOS and CUSAT
- Executive Director, Centre for Water Resources Development and Management
- Director, National Centre for Earth Science Studies
- Executive Director, VKWMU (Member Convenor)

VKWAC will provide strategic guidance and technical and scientific inputs to the VKWMU. It will also advise SWAK for constitution of working groups or technical sub-committees for the implementation of certain activities of the IMP.

The Executive Director/ Chief Executive Officer, VKWMU will be designated as the head of the unit responsible for the implementation of the various work programmes of the organisation. The VKWMU is proposed to have the following divisions and staff structure (Table 22)

Table 22: Suggested structure of the VKWMU

Division	Role and purpose	Staffing
Research, monitoring and Evaluation	• Conduct wetland monitoring as per the approved monitoring plan • Publish periodic monitoring reports/wetland health cards • Coordinate implementation of specific research studies to address knowledge gaps	• Senior Hydrologist–- 1 • Senior Ecologist – 1 • Senior RS-GIS Specialist – 1 • Senior Social Scientist – 1 • Junior Hydrologist (water chemistry) – 1 • Junior Ecologist – 1 • Junior RS-GIS Specialist – 1 • Junior Social Scientist – 1
Participation and networking	• Engage with stakeholders to assess their views, rights, and capacities for wetland management • Develop networks with local, national and international	• Networking Officer - 1

Division	Role and purpose	Staffing
	organisations to support wetland management • Monitor partnerships in terms of their contribution to overall objectives of wetlands management	
Communication and outreach	• Design and implement the communication, education, participation and awareness plan for conservation and wise use of VKW • Conduct capacity development programmes for various line departments, stakeholders for integrated management of VKW	• Senior Communications Officer – 1 • Senior Capacity Development Officer – 1
Legal and regulation	• Monitor implementation of extant wetland regulatory regimes • Ensure enforcement of extant regulatory regimes through the concerned authority or nodal government department • Collect public grievances related to management of VKW and bring it to the notice of the concerned administrative authority	• Legal Officer – 1 • Public Grievance Officer - 1
General administration	• Provide direction for the wise use and conservation of VKW as per the provision of the approved management plan • Facilitate management and business operations of the organisation • Providing development review, control, and approval functions; • Handling the accounts for the VKWMU	• Senior Administrative Officer – 1 • Junior Administrative Officer – 1 • Accounts Officer - 1

5. Management Framework

Management of (VKW) needs to be based on the recognition of multiple values of the wetland ecosystem (intrinsic, instrumental, and relational) and their mainstreaming in development plans, programmes and investments at all levels. Management effectiveness is reflected in the ability to sustain multiple usages of the wetland, including traditional resource use practices, without undermining the critical ecological and social processes that underpin the VKW socio-ecological system. This requires realigning the emphasis of current management, primarily extractive in nature (in the form of tourism and agriculture), to a management which looks into a wider spectrum of objectives related to wetland hydrology, species and resource use systems. The commitment to the wise use of VKW requires that the capability of the wetland ecosystem to provide ecosystem services and sustain rich biota is maintained now and in future on pathways aligned with ecosystem approaches within the framework of sustainable development. With the unfolding impacts of climate change, it is also pertinent to factor in climate risks and incorporates risk reduction interventions in management response.

The current chapter sets out the management planning framework for VKW. It discusses the management goal and purpose, strategies, objectives, targets and indicators, and risks and risk-mitigation options on the management plan implementation.

5.1 Management Goal and Purpose

The goal of the management of Vembanad-Kol wetlands is to maintain the Ramsar site's ecological character in a healthy condition to enable the delivery of the wetland"s full range of ecosystem services and sustain biological diversity values.

The purpose of management is to:

- Provide a natural buffer to Kochi and its surroundings
- Provide livelihood opportunities through fisheries, inland waterways and tourism
- Provide habitat for wetland-dependent species, including species migrating in ecological corridors along the Central Asian Flyways
- Sustain cultural and relational linkages of people with Vembanad-Kol wetlands

5.2 Management Strategy

Wetlands as Nature-based solutions: As defined by UN Environment Assembly, nature-based solutions are described as"actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which addresses social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits" The climate change projections for coastal Kerala indicate increasing risks of floods, thus making the hydrological regime buffering capability of Vembanad-Kol a critical risk-reduction measure. The management plan thus posits conservation and wise use of VKW as a nature-based solution to address the challenges posed by climate change while also providing for human well-being through its diverse ecosystem services.

Creation of a dedicated institution for wetland management and inter-sectoral coordination: Integrated management of Vembanad-Kol requires a designated institution for coordinating the implementation of sectoral action plans, maintaining an overview of the status and trends of wetland and associated catchments, stakeholder engagement and representing the concerns related to wetlands in sectoral planning. Based on the review of existing institutional arrangements and national experiences, it is recommended to constitute a Vembanad-Kol Wetlands Management Unit (VKWMU) functioning under the aegis of SWAK as the nodal institution to ensure integrated management in collaboration with concerned state government agencies, Ministry of Environment Forests and Climate Change, research agencies, non-

government organisations, civil society organisation and local communities. An essential task of VKWMU will be to ensure a unified vision of wetland conservation and wise use in the sectoral plans, especially for agriculture, water resources, fisheries, rural development and climate change adaptation.

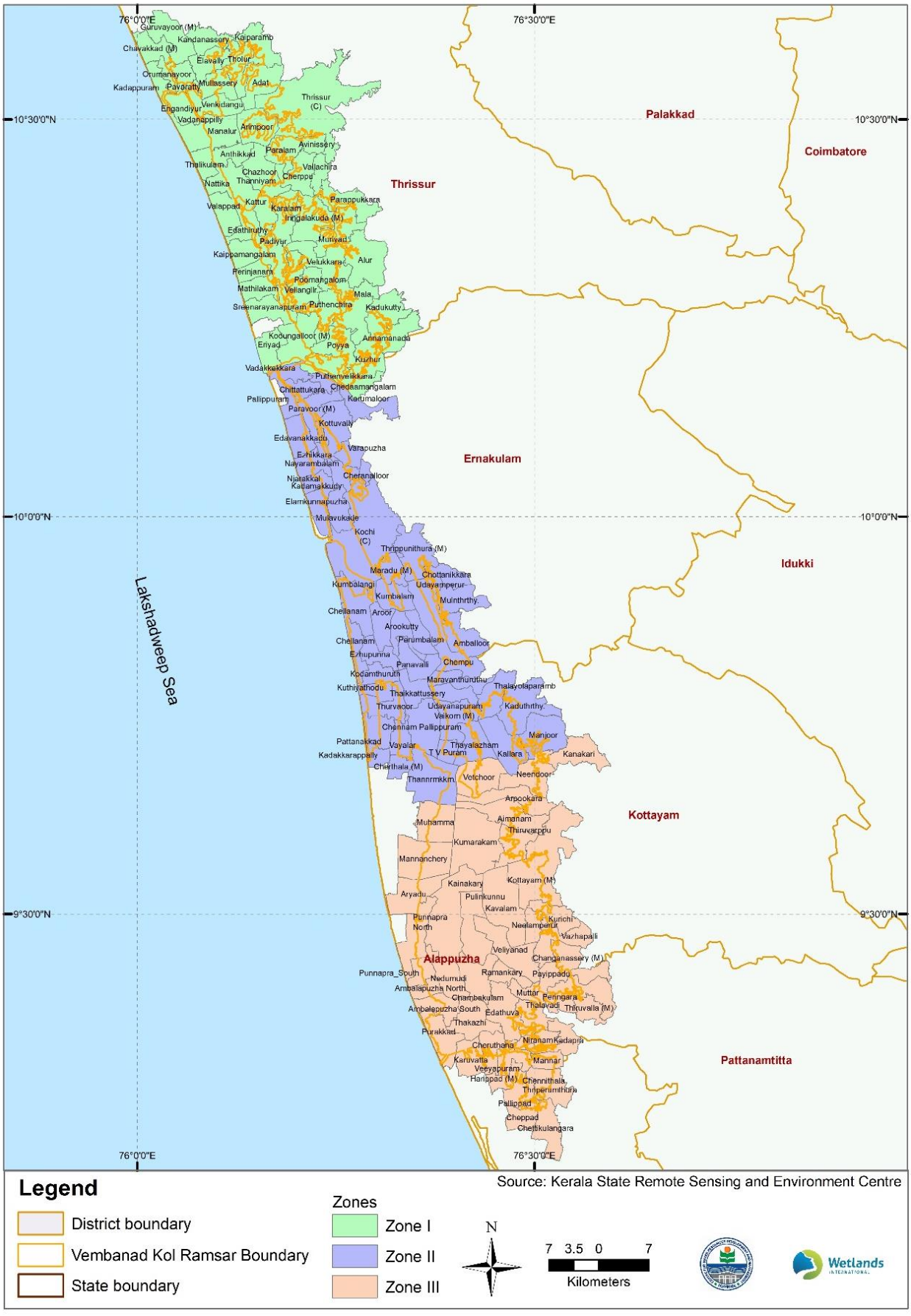
Management zoning for multiple ecosystem services: The three physiographic divisions of Vembanad-Kol, namely the Vembanad Estuary, Kuttanad and Kol lands, though interlinked and forming an integral part of the wetland complex, have specific ecosystem services and biological diversity characteristics. Vembanad Estuary, the predominant water-spread area where capture fisheries and clams are available, is a significant tourism focus and can be managed to achieve the wetland"s hydrological regime regulation functions. Kuttanad and Kol lands have been modified as production systems wherein rice paddies and aquaculture co-exist with high biological diversity, particularly waterbirds. Given the level of site complexity, a zoning strategy will be used for VKW wherein production values of Kuttanad and Kol are managed to avoid any adverse impacts on Vembanad Estuary, and the estuary managed to support ecological processes, for example, ensuring circulation and mixing, and species migration. Management of sites with high recorded species diversity as Pathiramanal Island, Mangalvanam Bird Sanctuary and Kumarakom, can be aligned with biodiversity conservation objectives of wetland management.

For management planning, the Vembanad-Kol wetland system has been divided into three zones – Zone I, Zone II and Zone III. Zone, I cover the freshwater-dominated Thrissur Kol floodplains and extend from the Chettuva estuary mouth to the Azhikode estuary. The super-saturated Piedmont alluvial soils, clay-dominated and comprising coarse clastic particles derived from the surrounding lateritic hills characterize these floodplains. Paddy cultivation is critical for sustaining these wetland systems. The brackish water-dominated system covering the Vembanad estuary extending from Munambam, Ernakulam to Thanneermukkom barrage constitutes Zone II. Zone III extends south of the Thanneermukkom barrage covering parts of the estuary south of Thanneermukkom Barrage and Kuttanad that are dominated by below-sea-level paddy wetlands. The Local Self Governments overlaying the respective zones are listed in the three management zones and corresponding local Self- Governments are indicated in the Map 24 with details in the Annex XIII.

Stakeholder-led wetland management that balances biodiversity conservation and livelihoods and is compatible with wetland regimes should be encouraged. Further, in the entire wetland catchment, land and water use needs to be influenced to ensure that the wetland retains its hydrological connectivity with the rivers and the sea and that the natural regimes of water spread and salinity are maintained.

Sustainability of backwater tourism: Backwater tourism has emerged as a hallmark of Kerala. The high concentration of tourism infrastructure in the Alappuzzha region (number of houseboats, tourist accommodations) and insufficient waste treatment facilities are significant threats to the ecological character of VKW. Tourism in VKW must be managed based on carrying capacity, and ecological and social safeguards are put in place to synergize4 the sector with conservation and wise use of the wetland complex.

Sustaining wetland agriculture: Rice paddies of Kutttanad and Kol have been developed to meet the food security needs of the State. However, there are several indications of ecological and social limits to the levels of production and productivity that can be achieved from the wetland ecosystem. These limits must be recognized in diversified planning and production strategies to ensure that management objectives of maintenance of ecological character are met in an ecologically and socially efficient manner. Farming systems compatible with wetland environments must be promoted in the two regions.



Map 24: Map showing Local Self Government bodies overlaying VKW Ramsar site

Multiple values of nature and nature's contribution to people: Management plan implementation will consider the diverse ways in which nature and nature's contribution to people support their well-being. These will include intrinsic values (the value of VKW as an ecosystem with its complex ecological functions), instrumental values (the values of VKW towards meeting food security, water quality regulation and climate moderation), and relational values (the values linked with a sense of place and cultural identity which communities attribute to VKW). The management plan will be built on the full range of values to bring multiple perspectives in the decision-making and implementation of programmes.

Focus on behaviour change: The management plan entails a shift from a high emphasis on wetland regulation to inducing positive behaviour within wetland communities and stakeholders, which are aligned with wise use. The VKWMU will use strategic communication to inform stakeholders on the role of VKW in their overall well-being and how these groups can engage in ensuring that the wetland continues to deliver its wide-ranging services. Information, education and communication tools, tailor-made to the needs of various stakeholder groups, would be proactively used to trigger behaviour change, along with building capacities and opportunities for participation in wetlands management.

Adaptive management: VKW, like several other wetland ecosystems, have an inherent uncertainty and unpredictability in their behaviour owing to complex and multi-scalar ecological, social and institutional interactions that shape their features and governing factors. There are several reasons, including:

- The environmental variation that is uncontrollable (such as increasing intensity and frequency of precipitation)
- Partial observability (as not all wetland features and factors can be monitored)
- Partial controllability of actions (as management interventions are implemented through several agencies)
- Structural uncertainty arising out of a lack of complete understanding of how the ecosystem functions

Given that the knowledge on the ecosystem is always likely to be incomplete, an adaptive management based on iterative learning, and using that learning to improve management using a goal-oriented and structured process shall be applied. Adaptive management will be enabled in the management of VKW by a combination of techniques, such as:

- Structured decision-making to clarify management goals, objectives and actions, involving stakeholders
- Investing into monitoring and learning for management. Each management intervention in reality, is an experiment based on a working hypothesis of ecosystem functioning. Monitoring enables assessment of whether the hypothesis works in reality (for example, whether changing sewage composition is leading to epidemiological concerns for the wetlands communities)
- Investing into cross-scale communication. Understanding change at multiple levels may help better understand ecosystem functioning and variability.
- Adaptive governance, based on collaborative and participatory management, has the flexibility of sharing management responsibilities. Successful adaptive governance requires leadership with a vision, systematic monitoring, complementary legislation framework which allows for adaptive management, information flow amongst stakeholders, and clear opportunities for stakeholders to collaborate.

5.3 Management Objectives and Performance Indicators

Objectives	Performance Indicators	Desired Outcomes
Land use and land cover of VKW is maintained in line with regulatory requirements under the Coastal Regulation Zone Notification and Wetlands (Conservation and Management) Rules	LULC with respect to 2002 baseline Number of violations of extant regulatory regimes	No illegal transformation of Land use land cover No instances of violations of extant regulatory regimes
Flood buffering capacity of VKW is maintained	Water holding capacity	Water holding capacity is restored to 2002 levels
Salinity gradient within VKW is maintained in line with ecological requirements of wetland dependent species and below sea level agriculture	Salinity in different parts of the wetland Poldarisation and density of linear infrastructure/fragmentation	Freshwater conditions in Kuttanad and Kol-lands Brackish conditions in Vembanad estuary and oligohaline conditions towards Kol and Kuttanad polders
Sewage quality and quantity received in the wetland is efficiently treated	Key water quality parameters BOD, COD, Salinity, Micro-plastic, (agri. contaminants), conc. of polyphenols	Desired levels are maintained as per Thresholds/Standards
Diversity of biota within VKW is maintained and enhanced	Species richness Population of migratory waterbirds Sighting of high conservation value such as Otters Key habitat areas are maintained (Clam beds, Mangrove areas)	No species extirpation Counts are maintained in the range of 20% deviation from average of last five years Preferred habitat is maintained Habitat quality and extent restored to Ramsar Site designation levels in 2002
Species invasion threat to fisheries and wetland agriculture is reduced	Occurrence of invasive species in wetlands and agriculture systems	Occurrence is reduced by at least 80% of the levels as of 2022
Wetland based agriculture systems in Kuttanad and Kol are sustained in line with ecological character of VKW	Area under wetland agriculture Reduction in use of chemical fertilisers and pesticides	Area of wetland agriculture as in 2022 is maintained At least 50% reduction in use of chemical fertilisers and pesticides against the levels of 2022
Livelihood vulnerability of wetland dependent communities is reduced	Resource productivity (fish-catch, Clam harvest, Rice-Shrimp production from Pokkali, Rice production from Kol-lands and Kuttanad. Instances of water-borne diseases Diversification of income sources of communities	Non-declining harvest (Fish, Clam) Reduce by at least 80% of 2022 Wetlands communities having income in lower 25% quantiles gain additional sources of income

Objectives	Performance Indicators	Desired Outcomes
Individual and collective capacity and opportunities for stakeholders to participate in wetlands management and contribute to wetlands wise uses is enhanced	Participation of wetland communities and community-based institutions in wetland management Evidences of affirmative behaviour change within communities living in and around VKW supporting wetlands wise use Evidences of community based collaborative actions for wise use of VKW	Community views, rights and capacities are integrated in management plan integration and monitoring Local action for preventing adverse land use change, encroachment, pollution abatement and over harvesting of biological resources
Systematic wetlands inventory, assessment and monitoring system is used to inform management decisions and assess effectiveness	Availability of time-series data on wetland ecological character Availability of data on threats leading to adverse change in ecological character Evidences of use of data generated from WIAMS in decision-making	Time series data on wetlands features is accessible on SWAK WIAMS web portal Data on trend in threats is accessible on SWAK WIAMS web portal Monitoring data is systematically analysed and presented in SWAK meetings and made available to decision makers and stakeholders
Integration of multiple values of wetlands in sectoral development plans, programmes and investments is enhanced	Number of sectoral plans, programmes and investments (which influence VKW) which take into account wetland values Reduction in number of sectoral plans, programmes and invest which adversely impact VKW ecological health	SWAK meets periodically to review sectoral plans, programmes and investments in terms of their implications for VKW and communicates to the respective departments SWAK establishes sectoral convergence benefitting VKM ecosystem Instances of conflict/s are reduced
Sustainable tourism practices aligned with wetland wise use principles are promoted	Number of houseboats with respect to carrying capacity of the VKW Environmentally sensitive behaviour of tourists, and tour operators Adherence to extant regulatory frameworks with respect to tourism and pollution abatement	Number of houseboats is limited to below carrying capacity of VKW All houseboats are fitted with adequate waste collection and disposable facility and access STP for treatment Tourists are sensitised on significance of the VKW and adhere to do's and don'ts

5.4 Risk and risk-mitigation options

The management plan design for the VKW is based on certain assumptions. The table below identifies the risks of these assumptions impacting management plan implementation adversely and possible risk reduction measures that are proposed to be deployed with the SWAK having the overall remit of implementing these actions.

Risks	Risk reduction measures
At goal level	
Limited participation of local self governments and community-based organisations in the conservation and management of VKW	A Community Advisory Group will be constituted to provide advice regarding management plan implementation and dissemination of information within communities. Most activities pertaining to livelihoods and resource management, stakeholder education and awareness will be implemented through the local self-governments.
At objective level	
Limited availability of trained human resources for the management of VKW	SWAK will put in place a technical team to coordinate management plan implementation. Periodic training of concerned line departments and agencies will be conducted and hand-holding support will be provided.
Absence of a long-term financial framework for conservation and wise use of VKW	Funding from various convergence sources will be leveraged, including from the private sector Organisations
Management is not adapted based on monitoring records	The wetland monitoring system will be made proactive and the monitoring data will be presented to the decision-makers at periodic intervals. Specific aspects requiring attention will be highlighted.
At Output level	
Absence of qualified trainers and experts for capacity development of line managers	A roster of experts and trainers will be prepared to support capacity development.
Absence of flexible strategies for adaptation	SWAK will present the progress of management plan implementation in the meetings. Monitoring data from monitoring (the WIAMS) will be analysed to assess the effectiveness of interventions.
Lack of robust monitoring mechanisms and scientific approach application in resolving conflicting issues	Wetlands Inventory, Assessment and Monitoring system (WIAMS) will be continued and used throughout the management plan implementation
Lack of capable NGOs available to assist community-based activities	SWAK will put in place a process of selecting and inducting NGOs/CBOs into management plan implementation

6. Monitoring Plan

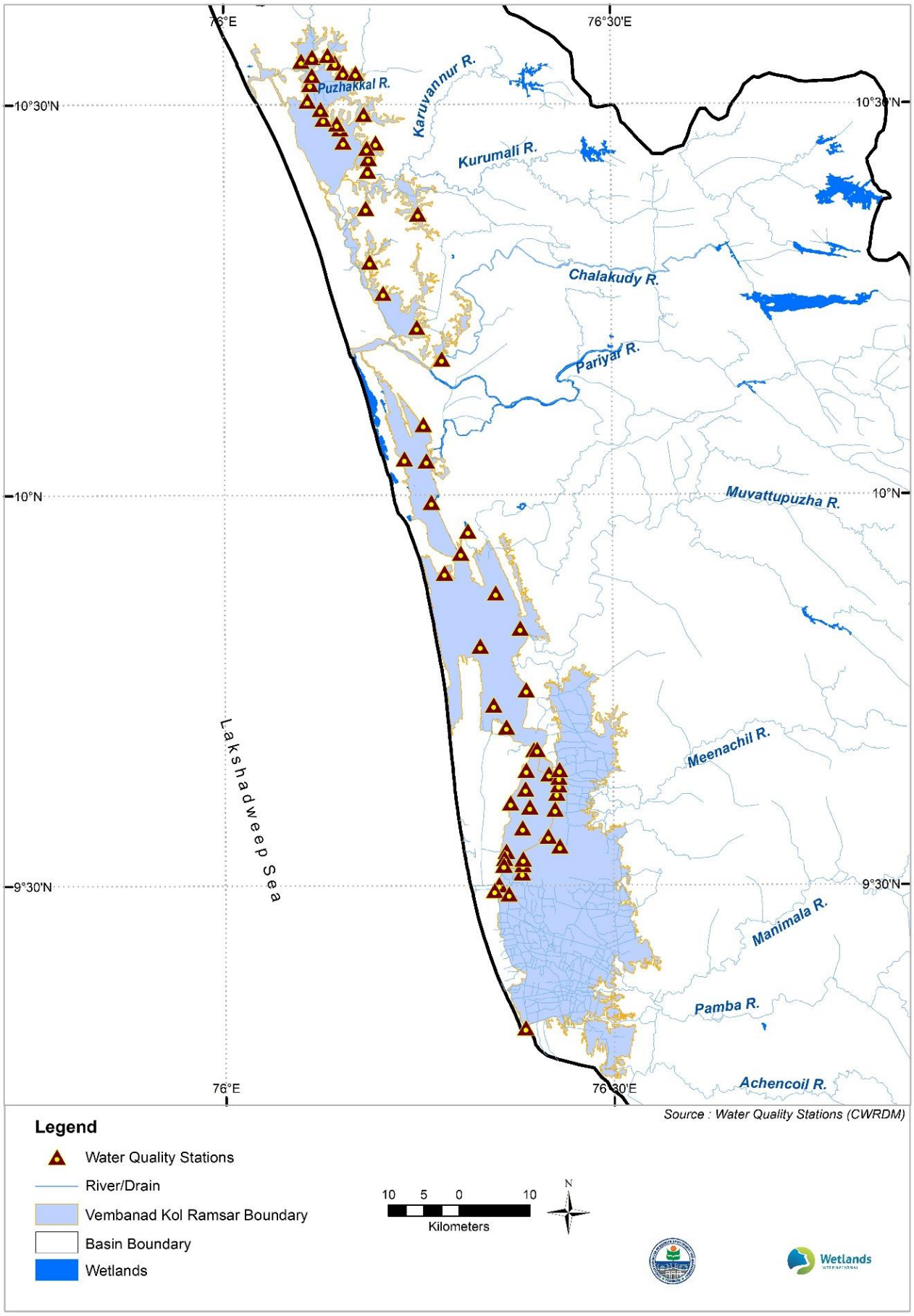
The management of Vembanad-Kol Wetlands Ramsar Site seeks to 'maintain its ecological character' and retain those essential ecological and hydrological functions that ultimately enable the wetland to provide its full range of provisioning, regulating, cultural ecosystem services and provide habitats to diverse life-forms. Therefore, a system to describe, monitor and detect changes in ecological character is critical to support decision-making for the wise use of VKW. Equally important is being able to assess management effectiveness from time to time in developing and implementing an integrated planning, management and evaluation system to secure wise use of this Ramsar Site.

As part of the implementation of the Centrally Sponsored Scheme-Implementation of the approved Management Action Plans (MAPs) of three Ramsar Sites of Kerala, work on establishing an Integrated Wetland Inventory, Assessment and Monitoring System (WIAMS) was initiated by CWRDM with SWAK support in 2021. Under the monitoring framework, 64 water quality stations have been established within Vembanad estuary for monitoring all major physico-chemical parameters since January 2021. Apart from that 29 stations in Kol lands have been established and are being periodically monitored by CWRDM under WIAMS (Map 25). These data are stored on a web portal (https://wiams.keltron.org). Besides these, the CWRDM also maintains long-term data on river inflows to Vembanad-Kol wetlands.

Agencies such as KSPCB, IDRB, ATREE-CERC are regularly conducting water quality monitoring in VKW. Some of the monitoring points maintained by different agencies are listed below.

- **Kerala State Pollution Control Board (KSPCB)** - Five points are measured by the Kerala State Pollution Control Board (KSPCB) under State/National Water Quality Monitoring Programme (NWMP) and eleven points under the Project of Backwater Resources in Alappuzha district. Seven drains flowing through Kochi city falling into Vembanad estuary, Oil Tanker Jetty, near Marine Drive, four other stations in Ernakulam district and seven stations in Kottayam are being monitored under the NWMP. (Details are given in Table 23).
- **ATREE CERC –** is doing participatory water quality monitoring stations under the Jaladarpanam programme at six locations
- **Nansen Environmental Research Centre** is running a Citizen Science Programme on mobile based water quality monitoring using TurbAqua application developed in collaboration with CMFRI and NIO
- **CUSAT and MG University** are monitoring water quality using remote sensing satellites

The Central Marine Fisheries Research Institute (CMFRI) monitors and performs stratified multistage random sampling methods to estimate marine fish landings at all major landing sites along Vembanad-Kol. CMFRI's effort to rejuvenate the black clam resource in the Vembanad Estuary has yielded results with fishermen harvesting good catch from the region. Kerala Engineering Research Institute (KERI) collects data and conducts regular field studies on coastal erosion in the region. Under the provisions of the Kerala Ground Water (Control and Regulation) Act, 1997, the Kerala Region office of the Central Ground Water Board (CGWB) monitors the demonstration of cost-effective techniques for the replenishment of groundwater in various hydrogeological settings within the catchment area of Vembanad-Kol.



Map 25: Water quality monitoring stations under WIAMS in Vembanad-Kol

Table 23: A list of some of the KSPCB monitoring stations

S.No.	KSPCB monitoring stations
1	Kidangoor 1339
2	Thekoy K29
3	Bharanganam
4	Punnamad finishing point
5	Pathiramanal
6	Downstream Thanneermukkom
7	Upstream Thanneermukkom
8	Thakazhy
9	Pulinkunnu
10	Boarding point
11	Chandiroor
12	Kayipuram
13	Oil tanker jetty

There is quite some data being generated on the different wetland features and their governing factors, yet, no attempt is made to systematically collate and analyse these in terms of established baselines and thresholds so that trends in ecological character could be discerned. The current chapter describes a monitoring system to support conservation and wise use of Vembanad-Kol wetlands. The chapter describes a monitoring strategy, an approach for assessing management effectiveness, infrastructure and human resource requirement, reporting and quality control systems, and review and adaption mechanisms. The cost implications of the monitoring plan have been factored in Chapter 7 (Management Planning Framework) and Chapter 8 (Budget).

6.1 Monitoring Objective

The Integrated Wetland Inventory, Assessment and Monitoring System (WIAMS) is required for VKW to address the overall information needs for wetland management and to provide a robust decision support system for the same. The ambit of monitoring is also envisaged to include an assessment of management effectiveness. The following are the specific objectives for establishing WIAMS:

- Developing up-to-date and scientifically valid information on the status and trends of features of VKW and their influencing factors
- Establishing a baseline for assessing change in wetland ecological character
- Informing decision-makers and stakeholders on the status and trends in biodiversity, ecological functioning and ecosystem services of the wetland
- Supporting compliance with national and state legal requirements and regulatory regimes
- Determining impacts of developmental projects on the wetland ecosystem
- Identifying existing and consequential risks to the ecological character and provide support to the development of response strategies and facilitate adaptive management to mitigate such risks
- Assessing effectiveness of management being applied for achieving conservation and wise use of VKW

6.2 Monitoring Strategy

The information needs for managing VKW pertain to the following:

- inventory–- to establish the ecological character baseline
- assessment – to verify status, trends and threats to wetland using inventory information
- monitoring – to assess changes in status and trends, including a reduction in existing threats or appearance of new threats, or even differences in management effectiveness

As this information pertains to various spatial scales, the overall information requirements can be classified following a hierarchy in line with the three identified information levels:

Level I – Ramsar Site ecological zones (Vembanad Estuary, Kuttanad, and Kol lands)

Level II – Vembanad-Kol Wetland Complex

Level III – Vembanad-Kol Basin and Coastal Zone

A hierarchical classification of inventory, assessment and monitoring needs for VKW is presented in Figure 22. The information needed for inventory are derived from the core datasets required to establish a baseline on ecological character[160] for VKW containing all essential ecosystem components, processes and services, as well as management-related parameters that characterise the site. At level I, information needs pertain to land use and land cover change, wetland indicators such as hydrophytic vegetation and inundation regime, and threats such as solid waste dumping, sewage disposal, untreated effluent discharge, unsustainable tourism, etc. At level II, the information requirement relates to wetland complex in its entirety focussing on processes such as fish migration, salinity regime development, coastal processes, sediment dynamics and others. At level III, the information required is related to geo-morphological and climatological setup and basin comprehensive management arrangements, particularly those related to land and water resources and urban planning. At all levels, information on institutional structures and management practices is included to create a baseline on sectoral programmes and the linked stakeholders likely to impact the wetland system. Besides the assessments mentioned as a part of this monitoring plan, specific strategic environmental assessments can be commissioned for any developmental project that is likely to harm the wetlands.

Information needs for monitoring VKW have been derived from the ecological character assessments carried out for the management plan"s development. Four clusters of requirements have been identified: a) land use and land cover change to assess the dynamics of land use within the catchment; b) hydrological regimes, to assess the flux of water, sediments and nutrients; c) ecological components and processes, to assess the biodiversity, habitat quality and resource productivity; and d) socioeconomics and livelihoods to assess the trends in ecosystem services – livelihoods interlinkages.

This monitoring information adequately addresses the needs of Coastal Regulation Zone Notification (2011), Kerala Conservation of Paddy Land and Wetland Act, 2008 and Wetlands (Conservation and Management) Rules, 2017, of the Ministry of Environment, Forests and Climate Change. A list of wetland features, indicators and corresponding methods and data collection frequency is provided as Table 24.

The monitoring and assessment needs are envisaged to be addressed by a dedicated monitoring programme and specific research and assessment projects. Inventory, based on collated

[160] Derived from the core inventory fields required for ecological character description as per Ramsar Convention Resolution X.15: Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance. These fields have been further integrated into guidance related to information requirement for describing Ramsar site at the time of designation and subsequent updates (Ramsar Convention Resolution XI.8 and XI.8 annex 1)

information on identified wetland features and management practices, will be developed based on the monitoring and assessment information and secondary sources.

Inventory, assessment and monitoring would form an integral part of wetland management and, thereby, the core activity of the proposed VKWMU. The management plan proposes establishing a dedicated wetland monitoring unit with adequate infrastructure support to deliver this function effectively.

Linkages also need to be developed so that data from the existing monitoring networks of different agencies (for example, inundation and flooding information from Central Water Commission and Irrigation Department; groundwater quality and quantity from Central Ground Water Board; select surface water quality parameters from Kerala State Pollution Control Board; and fish production from Central Marine Fisheries Research Institute - CMFRI) can be accessed and shared. Similarly, provision for participation of Wetland Mitra (NGOs and civil society organisations) in a monitoring programme has also been built, especially for socioeconomics and livelihoods aspects and biodiversity monitoring (for example, the waterbird census being implemented by NGOs under the aegis of Asian Waterbird Census). Thematic management needs-based research can be taken up by specialised agencies such as KFRI, ZSI, BSI, and other research organisations to complement the monitoring programme.

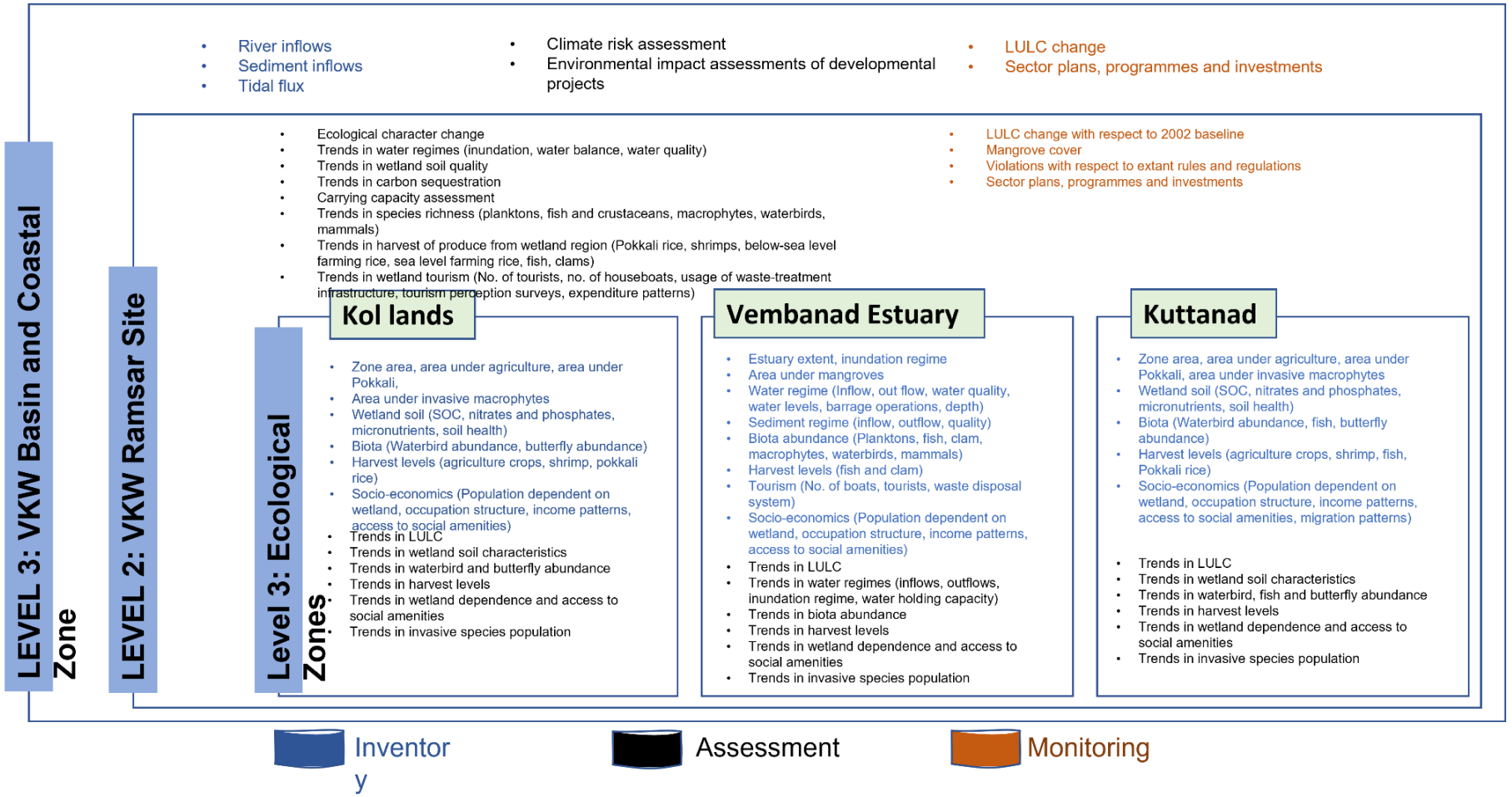


Figure 22: Inventory, assessment and monitoring needs for managing VKW

Table 24: Monitoring and assessment parameters and indicators

Parameter		Indicator	Priority	Monitoring Scale	Monitoring Method	Monitoring Frequency
Land Use and Land Cover						
	Land use and land cover change	% Area under various land use and land cover classes (agriculture, forest cover, aquatic vegetation, settlements, wetlands)	High	Ecological Zones (Kol lands, Vembanad Estuary, and Kuttanad)	GIS and Remote Sensing data	Annual
	Land use and land cover change	Do	High	VKW Ramsar Site		Biannual
	Land use and land cover change	Do	High	VKW Basin and Coastal Zone		Once in 5 years
Hydrological regimes						
Water and sediment flux		Water inflow	High	VKW Basin and Coastal Zone	Monitoring stations at gauging stations (36 stations monitored by CWRDM)	Daily
		Water outflow	High			Daily
		Sediment inflow	Medium			Annual
		Sediment outflow	Medium			Annual
Water holding capacity	Vembanad estuary	Bathymetry	High	Ecological Zones	Bathymetric surveys	Once in 5 years
Inundation Regime	Vembanad estuary, Kol lands, Kuttanad region	Seasonal fluctuation in water spread area	High	VKW Ramsar Site	Remote sensing supported with ground check	Seasonal
Surface water quality	Vembanad estuary, Kol lands, Kuttanad region	Temperature	Medium	VKW Ramsar Site	Standard procedures of APHA measured at 36 stations monitored under WIAMS and major effluent discharge points	Bi-monthly
		pH	High			Bi-monthly
		Dissolved Oxygen	High			Bi-monthly
		Specific Conductivity	High			Bi-monthly
		Nutrients and Nutrient Cycling (Nitrate, Phosphate, Silicate)	High			Bi-monthly
		Cations and Anions (Calcium, Magnesium, Sulphate, Chloride, Fluoride, Sulphite)	High			Bi-monthly
		Chemical Oxygen Demand	High			Bi-monthly
		Heavy metals (Arsenic, Mercury, Cadmium, Chromium, Lead)	High			Bi-monthly
		Biological oxygen demand	Medium		Do	Bi-monthly
		Total Coliform	High			Bi-monthly
		Faecal coliform	High			Bi-monthly
		Microplastics	High			Annual
Sewage water quality (from households)		All parameters listed above	Medium		Do	Annual
		Texture	Low			Annual

Parameter		Indicator	Priority	Monitoring Scale	Monitoring Method	Monitoring Frequency
Wetland soils/sediments	Vembanad estuary, Kol lands, Kuttanad region	pH	High	Ecological Zones	Standard procedures of APHA	Annual
		Organic carbon	High			Annual
		Available nitrogen	High			Annual
		Available phosphorus	High			Annual
		Available calcium carbonate	Medium			Annual
		Heavy metals (Arsenic, Mercury, Cadmium, Chromium, Lead)	High			Annual
Ground water	Vembanad-Kol wetland complex	Water level	High	VKW Ramsar Site	Methodology approved by Groundwater Estimation Committee (1997)	Seasonal (Summer, Monsoon, Post-monsoon, Winter)
		Conductivity	Medium			Annual
		Total hardness	Medium			Annual
		Chloride	Medium			Annual
		Fluoride	High			Annual
		Heavy metals	High			Annual
Water abstraction	Vembanad Kol wetland complex	Water abstracted for irrigation	Medium	VKW Ramsar Site	Survey	Annual
		Water abstracted for domestic use	Medium			
	Vembanad Kol basin	No. of hydrological structures	High	VKW Basin and Coastal Zone	Remote sensing and CWC data	Once in 5 years
		Water abstracted from hydrological structures	High			
Air quality	Vembanad Kol wetland complex	Suspended Particulate Matter (PM 2.5, PM 10)	High	VKW Ramsar Site	Standard procedures laid by CPCB for air quality monitoring	Daily
		Temperature and Relative Humidity	High			
Ecosystem processes and diversity						
Flora	Vembanad estuary, Kol lands, Kuttanad region	Phytoplankton (diversity and abundance)	Medium	Ecological Zones	Taxonomic studies, Standard procedures in Central Inland Fisheries Research Institute Bulletin No. 10	Seasonal
		Periphyton	Medium			Seasonal
		Macrophytes (diversity and abundance)	High			Seasonal
		Species invasion	High		Habitat Sampling and Remote sensing (using high resolution data)	Once in 2 years
		Primary production	High		Standard procedures in Central Inland Fisheries Research Institute Bulletin No. 10	Seasonal
		Zooplankton (diversity and abundance)	Medium	Ecological Zones	Taxonomic studies, Standard procedures in Central Inland	Seasonal

Parameter		Indicator	Priority	Monitoring Scale	Monitoring Method	Monitoring Frequency
					Fisheries Research Institute Bulletin No. 10	
Fauna	Level I - Vembanad estuary, Kol lands, Kuttanad region	Aquatic macro-invertebrates	Medium	Ecological Zones	Taxonomic studies, Standard procedures in Central Inland Fisheries Research Institute Bulletin No. 10	Seasonal
		Aquatic Insects	Medium	Ecological Zones	Taxonomic studies, Standard procedures in Central Inland Fisheries Research Institute Bulletin No. 10	Seasonal
		Fish diversity	High	Ecological Zones	Taxonomic studies	Once in 5 years
		Amphibians	High	Ecological Zones	Taxonomic studies	Once in 5 years
		Reptiles	High	Ecological Zones	Taxonomic studies	Once in 5 years
		Fish catch and effort (number of harvest cycles, catch)	High	Ecological Zones	Standard procedures in Central Inland Fisheries Research Institute Bulletin No. 10	Monthly
	Vembanad Kol wetland complex	Bioaccumulation in fish	High	VKW Ramsar Site	Environmental monitoring protocols of ICAR–- CIFRI	Annual
	Vembanad estuary, Kol lands, Kuttanad region	Water Bird population and diversity	High	Ecological Zones	Census and Taxonomic studies	Bi-monthly
		Avian disease	Medium		Surveillance	Annual
Socioeconomics and livelihoods						
Community dependence on wetland ecosystem services	Vembanad estuary, Kol lands, Kuttanad region	Fish catch	High	Ecological Zones	Socioeconomic survey	Monthly
		Performance of fish/clam collection cooperatives (Capitalization, infrastructure, catch processed, membership)	High			Annual
		% Contribution of fisheries and clam collection to income and employment	High			Bi-annual
		Number of tourists visiting wetland and direct and indirect spending	High			
Livelihood status of		Physical capital, financial capital, social	Medium			

Parameter		Indicator	Priority	Monitoring Scale	Monitoring Method	Monitoring Frequency
wetland dependent communities		capital, human capital indicators of livelihood systems				
		Number of reported instances of conflicts	Medium			
Institutions and governance						
Encroachment of wetland area	Vembanad estuary, Kol lands, Kuttanad region	Number of violations of extant regulation as the Kerala Conservation of Paddy lands and Wetlands Act 2008 and Wetlands (Conservation and Management) Rules, 2017	High	Ecological Zones	Mobile based surveillance system operated by LSG monitoring committees Drone mapping and other technologies for surveillance of land use change	Daily One in every six months
Sustainable tourism practices		Number of houseboats	High	Ecological Zones	Surveillance by designated government agencies	Annual
		Number of houseboats adhering to environmental norms as biotiolets, solid water disposal, STP treatment	High			Annual
		Number of violations	High			Annual
Sustainable fishing practices		Violations of extant regulation–- The Kerala Inland Fisheries and Aqua Culture Act 2010	Medium	Ecological Zones	Surveillance by designated government agencies	Annual
Sustainable agriculture practices		Adherence to crop calendars decided by multistakeholder group.	Medium	Ecological Zones	Surveillance by designated government agencies	Biannual
		Use of pesticides and fertilizers	Medium			Biannual

6.3 Assessing management effectiveness

VKW is a dynamic ecosystem, and so are its management needs. Management plans, which are developed based on assumptions known to managers, need to be periodically assessed to ensure the set goals and objectives are being achieved.

The effectiveness of management towards achieving the overarching objective of maintenance of ecological character can be greatly enhanced if the following questions are periodically reflected upon:

- What is the current status of the VKW?
- Is the management achieving the goal of maintenance of ecological character?
- What are the current and future threats?
- Are adequate resources available for implementing management, and if not, how can they be improved?
- Are management processes adequate, effective, and efficient?
- What other steps can be taken to improve the management?

The Contracting Parties to the Ramsar Convention adopted the R-METT (Ramsar Site Management Effectiveness Tracking Tool) to assist Ramsar site managers in assessing the effectiveness of management in achieving wetland-wise use outcomes. The assessment looks into the following aspects:

- **Context** of management (wetland ecological character, threats and risks of adverse change).
- **Management planning** that defines how the management goals and objectives have been defined.
- **Inputs** including human, technical and financial resources applied to implement management actions.
- **Process** of management plan implementation.
- **Outputs** (tangible and intangible) that result from the implementation of management actions.
- **Outcomes** concerning the objectives defined by the management plan

It is proposed that management effectiveness assessments for VKW is done at least once in five years, so that the management action plans are revised and updated to reflect the condition of the wetland as well as the management's ability to prevent adverse change in ecological character.

6.4 Infrastructure and human resources requirements

Implementing the monitoring strategy as outlined in the previous sections requires the following physical and human infrastructural support:

- Improving the remote Sensing and GIS unit with advanced capabilities of remote sensing image processing, preparation of maps and development and maintenance of spatial datasets
- Improvement of ecological monitoring laboratory with capabilities for analysis of chemical, physical and biological properties of water and soil
- Mobile-based citizen reporting system for recording and reporting illegal encroachments (like the Mobile App of WIAMS portal developed for the Wetland Mitra which is already in place)
- Database system for storing and retrieving monitoring and assessment data. The monitoring data would be stored along with metadata, as per the quality control procedures suggested in the following sections.
- Maintenance and enhancement of the network of hydro-meteorological and water quality stations for hydro-biological monitoring

It is envisaged that the WIAMS web portal and Mobile App will be continuously and operationally utilized by VKWMU working with specialised agencies such as CWRDM, KUFOS, CMFRI, and others. Need-based training programmes will also be conducted to upgrade skills of the concerned state government departments and agencies.

6.5 Reporting and Quality Control

Reporting constitutes an essential element of the wetland monitoring programme. The intended user group, format, style and peer review requirement need to be set in the initial phases of set up of the monitoring programme. Periodic reports, for example, as a part of the annual report of the proposed VKWMU should aim to provide a summary overview of the monitoring outcomes. Special publications, for example wetland atlases constituting thematic maps on various parameters, are intended to inform the stakeholders on wetland status and trends.

Outcomes of specific assessments, for example ecological character status and trends, economic valuation, environmental flows etc., could be made available in the form of technical report series, with an extended summary for a general readership. As the monitoring programs get sophisticated over time, real-time monitoring options through satellite-based data communication techniques will be explored.

Quality control in monitoring systems is required to ensure the scientific validity of sampling, laboratory analysis, data analysis and reporting. They also play a crucial role in preventing the introduction of random and systematic errors in data collection, analysis and reporting.

It is recommended that a Quality Management and Assurance Plan is developed for the monitoring programme. The plan should determine, *among other things*:

Specification of objectives for the sampling programme

Data quality objectives: maximum amount of uncertainty that can be tolerated to ensure that the data is fit for intended use

Sampling programme design: Statistical robustness of sampling frame; means to ensure that samples are representative of the environment; sample recording; procedures for minimising environmental impact

Documentation: Procedures for field sample record keeping and methods of documentation

Sample processing validity (especially for water quality and biological components)

Data quality control methods: processes for quality control samples, duplicates and replicates,

Performance audit procedures, including data and systems audit

6.6 Review and adaptation

A periodic review of the monitoring programme is required to determine the extent to which the objectives, mainly supporting the management, is achieved, and monitoring systems remain relevant for the wetland (particularly in the light of new and emerging threats). The review process should also aim at increasing the monitoring system's sophistication to assess complex landscape-scale processes affecting the ecological character of wetland and related management.

The review process should include documentation on how wetland inventory, assessment and monitoring information is used to support management planning and policy goals. The review should also include the identification of appropriate alternate resource flow mechanisms to ensure that wetland monitoring is continued in the event of a funding shortfall.

7. Action Plan

Activities to meet the twelve objectives are clustered under six components: Institutions and Governance, Water Management, Species and Habitat Conservation, Water Management, Community Fisheries Management, Sustainable Wetland Agriculture Interactions and Sustainable Wetland Tourism (Table 25).

Table 25: Management plan components

Component	Objectives
Component 1 – Institutions and Governance	Objective 1. Land use and land cover of VKW is maintained in line with regulatory requirements under Coastal Regulation Zone Notification and Wetlands (Conservation and Management) Rules, 2017. Objective 10. Systematic wetlands inventory, assessment and monitoring system is used to inform management decisions and assess effectiveness. Objective 11. Integration of multiple values of wetlands in sectoral development plans, programmes and investments is enhanced.
Component 2. Water management	Objective 2. Flood buffering capacity of VKW is maintained. Objective 3. Salinity gradient within VKW is maintained in line with ecological requirements of wetland dependent species and below sea agriculture. Objective 4. Sewage quality and quantity received in the wetland is efficiently treated.
Component 3. Species and Habitat Conservation	Objective 5. Diversity of biota within VKW is maintained and enhanced. Objective 6. Species invasion threat to fisheries and wetlands agriculture is reduced.
Component 4. Community based fisheries management	Objective 8. Livelihood vulnerability of wetland dependent communities is reduced. Objective 9. Individual and collective capacity and opportunities for stakeholders to participate in wetlands management and contribute to wetlands wise uses is enhanced.
Component 5. Sustainable wetlands agriculture interactions	Objective 7. Wetlands based agriculture systems in Kuttanad and Kol are sustained in line with ecological character of VKW. Objective 8. Livelihood vulnerability of wetlands dependent communities is reduced.
Component 6. Sustainable wetlands tourism	Objective 12. Sustainable tourism practices aligned with wetland wise use principles are adopted Objective 8. Livelihood vulnerability of wetlands dependent communities is reduced. Objective 9. Individual and collective capacity and opportunities for stakeholders to participate in wetlands management and contribute to wetlands wise uses is enhanced.

The action planning for Vembanad Kol wetland has been organised at two levels (1) Basin level activities and (2) Zone level activities. The activities are described below

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
7.1 Basin level Activities												
Component 1: Institutions and Governance												
1.1	Creation of Vembanad Kol Management Unit	VKWMU is proposed to be established as a nodal agency mandated for coordinating integrated management of VKW.										
			1.1.1		Government notifications	Necessary Government Orders for establishment of VKWMU and VKWAC will be issued. These orders shall specify the constitution, roles, and purpose of these bodies and their reporting mechanisms. Details on the proposed institutional arrangements are provided in Section 4.3 of the management plan.	Activity encompasses all the three zones				SWAK	
			1.1.2		Appointment of staff	Staffing and work allocation would be as per the structure suggested in Section 4.3 of Chapter 4. 5 divisions namely: Research, monitoring and Evaluation; Participation and networking; Communication and outreach; Legal and regulation; and General administration. The Executive Director / Chief Executive Officer, VKWMU is to be designated as the head of the unit, responsbile for implementation of the various work programmes of the organization.	Activity encompasses all the three zones				SWAK	
			1.1.3		Allocation of designated space	The VKWMU office will be created within the premises of proposed wetland interpretation center at Alappuzha	Activity encompasses all the three zones				SWAK	
			1.1.4		Annual planning	The Executive Director/ Chief Executive Officer of the VKWMU will prepare annual plans detailing the year-wise activities to be executed based on the approved IMP. These yearly plans will take into account the year-wise progress of the IMP implementation and address any delays and bottlenecks in the execution of the activities through adaptive planning after seeking suggestions and a review by VKWAC. SWAK will consider and approve the annual plans and budgets of the VKWMU after reviewing progress and monitoring of the actions.	Activity encompasses all the three zones				VKWMU	SWAK
			1.1.5		VKWAC meetings	The VKWAC will meet twice a year or more frequently if required to provide strategic guidance to the VKWMU. The SWAK on the advice of the VKWAC may constitute working groups or technical sub-committees for the implementation of certain activities of the IMP.	Activity encompasses all the three zones				VKWMU	SWAK
			1.1.6		VKWMU meetings	The Executive Director/ Chief Executive Officer shall convene meetings of the VKWMU at least twice a year to review the progress of implementation of the management plan, ensure coordination between implementing agencies and address emerging issues. All minutes will be made available on the SWAK portal.	Activity encompasses all the three zones				VKWMU	SWAK

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
1.2	Wetland boundary demarcation	The notified wetland boundary will be demarcated on ground using geotagged pillars, to be placed at intervals of 80-100 meters										
			1.2.1		Ground truthing survey	SWAK will commission field surveys led by the Department of Survey and Land Records wherein demarcation of the wetland extent using the existing Ramsar Site Boundary maps and land records. Coastal zone mapping done by National Centre for Earth Science Studies and the National Centre for Sustainable Coastal Management and surveys of the Directorate of Survey and Land Records will be appropriately referenced.	Activity encompasses all the three zones				VKWMU, SWAK	Department of Survey and Land records, Kerala State Remote Sensing and Environment Centre (KSREC)
			1.2.2		Placement of geotagged pillars	Concrete boundary pillars will be placed with appropriate numbering and detailing.	Activity encompasses all the three zones				VKWMU, SWAK	Revenue department, District Collectors
			1.2.3		Maintenance of pillars	Physical wear and tear and other damages will be repaired on needs basis	Activity encompasses all the three zones				VKWMU, SWAK	Revenue department, District Collectors
1.3	Wetlands Inventory, Assessment and Monitoring System	An integrated wetland inventory, assessment and monitoring system (already under implementation) will be operated as per the objectives and framework detailed in Chapter 6 of the management plan.										
			1.3.1		Establishment of zone-wise sub-centers	A state-of-the-art wetland monitoring and research centre at Alappuzha/Kumarakom - housed in the VKWMU and Ramsar Interpretation Centre - will be established for monitoring the ecological, hydrological and socio-economic features of VKW. Two sub centres will be established at Thrissur and at Kochi for specifically catering to the monitoring and research needs of the Kol wetlands and Vembanad estuary.	Thrissur	Kochi	Alappuzha (Punnamada Nehru Trophy Finishing point-DTPC)) /Kumarkom		VKWMU	CWRDM, KUFOS, CUSAT, MGU
			1.3.2		Development of database management system	The existing WIAMS database system (functioning as a web GIS portal) will be scaled up, made fully functional and accessible to the public and decision-makers. Activities will include: a) Development of data quality management and assurance plan including specification of data collection objectives, data quality objectives, sampling programme design, data and metadata documentation procedure, data quality control methods and performance audit procedures; and, b) Scaling up existing web GIS based database system to integrate modules for 3 zones connected with individual monitoring and research sub-centres.	Thrissur	Kochi	Alappuzha		VKWMU	CWRDM, KUFOS, CUSAT, MGU
			1.3.3		Ecosystem Health Report Cards	It is proposed to develop an Ecosystem Health Report Card for VKW, and publish biannually to assess and communicate wetland monitoring information to decision-makers and stakeholders. The health report card summarizes indicators along major indices (water quality, catchment status, biodiversity status) which represent various ecosystem features of the lake, and are reported against respective thresholds set in line with the management goals.	Activity encompasses all the three zones				VKWMU	All KPs
				1.3.3.1	*Convening a methodology workshop*						VKWMU	All KPs

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.3.3.2	*Generation of Ecosystem Health Report Card*						VKWMU	All KPs
				1.3.3.3	*Report card publication*						VKWMU	All KPs
				1.3.3.4	*Stakeholder dissemination workshop*						VKWMU	All KPs
			1.3.4		Establishments of Hydrological monitoring stations	The existing network of 64 stations (for monitoring physico-chemical and biological properties of water and sediments within Vembanad estuary) and 29 stations in Kol lands (Map 24) will be upgraded to support the monitoring of additional parameters as per the monitoring plan given in Chapter 6. Additional monitoring stations will be established in Kol and Kuttanad regions. Permanent tide gauge stations will be established at Munambam, Chettuva and Kayamkulam. River gauge stations will be established for all 10 rivers (and exisitng stations refurbished on needs basis). "A real-time water quality monitoring system significantly increases the efficiency and reliability of monitoring by reducing human error. This will allow for characterization and monitoring of the dynamic hydrological environment at appropriate temporal and spatial scales. It is proposed to place floating buoys at strategic locations in the VKW with mounted sensors to measure key parameters such as Salinity, Temperature, Conductivity, Dissolved Oxygen, pH, and Depth. The sensor would transmit the data on a real-time basis to the Wetland Monitoring and Research Center for further processing and analysis and linking to the WIAMS decision support system.	Activity encompasses all the three zones				CWRDM	SWAK, KSPCB, IDRB-Irrigation Department, Kerala Maritime Board, Survey of India-HSW
				1.3.4.1	*Stations to monitor water and sediment flux*					Basin wide	CWRDM	SWAK, KSPCB, IDRB-Irrigation Department, Kerala Maritime Board, Survey of India-HSW
				1.3.4.2	*Tide gauge stations*		Chettuva	Munambam,	Thottapally spillway, Kayamkulam		CWRDM	SWAK, KSPCB, IDRB-Irrigation Department, Kerala Maritime Board, Survey of India-HSW
				1.3.4.3	*River gauge stations*					Basin wide across ten rivers	CWRDM	SWAK, KSPCB, IDRB-Irrigation Department, Kerala Maritime Board, Survey of India-HSW
				1.3.4.4	*Water quality monitoring buoys*						CWRDM	SWAK, KSPCB, IDRB-Irrigation Department
			1.3.5		Establishment of laboratory facilities	An integrated wetland monitoring laboratory is proposed to be established at Alapuzza within the Wetland Interpretation Center, under the management of VKWMU. Two satellite centers will also be established at Kochi and Thrissur to address in-situ monitoring of Vembanad, Kuttanad and Kol regions.	Activity encompasses all the three zones				VKWMU	CWRDM, KUFOS, CUSAT, MGU

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			1.3.6		Wetland monitoring	Parameters for monitoring landuse and landcover, hydrological regimes, ecosystem processes, biological diversity, socio-economics and livelihoods and Institutions and governance as specified in Chapter 6 will be monitored. Annual monitoring reports will be prepared by the wetland monitoring and research centre division of VKWMU and presented at the Executive Committee meetings.	Activity encompasses all the three zones				VKWMU	All KPs
			1.3.7		Consultation workshop for harmonizing water quality monitoring	A consultation workshop involving KSPCB, ATREE CERC, CWRDM, Nansen Environmental Research Center, CUSAT, MG University will be convened to discuss harmonization of water quality monitoring and integration with WIAMS so as to avoid duplication of efforts and standardize collection, analysis and reporting.	Activity encompasses all the three zones				VKWMU	All KPs
			1.3.7		Specific studies	Specific research studies are proposed to be commissioned to support wetland management. The studies will be coordinated by VKWMU. The specific terms of reference will be approved by the VKWAC, and prepared in consultation with subject matter experts. For each study, workshops at inception, mid-term, draft final and conclusion will be held, with stakeholders. The study outcomes will be placed on the SWAK website. To assess the risk of climate change to wetland ecological character, project scenarios for wetlands and identify mitigation and adaptation strategies to respond to adverse changes. To assess the intrinsic, instrumental and relational values of VKW, and the ways in which these values can be orientated towards behaviour change for wetland-wise use. To assess the chain of heavy metal contamination in VKW, quantity of toxic metals accumulating in fish, vegetables and crops cultivated in VKW and identify possible remedial measures. The study is to be carried separately for the three zones. To identify the extent of plastic pollution in VKW, pollution sources and risk of adverse change in VKW. The study will recommend response strategy and actions to reduce plastic pollution in VKW. For zone 3 the study will include quantification of load of microplastic, mesoplastic and macroplastics in the water column and sediments. To assess the role of VKW in sequestering carbon and GHG flux, and so as to integrate the role of these wetlands in climate change mitigation strategies and actions. To determine the optimal number of house boats that can be operated in VKW without creating a risk of adverse change to the wetland. The recommendation will inform the Department of	Activity encompasses all the three zones					
				1.3.7.1	*Climate risk assessments (including land ocean interactions to inform flood management strategies)*						CWRDM	ICCS

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.3.7.2	*Multiple value assessments*						CWRDM	WISA
				1.3.7.3	*Bioaccumulation studies of fish and crops including emerging pollutants*						KUFOS	CUSAT, MGU
				1.3.7.4	*Macro, meso and microplastic risk assessments*						KUFOS	CUSAT, MGU
				1.3.7.5	*Carbon sequestration and GHG flux assessments*						CWRDM	
				1.3.7.6	*Carrying capacity assessment for the wetland for tourism operations*						VKWMU	CWRDM/KTDC/KITTS, DTPC, Expert Agency
				1.3.7.7	*Trophic level interaction assessment*						VKWMU	KUFOS
				1.3.7.8	*Morpho-dynamics of coastal areas*						VKWMU,Commissioned agency	Irrigation Department, CWRDM, KUFOS, Fisheries Department,
				1.3.7.9	*Influence of river plumes on coastal upwelling dynamics*		-	-	Thottapally spliiway mouth		SWAK, VKWMU	KUFOS
				1.3.7.10	*Hydrodynamic study of Thotapally spillway and leading channel*		-	-	Thottapally spliiway mouth		SWAK, VKWMU	CWRDM, KUFOS, Hydrographic Survey Wing(HSW), Irrigation Dept.
				1.3.7.11	*Pilot study on possibility of converting fallow lands around rivers in catchment area into water retention dams*		-	Zone II river basins	-		VKWMU	Department of soil Survey and soil conservation, CWRDM
				1.3.7.12	*Invasion pathways for invasive fish species (Nile Tilapia, African catfish)*						VKWMU	KUFOS, ATREE
1.4	Communication Education Participation and Awareness (CEPA)	Stakeholder engagement in wetland management will be promoted by creating awareness of biodiversity and ecosystem services values, and creating opportunties for participation.										
			1.4.1		Ramsar Signages - Installation and periodical maintenance	Signage indicating VKW as a Ramsar Site as per Ramsar Guidelines, and general dos and don'ts in the Ramsar Site will be placed at all major entry points.	Activity encompasses all the three zones				VKWMU	All KPs
			1.4.2		WIAMS Web Portal and Mobile App maintenance	The WIAMS web portal and mobile app developed will be periodically updated with information, datasets and communication products. The website on WIAMS https://wiams.kerala.gov.in serves as an important interface for VKWMU, SWAK, Government of Kerala and general public on issues related to conservation of VKW. It will be made accessible to all relevant stakeholders and information seekers.	Activity encompasses all the three zones				SWAK	All KPs
			1.4.3		Community mobilisation and proactive stakeholder engagement	It is proposed to constitute formal Community Advisory Groups for each wetland zone – Zone I, Zone II and Zone III with representatives from each Grama Panchayats and Municipalities falling within respective zones, Wetland Mitras, members of academia, CSOs, CBOs, VKWMU, and relevant line departments.	Activity encompasses all the three zones					

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
						A formal structure of this group will be worked out by the VKWMU. The Community Advisory Group will be encouraged to appoint community wardens to work as a para-network of wetland monitoring group. The community wardens will be responsible for collecting information on various aspects of wetlands features, and through the WIAMS Mobile App, transmit the same to the VKWMU. The community wardens will also be engaged in the awareness and outreach programmes. Community Advisory Groups with the help of Community Wardens and as per VKWMU advice, will coordinate targeted stakeholder education, awareness, and behaviour change campaigns to motivate affirmative actions for wetlands conservation and protection. Specific campaigns will be held to a) Identify and popularise cultural identity and run community campaigns relating the icon to wetlands conservation and sustainable management; b) Promote sustainable resource use; and, c) Encourage gender-balanced representation and involvement in wetland conservation activities. The campaign will be designed by hiring an expert agency to identify key messages, target audience and communication objective, dissemination action (print media, electronic media, direct media) and key performance indicators.						
				1.4.3.1	*Establishment of community Advisory Groups for each wetland zone*						VKWMU	All KPs
				1.4.3.2	*Annual meetings*						VKWMU	All KPs
				1.4.3.3	*Community campaigns*						VKWMU	All KPs
			1.4.4		Resource materials	Resource materials on following themes are proposed to be published: • Vembanad-Kol Wetlands Ramsar Site • Environmental monitoring system in VKW • Citizen participation in wetlands management • Biological diversity of VKW • Emerging threats to agricultural activities in VKW	Activity encompasses all the three zones				VKWMU	All KPs
			1.4.5		Newsletter	A biannual newsletter highlighting progress made in management plan implementation and key emerging issues related to VKW is proposed to be published in English and Malayalam, and disseminated to all stakeholders.	Activity encompasses all the three zones				VKWMU	All KPs
			1.4.6		Workshops and public events	Public events are proposed to be organized on the eve of World Wetlands Day (Feb 2), World Environment Day (June 5) and International Day for Biological Diversity (May 22) as a means of reaching out to public on the issues of wetland conservation and wise use. Public events on specific issues, such as pollution control or water management are also proposed to be organized as a means of engaging with stakeholders.	Activity encompasses all the three zones				VKWMU	All KPs

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
1.5	Capacity development	To support integrated management of VKW, the human capacity of VKWMU, concerned line departments and local communities and LSG's will be enhanced by conducting targeted training workshops and follow-up hand-holding support.										
			1.5.1		Training workshops for VKWMU	The capacities of VKWMU will be enhanced through professional training workshops on themes such as integrated wetlands management, wetlands inventory assessment and monitoring, land use planning for multiple wetlands use, wetlands and climate change mitigation and adaptation, integrating wetlands wise use in developmental planning and other training needs as identified through capacity needs assessments.	Activity encompasses all the three zones					
				1.5.1.1	*Capacity and training needs assessment workshop*						VKWMU	All KPs
				1.5.1.2	*Preparation of training calendar as per identified capacity and training needs*						VKWMU	All KPs
				1.5.1.3	*Engagement of Capacity Development Agencies/ knowledge partners for developing training content and Pedagogy*						VKWMU	All KPs
				1.5.1.4	*Training*						VKWMU	All KPs
			1.5.2		Training of local communities and LSGs	The local communities and LSGs would be trained on regulatory aspects of wetlands management, and sustainable resource use practices.	Activity encompasses all the three zones					
				1.5.2.1	*Engagement of Capacity Development Agencies/ knowledge partners for developing training content and Pedagogy*						VKWMU	All KPs & LSGs
				1.5.2.2	*Training on extant wetland management rules and regulations*						VKWMU	All KPs & LSGs
				1.5.2.3	*Training on ecosystem-based wetland management*						VKWMU	All KPs & LSGs
				1.5.2.4	*Trainings on creation of Peoples Biodiversity Register and community level wetland monitoring*						VKWMU	All KPs, LSGs, KSBB
1.6	Management Effectiveness Tracking	The Management Effectiveness Tracking Tool shall be applied to derive management effectiveness scores every two years. The trends in these scores will be an input to VKMU and SWAK in assessing the effectiveness of management. The assessment protocol as prescribed in the 'Management Effectiveness Tracking Tool for Indian Wetlands: A Practitioners Guide' will be used for the purpose. (https://indianwetlands.in/wp-content/uploads/library/1707134041.pdf) Prior to the assessment, a meeting of all concerned agencies involved in management plan implementation will be convened to apprise them on the assessment objectives, expected outcomes and methods. The assesssment format would be filled up in a workshop settings. A synthesis report on METT assessment findings will be prepared and presented in the meeting of VKMU and SWAK. Necessary course correction for management plan implementation will be identified and incorporated in management plan implementation.					Activity encompasses all the three zones					
				1.6.1.1	*Orientation workshop*						VKWMU	WISA and other KPs

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.6.1.2	*METT assessment*						VKWMU	WISA and other KPs
				1.6.1.3	*METT synthesis and reporting*						VKWMU	WISA and other KPs
1.7	Review and Adaptation	A mid-term and end-term review of management plan implementation is proposed to assess the extent to which stipulated objectives have been achieved with a high degree of resource efficiency and participation with stakeholders. Wetlands International South Asia (WISA) - a Knowledge Partner of MoEFCC shall carry out the evaluation, specifically looking at the following elements: a) Degree to which wetland ecological character is being maintained as a result of management being applied; b) Implementation quality, timeliness, and resourcing of activities; c) Quality and comprehensiveness of wetlands monitoring; d) Effectiveness of management being applied, in terms of design, activities, outcomes and impacts; e) Quality of stakeholder engagement in implementation of various activities and discharging wetland management functions, and f) Changes in external environment, requiring adaptation in management plan.				Activity encompasses all the three zones					
				1.7.1.1	*Mid-term review*						SWAK, VKWMU	WISA and other KPs
				1.7.1.2	*End term review*						SWAK, VKWMU	WISA and other KPs
Component 2: Catchment conservation and management												
2.1	Development of catchment management plan	The ongoing catchment conservation programmes within the catchment of VKW will be continued.				Activity encompasses all the three zones					VKWMU	CWRDM, WISA & Catchment Conservation Committees
				2.1.1	*Development of catchment treatment plan*						VKWMU	CWRDM, WISA & Catchment Conservation Committees
				2.1.1.2	*Appointment of expert agencies*						VKWMU	CWRDM, WISA & Catchment Conservation Committees
				2.1.1.3	*Development of catchment treatment plan*						VKWMU	CWRDM, WISA & CCCs
				2.1.1.4	*Consultations and finalisation of the catchment treatment plan*						VKWMU	CWRDM, WISA & CCCs
2.2	Constitution of watershed management committees in the target micro-watersheds	In certain parts of the VKW catchment, watershed committees were constituted. Such committees will be constituted where this is yet to be completed. These actvities will be undertaken under convergence with the ongoing Forestry Sector Schemes of the Forest Department.				Activity encompasses all the three zones						
2.3	Implementation of catchment management measures	Biological and small scale engineering measures as recommended by the catchment management plan will be implemented.				Activity encompasses all the three zones						
				2.3.1.1	*Biological measures*						Department of soil Survey and soil conservation, VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				2.3.1.2	*Small scale engineering measures*						Department of soil Survey and soil conservation, VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS
				2.3.1.3	*Monitoring, review and adaptation*						Department of soil Survey and soil conservation, VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS
7.2 Zone Level Activities												
Component 1. Water management												
1.1	Preparation of zone level integrated water management strategy document	This activity will include an estimation of the water balance within each of the 3 zones, an assessment of water use for human and ecological purposes, trade-offs and preparation of zone-specific water management strategies. These strategies will support the integration of wetlands within river basin and coastal zone scale water management planning under Rebuild Kerala Initiative.					Activity encompasses all the three zones					
			1.1.1		Zone-wise water balance estimation	Survey, estimation and monitoring of the natural bathymetric profile of the Vembanad estuary, Kol wetlands and Kuttanad region including inlets and outlets and identification of areas that are highly silted is proposed as an activity. Detailed survey using echo sounders will be commissioned for the Vembanad estuary and adjoining Kuttanad and Kol areas in a phased manner. GIS tools will be employed wherever a bathymetric survey is not possible. Existing bathymetric studies for the southern and central sectors of the Vembanad estuary will be used to suitably inform this assessment. A workshop with concerned line departments and expert agencies will convened by SWAK to finalise the assessment terms of reference. The Hydrographic Survey Wing, Government of Kerala and other relevant line departments will be engaged in undertaking a comprehensive survey of the entire Vembanad estuary and all inlets and outlets on high priority. A long-term water balance (based on at least 30 years of hydrological information, and incorporating inland as well as marine flows), and spatial and temporal trends in freshwater and brackish water contribution will be developed. The sub-activities are: a) Submission of a draft report to the VKWMU detailing the depth profile and carrying capacity of the Vembanad-Kol wetlands, the Base Floor Depth of Vembanad to be maintained and the quantum of sediment to be removed and advice on sediment disposal.	Activity encompasses all the three zones					

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.1.1.1	*Terms of reference workshop*						SWAK	Kerala State Planning Board, Irrigation Department, CWRDM, SDMA, Agriculture Department, KLDC, KUFOS, HSW
				1.1.1.2	*Engagement of expert agency*						SWAK and Irrigation Department	Kerala State Planning Board,SDMA, Agriculture Department, KUFOS, Other agencies, KLDC
				1.1.1.3	*Survey and water balance assessments*						VKWMU, SWAK	Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, HSW
				1.1.1.4	*Draft report consultations*						Commissioned agency	SWAK, Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, CWRDM, Other agencies
				1.1.1.5	*Assessment report finalisation and publication*						SWAK	Kerala State Planning Board, CWRDM, Irrigation Department, SDMA, Agriculture Department, KUFOS, Other agencies, KLDC
			1.1.2		Formulation of comprehensive zone wise water management strategies	Post 2018 flood recovery approaches have emphasized the need for holistic management of water resources based on the IWRM approach. The State government is in advanced stages of notifying a Kerala River Basin Conservation and Management Authority (KRBCMA). Preparation of basin-wide master plans linking upstream, and downstream zones have been prioritised. The activity aims at bringing together all stakeholders to develop and formulate an agreed-upon set of policies and strategies to harmonise land, water and natural resource management within the respective zones. Preparation of zone-wise water management strategies will be based on systematic analysis of data on water availability, uses, management practices, trade-offs and risks and risk reduction measures. This activity is proposed in the third year of the management plan.	Activity encompasses all the three zones					
				1.1.2.1	*Consultation workshops*						SWAK, Irrigation department	Kerala State Planning Board, CWRDM, SDMA, Agriculture Department, KUFOS, CWRDM, Other agencies

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.1.2.2	*Preparation of draft strategy documents*						SWAK, Irrigation department	CWRDM, KUFOS
				1.1.2.3	*Review, finalisation and approval*						Kerala State Planning Board, Irrigation Department (and proposed Authority constituted under Kerala River Basin Conservation and Management Authority Bill)	SWAK, CWRDM, KUFOS
1.2	Rejuvenating hydrological regime connectivity	This activity includes unclogging and removal of encroachments across rivers, canals and waterways to enhance hydrological connectivity between Vembanad Estuary, Kuttunad and Kol lands so as to reduce flooding risks.					Activity encompasses all the three zones					
			1.2.1		Unclogging and removal of encroachments along river stretches	A critical need is to enhance the discharge volume of the rivers and canals, for which an assessment of the current discharge volumes is needed. Declogging will be done with utmost care as the river beds are presently in the initial stages of natural recovery after the 2018 floods. This task will be specifically implemented in river stretches with observed clogging and where there is a need for widening and not deepening of the riverbeds. The activity will be dovetailed with the ongoing River Desiltation programme in the 41 rivers within the state carried out by the Irrigation Department with the support from the Kerala State Disaster Management Authority, Revenue Department, and the Local Self-Governments. It is proposed to commission bathymetric survey of the tidal rivers and canals wherever there is a perceived need and a possibility to do so. The HSW along with KUFOS under the guidance of SWAK and the proposed Kerala River Basin Conservation and Management Authority can be engaged for the activity. A detailed plan on desiltation works at river mouths, declogging along rivers, desiltation of canals and other major inlets and outlets of estuary will be prepared by a technical committee accompanied by required Environment Impact Assessments under the supervision of SWAK and KRBCMA. This will be aligned with and supplement the desiltation works in the Vembanad Estuary.	Activity encompasses all the three zones					

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.2.1.1	*Survey and identification of encroached rivers stretches*						LSGs, Irrigation Department	Irrigation Department, Agriculture Department and Padasekhram Committees, PWD, SDMA, SWAK, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)
				1.2.1.2	*Removal of encroachments*						Irrigation Department	LSGs, KRBCMA
				1.2.1.3	*Bathymetric survey of tidal rivers and canals*						SWAK, VKWMU	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)
				1.2.1.4	*Preparation of detailed plan on declogging works*						SWAK, VKWMU, Irrigation Department, KRBCMA	Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), KUFOS
				1.2.1.5	*Comprehensive EIA study of the proposed works*						Irrigation Department	SWAK, Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.2.1.6	*Implementation of declogging works*						Irrigation Department	SWAK, Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)
			1.2.2		Desiltation and removal of encroachments along canals and waterways		Activity encompasses all the three zones					
				1.2.2.1	*Surveys to identify blocked canals and waterways*						LSGs, Irrigation Department, SWAK	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence) Local Community Based Organisations, Padasekhram Committees,
				1.2.2.2	*Removal of blockage and encroachments*						Irrigation Department	LSGs, Local Community Based Organisations, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA
				1.2.2.3	*Implementation of canal desiltation works*						SWAK, Irrigation Department,	LSGs, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA, Local CBOs
			1.2.3		Renovation of Panchayat ponds	Rejuvenation of silted panchayat ponds is suggested as a measure to serve domestic water needs and to enhance the flood buffering capacity of the landscape. Around 100 ponds in Zone I, 50 in Zone II around Vembanad estuary and 100 ponds in Zone III have been proposed. Pond bunds will be strengthened with Vetiver grass and geo-textiles where needed.	Activity encompasses all the three zones					
				1.2.3.1	*Identification of silted ponds*						VKWMU	LSGs, Irrigation Department, Agriculture department,
				1.2.3.2	*Implementation of desiltation plan*						VKWMU, Irrigation Department	LSGs, Padasekhram Samithi
				1.2.3.3	*Strengthening of bunds around ponds*						VKWMU, KFRI	LSGs, Padasekhram Samithi

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			1.2.4		Maintenance of estuaries, spillways and estuary outlets	Estuary mouths viz. Chettuva in Zone I, Cochin barmouth, Kodungallur-Azhikode estuary, Munambam barmouth, Andhakaranzhi mouth in Zone II and Thottappally spillway in Zone III require regular dredging and maintenance works. Zone wise strategies for Integrated Water Management in VKW will inform and guide the dredging actions that are carried out by the Harbour Engineering Department, Kerala Maritime Board and Irrigation Department.						
				1.2.4.1	*Maintenance of estuary mouths, spillways, ports and fishing harbours*		Chettuva harbour and channel	Cochin port and estuary; Kodungallur-Azhikode estuary and Munambam fishing harbour; Chellanam I and II fishing harbour	Thottapally spillway and fishing harbour, Andhakaranazhi outlet		Kerala State Maritime Board, Harbour Engineering Department,	Harbour Engineering Department, Irrigation Department, CWRDM, KUFOS, Fisheries Department- KSCADC,
				1.2.4.2	*Study of environmental impacts of exisiting brerakwaters at Chettuva*		Chettuva Barmouth	-	-		VKWMU,Commissioned agency	Harbour Engineering Department, Irrigation Department, CWRDM, KUFOS, Fisheries Department-KSCADC
				1.2.4.4	*DPR preparation and implementation of desiltation works in Vembanad estuary using traiditional methods*		-	Vembanad estuary	-		VKWMU	LSGs, KUFOS, HSW, CWRDM, Fisheries Department-KSCADC, Irrigation Department
			1.2.5		Improving efficiency of Thottapally spillway to its designed capacity	Different studies made by expert agencies like CWC , IIT Madras and CWRDM have pointed out the need to undertake different measures to improve the efficiency of the Thottapally spillway. Suggestions made by KUFOS include measures for lowering the sill height of the Thottapally spillway to 4 m below the Mean Sea Level from 2.03 m below the Mean Sea Level at present. Stakeholder consultations will be held to review options for reengineering of the Thottappally spillway in order to restore natural settings around the Barmouth and for efficient discharge of floodwaters including (1) Widening of approach channel to Thottapally; (2) Removal of Breakwaters (3) Construction of two bypass channels (4) Relocation of spillway (5) lowering of sill height and (6) other measures. The consultations will be followed by DPR preparation and implementation of engineering works	-	-	Thotappally spillway		Irrigation Department	SWAK, VKWMU, CWRDM, KUFOS, Hydrographic Survey Wing(HSW), Agriculture Department, Kuttanad Development Coordination Council

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
						Improving the efficiency of the Thottappally spillway to its designed capacity will involve: a) electrification of shutters, b) maintenance of spillway structures, embedded parts and shutter groves.						
				1.2.5.1	*Stakeholder Consultation workshops to review options for reengineering of Thottappally spillway*							
1.3	Enhancing flows and connectivity											
			1.3.1		Construction, repair and modification of culverts & bridges	In Zone I major construction and repair work on culverts and bridges is being carried out by KLDC under TCR Ponnani Kole Phase IV five-year project from 2022 onwards. This will continue till 2024. This includes work on 308 culverts, 14 sluices, and 238 ramps. SWAK can, with the support of expert agencies, guide and recommend the planning and design of the structures that are amenable to wetland regimes in all the three zones. VKWMU will organise meetings with Public Works Department, LSGs, Irrigation Department officials and conduct detailed survey of existing culverts and bridges to detect blockage and repairs and assess new construction needs and suggest designs.	Activity encompasses all the three zones					
				1.3.1.1	*Implementation of ongoing works*						KLDC, Irrigation department, VKWMU	SWAK, Agriculture Department, KUFOS, KAU
				1.3.1.2	*Detailed survey of existing culverts and bridges*						VKWMU, Irrigation Department	SWAK, Agriculture Department, KUFOS, KAU, Other agencies
				1.3.1.3	*DPR preparation for work on new culverts, bridges and regulators in all three zones*						VKWMU, Irrigation Department	ADAK-Fisheries Department
				1.3.1.4	*DPR implementation, monitoring and review*						Irrigation Department	VKWMU, Agriculture Department, LSGs, PWD, Other agencies

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			1.3.2		Removal of invasive macrophytes (water hyacinth) from canals	Growth of invasive macrophytes to be managed by either manual or mechanical removal to improve hydrological connectivity, check eutrophication and increase fish breeding areas. Control of the spread of invasive macrophytes such as water hyacinth can also be done through meshing of inlets wherever possible. The respective Local Self Governments as suggested in the action plan will undertake the activity of identification and removal of water hyacinth manually in the first, third and fifth year of implementation. In Zone II, this includes areas such as Pallipuram, Vayalar, Talayazham, Turavoor South, Kodnaturuttu, Ezhupunna, Aroor, and Vaikom. The salinity in the northern sector is expected to limit the macrophyte growth but an accumulation of water hyacinth around river and canal mouths can be observed here in Kakkanad and Perumbalam Panchayats. Some major areas of water hyacinth infestation in Zone II are shown in the Map 26.	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.	Grama Panchayats- Thanneermukkam, Aryadu, Pallippad, Kumarakam, Kainakary, Panchayats along AC canal; Nedumudi, Thakazhi, Punnapra North, Pulinkunnu, Nedumudi, Ramankary, Changnassery, Velyanad		VKWMU	LSGs, Agriculture, Irrigation
			1.3.3		Utilization of water hyacinth as a bio-fuel	Water hyacinth has been proven to be promising as a potential alternate energy source in pilot studies. Biogas plant distribution and hand holding support wiil be provided with the help of Payal Jwala, CRAR-SD College, Alappuzha to households living near areas infested with water hyacinth. Other possibilities like manufacturing and marketing of weed powder for bio-diesel production at established units will be explored and training will be imparted to beneficiaries in Zone II.	Activity encompasses all the three zones					
				1.3.3.1	*Biogas plants distribution to households*		Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.	Thanneermukkam North and South, Kokkothamangalam, Komlapuram, Aryad South, Mulakkal, Kumarakam, Kainakary North, Panchayats along AC canal, Champpakula, Kuttanad, Pazhvadu, Mancombu, Nedumudi, Ramankary, Changnassery, Velyanad		VKWMU	Pyal Jwala,CRAR SD College, Alappuzha

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.3.3.2	*Training and hand holding support*		Kodangallur, Pulloot GP; Edathirinji, Padiyur GP	Vaikom, Aroor, Pallipuram	Alappuzha		VKWMU	Pyal Jwala,CRAR SD College, Alappuzha
				1.3.3.3	*Training on manufacturing and marketing of weed powder*		-	Vaikom, Aroor, Pallipuram	-		VKWMU	Pyal Jwala, CRAR SD College, Alappuzha
				1.3.3.4	*Review and Cost Benefit Analysis*						VKWMU	Commissioned agency
			1.3.4		Utilisation of water hyacinth for making value added products	Opportunities for utilisation of water hyacinth for making products such as "Biochar" or other products with the help of organisations such as FERI – Trust and Kottappuram Integrated Development Society (KIDS), Eichhotech- a startup company, CRAR-SD College will be explored.	Activity encompasses all the three zones					
				1.3.4.1	*Formation of SHGs and provision of seed capitals*		Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.	Grama Panchayats- Thanneermukkam, Aryadu, Pallippad, Kumarakam, Kainakary, Panchayats along AC canal; Nedumudi, Thakazhi, Punnapra North, Pulinkunnu, Nedumudi, Ramankary, Changnassery, Velyanad		VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE)
				1.3.4.2	*Training on water hyacinth collection and processing*		Kodangallur, Pulloot GP; Edathirinji, Padiyur GP	Vaikom, Aroor, Pallipuram	Alappuzha, Thanneemukkam, Ramankari, Ambalapuzha, Muhamma		VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE), ATREE-CERC & Social Innovation Centre
				1.3.4.3	*Training on water hyacinth craft and product making*		Kodangallur, Pulloot GP; Edathirinji, Padiyur GP	Vaikom, Aroor, Pallipuram	Alappuzha, Thanneemukkam, Ramankari, Ambalapuzha		VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE)
				1.3.4.4	*Marketing and enterprise development*		Kodangallur, Pulloot GP; Edathirinji, Padiyur GP	Vaikom, Aroor, Pallipuram	Alappuzha, Thanneemukkam, Ramankari, Ambalapuzha		VKWMU	Kerala Academy of Skills Excellence (KASE)

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
1.4	Pollution abatement measures	This activity will include assessment of current and future sewage loads and planning for pollution abatement measures; containment, treatment and safe disposal of municipal and industrial effluents; installation of decentralised wastewater treatment systems; construction of improved toilets and establishment of integrated plastic waste management facilities.										
			1.4.1		Assessment of sewage load (current and future projections) and planning for pollution abatement measures	The current sewage generation estimates in the state are based on the water consumption and wastewater generated calculated based on the resident population projected for 2020. However, the Vembanad-Kol districts see high seasonal influx of tourists. The 1.8 million population of Kuttanad majorly comprises migrant farm labourers from other states. This has major social and economic implications and needs to be accommodated in developmental planning decisions including planning for water pollution abatement measures. Management Plan implementation will include a reassessment of the sewage load generation in the districts Ernakulam, Kottayam, Alappuzha and Thrissur districts. To facilitate this, a terms of reference workshop will be organised by the VKWMU in coordination with the relevant departments as the Kerala State Pollution Control Board (KSPCB), State Planning Board, The Planning and Economic Affairs Department, Kerala Water Authority, and the Local Self Government (Planning) Department. Expert agencies such as the KSPCB or as decided will be appointed to undertake the sewage load assessments.	Activity encompasses all the three zones					
				1.4.1.1	*Terms of reference workshop*						SWAK	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM
				1.4.1.2	*Appointment of expert agencies*						Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU
				1.4.1.3	*Survey and sewage load assessments*						Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.4.1.4	*Stakeholder consultation meetings to plan for pollution abatement measures*						KSPCB, VKWMU	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM
				1.4.1.5	*Draft report consultation*						Commissioned agency, Kerala State Pollution Control Board (KSPCB)	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM
				1.4.1.6	*Report finalisation and publication*						Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU
			1.4.2		Containment, treatment and safe disposal of municipal sewage and solid waste (around municipal corporation areas)	The work on construction of STPs (proposed and ongoing) under various missions as AMRUT mission, Suchitwa mission, Kochi Metro Rail Limited Integrated Water Transport, Cochin Smart City Mission, will be completed by allocating suitable space and by resolving conflicts with residents.	Annex XVIII A and XVIII B of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.)	Annex XVIII A and XVIII B of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.)	Annex XVIII A and XVIII B of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.)		Industries Dept.,LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, KSPCB, SDMA, SUCHITWA MISSION, KWA
			1.4.3		Containment, treatment, and safe disposal of industrial effluents	KSPCB has been identifying and mapping the polluting industries around Vembanad estuary and has prescribed corrective measures. A more comprehensive plan for the three wetland zones for containment, treatment and safe disposal of industrial effluents will be drawn and follow up action will be pursued by the VKWMU in coordination with the KSPCB, District Collectors by addressing any resource and staff constraints issues.	Do	Do	Do		Industries Dept.,LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, KSPCB, SDMA, SUCHITWA MISSION, KWA

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			1.4.4		Installation of decentralised waste water treatment systems	Decentralised wastewater treatment systems are proposed to be installed in the slum areas of Kochi and Thripunithura in Ernakulam in Zone II, in Alissery ward and Zacharia Bazaar - Alappuzha; Kayamkulam, Mavelikkara, Chengannur municipalities in Allappuzha district in Zone III and Chavakkad, Thrissur slum areas in Zone I.	Chavakkad, Thrissur slum areas	Slum areas of Kochi and Thipunithura in Ernakulum	Alissery ward and Zacharia Bazaar - Alappuzha; Kayamkulam, Mavelikkara, Chengannur municipalities in Allappuzha district		Industries Dept.,LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, VKWMU, KSPCB, SDMA, SUCHITWA MISSION
			1.4.5		Construction of improved septic tanks in PHCs, Schools and Aanganwadi Centres in high water table areas	Construction of improved septic tanks as anaerobic baffled reactors and anaerobic filters is proposed at the community level in areas with high water table and waterlogging.	Poomangalam, Valivattam, Padiyoor, Edathirinji, Manavalasseri, Vellookkara, Vadakkumkara, Tekumkkara, Karumtara, Pulloot, Puttanchira, Aranattukara, Kurukkancherri	Pallipuram, Vayalar, Talayazham, Turavoor South, Kodnaturuttu, Ezhupunna, Aroor, Vaikom	Nelamperoor, Ramankari, Mannanchery, Thiruvalla, Mavelikkara, Thalvady, Cheppad, Alappuzha, Nedumudi, Pazhavidu panachayats		LSG	Kerala Rural Water Supply and Sanitation Agency, VKWMU
			1.4.6		Subsidy for households for modified prefabricated septic tanks and specially designed septic tanks	400 households in Kuttanad (Zone III), 100 households in Kol floodplains (Zone I) and 200 households in the Vembanad estuary (Zone II) situated in low lying areas prone to flooding will be provided with subsidies for the installation of modified prefabricated septic tanks.	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	Gram Panchayats- Pallipuram, Talayazham, Kuthiyathodu, Kodamturuttu, Ezhupunna, Aroor, Vaikom	Grama Panchayats - Nelamperoor, Ramankari, Mananchery, Thiruvalla, Thalvady, Cheppad, Arayadu, Punnapra North, Kainakary		LSGs, LSG Department Planning, VKWMU	Kerala Rural Water Supply and Sanitation Agency
			1.4.7		Subsidy for households for biodigester tanks in all zones	VKWMU will coordinate with the LSGs and the Kerala Rural Water Supply and Sanitation Agency (KRWSA) for installing biodigeter tanks.	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	Gram Panchayats- Pallipuram, Talayazham, Kuthiyathodu, Kodamturuttu, Ezhupunna, Aroor, Vaikom	Grama Panchayats - Nelamperoor, Ramankari, Mananchery, Thiruvalla, Thalvady, Cheppad, Arayadu, Punnapra North, Kainakary		LSGs, LSG Department Planning, VKWMU	Kerala Rural Water Supply and Sanitation Agency

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			1.4.8		Support to LSGs for implementing pollution control measures	The LSGs are responsible for undertaking pollution control measues such as handling of solid and liquid waste, drainage and water resource management and water and sanitation works. The grants and other funds available for the LSGs wherever found insufficient will be supplemented on a need basis. The Haritha Karma Sena collects non-biodegradable waste from houses and establishments to shredding units for recycling. Convergence will be sought to ensure regular training across all LSGs in the three VKW zones on waste management themes to women-led community groups provided under the Kudambashree Mission in coordination with the Haritha Keralam Mission, Suchitwa Mission and Clean Kerala Company. Support such as E-Autos, Trolleys, and vehicles for Haritha Karma Sena including support for plastic waste management will be provided. LSGs lacking infrastructure will be prioritized for providing financial support. It is proposed to cover all 51 local governments in Zone I, 51 in Zone II and 45 in Zone III. Screens are proposed to be placed at all inlets to prevent the transport of plastic in the canal system of the wetland.	Activity encompasses all the three zones					
				1.4.8.1	*Training programme for SHGs, entrepreneurs and LSGs*						VKWMU, Expert agencies	LSGs
				1.4.8.2	*Survey and identification of canals, storm drains, wetlands with high pollution loads for cleaning*						VKWMU	LSG Planning Department, Gram Panchayats
				1.4.8.3	*Annual cleaning of canals and wetlands, manual scoring of scum and other waste material under pre-monsoon pollution abatement activities by Haritha Karma Sena*						VKWMU	LSGs
				1.4.8.4	*Infrastructure support for Haritha Karma Sena*						VKWMU	LSG Planning Department, Gram Panchayats
				1.4.8.5	*Installation of mesh for screening waste*						VKWMU	LSGs, Expert agencies
			1.4.9		Awareness programmes on plastic waste management and support for establishment of integrated plastic waste management facilities in Zone I, Zone II and Zone III	Awareness programmes on plastic waste management will be conducted. The SWAK with work with the relevant government agencies to declare VKW as a zero-plastic zone. A management framework for this purpose, including components on regulation and behaviour change will be detailed in consultation with stakeholders. The training will be imparted with support from the Kerala Institute of Local Administration (KILA).	Activity encompasses all the three zones					

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
						Plastic waste segregation and recycling at the LSG level by Haritha Karma Sena will be promoted with the support from the involved agencies such as the Clean Kerala Company Ltd. For this support for procuring E-autos, trolleys, vehicles to the LSGs not having sufficient funds for the same will be provided as mentioned in activity under 1.4.8 above. Plastic waste recycling units are proposed to be established in the urban local bodies of the VKW. Recovered plastic may be used to make plastic boards or road construction materials. The waste collectors will form an integral part of the solid waste management system. Convergence should be sought under the Kerala Solid Waste Management Project (KSWMP). VKWMU will facilitate coordination with the State and District Project Management units of the KSWMP on this to integrate the needs of solid waste management around VKW in the Uban areas.						
				1.4.9.1	*Awareness programme on plastic waste management*						VKWMU	KILA, ATREE
				1.4.9.2	*Support to integrated plastic waste management activities in all LSGs*						SWAK, Clean Kerala Company Limited	LSGs,VKWMU, KSPCB
				1.4.9.3	*Feasibility assessment and planning for establishment of plastic recycling units in LSGs*						SWAK, Clean Kerala Company Limited	LSGs,VKWMU, KSPCB
				1.4.9.4	*Establishment integrated plastic waste recycling and management facility in Zone II*						Clean Kerala Company Limited	LSGs,SWAK, VKWMU
			1.4.10		Installation of modular ready to install sewage treatment plant - Johkasou (20 KLD capacity) in Zone III	Slum areas in Kayamkulam, Mavelikkara, Chengannur municipalities in Alappuzha district will be targetted for installation of modular STPs.	-	-	Slum area in Kayamkulam, Mavelikkara, Chengannur municipalities in Allappuzha district		Alappuzha Municipality	SWAK, VKWMU, KSPCB
			1.4.11		Feasibility assessment for development of a model park using ecosystem-based solutions in Kochi	It is proposed to scope the feasibility of developing a model park using an ecosystem-based solution based on a public-private-partnership model in Kochi (on the lines of Hyderabad Golf course). A project design can be developed after formal approvals.	-	Kochi	-			
				1.4.11.1	*Engagement of expert agency*		-	Kochi	-		SWAK, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, Kochi Municipal Corporation, WRI and Kerala Tourism Development Corporation (KTDC)

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.4.11.2	*Project design*		-	Kochi	-		Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, Kochi Municipal Corporation
				1.4.11.3	*Consultation workshops*		-	Kochi	-		KSPCB, VKWMU	Kochi Municipal Corporation
				1.4.11.4	*Review, finalization, and approval*		-	Kochi	-		Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, KMC
			1.4.12		Phytoremediation measures for polluted canals in Kochi and Ernakulum	Pilot projects to treat polluted canals around major urban centres such as Kochi, and Ernakulam such as Perandoor canal using suitable native species, such as *Ludwigia adscendens* and *Ludwigia perennis* in Zone II will be undertaken with the help of expert agencies.	-	Polluted canals in Kochi, and Ernakulum or other Municipalaities such as Perandoor canal, Thevara canal, Edapally canal, Konthuruthy, Market canal	-		VKWMU, Commissioned agency	Kochi Municipal Corporation, KSPCB, NEERI, Suchitwa
1.5	Support to well based rooftop rain water harvesting and recharge system (Mazhapolima) in community institutions and individual households	Thrissur district and parts of the Kottayam district face water scarcity and water conservation measures are deemed useful. Mazhapolima is a community-based roof-rainwater harvesting and open well recharge project being implemented in Thrissur district. The Mazhpolima system has been recognised as a project for drought risk reduction vide GO (Rt) No. 5634/2015/DMD dated 8-05-2015 in all the districts through the District Authorities										
				1.5.1.1	*Community education and awareness generation*		Zone I	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk	-		VKWMU, Kerala Rural Water Supply and Sanitation Agency (KRWSA)	SDMA, LSGs, CSOs
				1.5.1.2	*Demonstration and trainings*		Zone I	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk	-		VKWMU, KRSWA	SDMA, Expert Agencies

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.5.1.3	*Financial support to LSGs for implementation of Mazhapolima water harvesting systems*		Zone I	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk	-		VKWMU, KRSWA	Expert Agencies, LSGs
				1.5.1.4	*Pilot study on possibility of converting fallow lands around rivers in catchment area in to water retention dams*			Zone II catchment area	-		VKWMU	Department of soil Survey and soil conservation, CWRDM
				1.5.1.5	*Review and assessment*		Zone I	Zone II	-		VKWMU, KRSWA	CWRDM,SDMA
1.6	Modernisation and automation of the operation of Thanneermukkom Barrage	The management plan envisages scoping the possibility of automatic operations of Thaneermukkom operations based on salinity levels.										
			1.6.1		Feasibility study	The study shall assess the feasibility of snap openings of Thanneermukkom Barrage based on salinity levels.	-	Zone II	-		VKWMU, Irrigation Department	CWRDM, KUFOS, Agriculture Dept.
			1.6.2		Monitoring of tidal propagation	CWRDM will monitor the three season tidal propagation as a part of WIAMs	-	Zone II	-		VKWMU, Irrigation Department	CWRDM
			1.6.3		Review of opening and closure process of Thanneermukkom Barrage		-	Zone II	-			
				1.6.3.1	*Stakeholder workshops*		-	Zone II	-		VKWMU, Irrigation Department	VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives,
				1.6.3.2	*DPR preparation for modernization of Thaneermukkom Barrage*		-	Zone II	-		VKWMU, Irrigation Department	District Collector, Kottayam, VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries Department, LSG
				1.6.3.3	*Installation of salinity sensors and automation based on approved DPR*		-	Zone II	-		VKWMU, Irrigation Department, PWD Electronics wing	District Collector, Alappuzha, District Collector, Kottayam, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries Department, LSG

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.6.3.4	*Biannual stakeholder meetings for barrage opening and closure*		-	Zone II	-		District Collector, Alappuzha	District Collector, Kottayam, VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries Department, LSG
1.7	Improved management of irrigation dams of Kol lands, Zone I	Peechi and Varani are irrigation dams feed the paddy fields of Kol lands. During stakeholder consultations for IMP formulation, the need for restoration of the storage capacity of these dams was highlighted. As documented, the Peechi reservoir has lost 14% of its initial storage capacity of 110.43 MCM. A detailed sedimentation and hydraulic study of irrigation structures in Kol lands including Peechi, Vazhani and Chimmini dam is proposed to assess the need and identify solutions to tackle siltation issues in Kol lands.										
				1.7.1.1	*Sedimentation and hydraulic study of irrigation structures*		Peechi, Vazhani, Chimmini dams	-	-		IDRB - Irrigation Department, (Irrigation Design and Research Board) SWAK	Kerala Engineering Research Institute, CWRDM, KAU, KWA, Agriculture Department, KLDC
				1.7.1.2	*Stakeholder meetings for finalisation of recommended actions*		Peechi, Vazhani, Chimmini dams	-	-		IDRB - Irrigation Department, SWAK	KERI, CWRDM, KAU, KWA, Agriculture Department
				1.7.1.3	*Implementation of recommended actions*		Peechi, Vazhani, Chimmini dams	-	-		IDRB - Irrigation Department, SWAK	SWAK, KERI
				1.7.1.4	*Post implementation monitoring and review*		Peechi, Vazhani, Chimmini dams	-	-		IDRB - Irrigation Department	SWAK, KERI, CWRDM
				1.7.1.5	*Research for further refinement and adaptation*		Peechi, Vazhani, Chimmini dams	-	-		IDRB - Irrigation Department, SWAK	KERI, CWRDM, KAU, KWA, Agriculture Department
1.8	DPR preparation for restoration of minor outlets (Pozhi) based on IIT Madras study in Zone III	A study by IIT Madras has recommended restoration of minor outlets/Pozhi to restore natural connectivity and reduce flood risks.										
				1.8.1.1	*Stakeholder consultations for reviewing the study recommendations*		-	-	Kuttanad Coastal Belt		SWAK,VKWMU	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, SDMA, Agriculture Department, KUFOS,

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				1.8.1.2	*Review, Adaptation and DPR preparation*		-	-	Kuttanad Coastal Belt		SWAK,VKWMU	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, SDMA, Agriculture Department, KUFOS,
1.9	Development of comprehensive WASH plans in the local self governments in Zone II and Zone III	Development of comprehensive WASH plans in the local self-governments in the zone II and zone III of the VKW will be undertaken, incirporating the role of wetlands										
				1.9.1.1	*Consultation workshops*		-	-	Zone III		KWA, Suchitwa Mission, LSGs	VKWMU
				1.9.1.2	*Development of LSG level WASH plans*		-	-	Zone III		KWA, Suchitwa Mission, LSGs	VKWMU
				1.9.1.3	*Implementation of WASH activities*		-	-	Zone III		KWA, Suchitwa Mission, LSGs	VKWMU
1.10	Drinking water supply scheme to residents of Kuttanad in Zone III	A drinking water supply scheme for 181 wards of 13 Grama Panchayats in Kuttanad is specifically included here. This is funded under Kuttanad Drinking Water Project – IInd Phase by Kerala Infrastructure Investement Fund Board (KIIFB).					-	-	Zone-III: Kuttanad Floodplain area - 181 wards of 13 GPs in Alappuzha District		KWA, LSGs	VKWMU
Component 2. Species and habitat conservation												
2.1	Asian Waterbird Census	Regular monitoring of waterbird population using Asian Waterbird Census protocol will be done at all major congregation sites within and around VKW to understand comprehensively the significance of the wetland for waterbirds (both resident and migratory) and to plan and monitor habitat management interventions. The census will be carried out in collaboration with local NGOs with prior experience in conducting such census. Co-ordinators will form their respective groups of trained personnel to carry out the census. Census programmes will include training of prospective census participants and local wildlife enthusiasts. The management plan will support mid-winter counts of waterbirds as per the Asian Waterbird Census protocol. Data collected during this monitoring work will include collection of detailed information on habitat structure, seasonal abundance, and foraging habits. Information collected should enable realistic population estimates and trends of different species of waterbirds to be developed and provide guidance for management activities.					Activity encompasses all the three zones					
				2.1.1.1	*Empanelment of census co-ordinators*						SWAK,VKWMU	WISA, ATREE-CERC, Kol Birders Soc., KAU-FD
				2.1.1.2	*Formation of census groups*						SWAK,VKWMU	WISA, ATREE-CERC, Kol Birders Soc., KAU-FD
				2.1.1.3	*Waterbird census training*						SWAK,VKWMU	WISA, ATREE-CERC, Kol Birders Soc., KAU-FD

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				2.1.1.4	*Census*						SWAK,VKWMU	WISA, ATREE-CERC, Kol Birders Soc., KAU-FD
				2.1.1.5	*Data compilation and reporting*						SWAK,VKWMU	WISA, ATREE-CERC, Kol Birders Soc., KAU-FD
2.2	Annual fin fish and shell fish Census	Annual fin fish and shell fish census will be taken up to determine the species count and population trends using established census protocols. Experimental fishing techniques such as gill nets, cast nets and trawl nets will be deployed. This census will help track trends in the number of different species, their population and habitat conditions, also revealing information related to the prevalence of fish diseases and the spread of invasives. The census will be coordinated by KUFOS, CERC-ATREE and trained ichthyologists, with active involvement of CBOs such as Vembanad Kayal Sanrakshan Samiti.				Activity encompasses all the three zones						
				2.2.1.1	*Empanelment of census co-ordinators*						SWAK,VKWMU	KUFOS, ATREE- CERC
				2.2.1.2	*Formation of census groups*						SWAK,VKWMU	KUFOS, ATREE- CERC
				2.2.1.3	*Fish census training*						SWAK,VKWMU	KUFOS, ATREE- CERC
				2.2.1.4	*Census*						SWAK,VKWMU	KUFOS, ATREE- CERC
				2.2.1.5	*Data compilation and reporting to guide management interventions.*						SWAK,VKWMU	KUFOS, ATREE- CERC
2.3	Comprehensive VKW biodiversity assessment	A biodiversity baseline of VKW will be established for all major taxonomic orders. For comprehensive assessments, a terms of reference workshop will be organized for each ecological zone. Survey methods, data collection and reporting protocols will be finalised along with the appointment of lead agencies for coordinating the surveys. Agencies with expertise in biodiversity surveys such as KUFOS, ZSI for faunal orders, CERC-ATREE, BSI for floral orders and KFRI for areas under forest cover will be involved in the assessment.				Activity encompasses all the three zones						
				2.3.1.1	*Terms of Reference workshop*						VKWMU	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
				2.3.1.2	*Selection and appointment of the expert agencies*						VKWMU	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
				2.3.1.3	*Biodiversity surveys*						Expert Agency	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
				2.3.1.4	*Preparation of draft report*						Expert Agency	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
				2.3.1.5	*Draft report review*						Expert Agency	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
				2.3.1.6	*Report finalisation and publication*						Expert Agency	WISA, KUFOS, KSBB, ATREE, KAU, KFRI, Local NGOs
2.4	Monitoring of invasive macrophytic species	For the management of invasive species in VKW, site surveys are proposed in the three zones for mapping areas with high presence of invasive species. These invasive macrophytes are proposed to be alternatively used in manure, and handicrafts products development.				Activity encompasses all the three zones						

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				2.4.1.1	*Mapping of invasive species distribution*						ATREE CERC	KUFOS, KFRI, KAU
				2.4.1.2	*Stakeholder sensitization workshops*						KUFOS	CMFRI
				2.4.1.3	*Surveillance and control measures*						VKWMU	SWAK
				2.4.1.4	*Followup support to promote development of handicraft products and other economic uses as feasible*						VKWMU	SWAK
2.5	Mapping and protection of key habitat areas	VKW serves as an important breeding and feeding ground for fishes and waterbirds. Actions include mapping of key habitats followed by regular monitoring and surveillance through community groups. Community sensitization and training to monitor water bird habitats and to control anthropogenic activities. Incentives in the form of recognition and training as bird guides could be provided to the committee members. Community workshops will be conducted to develop conservation strategies for regular watch and ward of habitats. Community wardens are to be appointed and their services recognised.										
				2.5.1.1	*Survey and mapping of fish breeding grounds*						ATREE CERC	KUFOS
				2.5.1.2	*Survey and mapping of bird congregation areas*						KAU	KBS
				2.5.1.3	*Survey and mapping of mangroves and associated habitats*						CMFRI	KUFOS, KFRI, WISA
				2.5.1.4	*Community workshops to develop conservation strategies*						KUFOS	CMFRI, WISA, CWRDM
				2.5.1.5	*Mangrove restoration in Chettuva estuary*		Chettuva estuary	Kodangallur-Azhikode estuary, CRZ I A areas in Aroor, Perumbalam, Palluruthy, Edakochi, Elankunnapuzha, Along National Waterway 3	Kayamkulam estuary, Along NW-3		Fisheries Department, VKWMU, Social Forestry Dept.	CMFRI, WISA, KFRI, KUFOS
				2.5.1.6	*Appointment of community wardens in LSG*						VKWMU	LSG and CBOs such as Vembanad Kayal Samrakshana Samithi, Clam Cooperatives
				2.5.1.7	*Honararium for community wardens*						VKWMU	LSGs
				2.5.1.8	*Watch and ward of habitats*						Wetland Mitra, Communities	VKWMU, SWAK

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
2.6	Zoonotic disease surveillance	The State Government of Kerala in 2022 has launched the One Health Scheme as part of the Navakeralam Action Plan, to monitor the occurrence of abnormalities in animal diseases, early detection of the factors that lead to them, and participatory interventions as needed. Within the framework of this scheme. the management plan envisages putting in place a surveillance system for zoonotic diseases. This will entail the development of SOPs for handling zoonotic diseases for VKW, organising awareness generation workshops and periodic surveillance and reporting. Field staff should be trained to undertake safety protocols to control the spread of zoonotic diseases like isolation of affected individuals and clearing debris. A community awareness workshop is suggested to observe any unusual behaviour among the bird and animal species due to zoonotic diseases. Sálim Ali Centre for Ornithology and Natural History (SACON) and the State Institute for Animal Diseases (SIAD) of the Animal Husbandry Department will be contacted for prompt disease diagnosis in the event of disease outbreaks, frame protocols to control the spread of zoonotic diseases like isolation of affected individuals and clearing debris and participate in development of SOP for the containment and control measures for wild bird species in case of contagious diseases like Avian Influenza. This activity, in its later stages, will also focus on monitoring the health of fish and clam species.				Activity encompasses all the three zones					
				2.6.1.1	*SOP development for handling zoonotic diseases episodes*						SACON	SIAD
				2.6.1.2	*Awareness generation workshops*						SACON	SIAD
				2.6.1.3	*Annual disease surveillance and reporting*						SIAD, Fisheries Department	SACON, KAU, KVASU, WWF
Component 3. Community based fisheries management												
3.1	Stock assessment	The fish stock assessment of Venbanad estuary is aimed at devising management systems to mitigate fishery resource depletion. The assessment will include an evaluation of the state of the fish stocks including changes in the abundance or composition of the stock to changes in the amount of fishing. The assessment will be used to determine the maximum sustainable yield, fish mortality, and input and output into the fisheries.				Activity encompasses all the three zones						
				3.1.1.1	*Protocol development workshop*						Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI
				3.1.1.2	*Data collection*						Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI
				3.1.1.3	*Stakeholder workshop on draft conclusions*						Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI
				3.1.1.4	*Report finalisation and publication*						Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI
3.2	Development of fishing calendar and zones	A fishing calender incorporating outcomes of stock assessments, expert knowledge and indigenous and traditional knowledge is proposed to be developed. Fishing zones to allow sustainable harvest will also be demarcated as a part of the process.				Activity encompasses all the three zones						
				3.2.1.1	*Constitution of committee of experts and stakeholders*						VKWMU, Dept. of Fisheries	KUFOS, CMFRI
				3.2.1.2	*Consultation meetings*						VKWMU, Dept. of Fisheries	KUFOS, CMFRI
				3.2.1.3	*Production of draft calendar and zone revisions*						VKWMU, Dept. of Fisheries	KUFOS, CMFRI
				3.2.1.4	*Community monitoring and enforcement*						Fisher Cooperatives	Clam Collectors Society

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
3.3	Maintaining clam and fish protected areas	The Department of Fisheries, Govt. of Kerala under the Integrated Fishery Resource Management (IFRM) activities is maintaining clam and fish protected areas in Karuvannur-Chettuva Aquatic Ecosystem in Zone I and in Vembanad Estuary in Alappuzha and Kottayam districts in Zone II and Zone III. Given its importance in maintaining fish and clam diversity in the wetlands, this activity will be further extended to areas that have so far not covered in the Vembanad estuary.										
				3.3.1.1	*Establishment of protected area for clams/fish*		(Zone I) Karuvannur-Chettuva Aquatic Ecosystem - 14 PA	Kottayam	Allapuzha		Dept. of Fisheries, Govt. of Kerala	KUFOS
				3.3.1.2	*Maintenance of existing protected areas*		(Zone I) Karuvannur-Chettuva Aquatic Ecosystem - 14 PA	Kottayam	Allapuzha		Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community wardens
				3.3.1.3	*Ranching to replenish the depleted stock of commercially important fish species*		(Zone I) Karuvannur and Chettuva Aquatic Ecosystem (existing) Keechery, Puzhakkal (Proposed)	Kottayam	Allapuzha		Dept. of Fisheries, Govt. of Kerala	Co-operative Society/SHGs
				3.3.1.4	*Support to fisher cooperatives for establishing freshwater prawn hatchery*		-	-	Alappuzha		VKWMU	Fisher Cooperatives, KUFOS
3.4	Conservation and awareness program	The conservation and awareness program will aim at garnering support from the locals to enhance species and habitat protection by volunteering in monitoring and reporting of deleterious activities such as habitat destruction and over-extraction of bio-resources.										
				3.4.1.1	*Procurement of patrolling boat for VKW conservation works*		-	Kottayam	Allapuzha		VKWMU,Dept. of Fisheries, Govt. of Kerala	
				3.4.1.2	*Maintenance of patrolling boats*		-	Kottayam	Allapuzha		VKWMU,Dept. of Fisheries, Govt. of Kerala	Fisher Cooperatives, Community wardens,
				3.4.1.3	*Formation of fisheries management committee (FMC)*		-	Kottayam	Allapuzha		Fisheries Department	VKWMU, Fisher Cooperatives
				3.4.1.4	*Support to fisheries management councils (FMC) for active surveillance*		-	Kottayam	Allapuzha		VKWMU	Fisheries Department, Fisher Cooperatives
				3.4.1.5	*Awareness Programmes on sustainable fishing practices*		-	Kottayam	Allapuzha		Fisheries Department	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
3.5	Appointment of project coordinator	A full-time project coordinator will be appointed by the Department of Fisheries, Govt. of Kerala. The project coordinator will liaise with the VKWMU and Fish Cooperatives for the implementation of fishery-related activities.					Activity encompasses all the three zones					
				3.5.1.1	*Honorarium to project coordinator*						Dept. of Fisheries, Govt. of Kerala	VKWMU
Component 4: Sustainable Wetland agriculture interactions												
4.1	Revival of traditional Pokkali farming system in Zone I and Zone II	Pokkali farming in Thrissur, Ernakulam, and Alappuzha districts will be revived through the creation of incentives, improving cropping practices and establishing forward and backward market linkages.										
			4.1.1		Incentive programmes for Pokkali farmers	This will entail providing a monetary benefit of Rs 25,000 to Pokkali farmers for growing Pokkali paddy on their agricultural lands and adopting best practices. This program will reach out to farmers who have abandoned Pokkali farming or switched to prawn monoculture because of poor market price of Pokkali rice. This will help them to cover the high labour costs and any farm mechanization needs.	Thrissur district	Ernakulum district (Panchayats sucha s Kadamakkudy, Nayarambalam, Edvanakkad,Pallipp uram, Njarakkal among others)	-		Agriculture Department, PLDA	KAU, CMFRI
			4.1.2		Supporting Pokkali harvest festival	Pokkali harvest festivals are organized every year in October to mark the closing of the Pokkali rice cultivation cycle that starts in June with field preparations and sowing and ends in October with the harvest. It is an occasion to popularise and revive the practice which also helped Kerala to gain its first GI tag. Support will be extended for the celebration of harvest festivals in Zone I and Zone II.	Thrissur district	Ernakulum district	-		Agriculture Department, PLDA	KAU, CMFRI
			4.1.3		Organising awareness drives for Pokkali farmers on best practices	Farmers will be sensitised on the following themes with the support from KAU, KUFOS, Department of Agriculture & Farmers Welfare and CMFRI on • Benefits of rotational Pokkali rice cultivation and shrimp farming as a climate-smart farming and organic technique • Best practices and techniques of the integrated Pokkali rice and shrimp farming • Prawn diseases such as White Spot Syndrome (WSS) viral infection of shrimps • Adverse environmental and health impacts of prawn monoculture due to use of pesticides and antibiotics • Sensitisation of farmers and Padasekharam Samitis to regulate bund operations to keep salinity below 5 ppt needed for Pokkali rice cultivation • VKWMU should organise awareness meetings for industries situated in Pokkali belt to adopt pollution control measures. This should be backed by necessary penal measures as set by the KSPCB.	Thrissur district	Ernakulum district	-		Agriculture Department, PLDA	KAU, CMFRI,KUFOS

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
			4.1.4□		Strengthening market linkages	It is proposed to establish four Pokkali seed centers in Zone I and Zone II in the Panchayats in the Pokkali cultivation belt. The centers will make available the traditional Pokkali paddy seeds such as Pokkali, Churuttu Pokkali, Chettyviruppu, Anakkondan and Cheruviruppu and the improved varieties of Vyttila (VTL-1 to VTL-8) in a timely and satisfactory manner. Annual support will be provided for the operation of these seed centres. Additional costs will be covered through convergence.	Thrissur district		-			
				4.1.4.1	*Establishment of Pokkali seed centres*		Thrissur district	Ernakulum district	-		Agriculture Department, PLDA	KAU, CMFRI,KUFOS
				4.1.4.2	*Operation of Pokkali seed centres*		Thrissur district	Ernakulum district	-		Agriculture Department, PLDA	KAU, CMFRI,KUFOS
				4.1.4.3	*Establishment of local procurement centres for collection and distribution of fish and Pokkali rice. It is proposed to establish one centre each in Zone I and Zone II.*		Thrissur district	Ernakulum district	-		Fisheries Department, PLDA	KAU, CMFRI,KUFOS
				4.1.4.4	*Operation of local procurement centres for collection and distribution of fish and Pokkali rice*		Thrissur district	Ernakulum district	-		Fisheries Department, PLDA	CMFRI
				4.1.4.5	*Support for polder improvement works*		Thrissur district	Ernakulum district	-		Agriculture Department, PLDA	KAU, CMFRI, VKWMU
				4.1.4.6	*Support for enterprise development*		Thrissur district	Ernakulum district	-		SWAK, VKWMU	Agriculture Department, PLDA, Fisheries Department, KAU
4.2	Polder improvisation and strengthening and reorganization	Farming on low lands of the Kuttanad region as well as Kol floodplains require regular bund maintenance operations. Each Compartment or Padasekharam is protected by an outer bund with a series of small canals taking water to the individual paddy fields. The outer bund serves the function of flood protection and has inlets for the entry of water into the Padasekharams and has a height above the normal/maximum flood level. The outer bunds are renovated every year before the onset of the Punja crop season. During floods, spillover of the streamflow helps reduce flow velocities and dampens damages. During stakeholder consultations, recommendations for lowering bund heightfrom the maximum flood level to the average monsoon flood level were made. It was also proposed to increase the width and number of sluice gates to revive the filtration efficiency of polders.					Activity encompasses all the three zones					
			4.2.1		Restoration of outer bunds of Padasekharams and flood mitigation works in all three zones	In Kol lands (Zone I), restoration of outer bunds is being carried out by KLDC as infrastructure assistance in Kol land Padasekharams under TCR Ponnani Kole Phase IV project funded under the Rebuild Kerala Initiative. A total of 6570 infrastructure works will be carried out from 2022 – 2027. In Zone II and Zone III, under the Kuttanad Package II, Flood Management works such as strengthening and raising of outer bunds of padasekharams, and allied works such as construction of motorthara/shed, sluice,					Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
						culverts etc. are being executed by the Irrigation department using Irrigation Department's Plan funds and NABARD RIDF funds. The details of major ongoing works are given in Table 30. In the Kol paddy fields located in Zone I the work is carried out by the KLDC under the Thrissur Ponnani Kol Phase IV project.						
				4.2.1.1	*Restoration of outer bunds of Padasekharams*						KLDC, Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi, LSG
				4.2.1.2	*Construction of ramp and sluice*						KLDC, Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi, LSG
				4.2.1.3	*Construction of box culverts*						KLDC, Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi, LSG
				4.2.1.4	*Construction of Engine sheds and Engine Thara*						KLDC, Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi, LSG
				4.2.1.5	*Replacement of Petti- Para with Vertical Axial Flow pump sets*						KLDC, Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi, LSG
4.3	Study on revision of cropping calendars in all three zones	Several assessments, notably MS Swaminathan Kuttanad Package report have recommended the adoption of one medium-duration crop and one short-duration crop in Kuttanad. It has also been recommended to conclude the Punja crop cycle by February to facilitate bund opening by the mid of March.					Activity encompasses all the three zones					
				4.3.1.1	*Terms of reference workshop*						VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG
				4.3.1.2	*Finalisation of consultants*						VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG
				4.3.1.3	*Stakeholder workshops*						VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG
				4.3.1.4	*Draft report presentation*						VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				4.3.1.5	*Reports/Crop Calendar finalisation and publication*						VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG
4.4	Promoting good agricultural practices	VKWMU will coordinate with the Kerala Agricultural University, Irrigation Department, Agriculture Department, and Department of Soil Survey and Soil Conservation to address water management issues, reduce pollution from agricultural farmlands, and collate and publish a wetland-friendly package of practices with outreach workshops to promote best agricultural practices and to address issues of farmers. Alongside, incentives for adopting good agricultural practices as reducing the use of artificial fertilizers and pesticides on farmlands and adopting organic farming would be provided to the farmers. Effective Hand-holding support and follow-up action would be initiated in coordination with the capacity development institutions and responsible enforcement agencies with a push for the development of integrated farming systems plots for testing appropriate systems suited to wetlands					Activity encompasses all the three zones					
				4.4.1.1	*Collation and publication of wetland-friendly package of practices*						VKWMU	KAU, Agriculture Department, Veterinary department
				4.4.1.2	*Outreach workshops*						VKWMU	KAU, Agriculture Department, Veterinary department
				4.4.1.3	*Incentives for adopting good agricultural practices*						Agriculture Department, VKWMU	KAU, VKWMU
				4.4.1.4	*Hand-holding support*						Agriculture Department, VKWMU	KAU, VKWMU
				4.4.1.5	*Support for integrated farming systems plots*						Agriculture Department, VKWMU	KAU, VKWMU
4.5	Soil health monitoring in Kuttanad	Soil salinity and soil acidity issues are reported from some parts of Kuttanad, especially in the Panchayats situated at the southern end of the Achenkovil River basin such as Haripad, Purakkad, Thakazhy, Cheppad, Kannamangalam. Salinity intrusion is reported from the Kayamkulum estuary. The activity will strengthen the agriculture department's work in monitoring soil health in the area. Soil salinity sensors are proposed to be placed in individual farms. A mapping of soil salinity will be carried out using existing data and data collected from installed soil sensors.										
				4.5.1.1	*On site soil salinity monitoring*		-	-	Zone III		VKWMU	Agriculture department, KAU
				4.5.1.2	*Soil salinity mapping in Kuttanad*		-	-	Zone III		VKWMU	KAU, VKWMU
				4.5.1.3	*Stakeholder meetings for scientific prevention and management of soil salinity problems*		-	-	Zone III		KAU, Agriculture Department	VKWMU

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				4.5.1.4	*Crop insurance to marginalised farmers for salinity damage*		-	-	Southern end of Achenkovil River basin in Haripad-Pallippad GP, Purrakad, Thakazy, Cheppad and other salinity affected area established by soil testing		Agriculture department	Padasekhram Samithi
				4.5.1.5	*Upgradation of soil and water testing facilities in district laboratories*		-	-	District laboratory at Alappuzha of Agriculture Department		Agriculture department, KAU	VKWMU, CWRDM
				4.5.1.6	*Financial support for regulation of soil acidity to marginal farmers of affected Padasekharam Samithis*		-	-	Southern end of Achenkovil River basin in Haripad-Pallippad GP, Purrakad, Thakazy, Cheppad and other salinity affected area established by soil testing		Agriculture department, KAU	VKWMU, KAU, Padasekhram Samithi
4.6	Support to Registered seed growers	Support will be provided to 50 registered seed growers for climate resilient paddy varieties through existing schemes of the agriculture department. Agriculture extension activities for popularising the cultivation of these varieties by farmers has to be undertaken.					-	-	Zone III		Agriculture department, KAU	VKWMU, Padasekhram Samithi
4.7	Vermicomposting	Trainings will be provided on vermicomposting. Establishment of vermicompost units and hand holding support to beneficiaries will be provided through Agriculture Department Strengthening Agriculture Extension Scheme.										
				4.7.1.1	*Training of Village communities*		-	-	Zone III GPs		Agriculture Department, Krishi Vigyan Kendras, Krishi Bhavans	VKWMU
				4.7.1.2	*Establishment of Vermicompost units*		-	-	Zone III GPs		Agriculture Department, Krishi Vigyan Kendras, Krishi Bhavans	VKWMU

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
Component 5: Sustainable wetland tourism												
5.1	Capacity development support and incentives for maintaining standards	The Government of Kerala has set standards for the classification and approval of houseboats. Necessary conditions for the diamond, gold and silver category of houseboats have been prescribed including conditions for waste management and other eco-friendly solutions as per G.O.(Ms) No.12/2019/TSM dated 8/7/2019. The State Tourism Policy (2012) strengthens Responsible Tourism and promotes the need for rational use of ecological resources for nature-based tourism. Systematic capacity development programmes for houseboats and Shikara owners need to be conducted to promote adherence to the prescribed standards for sustainable tourism with a special focus on waste management.					Activity encompasses all the three zones					
				5.1.1.1	*Needs assessments*						VKWMU, SWAK	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc
				5.1.1.2	*Programme design*						VKWMU, SWAK	DTPC, Houseboat owners, Resorts, hotel owners etc
				5.1.1.3	*Training workshops*						VKWMU	Tourism Department, DTPC, SWAK
				5.1.1.4	*Incentives programme for standard maintenance*						DTPC	VKWMU, Tourism Department, SWAK
				5.1.1.5	*Follow up support*						VKWMU	Tourism Department, DTPC, SWAK
5.2	Surveillance and enforcement of extant regulation	Many unregistered houseboats operate in the Vembanad estuary. The Kerala Maritime Board issues licenses to houseboats and is responsible for the implementation of the Kerala Inland Vessel Rules, 2010. It issues Stop Memos to the unauthorised houseboats; however, the memos are not enforced because of staff and space shortages for parking the seized boats. It is proposed to allocate additional resources to overcome these issues and facilitate adherence to regulation. The Kerala Maritime Board shall undertake surveillance for compliance with Kerala Inland Vessels Rules, 2010. LSGs can play an important role by being watchful and ensuring compliance with the prescribed standards. Community wardens/Wetland Mitras will be engaged to inform violations by houseboat owners, and tourist facilities owners through VKWMU to the respective agencies such as the Kerala Maritime Board, KSPCB and SWAK for further action.					Activity encompasses all the three zones					
				5.2.1.1	*Periodic surveillance*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
				5.2.1.2	*Reporting of violations to concerned authorities*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
				5.2.1.3	*Implementation of penal provisions*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
5.3	STP infrastructure upgradation for houseboats	The STP at Kunumma (currently not operational) can treat 0.18 MLD sewage, whereas the STP at Kumarkom can treat an additional 0.09 MLD. The combined capacities of the two DTPC STPs is inadequate to treat the waste generated from all the houseboats (as the houseboats on average generate 0.49 MLD wastewater during peak tourism season). A large number of houseboats are unregistered and add to the pollution loads.										
			5.3.1 ☐		Assessment of current waste generation, management, and gaps in Zone II and Zone III	An assessment of waste generation will help plan for adequate treatment capacity required to handle sewage generation including requirements for new STPs and other infrastructure. A more comprehensive planning will also include assessment of sewage loads from tourist facilities around Vembanad need to be carried out. VKWMU will facilitate meetings of relevant stakeholders such as the houseboat associations, Kerala Maritime Board, DTPC, LSGD (Planning), KSPCB and support proposal development and submission for subsequent funding from possible sources	-	Zone II	Zone III		VKWMU	KSPCB, DTPC, Maritime Board
			5.3.2		Operationalisation of existing STP at H block, Kunnumma in Zone III	The Sewage Treatment Plant at H-Block, Kunnumma, Alappuzha a facility used by houseboats to empty sewage was damaged during the 2018 floods. In a subsequent inspection by KSPCB the plant was found to be lacking in treating the waste properly following which the DTPC had shut down the plant. In its absence, the houseboats in Alappuzha are emptying their sewage directly into the Vembanad. The STP plants needs to be reopened by providing necessary resources and addressing any technology issues.	-	Zone II	Zone III		VKWMU	KSPCB, DTPC
			5.3.3		Feasibility assessment of new STPs in Zone II and Zone III	The proposal for new STPs proposed as part of activity 5.3.1 will be accompanied by a feasibility assessment of new STPs detailing the design parameters, treatment technology, adherence to environmental norms (CPHEEO) etc.	-	Zone II	Zone III			
				5.3.3.1	*Finalization of terms of reference and appointment of consultants*		-	Zone II	Zone III		VKWMU	KSPCB, DTPC, Maritime Board
				5.3.3.2	*Feasibility assessment*		-	Zone II	Zone III		VKWMU	KSPCB, DTPC
				5.3.3.3	*Draft report*		-	Zone II	Zone III		VKWMU	KSPCB, DTPC
				5.3.3.4	*Finalization after incorporation of review comments*		-	Zone II	Zone III		VKWMU	KSPCB, DTPC, House boats owners association
			5.3.4		Operationalization of four STP collection barges for point-to-point sewage collection from houseboats in Zone II and Zone III	The frequency at which the houseboats need to empty their waste varies from houseboats to houseboats and depends on usage. However, during the peak tourist season, there is a need to empty the sewage tank more frequently (on an average every three days) but houseboats find it difficult to visit the STP plant for emptying the sewage. One barge at present is being operated by DTPC Kottayam in the STP at Kumarkom. It is proposed to seek convergence with the Department of Tourism under responsible tourism initiatives to procure an additional barge for the point-to-	-	Zone II	Zone III		VKWMU	KSPCB, DTPC, House boats owners association

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
						point collection of sewage from houseboats in Zone II and two barges for Zone III.						
5.4	Orientation programmes for houseboat owners, tourism facility owners and tour operators	The Department of Tourism, Government of Kerala has prescribed accreditation conditions for tour operators. The Ministry of Tourism, GoI has recently revised the conditions and gives recognition to inbound domestic tour operators, travel agents, tourist transport operators with an objective to encourage quality and standard of services. Adherence to prescribed conditions will be promoted by organising orientation programmes for tour operators				Activity encompasses all the three zones						
				5.4.1.1	*Orientation programme design*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
				5.4.1.2	*Orientation workshops*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
				5.4.1.3	*Follow up support*						DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
5.5	Nature awareness programmes for tourists	VKWMU will involve various tourism stakeholders (such as NGOs, DTPC, LSGs, Kudambshree units, community leaders, environmentalists, media persons, academicians and schools) to design nature education programmes for tourists of the 3										
				5.5.1.1	*Nature education programme design in consultation with stakeholders*		Zone I	Zone II	Zone III		Expert Agency	Local NGOs
				5.5.1.2	*Workshops and events*		Zone I - Shakthan Thampuran Palace, Vadakkechira, Chemmappilly, Conolly canal	Zone II	Zone III		VKWMU	Local NGOs
				5.5.1.3	*Programme evaluation and follow up support*		Zone I	Zone II	Zone III		VKWMU	SWAK, Local NGOs
5.6	Wetland nature-tourism programme design	In alignment with the Nature-Tourism component of Amrit Dharohar, the management plan envisages the development of a nature tourism plan for VKW which will aim to convert high-volume backwater tourism into high-value nature tourism. Key elements of Nature Tourism in ecologically fragile areas are articulated in the 'Guidelines for Sustainable Ecotourism in Forest and Wildlife Areas' (issued by MoEFCC in 2021) and 'National Strategy of Ecotourism' (developed by the Ministry of Tourism in 2022). Nature Tourism would not just focus on biodiversity (such as the sighting of migratory birds) or amenity aspects of the wetland but shall be designed to showcase the full range of biodiversity, socio-cultural, heritage and recreational dimensions of Ramsar Sites. It is envisaged that Nature Tourism is not centred on VKW alone but is connected to a wider wetland tourism circuit. The ToR shall include carrying-capacity analysis, identification of the Nature Tourism zones, potential partners, categorisation of infrastructural support that may be needed, funding sources, training and capacity needs. Recommendations for connectivity, and hard and soft interventions for site development will also be included.				Activity encompasses all the three zones					

Activities		Description	Tasks and sub-tasks			Task description	Geographical location				Implementing agency	
							Zone I	Zone 2	Zone 3	Catchment / River Basin level	Lead	Support
				5.6.1.1	*Finalization of Terms of Reference and appointment of expert agency*						SWAK, VKWMU	DTPC
				5.6.1.2	*Inception workshop*						SWAK, VKWMU	DTPC
				5.6.1.3	*Plan drafting as per the Terms of Reference*						SWAK, VKWMU	DTPC
				5.6.1.4	*Plan review and finalization*						DTPC	VKWMU
5.7	Feasibility assessment for construction of Dry Dock Facility for houseboats to facilitate compliance with safety standards in zone III	The Kerala Inland Vessel Rules 2010 mandate periodic dry-docking inspections of houseboats to ensure compliance with safety standards and statutory requirements. Adequate dry dock facilities in VKW are essential for maintenance, repairs, and ensuring the safety of vessels and adherence to environmental standards. The Wetlands (Conservation and Management) Rules 2017 restrict the construction of permanent structures within fifty metres from the mean high flood level. Given the unique operational demands of the houseboat industry, it is envisaged to assess the feasibility for the construction of a dedicated dry dock facility within the existing regulatory frameworks and in consultation with stakeholders.										
				5.7.1.1	*Establishment of Terms of Reference*		-	-	Muhamma or any other feasible location		DTPC, Tourism Department	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders
				5.7.1.2	*Recruitment of consultants*		-	-	Muhamma or any other feasible location		Expert Agency	DTPC, Tourism Department
				5.7.1.3	*Preparation of feasibility report*		-	-	Muhamma or any other feasible location		Expert Agency	DTPC, Tourism Department, VKWMU
				5.7.1.4	*Report review and finalization for presentation to SWAK*		-	-	Muhamma or any other feasible location		Expert Agency	DTPC, Tourism Department, VKWMU

BOX 6: Declogging of rivers and desiltationof canals, ponds and estuaries

The MoEFCC, Government of India framed the Sustainable Sand mining Guidelines in 2016, after consultation with various stakeholders. As per MoEFCC notification dated 15 January 2016, certain amendments have been made in Annexure IX of the Environmental Impact Assessment Notification, 2006, exempting certain cases from the requirement of environmental clearance. The de-silting of reservoirs, dredging for upkeep and maintenance of structures, channels and averting natural disasters is not to be treated as mining for the purpose of environmental clearance. Similarly, customary extraction of sand and ordinary earth from sources situated in Grama Panchayat for personal use or community work in village and community work like de-silting of village ponds or tanks, construction of village roads, ponds, bunds undertaken in Mahatma Gandhi National Rural Employment and Guarantee Scheme, other Government sponsored schemes, and community efforts also don't require a prior environmental clearance.

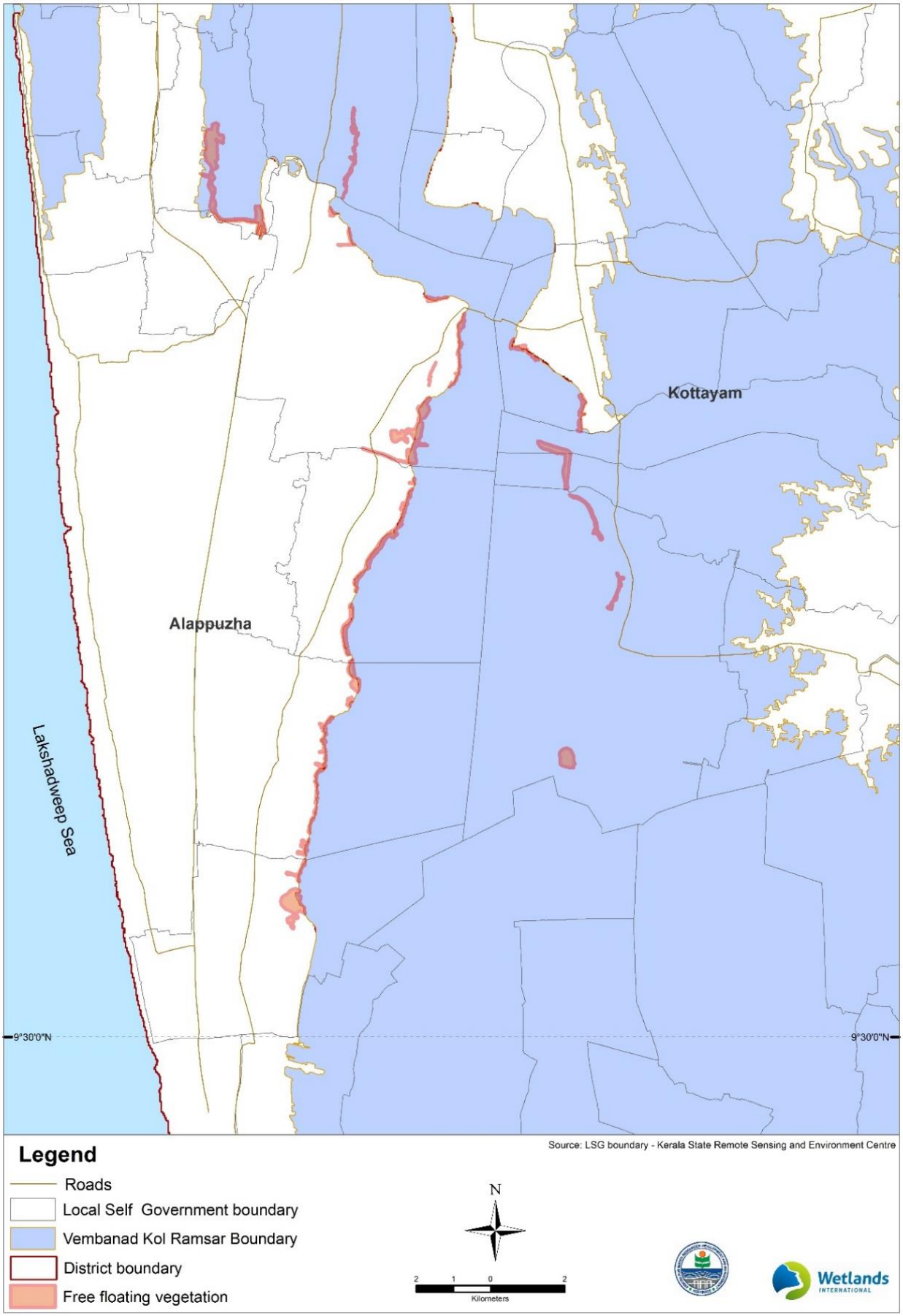
The Ministry of Water Resources constituted a multidisciplinary Committee (Mittal Committee) in 2001 to examine the need and feasibility of a river desiltation program in the country. The Committee concluded that desilting rivers for flood control is not an economically viable solution and dredging should not be resorted to, particularly in major rivers. Desilting in general is not feasible technically, due to several reasons like non-sustainability, non-availability of vast land required for disposal of dredged material etc. However, some locations such as tidal rivers, confluence points with narrow constrictions, and the like can be tackled by desilting after a thorough examination and techno-economic justification.

Hon'ble National Green Tribunal, Principal Bench, ND in the Judgment dated 26.02.2021 vide OA No.360/2015, 456, 726/2018 and others, ordered to take strict action against illegal, unscientific mining of sand in the country.

In the context of Vembanad-Kol, since the inflow to the wetland system is received from ten rivers, there is a need to maintain the optimal discharge volume of the rivers and canals, for which the cross-sectional area needs to be increased. However, de-siltation may be restricted to unavoidable pockets whereas in other places this may be achieved through widening the rivers and not through the deepening of river beds. This is because the river beds are now in an initial stage of recovery and any removal of the fine sand from river beds in the name of de-siltation needs to be prevented. As advised by the MoWR Mittal committee guidelines, the ecological, economic, and technological feasibility of desiltation activities need to be assessed with the help of experts.

Prior to any declogging and desiltation works a resurvey of all deltaic rivers and canals should be undertaken and all types of river encroachments need to be removed. A detailed acoustic survey of all deltaic rivers and canals is suggested wherever possible to decide the required Base Floor Depths to maintain smooth flow.

Wherever feasible the conventional methods of desiltation involving manual clay digging should be adopted. Traditional polder reclamation that involves a combination of clay digging from the Kayal bed and subsequent bund formation using the material dug out from the Kayals. This will reduce the risk of damage to Kayal bed besides providing the marginalized communities with additional employment.



Map 26: Water hyacinth infested area in Vembanad estuary, Zone II

8 Budget

Management plan implementation will require a budget of ₹ 179.88 crores. Of this, the budget allocated for the basin-level actions is ₹ 71.56 crores. The activities proposed for Zone I will require ₹ 25.19 crores; Zone II will require about ₹ 58.77 crores and Zone III will require ₹ 24.36 crores. Of the total budget, Rs 21.72 crores can be mobilized through convergence with ongoing projects and schemes of various activities. Table 26.

Table 26: Summarised budget for management plan implementation at the basin and zone levels

	Total amount (in lakhs)	Total NPCA funding support needed (in lakhs)	NPCA (100%) (in lakhs)						NPCA (50%) and Convergence funding (50%) (in lakhs)						NPCA (60%) and Convergence funding (40%) (in lakhs)					
			1st yr	2nd yr	3rd yr	4th yr	5th yr	Total	1st yr	2nd yr	3rd yr	4th yr	5th yr	Total	1st yr	2nd yr	3rd yr	4th yr	5th yr	Total
Basin level actions	**7156**	**7006**	**5568**	**547**	**337**	**227**	**177**	**6856**	**300**	**0**	**0**	**0**	**0**	**300**						**0**
Component I: Institutions and Governance	6771	6771	5483	547	337	227	177	6771	0	0	0	0	0	0						0
Component II: Catchment Conservation and Mangement	385	235	85	0	0	0	0	85	300	0	0	0	0	300						0
Zone wise actions																				
Zone I	**2519.4**	**2179.75**	632.0	448.8	246.6	259.6	197.0	**1784.0**	10.0	131.4	126.2	115.7	71.2	**454.4**						**281**
Component I: Water Management	1244.3	1170.25	458.0	247.5	120.8	144.8	125.2	1096.3	10.0	65.0	59.5	9	4.5	148.0						0
Component 2: Species and Habitat Conservation	321.5	321.5	81.4	83.4	43.4	69.9	43.4	321.5						0.0						0
Component 3: Community based Fisheries Management	401.2	288.8	69.6	13.4	12.4	12.4	12.4	120.2							56.2	56.2	56.2	56.2	56.2	281
Component 4: Sustainable Wetland Agriculture Interactions	266.4	213.2	9	91.5	39	11.5	9	160.0	0.0	66.4	0.0	40	0	106.4						0
Component 5: Sustainable Wetland Tourism	286.0	186	14	13	31	21	7	86.0	0.0	0.0	66.7	66.7	66.7	200.0						0
Zone II	**5877.5**	**4674.6**						**3328.5**						**1833**						**716**
Component I: Water Management	3636.0	3074	474.0	682.4	500.2	452.2	403.3	2512.0	25.25	990.25	86.75	21.75	0	1124						0
Component 2: Species and Habitat Conservation	351.5	326.5	82	63	43	70.5	43	301.5	0	25.0	25.0	0.0	0.0	50						0
Component 3: Community based Fisheries Management	996.0	709.6	227.95	18.95	11.45	11.45	10.2	280.0						0	143.2	143.2	143.2	143.2	143.2	716
Component 4: Sustainable Wetland Agriculture Interactions	350.0	245.5	101.5	14	11.5	14	0	141.0	15	77.2	39.7	77.2	0.0	209						0
Component 5: Sustainable Wetland Tourism	544.0	319	14	13	35	30	2	94.0	0	0.00	150.00	150.00	150.00	450						0
Zone III	**2436.0**	**2155.00**						**1874.0**						**562.0**						**0**
Component I: Water Management	1432.5	1358	355.8	629.5	122.5	155.8	20.0	1283.5	11.3	51.3	51.3	23.3	12.0	149.0						0
Component 2: Species and Habitat Conservation	309.5	309.5	81.0	73.0	43.0	69.5	43.0	309.5						0.0						0
Component 3: Community based Fisheries Management	20.0	20	0.0	20.0	0.0	0.0	0.0	20.0						0.0						0
Component 4: Sustainable Wetland Agriculture Interactions	200.0	131	21.0	23.0	18.0	0.0	0.0	62.0	29.3	79.3	29.3	0.0	0.0	138.0						0
Component 5: Sustainable Wetland Tourism	474.0	336.5	39.0	63.0	38.3	36.3	22.3	199.0	15.0	15.0	81.7	81.7	81.7	275.0						0
Total	**17988.9**	**16015.4**						**13842.5**						**3149.4**						**997.0**

Source of funding

NPCA = 100 % funding under NPCA

NPCA (50%) and Convergence funding (50%) = 50% of the physical targets to be covered under NPCA and rest 50 % through convergence

NPCA (60%) and Convergence funding (40%)= 60% of the physical targets to be covered under NPCA and rest 40 % through convergence

Details of activities to be carried out though 100 % convergence support are given in the budget sheets and is not included here

Detail activity wise budget plan for the Vembanad Kol wetland basin level Table 27 and the three ecological zones viz., Zone I (Table 28), Zone II (Table 29), Zone III (Table 30) indicating year wise phasing, implementation locations, possible convergence sources are as follows:

Table 27: Detailed activity wise budget for Vembanad Kol Wetlands basin level activities

Activity		Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
1	**Institutions and Governance**																		
	1.1	Creation of VKWMU including Ramsar Interpretation Centre																	
		1.1.1	Government notification for constitution		SWAK		Alappuzha-Zone III (Punnamada Nehru Trophy Finishing point- DTPC)	✓					1	-	1	-	0	Core	
		1.1.2	Appointment of staff		SWAK			✓	✓	✓	✓	✓	1	10,25,000	per month	615.0	State Plan	Core	100%
		1.1.3	Designation of office space including establishment		SWAK			✓					1	22,00,000	Per year	22.0	State Plan	Core	100%
		1.1.4	Annual plan development		VKWMU	SWAK		✓					1	-	1	-	0	Core	
		1.1.5	Annual Governing Body meeting		VKWMU	SWAK		✓	✓	✓	✓	✓	5	1,00,000	per annum	5.0	State Plan	Core	100%
		1.1.6	Executive Committee meeting		VKWMU	SWAK		✓	✓	✓	✓	✓	10	50,000	biannually	5.0	State Plan	Core	100%
	1.2	Wetland boundary demarcation																	
		1.2.1	Wetland Demarcation																
			1.2.1.1	Ground truthing survey	VKWMU, SWAK	Department of Survey and Land records, Kerala State Remote Sensing and Environment Centre (KSREC)	Entire Wetland	✓					1	15,00,000	per survey	15.0	NPCA	Core	
			1.2.1.2	Placement of geo-tagged pillars	VKWMU, SWAK	Revenue department, District Collectors	Entire Wetland	✓					25000	6,000	per pillar	1,500.0	NPCA	Core	
			1.2.1.3	Maintenance of installed pillars	VKWMU, SWAK	Revenue department, District Collectors	Entire Wetland		✓	✓	✓	✓	4	5,00,000	lumpsum per year	20.0	NPCA	Core	
	1.3	Wetland Inventory, Assessment & Monitoring (WIAMS)																	
		1.3.1	Establishment of zone wise wetland monitoring and research sub-centres		VKWMU	CWRDM, KUFOS, CUSAT, MGU	Alappuzha, Kochi, Thrissur	✓					3		Lumpsum	2550	NPCA	Core	

Activity	Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
	1.3.2	Development of database management system - Establishment of zone wise data collection and collation infrastructure		VKWMU	CWRDM, KUFOS, CUSAT, MGU	Alappuzha, Kochi, Thrissur	✓	✓	✓	✓	✓	3		Lumpsum				
	1.3.3	Ecosystem Health Report Cards		VKWMU	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	3		Lumpsum				
	1.3.4	Publication of seasonal/annual/special monitoring reports		VKWMU	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	3		Lumpsum				
	1.3.5	Wetland monitoring and evaluation as per the monitoring plan detailed in the IMP report		VKWMU	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	3		Lumpsum				
	1.3.6	Hydrological monitoring																
		1.3.6.1	Establishment of monitoring stations to measure water and sediment flux including tide gauge stations at Munambam, Thottapally spillway and river gauge stations across the basin	CWRDM	SWAK, KSPCB, IDRB-Irrigation Department, Kerala Maritime Board, Survey of India-HSW	Basin wide	✓	✓				To be estimated as per the requirement		Lumpsum	800	NPCA	Core	
		1.3.6.2	Placement of monitoring buoys	CWRDM	SWAK, KSPCB, IDRB-Irrigation Department	Zone I, Zone II, Zone III	✓					6	15,00,000	Per buoy	90.0	NPCA	Core	
		1.3.6.3	Data collection and collation	CWRDM	SWAK, Irrigation Department, IDRB-Irrigation Department	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	5	5,00,000	Per year	25.0	NPCA	Core	
		1.3.6.4	Water quality monitoring	CWRDM	ATREE CERC, KSPCB, NERCI, CUSAT,KUFOS, IDRB-Irrigation Department	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	5	76,00,000	Per year	380.0	NPCA	Core	
	1.3.7	Establishment of laboratory facilities		VKWMU	CWRDM, KUFOS, CUSAT, MGU	Zone I, Zone II, Zone III	✓					3	2,00,00,000		600.0	NPCA	Non core	
	1.3.8	Specific studies																
		1.3.8.1	Climate risk assessments (including land ocean interactions to inform flood management strategies)	CWRDM	ICCS				✓					Lumpsum	30.0	NPCA	Core	

Activity	Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
		1.3.8.2	Environmental Impact Assessments of existing and new development projects	CWRDM	WISA					✓				Lumpsum	30.0	NPCA	Core	
		1.3.8.3	Multiple ecosystem service value assessments	WISA						✓				Lumpsum	30.0	NPCA	Core	
		1.3.8.4	Bioaccumulation studies for f+E23ish and crop including emerging pollutants based on available data	KUFOS	CUSAT, MGU		✓		✓		✓			Lumpsum	90.0	NPCA	Core	
		1.3.8.5	Macro and microplastic risk assessments	KUFOS	CUSAT, MGU				✓					Lumpsum	30.0	NPCA	Core	
		1.3.8.6	Carbon and GHG flux assessments	CWRDM						✓				Lumpsum	30.0	NPCA	Core	
		1.3.8.7	Carrying capacity assessment for the wetland for tourism operations including house boats	VKWMU	CWRDM/KTDC/KITTS, DTPC, Expert Agency				✓					Lumpsum	60.0	NPCA	Core	
		1.3.8.8	Study of trophic level interactions and biological diversity of Vembanad Kol system	VKWMU	KUFOS				✓					Lumpsum	30.0	NPCA	Core	
		1.3.8.9	Study on morpho-dynamics of coastal areas	VKWMU,Commissioned agency	Irrigation Department, CWRDM, KUFOS, Fisheries Department,			✓	✓			1	20,00,000	per study	20.0	NPCA	Core	
1.4	Communication Education Participation and Awareness																	
	1.4.1	Ramsar Signages - Installation and periodical maintenance		VKWMU	All KPs	Zone I, Zone II, Zone III	✓					60	50,000	per signage	30.0	NPCA	Core	
	1.4.2	WIAMS Web Portal and Mobile App maintenance		SWAK	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	1		lumpsum	15.0	NPCA	Core	
	1.4.3	Community mobilisation and proactive stakeholder engagement																
		1.4.3.1	Establishment of a community advisory groups for each wetland zone - Kol floodplains, Vembanad estuary, Kuttanad region	VKWMU	All KPs	Zone I, Zone II, Zone III	✓					3	3,00,000	per zone	9.0	NPCA	Core	
		1.4.3.2	Annual meetings of community advisory groups	VKWMU	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	3	5,00,000	per zone	15.0	NPCA	Core	

Activity	Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
		1.4.3.3	Community campaigns	VKWMU	All KPs	Zone I, Zone II, Zone III	✓	✓	✓	✓	✓	15	5,00,000	per campaign	75.0	NPCA	Core	
	1.4.4	Resource material		VKWMU	All KPs		✓	✓	✓	✓	✓	5	5,00,000	per annum	25.0	NPCA	Core	
	1.4.5	Newsletter		VKWMU	All KPs		✓	✓	✓	✓	✓	5	2,00,000	per publication	10.0	NPCA	Core	
	1.4.6	Workshops and public events		VKWMU	All KPs		✓	✓	✓	✓	✓	10	5,00,000	per event	50.0	NPCA	Core	
1.5	Capacity development																	
	1.5.1	Site Manager and his professional team training																
		1.5.1.1	Capacity and training needs Assessment Workshop	VKWMU	All KPs		✓					3	3,00,000	Per workshop	9.0	NPCA	Core	
		1.5.1.2	Prepare training calendar as per identified capacity and training needs	VKWMU	All KPs		✓										Core	
		1.5.1.3	ToR finalisation and agreements with respective capacity development agencies	VKWMU	All KPs		✓										Core	
		1.5.1.4	Trainings as per identified training needs	VKWMU	All KPs		✓	✓	✓	✓	✓			Lumpsum	60.0	NPCA	Core	
	1.5.2	Training of local communities and LSGs																
		1.5.2.1	Stakeholder consultations, ToR finalisation and agreements with respective capacity development agencies	VKWMU	All KPs & LSGs	Zone I, Zone II, Zone III	✓							Lumpsum	100.0	NPCA	Core	
		1.5.2.2	Training to LSGs on extant wetland management rules and regulations awareness programme	VKWMU	All KPs & LSGs	Zone I, Zone II, Zone III	✓	✓									Core	
		1.5.2.3	Training of local communities and bodies such as Panchayati Raj Institutions and CBOs on ecosystem-based wetland management	VKWMU	All KPs & LSGs	Zone I, Zone II, Zone III	✓	✓									Core	
		1.5.2.4	Trainings on creation of wetland peoples Biodiversity Register-ToR, Stakeholders Consultations	VKWMU	All KPs, LSGs, KSBB	Zone I, Zone II, Zone III	✓	✓									Core	
1.6	METT																	
	1.6.1	Workshops for development of Management Effectiveness Tracking Tool (METT)		VKWMU	WISA and other KPs		✓					2	5,00,000	per workshop	10.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
1.6.2	Pilot testing of METT	VKWMU	WISA and other KPs		✓					1	2,00,000	per site visit /testing	2.0	NPCA	Core	
1.6.3	Stakeholders consultation	VKWMU	WISA and other KPs		✓					2	1,00,000	per consultation	2.0	NPCA	Core	
1.6.4	Finalisation of METT	VKWMU	WISA and other KPs		✓								-			
1.6.5	Periodic monitoring of management effectiveness using METT	VKWMU	WISA and other KPs			✓	✓	✓	✓	4	1,00,000	per assessment	4.0	NPCA	Core	
1.7	Review & Adaptation															
1.7.1	Mid term review	SWAK, VKWMU	WISA and other KPs				✓			1	10,00,000	per assessment	10.0	NPCA	Core	
1.7.2	End term review	SWAK, VKWMU	WISA and other KPs						✓	1	15,00,000	per assessment	15.0	NPCA	Core	
Sub Total (NPCA)													**6,771.0**			
Sub total Convergence 50%																
Sub total Non core NPCA															**600.0**	
Sub total Non core Convergence 50%																
2	**Catchment Conservation and Management**															
2.1	Development and implementation of catchment treatment plan	VKWMU	CWRDM, WISA & Catchment Conservation Committees	Vembanad-Kol drainage basin								Lumpsum	50.0	NPCA	Non core	
2.1.1	Consultation workshops	VKWMU	CWRDM, WISA & Catchment Conservation Committees	Vembanad-Kol drainage basin	✓											
2.1.2	Appointment of expert agencies	VKWMU	CWRDM, WISA & Catchment Conservation Committees	Vembanad-Kol drainage basin	✓											
2.1.3	Development of catchment treatment plan with estimates	VKWMU	CWRDM, WISA & CCCs	Vembanad-Kol drainage basin	✓											
2.1.4	Consultations and finalisation	VKWMU	CWRDM, WISA & CCCs	Vembanad-Kol drainage basin	✓											
2.2	Creation of watershed management committees in the target micro-wat	VKWMU	Department of soil Survey and soil conservation	Vembanad-Kol drainage basin	✓	✓						Lumpsum	25.0	NPCA	Non core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in Lakh)	Source of funds (NPCA/ Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes (2022-23)
2.3	Treatment of degraded catchments											Lumpsum	300.0	NPCA (50%), Convergence (50%)	Non core	MGNREGS (50%)
2.3.1	Afforestation activities	Department of soil Survey and soil conservation , VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS	Vembanad-Kol drainage basin	✓	✓	✓	✓	✓							
2.3.2	Aided vegetative cover regeneration	Department of soil Survey and soil conservation , VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS	Vembanad-Kol drainage basin	✓	✓	✓	✓	✓							
2.3.3	Soil conservation measures	Department of soil Survey and soil conservation , VKWMU	CWRDM, WISA & CCCs, LSGs, Agriculture Dept., MGNREGS	Vembanad-Kol drainage basin	✓	✓	✓	✓	✓							
2.2.2	Monitoring, review and adaptation	VKWMU	CWRDM, WISA & CCCs, LSGs	Vembanad-Kol drainage basin				✓				Lumpsum	10.0	NPCA	Non core	
Sub Total (NPCA)													**85.0**			
Sub total Convergence 50%													**300.0**			
Sub total Non core NPCA															**85.0**	
Sub total Non core Convergence 50%															**300**	
Total (NPCA)													**6,856.0**			
Total (Convergence 50 %)													**300.0**			
Total Non Core NPCA															**685**	
Total Non Core Convergence 50 %															**300.0**	

Table 28: Detailed activity wise budget for Zone I

Activity	Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
1 Water management																		
1.1 Water Balance estimation and integrated water management plan for Zone I and Zone II																		
	1.1.1 Water Balance estimation for Zone I and zone II																	
		1.1.1.1	Terms of reference workshop	SWAK	Kerala State Planning Board, Irrigation Department, CWRDM, SDMA, Agriculture Department, KLDC, KUFOS, HSW	Zone I and Zone II	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
		1.1.1.2	Engagement of expert agency	SWAK and Irrigation Department	Kerala State Planning Board,SDMA, Agriculture Department, KUFOS, Other agencies, KLDC	Zone I and Zone II	✓					1				NPCA	Core	
		1.1.1.3	Survey and water balance assessments	VKWMU, SWAK	Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, HSW	Zone I and Zone II	✓					1	25,00,000	Per assessment	25.0	NPCA	Core	
		1.1.1.4	Draft Report consultations	Commissioned agency	SWAK, Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, CWRDM, Other	Zone I and Zone II		✓				1	2,00,000	Per workshop	2.0	NPCA	Core	
		1.1.1.5	Assessment report finalisation and publication	SWAK	Kerala State Planning Board, CWRDM, Irrigation Department, SDMA, Agriculture Department, KUFOS, Other	Zone I and Zone II		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
	1.1.2 Formulation of comprehensive water management strategy for Zone I based on IWRM approach																	
		1.1.2.1	Consultation workshops for water management strategy for Zone I	SWAK, Irrigation department	Kerala State Planning Board, CWRDM, SDMA, Agriculture Department, KUFOS, CWRDM, Other agencies	Zone I			✓			2	3,00,000	Per workshop	6.0	NPCA	Core	
		1.1.2.2	Formulation of draft plan	SWAK, Irrigation department	CWRDM, KUFOS	Zone I			✓			1	3,00,000	Per activity	3.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
1.1.2.3	Review, finalisation and approval		Kerala State Planning Board, Irrigation Department (and proposed Authority constituted under Kerala River Basin Conservation and	SWAK, CWRDM, KUFOS	Zone I			✓			1	1,00,000	Per workshop	1	NPCA	Core	
1.2	Removal of encroachments, unclogging of river stretches, desiltation of canals,ponds and estuaries																
1.2.1	Unclogging and removal of encroachments along River stretches (where there is observed clogging and where there is need for widening and not deepening of riverbeds)																
1.2.1.1	Survey and identification of rivers stretches in Zone I for removal of encroachments		Irrigation Department	LSGs, Agriculture Department and Padasekhram Committees, PWD, SDMA, VKWMU	Zone I rivers	✓	✓						Lumpsum	28.0	Convergence (10	Core	Room For River allocations (source SDRF Funds - 2022 MGNREGS) For Chalakkudy, Puzhakkal, Karuvannur and Keechery. (28 Lakh)
1.2.1.2	Removal of river encroachments		Irrigation Department	SWAK, VKWMU, LSGs, Revenue Dept., Survey and Land records, KRBCMA, KLDC	Zone I rivers	✓	✓	✓	✓	✓					Convergence (10	Core	
1.2.1.3	Bathymetric survey of rivers and canals to decide the required base flow depths wherever deemed necessary		SWAK, VKWMU	HSW, KUFOS, Irrigation Department- KERI, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	Zone I rivers and canals	✓					1	5,00,0000	Lumpsum	50.0	NPCA	Core	
1.2.1.4	Preparation of detailed plan on required declogging works for rivers and/or desiltation of canals to ensure smooth flow by a technical committee		SWAK, VKWMU, Irrigation Department, KRBCMA	Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), KUFOS, KLDC	Zone I rivers and canals		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	1.2.1.5	Comprehensive EIA study of the proposed works	SWAK, VKWM	KUFOS, CWRDM	Zone I and Zone II rivers and canals		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	
	1.2.1.6	Implementation of required declogging works for rivers and desiltation of canals to ensure smooth flow as per the approved plan	Irrigation Department	SWAK, VKWMU, Agriculture Department and Padasekhram Committees, KLDC, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	As per approved desiltation plan for rivers and canals of zone I				✓	✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (100%)	Core	RKI
1.2.2	Canals and waterways																
	1.2.2.1	Implementation of ongoing desiltation works of canals and waterways	KLDC	VKWMU	As per KLDC work plan under RKI	✓	✓	✓	✓		99 km - Main channels, 483 kms - Inner canals		Lumpsum	6684	Convergence (10	Core	Rebuild Kerala Initiative (RKI), TCR Ponnani Kole Phase IV 5year project started in 2022 - Total budget outlay 298 crores. KLDC was allocated Rs 235 crores of which Rs 153 crores is for Infrastructure assistance in Kol lands, 66.84 crores for deepening and widening of canals and 6.52 crores for construction of Engine sheds and Engine Thara in Thrissur-
	1.2.2.2	Feasibility study of desiltation of canals that are part of State waterways	KIIFB, Irrigation Department	VKWMU, Irrigation Department-Inland Navigation and National Watereways Authority, KLDC, Port Authority, Kerala State Port Department	Conolly canal, Other State waterways		✓				1	20,00,000	Per study	20	Convergence (10	Core	Possible convergence source can be KIIFB - Rs 1118 crore project for development of Conolly canal. was given in principle approval https://www.thehindu.com/news/cities/kozhikode/kiifb-project-to-develop-connolly-canal-as-waterway/article65059203.ece.
	1.2.2.3	Implementation of canal desiltation works as per approved plan under activity 1.2.1.4	Irrigation Department, KLDC	SWAK, LSGs, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA	As per approved desiltation plan for rivers and canals of zone I					✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (10	Core	Rebuild Kerala Initiative
	1.2.2.4	Post implementation monitoring and review of desiltation and infrastructure development works of Padasekhram in Kol lands	VKWMU, Knowledge partner	KAU, CWRDM, KLDC					✓	✓	1	15,00,000	Per study	15	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
1.2.3	Renovation of Panchayat ponds																
	1.2.3.1	Identification of silted ponds and preparation of desiltation plan by LSGs	VKWMU	LSGs, Irrigation Department, Agriculture department,	Zone I	✓	✓				100		Lumpsum	5.0	NPCA	Core	
	1.2.3.2	Implementation of desiltation plan	VKWMU, Irrigation Department	LSGs, Padasekhram Samithi	Zone I			✓	✓		100	800	Rs 800 per man-day @ 100 man-day per pond of approx. 1 ha	80.0	NPCA	Core	
	1.2.3.3	Strengthening of bunds around ponds using Vetiver and geo textiles	VKWMU, KFRI	LSGs, Padasekhram Samithi,				✓	✓		30	1,00,000	Per unit	30.0	NPCA	Core	MGNREGS funds can be leveraged to scale up the activity
1.2.4	Estuaries																
	1.2.4.1	Study to evaluate environmental impacts of existing breakwaters at Chettuva	VKWMU,Commissioned agency	Harbour Engineering Department, Irrigation Department, CWRDM, KUFOS, Fisheries Department-KSCADC	Chettuva Barmouth			✓	✓		1	20,00,000	per study	20.0	NPCA	Core	
	1.2.4.2	Maintenance of Chettuva harbour and approach channel	Harbour Engineering Department	Irrigation Department, CWRDM, KUFOS, Fisheries Department-KSCADC	Chettuva harbour and channel	✓	✓	✓	✓	✓		30000000	Lumpsum	300.0	Convergence (10	Core	Approx budget estimates based on the onging maintenance related works of Harbour Engineering Department totalling around Rs 265 lakhs - (Rs 7.40 lakhs, Rs 169 lakhs, Rs 46.43 lakhs, Rs 20.26 lakh, Rs 15.37 lakhs, Rs 5.82 lakhs)
1.3	Enhancing flows and connectivity																
1.3.1	Construction, repair, modification of culverts, sluices and ramps																
	1.3.1.1	Implementation of ongoing works	KLDC, Irrigation department	SWAK, Agriculture Department, KUFOS, KAU	As per KLDC work plan under RKI	✓	✓	✓	✓		308 Culverts 14 sluice 238 ramps		Lumpsum	15300	Convergence (10	Core	Rebuild Kerala Initiative (RKI), TCR Ponnani Kole Phase IV 5year project started in 2022 - Total budget outlay 298 crores. KLDC was allocated Rs 235 crores of which Rs 153 crores is for Infrastructure assistance in KoI lands that includes development of culverts, sluices and ramps

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	1.3.1.1	Detailed survey of existing culverts and bridges to detect blockage, repair needs and assesing need for new culverts, bridges, regulators	VKWMU, Irrigation Department	SWAK, Agriculture Department, KUFOS, KAU, KLDC	Zone I			✓			1	10,00,000	Per Survey	10.0	NPCA	Core	
	1.3.1.2	Planning and DPR preparation for work on new culverts and bridges, regulators	VKWMU, Irrigation Department	ADAK-Fisheries Department	Zone I				✓		1	10,00,000	Per activity	10.0	NPCA	Core	
	1.3.1.3	Construction, repair, modification of culverts and bridges based on plan	Irrigation Department	VKWMU, Agriculture Department, LSGs, PWD, Other agencies	Zone I					✓		Will be estimated based on I			Convergence (10	Core	Rebuild Kerala Initiative
1.3.2	Removal of invasive macrophytes (water hyacinth) from canals																
	1.3.2.1	Identification and manual removal of water hyacinth from clogged canals and waterways by LSGs	VKWMU	LSGs, Agriculture, Irrigation	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)	✓		✓		✓	150	800	Rs 800 per man day @100 manday per ha	120.0	NPCA	Core	
1.3.3	Utilization of water hyacinth as a bio- fuel																
	1.3.3.1	Biogas plants distribution to households	VKWMU	Pyal Jwala	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)		✓	✓			150	25000	per biogas plant of 8 litre capacity	37.5	Convergence (50%)	Core	GOBARDHAN of Department of Drinking Water and Sanitation, National Biogas Development Project (Agriculture Department), scheme
	1.3.3.2	Training and hand holding support	VKWMU	Pyal Jwala	Kodangallur, Pulloot GP; Edathirinji, Padiyur GP		✓	✓			2	100000	Per training	2.0	NPCA	Core	
	1.3.3.3	Review/ Cost Benefit Analysis	VKWMU	Commissioned agency					✓		1	1000000		10.0	NPCA	Core	
1.3.4	Utilisation of water hyacinth for making value added products																

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	1.3.4.1	Formation of SHGs and Incentives support	VKWMU		Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)			✓	✓		11	75000	Per SHG	8.3	NPCA	Core	
	1.3.4.2	Training to beneficiaries on water hyacinth collection and processing	VKWMU	FERI, KIDS, Kottapuram Integrated Development Society (KIDS),Kerala Academy of Skills Excellence (KASE), CRAR, SD College Alappuzha	Kodangallur, Pulloot GP; Edathirinji, Padiyur GP			✓	✓		3	300000	per training	9.0	Convergence (50	Core	Pradhanmantri Kaushal Vikas Yojana
	1.3.4.3	Training to beneficiaries on water hyacinth craft and product making	VKWMU	FERI, KIDS, Kottapuram Integrated Development Society (KIDS),Kerala Academy of Skills Excellence (KASE), CRAR, SD College Alappuzha	Kodangallur, Pulloot GP; Edathirinji, Padiyur GP			✓	✓		3	300000	per training	9.0	Convergence (50	Core	Pradhanmantri Kaushal Vikas Yojana
	1.3.4.4	Marketing and enterprise development	VKWMU	Kerala Academy of Skills Excellence (KASE)	Kodangallur, Pulloot GP; Edathirinji, Padiyur GP			✓	✓	✓			Lumpsum	20.0	NPCA	Core	
1.4	Pollution abatement measures																
	1.4.1	Assessment of sewage load (current and future projections)															
	1.4.1.1	Terms of reference workshop	SWAK, VKWMU	Kerala State Pollution Control Board (KSPCB), Kerala CZMA	Thrissur	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	

Activity			Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
			1.4.1.2	Appointment of expert agencies	Kerala State Pollution Control Board (KSPCB), VKWMU, NEERI	SWAK		✓					1			-	NPCA	Core	
			1.4.1.3	Survey and sewage load assessments	Commissioned agency, Kerala State Pollution Control Board (KSPCB), VKWMU	SWAK	Zone I	✓					3	50,00,000	Per assessment	150.0	NPCA	Core	
			1.4.1.4	Stakeholder consultation meetings	KSPCB, VKWMU	LSG Planning Department, Municipalities and Panchayats, SWAK	Thrissur		✓				1	3,00,000	Per meeting	3.0	NPCA	Core	
			1.4.1.5	Draft report consultation	Commissioned agency, Kerala State Pollution Control Board (KSPCB), VKWMU	SWAK, CWRDM			✓				1	2,00,000	Per report	2.0	NPCA	Core	
			1.4.1.6	Report finalisation and publication	Commissioned agency, Kerala State Pollution Control Board (KSPCB), VKWMU	SWAK			✓				1	5,00,000	Per report	5.0	NPCA	Core	
		1.4.2	Containment, treatment and safe disposal of municipal sewage and solid waste (around municipal corporation areas)		LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, KSPCB, SDMA	Zone I Municipalities (Refere to Annex 18 and 19)	✓	✓	✓	✓	✓			Activities are budgeted under projects of different departments		Convergence (10	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
1.4.3	Containment, treatment and safe disposal of industrial effluents	Industries Dept., LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, KSPCB, SDMA, SUCHITWA MISSION	Zone I Municipalities (Refere to Annex 18 and 19)	✓	✓	✓	✓	✓			Activities are budgeted under projects of different departments		Convergence (10	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission
1.4.4	Installation of Decentralised Waste water treatment systems	Industries Dept.,LSG Department Planning, LSGs, Kerala CZMA, VKWMU	SWAK, VKWMU, KSPCB, SDMA, SUCHITWA MISSION	Chavakkad, Thrissur slum areas	✓	✓	✓	✓	✓	2	1500000	Per 50 household (@30,000 per household	30.0	NPCA	Core	
1.4.5	Construction of improved septic tanks as Anaerobic Baffled reactors and anaerobic filters in PHCs, schools and Aanganwadi centres in high water table areas	LSGs, LSG Department Planning, VKWMU	Kerala Rural Water Supply and Sanitation Agency	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)		✓	✓			15	150000	per structure	22.5	Convergence (50	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.6	Subsidy for households for Modified Prefabricated Septic tanks and specially designed septic tanks	LSGs, LSG Department Planning, VKWMU	Kerala Rural Water Supply and Sanitation Agency	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)		✓	✓			100	25000	per household	25.0	Convergence (50	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.7	Subsidy for households for biodigester tanks for IHHL	LSGs, LSG Department Planning, VKWMU	Kerala Rural Water Supply and Sanitation Agency	Gram Panchayats - Poomangalam, Vellangallur, Padiyoor, Karalam, Velukkara, Kodungalloor, Puttanchira, Thrissur(Aranattukara, Kurukkancherri)		✓	✓			50	50000	per household	25.0	Convergence (50	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)

Activity	Sub-activity			Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	1.4.8	Support to LSGs (Gram Panchayats) for implementing pollution control measures in rural areas																
		1.4.8.1	Training programme for SHGs, entrepreneurs LSGs involved in waste management under Suchitwa mission	VKWMU, Expert agencies	LSGs	Zone I local governments	✓	✓				51	Activities are budgeted in the Suchitwa Mission			Convergence (10	Core	LSG grants, Suchitwa Mission
		1.4.8.2	Panchayat wise survey and identification of canals, storm drains, wetlands with high pollution loads for cleaning	VKWMU	LSG Planning Department, Gram Panchayats	Zone I local governments	✓	✓				Covered under Activity 1.3.2.1	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	Convergence (10	Core	LSG grants, Suchitwa Mission
		1.4.8.3	Annual cleaning of canals and wetlands, manual scoring of scum and other waste material under pre monsoon pollution abatement activities by Haritha Karma Sena	VKWMU	LSGs	Zone I local governments	✓	✓				Covered under Activity 1.3.2.1	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	Convergence (10	Core	LSG grants, Suchitwa Mission
		1.4.8.4	Infrastructure support for Haritha Kermi Sena such as Autos, Trolleys, vehicles for Haritha Karma Sena	VKWMU	LSG Planning Department, Gram Panchayats	Zone I local governments	✓	✓				51	600000	Per Panchayat	306.0	NPCA	Non core	
		1.4.8.5	Installation of mesh for screening out of waste from streams and irrigation canals	VKWMU	LSGs, Expert agencies	Zone I local governments	✓	✓				51	100000	Per Panchayat	51.0	NPCA	Core	
	1.4.9	Awareness programmes on plastic waste management and support for establishment of integrated plastic waste management facilities																
		1.4.9.1	Awareness programme on plastic waste management	VKWMU	KILA, ATREE	Zone I		✓		✓		51	50,000	Per Panchayat	51.0	NPCA	Core	
		1.4.9.2	Support to integrated plastic waste management activities in all LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU	Zone I	✓	✓				Covered under Activity 1.4.8.4					Non core	
		1.4.9.3	Feasibility assessment and planning for establishment of plastic recycling units in zone II LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU	Zone I		✓				3	3,00,000	per workshop	9	NPCA	Core	Rebuild Kerala Initiative
		1.4.9.4	Plastic load assessment study to quantify load of microplastic, mesoplastic and macroplastic in the water column and sediment	SWAK, VKWMU	KUFOS, CWRDM	Zone I		✓				1	15,00,000	Per study	15	NPCA	Core	
1.5	Rain water harvesting and groundwater recharge																	
	1.5.1	Support to well based rooftop rain water harvesting and recharge system in community institutions and individual households such as "Mazhapolima"																
		1.5.1.1	Community Education and awareness generation	VKWMU, Kerala Rural Water Supply and Sanitation Agency (KRWSA)	SDMA, LSGs, CSOs	Zone I			✓	✓		-	10,00,000	Lumpsum	10.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	1.5.1.2	Demonstration and trainings	VKWMU, KRSWA	SDMA, Expert Agencies	Zone I			✓	✓		10	1,00,000	Per training	10.0	Convergence (10	Core	Jalanidhi programme of KRWSA
	1.5.1.3	Incentive support and implementation	VKWMU, KRSWA	Expert Agencies, LSGs	Zone I			✓	✓		50	25,000	Per GP	12.5	Convergence (10	Core	Jalanidhi programme of KRWSA
1.5.2	Review and assessment		VKWMU, KRSWA	CWRDM,SDMA	Zone I			✓	✓		1	10,00,000	Per assessment	10.0	NPCA	Core	
1.6	Improved management of irrigation dams of Kol lands																
1.6.1	Sedimentation and hydraulic study of irrigation str		IDRB - Irrigation Department, (Irrigation Design and Research Board) SWAK	Kerala Engineering Research Institute, CWRDM, KAU, KWA, Agriculture Department, KLDC	Peechi, Vazhani, Chimmini dams	✓	✓				1	20,00,000	Per study	20.0	Convergence (50	Core	Irrigation Department
1.6.2	Stakeholder meetings for finalisation of recommer		IDRB - Irrigation Department, SWAK	KERI, CWRDM, KAU, KWA, Agriculture Department				✓			1	3,00,000	Per workshop	3.0	NPCA	Core	
1.6.3	Implementation of recommended actions		IDRB - Irrigation Department, SWAK	SWAK, KERI	Peechi, Vazhani, Chimmini dams			✓						Will be estimated based on the plan 1.5.2	Convergence (10	Core	
1.6.4	Post implementation monitoring and review		IDRB - Irrigation Department	SWAK, KERI, CWRDM	Peechi, Vazhani, Chimmini dams				✓		1	3,00,000	Per workshop	3.0	NPCA	Core	
1.6.5	Research for further refinement and adaptation		IDRB - Irrigation Department, SWAK	KERI, CWRDM, KAU, KWA, Agriculture Department	Peechi, Vazhani, Chimmini dams				✓		1	3,00,000	Per workshop	3.0	NPCA	Core	
Sub Total (NPCA)														**1,096.3**			
Sub Total (Convergence 50 %)														**148.0**			
Non core NPCA																**306.0**	
Non core Convergence 50 %																**72.5**	
2 Species and Habitat Conservation																	
2.1	Asian waterbird census																
2.1.1	Empanelment of census co ordinators		SWAK, VKWMU	WISA, Kol Birders Soc., KAU-FD	Zone I	✓								-	NPCA	Core	
2.1.2	Formation of census groups		SWAK, VKWMU	WISA, Kol Birders Soc., KAU-FD, KFRI	Zone I	✓					1	50,000	Per ecological zone	0.5	NPCA	Core	
2.1.3	Waterbird census training		SWAK, VKWMU	WISA, Kol Birders Soc., KAU-FD, KFRI	Zone I	✓					2	50,000	Per training workshop	1.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
2.1.4	Census		SWAK, VKWMU	WISA, Kol Birders Soc., KAU-FD, KFRI	Zone I	✓	✓	✓	✓	✓	5	5,00,000	Per annual census	25.0	NPCA	Core	
2.1.5	Data compilation and reporting		SWAK, VKWMU	WISA, Kol Birders Soc., KAU-FD, KFRI	Zone I	✓	✓	✓	✓	✓	5	50,000	Per year	2.5	NPCA	Core	
2.2	Fin and shell fish census																
2.2.1	Empanelment of census co ordinators		SWAK, VKWMU	KUFOS, ATREE-CERC	Zone I	✓					1	-	Per ecological zone	-	NPCA	Core	
2.2.2	Formation of census groups		SWAK, VKWMU	KUFOS, ATREE-CERC	Zone I	✓					5	50,000	Per ecological zone	2.5	NPCA	Core	
2.2.3	Fish census training		KUFOS, VKWMU	SWAK, ATREE-CERC	Zone I	✓					2	50,000	Per training workshop	1.0	NPCA	Core	
2.2.4	Census		KUFOS, VKWMU	NGOs, KUFOS, ATREE-CERC	Zone I	✓	✓	✓	✓	✓	5	5,00,000	Per annual census	25.0	NPCA	Core	
2.2.5	Data compilation and reporting		KUFOS, VKWMU	NGOs, KUFOS, ATREE-CERC, KAU	Zone I	✓	✓	✓	✓	✓	5	50,000	Per annual report	2.5	NPCA	Core	
2.3	Comprehensive VKW biodiversity assessment																
2.3.1	Terms of reference workshop		VKWMU	WISA, KSBB, ATREE, KUFOS, KAU, KFRI, Local NGOs	Zone I	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
2.3.2	Appointment of expert agencies		VKWMU	WISA, KSBB, ATREE, KUFOS, KAU, KFRI, Local NGOs	Zone I	✓								-	NPCA	Core	
2.3.3	Biodiversity surveys (biannual)		Expert Agency	WISA, KSBB, ATREE, KUFOS, KAU, KFRI, Local NGOs	Zone I	✓	✓	✓	✓	✓	10	5,00,000	Per census	50.0	NPCA	Core	
2.3.4	Draft report consultation		Expert Agency	WISA, KSBB, ATREE, KUFOS, KAU, KFRI, Local NGOs	Zone I	✓					1	2,00,000	Per consultation	2.0	NPCA	Core	
2.3.5	Report finalisation and publication		Expert Agency	WISA, KSBB, ATREE, KUFOS, KAU, KFRI, Local NGOs	Zone I	✓	✓	✓	✓	✓	5	1,00,000	Per annual report	5.0	NPCA	Core	
2.4	Monitoring of invasive species																
2.4.1	Mapping of invasive species distribution in two seasons pre and post monsoon		ATREE CERC	KUFOS, KFRI, KAU	Zone I	✓			✓		4	10,00,000	Per activity (biannual)	40.0	NPCA	Core	

Activity		Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	2.4.2	Stakeholders sensitization workshops	KUFOS	CMFRI	Zone I	✓			✓		1	3,00,000	Per workshop	3.0	NPCA	Core	
	2.4.3	Surveillance and control measures				✓			✓		2	5,00,000	per year	10.0	NPCA		
	2.4.4	Follow up support	VKWMU	SWAK	Zone I	✓	✓	✓	✓	✓	1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5	Mapping and protection of key habitat areas																
	2.5.1	Survey and mapping of fish breeding grounds	ATREE CERC	KUFOS	Zone I		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	
	2.5.2	Survey and mapping of bird congregation areas	KAU	KBS	Zone I		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
	2.5.3	Survey and mapping of mangroves and associated habitats	CMFRI	KUFOS, KFRI, WISA	Zone I		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
	2.5.4	Community workshops to develop conservation strategies	KUFOS	CMFRI, WISA, CWRDM	Zone I		✓				2	3,00,000	Per workshop	6.0	NPCA	Core	
	2.5.5	Mangrove restoration in Chettuva estuary	Fisheries Department, VKWMU, Social Forestry Dept.	CMFRI, WISA, KFRI, KUFOS	Chettuva estuary		✓					20,00,000	Lumpsum	20.0	NPCA	Core	1.3 lakhs avaiable for convergence under Fisheries Department scheme on mangove afforestation in the estauary for 1000 saplings over three years from 2022-25
	2.5.6	Appointment of community wardens in LSG	VKWMU	LSGs	Zone I	✓					15				NPCA	Core	
	2.5.7	Honararium for community wardens	VKWMU	LSGs	Zone I	✓	✓	✓	✓	✓	15	1,20,000	Per warden	90.0	NPCA	Core	
	2.5.8	Watch and ward of habitats	Wetland Mitra, Communities	VKWMU, SWAK	Zone I	✓	✓	✓	✓	✓	5	2,00,000	Per year	10.0	NPCA	Core	
2.6	Animal disease surveillance																
	2.6.1	Develop an SOP for handling avian diseases episodes	SACON, KVASU	SIAD	Zone I	✓					1	1,00,000	Per ecological zone	1.0	NPCA	Core	
	2.6.2	Conduct workshops to spread awareness on avian diseases and their controls	SACON	SIAD	Zone I	✓					1	50,000	Per ecological zone	0.5	NPCA	Core	
	2.6.3	Annual disease surveillance and reporting including avifauna, fish and clam species	SIAD, Fisheries Department	SACON, KVASU, KAU	Zone I	✓	✓	✓	✓	✓	5	100000	Per annum	5.0	NPCA	Core	One Health Programme
Sub Total (NPCA)														**321.5**			
Sub Total (Convergence 50 %)																	
Non Core NPCA																-	
Non core Convergence 50 %																-	
3	**Community based fisheries management**																
3.1	Systematic catch assessment																
	3.1.1	Protocol development workshop	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone I	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
	3.1.2	Monthly data collection based on scientific methodology	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone I	✓	✓	✓	✓	✓	5	6,00,000	Per annum	30.0	NPCA	Core	
	3.1.3	Stakeholder workshop on draft findings	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone I	✓	✓	✓	✓	✓	5	1,00,000	Per workshop	5.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
3.1.4	Report finalisation and publication		Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone I	✓	✓	✓	✓	✓	5	60,000	Per report	3.0	NPCA	Core	
3.2	Development of fishing calendar and zones																
3.2.1	Constitution of committee of experts and stakeholders		VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone I	✓					1	1,00,000	Per activity	1	NPCA	Core	
3.2.2	Consultation meetings		VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone I	✓					1	5,00,000	Per activity	5	NPCA	Core	
3.2.3	Production of draft calendar and zone regulations		VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone I	✓	✓				1	2,00,000	Per activity	2	NPCA	Core	
3.2.4	Community monitoring and enforcement		Fisher Cooperatives	Clam Collectors Society	Zone I	✓	✓	✓	✓	✓	5	1,00,000	Per annum	5	NPCA	Core	
3.3	Establishment of 2ha Fish/Clam Protected Area																
3.3.1	Surveys to identify new sites for establishing Fish/Clam Protected Area		Dept. of Fisheries, Govt. of Kerala	KUFOS	(Zone I) Karuvannur-Chettuva Aquatic Ecosystem - 14 PA	✓	✓				2		Year wise allocations given under convergence schemes	7.62	Convergence (100%)	Core	Ongoing since 2022-23. 6 Lakh (2022-23) 6 Lakh (2023-24) 1.62 lakh (2024-25)
3.3.2	Maintenance of existing Protected areas		Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community	(Zone I) Karuvannur-Chettuva Aquatic Ecosystem - 14 PA		✓	✓	✓	✓	14	80,000	Per Protected area	11	NPCA	Core	
3.3.2	Ranching		Dept. of Fisheries, Govt. of Kerala	Co-operative Society/SHGs	(Zone I) Karuvannur and Chettuva Aquatic Ecosystem (existing) Keechery, Puzhakkal (Proposed)	✓	✓	✓	✓	✓	5	31,80,000	Per annum	159.0	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Ongoing since 2022-23. 31.8 Lakh (2022-23) 31.8 Lakh (2023-24) 31.8 Lakh (2024-25) Proposed activity on 3rd, 4th and 5th year with same budget allocations.
3.4	Surveillance and awareness programme																
3.4.1	Procurement of patrolling boat		Dept. of Fisheries, Govt. of Kerala		(Zone I) Karuvannur-Chettuva Aquatic Ecosystem	✓						50,00,000	Lumpsum	50.0	NPCA	Core	Dept. of Fisheries - 1 patrolling boat (FRP, 18 feet) with OBM purchased by the department in 2022-23 using budget of Rs 6.45 lakhs.
3.4.2	Maintenance of patrolling boats		Dept. of Fisheries, Govt. of Kerala		(Zone I) Karuvannur-Chettuva Aquatic Ecosystem	✓	✓	✓	✓	✓	5	18,50,000	Per year	92.5	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Dept. of Fisheries

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
3.4.3	Formation and Functioning of FMCs		Dept. of Fisheries, Govt. of Kerala	Co-operative Society/SHGs	(Zone I) Karuvannur-Chettuva Aquatic Ecosystem	✓	✓	✓	✓	✓	5	80,000	Lumpsum per year	4.0	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Convergence budgets available with Dept of Fisheries 0.3 Lakh (2022-23) 0.8 Lakh (2023-24) 0.8 Lakh (2024-25)
3.4.4	Support to fisheries management councils (FMC) for active surveillance		VKWMU	Fisheries Department, Fisher Cooperatives		✓	✓	✓	✓	✓	5	1,00,000	Per annum	5	NPCA	Core	
3.4.5	Awareness Programmes on sustainable fishing practices		Dept. of Fisheries, Govt. of Kerala	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs	(Zone I) Karuvannur-Chettuva Aquatic Ecosystem	✓	✓	✓	✓	✓	5	1,50,000	Lumpsum	7.5	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Ongoing since 2022-23. 1.5 Lakh (2022-23) 1.5 Lakh (2023-24) 1.5 Lakh (2024-25)
3.5	Appointment of project coordinator																
3.5.1	Honorarium		Dept. of Fisheries, Govt. of Kerala		(Zone I) Karuvannur-Chettuva Aquatic Ecosystem	✓	✓	✓	✓	✓	5	3,60,000	per individual per year	18.0	Convergence (1st and 2nd year 100 %) and Covered for 4 th and 5 th years under NPCA	Core	Ongoing since 2022-23. 3.6 Lakh (1st Year) 3.6 Lakh (2nd Year) 3.6 Lakh (3rd Year)
Sub Total (NPCA)														**120.2**			
Sub Total (Convergence 50 %)																	
Sub Total (Convergence 40 %, NPCA 60 %)														**281.0**			
Non core NPCA																	
Non core Convergence 50 %																	
4	**Sustainable Wetland agriculture interactions**																
4.1	Revival of traditional Pokkali farming system																
4.1.1	Incentive programmes for Pokkali farmers		Agriculture Department, PLDA	KAU, CMFRI	Thrissur district		✓		✓		200	25,000	Per farmer	50	Convergence (50	Non core	Agriculture department special Agriculture Zone Funds- Rs 7600 lakhs
4.1.2	Supporting Pokkali harvest festival		Agriculture	KAU, CMFRI	Thrissur district		✓		✓		2	2,50,000	Per festival	5	NPCA	Non core	
4.1.3	Organising awareness drives for Pokkali farmers on best practices		Agriculture Department, PLDA	KAU, CMFRI,KUFOS	Thrissur district		✓		✓		10	3,00,000	Per programme	30	Convergence(50%	Non core	Agriculture department Extension scheme
4.1.4	Strengthening market linkages				Thrissur district												
	4.1.4.1	Establishment of pokkali seed	Agriculture	KAU,	Thrissur district		✓				4	7,50,000	Per centre	30	NPCA	Non core	
	4.1.4.2	Operation of pokkali seed centres	Agriculture	KAU,	Thrissur district		✓	✓	✓	✓	4	1,00,000	Per centre	16	NPCA	Non core	
	4.1.4.3	Establishment of local procurement centres for collection and distribution of fish and Pokkali rice	Fisheries Department, PLDA	KAU, CMFRI,KUFOS	Thrissur district		✓				1	30,00,000	Per centre	30	NPCA	Non core	
	4.1.4.4	Operation of local procurement centres for collection and distribution of fish and Pokkali rice	Fisheries Department, PLDA	CMFRI	Thrissur district		✓	✓	✓	✓	1	5,00,000	Per centre per year	20	NPCA	Non core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
	4.1.4.5	Support for polder improvement works	Agriculture Department, PLDA	KAU, CMFRI, VKWMU	Thrissur district		✓	✓	✓	✓	4	50,00,000	Per year	200	Convergence (10	Non core	NABARD, Agency for Development of Aquaculture, Kerala schemes. Scheme of "Oru nellum, oru meenum " was using National Adaptation Fund for Climate change of Rs 33. 73 crores was operational till 2021 since 2015
	4.1.4.6	Support for enterprise development	SWAK, VKWMU	Agriculture Department, PLDA, Fisheries Department, KAU	Thrissur district			✓			1	30,00,000	Lumpsum	30	NPCA	Non core	
4.2	Polder improvisation and strengthening																
	4.2.1	Restoration of outer bunds of Padasekharams	KLDC, Agriculture Department, SDMA	Padasekhram Samithi, LSG	Zone I	✓	✓				6570			15300	Convergence(10(	Non core	153 crores allocated to KLDC for Infrastructure assistance in Kole land padasekhrams under TCR Ponnani Kole Phase IV project (total budget 298 crores), RKI
	4.2.2	Construction of ramp and sluice	KLDC, Agriculture Department, SDMA	Padasekhram Samithi, LSG	Zone I	✓	✓				252				Convergence(10(	Non core	
	4.2.3	Construction of box culverts	KLDC, Agriculture Department, SDMA	Padasekhram Samithi, LSG	Zone I	✓	✓				308				Convergence(10(	Non core	
	4.2.4	Construction of Engine sheds and Engine Thara	KLDC, Agriculture Department, SDMA	Padasekhram Samithi, LSG	Zone I	✓	✓				162 works			1400	Convergence(10(	Non core	14 crores allocated to KLDC under RKI for TCR Ponnani Kole Phase IV project - 298 crores
	4.2.5	Replacement of Petti- Para with Vertical Axial Flow pump sets	KLDC, Agriculture Department, SDMA	Padasekhram Samithi, LSG	Zone I	✓	✓				315			5700	Convergence(10(	Non core	57 crores allocated to Agriculture Department (Engineering Wing) under RKI for TCR Ponnani Kole Phase IV project - 298 crores
4.3	Review and adaptation of cropping calendars for Kole lands																
	4.3.1	Stakeholder workshop to discuss existing and new calendars for single and double cropping system	VKWMU, KAU	Agriculture Department, Padasekhram Samithi, KUFOS, Fisheries Department, LSG	Zone I	✓					2	3,00,000	Per workshop	6.0	NPCA	Core	
	4.3.2	Draft report presentation suggesting refinements and adaptation	VKWMU, KAU	Agriculture Department, Padasekhram Samithi, KUFOS, Fisheries Department, LSG	Zone I	✓					1	2,00,000	per report	2.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
4.3.3	Report finalisation and publication		VKWMU, KAU	Agriculture Department, Padasekhram Samithi, KUFOS, Fisheries Department, LSG	Zone I	✓					1	1,00,000	per report	1.0	NPCA	Core	
4.4	Promoting good agricultural practices																
4.4.1	Collation and publication of wetland-friendly package of practices		VKWMU	KAU, Agriculture Department, Veterinary department, KUFOS, Fisheries Department	Zone I		✓				1	10,00,000	Per publication	10.0	NPCA	Non core	
4.4.2	Outreach workshops		VKWMU	KAU, Agriculture Department, Veterinary department, KUFOS, Fisheries Department	Zone I		✓				20	50,000	Per workshop	10.0	NPCA	Non core	
4.4.3	Incentives for adopting good agricultural practices		Agriculture Department, VKWMU	KAU, VKWMU	Zone I		✓				300	8,800	Per ha	26.4	Convergence(50%	Non core	Agriculture department - Scheme on "Organic farming and good agricultural practices" - Rs 600 lakhs
4.4.4	Hand-holding support		Agriculture Department	KAU, VKWMU	Zone I		✓				500	Lumpsum		10.0	Convergence(100	Non core	
Sub Total (NPCA)														**160.0**			
Sub Total (Convergence 50 %)														**106.4**			
Non core NPCA																**151.0**	
Non core Convergence 50 %																**106.4**	
5 Sustainable wetland tourism																	
5.1	Capacity development support and incentives for maintaining standards																
5.1.1	Needs assessments		VKWMU	DTPC, SWAK	Zone I	✓	✓				1	2,00,000	Per workshop	2.0	NPCA	Core	
5.1.2	Programme design		VKWMU	DTPC, SWAK	Zone I	✓	✓				1	5,00,000		5.0	NPCA	Core	
5.1.3	Training workshops		VKWMU	DTPC, SWAK	Zone I	✓	✓				1	5,00,000	Per workshop	5.0	NPCA	Core	
5.1.4	Incentives programme for standard maintenance		DTPC	VKWMU, SWAK	Zone I		✓		✓		2	10,00,000	Per annum	20.0	Convergence(100	Core	Kerala Tourism 2.0 - Development of tourism corridor - Rs 362.15 crores of which Rs 9.5 crore is for responsible
5.1.5	Follow up support		VKWMU	DTPC, SWAK	Zone I	✓	✓	✓	✓	✓			Lumpsum	10	NPCA		
5.2	Orientation programmes for houseboat owners, tourism facility owners and tour operators																
5.2.1	Orientation programme design		DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone I			✓			1	10,00,000	Per study	10.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core activities as per NPCA	Convergence Schemes
5.2.2	Orientation workshops		DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone I - Shakthan Thampuran Palace, Vadakkechira, Chemmappilly,,Conolly canal			✓	✓		3	3,00,000	Per workshop	9.0	NPCA	Core	
5.2.3	Follow up support		DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone I			✓	✓	✓			Lumpsum	10.0	NPCA	Core	
5.3	Nature education programmes for tourists																
5.3.1	Nature awareness programme design		Expert Agency	Local NGOs	Zone I			✓	✓		1	10,00,000	Per study	10.0	NPCA	Core	
5.3.2	Workshops and events		VKWMU	Local NGOs	Zone I - Shakthan Thampuran Palace, Vadakkechira, Chemmappilly, Conolly canal			✓	✓		3	3,00,000	Per workshop	9.0	NPCA	Core	
5.3.3	Programme evaluation and follow up support		VKWMU	SWAK, Local NGOs	Zone I			✓	✓	✓	1	5,00,000	Lumpsum	5.0	NPCA	Core	
5.4	Wetland specific tourism programme design for Zone I																
5.4.1	Programme design workshop		SWAK, VKWMU	DTPC	Zone I	✓					2	3,00,000	Per workshop	6.0	NPCA	Core	
5.4.2	Formulation of draft plan		SWAK, VKWMU	DTPC	Zone I		✓				1	2,00,000	Per activity	2.0	NPCA	Core	
5.4.3	Review, finalisation and approval		SWAK, VKWMU	DTPC	Zone I		✓				1	3,00,000	Per workshop	3.0	NPCA	Core	
5.4.4	Implementation of the program		DTPC	VKWMU	Zone I			✓	✓	✓	1		Lumpsum	200.0	NPCA (50%) Convergence (50%)	Core	
Sub Total (NPCA)														**86.0**			
Sub Total (Convergence 50 %)														**200.0**			
Non core NPCA																	
Non core Convergence 50 %																	
Total (NPCA)														**1,784.0**			
Total (Convergence 50 %)														**454.4**			
Total (Convergence 40 %, NPCA 60 %)														**281.0**			
Total Non core NPCA																**457.0**	
Total Non core Convergence 50 %																**178.90**	

Note

Source of funding(column R)

NPCA = 100 % funding under NPCA

Convergence (50%) = 50% of the physical targets to be covered under NPCA and rest 50 % through convergence

Convergence (100%) = 100% of the funding through convergence

Table 29: Detailed activity wise budget for Zone II

Activity			Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1 Water management																		
1.1 Water Balance estimation and integrated water management plan for Zone I and Zone II																		
		1.1.1	1.1.1.1	Terms of reference workshop	SWAK	Kerala State Planning Board, Irrigation Department, CWRDM, SDMA, Agriculture Department, KLDC, KUFOS, HSW	Zone I and Zone II	✓					1	3,00,000	Per workshop	A common budget for Water balance estimation for Zone I and zone II is given in Zone I action plan	NPCA	Core	
			1.1.1.2	Engagement of expert agency	SWAK and Irrigation Department	Kerala State Planning Board,SDMA, Agriculture Department, KUFOS, Other agencies, KLDC	Zone I and Zone II	✓					1				NPCA	Core	
			1.1.1.3	Survey and water balance assessments	VKWMU, SWAK	Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, HSW	Zone I and Zone II	✓					1	25,00,000	Per assessment		NPCA	Core	
			1.1.1.4	Draft Report consultations	Commissioned agency	SWAK, Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, CWRDM, Other agencies	Zone I and Zone II		✓				1	2,00,000	Per workshop		NPCA	Core	
			1.1.1.5	Assessment report finalisation and publication	SWAK	Kerala State Planning Board, CWRDM, Irrigation Department, SDMA, Agriculture Department, KUFOS, Other agencies, KLDC	Zone I and Zone II		✓				1	2,00,000	Lumpsum		NPCA	Core	
		1.1.2	Formulation of comprehensive water management strategy for Zone II based on IWRM approach															
			1.1.2.1	Consultation workshops for water management strategy for Zone II	SWAK, Irrigation department	Kerala State Planning Board, CWRDM, SDMA, Agriculture Department, KUFOS, CWRDM, Other agencies	Zone II			✓			2	3,00,000	Per workshop	6.0	NPCA	Core	
			1.1.2.2	Formulation of draft plan	SWAK, Irrigation department	CWRDM, KUFOS	Zone II			✓			1	3,00,000	Per activity	3.0	NPCA	Core	

Activity			Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1 Water management																		
1.1 Water Balance estimation and integrated water management plan for Zone I and Zone II																		
		1.1.1	1.1.1.1 Terms of reference workshop	SWAK	Kerala State Planning Board, Irrigation Department, CWRDM, SDMA, Agriculture Department, KLDC, KUFOS, HSW	Zone I and Zone II	✓					1	3,00,000	Per workshop	A common budget for Water balance estimation for Zone I and zone II is given in Zone I action plan	NPCA	Core	
			1.1.1.2 Engagement of expert agency	SWAK and Irrigation Department	Kerala State Planning Board,SDMA, Agriculture Department, KUFOS, Other agencies, KLDC	Zone I and Zone II	✓					1				NPCA	Core	
			1.1.1.3 Survey and water balance assessments	VKWMU, SWAK	Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, HSW	Zone I and Zone II	✓					1	25,00,000	Per assessment		NPCA	Core	
			1.1.1.4 Draft Report consultations	Commissioned agency	SWAK, Irrigation Department, SDMA, Agriculture Department, KUFOS, KLDC, CWRDM, Other agencies	Zone I and Zone II		✓				1	2,00,000	Per workshop		NPCA	Core	
			1.1.1.5 Assessment report finalisation and publication	SWAK	Kerala State Planning Board, CWRDM, Irrigation Department, SDMA, Agriculture Department, KUFOS, Other agencies, KLDC	Zone I and Zone II		✓				1	2,00,000	Lumpsum		NPCA	Core	
		1.1.2	Formulation of comprehensive water management strategy for Zone II based on IWRM approach															
			1.1.2.1 Consultation workshops for water management strategy for Zone II	SWAK, Irrigation department	Kerala State Planning Board, CWRDM, SDMA, Agriculture Department, KUFOS, CWRDM, Other agencies	Zone II			✓			2	3,00,000	Per workshop	6.0	NPCA	Core	
			1.1.2.2 Formulation of draft plan	SWAK, Irrigation department	CWRDM, KUFOS	Zone II			✓			1	3,00,000	Per activity	3.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.1.2.3	Review, finalisation and approval	Kerala State Planning Board, Irrigation Department (and proposed Authority constituted under Kerala River Basin Conservation and Management Authority Bill)	SWAK, CWRDM, KUFOS	Zone II			✓			1	3,00,000	Per workshop	3.0	NPCA	Core	
1.2 Removal of encroachments, unclogging of river stretches, desiltation of canals,ponds and estuaries																
1.2.1 Unclogging and removal of encroachments along River stretches (where there is observed clogging and where there is need for widening and not deepening of riverbeds)																
1.2.1.1	Survey and identification of rivers stretches in Zone II for removal of encroachments	LSGs, Irrigation Department	Irrigation Department, Agriculture Department and Padasekhram Committees, PWD, SDMA, SWAK, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	Zone II rivers		✓						Lumpsum	50.0	NPCA	Core	Convergence sources are available from Irrigation Department for desilting of Thodu under FMP. SDRF funds are also available under Room for River allocations
1.2.1.2	Removal of river encroachments	Irrigation Department	LSGs, KRBCMA	Zone II rivers		✓		✓								
1.2.1.3	Bathymetric survey of rivers and canals to decide the required base flow depths wherever possible	SWAK, VKWMU	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	Zone II rivers and canals		✓				1	35,00,000	Lumpsum	35.0	NPCA	Core	
1.2.1.4	Preparation of detailed plan on unclogging works for rivers and desiltation of canals by a technical committee including the Environmental impacts	SWAK, VKWMU, Irrigation Department, KRBCMA	Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), KUFOS	Zone II rivers and canals			✓			1	10,00,000	Lumpsum	10.0	NPCA	Core	

Activity			Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
		1.2.1.5	Implementation of river desiltation works as per approved plan	Irrigation Department	SWAK, Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	As per approved desiltation plan for rivers and canals of zone II				✓	✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (100%)	Core	RKI
	1.2.2	Canals and waterways																
		1.2.2.1	Surveys to identify blocked canals and waterways (covered in 1.2.1.3)	LSGs, Irrigation Department, SWAK	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence) Local Community Based Organisations, Padasekhram Committees,	Canals of zone II		✓							covered in 1.2.1.3)	NPCA	Core	
		1.2.2.2	Removal of blockage and encroachments	Irrigation Department	LSGs, Local Community Based Organisations, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA	Canals of Zone II		✓	✓						Actual budget allocations are made by the Irrigation Department and other departments as per the works	Convergence (100%)	Core	Rebuild Kerala Initiative, Irrigation Deapartment funds
		1.2.2.3	Implementation of canal desiltation works as per appoved plan under activity 1.2.1.5	SWAK, Irrigation Department,	LSGs, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA, Local CBOs	As per approved desiltation plan for rivers and canals of zone II				✓	✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (100%)	Core	RKI, KLDC
	1.2.3	Renovation of Panchayat ponds																
		1.2.3.1	Identification of silted ponds and preparation o	VKWMU	LSGs, Irrigation	Zone II	✓	✓				50		Lumpsum	5.0	NPCA	Core	
		1.2.3.2	Implementation of desiltation plan	VKWMU, Irrigation Department	LSGs, Padasekhram Samithi	Zone II			✓	✓		50	800	Rs 800 per man-day @ 100 man-day per pond of approx. 1 ha	40.0	NPCA	Core	
		1.2.3.3	Strengthening of bunds around ponds using Vetiver and geo textiles	VKWMU, KFRI	LSGs, Padasekhram Samithi				✓	✓		30	1,00,000	Per unit	30.0	NPCA	Core	
	1.2.4	Estuaries																

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.2.4.1	Maintenance of estuary mouths and estuaries, ports and fishing harbours	Kerala State Maritime Board, Harbour Engineering Department,	Harbour Engineering Department, Irrigation Department, CWRDM, KUFOS, Fisheries Department- KSCADC,	Cochin port and estuary; Kodungallur-Azhikode estuary and Munambam fishing harbour; Chellanam I and II fishing harbour	✓	✓	✓	✓	✓			Lumpsum	11,913.0	Convergence (100%)	Core	1. **Harbour Engineering Department -** Munambam (Operational) - Rs 1952 lakhs; Chellnam I and II (Ongoing) - Rs 3527 lakhs (Source:http://www.hed.kerala.gov.in/index.php/about-us/programmes-activities) 2. **Ports Department -** Cochin port trust total expenses for 2020-21 - Rs 34,343 lakhs of which Dredging and Marine survey work expenses are Rs 80,01,45,708. (Rs 8001 lakhs). Expenditures on Cochin Fisheries Harbour - Rs 385 lakhs (Source:https://www.cochinport.
1.2.4.2	DPR preparation and implementation of required works for desiltation (traditional means) in Vembanad estuary based on comprehensive water management strategy prepared under activity 1.1.2	VKWMU	LSGs, KUFOS, HSW, CWRDM, Fisheries Department-KSCADC, Irrigation Department			✓	✓	✓	✓	4	1,50,00,000	per annum	600.0	NPCA	Core	
1.3 Enhancing flows and connectivity																
1.3.1 Construction, repair, modification of culverts and bridges																
1.3.1.1	Detailed survey of existing culverts and bridges to detect blockage, repair needs and assesing need for new culverts, bridges, regulators	VKWMU, Irrigation Department	SWAK, Agriculture Department, KUFOS, KAU, Other agencies	Zone II		✓				1	10,00,000	Per Survey	10.0	NPCA	Core	
1.3.1.2	Planning and DPR preparation for work on new culverts and bridges, regulators	VKWMU, Irrigation Department	VKWMU	Zone II			✓			1	10,00,000	Per activity	10.0	NPCA	Core	
1.3.1.3	Construction, repair, modification of culverts and bridges based on plan	Irrigation Department	VKWMU, Agriculture Department, LSGs, PWD, Other agencies	Zone II				✓	✓				The amount will be estimated based on the plan 1.3.1.2	Convergence (100%)	Core	Work of culvert and bridges for 2023-24 are covered under the following schemes. 1. **Irrigation Department** (2023-24 approx outlay) - Flood Mangement Programme (Plan scheme) - Rs 3000 lakh, NABARD- RIDF - Rs 10000 lakh, PMSKY - Rs 1100 lakh 2. **Agriculture Department** - Development of Agriculture in Kuttanad scheme - Rs 1200 lakhs; NABARD RIDF - Rs 1000 lakhs (Source: https://keralaagriculture.gov.in/en/2021/05/07/development-kuttanad/)

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.3.2	Removal of invasive macrophytes (water hyacinth) from canals															
1.3.2.1	Identification and removal of water hyacinth from clogged canals and waterways by LSGs	VKWMU	LSGs	Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.	✓		✓		✓	150	800	Rs 800 per man day @100 manday per ha	120.0	NPCA	Core	
1.3.2.2	Pilot scale implementation of biological control of water hyacinth	VKWMU	ATREE	Select Grama Panchayats to be decided		✓	✓			2	10,00,000	Per Panchayat	20.0	NPCA	Core	
1.3.3	Utilization of water hyacinth as a bio- fuel															
1.3.3.1	Biogas plants distribution to households	VKWMU	Pyal Jwala, CRAR SD College, Alappuzha	Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.	✓	✓				100	25000	per biogas plant of 8 litre capacity	25.0	Convergence (50%)	Core	GOBARDHAN of Department of Drinking Water and Sanitation, National Biogas Development Project (Agriculture Department), scheme
1.3.3.2	Training and hand holding support	VKWMU	Pyal Jwala, CRAR SD College, Alappuzha	Vaikom, Aroor, Pallipuram	✓	✓				3	100000	Per training	3.0	NPCA	Core	
1.3.3.2	Training on manufacturing and marketing of weed powder	VKWMU	Pyal Jwala, CRAR SD College, Alappuzha	Vaikom, Aroor, Pallipuram	✓	✓				3	300000	Per training	9.0	NPCA	Core	
1.3.4	Utilisation of water hyacinth for making value added products			Vaikom, Aroor, Pallipuram												
1.3.4.1	Formation of SHGs and Incentives support	VKWMU		Pallipuram, Talayazham,Kuthiyathodu, Kodamthuruth, Ezhupunna, Aroor, Vaikom, Udayamperoor, Perumbalam, etc.			✓	✓		16	75000	Per SHG	12.0	NPCA	Core	
1.3.4.2	Training to beneficiaries on water hyacinth collection and processing	VKWMU	CRAR- SD College, FERI, KIDS, Kottapuram Integrated Development Society (KIDS),Kerala Academy of Skills Excellence (KASE)	Vaikom, Aroor, Pallipuram			✓	✓		3	300000	per training	9.0	Convergence (50%)	Core	Pradhanmantri Kaushal Vikas Yojana

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.3.4.3	Training to beneficiaries on water hyacinth craft and product making	VKWMU	CRAR- SD College, FERI, KIDS, Kottapuram Integrated Development Society (KIDS),Kerala Academy of Skills Excellence (KASE)	Vaikom, Aroor, Pallipuram			✓	✓		3	300000	per training	9.0	Convergence (50%)	Core	Pradhanmantri Kaushal Vikas Yojana
1.3.4.4	Marketing and enterprise development	VKWMU	KASE	Vaikom, Aroor, Pallipuram			✓	✓	✓			Lumpsum	20.0	NPCA	Core	
1.4 Pollution abatement measures																
1.4.1 Assessment of sewage load(current and future projections), industrial effluents and planning for pollution abatement measures in Zone II																
1.4.1.1	Terms of reference workshop	SWAK	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM	Cochin	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
1.4.1.2	Appointment of expert agencies	Kerala State Pollution Control	SWAK, VKWMU		✓					1			-	NPCA	Core	
1.4.1.3	Survey and sewage load assessments and wastewater from all sources including industries such as peeling sheds	Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU	Zone II	✓					3	50,00,000	Per assessment	150.0	NPCA	Core	
1.4.1.4	Stakeholder consultation meetings to plan for pollution abatement measures	KSPCB, VKWMU	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM	Cochin	✓					2	3,00,000	Per meeting	6.0	NPCA	Core	
1.4.1.5	Draft report consultation	Commissioned agency, Kerala State Pollution Control Board (KSPCB)	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM		✓					1	2,00,000	Per report	2.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.4.1.6	Report finalisation and publication	Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU		✓								-	NPCA	Core	
1.4.1.7	Impact of peeling sheds on wetland water quality	VKWMU	KSPCB, Commissioned agency							1	15,00,000	Per study	15.0	NPCA	Core	
1.4.2	Containment, treatment and safe disposal of municipa	LSG	Kerala Water Authority, KSPCB	Annex 18 and 19 of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.) The Muttar – 16.5 MLD, Perandoor - 19 MLD, Vennala - 24 MLD, Elamkulam - 17.5 MLD STPs have recently been tendered for funding under National River Conservation Plan	✓	✓	✓	✓	✓				Actual budgets allocations for individual STPs/ETPs are made as per design and capacity specifications and is funded under different schemes as mentioned in the Convergence column	Convergence (100%)	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission, National River Conservation Plan
1.4.3	Containment, treatment and safe disposal of industrial effluents	Industries Department	LSG, KSPCB		✓	✓	✓	✓	✓				Actual budgets allocations for individual STPs/ETPs are made as per design and	Convergence (100%)	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission
1.4.4	Installation of Decentralised Waste water treatment systems	LSG	SWAK, VKWMU, KSPCB	Slum areas of Kochi and Thipunithura in Ernakulum	✓	✓	✓	✓	✓	2	1500000	Per 50 household (@30,000 per household	30.0	NPCA	Core	
1.4.5	Construction of improved septic tanks such as Anaerobic Baffled reactors and anaerobic filters in PHCs, schools and Aanganwadi centres in high water table areas	LSG	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Gram Panchayats- Pallipuram, Talayazham, Kuthiyathodu, Kodamturuttu, Ezhupunna, Aroor, Vaikom		✓	✓			20	150000	per structure	30.0	Convergence (50%)	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.4.6	Subsidy for households for Modified Prefabricated Septic tanks and specially designed septic tanks	LSG	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Do		✓	✓			200	25000	per household	50.0	Convergence (50%)	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.7	Subsidy for households for biodigester tanks	LSG	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Do		✓	✓			100	50000	per 5000 litre tank	50.0	Convergence (50%)	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.8	Support to LSGs for implementing pollution control measures															
1.4.8.1	Training programme for SHGs, entrepreneurs LSGs involved in waste management under Suchitwa mission	VKWMU, Expert agencies	LSGs, KILA	Zone II LSGs	✓	✓				51			Activities are budgeted in the Suchitwa Mission	Convergence (100%)	Core	LSG grants, Suchitwa Mission
1.4.8.2	Survey and identification of canals, storm drains, wetlands with high pollution loads for cleaning	VKWMU	LSG Planning Department, Village Panchayats	Zone II LSGs	✓	✓				250	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	NPCA	Core	
1.4.8.3	Annual cleaning of canals and wetlands, manual scoring of scum and other waste material under pre monsoon pollution abatement activities by Haritha Karma Sena	VKWMU	LSGs	Zone II LSGs	✓	✓				250	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	NPCA	Core	
1.4.8.4	Infrastructure support for Haritha Karma Sena such as e-Autos, Trolleys, vehicles for Haritha Karma Sena including support for plastic waste management	VKWMU	LSG Planning Department, Village Panchayats	Zone II LSGs	✓	✓				51	600000	Per LSG (Panchayat)	306.0	NPCA	Non core	
1.4.8.5	Installation of mesh for screening out of waste from streams and irrigation canals	VKWMU	LSGs, Expert agencies	Zone II LSGs	✓	✓				51	100000	Per LSG(Panch	51.0	NPCA	Core	
1.4.9	Awareness programmes on plastic waste management and support for establishment of integrated plastic waste management facilities															
1.4.9.1	Awareness programme on plastic waste management	VKWMU	KILA, ATREE	Zone II		✓		✓		51	40,000	Per LSG(Panch	40.8	NPCA	Core	
1.4.9.2	Support to integrated plastic waste management activities in all LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU, KSPCB	Zone II	✓	✓		Covered under 1.4.8.4						NPCA	Non core	
1.4.9.3	Feasibility assessment and planning for establishment of plastic recycling units in zone II LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU, KSPCB	Zone II		✓				3	3,00,000	per workshop	9	NPCA	Core	Rebuild Kerala Initiative
1.4.9.4	Establishment of plastic recycling and integrated plastic waste managemnet facility units in LSGs	Clean Kerala Company Limited	LSGs,SWAK, VKWMU	All three zones		✓	✓	✓		1	535000000	per activity	5350	Convergence (100%)	Non core	Clean Kerala Company is working on plastic recycling alongwith LSGs. As per newspaper report Rs 53.5 crores from Rebuild Kerala Initiative were made available for the purpose. The source - https://www.newindianexpress.com/states/kerala/2022/jun/17/clean-kerala-push-for-plastic-recycling-units-in-800-lsgs-2466505.html
1.4.10	Feasibility assessment for development of a model park using Ecosystem Based Solutions in Kochi (on lines of Hyderabad Golf course) on Public Private Partnership mode															

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.4.10	Feasibility assessment for development of a model park using Ecosystem Based Solutions in Kochi (on lines of Hyderabad Golf course) on Public Private Partnership mode															
1.4.10.1	Terms of reference workshop	SWAK	Kerala State Pollution Control Board (KSPCB), Kochi Municipal Corporation	Kochi	✓	✓				1	5,00,000	Per workshop	5.0	NPCA	Core	
1.4.10.2	Engagement of expert agency	Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, Kochi Municipal Corporation, WRI and Kerala Tourism Development Corporation (KTDC)	Kochi	✓	✓							-	NPCA	Core	
1.4.10.3	Project design	Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, Kochi Municipal Corporation	Kochi		✓				1	1,00,00,000	Per activity	100.0	NPCA	Core	
1.4.10.4	Consultation workshops	KSPCB, VKWMU	Kochi Municipal Corporation	Kochi	✓	✓				1	10,00,000	Per workshop	10.0	NPCA	Core	
1.4.10.5	Review, finalisation and approval and implementation	Commissioned agency, Kerala State Pollution Control Board (KSPCB)	SWAK, VKWMU, KMC	Kochi		✓				1	9,00,00,000		900.0	Convergence (50%)	Core	
1.4.11	Phytoremediation measures for pollluted canals using Vetiver Grass and other suitable native species such as Ludwigia adscendens and Ludwigia perennis	VKWMU, Commissioned agency	Kochi Municipal Corporation, KSPCB, NEERI, Suchitwa	Polluted canals in Kochi, and Ernakulum or other Municipalaities such as Perandoor canal, Thevara canal, Edapally canal, Konthuruthy, Markt canal		✓				32	1,00,000	Per km of canal length	32.0	NPCA	Core	Convergence possibility from IURWTS (Integrated Urban Regeneratiin and Water Transport System) project of Kochi Metro Rail Limited of worth Rs 1528 crores.
1.5	Rain water harvesting and groundwater recharge															
1.5.1	Support to well based rooftop rain water harvesting and recharge system in community institutions and individual households such as "Mazhapolima"															
1.5.1.1	Community Education and awareness generation	VKWMU, Kerala Rural Water Supply and Sanitation Agency (KRWSA)	SDMA, LSGs, CSOs	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk	✓	✓				-	10,00,000	Lumpsum	10.0	NPCA	Core	
1.5.1.2	Demonstration and trainings	VKWMU, KRWSA	SDMA, Expert Agencies	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk			✓	✓		10	1,00,000	Per training	10.0	Convergence (100%)	Core	Jalanidhi programme of KRWSA

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.5.1.3	Incentive support and implementation	VKWMU, KRWSA	Expert Agencies, LSGs	Ernakulum district - Kanayannur Taluk, Kottayam - Vaikom and Kottayam Taluk			✓	✓		40	25,000	Per LSG	10.0	Convergence (100%)	Core	Jalanidhi programme of KRWSA
1.5.1.4	Pilot study on possibility of converting fallow lands around rivers in catchment area in to water retention areas.	VKWMU	Department of soil Survey and soil conservation, CWRDM	Zone II catchment area		✓	✓	✓		1	25,00,000	Lumpsum	25.0	NPCA	Core	
1.5.2	Review and assessment	VKWMU, KRWSA	CWRDM,SDMA					✓		Covered under Zone I activity						
1.6	Modernisation and automation of the operation of Thanneermukkom Barrage based on salinity, water level and tidal water flow data															
1.6.1	Study to explore the possibility of snap openings of Thaneermukkam Bund to control salinity and automation of shutters in the Thanneermukkam Bund	VKWMU, Irrigation Department	CWRDM, KUFOS, Agriculture Dept.	Zone II and Zone III	✓	✓				2	25,00,000	Per study	50.0	NPCA	Core	
1.6.2	Comprehensive monitoring of three season tidal propagation	VKWMU, Irrigation Department	CWRDM	Zone II and Zone III	✓	✓	✓	✓	✓	Covered as part of monitoring activities specified under Activity 1.4.3					Core	
1.6.3	Review of opening and closure process of Thaneermukkam barrage														Core	
1.6.3.1	Stakeholder workshops to discuss and decide the feasibility of modernisation of Thaneemukkam barrage based on study on possibility of snap openings under activity 1.6.1	VKWMU, Irrigation Department	VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives,	Alappuzha		✓				1	3,00,000	Per workshop	3.0	NPCA	Core	
1.6.3.2	Plan preparation and approval for modernisation of Thaneemukkam barrage once decided under activity 1.6.3.1	VKWMU, Irrigation Department	District Collector, Kottayam, VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries Department, LSG	Zone II and Zone III			✓			1	3,00,000	Per workshop	3.0	NPCA	Core	
1.6.3.3	Modernisation of the Thaneermukkon bund - Installation of salinity sensors and automation based on approved plan (under activity 1.6.3.2)	VKWMU, Irrigation Department, PWD Electronics wing	District Collector, Alappuzha, District Collector, Kottayam, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries	Zone II and Zone III			✓	✓	✓	3	2,00,00,000	per activity	600.0	NPCA	Core	
1.6.3.4	Repair and maintenance of Thaneermukkom barrage and installation of lights and signboards	Irrigation Department		Zone II and Zone III	✓					5		per activity	44.8	Convergence (100%)	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
1.6.3.5	Biannual stakeholder meetings for barrage opening and closure	District Collector, Alappuzha	District Collector, Kottayam, VKWMU, Irrigation Department, LSGs, Padasekhram Samithi, Fish cooperatives, KAU,Agriculture Department, Fisheries Department, LSG	Alappuzha	✓	✓	✓	✓	✓	10	30,000	Per meeting	3.0	NPCA	Core	
1.7	Development of comprehensive WASH plans in the local self governments															
1.7.1	Consultation workshops	KWA, Suchitwa Mission, LSGs	VKWMU	Zone II	✓	✓				4	3,00,000	Per workshop	12.0	NPCA	Non core	
1.7.2	Development of LSG-level WASH plans	KWA, Suchitwa Mission, LSGs	VKWMU	Zone II	✓	✓	✓	✓		51	20000	17 LSG per year	10.2	NPCA	Non core	
1.7.3	Support for Implementation of WASH actions	KWA, Suchitwa Mission, LSGs	VKWMU	Zone II	✓	✓	✓	✓		51	100000	17 LSG per year	51.0	NPCA (50%), Convergence(50 %)	Non core	SBA (50%)
Sub Total (NPCA)													**2,512.0**			
Sub Total (Convergence 50 %)													**1,124.0**			
Non core NPCA															**306.0**	
Non core Convergence 50 %															**130.0**	
2 Species and Habitat Conservation																
2.1	Asian waterbird census															
2.1.1	Empanelment of census co ordinators	SWAK,VKWMU	WISA	Zone II	✓								-	NPCA	Core	
2.1.2	Formation of census groups	SWAK,VKWMU	WISA	Zone II	✓					1	50,000	Per ecological zone	0.5	NPCA	Core	
2.1.3	Waterbird census training	SWAK,VKWMU	WISA	Zone II	✓					2	50,000	Per training workshop	1.0	NPCA	Core	
2.1.4	Census	SWAK,VKWMU	WISA	Zone II	✓	✓	✓	✓	✓	5	5,00,000	Per annual census	25.0	NPCA	Core	
2.1.5	Data compilation and reporting	SWAK,VKWMU	WISA	Zone II	✓	✓	✓	✓	✓	5	50,000	Per year	2.5			
2.2	Fin fish and shell fish census															
2.2.1	Empanelment of census co ordinators	SWAK,VKWMU	KUFOS, CERC-ATREE	Zone II	✓					1	-	Per ecological zone	-	NPCA	Core	
2.2.2	Formation of census groups	SWAK,VKWMU	KUFOS, CERC-ATREE	Zone II	✓					5	50,000	Per ecological zone	2.5	NPCA	Core	
2.2.3	Fish census training	SWAK,VKWMU	KUFOS, CERC-ATREE	Zone II	✓					2	50,000	Per training workshop	1.0	NPCA	Core	
2.2.4	Census	SWAK,VKWMU	KUFOS, CERC-ATREE	Zone II	✓	✓	✓	✓	✓	5	5,00,000	Per annual census	25.0	NPCA	Core	
2.2.5	Data compilation and reporting	SWAK,VKWMU	KUFOS, CERC-ATREE	Zone II	✓	✓	✓	✓	✓	5	50,000	Per annual report	2.5	NPCA	Core	
2.3	Comprehensive VKW biodiversity assessment															
2.3.1	Terms of reference workshop	VKWMU	WISA, KUFOS	Zone II	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	

Activity		Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
2.3.2	Appointment of expert agencies	VKWMU	WISA, KUFOS	Zone II	✓								-	NPCA	Core	
2.3.3	Biodiversity surveys (biannual)	Expert Agency	WWF, KUFOS	Zone II	✓	✓	✓	✓	✓	10	5,00,000	Per ecological zone	50.0	NPCA	Core	
2.3.4	Draft report consultation	Expert Agency	Local NGOs	Zone II	✓					1	2,00,000	Per consultation	2.0	NPCA	Core	
2.3.5	Report finalisation and publication	Expert Agency	Local NGOs	Zone II	✓	✓	✓	✓	✓	5	1,00,000	Per annual report	5.0	NPCA	Core	
2.4	Monitoring of invasive species															
2.4.1	Mapping of invasive species distribution in two seasons pre and post monsoon	ATREE CERC	KUFOS	Zone II	✓			✓		4	10,00,000	Per activity	40.0	NPCA	Core	
2.4.2	Stakeholders sensitization workshops	KUFOS	CMFRI	Zone II	✓			✓		1	3,00,000	Per workshop	3.0	NPCA	Core	
2.4.3	Surveillance and control measures	VKWMU	SWAK	Zone II	✓			✓		2	5,00,000	per year	10.0	NPCA	Core	
2.4.4	Follow up support	VKWMU	SWAK	Zone II	✓			✓		1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5	Mapping and protection of key habitat areas															
2.5.1	Survey and mapping of fish and clam breeding grounds	ATREE CERC	KUFOS	Zone II		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	
2.5.2	Survey and mapping of bird congregation areas	KAU	KBS	Zone II		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5.3	Survey and mapping of mangroves and associated habitats	CMFRI	KUFOS, KFRI, WISA	Zone II		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5.4	Community workshops to develop conservation strategies	KUFOS	CMFRI, WISA	Zone II		✓				2	3,00,000	Per workshop	6.0	NPCA	Core	
2.5.5	Mangrove restoration	Forest Department, VKWMU	CMFRI, WISA, KFRI, Fisheries Department	Kodangallur-Azhikode estuary, CRZ I A areas in Aroor, Perumbalam, Palluruthy, Edakochi, Elankunnapuzha, Along National Waterway 3		✓	✓				30,00,000	Lumpsum	50.0	Convergence (50%)	Core	Forest Department - Conservation and Management of Mangroves and Coral Reef (central scheme)- Approx. Rs 7.61 crores, National Coastal Management Programme - Rs 87 crores for five years (till 2026), Fisheries Department schemes
2.5.6	Appointment of community wardens in LSGs	VKWMU	LSG and CBOs	Zone II	✓					15				NPCA	Core	
2.5.7	Honararium for community wardens	VKWMU	LSG and CBOs	Zone II	✓	✓	✓	✓	✓	15	120000	Per warden	90.0	NPCA	Core	
2.5.8	Watch and ward of habitats	VKWMU	Wetland Mitras/Communites	Zone II	✓	✓	✓	✓	✓	5	2,00,000	Per year	10.0	NPCA	Core	
2.6	Animal disease surveillance															
2.6.1	Develop an SOP for handling avian diseases episodes	SACON	SIAD	Zone II	✓					1	1,00,000	Per ecological zone	1.0	NPCA	Core	
2.6.2	Conduct workshops to spread awareness on avian diseases and their controls	SACON	SIAD	Zone II	✓					1	50,000	Per ecological	0.5	NPCA	Core	
2.6.3	Annual disease surveillance and reporting including avifauna, fish and clam species	SIAD, Fisheries Department	SACON, KAU, KVASU, WWF	Zone II	✓	✓	✓	✓	✓	5	100000	Per annum	5.0	NPCA	Core	One Health Programme
Sub Total (NPCA)														**301.5**			
Sub Total (Convergence 50 %)														**50.0**			
Non core NPCA																	
Non core Convergence 50 %																	
3	**Community based fisheries management**																
3.1	Systematic catch assessment																
3.1.1	Protocol development workshop	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone II	✓					1	3,00,000	Per workshop	3	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
3.1.1	Protocol development workshop	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone II	✓					1	3,00,000	Per workshop	3	NPCA	Core	
3.1.2	Data collection	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone II	✓	✓	✓	✓	✓	1	6,00,000	Per activity per year	30	NPCA	Core	
3.1.3	Stakeholder workshop on draft conclusions	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone II	✓	✓	✓	✓	✓	1	3,00,000	Per workshop	3	NPCA	Core	
3.1.4	Report finalisation and publication	Dept. of Fisheries	KUFOS, ATREE-CERC, NBFGR, CMFRI	Zone II	✓	✓	✓	✓	✓				-	-	Core	
3.2	Development of fishing calendar and zones															
3.2.1	Constitution of committee of experts and stakeholders	VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone II	✓									NPCA	Core	
3.2.2	Consultation meetings	VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone II	✓					2	3,00,000	Per workshop	6	NPCA	Core	
3.2.3	Production of draft calendar and zone regulations	VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Zone II	✓	✓				1	5,00,000	Per activity	5	NPCA	Core	
3.2.4	Community monitoring and enforcement	Fisher Cooperatives	Clam Collectors Society	Zone II	✓	✓	✓	✓	✓	5	1,00,000	Per annum	5	NPCA	Core	
3.3	Maintaining fish diversity and production															
3.3.1	Establishment of protected area for clam/fish	Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓	✓				10	1,00,000	Per Protected area	10	NPCA	Core	
3.3.2	Maintenance of existing Protected areas	Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community wardens	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	10	80,000	Per Protected area	8	NPCA	Core	
3.3.3	Ranching to replenish depleted stock of commercially important fish species	Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community wardens	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	43,20,000	Per annum	216	Convergence (First two years) NPCA (3,4 and 5 th years)	Core	Fisheries department schemes allocations 25.6 Lakh (Alappuzha) (2022-23) 25.6 Lakh (Alappuzha) (2023-24) 25.6 Lakh (Alappuzha) (2024-25) 17.6 Lakh (Kottayam) (2022-23) 17.6 Lakh (Kottayam) (2023-24) 17.6 Lakh (Kottayam) (2024-25)
3.4	Conservation and awareness program															
3.4.1	Procurement of patrolling boat	VKWMU,Dept. of Fisheries, Govt. of Kerala		Allapuzha and Kottayam (Zone II and zone III)	✓							Lumpsum	200	NPCA	Core	Fisheries department - 13 lakhs 6.45 Lakh (Alappuzha) (2022-23) 6.45 Lakh (Kottayam) (2022-23)
3.4.2	Maintenance of patrolling boats	VKWMU,Dept. of Fisheries, Govt. of Kerala	Fisher Cooperatives, Community wardens,	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	1852000	Lumpsum per year	463	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Fisheries department - 37.04 lakhs 18.52 Lakhs - 1boat (Alappuzha) (2022-23) 18.52 Lakhs - 1boat (Kottayam) (2022-23)

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
3.4.3	Formation and functioning of fisheries management committee (FMC)	Fisheries Department	VKWMU, Fisher Cooperatives	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	80,000	Lumpsum per year	4.0	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Fisheries budgets 0.3 Lakh (Alappuzha) (2022-23) 0.8 Lakh (Alappuzha) (2023-24) 0.8 Lakh (Alappuzha) (2024-25) 0.3 Lakh (Kottayam) (2022-23) 0.8 Lakh (Kottayam) (2023-24) 0.8 Lakh (Kottayam) (2024-25)
3.4.4	Support to fisheries management councils (FMC) for active surveillance	VKWMU	Fisheries Department, Fisher Cooperatives	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	2,00,000	Per year	10	NPCA	Core	Fisheries Department - Extension and training
3.4.5	Awareness Programmes on sustainable fishing practices	Fisheries Department	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	3,00,000	Lumpsum per year	15	Convergence (1st and 2nd year - 100%) and NPCA (3rd,4th and 5th year)	Core	Fisheries budgets 1.5 Lakh (Alappuzha) (2022-23) 1.5 Lakh (Alappuzha) (2023-24) 1.5 Lakh (Alappuzha) (2024-25) 1.5 Lakh (Kottayam) (2022-23) 1.5 Lakh (Kottayam) (2023-24) 1.5 Lakh (Kottayam) (2024-25)
3.5	Appointment of project coordinator															
3.5.1	Honorarium to project coordinator (for fisheries)	Dept. of Fisheries, Govt. of Kerala		Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	3,60,000	per individual per year	18.0	Convergence (1st and 2nd year 100 %) and Covered for 4 th and 5 th years under NPCA	Core	Fisheries depart ment scheme - Ongoing since 2022-23. 3.6 Lakh (1st Year) 3.6 Lakh (2nd Year) 3.6 Lakh (3rd Year)
Sub Total (NPCA)													**280.0**			
Sub Total (Convergence 50 %)																
Sub Total (Convergence 40 %, NPCA 60 %)													**716.0**			
Non Core NPCA																
Non core Convergence 50 %																
4	**Sustainable Wetland agriculture interactions**															
4.1	Revival of traditional Pokkali farming system															
4.1.1	Incentive programmes for Pokkali farmers	Agriculture Department, PLDA	KAU, CMFRI	Ernakulum district (Panchayats sucha s Kadamakkudy, Nayarambalam, Edvanakkad,Pallip puram, Njarakkal among others)		✓		✓		500	25,000	Per farmer	125	Convergence (50%)	Non core	Agriculture department special Agriculture Zone Funds- Rs 7600 lakhs
4.1.2	Supporting Pokkali harvest festival	Agriculture	KAU, CMFRI	Ernakulum district		✓		✓		2	2,50,000	Per festival	5	NPCA	Non core	
4.1.3	Organising awareness drives for Pokkali farmers on best practices	Agriculture Department, PLDA	KAU, CMFRI,KUFOS	Ernakulum district		✓		✓		10	3,00,000	Per programme	30	Convergence(50 %)	Non core	Agriculture department Extension scheme
4.1.4	Strengthening market linkages															
4.1.4.1	Establishing pokkali seed centres	Agriculture	KAU, CMFRI,KUFOS	Ernakulum district		✓				4	7,50,000	Per centre	30	NPCA	Non core	
4.1.4.2	Operation of pokkali seed centres	Agriculture	KAU, CMFRI,KUFOS	Ernakulum district		✓	✓	✓	✓	4	1,00,000	Per centre	16	NPCA	Non core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
4.1.4.3	Establishment of local procurement centres for collection and distribution of fish and Pokkali rice	Fisheries Department, PLDA	KAU, CMFRI,KUFOS	Ernakulum district		✓				1	20,00,000	Per centre per year	20	NPCA	Non core	Fishery department scheme - Integrated Fshery Resource Development
4.1.4.4	Operation of local procurement centres for collection and distribution of fish and Pokkali rice	Fisheries Department, PLDA	CMFRI	Ernakulum district		✓	✓	✓	✓	1	5,00,000	Per centre per year	20	NPCA	Non core	
4.1.4.5	Support for polder Strengthening works	SWAK, VKWMU	KAU, CMFRI, VKWMU	Ernakulum district		✓	✓	✓	✓	4	50,00,000	Per year	200	Convergence (100%)	Non core	NABARD, Agency for Development of Aquaculture, Kerala schemes. Scheme of "Oru nellum, oru meenum " was operational till 2021 since 2014-2015 abd used National Adaptation Fund for Climate change of Rs 33. 73 crores
4.1.4.6	Support for enterprise development	SWAK, VKWMU	Agriculture Department, PLDA, Fisheries Department, KAU	Ernakulum district			✓			1	30,00,000	Lumpsum	30	NPCA	Non core	
4.2	Polder improvisation and strengthening															
4.2.1	Restoration of outer bunds of Padasekharams	Irrigation Dept, Agriculture Department, SDMA, KLDC	Padasekhram Samithi, LSG	Zone II and Zone III	✓	✓	✓	✓	✓	5		Lumpsum	66,900	Convergence(100 %)	Non core	Roughly the dudget allocations for 2023-24 are as follows 1. Irrigation Department (2023-24 approx outlay) - Flood Mangement Programme (Plan scheme) - Rs 3000 lakh, NABARD- RIDF - Rs 10000 lakh, PMSKY - Rs 1100 lakh 2. Agriculture Department - Development of Agriculture in Kuttanad scheme - Rs 1200 lakhs; NABARD RIDF - Rs 1000 lakhs The projections here are based on the DPRs prepared by the Irrigation Department - EE Irrigation Thanneermukkom - DPRs were prepared for improving the infrastructural facilities of 231 padasekharams under KEL III (FMP scheme central share 50% state share 50%) for an amount of 379.05 crore based on SOR 2009. Out of this, 57 works for improving 94 padasekharams were executed and the expenditure for the same is 89.61 crores.
4.2.2	Construction of ramp and sluice	KLDC, Agriculture Department, SDMA, Irrigation Dept	Padasekhram Samithi, LSG	Zone II and Zone III	✓	✓	✓	✓	✓			Lumpsum	66,900	Convergence(100 %)	Non core	
4.2.3	Construction of box culverts	KLDC, Agriculture Department, SDMA, Irrigation Dept	Padasekhram Samithi, LSG	Zone II and Zone III	✓	✓	✓	✓	✓					Convergence(100 %)	Non core	
4.2.4	Construction of Engine sheds and Engine Thara	KLDC, Agriculture Department, SDMA, Irrigation Dept	Padasekhram Samithi, LSG	Zone II and Zone III	✓	✓	✓	✓	✓					Convergence(100 %)	Non core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
																Later, DPRs were prepared for improving 411 padasekharams in Kuttanad Taluk and Veeyapuram Panchayath for an amount of 1212.45 crores based on SOR 2014, out of which 83 works were sanctioned for an amount of 758.39 crore. Among these works, 57 works were completed and the expenditure comes to 162.45 crores. If cost escalation is not taken into account, the balance
4.2.5	Replacement of Petti- Para with Vertical Axial Flow pump sets	KLDC, Agriculture Department, SDMA, Irrigation Dept	Padasekhram Samithi, LSG	Zone II and Zone III	✓	✓	✓	✓	✓	5	17,00,00,000	Per annum	8500	Convergence(100 %)	Non core	**Agriculture department -** Rs 1200 lakhs under "Development of various padasekhrams in Kuttanad and the establishment and replacement of Petti & para with VAF pumps" and Rs 500 lakh as PM KUSUM Top up subsidy to promote renewable energy
4.3	Study on revision of cropping calendars															
4.3.1	Stakeholder workshops	VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG	Zone II	✓					Covered as part of Zone III activities					Core	
4.3.2	Draft report preparation	VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG	Zone II	✓										Core	
4.3.3	Report finalisation and publication	VKWMU, KAU	Agriculture Department, Padasekhram Samithi, LSG	Zone II	✓										Core	
4.4	Promoting good agricultural practices															
4.4.1	Collation and publication of wetland-friendly package o	VKWMU	KAU, Agriculture Department, Veterinary department	Zone II		✓				1	10,00,000	Per publication	10.0	NPCA	Non core	
4.4.2	Outreach workshops	VKWMU	KAU, Agriculture Department, Veterinary department	Zone II		✓		✓		20	50,000	Per workshop	10.0	NPCA	Non core	
4.4.3	Incentives for adopting good agricultural practices	Agriculture Department, VKWMU	KAU, VKWMU	Zone II		✓	✓	✓		500	8,800	Per ha	44.0	Convergence (50%)	Non core	Agriculture department - Scheme on "Organic farming and good agricultural practices" - Rs 600 lakhs
4.4.4	Hand-holding support	Agriculture Department, VKWMU	KAU, VKWMU	Zone II		✓				500	Lumpsum		10.0	Convergence (100%)	Non core	
4,4.5	Support for development of integrated farming systems plots for testing appropriate systems suited to wetlands	Agriculture Department, VKWMU	KAU, VKWMU	Zone II			✓			10	25000	per plot	10.0	Convergence (50%)	Non core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
Sub Total (NPCA)													**141.0**			
Sub Total (Convergence 50 %)													**209.0**			
Non Core NPCA															**141.0**	
Non core Convergence 50 %															**209.0**	
5 Sustainable wetland tourism																
5.1 Capacity development support and incentives for maintaining standards																
5.1.1	Needs assessments	VKWMU, SWAK	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone II	✓	✓				1	2,00,000	Per workshop	2.0	NPCA	Core	
5.1.2	Programme design	VKWMU, SWAK	DTPC, Houseboat owners, Resorts, hotel owners etc	Zone II	✓	✓				1	5,00,000		5.0	NPCA	Core	
5.1.3	Training workshops	VKWMU	Tourism Department, DTPC, SWAK	Zone II	✓	✓				1	5,00,000	Per workshop	5.0	NPCA	Core	
5.1.4	Incentives programme for standard maintenance	DTPC	VKWMU, Tourism Department, SWAK	Zone II	✓	✓	✓	✓	✓	5	15,00,000	Per year	75.0	Convergence(100 %)	Core	Kerala Tourism 2.0 - Development of tourism corridor - Rs 362.15 crores of which Rs 9.5 crore is for responsible tourism initiaves.
5.1.5	Follow up support	VKWMU	Tourism Department, DTPC, SWAK	Zone II	✓	✓	✓	✓	✓			Lumpsum	10	NPCA	Core	
5.2 Surveillance & enforcement of extant regulation																
5.2.1	Periodic surveillance	VKWMU	KSPCB, Directorate of ports, Network of community wardens	Zone II			✓			1	5,00,000	Per year	5.0	NPCA	Core	
5.2.2	Reporting of violations to concerned authorities	KSPCB, Directorate of ports, Network of community wardens	VKWMU, SWAK, Maritime Board	Zone II	✓	✓	✓	✓	✓	Covered under zone III activities					Core	
5.2.3	Implementation of penal provisions	KSPCB, Directorate of ports, SWAK	VKWMU	Zone II	✓	✓	✓	✓	✓						Core	
5.3 STP infrastructure upgradation around tourist sites and for houseboats																
5.3.1	Assessment of current waste generation, management and gaps	VKWMU	KSPCB, DTPC, Maritime Board	Zone II and Zone III			✓	✓		Covered under					Core	
5.3.2	Operationalisation of existing STPs around major tourist locations	VKWMU	KSPCB, DTPC	Zone II and Zone III			✓	✓					Common activity covered under zone III	Convergence(100 %)	Core	Kerala Tourism 2.0 - Development of tourism corridor - Rs 362.15 crores of which Rs 9.5 crore is for responsible tourism initiaves.
5.3.3	Feasibility assessment of new STPs	VKWMU	KSPCB, DTPC	Zone II			✓	✓		1	3,00,000	Per year	3.0	NPCA	Core	
5.3.4	STP collection barge for point to point sewage collection from houseboats	VKWMU	KSPCB, DTPC, House boats owners association	Zone III			✓	✓		1	1,00,00,000	Per Barge	100.0	Convergence(100 %)	Core	
5.4 Orientation programmes for houseboat owners, tourism facility owners and tour operators																
5.4.1	Orientation programme design	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone II			✓	✓		1	10,00,000	Per study	10.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds (NPCA (NPCA/Non-NPCA)	Core/ Non core	Convergence Schemes (2022-23)
5.4.2	Orientation workshops	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone II			✓	✓		3	3,00,000	Per workshop	9.0	NPCA	Core	
5.4.3	Follow up support	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone II			✓	✓				Lumpsum	10.0	NPCA	Core	
5.5	Nature awareness programmes for tourists															
5.5.1	Nature awareness programme design	Expert Agency	Local NGOs	Zone II			✓	✓		1	10,00,000	Per study	10.0	NPCA	Core	
5.5.2	Workshops and events	VKWMU	Local NGOs	Zone II			✓	✓		3	3,00,000	Per workshop	9.0	NPCA	Core	
5.5.3	Programme evaluation and follow up support	VKWMU	SWAK, Local NGOs	Zone II			✓	✓		1	5,00,000	Lumpsum	5.0	NPCA	Core	
5.6	Wetland specific tourism programme design for Zone II															
5.6.1	Programme design workshop	SWAK, VKWMU	DTPC	Zone II	✓					2	3,00,000	Per workshop	6.0	NPCA	Core	
5.6.2	Formulation of draft plan	SWAK, VKWMU	DTPC	Zone II		✓				1	2,00,000	Per activity	2.0	NPCA	Core	
5.6.3	Review, finalisation and approval	SWAK, VKWMU	DTPC	Zone II		✓				1	3,00,000	Per workshop	3.0	NPCA	Core	
5.6.4	Implementation of the program	DTPC, Tourism Department	VKWMU	Zone II			✓	✓	✓	1		Lumpsum	450.0	NPCA (50%) Convergence(50 %)	Core	
Sub Total (NPCA)													**94.0**			
Sub Total (Convergence 50 %)													**450.0**			
Non Core NPCA																
Non core Convergence 50 %																
Total (NPCA)													**3,328.5**			
Total (Convergence 50 %)													**1,833.0**			
Total (Convergence 40 %, NPCA 60%)													**716.0**			
Total Non core NPCA															**447.0**	
Total Non core Convergence 50 %															**339.00**	

Table 30: Detailed activity wise budget for Zone III

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
1 Water management																
1.1 Water balance estimation and integrated water management plan for Zone III																
1.1.1 Water balance estimation																
	1.1.1.1 Terms of reference workshop	VKWMU, SWAK	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board, Irrigation Department-IDRB, SDMA, Agriculture Department, KUFOS, HSW, KPs	Zone III	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
	1.1.1.2 Engagement of expert KP/KPs	VKWMU, SWAK and Irrigation Department-IDRB	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, SDMA, Agriculture Department, KUFOS, KPs	Zone III	✓					1	-	-		NPCA	Core	
	1.1.1.3 Survey and water balance assessments	VKWMU, SWAK	Irrigation Department, SDMA, CWRDM, Agriculture Department, KUFOS, HSW, Other KPs	Zone III	✓					1	25,00,000	Per assessment	25.0	NPCA	Core	
	1.1.1.4 Draft report consultations	Commissioned KP	VKWMU-SWAK, Irrigation Department-IDRB, SDMA, Agriculture Department, KUFOS, Other KPs	Zone III		✓				1	2,00,000	Per workshop	2.0	NPCA	Core	
	1.1.1.5 Report finalisation and publication	VKWMU-SWAK	Kerala State Planning Board, CWRDM, Irrigation Department-IDRB, SDMA, Agriculture Department, KUFOS, Other KPs	Zone III		✓				1	3,00,000	Lumpsum	3.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
1.1.2	Formulation of comprehensive water management strategy for Zone III based on the water balance estimation and IWRM approach															
	1.1.2.1 Consultation workshops for water management strategy for Zone III	VKWMU-SWAK, IDRB-Irrigation department	Kerala State Planning Board, CWRDM, Irrigation Department-IDRB, SDMA, Agriculture Department, KUFOS, Other KPs	Zone III			✓			2	3,00,000	Per workshop	6.0	NPCA	Core	
	1.1.2.2 Formulation of draft plan			Zone III				✓	✓	1	3,00,000	Per activity	3.0	NPCA	Core	
	1.1.2.3 Review, finalisation and approval	VKWMU, SWAK, Kerala State Planning Board	Kuttanad Development Coordination Council, Chief Engineer-Kuttanad	Zone III					✓	1	1,00,000	per review	1.0	NPCA	Core	
1.2	Removal of encroachments, unclogging of river stretches, desiltation of canals,ponds and estuaries															
1.2.1	Unclogging and removal of encroachments along River stretches (where there is observed clogging and where there is need for widening and not deepening of riverbeds)															
	1.2.1.1 Survey and identification of rivers stretches in Zone III for removal of encroachments	LSGs, Irrigation Department	IDRB-Irrigation Department, Agriculture Department-Padasekhram Committees, PWD, SDMA, VKWMU, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence)	Zone III rivers as Achenkovil, Pampa, Manimala and Meenachil river and other river stretches		✓				1		lumpsum	50.0	NPCA	Core	
	1.2.1.2 Removal of river encroachments	Irrigation Department	LSGs, KRBCMA	Zone III rivers		✓		✓		2	12100000.0	Per annum	242.0	Convergence (1	Core	Irrigation department - Desilting of Thodu under FMP - Rs 45.7 lakhs , Room For River allocations for Pamba, Achenkovil, Meenachil, Manimala rivers (sourced from MGNREGS, Revenue department, State Disaster Funds)- Rs 75 lakhs in 2022-23

Activity			Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
			1.2.1.3	Bathymetric survey of rivers and canals to decide the required base flow depths wherever possible	SWAK	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), ATREE-CERC, CBOs as Vembanad Kayal Sanrakshna Samiti	Zone III canals and rivers		✓				1	25,00,000	Lumpsum	25.0	NPCA	Core	
			1.2.1.4	Preparation of detailed plan on required declogging works for rivers and desiltation of canals to ensure smooth flow by a technical committee	SWAK, Irrigation Department, KRBCMA	Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), KUFOS	Zone III rivers and canals			✓			1	10,00,000	Lumpsum	10.0	NPCA	Core	
			1.2.1.5	Comprehensive EIA study of the proposed works	SWAK, VKWMU	KUFOS, CWRDM	Zone III rivers and canals		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	
			1.2.1.6	Implementation of required declogging works for rivers and/or desiltation of canals to ensure smooth flow as per the approved plan	Irrigation Department	SWAK, Agriculture Department and Padasekhram Committees, PWD, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), KUFOS	As per approved desiltation plan for rivers and canals of zone III				✓	✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (100%)	Core	Ongoing River Desiltation works for 41 rivers in Kerala
		1.2.2	Canals and waterways																

Activity	Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
	1.2.2.1	Surveys to identify blocked canals and waterways (covered in 1.2.1..3)	LSGs, Irrigation Department, SWAK	HSW, KUFOS, Irrigation Department, SDMA, KRBCMA (Kerala River Basin Conservation and Management Authority when it comes in to existence), ATREE-CERC, CBOs as Vembanad Kayal Sanrakshna Samiti	Canals of zone III		✓								Convergence (100%)	Core	Rebuild Kerala Initiative
	1.2.2.2	Removal of blockage and encroachments	Irrigation Department	LSGs, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA	All canals of zone III		✓	✓							Convergence (100%)	Core	Rebuild Kerala Initiative
	1.2.2.3	Implementation of canal desiltation works as per approved plan under activity 1.2.1.5	SWAK, Irrigation Department	LSGs, Irrigation Department, Padasekhram Committees, PWD, SDMA, KRBCMA, CBOs as Vembanad Kayal Sanrakshna Samiti, Clam Cooperatives	As per approved desiltation plan for rivers and canals of zone III				✓	✓			Lumpsum	The amount will be estimated based on the plan 1.2.1.4	Convergence (1	Core	
1.2.3	Renovation of Panchayat ponds																
	1.2.3.1	Identification of silted ponds by LSGs	SWAK	LSGs, Irrigation Department,	Zone III			✓	✓		100					Core	
	1.2.3.2	Implementation of desiltation plan	SWAK	Agriculture department, Fisheries department	Changanassery, Thiruvalla, Chengannur taluks of Kuttand region			✓	✓		100	800	Rs 800 per man-day @ 100 man-day per pond of approx. 1 ha	80.0	NPCA	Core	
	1.2.3.3	Strengthening of bunds around ponds using Vetiver and geo textiles						✓	✓		30	1,00,000	Per unit	30.0	NPCA	Core	
1.2.4	Coastal spillway and Andhakaranzhi outlet																

Activity	Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
	1.2.4.1	Hydrodynamic study of Thottapally spillway and leading channel including feasibility analysis of reengineering works for efficient discharge of floodwaters and restoration of natural settings such as - Widening measures, - Removal of Breakwaters, - Construction of bypass channels, - Lowering of sill height (to 4 m below sea level from 2.03 m below sea level at present) - Relocation etc.	SWAK, VKWMU	CWRDM, KUFOS, Hydrographic Survey Wing(HSW), Irrigation Dept.	Thottapally mouth	✓					1	20,00,000	per study	20.0	NPCA	Core	
	1.2.4.2	influence of river plumes on coastal upwelling dynamics and efficiency of Thottapally spillway	SWAK, VKWMU	KUFOS	Thottapally mouth		✓				1	10,00,000	per study	10.0	NPCA	Core	
	1.2.4.3	Stakeholder consultations to review options for reengineering Thottappally spillway in order to restore natural settings around the Barmouth and for efficient discharge of floodwaters including - Widening of approach channels to Thottapally, - Removal of Breakwaters, - Construction of two bypass channels, - Relocation of spillway -lowering of sill height	SWAK, VKWMU	CWRDM, KUFOS, Hydrographic Survey Department	Thottapally mouth		✓				2	3,00,000	Per workshop	6.0	NPCA	Core	
	1.2.4.4	Improving the efficiency of Thottappally spillway to its designed capacity	Irrigation Department	SWAK, VKWMU, CWRDM, KUFOS, Hydrographic Survey Wing(HSW), Agriculture Department, Kuttanad Development Coordination Council							1	1,80,00,000	Lumpsum	180.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
	1) Electrification of shutters						✓										
	2) Maintenance of spillway structure embedded parts and shutter grooves					✓	✓	✓	✓	✓							
	3) DPR preparation and implementation of engineering works as decided through stakeholder consultations in activity 1.2.4.2							✓	✓								
1.2.4.5	Maintenance of Thottapally spillway mouth, Thottapally fishing harbour and Andhakaranazhi outlet		Kerala State Maritime Board, Harbour Engineering Department,	Harbour Engineering Department, Irrigation Department, CWRDM, KUFOS, Fisheries Department-KSCADC,	Thottapally spillway and fishing harbour, Andhakaranazhi outlet	✓	✓	✓	✓	✓				Activities are budgeted as per the maintenanc e needs	Convergence (1	Core	Harbour Engineering Department - Thotappaly fishing harbour (Operational) - Project cost Rs 1823.23 sanctioned in year 2004 Irrigation Department recently in 2021 completed removal of 249121.5 m3 of sand w ith the hlep of KMML w ith a cost of apprrox. Rs 1517 lakhs
1.3	Enhancing flows and connectivity																
	1.3.1	Construction, repair, modification of culverts and bridges															
1.3.1.1	Detailed survey of existing culverts and bridges to detect blockage, repair needs and assesing need for new culverts, bridges, regulators		VKWMU, Irrigation Department	SWAK, Agriculture Department, KUFOS, KAU, Other agencies	Zone III		✓				1	10,00,000	Per Survey	10.0	NPCA	Core	
1.3.1.2	Planning and DPR preparation for work on new culverts and bridges, regulators		VKWMU, Irrigation Department	VKWMU	Zone III			✓			1	10,00,000	Per activity	10.0	NPCA	Core	
1.3.1.3	Construction, repair, modification of culverts and bridges based on plan		Irrigation Department	VKWMU, Agriculture Department, LSGs, PWD, Other agencies	Zone III				✓	✓				The amount will be estimated based on the plan 1.3.1.2	Convergence (1	Core	Work of culvert and bridges for 2023-24 are covered under the following schemes. 1. **Irrigation Department** (2023-24 approx outlay) - Flood Mangement Programme (Plan scheme) - Rs 3000 lakh, NABARD- RIDF - Rs 10000 lakh, PMSKY - Rs 1100 lakh 2. **Agriculture Department** - Development of Agriculture in Kuttanad scheme - Rs 1200 lakhs; NABARD RIDF - Rs 1000 lakhs

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
																(Source: https://keralaagriculture.gov.in/en/2021/05/07/development-kuttanad/)
1.3.2	Removal of invasive macrophytes (water hyacinth) from canals															
	1.3.2.1 Identification and removal of water hyacinth from clogged canals and waterways by LSGs	VKWMU	LSGs	Grama Panchayats-Thanneermukkam, Aryadu, Pallippad, Kumarakam, Kainakary, Panchayats along AC canal; Nedumudi, Thakazhi, Punnapra North, Pulinkunnu, Nedumudi, Ramankary, Changnassery,		✓		✓		150	800	Rs 800 per man day @100 manday per ha	120.0	NPCA	Core	Fisheries Department
1.3.3	Utilization of water hyacinth as a bio-fuel															
	1.3.3.1 Biogas plants distribution to households	VKWMU	Pyal Jwala	Thanneermukkam North and South,		✓	✓			200	25000	per biogas plant of 8	50.0	Convergence (5	Core	GOBARDHAN of Department of Drinking Water and Sanitation, National Biogas Development Project (Agriculture Department), scheme
	1.3.3.2 Training and hand holding support	VKWMU	Pyal Jwala	Alappuzha		✓	✓			1	100000	Per training	1.0	NPCA	Core	
1.3.4	Utilisation of water hyacinth for making value added products															
	1.3.4.1 Formation of SHGs and Incentives support	VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE)	Grama Panchayats-Thanneermukkam, Aryadu, Pallippad, Kumarakam, Kainakary, Panchayats along AC canal; Nedumudi, Thakazhi, Punnapra North, Pulinkunnu, Nedumudi, Ramankary, Changnassery, Velyanad				✓	✓	20	75000	Per SHG	15.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
	1.3.4.2	Training to beneficiaries on water hyacinth collection and processing	VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE), ATREE-CERC & Social Innovation Centre	Alappuzha, Thanneemukkam, Ramankari, Ambalapuzha, Muhamma				✓	✓	4	300000	per training	12.0	Convergence (5	Core	Pradhanmantri Kaushal Vikas Yojana
	1.3.4.3	Training to beneficiaries on water hyacinth craft and product making	VKWMU	CARC-SDC, FERI, KIDS, Kerala Academy of Skills Excellence (KASE)	Alappuzha, Thanneemukkam, Ramankari, Ambalapuzha				✓	✓	4	300000	per training	12.0	Convergence (5	Core	Pradhanmantri Kaushal Vikas Yojana
	1.3.4.4	Marketing and enterprise development	VKWMU	Kerala Academy of Skills Excellence (KASE)	Do				✓	✓			Lumpsum	20.0	NPCA	Core	
1.4	Pollution abatement measures																
	1.4.1	Assessment of sewage load(current and future projections), industrial effluents and planning for pollution abatement measures in Zone III															
	1.4.1.1	Terms of reference workshop	SWAK	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department, Municipalities and Panchayats, CWRDM	Zone III	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
	1.4.1.2	Appointment of expert KP/KPs	KSPCB	SWAK, VKWMU	Zone III	✓					1			-	NPCA	Core	
	1.4.1.3	Survey and sewage load assessments	Commissioned KP/KPs, KSPCB	SWAK, VKWMU, KWA, LSG-Suchitwa Mission	Zone III	✓					3	50,00,000	Per assessment	150.0	NPCA	Core	
	1.4.1.4	Stakeholder consultation meetings	KSPCB, VKWMU	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department,	Zone III	✓					2	3,00,000	Per meeting	6.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
			Municipalities and Panchayats, CWRDM													
1.4.1.5	Draft report consultation	Commissioned KP/KPs, KSPCB	Kerala State Pollution Control Board (KSPCB), Suchitwa Mission, Kerala Water Authority, Kerala Rural Water Supply and Sanitation Agency, LSG Planning Department,	Zone III	✓					1	2,00,000	Per report	2.0	NPCA	Core	
1.4.1.6	Report finalisation and publication	Commissioned KP/KPs, KSPCB	SWAK, VKWMU	Zone III	✓					1	5,00,000	Per report	5.0	NPCA	Core	
1.4.2	Containment, treatment and safe disposal of municipal sewage and solid waste (around municipal corporation areas)															
				Zone III Municipalities - Annex 18 and 19 of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.) The Muttar – 16.5 MLD, Perandoor - 19 MLD, Vennala - 24 MLD, Elamkulam - 17.5 MLD STPs have recently been tendered for funding under National River Conservation Plan	✓	✓	✓	✓	✓				Actual budgets allocations for individual STPs/ETPs are made as per design and capacity specifications and is funded under different schemes as mentioned in Convergence column	Convergence (1	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
1.4.3	Containment, treatment and safe disposal of industrial effluents															
		Industries Department	LSG, KSPCB	Zone III Municipalities - Annex 18 and 19 of IMP contains details of existing common STPs/Common septage treatment plants in Ernakulum district (and Alappuzha, Kottayam and Thrissur.) The Muttar – 16.5 MLD, Perandoor - 19 MLD, Vennala - 24 MLD, Elamkulam - 17.5 MLD STPs have recently been tendered for funding under National River Conservation Plan	✓	✓	✓	✓	✓				Actual budgets allocations for individual STPs/ETPs are made as per design and capacity specifications and is funded under different schemes as mentioned in Convergence column	Convergence (1	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission
1.4.4	Installation of Decentralised Waste water treatment systems															
		Alappuzha Municipality	SWAK, VKWMU, KSPCB	Alissery ward and Zacharia Bazaar - Alappuzha; Kayamkulam, Mavelikkara, Chengannur municipalities in Allappuzha district	✓	✓	✓	✓	✓	5	1500000	Per 50 household (@30,000 per household	75.0	Convergence (1	Core	AMRUT; Cochin Smart City Mission; Kochi Metro Rail Ltd. Integrated Water Transport System Project, KIIFB, Suchitwa Mission
1.4.5	Construction of improved septic tanks as Anaerobic Baffled reactors and anaerobic filters in PHCs, schools and Aanganwadi centres in high water table areas															
		LSG	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Grama Panchayats - Nelamperoor, Ramankari, Mananchery, Thiruvalla, Thalvady, Cheppad, Arayadu, Punnapra North, Kainakary		✓	✓			20	150000	per structure	30.0	Convergence (5	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
1.4.6	Subsidy for households for Modified Prefabricated Septic tanks and specially designed septic tanks															
		LSGs	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Grama Panchayats - Nelamperoor, Ramankari, Mananchery, Thiruvalla, Thalvady, Cheppad, Arayadu, Punnapra North, Kainakary		✓	✓			400	25000	per household	100.0	Convergence (1	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.7	Subsidy for households for biodigester tanks for IHHL															
		LSGs	Kerala Rural Water Supply and Sanitation Agency, VKWMU	Do		✓				100	50000	per household	50.0	Convergence (1	Non core	Suchitwa Mission schemes - Source Level Treatment of Waste (Approx. 400 lakhs)
1.4.8	Support to LSGs (Panchayats) for implementing pollution control measures in rural areas															
1.4.8.1	Training programme for SHGs, entrepreneurs LSGs involved in waste management under Suchitwa Mission	VKWMU, Expert agencies	LSGs	Zone III LSG	✓	✓				45			Activities are budgeted in the Suchitwa Mission	Convergence (1	Core	LSG grants, Suchitwa Mission
1.4.8.2	Panchayat wise survey and identification of canals, storm drains, wetlands with high pollution loads for cleaning	VKWMU	LSG Planning Department, Grama Panchayats	Zone III LSG	✓	✓				200	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	NPCA	Core	LSG grants, Suchitwa Mission
1.4.8.3	Annual cleaning of canals and wetlands, manual scoring of scum and other waste material under pre monsoon pollution abatement activities by Haritha Karma Sena	VKWMU	LSGs	Zone III LSG		✓				200	800	Rs 800 per man day @100 manday per ha	Covered under Activity 1.3.2.1	NPCA	Core	Panchayat funds
1.4.8.4	Infrastructure support for Haritha Kermi Sena such as e-Autos, Trolleys, vehicles for Haritha Karma Sena including support for plastic waste management	VKWMU	LSG Planning Department, Grama Panchayats	Zone III LSG	✓	✓				45	600000	Per LSG	270.0	NPCA	Non core	
1.4.8.5	Installation of mesh for screening out of waste from streams and irrigation canals	VKWMU	LSGs, Expert agencies	Zone III LSG		✓				45	100000	Per LSG	45.0	NPCA	Core	

Activity	Sub-activity		Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
	1.4.8.6	Establishment of waste dumping station for houseboats from where Panchayats can collect solid waste	VKWMU	LSG Planning Department, Grama Panchayats	13 locations within the following suggested GPs- Thanneermukkam, Kokkothamangalam, Aryad, Punnapra North, Kumarakam		✓				13	100000	Per LSG	13.0	NPCA	Core	
1.4.9	Awareness programmes on plastic waste management and support for establishment of integrated plastic waste management facilities																
	1.4.9.1	Awareness programme on plastic waste management	VKWMU	KILA, ATREE	Zone III		✓		✓		45	40000	Per LSG	36.0	NPCA	Core	
	1.4.9.2	Support to integrated plastic waste management activities in all LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU	Zone III		✓		✓		45	d under 1.4.9.4				Non core	
	1.4.9.3	Feasibility assessment and planning for establishment of plastic recycling units in zone III LSGs	SWAK, Clean Kerala Company Limited	LSGs,VKWMU	Zone III		✓				3	300000	per workshop	9.0	NPCA	Core	Rebuild Kerala Initiative
	1.4.9.4	Plastic load assessment study to quantify load of microplastic, mesoplastic and macroplastic in the water column and sediment	SWAK, VKWMU	KUFOS, CWRDM	Zone III		✓				1	15,00,000	Per study	15	NPCA	Core	
1.4.10	Installation of modular ready to install sewage treatment plant - Johkasou (20 KLD capacity)																
			Alappuzha Municipality	SWAK, VKWMU, KSPCB	Slum area in Kayamkulam, Mavelikkara, Chengannur municipalities in Allappuzha district		✓	✓			5	1250000	Per unit	62.5	NPCA	Core	
1.5	DPR preparation for restoration of channels and outlets based on IIT Madras study recommendations																
1.5.1	Stakeholder consultations for reviewing the study recommendations																
			SWAK,VKWMU	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, Agriculture Department, KUFOS, SDMA	Kuttanad Coastal Belt			✓			2	3,00,000	Per workshop	6.0	NPCA	Core	
1.5.2	Review, Adaptation and DPR preparation																

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
		SWAK,VKWMU	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, SDMA, Agriculture Department, KUFOS,	Kuttanad Coastal Belt			✓	✓		1	3,00,000	Per activity	3.0	NPCA	Core	
1.5.3	Implementation of recommended and approved activities as per the DPR															
		SWAK,VKWMU	Kuttanad Development Coordination Council (KDCC), Kerala State Planning Board,CWRDM, SDMA, Agriculture Department, KUFOS,	Kuttanad Coastal Belt					✓	1			To be estimated based on ac		Core	
1.6	Development of comprehensive WASH plans in the local self governments															
1.6.1	Consultation workshops	KWA, Suchitwa Mission, LSGs	VKWMU	Zone III	✓	✓				3	3,00,000	Per workshop	9.0	NPCA	Non core	
1.6.2	Development of LSG-level WASH plans															
		KWA, Suchitwa Mission, LSGs	VKWMU	Zone III	✓	✓	✓	✓		45	20000	11-12 LSG per year	9.0	NPCA	Non core	
1.6.3	Support for Implementation of WASH actions															
		KWA, Suchitwa Mission, LSGs	VKWMU	Zone III	✓	✓	✓	✓		45	100000	11-12 LSG per year	45.0	NPCA (50%), Convergence(50%)	Non core	SBA (50%)
1.7	Drinking water supply scheme to residents of Kuttanad															
		KWA, LSGs	VKWMU	Zone-III: Kuttanad Floodplain area - 181 wards of 13 GPs in Alappuzha District		✓	✓	✓		1		Lumpsum		Converegnce	Non core	Convergence (100%). KIIFB funded Kuttanad Drinking water Project IInd Phase in Alappuzha District covering 181 wards of 13 Grama Panchayats
Sub Total(NPCA)													**1,283.5**			
Sub Total(Convergence 50 %)													**149.00**			

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
Sub total Non core NPCA															**270.0**	
Sub total Non core Convergence 50%															**30.0**	
2 Species and Habitat Conservation																
2.1 Asian waterbird census																
2.1.1	Empanelment of census co ordinators	SWAK,VKWMU	WISA, ATREE-CERC	Zone III	✓									NPCA	Core	
2.1.2	Formation of census groups	SWAK,VKWMU	WISA, ATREE-CERC	Zone III	✓					1	50,000	Per ecological zone	0.5	NPCA	Core	
2.1.3	Waterbird census training	SWAK,VKWMU	WISA, ATREE-CERC	Zone III	✓					2	50,000	Per training workshop	1.0	NPCA	Core	
2.1.4	Census	SWAK,VKWMU	WISA, ATREE-CERC	Zone III	✓	✓	✓	✓	✓	5	5,00,000	Per annual census	25.0	NPCA	Core	
2.1.5	Data compilation and reporting	SWAK,VKWMU	WISA, ATREE-CERC	Zone III	✓	✓	✓	✓	✓	5	50,000	Per year	2.5			
2.2 Fin fish and shell fish census													-			
2.2.1	Empanelment of census co ordinators	SWAK,VKWMU	KUFOS, ATREE-CERC	Zone III	✓					1	-	Per ecological zone	-	NPCA	Core	
2.2.2	Formation of census groups	SWAK,VKWMU	KUFOS, ATREE-CERC	Zone III	✓					5	50,000	Per ecological zone	2.5	NPCA	Core	
2.2.3	Fish census training	SWAK,VKWMU	KUFOS, ATREE-CERC	Zone III	✓					2	50,000	Per training workshop	1.0	NPCA	Core	
2.2.4	Census	SWAK,VKWMU	KUFOS, ATREE-CERC	Zone III	✓	✓	✓	✓	✓	5	5,00,000	Per census	25.0	NPCA	Core	
2.2.5	Data compilation and reporting	SWAK,VKWMU	KUFOS, ATREE-CERC	Zone III	✓	✓	✓	✓	✓	5	50,000	Per annual report	2.5	NPCA	Core	
2.3 Comprehensive biodiversity assessment																
2.3.1	Terms of reference workshop	VKWMU	WISA, KUFOS	Zone III	✓					1	3,00,000	Per workshop	3.0	NPCA	Core	
2.3.2	Appointment of expert agencies	VKWMU	WISA, KUFOS	Zone III	✓								-	NPCA	Core	
2.3.3	Biodiversity surveys(biannual)	Expert Agency	WISA, KUFOS	Zone III	✓	✓	✓	✓	✓	10	5,00,000	Per ecological zone	50.0	NPCA	Core	
2.3.4	Draft report consultation	Expert Agency	Local NGOs	Zone III	✓					1	2,00,000	Per consultation	2.0	NPCA	Core	
2.3.5	Report finalisation and publication	Expert Agency	Local NGOs	Zone III	✓	✓	✓	✓	✓	5	1,00,000	Per annual report	5.0	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
2.4	Monitoring of invasive species															
2.4.1	Mapping of invasive species distribution in two seasons pre and post monsoon															
		ATREE CERC	KUFOS	Zone III	✓			✓		4	10,00,000	Per activity (biannual)	40.0	NPCA	Core	
2.4.2	Stakeholders sensitization workshops	KUFOS	CMFRI	Zone III	✓			✓		1	3,00,000	Per workshop	3.0	NPCA	Core	
2.4.3	Surveillance and control measures	VKWMU	SWAK	Zone III	✓			✓		2	5,00,000	per year	10.0	NPCA	Core	
2.4.4	Follow up support	VKWMU	SWAK	Zone III	✓	✓	✓	✓	✓		2,00,000	Lumpsum	-	NPCA	Core	
2.5	Mapping and protection of key habitat areas															
2.5.1	Survey and mapping of fish and clam breeding grounds															
		ATREE CERC	KUFOS	Zone III		✓				1	10,00,000	Lumpsum	10.0	NPCA	Core	
2.5.2	Survey and mapping of bird congregation areas															
		KAU	KBS	Zone III		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5.3	Survey and mapping of mangroves and associated habitats															
		CMFRI	KUFOS	Zone III		✓				1	2,00,000	Lumpsum	2.0	NPCA	Core	
2.5.4	Community workshops to develop conservation strategies															
		KUFOS	CMFRI	Zone III		✓				2	3,00,000	Per workshop	6.0	NPCA	Core	
2.5.5	Mangrove restoration along Kayamkulam Kayal and along National Waterway 3															
		KUFOS	CMFRI , ATREE-CERC	Kayamkulam estuary, Along NW-3		✓					10,00,000	Lumpsum	10.0	NPCA	Core	
2.5.6	Appointment of community wardens	VKWMU	LSG and CBOs such as Vembanad Kayal Samrakshana Samithi, Clam Cooperatives	Zone III	✓									NPCA	Core	
2.5.7	Honararium for community wardens	VKWMU	LSG and CBOs	Zone III	✓	✓	✓	✓	✓	15	1,20,000	Per warden	90.0	NPCA	Core	
2.5.8	Watch and ward of habitats	Wetland Mitras/Communites		Zone III	✓	✓	✓	✓	✓	5	2,00,000	Per year	10.0	NPCA	Core	
2.6	Animal disease surveillance															
2.6.1	Develop an SOP for handling avian diseases episodes															
		SACON	SIAD	Zone III	✓					1	1,00,000	Per ecological zone	1.0	NPCA	Core	
2.6.2	Conduct workshops to spread awareness on avian diseases and their controls															
		SACON	SIAD	Zone III	✓					1	50,000	Per ecological zone	0.5	NPCA	Core	
2.6.3	Annual disease surveillance and reporting including avifauna, fish and clam species															

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
Sub Total (NPCA)													**309.5**			
Sub Total(Convergence 50 %)																
Sub total Non core NPCA																
Sub total Non core Convergence 50%																
3 Community based fisheries management																
3.1 Systematic catch assessment																
3.1.1	Protocol development workshop	CMFRI	KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓					1	3,00,000	Per workshop	No separate budget for	NPCA	Core	
3.1.2	Data collection	CMFRI	KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	1	6,00,000	Per activity per year	Covered together with zone II	NPCA	Core	
3.1.3	Stakeholder workshop on draft conclusions															
		CMFRI	KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	1	30,00,000	Per study	Covered together with zone II	NPCA	Core	
3.1.4	Report finalisation and publication	CMFRI	KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	1	3,00,000	Per workshop	Covered together with zone II	NPCA	Core	
3.2 Development of fishing calendar and zones																
3.2.1	Constitution of committee of experts and stakeholders															
		VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Alapuzha and Kottayam (Zone II and zone III)	✓									NPCA	Core	
3.2.2	Consultation meetings	VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Alapuzha and Kottayam (Zone II and zone III)	✓					2	3,00,000	Per workshop	Covered together with zone II	NPCA	Core	
3.2.3	Production of draft calendar and zone regulations															
		VKWMU, Dept. of Fisheries	KUFOS, CMFRI	Alapuzha and Kottayam (Zone II and zone III)	✓	✓				1	5,00,000	Per activity	Covered together with zone II	NPCA	Core	
3.2.4	Community monitoring and enforcement															
		Fisher Cooperatives	Clam Collectors Society, CBOs, Community wardens	Alapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	1,00,000	Per annum	Covered together with zone II	NPCA	Core	
3.3 Maintaining fish diversity and production																
3.3.1	Establishment of protected area for clam/fish															
		Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS	Allapuzha and Kottayam (Zone II and zone III)	✓	✓				10	1,00,000	Per Protected area	Covered together with zone II	NPCA	Core	
3.3.2	Maintenance of existing Protected areas															
	Vembanad Kol Action plans_12September2023	Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community wardens	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	10	80,000	Per Protected area	Covered together with zone II	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
3.3.3	Ranching to replenish depleted stock of commercially important fish species															
		Fisheries Department, VKWMU	Fisher Cooperatives, KUFOS, Clam cooperatives, Community wardens	Allapuzha and Kottayam (Zone II and zone III)	✓	✓						Per annum	Covered together with zone II	Convergence (1	Core	Fisheries department schemes allocations 25.6 Lakh (Alappuzha) (2022-23) 25.6 Lakh (Alappuzha) (2023-24) 25.6 Lakh (Alappuzha) (2024-25) 17.6 Lakh (Kottayam) (2022-23)
3.3.4	Support to establishment of freshwater prawn hatcheries															
		VKWMU	Fisher Cooperatives, KUFOS	Alappuzha		✓				1	20,00,000	Lumpsum	20.0	NPCA	Non core	
3.4	Conservation and awareness program															
3.4.1	Procurement of patrolling boat	VKWMU,Dept. of Fisheries, Govt. of Kerala		Allapuzha and Kottayam (Zone II and zone III)	✓	✓				4	5000000	Per boat	Covered together with zone II	NPCA (50%), Convergence (50%)	Core	Fisheries department - 13 lakhs 6.45 Lakh (Alappuzha) (2022-23) 6.45 Lakh (Kottayam) (2022-23)
3.4.2	Maintenance of patrolling boats	Dept. of Fisheries, Govt. of Kerala	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	4	1852000	Per boat per year	Covered together with zone II	NPCA (50%), Convergence (50%)	Core	Fisheries department - 37.04 lakhs 18.52 Lakhs - 1boat (Alappuzha) (2022-23) 18.52 Lakhs - 1boat (Kottayam) (2022-23)
3.4.3	Formation of fisheries management committee (FMC)															
		Fisheries Department	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs	Allapuzha and Kottayam (Zone II and zone III)	✓	✓				4	80,000	Lumpsum per year	Covered together with zone II	Convergence (1	Core	Fisheries budgets 0.3 Lakh (Alappuzha) (2022-23) 0.8 Lakh (Alappuzha) (2024-25) 0.8 Lakh (Alappuzha) (2025-26) 0.3 Lakh (Kottayam) (2022-23) 0.8 Lakh (Kottayam) (2023-24) 0.8 Lakh (Kottayam) (2024-25)
3.4.4	Support to fisheries management councils (FMC) for active surveillance															
		VKWMU	Fisheries Department, Fisher Cooperatives	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	2,00,000	Per year	Covered together with zone II	NPCA	Core	Fisheries Department - Extension and training
3.4.5	Awareness Programmes on sustainable fishing practices															
		Fisheries Department	VKWMU, Fisher Cooperatives, Clam cooperatives, Community wardens, CBOs	Allapuzha and Kottayam (Zone II and zone III)	✓	✓	✓	✓	✓	5	3,00,000	Lumpsum per year	Covered together with zone II	Convergence (50%) NPCA (50%)	Core	Fisheries budgets 1.5 Lakh (Alappuzha) (2022-23) 1.5 Lakh (Alappuzha) (2024-25) 1.5 Lakh (Alappuzha) (2025-26) 1.5 Lakh (Kottayam) (2022-23) 1.5 Lakh (Kottayam) (2023-24) 1.5 Lakh (Kottayam) (2024-25)

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
3.5 Appointment of project coordinator																
3.5.1	Honorarium to project coordinator	Dept. of Fisheries, Govt. of Kerala		Vembanad Estuary (Alappuzha and Kottayam)	✓	✓	✓	✓	✓	5	3,60,000	per individual per year	No separate budget for Zone III. Covered together with Zone II budgets	Convergence (100%)	Core	Ongoing since 2022-23. 3.6 Lakh (1st Year) 3.6 Lakh (2nd Year) 3.6 Lakh (3rd Year)
Sub Total (NPCA)													**20.0**			
Sub Total (Convergence 50 %)																
Sub total Non core NPCA															**20.0**	
Sub total Non core Convergence 50%																
4 Sustainable Wetland agriculture interactions																
4.1 Polder improvisation and strengthening																
4.1.1	Restoration of outer bunds of Padasekharams and flood mitigation works															
		Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi	Zone II and Zone III	✓	✓	✓	✓	✓	5		Lumpsum	66,950	Convergence(1(	Non core	Roughly the dudget allocations for 2023-24 are as follow s 1. **Irrigation Department** (2023-24 approx outlay) - Flood Mangement Programme (Plan scheme) - Rs 3000 lakh, NABARD- RIDF - Rs 10000 lakh, PMSKY - Rs 1100 lakh **2. Agriculture Department** - Development of Agriculture in Kuttanad scheme - Rs 1200 lakhs; NABARD RIDF - Rs 1000 lakhs. The projections here are based on the DPRs prepared by the Irrigation Department - EE Irrigation Thanneermukkom - DPRs w ere prepared for improving the infrastructural facilities of 231 padasekharams under KEL III (FMP scheme central share 50% state share 50%) for an amount of 379.05 crore based on SOR 2009. Out of this, 57 w orks for improving 94 padasekharams w ere executed and the expenditure for the same is 89.61 crores. Later, DPRs w ere prepared for improving 411 padasekharams in Kuttanad Taluk and Veeyapuram Panchayath for an amount of 1212.45 crores based on SOR 2014, out of w hich 83 w orks w ere sanctioned for an amount of 758.39 crore. Among these w orks, 57 w orks w ere completed and the expenditure comes to 162.45 crores. If cost escalation is not taken into account, the balance amount

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
																required comes to 1339.44 crore , out of which 50% may be allotted to restoration of outer bunds and 50% for
4.1.2	Reconstruction of side protection walls and shutter gates															
		Irrigation Department, Agriculture Department, KLDC, SDMA	Padasekhram Samithi	Zone II and Zone III	✓	✓	✓	✓	✓			Lumpsum	66,900	Convergence(100%)	Non core	
4.1.3	Construction of box culverts	Irrigation Department, Agriculture Department, SDMA	Padasekhram Samithi	Zone II and Zone III	✓	✓	✓	✓	✓					Convergence(100%)	Non core	
4.2	Study on revision of cropping calendars															
4.2.1	Stakeholder workshops	Agriculture department - International Research and Training Centre for Below Sea level Farming, KAU	VKWMU, Fisher Committees, Padasekhram committee, District Collector Office, Alappuzha	Zone III	✓					1	3,00,000	Per workshop	3.0	NPCA	Non core	
4.2.2	Draft report preparation	Do	Do	Zone III	✓					1	2,00,000	per report	2.0	NPCA	Non core	
4.2.3	Report finalisation and publication	Do	Do	Zone III	✓					1	1,00,000	per report	1.0	NPCA	Non core	
4.3	Promoting good agricultural practices															
4.3.1	Collation and publication of wetland-friendly package of practices															
		VKWMU	KAU, Agriculture Department, Veterinary	Zone III	✓					1	10,00,000	Per publication	10.0	NPCA	Non core	
4.3.2	Outreach workshops	VKWMU	KAU, Agriculture Department, Veterinary department, MS Swaminathan Research Foundation	Zone III	✓		✓			20	50,000	Per workshop	10.0	NPCA	Non core	
4.3.3	Incentives to paddy farmers for adopting organic farming and good agricultural practices, Integrated WEEDY rice management.															
		Agriculture Department, VKWMU	KAU, VKWMU	Zone III	✓	✓	✓			1000	8,800	Per ha	88.0	Convergence(50%)	Non core	Agriculture department - Scheme on "Organic farming and good agricultural practices" - Rs 600 lakhs
4.3.4	Hand-holding support	Agriculture Department	KAU, VKWMU	Zone III		✓	✓	✓	✓	1000		Lumpsum	10.0	Convergence(100%)	Non core	
4.3.5	Replacement of Petti- Para with Vertical Axial Flow pump sets															

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
		Agriculture Department	KAU	Zone III	✓	✓	✓	✓	✓	5	17,00,00,000	Per annum	8500	Convergence(100%)	Non core	Agriculture department - Rs 1200 lakhs under "Development of various padasekhrams in Kuttanad and the establishment and replacement of Petti & para with VAF pumps" and Rs 500 lakh as PM KUSUM Top up subsidy to promote renewable energy
4.4	Soil health monitoring															
4.4.1	On site soil salinity monitoring by installing soil salinity sensors in Kuttanad															
		VKWMU	Agriculture department, KAU	Zone III		✓						Lumpsum	10.0	NPCA	Non core	
4.4.2	Soil salinity mapping in Kuttanad	VKWMU	KAU, VKWMU	Zone III			✓			1	10,00,000	per	10.0	NPCA	Non core	
4.4.3	Stakeholder meetings for scientific prevention and management of soil salinity problems															
		KAU, Agriculture	VKWMU	Zone III		✓	✓			3	2,00,000	Per meeting	6.0	NPCA	Non core	
4.4.4	Crop insurance to marginalised farmers for salinity damage															
		Agriculture department	Padasekhram Samithi	Southern end of Achenkovil River basin in Haripad-Pallippad GP, Purrakad, Thakazy, Cheppad and other salinity affected area established by soil testing			✓	✓		Target to be decided by Agriculture department	25,000	Per farmer	Allocations as decided by Agriculture department	Convergence(10	Non core	Agricultural department - State Crop Insurnace scheme - Rs 3000 lakhs
4.4.5	Upgradation of soil and water testing facilities in district laboratories															
		Agriculture department, KAU	VKWMU, CWRDM	District laboratory at Alappuzha of Agriculture Department		✓				1	50,00,000	per unit	50.0	NPCA (50 %), Convergence (50%)	Non core	Agricultural department - - Modernization of departmental laboratories - Rs 400 lakhs
4.4.6	Financial support for regulation of soil acidity to marginal farmers of affected Padasekhram Samithis															
		Agriculture department, KAU	VKWMU, KAU, Padasekhram Samithi	Southern end of Achenkovil River basin in Haripad-Pallippad GP, Purrakad, Thakazy, Cheppad and other salinity affected area established by soil testing			✓	✓		Target to be decided by Agriculture department	5000	per farmer	Allocations as decided by Agriculture department	Convergence(10	Non core	Agriculture department - Soil and root health and productivity improvement - Rs 2210 lakhs

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
4.5 Support to Registered seed growers																
4.5.1	Support to Registered seed growers for t	Agriculture department, KAU	VKWMU, Padasekhram Samithi	Zone III			✓	✓		50	1,00,000	per seed grower	50	Convergence(1(	Non core	Agriculture department - Registered seed growers programme Rs 125 lakhs
4.6 Vermicomposting																
4.6.1	Training of village communities	Agriculture Department, Krishi Vigyan Kendras,	VKWMU	Zone III GPs		✓				5	200000	Per training	10	NPCA	Non core	
4.6.2	Establishment of vermicompost units and hand holding support to beneficiaries															
		Agriculture Department, Krishi Vigyan Kendras, Krishi Bhavans	VKWMU	Zone III GPs		✓				Target to be decided by Agriculture department				Convergence(1(	Non core	Agriculture Department Strengthening Agriculture Extension Scheme- Rs 2828 lakhs
Sub Total (NPCA)													**62.0**			
Sub Total(Convergence 50 %)													**138.00**			
Sub total Non core NPCA															**62.0**	
Sub total Non core Convergence 50%															**138.0**	
5 Sustainable wetland tourism																
5.1 Capacity development support and incentives for maintaining standards as part of Responsible Tourism model																
5.1.1	Needs assessments	VKWMU, SWAK	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone III	✓	✓				1	2,00,000	Per workshop	2	NPCA	Core	
5.1.2	Programme design	VKWMU, SWAK	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone III	✓	✓				1	5,00,000		5	NPCA	Core	
5.1.3	Training workshops	VKWMU	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone III	✓	✓				1	5,00,000	Per workshop	5	NPCA	Core	
5.1.4	Incentives programme for standard maintenance (including solid waste dumping at landing stations)															
		VKWMU	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone III	✓	✓	✓	✓	✓	5	15,00,000	Per year	75	Convergenec(50%) NPCA (50%)	Core	Kerala Tourism 2.0 - Development of tourism corridor - Rs 362.15 crores of which Rs 9.5 crore is for responsible tourism initiaves.
5.1.5	Follow up support	VKWMU	Tourism department, DTPC, Houseboat owners, Resorts, hotel owners etc	Zone III			✓	✓	✓			Lumpsum	10	NPCA	Core	
5.2 Surveillance & enforcement of extant regulation																

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
5.2.1	Periodic surveillance	VKWMU	KSPCB, Directorate of ports, Network of community wardens	Zone III			✓			1	5,00,000	Per year	5.0	NPCA	Core	
5.2.2	Reporting of violations to concerned authorities															
		KSPCB, Directorate of ports, Network of community wardens	VKWMU, SWAK	Zone III	✓	✓	✓	✓	✓	5	5,00,000	Per annum	25	NPCA	Core	
5.2.3	Implementation of penal provisions	KSPCB, Directorate of ports, SWAK	VKWMU	Zone III	✓	✓	✓	✓	✓	5	5,00,000	Lumpsum	25	Convergence(1	Core	Dept. of Kerala Tourism
5.3	STP infrastructure upgradation around tourist sites and for houseboats															
5.3.1	Assessment of current waste generation, management and gaps															
		VKWMU	KSPCB, DTPC	Zone III			✓	✓		1	5,00,000	Per Assessment	5.0	NPCA	Core	
5.3.2	Operationalisation of existing STPs around major tourist locations in Kuttanad															
		VKWMU	KSPCB, DTPC	Zone III - Vattakayal, Alappuzha; H block, Kunumma - Alappuzha			✓	✓		2				Convergence(1	Core	Dept. of Kerala Tourism
5.3.3	Feasibility assessment of new STPs	VKWMU	KSPCB, DTPC	Zone III			✓	✓		1	3,00,000	Per year	3.0	NPCA	Core	
5.3.4	STP collection barge for point to point sewage collection from houseboats															
		VKWMU	KSPCB, DTPC, House boats owners association	Zone III			✓	✓		2	1,00,00,000	Per Barge	200.0	Convergence(1	Core	DTPC
5.4	Orientation programmes for houseboat owners, tourism facility owners and tour operators															
5.4.1	Orientation programme design	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone III	✓					1	10,00,000	Per study	10	NPCA	Core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
5.4.2	Orientation workshops	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone III		✓	✓	✓		10	3,00,000	Per workshop	30	NPCA	Core	
5.4.3	Follow up support	DTPC	VKWMU, SWAK, House boats owners association, Houseboat/Hotel staff and other stakeholders	Zone III		✓	✓	✓	✓		20,00,000	Lumpsum	20.0	NPCA	Core	
5.5	Nature awareness programmes for tourists															
5.5.1	Nature awareness programme design	Expert Agency	Local NGOs	Zone III		✓				1	10,00,000	Per study	10	NPCA	Core	
5.5.2	Workshops and events	VKWMU	Local NGOs	Zone III	✓	✓	✓	✓	✓	10	3,00,000	Per workshop	30	NPCA	Core	
5.5.3	Follow up support and Programme evaluation															
		VKWMU	SWAK, Local NGOs	Zone III			✓	✓	✓		5,00,000	Lumpsum	-		Core	
5.6	Wetland specific tourism programme design for Zone III															
5.6.1	Programme design workshop	SWAK, VKWMU	DTPC	Zone III	✓					2	3,00,000	Per workshop	6.0	NPCA	Core	
5.6.2	Formulation of draft plan	SWAK, VKWMU	DTPC	Zone III		✓				1	2,00,000	Per activity	2.0	NPCA	Core	
5.6.3	Review, finalisation and approval	SWAK, VKWMU	DTPC	Zone III		✓				1	3,00,000	Per workshop	3.0	NPCA	Core	
5.6.4	Implementation of the program	DTPC	VKWMU	Zone III			✓	✓	✓	1		Lumpsum	200.0	NPCA (50%), Convergence	Core	
5.7	Feasibility assessment for construction of Dry Dock Facility for houseboats to facilitate compliance with safety standards															
5.7.1	Feasibility assessment (and site selection) for construction of dry dock facility including viability w.r.to existing environmental regulations															
		DTPC, Tourism	VKWMU, SWAK, House boats owners	Muhamma or any other feasible	✓					2	3,00,000	Per workshop	6.0	NPCA	Non core	
5.7.2	Design of facility	Expert Agency	DTPC, Tourism Department	Muhamma or any other feasible		✓				1	10,00,000	Per activity	10.0	NPCA	Non core	
5.7.3	Environmental Impact Assessment	Expert Agency	DTPC, Tourism Department,	Muhamma or any other feasible		✓				2	3,00,000	Per workshop	6.0	NPCA	Core	
5.7.4	Construction of dry dock facility	Expert Agency	DTPC, Tourism Department,	Muhamma or any other feasible			✓			1	3,00,00,000	Lumpsum	300.0	Convergence(100%)	Non core	

Activity	Sub-activity	Lead	Support	Implementation location suggestions	1st yr	2nd yr	3rd yr	4th yr	5th yr	Physical Target	Rate (Rs)	Unit	Budget (in lakhs)	Source of funds NPCA	Core/ Non Core (NPCA)	Convergence Schemes (2022-23)
5.7.5	Monitoring and review	DTPC, Tourism	House boats owners association,	Muhamma or any other feasible				✓	✓	2	3,00,000	Per workshop	6.0	NPCA	Core	
Sub Total (NPCA)													**199.0**			
Sub Total (Convergence 50 %)													**275.00**			
Sub total Non core NPCA																
Sub total Non core Convergence 50%																
Total (NPCA)													**1,874**			
Total (Convergence 50%)													**562**			
Total Non core NPCA															**352.0**	
Total Non core Convergence 50%															**168.0**	

References

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Annexes

Annex IA

List of large scale and PSU units around Vembanad-Kol wetlands

Sl. No.	Industry Name	Type of Industry
1	Hi Build Coatings pvt ltd	Paint Manufacturing
2	Appollo tyres pvt ltd	Tyre and Precured Tread Rubber Manufacturing
3	Cochin Kagaz	Craft Paper, White Liner, Craft liner Etc
4	BSES power ltd.	Generation of Electricity
5	Oen India Limited	Electro-mechanical Equipment Mfg
6	Betah Plastics pvt. Ltd	Plastic Moulded Ites
7	Steelco Metals and Profiles	Roofing Sheet
8	Malabar excrusions	Aluminium items
9	Kannangayathu metals	Aluminium Items
10	CAP SEA Foods	Food process
11	Cochin Security Press	Printing
12	Brmsco	Plastic Woven fabrics
13	Photone	Printing
14	Carborundum universal ltd.	Minerals
15	Metrolla Steel	Iron products
16	Kunnathan Chip Board	Particle board
17	M/S Kerala Ayurveda Ltd.	Ayurvedic Medicine
18	XO Pack Pvt Ltd	Packaging
19	Al Badr Sea Foods Pvt. Ltd.	Sea food
20	SFO technologies cable and wire	Electronics
21	Amy Exports Pvt Ltd	Jewellery
22	Synthite Industries Ltd	Flavors, spice products etc.
23	Plant lipids	Flavors, spice products etc.
24	Agappe Diagnostics Ltd	Diagnostic equipments
25	Philips Carbon	Carbon Black
26	Arjuna Natuaral Extracts Ltd	Processed Spices
27	Prima Agro Ltd	Cattle Feed
28	Sri Sreenivasa Roller Floor Mill Pvt Ltd	Flour Milling
29	Eastern treads	Tyre Treads
30	Rado tyres	Tyre
31	Palappillil Crub Rubbers	Rubber Products
32	Transformers and Electrical Kerala (TELK) Ltd., Angamalay	Power Transformers
33	HMT Kalamsherry	Machine Tool Manufacturing
34	BPCL Kochin refineries	Crudeoil refining, LPG - 44
35	Hindalco industries Ltd.	Alluminium, Alloys
36	HIL Ltd., Udyogmandal	DDT, Dicofol

37	Travancore cochin Chemicals Ltd.	Caustic soda, Liquid Chlorine, HCl acid, soda bleach
38	FACT fertilizer	Fertilizerand Petrochemicals, Engg Consultancy Ser
39	Indian Rare Earths Ltd	Minerals
40	Cochin shipyard ltd.	Ship Manufacture
41	Vazhakulam Agro and Fruit Producing Co. Ltd	Food products
42	Traco cable company ltd.	Electric cables, House wiring cables
43	IOC bottling plant	L P G Refilling
44	KCPL Gelatin (Nitta Gelatine)	Chemical
45	Kerala Solvent Extraction Ltd.	Chemical
46	Highrange Rubbers Pvt. Ltd	Rubber Products
47	Best Roof	Ceramics
48	IVE Links	Medical
49	Santhom Metacast Pvt Ltd	Metal
50	Travancore Cements	Cement
51	Canara Paper Mills	Paper
52	St. Mary's Rubbers Pvt Ltd	Rubber Products
53	Ashley Furniture	Home Furnishings
54	Hindustan News Print Ltd.	Media Production Company
55	MRF Limited	Rubber Products
56	Malayalam Manorama	Media Production Company
57	M/S Milma Kerala Cooperative Milk Marketing	Milk Products

Details of Micro and Small Enterprises and Artisan Units in Kottayam, Thrissur, Ernakulam and Alappuzha districts[161]

Type of Industry	Kottayam	Thrissur	Ernakulam	Alapuzzha
	No. of Units	No. of Units	No. of Units	No. of Units
Agro and Food based	295	2866	5225	2293
Soda water/Packaged drinking water	83	35	169	215
Cotton textile	29	21		106
Woolen, silk and artificial Thread based clothes	1	1754	16	8
Jute and Jute based	31	1144		
Ready-made garments and embroidery	125	843	1764	1103
Wood/wooden based furniture	693	46	2268	733
Paper and Paper products	99	212	502	163
Leather based	19	690	167	37
Chemical/Chemical based	14	2	874	153
Rubber, Plastic and petro based	518	275	924	270
Mineral based	2	1789	155	108
Metal based (Steel Fab)	482	523	810	307
Engineering units	252	1686	3612	1431
Electrical machinery and transport equipment	55	761	1017	148
Repairing and servicing	81	275	4959	1404
Gem designing				64
Fashion designing				82
Artisan Units			99	103
Others	5444	3350	4852	3081
Total	**8223**	**16272**	**27413**	**11809**

[161] Brief Industrial profile reports of districts, 2018-19, MSME Development Institute, Misntry of MSME, GoI)

Phytoplanktons[162]

S.no	Family	Genera
1.	Bacillariophyceae	Cocconeis*
2.		Cymbella*
3.		Euontia
4.		Fragilaria*
5.		Gomphoneis
6.		Melosira*
7.		Navicula*
8.		Pinnularia*
9.		Stauroneis*
10.		Surirella*
11.		Synedra*
12.	Chlorophyceae	Chlorella*
13.		Chlorococcum*
14.		Coelastrum*
15.		Dimorphococcus
16.		Eudorina*
17.		Kirchneriella
18.		Mougeotia
19.		Nephrocytium
20.		Oedogonium
21.		Pandorina*
22.		Pediastrum*
23.		Pleodorina
24.		Scenedesmus*
25.		Schroederia
26.		Selenastrum*
27.		Spirogyra*
28.		Tetraedron
29.		Terallantos
30.		Ulothrix*
31.		Volvox
32.	Chrysophyceae	Uroglenopsis
33.		Ananaena*
34.		Chroococcus
35.		Lyngbya*
36.		Merismopedia
37.		Microcystis*
38.		Myxosarcina

[162] Tessy, P.P and Sreekumar, R. 2008. A report on the pollution algae from the Thrissur Kol Wetlands (Part of Vembanad Kol, Ramsar Site), Kerala. 2008. Nature Environment and Pollution Technology. Vol. 7. No. 2. 311-314pp.

S.no	Family	Genera
39.		Oscillatoria*
40.		Spirulina*
41.		Tolypothrix
42.	Desmidiaceae	Cylindrocystis
43.		Gonatozygon
44.		Netrium
45.		Arthrodesmus
46.		Closterium*
47.		Cosmarium*
48.		Desmidium
49.		Docidium
50.		Euastrum
51.		Gymnozyga
52.		Hyalotheca
53.		Micrasterias
54.		Onyconema
55.		Penium
56.		Pleurotaenium
57.		Spondylosium
58.		Staurastrum
59.		Triploceras
60.		Xanthidium
61.	Euglenophyceae	Euglena*
62.		Lepocinclis*
63.		Phacus*
64.		Trachelomonas*

* Pollution tolerant genera

Macrophytes[163]

Free floating

1. *Eichhornia crassipes* Mart.
2. *Salvinia molesta* Mitch.
3. *Azolla pinnata* R.Br.
4. *Lemna minor* Linn.
5. *Pistia stratiotes* Linn.

Emergent

1. *Ischaemum travancorense* Stapf ex C.E.C.Fisch.
2. *Colocasia esculenta* Linn.
3. *Pandanus odoratissimus* Jacq.
4. *Melastoma malabathricum* Linn.
5. *Syzygium* sp.
6. *Lygodium microphyllum* Cav.
7. *Mikania micrantha* Kunth.
8. *Hymenachne acutigluma* Steud.
9. *Sacciolepis interrupta* Willd.
10. *Hygrophila ringens* Linn.
11. *Acrostichum aureum* Linn.
12. *Phragmites karka* Retz.
13. *Typha angustata* Bory. and Chaub.
14. *Cyperus cephalotes* Vahl.
15. *Limnocharis flava* Linn.
16. *Leersia hexandra* Sw.
17. *Alternanthera philoxeroides*≠ *Mart.*
18. *Ludwigia adscendens*≠ Linn.
19. *Bacopa monnieri* Linn.

Submerged

1. *Aponogeton appendiculatus* H.Bruggen.
2. *Cabomba caroliniana* A. Grav.

[163] Jayan, P. R and Sathyanathan, N. 2010. Overview of farming practices in the water-logged areas of Kerala, India. International Journal of Agricultural and Biological Engineering 3(4): 1-16.

Mangrove and associated vegetation[164]

Shrubs

1. *Acanthus ilicifolius* Linn.
2. *Acrostichum aureum* Linn.
3. Lumnitzera racemosa Willd.

Small Tree

1. *Aegiceras corniculatum* Linn.
2. *Avicennia marina* (Forsk.) Vierh.
3. *Bruguiera cylindrica* (Linn.) Bl.
4. *Bruguiera sexangula* (Lour.) Poir
5. *Ceriops tagal* (Perr.) C.B.Rob
6. *Kandelia candel* (Linn.) Druce
7. *Rhizophora apiculata* Blume.
8. *Rhizophora mucronata* Lamk.
9. *Excoecaria agallocha* Linn.

Medium sized Tree

1. *Avicennia officinalis* Linn.
2. *Excoecaria indica* (Willd) Mull.Arg.
3. *Sonneratia caseolaris* (Linn.) Engl.

Large Tree

1. *Bruguiera parviflora* W and A. exGriffith

Mangrove associates

Herbs

2. *Alternanthera sessilis* (Linn.) R. Br. Ex.DC
3. *Crinum defixum* Ker.
4. *Cyperus alopecuroides* Rottb.
5. *Cyperus* sp.
6. *Fimbristylis dichotoma* Vahl.
7. *Fimbristylis spathacea* Roth.
8. *Paspalum vaginarum* S.W.

Shurbs

1. *Ardisia littoralis* Andr.
2. *Clerodendrum inerme* Gaertn.
3. *Cyperus javanicus* Houtt.
4. *Phragmites karka* Trin.

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[164] Ram, T. A. and C. S. Shaji 2013. Diversity and Distribution of Mangroves in Kumbalam Island of Kerala, India. Journal of Environmental Science, Toxicology and Food Technology 4: 18-26.
KFRI, 2009. The Conservation of Mangroves in Kerala: Economic and Ecological Linkages. Report 487: 47 pp.

Climbing Shurbs

1. *Caesalpinia crista* Linn.
2. *Dalbergia candenatensis* Prain.
3. *Derris trifoliata* Lour.

Small Tree

1. *Cerbera odollam* Gaertn.
2. *Hibiscus tiliaceus* Linn.
3. *Pandanus fascicularis* Lamk.
4. *Premna serratifolia* Linn.
5. *Quassia indica* (Gaertn.) Noteb.

Medium sized Tree

1. *Barringtonia racemosa* (L.) Spreng.
2. *Dolichandrone spathacea Seem.*

Large Tree

1. *Calophyllum inophyllum* Linn.
2. *Heritiera littoralis* Dryand.
3. *Thespesia populnea* (Linn.) Sol. Ex Correa.

Zooplanktons[165]

S.no	Order	Family	Species
1.	Ploima	Brachionidae	*Anuraeopsis fissa*
2.			*Anuraeopsis navicula*
3.			*Brachionus angularis*
4.			*Brachionus calyciflorus*
5.			*Brachionus falactus*
6.			*Brachionus dichotomous*
7.			*Brachionus forficula*
8.			*Brachionus sessilis*
9.			*Platyias patulus*
10.			*Platyias quadricornis*
11.			*Keratella cochlearis*
12.			*Keratella tropica*
13.		Asplanchnidae	*Asplanchna brightwelli*
14.			*Asplanchna herricki*
15.			*Asplanchna priodonta*
16.		Mytinidae	*Mytilina sp.*
17.		Lecanidae	*Lecane bulla*
18.			*Lecane cornuta*
19.			*Lecane aculeate*
20.			*Lecane furcate*
21.			*Lecane monostyla*
22.			*Lecane luna*
23.			*Lecane lateralis*
24.			*Lecane inopinata*
25.			*Lecane pyriformis*
26.			*Lecane sp1*

[165] Fathibi, K., Sudhikumar, A.V and Aneesh, E.M. 2020. Species composition and abundance of rotifers (Rotifera: Eurotatoria) in Thrissur Kole wetland, Kerala, India. Egyptian Journal of Aquatic Biology and Fisheries Zoology Department, Faculty of Science, Ain Shams University, Cairo, Egypt. ISSN 1110 – 6131 Vol. 24. No. 6. 439–451pp.

S.no	Order	Family	Species
27.			*Lecane sp2*
28.		Trichocercidae	*Trichocerca cylindrica*
29.			*Trichocerca kostei*
30.			*Trichocerca longiseta*
31.			*Trichocerca similis*
32.			*Trichocerca rattus*
33.		Synchaetidae	*Synchaeta sp.*
34.			*Polyartha vulgaris*
35.			*Polyartha sp.*
36.	Floscullariacea	Conochilidae	*Conochilus unicornis*
37.			*Conohilus hippocrepis*
38.		Filinidae	*Filina opoliensis*
39.		Testudinellidae	*Testudinella patina*
40.		Trichosphaeridae	*Horaella brehmi*

Mammals[166]

S.no	Order	Family	Species	Common Name
1.	Insectivora	Erinaceidae	*Hemiechinus nudiventris*	South Indian Hedgehog
2.		Soricidae	*Suncus murinus*	Grey Musk Shrew
3.	Chiroptera	Pteropodidae	*Cynopterus sphinx*	Short-nosed Fruit Bat
4.			*Pteropus giganteus*	Indian Flying Fox
5.		Megadermatidae	*Megaderma lyra*	Greater False Vampire
6.			*Megaderma spasma*	Lesser False Vampire
7.		Rhinolophidae	*Rhinolophus rouxii*	Penninsular Horseshoe Boat
8.		Vespertilionidae	*Kerivovula picta*	Paited Bat
9.			*Pipisterellus sp.*	Bat
10.	Carnivora	Canidae	*Canis aureus*	Asiatic Jackal
11.		Mustellidae	*Lutra perspicillata*	Smooth-coated Otter
12.		Viverridae	*Paradoxurus hermaphroditus*	Common Palm Civet
13.			*Viverricula indica*	Small Indian Civet
14.		Herpestidae	*Herpes edwardsii*	Indian Gray Mangoose
15.		Felidae	*Felis chaus*	Jungle Cat
16.	Rodenta	Sciuridae	*Funambulus palmarum*	Indian Palm Squirrel
17.		Muridae	*Bandicota bengalensis*	Lesser Bandicoot Rat
18.			*B. indica*	Greater Bandicoot Rat
19.			*Rattus rattus*	House Rat, Roof Rat
20.			*Mus musculus*	House Mouse
21.			*M. booduga*	Common Indian Field Mouse

[166] Narayanan, S.P. and Sreekumar, B. 2012. A Decade of Vembanad Waterbird Counts. Department of Forests and Wildlife, Govt. of Kerala. Thiruvananthapuram.
Editor-Director. 2009. Faunal Diversity of Vembanad Lake - A Ramsar site in Kerala, India, Wetland Ecosystem Series, 10:1-192. (Published by the Director, Zoological Survey of India, Kolkata).

Birds[167]

Accipitridae

1. *Pandion haliaetus* (Linnaeus, 1758)
2. *Elanus caeruleus* (Desfontaines, 1789)
3. *Haliastur Indus* (Boddaert, 1783)
4. *Circus aeruginosus* (Linnaeus, 1758)
5. *Accipiter badius* (Gmelin, 1788)
6. *Aquila clanga* (Pallas, 1811)
7. *Milvus migrans* (Boddaert, 1783)
8. *Circus pygargus* (Linnaeus, 1758)
9. *Ichthyophaga ichthyaetus* (Horsfield, 1821)
10. *Accipiter nisus* (Linnaeus, 1758)
11. *Aquila nipalensis* (Hodgson, 1833)
12. *Hieraaetus pennatus* (Gmelin, 1788)

Alaudidae

13. *Eremopterix griseus* (Scopoli, 1786)
14. *Galerida malabarica* (Scopoli, 1786)
15. *Alauda gulgula* (Franklin, 1831)

Alcedinidae

16. *Alcedo atthis (Linnaeus, 1758)*
17. *Pelargopsis capensis (Linnaeus, 1766)*
18. *Halcyon smyrnensis (Linnaeus, 1758)*
19. *Ceryle rudis (Linnaeus, 1758)*
20. *Ceyx erithaca (Linnaeus, 1758)*
21. *Halcyon pileata* (Boddaert, 1783)

Anatidae

22. *Dendrocygna javanica (Horsield, 1821)*
23. *Tadorna ferruginea (Pallas, 1764)*
24. *Nettapus coromandelianus (Gmelin, 1789)*
25. *Anas clypeata (Linnaeus, 1758)*
26. *Anas acuta (Linnaeus, 1758)*
27. *Anas querquedula (Linnaeus, 1758)*
28. *Aythya nyroca (Güldenstädt, 1770)*
29. *Anas crecca (Linnaeus, 1758)*
30. *Anas poecilorhyncha*(Forster, 1781)

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[167] Narayanan, S.P. and Sreekumar, B. 2012. A Decade of Vembanad Waterbird Counts. Department of Forests and Wildlife, Govt. of Kerala. Thiruvananthapuram.
Narayanan, S.P., Thomas, A.P. and Sreekumar, B. 2011. Ornithofauna and its conservation in the Kuttanad wetlands, southern portion of Vembanad-Kole ramsar Site, India. Journal of threatened Taxa 3(4): 1663-1676.
Azeez, P.A., Bhupathy, S., Balasubramanian, P. and Arun, P.R. 2004. Study of the bird habitats at the Pathiramanal Island, Vembanad Lake, Kerala in view of the proposed eco-tourism project, Report submitted to Government of Kerala. Salim Ali Centre for Ornithology and Natural History, Coimbatore.
Rahmani, A., S. Laad, Z. U. Islam and A. Malekar (eds.). (2002). Asian water bird census. Final report, India. Bombay Natural History Society, Bombay, 34pp.

Anhingidae

31. *Anhinga melanogaster* (Pennant, 1769)

Ardeidae

32. Ardea cinerea (Linnaeus, 1758)
33. Ardea purpurea (Linnaeus, 1766)
34. Casmerodius albus (Linnaeus, 1758)
35. Bubulcus ibis (Linnaeus, 1758)
36. Ardeola grayii (Sykes, 1832)
37. Ixobrychus sinensis (Gmelin, 1789)
38. Ixobrychus cinnamomeus (Gmelin, 1789)
39. Egretta garzetta (Linnaeus, 1766)
40. Egretta gularis (Bosc, 1792)
41. Mesophoyx intermedia (Wagler, 1829)
42. Butorides striatus (Linnaeus, 1758)
43. Nycticorax nycticorax (Linnaeus, 1758)
44. *Dupetor flavicollis*(Latham, 1790)

Artamidae

45. *Artamus fuscus* (*Vieillot, 1817)*

Apodidae

46. *Apus affinis* (Gray, 1830)
47. *Apus pacificus* (Latham, 1802)
48. *Tachymarptis melba* (Linnaeus, 1758)
49. *Hirundapus giganteus* (Temminck, 1825)
50. *Cypsiurus balasiensis* (Gray, 1829)

Bucerotidae

51. *Ocyceros griseus* (Latham, 1790)

Campephagidae

52. *Tephrodornis pondicerianus* (Gmelin, 1789)
53. *Coracina macei* (Lesson, 1831)
54. *Coracina melanoptera* (Rüppell, 1839)
55. *Pericrocotus cinnamomeus* (Linnaeus, 1766)
56. *Pericrocotus flammeus* (Forster, 1781)

Charadriidae

57. *Pluvialis fulva* (Gmelin, 1789)
58. *Pluvialis squatarola* (Linnaeus, 1758)
59. *Charadrius dubius* (Scopoli, 1786)
60. *Vanellus malarbaricus* (Boddaert, 1783)
61. *Vanellus indicus* (Boddaert, 1783)
62. *Charadrius alexandrinus* (Linnaeus, 1758)
63. *Charadrius mongolus* (Pallas, 1776)
64. *Charadrius leschenaultii (*Lesson, 1826)

Ciconiidae

65. *Mycteria leucocephala* (Pennant, 1769)
66. *Anastomus oscitans* (Boddaert, 1783)
67. *Ciconia episcopus* (Boddaert, 1783)

Columbidae

68. *Columba livia* (Gmelin, 1789)
69. *Stigmatopelia chinensis* (Scopoli, 1786)
70. *Chalcophaps indica* (Linnaeus, 1758)
71. *Ducula badia* (Raffles, 1822)
72. *Treron pompadora* (Gmelin, 1789)

Coraciidae

73. *Coracias garrulus* (Linnaeus, 1758)
74. *Coracias benghalensis* (Linnaeus, 1758)

Corvidae

75. *Dendrocitta vagabunda* (Latham, 1790)
76. *Corvus splendens* (Vieillot, 1817)
77. *Corvus macrorhynchos* (Wagler, 1827)

Cuculidae

78. *Clamator jacobinus* (Boddaert, 1783)
79. *Cuculus micropterus* (Gould, 1837)
80. *Eudynamys scolopaceus* (Linnaeus, 1758)
81. *Centropus sinensis* (Stephens, 1815)
82. *Clamator coromandus* (Linnaeus, 1766)
83. *Hierococcyx varius* (Vahl,1797)
84. *Cacomantis passerinus* (Vahl, 1797)

Capitonidae

85. *Megalaima viridis* (Boddaert, 1783)
86. *Megalaima haemacephala* (Müller, 1776)

Caprimulgidae

87. *Caprimulgus atripennis* (Jerdon, 1845)

Chloropseidae

88. *Chloropsis cochinchinensis* (Gmelin, 1788)
89. *Chloropsis aurifrons* (Temminck, 1829)
90. *Aegithina tiphia* (Linnaeus, 1758)

Cisticolidae

91. Priniahodgsonii (Blyth, 1844)
92. Cisticola juncidis (Rafinesque, 1810)
93. Prinia socialis (Sykes, 1832)
94. Prinia inornata (Sykes, 1832)
95. Acrocephalus dumetorum (Blyth, 1849)
96. Acrocephalus stentoreus (Ehrenberg, 1833)
97. Orthotomus sutorius (Pennant, 1769)
98. Phylloscopus trochiloides (Sundevall, 1837)

99. *Phylloscopus magnirostris* (Blyth, 1843)

Dicruridae

100. Dicrurusmacrocercus (Vieillot, 1817)

101. Dicrurus leucophaeus (Vieillot, 1817)

102. Dicrurus aeneus (Vieillot, 1817)

103. *Dicrurus paradiseus* (Linnaeus, 1766)

Dicaeidae

104. Dicaeum erythrorhynchos (Latham, 1790)

Estrildidae

105. Lonchura striata (Linnaeus, 1766)

106. Lonchura punctulata (Linnaeus, 1758)

107. Lonchura malacca (Linnaeus, 1766)

Falconidae

108. Falco tinnunculus (Linnaeus, 1758)

109. Falco peregrinus (Tunstall, 1771)

Glareolidae

110. Glareola lactea (Temminck, 1820)

Hirundinidae

111. Hirundo rustica (Linnaeus, 1758)

112. Hirundo daurica (Linnaeus, 1771)

113. Hirundo smithii (Leach, 1818)

114. Hirundo fluvicola (Blyth, 1855)

115. Hirundo tahitica (Gmelin, 1789)

116. Riparia diluta (Sharpe and Wyatt, 1893)

Jacanidae

117. Hydrophasianus chirurgus (Scopoli, 1786)

118. Metopidius indicus (Latham, 1790)

Laniidae

119. Lanius cristatus (Linnaeus, 1758)

120. Lanius schach (Linnaeus, 1758)

Laridae

121. Sterna aurantia (Gray, 1831)

122. Larus ichthyaetus (Pallas, 1773)

123. Larus brunnicephalus (Jerdon, 1840)

124. Larus ridibundus (Linnaeus, 1766)

125. Gelochelidon nilotica (Gmelin, 1789)

126. Sterna caspia (Pallas, 1770)

127. Sterna bengalensis (Lesson, 1831)

128. Sterna bergii (Lichtenstein, 1823)

129. Sterna albifrons (Pallas, 1764)

130. Sterna fuscata (Linnaeus, 1766)

131. Chlidonias hybrid (Pallas, 1811)

132. Chlidonias leucopterus (Temminck, 1815)

Meropidae

133. Merops orientalis (Latham, 1802)
134. Merops philippinus (Linnaeus, 1766)
135. Merops leschenaulti (Vieillot, 1817)

Monarchidae

136. Terpsiphone paradisi (Linnaeus, 1758)
137. Hypothymis azurea (Boddaert, 1783)

Motacillidae

138. Motacilla alba (Linnaeus, 1758)
139. Motacilla flava (Linnaeus, 1758)
140. Motacilla cinerea (Tunstall, 1771)
141. Anthus rufulus (Vieillot, 1818)
142. Dendronanthus indica (Gmelin, 1789)
143. Motacilla citreola (Pallas, 1776)
144. Motacilla maderaspatensis (Gmelin, 1789)

Muscicapinae

145. Muscicapa dauurica (Pallas, 1811)

Nectariniidae

146. Nectarinia asiatica (Latham, 1790)
147. Nectarinia zeylonica (Linnaeus, 1766)
148. Nectarinia lotenia (Linnaeus, 1766)

Oriolidae

149. Oriolus oriolus (Linnaeus, 1758)
150. Oriolus xanthornus (Linnaeus, 1758)
151. Oriolus chinensis (Linnaeus, 1766)

Passeridae

152. Passer domesticus (Linnaeus, 1758)
153. Petronia xanthocollis (Burton, 1838)
154. Pelecanidae
155. Pelecanus philippensis (Gmelin, 1789)

Phalacrocoracidae

156. Phalacrocorax niger (Vieillot, 1817)
157. Phalacrocorax fuscicollis (Stephens, 1826)
158. Phalacrocorax carbo (Linnaeus, 1758)

Pittidae

159. Pitta brachyura (Linnaeus, 1766)

Ploceidae

160. Ploceus philippinus (Linnaeus, 1766)
161. Ploceus manyar (Horsfield, 1821)

Podicipedidae

162. Tachybaptus ruficollis (Pallas, 1764)

Psittacidae

163. Psittacula krameri (Scopoli, 1769)
164. Psittacula cyanocephala (Linnaeus, 1766)
165. Loriculus vernalis (Sparrman, 1787)

Paridae

166. Parus major (Linnaeus, 1758)

Picidae

167. Dendrocopos nanus (Vigors, 1832)
168. Dendrocopos mahrattensis (Latham, 1801)
169. Dinopium benghalense (Linnaeus, 1758)
170. Celeus brachyurus (Vieillot, 1818)

Pycnonotidae

171. Pycnonotus jocosus (Linnaeus, 1758)
172. Pycnonotus cafer (Linnaeus, 1766)

Rallidae

173. Amaurornis phoenicurus (Pennant, 1769)
174. Porzana pusilla (Pallas, 1776)
175. Gallicrex cinerea (Gmelin, 1789)
176. Porphyrio porphyrio (Linnaeus, 1758)
177. Gallinula chloropus (Linnaeus, 1758)
178. Fulica atra (Linnaeus, 1758)
179. Rallina eurizonoides (Lafresnaye, 1845)
180. Gallirallus striatus (Linnaeus, 1766)
181. Porzana fusca (Linnaeus, 1766)

Recurvirostridae

182. Himantopus himantopus (Linnaeus, 1758)

Rostratulidae

183. Rostratula benghalensis (Linnaeus, 1758)

Rhipiduridae

184. Rhipidura aureola (Lesson, 1830)

Scolopacidae

185. Limosa limosa (Linnaeus, 1758)
186. Numenius phaeopus (Linnaeus, 1758)
187. Tringa erythropus (Pallas, 1764)
188. Tringa totanus (Linnaeus, 1758)
189. Tringa stagnatilis (Bechstein, 1803)
190. Tringa nebularia (Gunnerus, 1767)
191. Tringa ochropus (Linnaeus, 1758)
192. Tringa glareola (Linnaeus, 1758)
193. Actitis hypoleucos (Linnaeus, 1758)

194. *Calidris minuta (Leisler, 1812)*
195. *Calidris temminckii (Leisler, 1812)*
196. *Calidris subminuta (Middendorff, 1853)*
197. *Calidris ferruginea (Pontoppidan 1763)*
198. *Philomachus pugnax (Linnaeus, 1758)*
199. *Gallinago gallinago (Linnaeus, 1758)*
200. *Numenius arquata (Linnaeus, 1758)*

Strigidae

201. *Otus bakkamoena (Pennant, 1769)*
202. *Athene brama (Temminck, 1821)*
203. *Ketupa zeylonensis (Gmelin, 1788)*
204. *Strix ocellata (Lesson, 1839)*
205. *Glaucidium radiatum (Tickell, 1833)*
206. *Ninox scutulata (Raffles, 1822)*

Sturnidae

207. *Sturnus malabaricus (Gmelin, 1789)*
208. *Sturnus pagodarum (Gmelin, 1789)*
209. *Acridotheres tristis (Linnaeus, 1766)*
210. *Acridotheres fuscus (Wagler, 1827)*
211. *Sturnus blythii (Jerdon, 1845)*
212. *Sturnus roseus (Linnaeus, 1758)*

Threskiornithidae

213. *Plegadis falcinellus (Linnaeus, 1766)*
214. *Threskiornis melanocephalus (Latham, 1790)*
215. *Platalea leucorodia (Linnaeus, 1758)*

Timaliidae

216. *Turdoides striata ((Dumont, 1823)*
217. *Turdoides affinis (Jerdon, 1845)*

Tytonidae

218. *Tyto alba (Scopoli, 1769)*

Turdidae

219. *Zoothera citrina (Latham, 1790)*
220. *Copsychus saularis (Linnaeus, 1758)*
221. *Saxicoloides fulicata (Linnaeus, 1758)*
222. *Saxicola torquatus (Linnaeus, 1766)*
223. *Saxicola caprata (Linnaeus, 1766)*
224. *Luscinia svecica (Linnaeus, 1758)*

Upupidae

225. *Upupa epops (Linnaeus, 1758)*

Zosteropidae

226. *Zosterops palpebrosus (Temminck, 1824)*

Fin and Shell fish[168]

Oligohaline fish

1. *Parambassis dayi*(Bleeker, 1874)
2. *Parambassis thomassi*
3. *Ambylpharyngodon mola*(Hamilton, 1822)
4. *Anabas testudineus* (Bloch, 1792)
5. *Anguilla bicolor bicolor* (McClelland, 1844)
6. *Channa striata*(Bloch, 1793)
7. *Dayella malabarica*(Day, 1873)
8. *Heteropneustes fossilis*(Bloch, 1794)
9. *Horabagrus brachysoma*(Günther, 1864)
10. *Mastacembelus armatus*(Lacepède, 1800)
11. *Mastacembelus guentheri*(Day, 1865)
12. *Mystus malabaricus*(Jerdon, 1849)
13. *Mystus oculatus*(Valenciennes, 1840)
14. *Ompok bimaculatus*(Bloch, 1794)
15. *Puntius amphibious*(Valenciennes, 1842)
16. *Puntius filamentosus*(Valenciennes, 1844)
17. *Puntius sarana*(Hamilton, 1822)
18. *Tetraodon leopardus* (Day, 1878)
19. *Wallago attu*(Bloch and Schneider, 1801)
20. *Xenentodon cancila (Hamilton, 1822)*
21. *Labeo dussumieri*(Valenciennes, 1842)
22. *Stenogobius gymnopomus*
23. *Channa marulius*
24. *Channa gachua*
25. *Mystus armatus*
26. *Mystus montanus*
27. *Anguilla bengalensis*
28. *Arius arius*
29. *Clarias macrocephalus*

Euryhaline fish

30. *Ambassis gymnocephalus* (Lacepède, 1802)
31. *Colletteichthys dussumieri* (Valenciennes, 1837)

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[168] Asha, C.V., Suson, P.S., Retina, C.I and Nandan, B. 2014. Decline in diversity and production of exploited fishery resources in Vembanad wetland system: Strategies for better management and conservation. Open Journal of Marine Science, Vol. 4. 344-357pp.
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32. *Brachirus orientalis* (Bloch and Schneider, 1801)
33. *Caranx sexfasciatus* (Quoy and Gaimard, 1825)
34. *Cynoglossus puncticeps* (Richardson, 1846)
35. *Daysciaena albida* (Cuvier, 1830)
36. *Ehirava fluviatilis* (Deranivaqala, 1929)
37. *Etroplus maculatus* (Bloch, 1795)
38. *Etroplus suratensis* (Bloch, 1790)
39. *Gerres filamentosus* (Cuvier, 1829)
40. *Gerres setifer* (Hamilton, 1822)
41. *Glossogobius giuris* (Hamilton, 1822)
42. *Hyporhamphus limbatus* (Valenciennes, 1847)
43. *Hyporhamphus xanthopterus* (Valenciennes, 1847)
44. *Leiognathus brevirostris* (Valenciennes, 1835)
45. *Leiognathus equulus* (Forsskål, 1775)
46. *Liza macrolepis* (Smith, 1846)
47. *Liza parsia* (Hamilton, 1822)
48. *Lutjanus argentimaculatus* (Forsskål, 1775)
49. *Megalops cyprinoides* (Broussonet, 1782)
50. *Mugil cephalus* (Linnaeus, 1758)
51. *Mystus gulio* (Hamilton, 1822)
52. *Oxyurichthys microlepis* (Bleeker, 1849)
53. *Oxyurichthys formosanus* (Nichols, 1958)
54. *Platycephalus crocodilus* (Cuvier, 1829)
55. *Tachysurus maculatus* (Thunberg, 1792)
56. *Terapon jarbua* (Forsskål, 1775)
57. *Sillago sihama* (Forsskål, 1775)
58. *Dendrophysa russelli* (Cuvier, 1830)
59. *Chelonodon patoca* (Hamilton, 1822)
60. *Tachysurus subrostratus* (Valenciennes, 1840)
61. *Sarotherodon mossambicus* (Peters, 1852)
62. *Oxyurichthys tentacularis* (Valenciennes, 1837)
63. *Psammogobius biocellatus* (Valenciennes, 1837)
64. *Sillago vincenti* (McKav, 1980)
65. *Valamugil cunnesius* (Valenciennes, 1836)
66. *Scaptophagus argus*
67. *Ambassis commersonii* (Lacepède, 1802)
68. *Anodontostoma chacunda* (Hamilton, 1822)
69. *Chanos chanos* (Forsskål, 1775)
70. *Dasyatis sephen* (Forsskål, 1775)
71. *Eleutheronema tetradactylum* (Shaw, 1804)
72. *Elops machnata* (Forsskål, 1775)
73. *Epinephelus tauvina* (Forsskål, 1775)
74. *Escualosa thoracata* (Valenciennes, 1847)
75. *Lates calcarifer* (Bloch, 1790)
76. *Muraenesox bagio* (Hamilton, 1822)
77. *Nematalosa nasus* (Bloch, 1795)
78. *Pomadasys argenteus* (Forsskål, 1775)
79. *Pseudorhombus arsius* (Hamilton, 1822)
80. *Siganus javus* (Linnaeus, 1766)
81. *Sphyraena jello* (Cuvier, 1829)
82. *Stolephorus commersonii* (Lecepede, 1803)
83. *Stolephorus waitei* (Jordan and Seale, 1926)

84. *Strongylura strongylura* (Van Hasselt, 1823)
85. Thryssa kamalensis
86. Thryssa purava
87. *Thryssa mystax* (Bloch and Schneider, 1801)
88. *Triacanthus brevirostris* (Temmnick and Schlegel, 1850)
89. *Liza subviridis* (Valenciennes, 1836)
90. *Lutjanus johnii* (Bloch, 1792)
91. *Platycephalus indicus* (Linnaeus, 1758)
92. *Ilisha sirishai* (Seshaqiri Rao, 1975)
93. *Ilisha melastoma* (Bloch and Schneider, 1801)
94. *Pisodonophis boro* (Hamilton, 1822)
95. *Stolephorus insularis* (Hardenberq, 1933)
96. *Tylosurus crocodilus crocodilus* (Peron and Lesueur, 1821)
97. *Gambusia affinis* (Baird and Girard, 1853)
98. *Atherina duodecimal* (Valenciennes, 1835)
99. *Carangoides praeustus* (Bennett, 1830)
100. *Drepane punctata* (Linnaeus, 1758)
101. *Awaous guamensis* (Valenciennes, 1837)
102. *Acentrogobius viridipunctatus* (Valenciennes, 1837)
103. *Acentrogobius caninus* (Valenciennes, 1837)
104. *Siganus canaliculatus* (Park, 1797)
105. *Leiognathus splendens* (Cuvier, 1829)
106. Secutor ruconius (Hamilton, 1822)
107. Zenarchopterus dispar (Valenciennes, 1847)
108. Oreochromis mossambicus
109. Puntius parrah
110. Puntius dorsalis
111. Puntius mahecola
112. Dawkensia filamentosa
113. Nandus nandus
114. Rasbora dandia
115. Catla catla
116. Labeo rohita
117. Cirrhinus mrigala
118. Amplypharyngodon melettinus
119. Cyprinus carpio
120. Danio malabaricus

Stenohaline fish

121. *Alectis indicus* (Ruppel, 1830)
122. Dasyatis uarnak
123. *Dussumieria acuta* (Valenciennes, 1847)
124. *Johnius belangerii* (Cuvier, 1850)
125. *Mylio berda* (Forsskal, 1775)
126. *Plectorhinchus nigrus*(Cuvier, 1830)
127. *Protonibea diacanthus* (Lecepede, 1802)
128. *Scomberoides tol* (Cuvier, 1832)
129. *Stolephorus indicus* (Van Hasselt, 1823)
130. *Synaptura commersonnii* (Lecepede, 1802)
131. *Taenioides cirratus* (Blyth, 1860)
132. *Thyrsoidea macrurus* (Hamilton, 1822)
133. *Upeneus sulphureus* (Cuvier, 1829)

134. *Upeneus vittatus* (Forsskal, 1775)
135. *Valamugil speigleri* (Bleeker1858)
136. *Valamugil seheli* (Forsskal, 1775)
137. *Sardinella longiceps* (Valenciennes, 1847)
138. *Sardinella gibbosa* (Bleeker1849)
139. *Thryssa setirostris* (Broussonet, 1782)
140. *Saurida undosquamis* (Richardson, 1848)
141. Rhynchorhampus georgii
142. Hemiramphus far
143. Belone belone
144. *Megalaspis cordyla* (Linnaeus, 1758)
145. *Alepes djedaba* (Forsskal, 1775)
146. *Scomberoides tala* (Cuvier, 1832)
147. *Trachinotus blochii* (Lecepede, 1801)
148. *Lutjanus fulviflamma* (Forskal, 1775)
149. *Lutjanus russelli* (Bleeker, 1849)
150. *Lutjanus rivulatus* (Cuvier, 1828)
151. *Gerres abbreviatus* (Bleeker, 1850)
152. *Lethrinus microdon* (Valenciennes, 1830)
153. *Parupeneus indicus* (Shaw, 1803)
154. *Eleotris fusca* (Foster, 1801)
155. *Butis butis* (Hamilton, 1822)
156. *Bunaka gyrinoides* (Bleeker, 1853)
157. *Gobiopsis macrostomus* (Steindachner, 1861)
158. *Taenioides buchanani* (Day, 1873)
159. *Trypauchen vagina* (Bloch and Schneider, 1801)
160. *Acanthurus matoides* (Forskal, 1775)
161. *Siganus lineatus* (Valenciennes, 1835)
162. *Synbranchus bengalensis* (McClelland, 1844)
163. *Solea ovate* (Richardson, 1846)
164. *Cynoglossus bilineatus* (Lecepede, 1802)
165. *Tetraodon fluviatilis* (Hamilton, 1822)
166. *Leiognathus bindus* (Valenciennes, 1835)
167. *Leiognathus daura* (Cuvier, 1829)
168. *Leiognathus berbis* (Valenciennes, 1835)
169. *Secutor ruconius* (Hamilton, 1822)
170. *Gazza minuta* (Bloch, 1795)
171. *Pygocentrus nattereri*

Estuarine prawn

1. *Metapenaeus dobsoni* (Miers, 1878)
2. *Metapenaeus monoceros* (Fabricius, 1798)
3. *Penaeus canaliculatus* (Olivier, 1811)
4. *Penaeus indicus* (H. Milne Edwards, 1837)
5. *Penaeus monodon* (Fabricius, 1798)
6. *Penaeus semisulcatus* (de Hann, 1844)

Freshwater prawn

7. *Macrobrachium idella* (Hilgendrof, 1898)
8. *Macrobrachium rosenbergii* (De Man, 1879)
9. *Macrobrachium scabriculum* (Heller, 1862)

Crab

1. *Portunus sanguinolentus* (Herbst, 1783)
2. *Portunus pelagicus* (Linnaeus, 1758)
3. *Scylla serrata* (Forskal, 1775)
4. *Ebalia malefactrix* (Kemp, 1915)
5. *Elamenopsis alcocki* (Kemp, 1915)
6. *Halicarcinus* sp.
7. *Scylla tranquebarica* (Fabricius, 1798)
8. *Portunus gladiator* (Fabricius, 1798)
9. *Charybdis lucifera* (Fabricius, 1798)
10. *Benthopanope indica* (de Man, 1887)
11. *Viaderiana* sp.
12. *Metopograpsus messor* (Forskal, 1775)
13. *Parasesarma plicatum* (Latreille, 1803)
14. *Pseudosesarma edwardsi* (de Man, 1888)
15. *Clistocoeloma balansae* (H. Milne Edwards, 1873)
16. *Xenophthalmus* sp.
17. *Dotilla* sp.
18. *Uca lacteal* (de Haan, 1835)
19. *Uca* sp.
20. *Spiralothelphusa hydrodroma* (Herbst, *1804)*

Clam

1. *Villorita cyprinoides* (Gray, 1825)
2. *Sunetta scripta* (Linnaeus, 1758)
3. *Meretrix casta* (Gemlin, 1791)
4. *Paphia malabarica*
5. *Villorita cornucopia* (Prashad, 1921)
6. *Meretrix meretrix* (Linnaeus, 1758)

Pearl producing fresh water bivalves

1. *Lamellidens marginalis* (Lamark, 1819)
2. *Parreysia corrugata* (Muller, 1775)

Mussels

1. *Perna viridis* (Linnaeus, 1758)
2. *Perna indica* (Kuriakose and Nair, 1976)

Brackishwater Oyster

1. *Crassostrea madrasensis*

Reptiles[169]

S.no	Order	Sub-Order	Family	Species
1.	Tesdudines		Emydidae	*Melanochelys trijuga*
2.			Testudinidae	*Lissemys punctata*
3.	Squamata	Sauria	Gekkonidae	*Hemidactylus brooki*
4.				*Hemidactylus fernatus*
5.			Agamidae	*Colotes versicolor*
6.				*Colotes colotes*
7.				*Cnemaspis sp.*
8.			Scincidae	*Mabuya carinata*
9.			Varanidae	*Varanus bengalensis*
10.		Serpentes	Typhlopidae	*Ramphotyphlops braminus*
11.			Boidae	*Python molurus*
12.			Colubridae	*Ptyas mucosa*
13.				*Dendrelaphis tristis*
14.				*Oligodon taeniolatus*
15.				*Lycodon aulicus*
16.				*Xenochrophis piscator*
17.				*Amphisema stolata*
18.				*Cerberus rhynchops*
19.				*Enhydris sieboldi*
20.				*Ahaetulla nasuta*
21.			Elapidae	*Bungarus caeruleus*
22.				*Naja naja*
23.			Viperidae	*Doboia ruselli*

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Butterflies

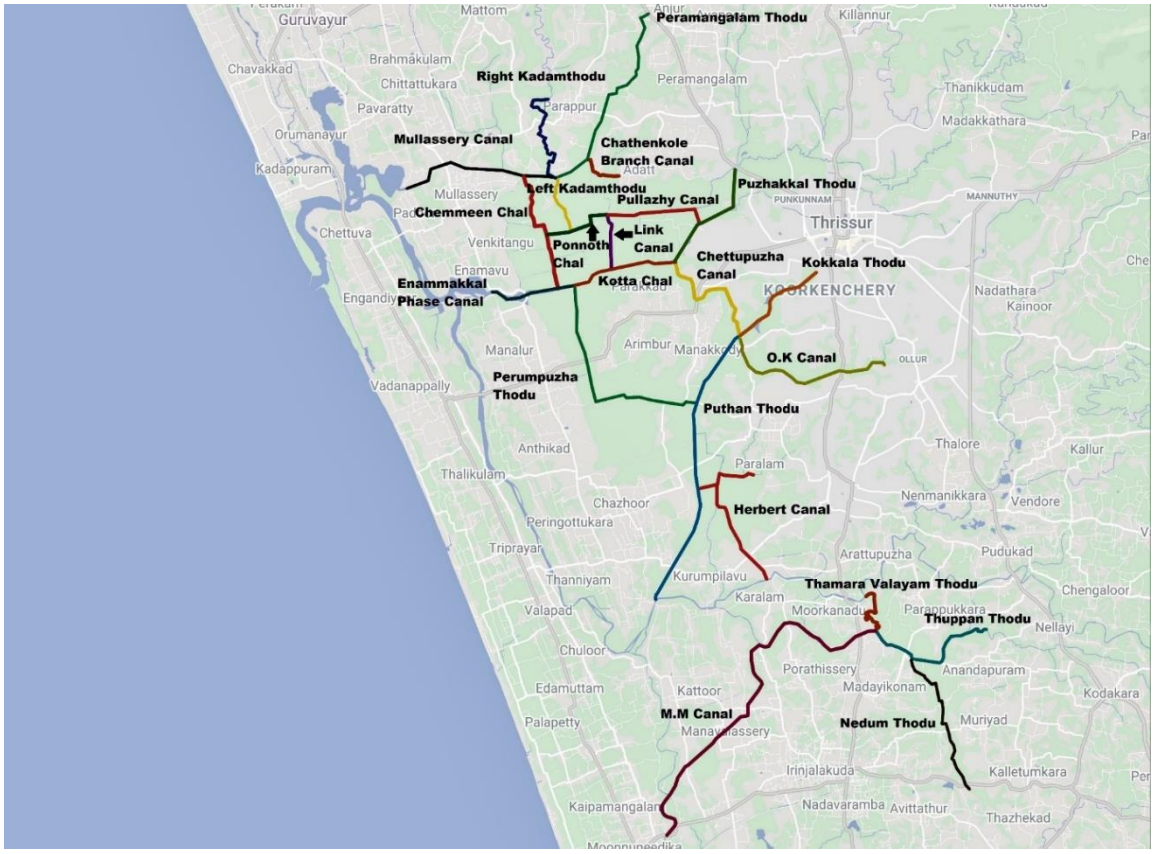
Sno	Family and Common Name	Species
	Family Papilionidae	
1.	Sahyadri Birdwing*	*Troides minos*
2.	Common Rose	*Pachliopta aristolochiae*
3.	Crimson Rose	*Pachliopta hector*
4.	Tailed Jay	*Graphium agamemnon*
5.	Lime Swallowtail	*Papilio demoleus*
6.	Red Helen	*Papilio helenus*
7.	Common Mormon	*Papilio polytes*
8.	Blue Mormon	*Papilio polymnestor*
	Family Pieridae	
9.	Lemon Emigrant	*Catopsilia pomona*
10.	Common Grass Yellow	*Eurema hecabe*
11.	Three-Spot Grass Yellow	*Eurema blanda*
12.	Small Grass Yellow	*Eurema brigitta*
13.	Indian Jezebel	*Delias eucharis*
14.	Psyche	*Leptosia nina*
15.	Chocolate Albatross	*Appias lyncida*
	Family Nymphalidae	
16.	Common Evening Brown	*Melanitis leda*
17.	Common Bushbrown	*Mycalesis perseus*
18.	Medus Brown	*Orsotriaena medus*
19.	Common Four-ring	*Ypthima huebneri*
20.	Common Five-ring	*Ypthima baldus*
21.	Tawny Coster	*Acraea terpsicore*
22.	Rustic	*Cupha erymanthis*
23.	Common Leopard	*Phalanta phalantha*
24.	Common Sailer	*Neptis hylas*
25.	Grey Count	*Tanaecia lepidea*
26.	Baron	*Euthalia aconthea*
27.	Gaudy baron	*Euthalia lubentina*
28.	Angled Castor	*Ariadne ariadne*
29.	Common Castor	*Ariadne merione*
30.	Lemon Pansy	*Junonia lemonias*
31.	Peacock Pansy	*Junonia almana*
32.	Grey Pansy	*Junonia atlites*

33.	Chocolate Pansy	*Junonia iphita*
34.	Danaid Eggfly	*Hypolimnas misippus*
35.	Great Eggfly	*Hypolimnas bolina*
36.	Glassy Tiger	*Parantica aglea*
37.	Blue Tiger	*Tirumala limniace*
38.	Plain Tiger	*Danaus chrysippus*
39.	Striped Tiger	*Danaus genutia*
40.	Common Crow	*Euploea core*
	Family Lycaenidae	
41.	Common Pierrot	*Castalius rosimon*
42.	Lesser Grass Blue	*Zizina otis*
43.	Common Cerulean	*Jamides celeno*
44.	Lime Blue	*Chilades lajus*
45.	Monkey Puzzle	*Rathinda amor*
	Family Hesperiidae	
46.	Common Awl	*Hasora badra*
47.	Pygmy Scrub Hopper	*Aeromachus pygmaeus*
48.	Bush Hopper	*Ampittia dioscorides*
49.	Chestnut Bob	*Iambrix salsala*
50.	Restricted Demon	*Notocrypta curvifascia*
51.	Oriental Palm Bob	*Suastus gremius*
52.	Dark Palm-Dart	*Telicota bambusae*
53.	Lesser Rice Swift	*Borbo bevani*
54.	Rice Swift	*Borbo cinnara*
55.	Small Branded Swift	*Pelopidas mathias*
56.	Conjoined Swift	*Pelopidas conjuncta*
57.	African Straight Swift	*Parnara bada*
58.	Indian Grizzled Skipper	*Spialia galba*

Amphibia

S.no	Order	Family	Species Name	
			Common English Name	Scientific Name
1.	Anura	Ranidae	Golden Frog	*Rana aurantiaca*
2.			Fungoid Frog	*Rana malabarica*
3.			Indian Bull Frog	*Hoplobatrachus tigerinus*
4.			Indian Rice Frog	*Fejervarya limnocharis*
5.			Skipper Frog	*Euphlyctis cyanophlyctis*
6.			Indian Green Frog	*Euphlyctis hexadactyus*
7.		Rhacophoridae	Common Tree Frog	*Polypedates maculatus*
8.			Malabar Gliding Frog	*Rhacophorus malabaricus*
9.			Bush Frog	*Philautus* sp.
10.		Bufonidae	Common Indian Toad	*Bufo melanosticus*

Major canal maintenance works in KoI lands of KLDC under RKI initiative[170]



[170] KLDC Office, Thiruvananthapuram

Annex XII B

Details of 32 major canals in Kol lands maintained by KLDC[171]

S. No	Item	Length (m)	Width (m)	Depth (m)	Increased water storage (m3)
1	Nedum thodu Ist and IInd reach	5932	11	0.8	52201.6
2	Thuppan thodu Ist reach	3230	23	0.8	59432
3	Thuppan thodu IInd reach	1833	35	0.8	51324
4	M.M. Canal -Ist reach Part-A	2329	37	0.8	68938.4
5	M.M. Canal-II nd reach	3190	49	0.8	125048
6	Herbert Canal - Ist reach	4010	15	0.8	48120
7	Herbert Canal IInd reach	2365	15	0.8	28380
8	Herbert Canal-III rd reach	1470	15	0.8	17640
9	Puthenthodu I, II, III reach	10370	20	0.8	165920
10	O.K. Canal	6627	18	1	119286
11	Kokkala Thodu	3886	18	1	69948
12	Mullassery Canal - Ist Reach	1600	30	1	48000
13	Mullassery Canal - IInd Reach	1520	58	1	88160
14	Peramangalam Thodu Ist reach	1812	6	1	10872
15	Peramangalam Thodu IInd reach	550	15	1	8250
16	Peramangalam Thodu IIIrd reach	1120	22	1	24640
17	Peramangalam Thodu Iv th reach	2358	25	1	58950
18	Left Chemmen Chal	4670	18	1	84060
19	Right Chemmen Chal	2913	20	0.8	46608

[171] KLDC Office, Thiruvananthapuram

20	Kadanthodu Left	2160	10	0.8	17280
21	Kandan thodu Right	2752	30	0.8	66048
22	Ponnathu Chal	935	10	0.8	7480
23	PullazhiThodu	3840	12	0.8	36864
24	Chathankole Kottachal Link Canal	1975	5	1	9875
25	Puzhakkal thodu	4500	70	0.8	252000
26	Chathen Kole Branch Canal	1450	7	0.8	8120
27	Thamaravalayam	1850	(4+30)/2	0.8	25160
28	Chettupuzha Canal	5019	45	1	225855
29	Kotta Chal	4523	100	1	452300
30	Enamakkal phase Canal	1600	100	1	160000
31	Perumpuzha Thodu	8200	20	0.8	131200
32	M.M Canal III rd reach	2330	45	0.8	83880
	2.6518 Million m^3 additional storage			**Total**	**2651840**

List of Local Self Governments in the three management zones overlaying the Vembanad-Kol wetlands Ramsar site boundary

Zone	Description	Sl. No.	District	IP	Block Panchayat	Local Government
Zone I	Covers the Thrissur Kol floodplains, extends from Chettuva estuary mouth till Azhikode estuary.	1	Thrissur	Chavakkad		Chavakkad (M)
		2				Guruvayoor (M)
		3			Chavakkad	Orumanayoor
		4			Chavakkad	Kadappuram
		5			Mullassery	Elavally
		6				Mullassery
		7				Pavaratty
		8				Venkidangu
		9			Thalikulam	Engandiyur
		10				Nattika
		11				Thalikulam
		12				Vadanappilly
		13				Valappad
		14		Kodungallur		Kodungalloor (M)
		15			Mala	Poyya
		16			Mathilakam	Edathiruthy
		17				Eriyad
		18				Kaippamangalam
		19				Mathilakam
		20				Perinjanam
		21				Sreenarayanapuram
		22		Mukundapuram		Iringalakuda (M)
		23			Chalakudi	Kadukutty
		24			Irinjalakkuda	Karalam
		25				Kattur
		26				Muriyad
		27				Parappukkara
		28			Mala	Alur
		29				Annamanada
		30				Kuzhur
		31				Mala
		32			Vellangallur	Padiyur
		33				Poomangalom
		34				Puthenchira
		35				Vellangallur
		36				Velukkara
		37		Thalappally	Chowvannur	Kandanassery
		38		Thrissur		Thrissur (C)
		39			Anthikkad	Anthikkad
		40				Arimpoor
		41				Chazhoor
		42				Manalur
		43				Thanniyam
		44			Cherppu	Avinissery
		45				Cherppu
		46				Paralam
		47				Vallachira

Zone	Description	Sl. No.	District	IP	Block Panchayat	Local Government
		48			Puzhackal	Adat
		49				Kaiparamb
		50				Tholur
		51	Ernakulam	Paravoor	Parakkadavu	Puthenvelikkara
Zone II	The zone extends from Munambam, Ernakulam till Thanneermukkom barrage. The brackish conditions prevail till the barrage.	1	Alappuzha	Cherthala		Cherthala (M)
		2			Kanjikkuzhy	Thanneermukkom
		3				Kadakkarappally
		4			Pattanakkadu	Kodamthuruth
		5				Pattanakkad
		6				Thurvaoor
		7				Vayalar
		8				Kuthiyathodu
		9				Aroor
		10				Ezhupunna
		11			Thaikkatussery	Arookutty
		12				Chennam Pallippuram
		13				Panavalli
		14				Perumbalam
		15				Thaikkattussery
		16	Ernakulam	Kanayannoor		Kochi (C)
		17				Thrippunithura (M)
		18				Maradu (M)
		19			Idappally	Cheranalloor
		20				Kadamakkudy
		21				Mulavukade
		22			Mulanthuruthy	Amballoor
		23				Chottanikkara
		24				Mulanthuruthy
		25				Udayamperur
		26			Palluruthy	Kumbalam
		27		Kochi	Idappally	Elamkunnapuzha
		28			Palluruthy	Chellanam
		29				Kumbalangi
		30			Vypin	Edavanakkadu
		31				Nayarambalam
		32				Njarakkal
		33				Pallippuram
		34		Paravoor		Paravoor (M)
		35			Alangad	Varapuzha
		36				Karumaloor
		37			Paravoor	Chittattukara
		38				Ezhikkara
		39				Kottuvally
		40				Vadakkekkara
		41				Chedaamangalam
		42	Kottayam	Vaikom		Vaikom (M)
		43			Kaduthuruthy	Kaduthuruthy
		44				Kallara
		45				Thalayolaparamb
		46			Uzhavoor	Manjoor
		47			Vaikom	Maravanthuruthu
		48				Thayalazham

Zone	Description	Sl. No.	District	IP	Block Panchayat	Local Government
		49				Udayanapuram
		50				Chempu
		51				T V Puram
Zone III	The areas south of the Thanneermukkom barrage covering parts of Kuttanad comprise Zone III. This zone is dominated by freshwater conditions.	1	Alappuzha	Ambalapuzha	Ambalapuzha	Ambalapuzha North
		2				Ambalapuzha South
		3				Punnapra North
		4				Punnapra_South
		5				Purakkad
		6			Aryadu	Aryadu
		7				Mannanchery
		8		Chengannur	Mavelikkara	Mannar
		9		Cherthala	Aryadu	Muhamma
		10		Karthikapally		Harippad (M)
		11			Harippad	Cheruthana
		12				Karuvatta
		13				Pallippad
		14				Veeyapuram
		15			Muthukulam	Cheppad
		16		Kuttanad	Champakkulam	Edathuva
		17				Nedumudi
		18				Thakazhi
		19				Thalavadi
		20				Chambakulam
		21				Kainakary
		22			Veliyanadu	Kavalam
		23				Muttar
		24				Neelamperur
		25				Pulinkunnu
		26				Ramankary
		27				Veliyanad
		28		Mavelikkara	Mavelikkara	Chennithala Thriperumthura
		29				Chettikulangara
		30	Kottayam	Changanasseri		Changanassery (M)
		31			Madappally	Vazhapalli
		32				Payippadu
		33			Pallom	Kurichi
		34		Kottayam		Kottayam (M)
		35			Ettumanoor	Aimanam
		36				Kumarakom
		37				Neendoor
		38				Thiruvarppu
		39		Meenachil	Uzhavoor	Kanakari
		40		Vaikom	Ettumanoor	Arpookara
		41			Vaikom	Vechoor
		42	Pathanamthitta	Thiruvalla		Thiruvalla (M)
		43			Pulikeezhu	Kadapra
		44				Niranam
		45				Peringara

Sustainable Clam Cultivation

(Findings of Vembanad post flood fish count 2018 Report)

The production of black clams has declined drastically from a peak of 75,592 metric tonnes in 2006 to 42,036 metric tonnes in 2019 in the Vembanad Estuary. Low production is owing to multiple reasons ranging from habitat degradation to unsustainable extraction of clams. The clam sector is organised under the co-operative societies. These societies are the main stakeholders in decision making in the clam sector. They ensure that the members are provided with welfare and livelihood security. Apart from the society members there are around 3000 unregistered clam collectors in the northern side of the barrage.

Focus group discussions and participatory mapping of clam resources were conducted at the Vembanad Nature Club, Muhamma in March, 2023. Major stakeholders included three clam societies from Muhamma, Kannankara and Vechoor respectively. They identified the availability of clam resources and mapped the low-and high-density areas of the Vembanad estuary for the relaying process. A total of 1.5 tons baby clams were relayed. The live baby clams from high density areas were collected and transported to the low-density areas for optimal growth.

Water hyacinth adversely affects the water quality and plastic waste hinders clam collection and transportation of clam collecting canoes. Excessive mat-like growth of weeds is present for more than 8 months a year which results in severe economic loss. Eradication of the weeds are costly and ineffective as they keep coming back. The selected canals of Muhamma and Thaneermukkom grama panchayats along the estuary were cleared and seven bamboo weed barriers were established by the Lake Protection Forum. These weed barriers sustains itself for three to four years in the estuary and help reduce the effort of fishermen in plying the clam collecting canoes.

These two activities were carried out by the Lake Protection Forum with the support of State Wetland Authority Kerala and Community Environment Resource Centre of Ashoka Trust for Research in Ecology and Environment as part of the implementation of the approved Integrated Management Plan of Vembanad-Kol.

Considering the market value of raw clam meat, there is also a high demand for clam value-added products. But the lack of proper training is one of the constraints. By giving them training in making various value-added products and marketing, they can get an extra income, thus enhancing the livelihood of clam collectors, especially women working in this sector. We hope that by the end of the project period, we can make a substantial contribution to increasing the clam resources in Vembanad and ensuring the livelihood security of these traditional stakeholders.

Apart from the high market value of raw clam meat there is also a potential to promote demand for clam value-added products as well. With proper training and capacity built, livelihoods of clam collectors especially women working in this sector can be enhanced.

Stakeholder consultations held for Vembanad – Kol Integrated Management Planning

Inception workshop, May 2022, Kumarakom, Kottayam		
Name	**Designation**	**Agency**
Lalji	AEE	Minor Irrigation Department
Jency Rose Jameson	Overseer	
Biju B	Executive Engineer	Kerala State Pollution Control Board
Anikar	Assistant Environment Engineer	
Smith Mohandas	Assistant Environment Engineer	
Soji J. Alumparambil	President	House Boat Owners Society, Kumarakom
Roy P.V	Secretary	
Robin Thomas	Planning Officer, Kottayam	Town Planning Department
Beeta Bhadran	Assistant Planner	
P. K Surendran	President	Muhamma Live Shell Co-operative Society
Ms. Rejatha	Joint Director	Agriculture Department, Alleppey
Prof. Dr K.G Padmakumar	Director	International Research and Training Centre for Below Sea Level Farming, Kuttanad
Ms. Rekha Bhaskar	Deputy Director	
Dr S. Suresh Kumar	HoD, Aquatic Environment Management	Kerala University of Fisheries and Ocean Studies
Dr. Anvar Ali	Faculty, Dept. of Fisheries	Kerala University of Fisheries and Ocean Studies
Dr.V.N.Sanjeevan	Former Director, CMLRE MoES	Kerala University of Fisheries and Ocean Studies
Jibin Thomas	Coordinator	M S Swaminathan Research Foundation,
		Kuttanad-Centre
Dr Drissia T.K	Senior Scientist	KSCSTE-Centre for Water Resources Development and Management
Dr Roshini Susan elias	Sr Scientist	Tropical institute of ecological sciences
Dr. Nadia C Raj	Assistant Professor	SN Arts and Science College, Kumarakom
Anitha R	Asst. Professor	SN Arts and Science College, Kumarakom
Ms. Sreemol	Reporter	Times of India
Dr. Prashanth Narayanan	Research Associate	Kottayam Nature Society
Dr. Ajit	Assistant Professor	RARS, Kumarakom
Babu U	Secretary	Padashekharam samithi
Ms. Swapna Shabu	President	Muhamma Grama Panchayth
KM Poovu	Secretary	Samyuktha Vemband Kayal Samrakshna Samithi
Ms. Drissia Viswan	Research Associate	KILA CANALPY
Ms. Reshma V	Resource person	Haritha Kerala Mission
Dr. G. D. Martin		CUSAT
Ms. Manjusha		SWAK
Dr. John C. Mathew		Department of Environment and Climate Change

Vembanad – Kol Integrated management Plan for Conservation and Wise use – Stakeholder Workshop Zone – 1, Thrissur, 04-11-2022		
Name	**Designation**	**Agency**
Siji P K	Researcher	Kole Birders
Unnikrishnan S	Director	River Research centre
Ishabe V I	Chairperson	Jubilee Kole Padav
Manoj Kumar	Deputy Town Planner	LSGD Planning
Subin K S	Birder	Kole Birders
Dr Sanil Kumar	Head, Dept. of Botany	SNM College malinakara
Dr P O Nameer	Dean	Kerala Agricultural University
Malik Fasil	Assistant Professor	Kerala Agricultural University
Krishna Kumar	Birder	Kole Birders
Raphy Nedumkav	Teacher, Film Director	WWF
Aneesh Kumar		Kerala Shasthra Sahithya Parishath
Joseph	Birder	Kole Birders
Drisya S	TA ic, Asst. Project Engineer	Kerala Land Development corporation
Shanthi Bhasi	President	Vadanappally Grama Panchayath
Sina P Raveendran	Assistant Executive Engineer	Minor Irrigation Department
P Parameswaran	President	Kole Padam Society
C P Sethu madhavan	Bird Watcher	Kole Birders
K Gopi	President	Pullazhi Panchayath
Dr Habeeb Rahman	Assistant Professor	CUSAT
Dr Ajay	TA	Department of Animal Husbandry
Dr Francis	Deputy Director	Department of Animal Husbandry
Dr Greeshma Paleri		Kole Birders
Manaswi C M	Assistant Engineer	Kerala Water Authority, Project Division, Nattika
K K Kochu Muhammed	President	Zilla Kole Karshaka Samithi
Manoj K	Co-ordinator	Kole Birders
Gladis Thomas	Overseer	Irrigation Department
Sahad	Technical Consultant	Suchitwa Mission
Dr Sheeja T Tharakan	Associate Professor	Vimala College
Vivek Chandran	PhD Scholar	Christ College
Sreekumar G	Birder	Kole Birders
Raju S	CEO	Thanal
Dr Thomas Aneesh Johnson	Assistant Director	Soil Survey and Soil Conservation Department
P S Surendran	Co-ordinator	Kole Land Development Agency
Abdul Majeed	President	Jubilee Thever Padav
Sarath Kumar	Co-ordinator	Kottapuram KIDS
Alan Sebastian	Marketing Executive	Kottapuram KIDS
T V Viswambaran		Kerala Shasthra Sahithya Parishath
Anjali	Assistant Project Engineer	Kerala Land Development Corporation
Rajnesh	ADPO	District Planning Office
Siji P K	Researcher	Kole Birders
Unnikrishnan S	Director	River Research centre

Vembanad – Kol Integrated management Plan for Conservation and Wise use – Stakeholder Workshop Zone – 2, Kochi, 03-11-2022		
Asha Devadas	District Soil Conservation Officer	Department of Soil Survey and Soil Conservation
Shahana M A	Asst. Environmental Engineer	Kerala State Pollution Control Board
Dr Chaithanya	Assistant Professor, School of Marine Science	CUSAT
Roshni Mohan	Research Scholar	CUSAT
Jayan K M	Senior Research Officer	CSES, Kochi
Vijaya Kumar CA	Industries Extension Officer	District Industries Center
Dr P A Vikas	Subject Matter Specialist	ICAR - KVK
Muhammad Uvas	Assistant Town Planner	LSGD Planning
Jini P	Assistant Fisheries Extension Officer	Matsya Bhavan, Chellanam
Dr Vrinda S	Assistant Professor	CUSAT
Manju S	District Soil Conservation Officer	Department of Soil Survey and Soil Conservation
Shaju S	Assistant Professor	CUSAT
Baburajan P K	Chief Environmental Engineer	Kerala State Pollution Control Board
Dr Ranjith R	Scientist	Nansen Environmental Research Center, NERCI
Dr Lakshmi E	Assistant Professor	Sacred Heart College, Thevara
Dr Jayachandran PR	Assistant Professor	St. Alberts College
Dr Rojith G	Research Scientist	FERI Trust
Dr Rajathi Sivalingam	Retd. Professor	CUSAT
Vidya P V	Research Scholar	CUSAT
Dr Rakesh V B	Director	FERI Trust
Mini Mary Sam	Senior Environmental Engineer	Kerala State Pollution Control Board
Dr Sruthy S	Programme Officer	Socio Economic Unit Foundation
Dr Ratheesh Kumar	Assistant Professor	CUSAT
Dr Sreekanth G B	Senior Scientist	ICAR - CCMRI
Dr V N Sanjeevan	Director	CARMAC

Vembanad – Kol Integrated management Plan for Conservation and Wise use - Stakeholder Workshop, Zone – 3, Alappuzha, 02-11-22		
Vineetha S	Member	Birds Club International
Seethal S	Research Assistant	CANALPY
Manmohan M	Assistant Town Planner	District Town Planning Office
Manoj Kumar	Deputy Town Planner	LSGD Planning
Akshay H	Research Assistant	CANALPY
K M Poovu		Kayal Samrakshana Samithi
P Thambi		Kayal Samrakshana Samithi
Remya P R	Research Assistant	IRTCBSF, Thottappally
Dr. Asha V Pillai	Assistant Professor	KVK, Kumarakom
Beena V S	Overseer	Soil Conservation Department
K V Xavier	ADMC	Kudumbasree
Dr. Padmakumar	Director	IRTCBSF, Thottappally
Risha P	Assistant Professor	MIS BC Kottayam
Jibin Thomas	Coordinator	MSSRF
Govind R G	Tracer	District Soil Conservation Department
Deepthy C K		KudumbaSree
Sandhya C R	Technical Consultant	Suchitwa Mission
Muhammed Hafis	Draftsman	Soil Survey and Soil Conservation

Vembanad – Kol Integrated management Plan for Conservation and Wise use - Stakeholder Workshop, Zone – 3, Alappuzha, 02-11-22		
Deepthi		District Panchayath
Savitha B	Deputy Director	Department of Agriculture
Er Vishnu B	Associate profesor	RARS Kumarakom
Dr Jayachandran		KSSP
Sindhu K K	Executive Engineer	Minor Irrigation, Kottayam
Rajesh M		KSSP
Arathi T R	FA	IRTCBSF, Thottappally
Maneeja Murali	Senior Programme Officer	ATREE CERC
Somalatha	Draftsaman	Soil Conservation
Benny William	Deputy Director	Department of Fisheries
Anikar	Assistant Executive Engineer	Kerala State Pollution Control Board
Reji	Vice President	Muhamma Grama Panchayath
Megha Sali	Assistant Engineer	Minor Irrigation, Cherthala
Nizam Abdul Rahman	Overseer	Soil Survey and Soil Conservation Department
Reema Anand	Senior Program officer	ATREE CERC
Sumi MP	Assistant Executive Engineer	Harbour Engineering Department
Dr. Prasanth Narayanan	Co-ordinator	Kottayam Nature Society
Chandrapraksh T G	District Coordinator	Kerala State Biodiversity Board
KS Rajesh	District Coordinator	Nava Keralam Karma Padhathi
Smitha C V	Environmental Engineer	Kerala State Pollution Control Board
Beeta Badran	Assistant Town Planner	LSGD Planning Office
Priya Mol		Fisheries Kottaym
Jojo	Programme manager	ATREE CERC
Kuriakose	Assistant Executive Engineer	KWA, Kottayam
Ramesh Sasidharan	Deputy Director	Fisheries Department
Honey S		District Panchayath
P Suresh		District Panchayath
Biju Thomas	Deputy Director	Agricultural Department

Meetings with stakeholders for Vembanad Kol IMP preparation, 02-03-23 to 04-03-23		
Sri. Priyesh R.	Chief Engineer, Irrigation and Administration	Irrigation Department
Ms. Sree Rekha	Add. Director-Crop Production	Agriculture Department
Ms. Rajeshwari SR	Add. Director-Extension Activities	
Ms Smitha	Deputy Director	Agriculture Department Alappuzha
Mr Sibi	Principal Agriculture Officer	
Mr Rupesh Kumar K.	Coordinator	Responsible Tourism RT Mission, Kerala
Dr Sheela A.M	Member Secretary	Kerala State Pollution Control Board
Dr Mahesh Sasidharan	Special Fisheries Officer	Fisheries Department Alappuzha
Ms Rafeeka Beevi P.	Executive Engineer-Quality Control and Monitoring	Inland Navigation and Kuttanad Package Irrigation Department
Sri. P.S. Rajeev	Managing Director	Kerala Land Development Corporation, Thiruvannathapuram
Mr. Praveen G. Panikkar	Vice President and President Incharge	Thanneermukkom Panchayat
Mr Achu R. Sekhar	Manager, Sustainable Cities and Transport	World Resources Institute (WRI)

Final Consultation Workshop for finalizing the Integrated Management Plan for Vembanad-Kol Wetland on 20.07.2023, Thiruvananthapuram		
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Robin C Koshy	Secretary to DTPC Kottayam, Department of Tourism / DTPC	Mob: 9946433566 Email: info@dtpckottayam.com
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Final Consultation Workshop for finalizing the Integrated Management Plan for Vembanad-Kol Wetland on 20.07.2023, Thiruvananthapuram		
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Fish landing centres in Vembanad-Kol wetlands

Sno	Longitude	Latitude	Locations	District
1	76.46	9.22	Devikulangara	Alappuzha
2	76.46	9.22	Muthukulam	Alappuzha
3	76.45	9.25	Chingoly	Alappuzha
4	76.78	9.08	Arattupuzha-1	Alappuzha
5	76.66	9.37	Arattupuzha-2	Alappuzha
6	76.40	9.29	Thrikunnappuzha	Alappuzha
7	76.35	9.55	Mannanchery	Alappuzha
8	76.37	9.61	Muhamma	Alappuzha
9	76.39	9.76	Vaikom (M)	Kottayam
%%510	76.39	9.78	Udayanapuram	Kottayam
11	76.39	9.82	Chempu	Kottayam
12	75.33	9.92	Maradu-1	Ernakulam
13	75.30	9.93	Maradu-2	Ernakulam
14	75.31	9.93	Maradu-3	Ernakulam
15	75.31	9.93	Maradu-4	Ernakulam
16	76.38	9.86	Udayamperoor-1	Ernakulam
17	76.38	9.87	Udayamperoor-2	Ernakulam
18	76.37	9.89	Udayamperoor-3	Ernakulam
19	76.36	9.89	Udayamperoor-4	Ernakulam
20	76.36	9.89	Udayamperoor-5	Ernakulam
21	76.36	9.90	Udayamperoor-6	Ernakulam
22	76.36	9.91	Udayamperoor-7	Ernakulam
23	76.36	9.91	Udayamperoor-8	Ernakulam
24	76.91	9.91	Udayamperoor-9	Ernakulam
25	76.33	9.95	Thripunithura-1	Ernakulam
26	76.28	9.88	Thripunithura-2	Ernakulam
27	76.30	9.89	Kumbalam-1	Ernakulam
28	76.31	9.88	Kumbalam-2	Ernakulam
29	76.32	9.90	Kumbalam-3	Ernakulam
30	76.31	9.89	Kumbalam-4	Ernakulam
31	76.24	10.07	Ezhikkara	Ernakulam
32	76.26	10.08	Varapuzha	Ernakulam
33	76.27	9.88	Chellanam	Ernakulam
34	76.23	10.01	Elamkunnapuzha	Ernakulam
35	76.22	10.05	Narakkal	Ernakulam
36	76.21	10.07	Nayarambalam	Ernakulam
37	76.20	10.10	Edavanakkad	Ernakulam
38	76.20	10.06	Kadamakudy-1	Ernakulam
39	76.25	10.05	Kadamakudy-2	Ernakulam
40	76.26	10.00	Mulavukad	Ernakulam
41	76.29	9.91	Cochin corporation-1	Ernakulam
42	76.30	9.91	Cochin corporation-2	Ernakulam
43	76.30	9.93	Cochin corporation-3	Ernakulam

Sno	Longitude	Latitude	Locations	District
44	76.28	9.93	Cochin corporation-4	Ernakulam
45	76.30	9.93	Cochin corporation-5	Ernakulam
46	76.30	9.93	Cochin corporation-6	Ernakulam
47	76.28	10.00	Cochin corporation-7	Ernakulam
48	76.27	10.02	Cochin corporation-8	Ernakulam
49	76.04	10.52	Engandiyur	Thrissur
50	76.08	10.50	Venkitangu	Thrissur

Details of ongoing and completed polder improvisation and strengthening works, flood mitigation works, construction of side protection walls and shutter gates, desilting of rivers (Thodu), construction of culverts of the Irrigation Department[172]

Sl. No.	Location	Cost (In lakhs)
	Restoration of outer bunds of Padasekharams	
1	Kuttanad Package -Restoring outer bund of MadathilkayalThazhcha, Madathi Kayal, Pokkam, Matha Kayal, Padinjare Venattukary, Puthenpura kayal, Thekkemathi kayal and Vadakkemathikayal in Pulimkunnu panchayat	741
2	Kuttanad Package -Restoring outer bund of ArupankuPadasekharam in Kainakary Grama panchayat	383
3	Kuttanad Package -Restoring outer bund of MarthandamPadasekharam in Kainakary Grama panchayat.	425
4	KanakasseryPadasekharam in KainkaryGrama Panchayat	457
5	Kuttanad Package -Restoring outer bund of KadannakkaduPadasekharams in Nedumudy panchayat.	332
6	Kuttanad Package -Restoring outer bund of KunnummaTharayilkkaryPadasekharam in Thakazhy panchayat.	298
7	KP - Mitigation of flood damages of Pothimangalampadasekharams in Thanneermukkom Grama Panchayath.	33
8	KP -Budget works 2021-2022 Restoring outer bund of ParakudiKiliruvakaPadasekharam in Ramankary Panchayath	86
9	KP- Mitigation of flood in the padasekharams of Kuttanad Taluk - Mitigation of flood in Manimalakkadpadasekharam in Champakulam Panchayath	130
10	KP- Mitigation of flood in the padasekharams of Kuttanad Taluk - Mitigation of flood in KavalamKizhakkumpurampadasekharam in Kavalam Panchayath	171
11	KP-Restoring outer bund of KarukamayyakonamPadaekharam in EdathuaGramapanchayath	98
12	KP - Budget works 2021-2022 -Restoring outer bund of MayakaduPadasekharam in Ramankary Panchayath	51
13	KP-Restoring and strengthening the temporary bund constructed at breached portion of KanakasseryPadasekharam in Kanakassery Grama Panchayath.	26
14	Closing the breached portion by constructing permanent structure as per Irrigation Design and Research Board(IDRB) design at KanakasseryPdasekharam in Kainakary Grama Panchayath in Kuttanad LAC	420
15	KP-Protecting the North side of the Vachal of Vezhapram East Padasekharam in Thakazhy panchayath.	4.18
16	Removal of accumulated earth from Parambikkerithodu at PadinjareParambikkeripadasekharam in Ward No. 9 of Haripad Municipality	23
17	KP- Improtvements to VazhankeryPulimbankarypadasekharam in Karuvatta Panchayath	77.1
18	KP- Mitigation of flood damages in Annapura- Chennavelipozhithodu in Kanichukulangarapadasekharam in ward no.2 of Mararikkulam north Panchayath	32

[172] Irrigation Department Kerala website

Sl. No.	Location	Cost (In lakhs)
19	KP - Infrastructural Development works of Thekkevarambinakom in Thiruvarppu Panchayath	48
20	KP - Infrastructural Development works of PuthiyeriPadasekharam in Thiruvarppu Panchayath	70
21	KP-Rectification works to ThekkumcheryPadasekharam in Thalayolapparambu Panchayath	158.7
22	KP-Flood Mitigation Programme-Outer bund protection works of Devaswamkaripadashekharam in Alappuzha Municipality	200
23	KP- Infrastructural Development works of AkathamtharaPadasekharam in kallaraPanchaythu.	45
24	KP-Mitigation of flood damages- Outer bund protection works and other appurtenant works in kandankerypadasekharam in Udayanapuram Panchayath.	106
25	KP-Infrastructure Development works of Paramban 54 padasekharam and Parambankari in kallara panchayath	17
26	KP-Infrastructure Development works of ThattamparambuThekkupadasekharam in kallara panchayath	56
27	KP- Mitigation of Flood Damages to ThyaganadiPadasekharam in Kottayam Muncipality in Kottayam District	78.2
28	KP- Measures to mitigate flood damages Kuzhiyanchalthodu near AnithanamperumkariPadasekharam in Manjoor Panchayath.	11
29	KP- Mitigation of flood damages to VeloorEravukeriPadasekharam Kottayam Muncipality in Kottayam District	67
30	Providing and protection work at both bank of changaramthodu near east side of changaram bridge in Kuthiyathodu and Kodamthuruthu Pts	35.9
31	Providing protection work left side of Karalamthodu in Pattanakadu Panchayath in ward No 1, 2	33.9
32	KP-FMP-Supplying NP3 class drainage pipes for Pothenmaalipadasekharam in Kallara panchayath. Price ID (2022/21/KP)	1.07
33	KP-Mitigation of flood damages to Annala thodu in Panavally panchayath(2022/9/KP)	7.8
34	GENERAL-KP-Budget 2022-23-Mitigation of flood in the Padasekharam of Kuttamadutaluk-Mitigation of flood in Munnuttambathumpadasekharam in Nedumudy Panchayath-General Civil Work	105.1
35	GENERAL-keecheri 400-KP -Restoring outer bund of Keecheri 400 Padasekharam in Ramnakary Panchayath-General Civil Work	105.4
36	GENERAL-PATHUM PADASHEKHARAM-KP- Flood Mitigation Programme and Improving the Infastructure Facilities of Pathum Padasekharam in Thakazhy Panchayath-General Civil Work	105.3
37	GENERAL-VETTITHURUTH PADASHEKARAM-KP- Restoring outer bund of Vettithuruthpadashekaram in EdathuaGramapanchayat-General Civil Work	105.4
38	GENERAL-Enapathumpadompadasekharam-KP- Mitigation of Flood in padasekharams of Kuttanad taluk- Mitigation of flood in Enpathumpadompadaekharam in Pulincunnu panchayath-General Civil Work	158
39	GENERAL-Olekary Padashekharam-1/2022-KP-FMP-Improvement works to Olekarypadashekharam in Aymanam Panchayath-General Civil Work	84
40	GENERAL-Nenmalassery Padasekharam-KP-Mitigation of flood in the Padasekharam OF Kuttanad taluk -Mitigation of flood in NenmalasserryPadasekharam in Kavalam panchayath-General Civil Work	158
41	GENERAL-Improvement works ThekkeputhusseriPadasekharam-KP-Rectification works to Thekkeputhusserypaadashekharam in ward number 12 of ThalayolapparambuGramapanchayath -General Civil Work	31.7

Sl. No.	Location	Cost (In lakhs)
42	GENERAL-Improvement works to SNV Padashekharam-Mitigation of flood Damages- Improvement works to SNV Padashekaharam in Thalayolaparampu Panchayath -General Civil Work	32
43	GENERAL-MulavanakkaryPadasekharam-KP-Mitigation of flood in the Padasekharam of Kuttanad Taluk- Mitigation of flood in MulavanakkaryPadasekharam in Muttar Grama Panchayath-General Civil Work	100
44	GENERAL-Outer bund at moolekalamThuavoor -Construction of outer bund at moolekalamPozhichaalThuravoor Grama Panchayath ward 15-General Civil Work	4.2
45	GENERAL-Improvement works to VadakkeputhusseriPadasekharam-Mitigation of flood damages- Infrastructural development works at VadakkeputhusseriPadasekharam in Thalayolaparampu Panchayath-General Civil Work	47
46	GENERAL-Improvements to Vadakke VadakkumMuttomPadasekharam-Infrastructural Development works for Vadakke VadakkumMuttomPadasekharam in Kottayam Municipality-General Civil Work	42.2
47	DEPOSIT-PALOOKKARY PADASEKHARAM-KP- Construction of Protection work for Palookkarypadasekharam of Ambalapuzha south panchayath -General Civil Work	60
48	General-Manthra Meenchal -Kp- Improving Irrigation Facilities of Manthra MeenchalPasasekharamIn Ward No.1 Of Karuvatta Panchayath-General Civil Work	200
49	GENERAL-Improvements to KadampadomCherikkalakamPadasekharam-Infrastructural Development works for KadampadamCherikkalakamPadasekharam in Vazhappally Panchayath-General Civil Work	42
50	DEPOSIT-KANNAMKURUDY PADASEKHARAM-Construction of outer bund Protection for KannamkurudyPadasekharam in Punnapra North Panchayath-General Civil Work	33.5
51	GENERAL-M.I.-Protection work to I Block 3500 kayalpadasekharam in ward 13 of Neelamperoor panchayath in Alappuzha district.-General Civil Work	58.3
52	GENERAL-Improving Agricultural fecilities in PachilaveliPadasekharam in ward No.5 of Budhanoor panchayath-MISC/Works/Estimate/05/2022-23-General Civil Work	120
53	GENERAL-Improvements to KolathukariValiyakariNjarakkaryPadasekharam-Mitigation of Flood and Irrigation Infrastructure Development for KolathukaryValiyakaryNjarakkaryPadasekharam in Kallara Panchayath. -General Civil Work	80
54	GENERAL-Improvements to PulinthanathukariPadasekharam-Flood mitigation and Infrastructural development for PulinthanathukariPadasekharam in ManjoorPanchayth - General Civil Work	49.8
55	GENERAL-Moolekkary Padashekharam-2022-Improvements to MoolekkaryPadashekharam in ward No. 8 of Thalayazham Panchayath-General Civil Work	52.5
56	GENERAL-Infrastructure Development for Various Padasekharams in kallara Panchayat - Infrastructure Development and FMP for ParavanthuruthVadakkupurathValiyakary, PazhookkaryTheyathukary, MattathikunnekaryKumarakathykary, Puthukkary and MundarMoosharayilPadasekharams in Kallara Panchayat - General Civil Work	32.7
57	GENERAL-Improvements to group of 5 padasekharams in Kumarakom Panchayath-Flood Mitigation of KizhakkePallikayal, PadinjarePallikayal, St. Joseph Pallikayal, KumarakomThumbekayal and KizhakkePazhayakayalPadasekharams in Kumarakom Panchayat - General Civil Work	58

Sl. No.	Location	Cost (In lakhs)
58	GENERAL-Thiruvaykary-Turkey Padasekharam-Flood Mitigation works for Thiruvaykary Turkey Padasekharam in Thiruvarpu Panchayath-General Civil Work	77
59	GENERAL-Edavazhikal Padashekaram-1/2022-KP-FMP-Improvement works to Edavazhikalpadashekharam in Nehru Trophy ward in Alappuzha Municipality-General Civil Work	35
60	GENERAL-Puthukary Padashekharam-1/2022-KP-FMP-Improvement works to Puthukarypadashekharam in Aymanam Panchayath-General Civil Work	96
61	GENERAL-KODAMBANADY PADASEKHARAM-MIPM Protecting the outer bund of KodambanadyPadasekharam in Thalavady Panchayath -General Civil Work	21
62	GENERAL-AnchumanackalAsariparabu-Improvement works - General Civil Work	163
63	GENERAL-Kanjikkuzhy Grama Panchayath Padasekharam (KadampozhyPadasekharam)-Infrastructural development works for KadampozhyPadasekharam in Kanjikkuzhy Panchayath-General Civil Work	16
64	GENERAL- Kaithalayi- Kanjiramparambuthodu -Protection works of Kaithalayi- Kanjiramparambuthodu in ward 5 of Kanjikkuzhy Panchayat - General Civil Work	30
65	GENERAL-Improvements to Vengaalivakka-PuthiyakaryPadasekharam-Flood mitigation works for Vengaalivakka-Puthiyakary Padasekharam in Manjoor Panchayt in Kaduthuruthy LAC-General Civil Work	26
66	GENERAL-CKN Block Padasekharam -Phase 1/KTM-Improvement works to CKN Block Padasekharam- Phase 1 in Thalayazham Panchayath of Vaikom Constituency-General Civil Work	74.8
67	GENERAL- Improvements to KattakkuzhyPadasekharam-Infrastructural Development works for KattakkuzhyPadasekharam in ChaganasseryMuncipality-General Civil Work	49
68	GENERAL-Kari Enpathupadasekharam-Rectification work at Karienpathupadasekharam in Veliyanadu Panchayath-General Civil Work	25.4
	Flood mitigation works	
1	Flood Mitigation Programme in MecherivakkaPadasekharam in Pulinkunnu Panchayath in Alappuzha District	343
2	Mitigation of flood in MoolapongapraPadashekaram in Champakulam Panchayat	370.3
3	Flood mitigation programme in Paruthikkattusseri Padasekharam in Muttar grama panchayath	123
4	Flood mitigation programme: Thekke Manapally Padasekharam in Pulimkunnu Grama Panchayat	375
5	Flood Mitigation Programme – Uthimada Padasekharam in Kainkary Panchayat	249
	Sub total	**8674.15**
	Reconstruction of side protection walls and shutter gates	
1	KP-FD Repairs of Motorthara construction &Motorshed, shutter arrangement and side protection to Vachal in KoduvathraPadashekaram in Aimanam Panchayath	8
2	KP - Construction of motor shed, motor thara and retaining wall for MavilackalPadinjarupadashekharam in Thakazhy Panchayath	15
3	KP-Re construction of side protection wall, near motorshed at PothimangalamPadasekharam in Thanneermukkom Panchayath.	11.4
4	KP- Construction of motor thara, shed and protection work of Kareelipadasekharam in Pallippad Panchayath	45

Sl. No.	Location	Cost (In lakhs)
5	Construction of retaining wall for Elambanamthodu near Ariyodichalpadasekharam and desilting of Kaithodu in Mannar Panchayath - Reach 1	36
6	KP-Providing protection work on the side of Mathrukathodu in Ward No 19 of PattanakkadPanchayat PriceID (2021/76/KP)	11
7	Protection work to Nediyarathodu along Payippadukannenthery road in Cheruthana Panchayath.	15
8	Construction of retaining wall for Elambanamthodu near Ariyodichalpadasekharam in Mannar Panchayath - Reach 2	40.75
9	Construction of Box culvert and Motor shed of Chirakkakampadasekharam in Ward No. 1 of Champakulam Grama Panchayath	18
10	Construction of Protection wall at both banks of Vachal thodu near Chalunkalpadasekharams in Karuvatta Grama Panchayath in Ward No. 15	65.1
11	GENERAL-PROTECTION WORK-Protection work at Kodikkalvalavu to Kaithathodu bridge in Muttar Grama Panchayat - General Civil Work	69
	Sub total	**334.25**
	Desilting of rivers (Thodu)	
1	Mitigation of flood damages -Desilting of ManiyanpozhiPazhampasserythodu in Ward no 1 & 22 of Cherthala south Panchayath.	7.4
2	KP- Measures to mitigate flood damages - Desilting of thodu near Vadakkupurathu - Valiyakari - KurichikariPadasekharam in Kallara Panchayath.	12
3	Mitigation of flood damages- Desilting and protecting the eroded banks of Anathodu near ManappallyLakshamveed Colony in ward No.10 of VayalarPanchayat. Price ID (2021/564/KP)	26.3
	Sub total	**45.7**
	Construction of culverts	
1	GENERAL-Naduvile Pocha vadakku and Pocha nanooru-Construction of Motorthara, Motor sheds and culverts in Naduvileppochavadakku and KanjiramthuruthupochananooruPadashekharams in ward No.2 of Cheruthana G.P - General Civil Work	150
2	KP - FMP - Construction of Box culvert at MN Block padasekharam in ward no. 14 in Thiruvarppu Panchayat in LAC Constituency Ettumanoor. PriceID (2021/582/KP)	33
3	KP- Construction of Pothumada, Culvert & Protection work in Nannattumalipadasekharam in Thakazhy Panchayath	274.4
4	GENERAL-CHUNGOM EDACHUNGOM PADASHEKARAM-Construction of Culvert at ChungomEdachungompadashekaram in Edathua grama panchayath-General Civil Work	21
	Sub total	**478.4**
	Repair and maintenance of Thanneermukkom barrage and installation of lights and signboards	
1	Emergency repair of damaged handrail portion of first and second stage of Thanneermukkom barrage.	4.2
2	Supply, Installation, Testing & Commissioning of IP based CCTV Surveillance System atThanneermukkom Bund Bridge.	26.11
3	Installation of High mast and mini mast lights and replacement of damaged street light fittings, accessiories of starter and panel boards in Thanneermukkom bund	14.52
	Sub total	**44.83**

Sl. No.	Location	Cost (In lakhs)
	Kuttanad Package - Modernization of Thanneermukkom Barrage to manage salinity and minimize ecological decay - Construction of central portion of Thanneermukkom Barrage (Completed)	**25500**

Details of existing common and under construction CSTP/FSTP in catchment districts as in April 2022[173]

District	Plant	Installed Capacity (MLD)	Location	Agency	Status	Utilized capacity	Process*
Kottayam	STP	0.09	Kumarakom	District Tourism Promotion Council, Kottayam	Operational	0.09	ASP
Ernakulam	STP	4.5	Elamkulum	Kerala Water Authority	Operational	3	ASP
	STP	0.45	Kadavanthra, Kochi	Greater Cochin Development Authority	Operational	0.45	ASP
	STP	3	Kadavanthra, Kochi	Kochi Corporation	Operational	3	ASP
	STP	0.01	Kalamassery	Kalamassery Municipality		0.01	MBBR
	STP	0.1	Brahmapuram	Kochi Corporation	Operational	0.1	MBBR
	STP	0.1	Wellington island	Kochi Corporation	Operational	0.1	MBBR
Thrissur	STP	3	Guruvayur	Thrissur District	Operational. The quantity of effluent confirming to standards	Commissio ned Started functioning	ASP
	FSTP	0.01	Mattampuram	Thrissur District	Completed. Not started functioning. PCB issued permission for conducting trial run	Completed not started functioning	Biological
	STP	0.035	Kuriyanchira Slaughter House	Thrissur corporation	Operational	0.035	
Pathanama thitta	STP	5	Sannidhanam	Travancore Devaswom Board	Seasonally operated during festival season	5	UASB and SBR
	STP	3.5	Pamba	Travancore Devaswom Board	Seasonally operated during festival season	3.5	Coagulati on & settling

[173] KSPCB Monthly progress report for the month of June 2022 submitted to NGT in the NGT Matter OA No, 673 of 2018, in compliance to NGT order dated 24.09.2020

ASP- Activated Sludge Process, MBBR – Moving Bed Biofilm Reactor, UASB – Upflow Anaerobic Sludge Blanket, SBR – Sequencing Batch Reactor

Details of proposed/under construction ETPs/STPs in catchment districts as in June 2022 updated on 30.09.23[174]

District	Plant	Installed Capacity (MLD)	Location	Funding scheme	Status/ Timeline
Alappuzha	FSTP	0.25	Cherthala Municipality, Alappuzha	Suchitwa Mission	DPR modification is going on. Transferred to Impact Kerala and RKI
	Mobile septage units	0.01(Two Units)	Alappuzha municipality	AMRUT	30.06.2022
	STP – Decentralised sewerage scheme	0.24	General hospital, Alappuzha	AMRUT	75% completed
	STP	0.015	Shatabdi Mandiram, Alappuzha	AMRUT	
	STP	0.05	Thottumadi colony	AMRUT	
	STP	250KLD Septage TP	Cherthala Municipality, Alappuzha	KIIFB	DPR approved by RKI
Kottayam	STP	0.085	Taluk Hospital, Pambady	Block Panchayat, Kottayam	Tendering Stage- Detailed estimate of an electric item is needed for getting electrical TS. Agency is correcting the same in DPR
	ETP	0.03	Kodimatha		At DPR Stage, DPR need to be submitted by the Agency with the new process flow given from SSM
	ETP	0.011	Kuravilangad Fish Market, Kuravialangad GP		At DPR Stage- DPR under technical scrutiny
Thrissur	STP – Decentralised sewerage scheme	2.5	Thrissur corporation	AMRUT	31.12.2024
	FSTP	0.1	Ramavarmapuram	AMRUT	31.03.2024
	FSTP	0.1	Chakkumkandam, Guruvayur Municipality	AMRUT	Under trial run
	STP	0.36	General hospital, Thrissur	AMRUT	30.09.2023
	STP	0.01	CHC Cherpu BP		90% completed 30-09-2023
	STP	0.15	General hospital, Irinjalakuda Muncipality		DPR submitted to the local body needs to be corrected by the agency.
	STP	1	Kunnamkulum Municipality, Thrissur	KIIFB	DPR Approved by KIIFB
	STP	0.035	Govt. Ayurvedic hospital, Kodakara GP		Tender has been called for STP Construction.
	STP	0.025	Community Health Centre, Pazhayanoor block Panchayat		
	STP	0.01	CHC at Mullashery block Panchayat, Thrissur		Project Dropped

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Ernakulam	Decentralised sewerage scheme	1.4	Kochi Corporation Div -15	AMRUT	
	Decentralised sewerage scheme	1.1	Kochi Corporation Div- 16	AMRUT	31.03.2024
	Decentralised sewerage scheme	1.4	Kochi Corporation Div- 17, Pai Road	AMRUT	
	STP	6.5	Division 1-4	Cochin Smart city Mission Limited	Awarded not started
	5 STPs	31	Elamkulum, Vennala, Edapally, Puthukalavattom, Perandur	Kochi Metro Rail Limited Integrated Water Transport System project	To be tendered
	STP	5	Elamkulum, Kochi	AMRUT	Operational trial run of core treatment at Elamkulam started on 21.05.23
	STP	0.025	CHC Kadayiruppu	Block Panchayat, Ernakulam	At DPR Stage- Under technical scrutiny at SM
	ETP for slaughter house	0.03	Marakkadavu, Ernakulam	Marakkadavu GP	DPR under correction by Agency

Stay in touch

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