BRIEF DOCUMENT OF VEMBANAD-KOL

State / Union Territory: Kerala

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Section 1: Identification, Location and Jurisdiction

1.1 **Name of the Wetland** (Alternative names, including in local language should be given in parenthesis after official name):

Vembanad-Kol Wetland Complex (Ramsar ID: 1214)

1.2 Name of the Village(s), Tehsil(s), Municipal area (s):

Villages:
Ariyad South, Komalapuram, Mannanchery, Arookutty, Aroor, Ezhupunna, Kodamthuruth, Kokkothamangalam, Kuthiyathodu, Pallippuram, Perumbalam, Thaikkattussery, Thanneermukkom North, Thanneermukkom South, VayalarEast,Kainakary North, Kavalam, Amballoor, Cheranalloor, Elankulam, Kadamakkudy, Keecherry, Kumbalam, Manakunnam, Maradu, Mulavucadu, Thekkunobhagom, Chellanam, Edavanakad, Elamkunnapuzha, Kumbalangi, Kuzhuppily, Nayarambalam, Njarakkal, Pallipuram, Puthuvypin, Chedaamangalam, Paravoor, Ezhikkara, Karumaloor, Kottuvally, Kunnumkara, Moothakunnam, Paravoor, Puthenvelikkara, Vadakkekkara, Arpookara, Ayimanam, Kumarakom, Chempu, Kulasekharamangalam, Naduvila, Thalayazham, TV Puram, Vadakkemuri, Vaikom, Vechoor, Chavakkad, Engandiyur, Guruvayur, Kadappuram, Kundaliyur, Mullassery, Nattika, Orimbranallur, Orumanayar, Pavaratty, Thalikulam, Vadanappilly, Valappad, Vammenad, Venkidanga, Ala, Azhikode, Chendrapinni, Edathiruthy, Kaipamangalom, Lokamaleswaram, Madathumpady, Methana, Pallippuram, Panangad, Pappimivattom, Perinjanam, Poyya, Pullut, Edathiringi, Kattur, Padiyoor, Poomangalom, Puthenchira, Thekkumkara, Vallivattom, Karamuck, Kizhuppallikkara, Manalur, Padiyam, Tanniyam, Vadakkummuri

Tehsils:
Ambalappuzha, Cherthala, Kuttanad, Kanayannoor, Kochi, Paravoor, Kottayam, Vaikom, Chavakkad, Kodungallur, Mukundapuram, Thrissur

Grama Panchayats:

Municipal areas: Vaikom

1.3 Name of the District(s) in which the wetland complex is located:

Alappuzha, Ernakulam, Kottayam, Thrissur

1.4 Geographical coordinates (Latitude and Longitude, to degree, minutes and second):

Latitude : From 9º16' to 10º36'

Longitude : From 76º01'to 76º35'

1.5 Name of the Department / Agency which has jurisdiction over the wetland / wetlands complex:

State Wetland Authority Kerala, Local Self Governments, Irrigation Department

Section 2: Site Characteristics

2.1 Area of wetland / wetlands category (ha): 132284

2.2 Wetland type (Please tick appropriate categories and sub-categories**):**

Category	Subcategory
❒Natural (Inland)	❒ Permanent lakes ❒ Seasonal/ intermittent lakes ❒Permanent streams/ creeks ❒ Seasonal/ intermittent streams/ creeks ❒ Oxbow ❒ River floodplain ❒ Permanent freshwater marshes ❒ Seasonal/ intermittent freshwater marshes ❒ Shrub-dominated wetlands ❒ Tree-dominated wetlands ❒ Geothermal wetlands ❒ Karst and other subterranean hydrological systems
☑Natural (Coastal).	❒ Coastal lagoon ☑ Estuary ❒ Intertidal mud, sand or salt flats

Category	Subcategory
	☑Mangroves
	❒Coral reefs
❒Human-made	❒ Aquaculture pond
	❒ Tank
	❒ Saltpan
	❒ Dam / Reservoir

2.3 **Depth** (m): Average -1.725 msl Maximum -9.9 msl

2.4 **Elevation** (m above mean sea level): 0 to 2640 m (Including Zone of Influence)

2.5 Water regimes

a) Main source of water (tick all applicable)

☑Rainfall ☑Groundwater ☑Catchment runoff ☑Direct / indirect inflow from river ☑Others, please specify____tidal saline waters from the sea_____

b) Water permanence

☑Mostly permanent ❒Mostly intermittent

c) Destination of water from wetland

☑Feeds groundwater ❒To downstream catchment ❒To river ☑To sea

d) Water pH

❒Acid (< 5.5) ❒Circumneutral (5.5 – 7.4) ☑Alkaline (> 7.4) ❒Not known

e) Water salinity

❒Fresh (< 0.5 g/l) ☑Brackish (0.5 – 30 g/l)) ❒Euhaline (30- 40 g/l) ❒Hypersaline (>40g/l) ❒Not known

f) Nutrient in water

❒Eutrophic ☑Mesotrophic ❒Oligotrophic ❒Not known

2.6 Climatic setting

a) Annual Rainfall (mm): 2970 to 4360

b) Temperature (°C): Minimum: 21, Maximum: 36

c) Humidity (%) Minimum: 80, Maximum: 95

2.7 **Area of zone of influence** (in ha) 1497169.69

2.8 **Major land use within zone of influence** (provide as approximate % of catchment area)

Forests	-	32.35
Plantation	-	06.10
Agriculture	-	28.42
Settlements (Rural & Urban)	-	27.99
Waterbody	-	04.08
Industry	-	01.06

2.9 Map of wetland complex and zone of influence:

(To be enclosed as Annex I and II to this proposal): To be provided by KSREC

Section 3: Biodiversity

3.1 **Notable plant species present in wetland**

Trees: *Acrocarpus fraxinifolius, Antiaris toxicaria, Cullenia exarillata, Dichopsis elliptica, Dipterocarpus indicus, Actinodaphne hookeri, Baccaurea courtallensis, Canarium strictum, Cinnamomum zeylancium, Elaeocarpus, Euonymus sp., Leea sambucina, Tectona grandis, Dalbergia latifolia, Pterocarpus marsupium, Adina sp.*
Aquatic macrophytes : *Lycopodium cernuum, Cyclosorus interruptus, Ceratopteris thalictroides, Salvinia molesta, Eichhornia crassipes, Ischaemum travancorense, Hymenachne acutigluma, Phragmiteskarka, Typha sp., Alternanthera philoxeroides, Pistia stratiotes, Eichhornia crassipes, Salvinia molesta, Nymphaea pubescens, Nymphoides sp, Blyxa aubertii , Hydrilla verticillata, Najas minor, Chara sp., Cabomba caroliniana, Ludwigia adscendens, Acrostichum aureum, Oryza sp, Aponogeton appendiculatus, Bacopa monnieri*
Shrub: *Pandanus fascicularis*
Mangroves: *Kandelia kandel, Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Sonneratia caseolaris, Avicennia officinalis* and *Excoecaria agallocha.*
Major mangrove associates: *Calophyllum inophyllum, Hibiscus tiliaceus, Thespesia populnea, Cerbera odollam, Clerodendrum inerme* and *Acrostichum aureum.*

3.2 **Notable animal species present in wetland**

Fish species: *Anguila bengalensis, Belone cancila, Strongylura strongylura, Anodontostoma chacunda , Stolephorus commersoni, Aplocheilus lineatus, Aplocheilus blockii, Elops machnata, Elops saurus, Megalops cyprinoids, Chanos chanos, Liza macrolepis, Liza parsia, Mugil cephalus, Anabas testudineus , Ambasis ambassis, Ambassis commersoni, Scomberoides tol, Lates calcarifer, Etroplus maculates,*

Etroplus suratensis, Oreochromis mossambicus, Butis butis, Epinephelus malabaricus, Glossogobius giuris, Leiognathus brevirostris, Secutor insidiator, Lutjanus argentimaculatus, Lutjanus johni, Eleutheronema tetradactylum, Scatophagus argus, Sillago sihama, Therapon jarbua, Cynogossus macrostomus, Psettodes erumei, Mystus singhala, Mystus gulio, Tetraodon nigropunctatus, Tetraodon viridipunctatus, Dayella malabarica, Horabagrus brachysoma, Mastacembelus guentheri, Mystus malabaricus, Mystus oculatus, Puntius filamentosus, Labeo dussumieri, Mugil sp., Lates calcarifer, Chanos chanos, Tachysurus maculatus, Hyporhamphus sp., Megalops sp., Etroplus suratensis.

Aquatic macroinvertebrates: *Sunetta scripta, Meretrix casta, Paphia malabarica, Villorita cyprinoides, Scylla serrata, Macrobrachium rosenbergii, Penaeus monodon, P. dobsoni* and *P. monoceros*.

Reptiles: Freshwater turtle, Indian black turtle (*Melanochelys trijuga coronata*) and the Indian flap-shelled turtle (*Lissemys punctata punctata*).

Water birds: 225 species of birds have been recorded from the lake during 1995-2010 of which 38% were migrants and 55 were found to breed in the area. One vulnerable (*Aquila clanga*) and 10 near threatened species (*Aythyanyroca, Mycteria leucocephala, Threskiornis melanocephalus, Pelecanus philippensis, Anhinga melanogaster, Ichthyophaga ichthyaetus, Limosa limosa, Numenius arquata, Sterna aurantia and Coracias garrulus*) have been reported from the Vembanad Estuary. Kol wetland records include 167 species of birds, belonging to 16 orders and 39 families among which 81 species are wetland dependent birds. Spot-billed Pelican (a near threatened species) and Rufous Babbler (an endemic species of WesternGhats) are known to frequent the region.

3.3 Species of conservation significance (rare, endangered, threatened, endemic species)

Plants: *Ischaemum travancorense, Kandelia kandel, Dopatrium junceum, Aponogeton natans, Ludwigia adscendens, Sagittaria guyanensis, Bergia capensis, Limnophila aromatica*

Animals: Spot-billed Pelican, Rufous Babbler, Oriental Darter, Indian Rock Python, Smooth-coated Otter, *Aquila clanga, Ichthyophaga ichthyaetus, Aythyanyroca, Anhinga melanogaster, Mycteria leucocephala, Coracias garrulus, Sterna aurantia, Pelecanus philippensis, Limosa limosa, Numenius arquata, Threskiornis melanocephalus, Horabagrus brachysoma, Ompakbi maculatus, Wallago attu, Mystus malabaricus, Melanochelys trijuga coronata, Crocodylus porosus*

3.4 Major plant invasive alien species

Eichhornia crassipes, Salvinia molesta, Limnocharis flava, Cabomba caroliniana, Alternanthera philoxeroides, Ipomoea carnea

3.5 Major animal invasive alien species

Clarias gariepinus, Oreochromis mossambicus, Piaractus brachypomus (Red-bellied Pacu), *Pangasius sp.*

Section 4: Ecosystem services

Importance	Relevant for the site (please tick yes or no)	If Yes, Details (upto 50 words for each category)
Source of drinking water for people living and around	❒Yes ☑No	-

Importance	Relevant for the site (please tick yes or no)	If Yes, Details (upto 50 words for each category)
Source of water for agriculture	☑Yes ❒No	Floodplain areas of Vembanad Estuary have been reclaimed for agriculture in Kuttanad, Kol and Pokkali areas. Three major crops namely Punja, Virupu and Mundakan are cultivated in the region. The Pokkali farming system in brackish water marshy flood plain on the western side of the estuary is unique to the region. Agriculture in Kuttanad alone provides sustenance to 90,000 farmers. Production from 1,216km^2 ha of rice paddies and plantations in Kuttanad and Kol paddy lands is an important base for food security in the State.
Fisheries	☑Yes ❒No	Capture fishery supports the livelihood of 5000 households around Vembanad. *Etroplus suratensis* is the most favoured species. Tilapia and African catfish have also been recorded in the catch. Vembanad is a rich source of clam fishery (white and black clam) which is a source of livelihood for 12,000 households.
Cultivation of aquatic food plants	❒Yes ☑No	-
For buffalo wallowing and use of domesticated animals	☑Yes ❒No	Animal husbandry and dairy is a major additional source of income and nutrition for many inhabitants in and around the wetland
Medicinal plants	☑Yes ❒No	Many species such as *Bacopa monnieri, Centella asiatica, Hygrophila schulli, Eclipta prostrata* are collected from the wetland and used for medicinal purposes.
Buffering communities from extreme events as floods and storms	☑Yes ❒No	Flood frequency analysis for the period 1964 – 86 indicated that floods with a return period of 10 to 25 years have only a marginal effect on the water level at Cochin bar mouth, thereby indicating the capacity of the wetland to contain floods. After the 2018 great flood, depth reduction was reported in the southern portion of the estuary to <2m which will definitely affect the water holding capacity. Detailed recent assessments are being done now.
Groundwater recharge	❒Yes ❒No	Not assessed quantitatively

Importance	Relevant for the site (please tick yes or no)	If Yes, Details (upto 50 words for each category)
Water purification	☑Yes ❒No	Not assessed quantitatively
Acts as a sink for sediments	☑Yes ❒No	Total sediment yield from all the river basins draining into Vembanad estuary and Kol lands has been estimated to be 32 million and 4 million tonnes respectively
Has significant cultural and religious values	☑Yes ❒No	Estuarine water spread of Vembanad and polders of Kuttanad form an important and favourite tourist attraction of Kerala. Nearly 0.2 million tourists visit the backwaters annually, supporting the livelihoods of owners and employees of 870 houseboats. Several spectacular boat races are held in the estuary each year which attract a large number of spectators including the Nehru Trophy boat race.
Is a site for recreation and tourism	☑Yes ❒No	Backwaters of Vembanad are one of the major global tourist destinations. Alappuzha and Kumarakom have high concentrations of houseboats.
Supports noteworthy plants species	☑Yes ❒No	Overall 338 plants including 26 trees, 14 shrubs, 21 climbers, 237 herbs, and 40 mangrove and associate species have been reported from the wetlands. 123 phytoplankton species as detailed in section 3.1
Supports noteworthy animal species	☑Yes ❒No	Vembanad estuary is an Important Bird Area supporting criteria A4i and A4iii. Over 20,000 birds are regularly sited in the 10 congregation areas in Vembanad-Kol wetland as detailed in section 3.2
Site of high congregation of migratory water birds	☑Yes ❒No	Counts for 2001-2010 indicate numbers over 20,000 regularly. Over 50 migratory species visit the wetland during winter.
Mining	☑Yes ❒No	Rate of mining of sub-fossil deposits is 41,000- 69,000 tons /annum. Vembanad backwaters are a rich source of clam, which form the base of livelihoods for around 12,000 households. The clam collectors are organised in societies, which have been in existence since 40s. Presently, the 13 clam collector's societies in Alappuzha and

Importance	Relevant for the site (please tick yes or no)	If Yes, Details (upto 50 words for each category)
		Kottayam districts, of which 8 pertain to black clams. Travancore Cements Limited, one of the largest consumers of white shells, uses dredgers for collection of sub-fossil deposits.
Inland Navigation	☑Yes ❒No	Vembanad estuary forms part of the West Coast Canal System extending to an overall length of 546 km, 209km 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. Kottapuram–Chettuva waterway supports inland navigation through the heart of Kol lands. Inland navigation in Vembanad presently supports the livelihoods of more than 50 boat and 200 houseboat owners.

Section 5: Pre-Existing Rights and Privileges

Nature of right and privilege	Relevant for the site (please tick yes or no)	Does this negatively impact the wetland's ecological health?	Brief description (upto 50 words for each category)
Community Fishing (without any lease or permission from government department)	☑Yes ❒No	❒Yes ☑No ❒Not assessed	Fishing is done all the year round, barring June and July which are monsoon months. A group of six fishermen return with a catch of 7 - 8 kg Karimeen (*Etroplus suratensis*).
Fishing under lease from government department	❒Yes ☑No	❒Yes ❒No ❒Not assessed	-

Nature of right and privilege	Relevant for the site (please tick yes or no)	Does this negatively impact the wetland's ecological health?	Brief description (upto 50 words for each category)
Harvest of plants (without any lease or permission from government department)	☑Yes ❒No	❒ Yes ☑ No ❒ Not assessed	Large scale harvesting of *Ischaemum travancorense* ('Kadakal pullu') for use as cattle fodder
Harvest of plants under lease from government department	❒Yes ☑No	❒Yes ❒No ❒Not assessed	-
Agriculture or horticulture within wetland	☑Yes ❒No	☑Yes ❒No ❒Not assessed	Reclamation of shallower wetland regions and marshes in the Kuttanad and Kol floodplain regions of the Estuary led to the emergence of polders, locally called 'padashekharams', to enable agriculture, especially rice farming.
Grazing	☑Yes ❒No	❒Yes ❒No ☑Not assessed	People use the wetland area for grazing their livestock, especially cattle.
Religious practices	❒Yes ☑No	❒Yes ❒No ❒Not assessed	-
Withdrawal of water for domestic use	☑Yes ❒No	❒Yes ❒No ☑Not assessed	Water from the wetland area is being used for many domestic purposes like washing clothes and utensils and bathing
Withdrawal of water for agriculture or fisheries	☑Yes ❒No	❒Yes ❒No ☑Not assessed	Water is utilised for the production from 1,216km^{2}ha of rice paddies and plantations in Kuttanad and Kol lands and is an important base for food security of the state.
Bathing or wallowing of domestic animals	☑Yes ❒No	❒Yes ❒No ☑Not assessed	People residing in and around the estuary use the open water bodies for this purpose

Nature of right and privilege	Relevant for the site (please tick yes or no)	Does this negatively impact the wetland's ecological health?	Brief description (upto 50 words for each category)
Plying of boats	☑Yes ❒No	❒Yes ❒No ☑Not assessed	While there is an increase in the number of houseboats catering to backwater tourism, the commensurate waste management facility is yet to be fully developed. Increased trends in nitrate, phosphate and silicate, linked to increased discharge of sewage from adjoining settlements and houseboats. Number of boats plying in Vembanad is much above the carrying capacity of the estuary (1 boat in 25 acres for recreational activities Wagner, 1991). Microbial contamination of the lake from toilets and septic tanks has increased faecal coliforms. This prevents tourists from engaging in water sports.
Any other, please list here	❒Yes ❒No	❒Yes ❒No ❒Not assessed	-

Section 6: Present and Potential Threats

Threat	Degree	Present or Potential	Additional information, if any
Changes in water inflow and outflow	❒High ☑Medium ❒Low	☑Present ❒Potential	Natural salinity gradients prevalent in the wetland complex have been altered to increase freshwater conditions in order to support rice paddies. Circulation and mixing patterns have also been impeded by the operation of the Thanneermukkom Barrage. Operation of upstream structures has altered the natural flow regime (for example diversion of the tailrace of Idukki Reservoir in Muvattupuzha has altered salinity regime north 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.

Threat	Degree	Present or Potential	Additional information, if any
Shrinkage of wetland regime	❒High ❒Medium ☑Low	☑Present ❒Potential	The wetland complex has been under constant threat of modification and reclamation for agriculture. Nearly 550 km^2 of the estuary and floodplain marshes have been converted in the Kuttanad region alone. Channelization of Kuttanad and Kol has altered the natural inundation regime. In the last five decades, mangrove marshes on the shoreline of the estuary have been reclaimed for development of infrastructure for tourism. Kuttanad region witnessed increased instances of conversion of wetland paddies for non-wetland usages in the last three decades before 2010.
Pollution	❒High ☑Medium ❒Low	☑Present ❒Potential	With an increase in the number of houseboats catering to backwater tourism, a commensurate waste management facility is yet to be developed. Intensification of agriculture and use of high yielding varieties of rice has also led to increased use of chemical fertilisers and pesticides. Coupled with changes in circulation and mixing pattern, excessive loading of nutrients is promoting growth of freshwater invasives in Kuttanad, clogging the channels and increasing water logging.
Unsustainable harvest of biological resources	☑High ❒Medium ❒Low	☑Present ❒Potential	Production of fisheries, clams as well as wetland agriculture has declined in recent periods stressing livelihoods of dependent communities and creating stakeholder conflicts. Operation of the Thanneermukkom Barrage is a perennial conflict between fishers (preferring natural salinity regimes) and farmers (preferring freshwater conditions all the year round). Environmental groups have for long rallied against increasing tourism operations in biodiversity hotspots such as Kumarakom and Pathiramanal islands.
Mining	❒High ☑Medium ❒Low	☑Present ❒Potential	Local clam collectors' societies are highly impacted by commercial clam trawling operations (major being Travancore Cements) which lead to considerable shifting of beds and harvesting of juveniles. Rate of mining of sub-fossil deposits of clams is 41,000 - 69,000 tons /annum.

Threat	Degree	Present or Potential	Additional information, if any
			River sand and gravel are mined extensively from the rivers of the Vembanad catchments. 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.
Siltation	❒High ☑Medium ❒Low	☑Present ❒Potential	Catchment degradation due to clearing of forests and urbanisation has led to extensive siltation and concomitant loss of water holding capacity of the wetland. Although baseline bathymetric surveys of the wetland have not been carried out, progressive decline in wetland depth of up to <2 m in the southern portion of the estuary has been reported for the recent period after the 2018 flood.
Encroachment	❒High ❒Medium ☑Low	☑Present ❒Potential	Analysis of remote sensing images for Kuttanad indicate that during 1963-2003, the area under paddy has declined, coupled with an increase in area left fallow and converted to non-agricultural uses. Several encroachments exist along the Vembanad Estuary. Kol lands are also undergoing transformation for non-wetland usage.
Spread of invasive species	❒High ☑Medium ❒Low	☑Present ❒Potential	Coupled with changes in circulation and mixing pattern, excessive loading of nutrients is promoting growth of freshwater invasives like Water Hyacinth in Kuttanad, clogging the channels and increasing waterlogging. Elimination/reduction of tidal flushing has increased nutrient levels in Kuttanad, further aggravated by increased use of chemical fertilisers and pesticides. Presence of invasive fish species has also been reported recently.

Section 7: Activities Proposed to be prohibited (other than those listed in Rule 4(2) of Wetlands Rules)

Activity	Prohibited within wetlands	Details of specific area wherein	Name of department / agency	Additional information, if any

	or zone of influence	activity is prohibited	responsible for regulation	
	❒Wetland / Wetlands complex boundary ❒ Zone of influence			

Section 8: Activities Proposed to be regulated

Activity	Place a tick mark if relevant	Regulation within wetlands or zone of influence	Level of regulation (in terms of people, restricted area or any other)	Name of department / agency responsible for regulation	Additional information, if any
Withdrawal of water / impoundment/diversion or any other hydrological intervention	☑	☑ Wetland / Wetlands complex boundary ☑ Zone of influence	Further large scale diversion/impoundment shall be restricted in the wetland area and the watershed area	SWAK, Wetland Management Unit (WMU), LSGs and District Collector	Large scale hydrological interventions need to get prior permission from WMU/SWAK
Harvesting of resources (living / non-living)	☑	☑ Wetland / Wetlands complex boundary ☑ Zone of influence	Live clam harvesting may be regulated to a sustainable level Sand mining may be regulated in the upstream river channels and floodplains in the watershed	SWAK, WMU, Fisheries Department, LSGs and District Collector, Revenue Department	Large scale harvesting of resources need to get prior permission from WMU/SWAK
Discharge of treated sewage/ effluent / wastewater	☑	☑ Wetland / Wetlands complex boundary ☑ Zone of influence	Direct discharge of treated effluent shall be regulated in the wetland and the zone of influence	SWAK, WMU, KSPCB, LSGs and District Collector	Need to get prior permission from WMU/SWAK

Activity	Place a tick mark if relevant	Regulation within wetlands or zone of influence	Level of regulation (in terms of people, restricted area or any other)	Name of department / agency responsible for regulation	Additional information, if any
Construction of boat jetties, and facilities for temporary use, as pontoon bridges	☑	☑ Wetland / Wetlands complex boundary ❒ Zone of influence	Construction of furthermore large commercial boat jetties shall be regulated	SWAK, WMU, LSGs and District Collector	Need to get prior permission from WMU/SWAK
Aquaculture, agriculture and horticulture activities within the wetland boundaries.	☑	☑ Wetland / Wetlands complex boundary ❒ Zone of influence	Agriculture and aquaculture shall be converted into partially organic and sustainable, avoiding artificial fertilisers and pesticides	SWAK, WMU, LSGs and District Collector, Department of Agriculture, Department of Fisheries	Large scale commercial aquaculture activities need to get permission from WMU/SWAK
Tourism	☑	☑ Wetland / Wetlands complex boundary ❒ Zone of influence	Need to be regulated to make it sustainable based on a master plan prepared after assessing the carrying capacity of the estuary	SWAK, WMU, LSGs and District Collector, Department of Tourism	Large scale commercial tourism activities need to get permission from WMU/SWAK
Fish/clam capture by local fishermen/clam collectors	☑	☑ Wetland / Wetlands complex boundary ❒ Zone of influence	Need to be regulated to make it sustainable based on a detailed/periodic assessment and schedules/plan	SWAK, WMU, LSGs and District Collector, Department of Fisheries	Schedules/plan need to be prepared by WMU and should be used to regulate the fish/clam collection activities

Section 9: Activities Proposed to be permitted

Activity	Place a tick mark if relevant	Within wetlands or zone of influence	Additional information, if any
	❒	❒ Wetland / Wetlands complex boundary ❒ Zone of influence	

Section 10: Listing of Available Scientific Resources Used

- Ambili V., Nisha N. V., Achary G. S., Harsha S. E. and Vidya S. 2015. Assessment of toxic metal concentration in surface sediments of the Central Vembanad Lagoon, South-western Indian Coast, Kerala. Indian Journal of Geosciences, 69(3&4): 293-308.
- Ansar C. P., Mogalekar H. S., Sudhan C., Chauhan D. L., Golandaj A. and Canciyal J., 2017. Finfish and Shellfish diversity of Vembanad Lake in the Kumarakom region of Kottayam, Kerala, India. Journal of Entomology and Zoology Studies, 5(2): 351-357
- Asha C. V., Cleetus R. I., Suson P. S. and Nandam S. B., 2015. Environmental factors structuring the fish assemblage distribution and production potential in the Vembanad Estuarine System, India. International Journal of Marine Science, 5(23): 1-13.
- Asha C. V.,Suson P. S., Retina C. I. and Nandan S. B., 2014. Decline in diversity and production of exploited fishery resources in the Vembanad Wetland System: Strategies for better management and conservation. Open Journal of Marine Science, 4: 344-357.
- Chandran M. S. S. and Ajaykumar B., 2018. Quantitative geomorphological analysis to infer the hydrological behaviour of streams draining into the Vembanad Lake – A Ramsar site along the Southwest Coast of India. Journal Geological Society of India, 92: 45-53.
- Chandran S. and Purkayastha S., 2018. History of reclaimed *Kayals*in Kuttanad wetland and associated social divide in Alappuzha district, Kerala. International Journal of Research and Analytical Reviews, 5(3): 573-581.
- Cleetus R. I., Asha C. V., Suson P. S. and Nandan S. B., 2015. Species diversity and community assemblages of planktonic Rotifers from Vembanad Estuary-Kerala, India. International Journal of Oceanography and Marine Ecological System, 4(1): 1-15.
- Jacob M., Mathew M. M. and Ray J. G., 2018. Critical Analysis of the Globally Important Agricultural Heritage System (GIAHS) of the FAO: A Case Study of Kuttanad, South India. Modern Concepts & Developments in Agronomy, 3(3): 1-9.
- John S., Revichandran C., Muraleedharan V. P., Srijith B., Seena G. and Abdul Azeez S., 2020. Current asymmetry and its implications for morphological changes in Vembanad Lake, the second largest wetland ecosystem in India. Estuarine, Coastal and Shelf Science 246 (2020) 107013: 1-21.
- Jyothi P. V. and Sureshkumar S., 2018. Patterns of Vegetation Dynamics across Mild Disturbance Gradient in a Freshwater Wetland System in Southern India. Wetlands, DOI 10.1007/s13157-018-1031-8
- Krishna A. V. andAmmini P., 2017. Population characteristics of *Villorita cyprinoides* in Vembanad Lake, India. Lake and Reservoir Management, 00: 1-11. DOI 10.1080/10402381.2017.1394941.
- Krishnakumar K. and Rajan P. D., 2012. Fish and fisheries in Vembanad Lake - Consolidated report of Vembanad Fish Count 2008-2011. CERC, ATREE, Alappuzha.

- Krishnakumar K., Anvar Ali, Benno Pereira and Rajeev Raghavan, 2011. Unregulated aquaculture and invasive alien species: a case study of the African Catfish *Clarias gariepinus* in Vembanad Lake (Ramsar Wetland), Kerala, India. Journal of Threatened Taxa, 3(5): 1737–1744
- Manoj M. C., Thakur B., Uddandam P. R. and Prasad V., 2018. Assessment of metal contamination in the sediments of the Vembanad wetland system, from the urban city of southwest India. Environmental Nanotechnology, Monitoring & Management, 10(2018): 238-252.
- Mogalekar H. S., Ansar C. P., Golandaj A. and Dinesh K. 2015. Biodiversity of Decapod Crustacean in the Vembanad Lake at Panangad-Kumbalam Region of Kochi, Kerala. Environment & Ecology 33(4B): 1920-1923.
- Nair P. K. And Babu D. S. S., 2016. Spatial Shrinkage of Vembanad Lake, South West India during 1973-2015 using NDWI and MNDWI. International Journal of Science and Research, 5(7): 1394-1401.
- Nandan S. B. and Sajeevan K., 2018. Distribution and abundance of phytoplankton in the Vembanad Estuary, a Ramsar site on the south west coast of India. International Journal of Engineering Technologies and Management Research, 5(3): 75-87. DOI: 10.5281/zenodo.1207427.
- Narayanan S. P, Thapanjith T. and Thomas A. P., 2005. A study on the Ichthyofauna of Aymanam Panchayat in Vembanad Wetland, Kerala. Zoo's Print Journal, 20(9): 1980-1982.
- Narayanan S. P. and Sreekumar B., 2012. A Decade of Vembanad Waterbird Counts. Department of Forests and Wildlife, Govt. of Kerala, Thiruvananthapuram
- Paul T. T., George G., Dennis A., Athira N. R., Biradar R. S., Khandagale R. and Padmakumar K. G., 2017. Ecosystem Responses in the Distribution of Black Clam (*Villorita cyprinoides*) Beds in Vembanad Estuary during Environmental Changes Using GIS and RS. Journal of Geographic Information System, 9: 245-266.
- Mogalekar, H. S., Ansar, C. P., Raman, N. N., Jayachandran, K. V., Dinesh, K., & Kolhe, S. (2015). Fish diversity of Vembanad lake in the Panangad-Kumbalam region of Kochi, Kerala, India. *Pollution Research*, *34*(2), 345-349.
- Rajan B., Varghese V. M. and Pradeepkumar A. P., 2011. Recreational Boat Carrying Capacity of Vembanad Lake Ecosystem, Kerala, South India. Environmental Research, Engineering and Management, 2(56): 11-19.
- Ranjith K. P., Raman N. N., Pranav P., Pamanna D., Amin A. and Sumanjali S. S., 2017. The physico-chemical characteristics of Vembanad backwaters in the Eramalloor region, Alappuzha district, Kerala, India. International Journal of Fisheries and Aquatic Studies 5(5): 258-262.
- Remani K. N., Jayakumar P. and Jalaja T. K., 2010. Environmental Problems and Management Aspects of Vembanad-Kol Wetlands in the South West Coast of India. Nature Environment and Pollution Technology, 9(2): 247-254.
- Sanilkumar M. G. and Thomas K. J., 2007. Indigenous medicinal usages of some macrophytes of the Muriyad wetland in Vembanad-Kol, Ramsar site, Kerala. Indian Journal of Traditional Knowledge, 6(2): 365-367.
- Selvam A. P., Priya S. L., Banerjee Kakolee, Hariharan G., Purvaja R. and Ramesh R. 2011. Heavy metal assessment using geochemical and statistical tools in the surface sediments of Vembanad Lake, Southwest Coast of India. Environmental Monitoring and Assessment, DOI 10.1007/s10661-011-2389-8.
- Sruthi N., Shyleshchandran M. S., Mohan M. and Ramasamy E. V., 2018. Distribution of priority pollutants in the sediment of Vembanad Estuary, Peninsular India. Marine Pollution Bulletin, 133(2018): 294-303
- Sruthi P., Jayalal L. and Gopal N. 2016. Gender Roles in Fisheries along the Vembanad Estuarine System. Asian Fisheries Science, 29(S): 193-203.
- Sruthy S. and Ramasamy E. V., 2017. Microplastic pollution in Vembanad Lake, Kerala, India: The first report of microplastics in lake and estuarine sediments in India. Environmental Pollution, 222(2017): 315-322.

- Sylas V. P., Antony M. J., John C. M. and Thomas A. P., 2015. Distribution of phytoplankton in relation with water quality of Alappuzha-Changanassery Canal of Kuttanad Wetland Ecosystem**,** Southern India. International Journal of Current Research, 7(3): 13738-13743.
- Tessy P. P. and Sreekumar R. 2017. Seasonal and spatial distribution of freshwater diatoms from Thrissur Kole lands (part of Vembanad - Kol, Ramsar site), Kerala. Phykos, 47(2): 129-134.
- Varkey L. M., Kumar P., Mridha N., Sekhar I. and Sahoo R. N., 2016. Ecosystem Services and Fishery Production Dynamics of Wetland Ecosystem: An Appraisal of Alappuzha District of Kerala, India. Fishery Technology 53(2016): 162-169.
- Vineetha S., Nandan S. B. and Gopalan R. K. P. 2015. Composition, abundance and diversity of macrobenthic fauna in Kole paddy fields, Vembanad Kol wetland, India. International Journal of Current Research, 7(10): 20941-20947.
- Walmiki N., Sharma D., and Kubal P., 2016. Aquatic diversity with reference to Phytoplankton, Zooplankton and Benthos in Lake Vembanad, Kottayam, Kerala, India. Research Journal of Marine Sciences, 4(3): 1-10.
- WISA, 2017. Vembanad-Kol Wetlands - An Integrated Management Planning Framework for Conservation and Wise Use. Technical Report submitted to the IUCN and MoEF&CC, New Delhi. Wetlands International South Asia, New Delhi, India.

CHECKLIST

☑ Responsible agency has been clearly identified and details of the contact person included

☑ Wetland/ wetlands complex boundary has been delineated using GIS and firmed up by adequate ground truthing

☑ Wetland/ wetlands complex map has been provided at required scale

❒ Zone of influence has been delineated and included in wetland map or a separate map

☑ Wetland zone of influence is sufficient to manage all activities

☑ Site's importance have been listed, and for major categories, justification is provided

☑ Site's biodiversity values are listed, and for major categories, justification is provided

☑ List of pre-existing rights and privileges is provided

❒ Consistency or inconsistency of pre-existing rights and privileges is indicated to be best of available knowledge

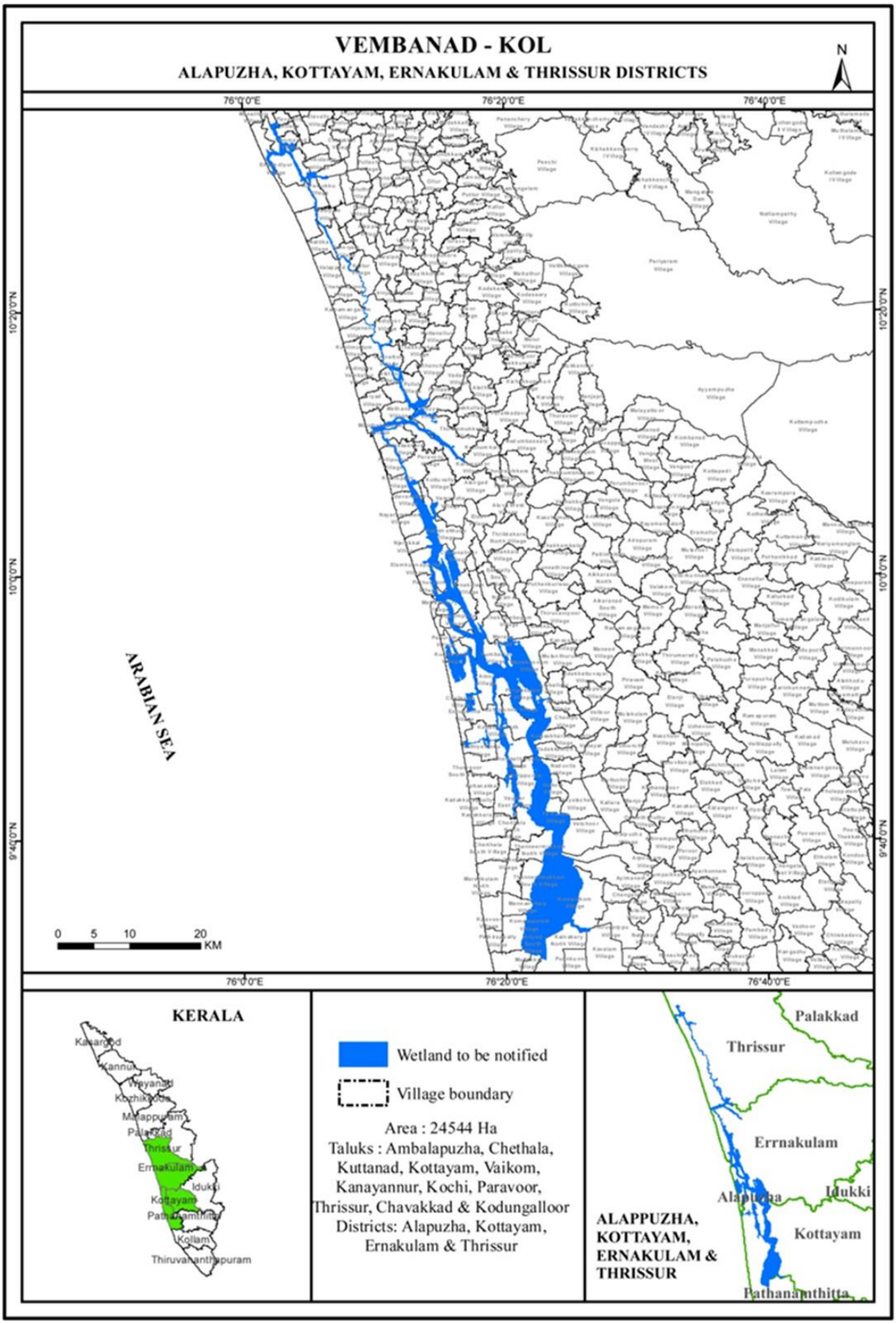
☑ Threats to site are listed, and for major categories details are provided

☑ Activities prohibited, beyond those already listed in Rule 4(2) have been mentioned

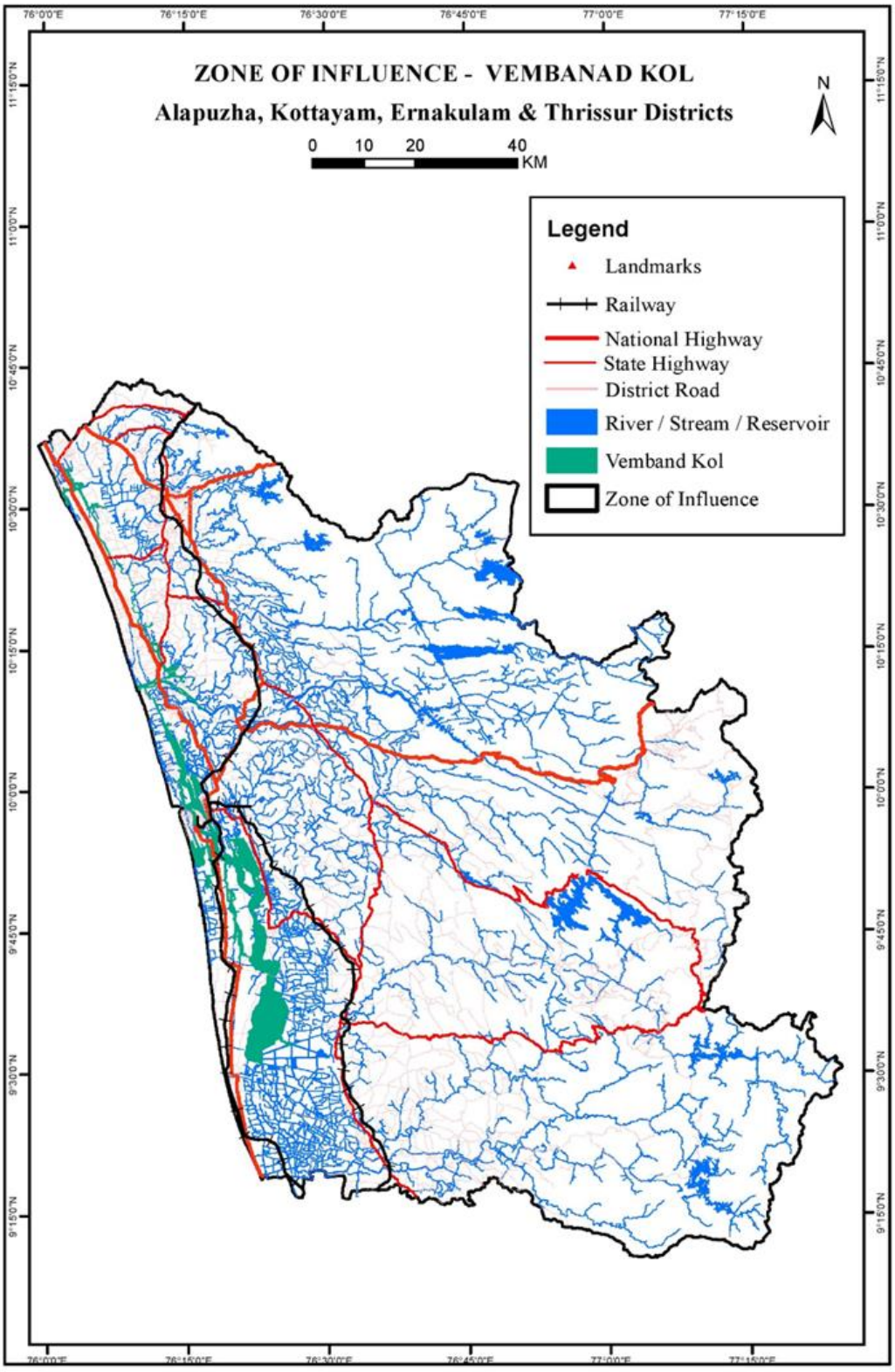
☑ List of activities to be regulated within wetlands and zone of influence is provided

❒ List of activities to be permitted is provided

Annexure I


VEMBANAD - KOL
ALAPUZHA, KOTTAYAM, ERNAKULAM & THRISSUR DISTRICTS
N
76°0'0"E
76°20'0"E
76°40'0"E
10°20'0"N
10°0'0"N
9°40'0"N
ARABIAN SEA
0 5 10 20 KM
KERALA
Kasaragod
Kannur
Wayanad
Kozhikkode
Malappuram
Palakkad
Thrissur
Ernakulam
Idukki
Kottayam
Pathanamthitta
Kollam
Thiruvananthapuram
Wetland to be notified
Village boundary
Area : 24544 Ha
Taluks : Ambalapuzha, Chethala, Kuttanad, Kottayam, Vaikom, Kanayannur, Kochi, Paravoor, Thrissur, Chavakkad & Kodungalloor
Districts: Alapuzha, Kottayam, Ernakulam & Thrissur
Palakkad
Thrissur
Errnakulam
Alapuzha
Idukki
Kottayam
Pathanamthitta
ALAPPUZHA, KOTTAYAM, ERNAKULAM & THRISSUR

Annexure II


ZONE OF INFLUENCE - VEMBANAD KOL
Alapuzha, Kottayam, Ernakulam & Thrissur Districts
0 10 20 40
KM
N
Legend
Landmarks
Railway
National Highway
State Highway
District Road
River / Stream / Reservoir
Vemband Kol
Zone of Influence