ENVIRONMENTAL PROBLEMS OF VEMBANAD-KOL WETLAND AND MANAGEMENT STRATEGIES

Jayakumar.P., Dr. K.N. Remani, Dr.Nirmala.E & Dr. Jalaja T.K
Centre for Water Resources, Development and Management,
Kozhikode, Kerala-673571.
(E-mail: esdcwrdm@eth.net)

ABSTRACT

The Vembanad wetland, the largest tropical estuary on the South west coast of India identified recently as a Ramsar site, lies between 9^0 00' and 10^0 40'N latitude and 76^0 00' and 77^0 30'E longitude . It extends from Alappuzha in the South to Azheekode in the North. The low lying Kole lands lying between 10^0 20' and 10^0 40'N latitude and 75^0 58' and 76^0 11'E longitude also joins the Vembanad wetland.

A variety of reasons have contributed to the environmental crisis of this wetland. It includes large scale pollution, indiscriminate exploitation of its resources and human interventions like land reclamations, unscientific operation of the Thaneermukkom barrage and Thottappally spillway.

About 18005 Ha of the wetland was reclaimed during the last 150 years for various agricultural and allied purposes. The Thaneermukkom salt water barrier constructed for facilitating the raising of a third crop has led to the decline in salinity levels in the backwaters, causing depletion of fishery resources, and stagnation of pollutants in the wetland. The Thottappally spillway constructed as a measure to control the floods in Kuttanad has led to saline water intrusion into the agricultural fields through spillway channels. A total of about 230 million litres/d of domestic sewage, 260million litres/d of trade effluents and 187 Tonnes of solid wastes are estimated to be discharged into the wetland. The boom in tourism in this sector has led to destruction of mangroves and deposition of waste materials from about 200 house boats and 50 passenger boats. Indiscriminate exploitation of resources of the wetland has led to the depletion of many renewable resources. The annual landing of fishery resources have declined by about 89%.The paper reviews the problems, causes and management objectives for the conservation of the wetland system.

INTRODUCTION

The Vembanad kol wetland system with its drainage basins covers an area of about 16200 km^2 which is about 40% of the total area of the Kerala State (Fig. 1). The Kole lands covering an area of 13.632 ha are spread over Thrissur and Malappuram districts extending from the northern bank of Chalakudy River in the south to the southern bank of Bharathapuzha River in the north. The area lies between $10^0$20' and $10^0$40' north latitudes and $75^0$58' and $76^0$11' east longitude. The system has almost all the values and attributes generally assigned to wetlands such as fishery, avian fauna, mangroves, associated vegetation, agriculture, recreation, tourism, inland navigation, port facilities and related industries. At the same time, it has become the most environmentally abused backwater system due to ill-planned human interventions and ever-increasing pollution loads. This is an inevitable consequence of heavy industrialisation and uncontrolled urbanisation. Developmental interventions such as Thanneermukkom

regulator and Thottappally spillway have, in fact, worked to hurt the lake's fragile ecosystem. As a result of this, the ecology of the backwater system has been totally upset and it is now facing an acute environmental and ecological crisis. The present paper is a review of the environmental status, problems and Management Action Plan of the wetland system.

ECOLOGICAL SIGNIFICANCE

Vembanad Lake and the associated wetlands are exceptionally rich biological regions which can be considered as "hot spots" of biodiversity with high degree of endemism. The fishery resources of this lake constitute a heterogeneous assemblage of marine, truly estuarine and fresh water fish species. 150 species of fishes belonging to 100 genera under 56 families have been reported from the lake (Kurup and Samuel, 1985). This wetland system regularly supports a bird population of more than 20000 during winter months, which include the endangered species like Spot billed Pelican, Oriental Darter, Water Cock, and Black billed Tern. Mangroves are seen fringing the Vembanad Lake in many areas like Kochi, Kumarakom, Vypeen, Puduveypu, Kannamali and Chettuva with rare species such as *Excoecaria agallocha* and *Bruguiera sexangula* forming a very complex ecosystem supporting the life of various organisms.

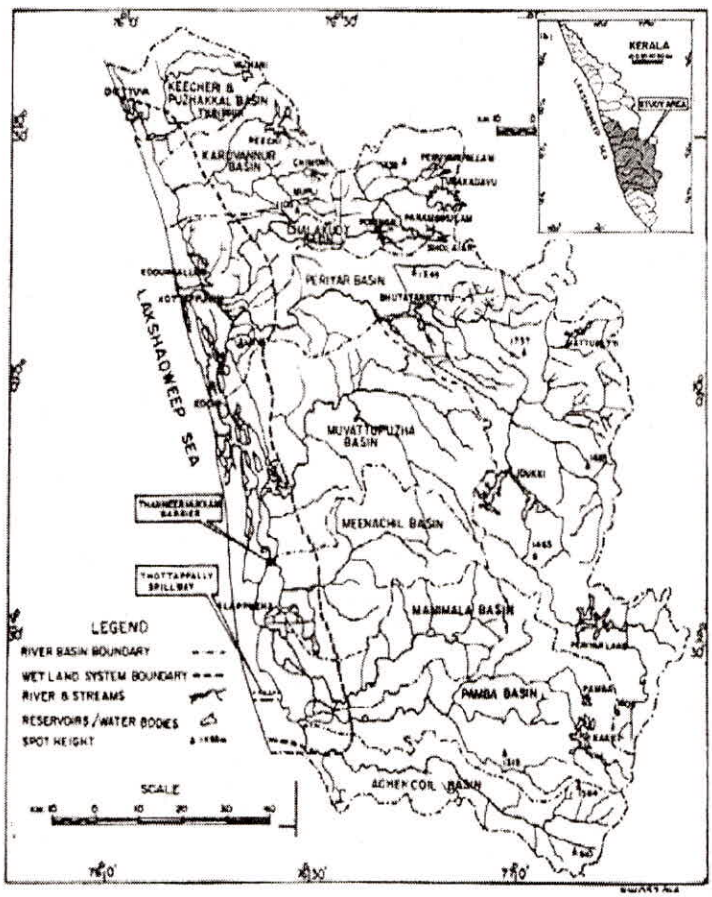


Fig. 1 Drainage basin - Vembanad Kol Wetland system

ECONOMIC POTENTIAL

The coastal wetlands comprising of Kuttanad and Kole lands constitute approximately 24% of the paddy lands of the State. Wetland generates 101.58 man-days / ha. of labour and the gross income from rice cultivation is Rs 25252.5 / Ha (Mathew, 2001). Estimates of fishery production in open waters and adjoining wetlands in Kuttanad revealed that the annual landing is 746.76 tonnes (Padmakumar *et al*; 2002). The exploited quantity of black clam from the lake during 1988-89 was 7025.85 tonnes. Coir industry is one of the important traditional cottage industries located predominantly in the Vembanad wetlands. It is estimated that 157million coconut husks are ret every year in Vembanad region covering an area of 247 ha. (James *et al*, 1996). Tourism generates revenue of about 158.55 crores from house boat operation. About 50 passenger boats and 200 house boats are found to be operational in the wetland.

PROBLEMS

The Vembanad – Kol wetland system has undergone severe ecological backlashes, the effect of which will be catastrophic from environmental point of view.

The backwater system has undergone shrinkage both in area and in depth. The mean depth of the estuary has been reduced from 6.7 m to 4.4 m and has reduced the water carrying capacity to 0.6 km^3 from 2.4 km^3 with a decline of 75%.

The water quality in many parts of the Lake has been severely deteriorated. The wetland has a high level of coliform bacteria, the levels being in general 10 times higher than the permissible limits for drinking water. The total solid content of the lake in several parts is abnormally high, values as high as 53,750 mg/l have been recorded during summer. Nearly 260 million litres of trade effluents reach daily from the industrial belt of Kerala (James *et al*, 1996). Coir retting also adds to the pollution due to the release of enormous quantities of organic pollutants.

At the onset of southwest monsoon, several areas of Kuttanad become submerged in floodwater. Though the construction of Thottappally Spillway has to some extent, mitigated the severity of monsoon floods, damages are still caused by the breaching of bunds during heavy rains. Water level rises by 2m in the upper reaches of Kuttanad and by 1m in Kayal lands during floods.

The fishery wealth of Vembanad Lake seems to be depleting at an alarming rate. The migratory fishes have been totally disrupted. About 13 euryhaline fish species prevalent earlier are now rare in the southern stretches.

During the past decade, bird life in the Vembanad Lake and adjoining wetlands have suffered great losses both with respect of diversity as well as with total number. The migrant ducks from Siberia and Europe have ceased roosting in the backwaters since 1995 (Vembanad Bird Count 2003). Ducks and teals have been reduced to one-fourth during the past ten years.

Mangrove forests, once prevalent all over the Vembanad wetlands have now become a few isolated patches. The evergreen stretches of mangroves fringing the banks of the Vembanad Lake have been subjected to commercial exploitation almost to the level of their extinction.

Aquatic weeds create conspicuous problems in farming, fishing and navigation. Due to the multiplication of waterweeds like *Eichornia, Salvinia* etc., the canals and water bodies are blocked, inland navigation has become difficult providing a breeding ground for mosquitoes and other vectors causing health hazards.

In most of the places in Kuttanad, the soil is highly acidic and contains toxic salts. In Kole lands also, soil is inherently acidic and the temporary wetting and drying condition prevailing in Kole wetlands aggravates the problem of soil acidity.

Saline water gets into the Kole lands through the channels connecting the wetlands to the backwaters at Enamakkal.

In Kole lands, there is sufficient water for irrigation in the *Mundakan* season to supplement the rainfall and other sources. However, drought occurs in summer season since *Punja* crop is entirely dependent on irrigation.

ANALYSIS OF CAUSES

Among the various types of man made stresses imposed on the aquatic ecosystems of Kuttanad, the most important one is the Thanneermukkom salt-water barrier. Thanneermukkom barrage has been relatively successful in preventing salinity intrusion into Kuttanad and has paved the way for devastating environmental problems such as interruption of migration of fishes, stagnation of water body and proliferation of aquatic weeds.
Thottappally spillway was constructed as a measure to control the floods in Kuttanad. It provides a direct outlet to the sea for the floodwaters instead of the long route through the Vembanad Lake to Cochin Bar Mouth. But, the spillway did not offer much help in preventing floods in Kuttanad and ultimately the project turned out to be a failure, due to structural limitations.

There has been a progressive reduction in the depth of the lake due to excessive sedimentation. The total annual sediment yield from all the rivers draining into the Vembanad lagoon is 32 million tonnes and that to the Kole wetlands is 4 million tonnes (James *et a l*, 1996).

Indiscriminate exploitation of resources through unscientific methods like over fishing, use of banned fishing gears, practices like water poisoning, use of explosives and electrocution has contributed heavily to the depletion of the renewable aquatic resources of the lake.

MANAGEMENT ACTION PLAN

Various Management Strategies both long term and short term have been developed. These are discussed below.

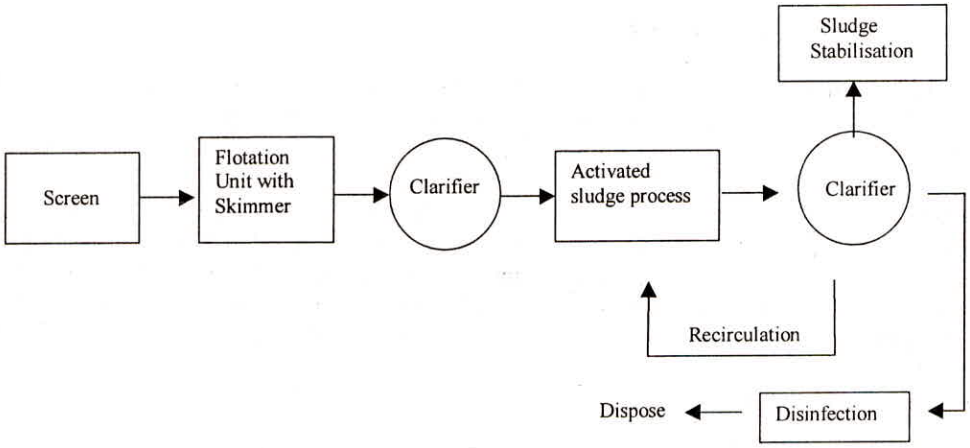
Liquid Wastes : Urban / Rural

The existing sewerage system in all cities and towns situated along the banks of the lake should be modified and their efficiency is to be enhanced to a great extent. The total volume of

urban sewage generated in the catchment area for the projected population in 2034 is as follows.

District	Area in Km^2	Population in 2001	Urban sewage generated (mld)	Projected population (2034)	Urban sewage
Ernakulam	94.88	1477085	138.6	2259503	203
Alappuzha	130.9	621457	71.5	1030566	92.75
Kottayam	53.7	299808	17.1	4942941	133

The sewage treatment plant in each of the above case may adopt the following typical treatment units to treat the sewage.



Direct outlet to the lake should be made a punishable offence. Subsidies should be issued for installing septic tanks in individual houses. Proper care should be taken while constructing roads, bridges and culverts in the wetland which may obstruct the free flow of water and in due course damage the entire wetland ecosystem.

Management of municipal solid waste

* Municipal authorities should establish and maintain storage facilities in such a manner that they do not create unhygienic and unsanitary conditions around it.
* Transportation of waste should be done using covered vehicles.
* The biodegradable waste should be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilisation. For the disposal of the non-biodegradable, inert waste and other waste which are not suitable either for recycling or for biological processing, land filling method can be adopted.

Industrial Waste

Industrial units discharging their effluents into the lake/rivers draining into the lake may be directed to implement control measures.

Regulation of Coconut Husk Retting

Government should entrust local Panchayats for licensing of retting areas and form a local committee comprising of government representatives, local people and technical personnel to advice the government on retting operations.

The areas worst hit due to retting activity should be closed for a few years to allow their ecological restoration. Recently developed retting technology, which dispenses with natural retting process, should be popularized.

Management of Fishery Resources

Conservation of fishery resources through ranching in open waters is a recognized strategy to rejuvenate declining fisheries and restore species diversity affected by habitat alteration and over fishing.

Promotion of natural recruitment of fish species can be achieved by establishing protected fish sanctuaries and fishing prohibition zones in various parts of the lake. It is also desirable to develop long term strategies such as observing 'closed fishing season' and 'forbidden fishing zones' for recruitment promotion of endemic species (Padmakumar, 2003). Suitable regulations should be enforced in the use of fishing gears also.(Kurup, 1983).

Conservation of Birds

Ecological reasons should be identified to determine the drastic reduction in the population of many groups of birds in the Vembanad – Kole wetlands. Further studies would be required for this purpose.A protected area has to be created in Pathiramanal Island, the marshy bird breeding area of the KTDC complex and the portion of the lake between these two areas together (Vembanad Bird Count, 2003).

Scientific Operation of Thaneermukkom Barrier

Studies should be conducted to demarcate the area of salt water intrusion and its extent during various seasons. Closure of shutters should ensure complete water tightness. Shutters which are damaged due to corrosion, have to be replaced at the earliest.

Flood Control Measures

A detailed evaluation of rain fall, river discharges, flood water extent and duration should be undertaken. Completing the flood control project initiated by the State PWD in 1976 to rectify the defects of the spillway would go a long way in saving Kuttanad from floods.

Regulators in kol lands

Regulators at Enamakkal has been designed for passing 760 Mm^3 of water and the observed capacity is found to be less and this worsens the flood conditions. Scientific studies have to be carried out on the structural limitations of the regulators and physical modifications need to be made in view of the interests of water supply, irrigation and flood protection. Effective operational policies for the regulators have to be developed.

Controlling Tourism Related Activities

The houseboats must be provided with separate collection chamber for human excreta and solid wastes, the terminals must have pits and treatment facilities to which the wastes are pumped, waste oil should be collected at terminals and it should be disposed off after recovering useful oil (Chand and Janaradhanan, 2002). Plastics must be separated and recycled if possible, or it can be effectively disposed.

Management of Agriculture

Proper management of cropping patterns especially in kayal lands and Lower Kuttanad is required. A rice based farming system involving fish could best reverse the trend of under utilization and non utilization of rice fields.

Controlling Weed Infestation

Aquatic weed *Salvinia molesta* can controlled by introducing the weevil *Cytobagous salviniae.*

Catchment Area Treatment

Afforestation: Reduction in forest coverage occurred during 1950-1999 mainly in the ranges of Kottayam (408.60 sq Km), Konni (175.216 sq.km) and Chalakkudy (439.65 sq.km). An area of about 385 sq.km is proposed for afforestation with indigenous species like *Albizzia lebbek, Artocarpus sps, Careya arborea, Caryota urens, Cassia fistula, Cinnamomum zeyalinicum, Dysoxylum malabaricum, Erythroxylon monogynum, Eugenia sps* etc.

Revival and conservation of mangrove forests: Along Vembanad lake restoration and regeneration of the mangrove ecosystem has to be attempted. It is estimated that in the catchment, approximately 400 ha of mangroves are degraded and under threat distributed in the districts of Ernakulum, Alappuzha, Kottayam and Thrissur.

Soil and Water Conservation

The standard methods effective in conserving soil and water, which can be adopted in the catchment are trenches and pits, contour bunds and terrace walls, brushwood check dams, centripetal terraces, loose rock dams and vegetative hedges (Table 1).

Table 1: Allocation for the soil and water conservation measures

Name of the River Basin	50% of the Total Catchment	Pits & Trenches (25% of allocation)		Contour Bunds (25% of allocation)		Brushwood Checkdam (5% of allocation)
		Area in Ha	Earthwork in m^3 ($75m^3$/ha)	Area in Ha	Earthwork in m^3 ($75m^3$/ha)	No. of brushwood (1brushwood/ha)
Pamba	112500	28125	2109375	28125	2109375	5625
Achenkovil	225000	56250	4218750	56250	4218750	11250
Manimala	42500	10625	796875	10625	796875	2125
Meenachil	62500	15625	1171875	15625	1171875	3125
Muvvatupuzha	77500	19375	1453125	19375	1453125	3875
Periyar	270000	67500	5062500	67500	5062500	13500
Chalakkudy	85000	21250	1523750	21250	1593750	4250
Karuvanur	52500	13125	984375	13125	984375	2625
Keecheri	20000	5000	375000	5000	375000	1000
Puzhakal	11700	2925	219375	2925	219375	585

Name of the River Basin	Loose rock dam (5% of allocation)		Centrepetal Terraces (10% of allocation)		Vegetative Hedges			
					Pineapple (15% of allocation)		Fodder grass (15% of allocation)	
	Area in ha	No	Area in ha	Nos. (150 trees/ha)	Area in ha	Nos (150 suckers/ ha)	Area in ha	Nos.1000 cuttings/ ha
Pamba	5625	5625	11250	1687500	16875	2531250	16875	16875000
Achenkovil	11250	11250	22500	3375000	33750	5062500	33750	33750000
Manimala	2125	2125	4250	637500	6375	956250	6375	6375000
Meenachil	3125	3125	6250	937500	9375	1406250	9375	9375000
Muvvatupuzha	3875	3875	7750	1162500	11625	1743750	11625	11625000
Periyar	13500	13500	27000	4050000	40500	6075000	40500	40500000
Chalakkudy	4250	4250	8500	1275000	12750	1912500	12750	12750000
Karuvanur	2625	2625	5250	787500	7875	1181250	7875	7875000
Keecheri	1000	1000	2000	300000	3000	450000	3000	3000000
Puzhakal	585	585	1170	175500	1755	263250	1755	1755000

Monitoring and evaluation

It is proposed that the aspects like hydrological characteristics, water quality parameters of the wetland system, biodiversity components have to be monitored periodically to study the status of the lake and the

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