CHAPTER - I

INTRODUCTION TO THE AREA

1.1. Name and Location :

Kanjirankulam Birds Sanctuary otherwise known as "Kanjirankulam Kanmai" is located at 9° 21' N and 78° 30' E. It is part of Kanjirankulam Village of Mudukulathur Taluk, Ramanathapuram District of Tamil Nadu. Location of the sanctuary is illustrated in ***Map 1 & 1a***. The sanctuary area is within the community tank embankments and its immediate water holding area of Kanjirankulam Kanmai. It is the third largest bird sanctuary in Ramanathapuram holding around 98 ha of total water spread area.

1.2. Constitution and Extent of Area :

The Kanjirankulam tank was declared as a bird sanctuary in the year 1989, with an estimated area of 66.66 Ha in Keela Kanjirankulam and 37.55 Ha in Mela Kanjirankulam. It is notified as a sanctuary with the meaning and scope of Section 18 (1) of Wildlife Protection Act 1972, through the G.O Ms. No 684, Environment and Forest Department (FRV) dated 21.09.89 and appeared in the Gazette Part II on Page No. 774 on 28.10.89 (***Annexure 1***). The sanctuary is managed as a single unit and there are no ranges or sections delineated within. Most notable feature of the sanctuary area is the prominent growth of Babul *(Acacia nilotica)* trees. The sanctuary can be identified as one compact seasonally perennial water body in the Survey of India toposheet 1:50,000 NO: 58 K/7. The extract of the Field Measurement Book showing the boundary of the Keela Kanjirankulam & Mela Kanjirankulam tank is given in **Annexure - 1A & 1B,** respectively.

1.3. Approach and Access :

The sanctuary is only approachable by road and it is 117 kms away from Madurai. The nearest town is Mudukulathur, approximately 8 kms away on the Mudukulathur – Kamuthi Road. Nearest bus stop is Mudukulathur from where buses ply to Ramanathapuram and Paramakudi on a regular interval. Nearest railway station is Paramakudi, which is 35 kms away and the nearest airport is Madurai.

1.4. The Statement of Significance :

The values of Kanjirankulam Bird Sanctuary are related to biodiversity richness, economic benefits, culture, catchment, human ecology, aesthetic significance and potential for scientific studies.

1.4.1. Locational value of falling in wetland complex :

Kanjirankulam Birds Sanctuary being part of the Madurai – Ramanathapuram Tank Country bestowed with numerous rainfed irrigation tanks, occupies the apex position in providing ideal nesting grounds for the winter migratory heronry species and colonial water birds.

1.4.2. Ecological value :

The sanctuary offers conducive breeding and feeding grounds for the birds especially the migratory ones, of which the most preferred nesting sites being the Babul trees (*Acacia nilotica*) planted extensively by the Forest Department under social forestry scheme.

1.4.3. Cultural value :

The sanctuary and adjoining village is mutually benefiting and healthy existence of human beings and avian wildlife. Residents of Kanjirankulam are known to protect the birds from any possible poaching or threats.

1.4.4. Economic value :

The sanctuary, that includes the earthen embankments, bunds and the resultant seasonally water holding marshy lake are equally beneficial for the birds as well as the villagers. Excess water that is stored during rainy season within the bunds, It is later utilized for agriculture purposes. The sanctuary acts as a store space for an efficient flood control, flood storage mechanism. It acts as a sediment control ground that prevents stream carried silt and urban residues from being divulged into the agricultural lands. The sanctuary is a control measure for the naturally occurring soil erosion. It is also acts as a natural system of nutrient removal from agricultural runoff and waste water systems.

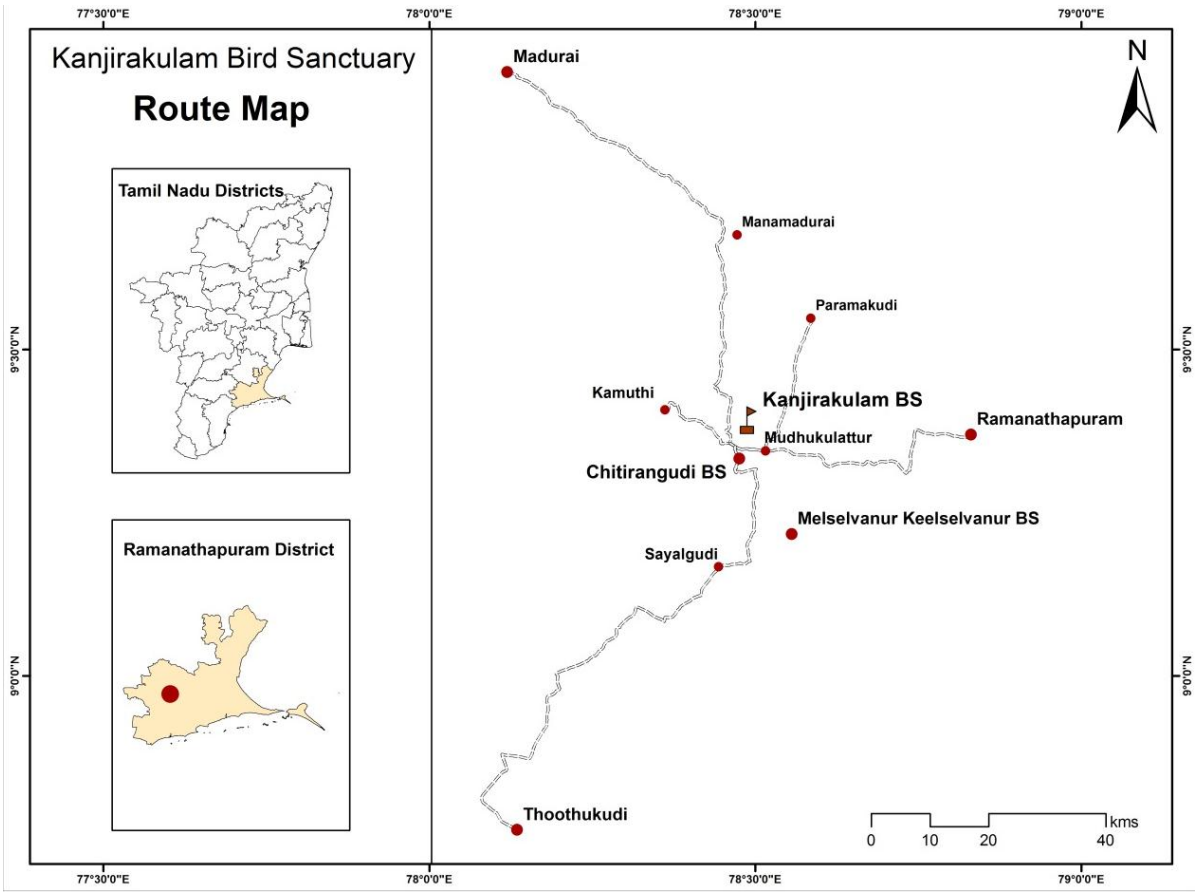
1.4.5. Tourism value :

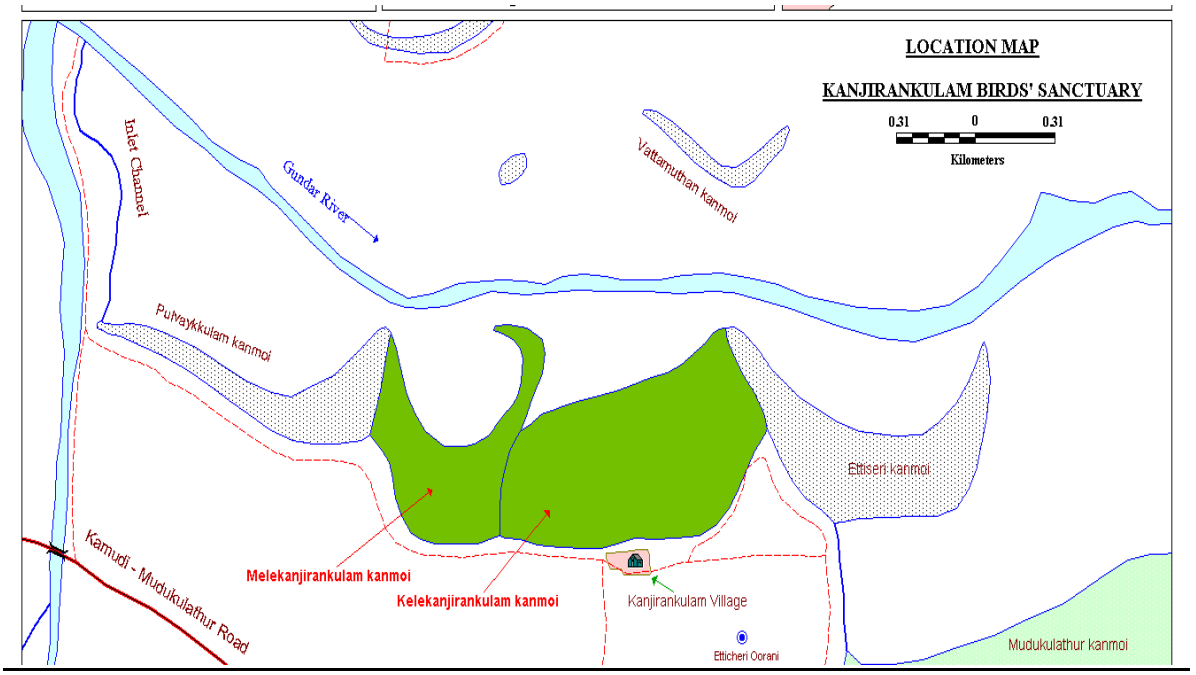
The sanctuary offers immense opportunity for eco-tourism based bird watching. Birds that are difficult to sight elsewhere are known to come close to human habitations thereby making Kanjirankulam an abode of bird watchers and ornithologists.

1.4.6. Scientific value :

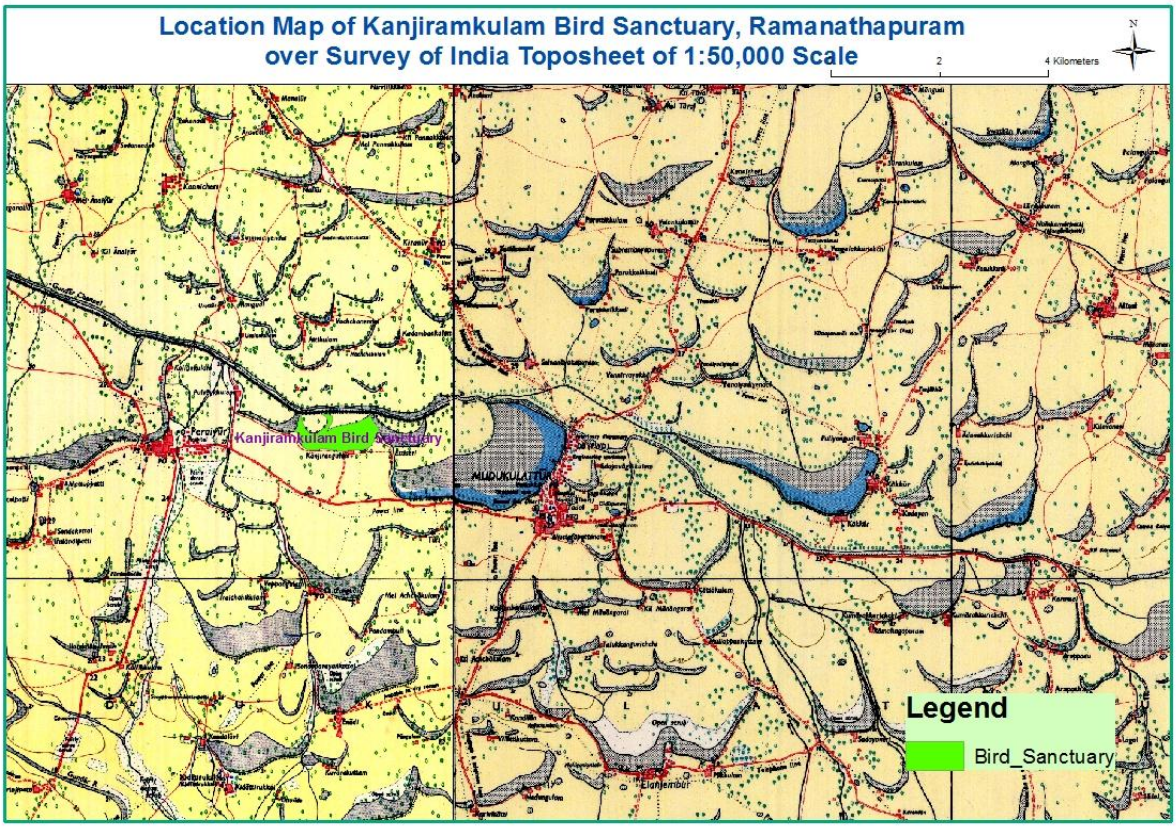
The sanctuary offers excellent possibilities for scientific research in Birds and their habitat. It offers unique opportunities for research, education and nature interpretation.

MAP No. - 1. LOCATION MAP OF KANJIRANKULAM BIRD SANCTUARY





MAP NO. 1(a) : LOCATION MAP OF KANJIRANKULAM BIRD SANCTUARY OVER THE SURVEY OF INDIA TOPO SHEET OF 1 : 50,000 SCALE



CHAPTER - II

BACKGROUND INFORMATION AND ATTRIBUTES

2.1. Boundaries :

The sanctuary boundaries can be defined in two ways, legal and ecological. Legal boundaries of the sanctuary are defined in terms of physically identifiable survey stones. Ecological boundaries are defined in terms of the ecological continuum that the sanctuary forms as individual nesting site for birds and also in association with other similar or less important tanks adjoining the sanctuary that provides feeding and nesting grounds for the birds.

2.1.1. Legal boundaries

The First Management Plan of the Sanctuary (1993-94 to 1997-98) mentions 'boundaries in the G.O could not be verified on the ground'. Refer ***Map 2*** for legal boundaries. A land survey conducted in the year 2003, has delineated the boundary description as provided in the G.O (***Annexure 1***). It comprises of two tanks Mela Kanjirankulam S.F. No. 71 (37.55 Ha) and Keela Kanjirankulam S.F. No. 123 (66.66 Ha). The boundary description, provided in the G.O (**Annexure 1**) is given as follows,

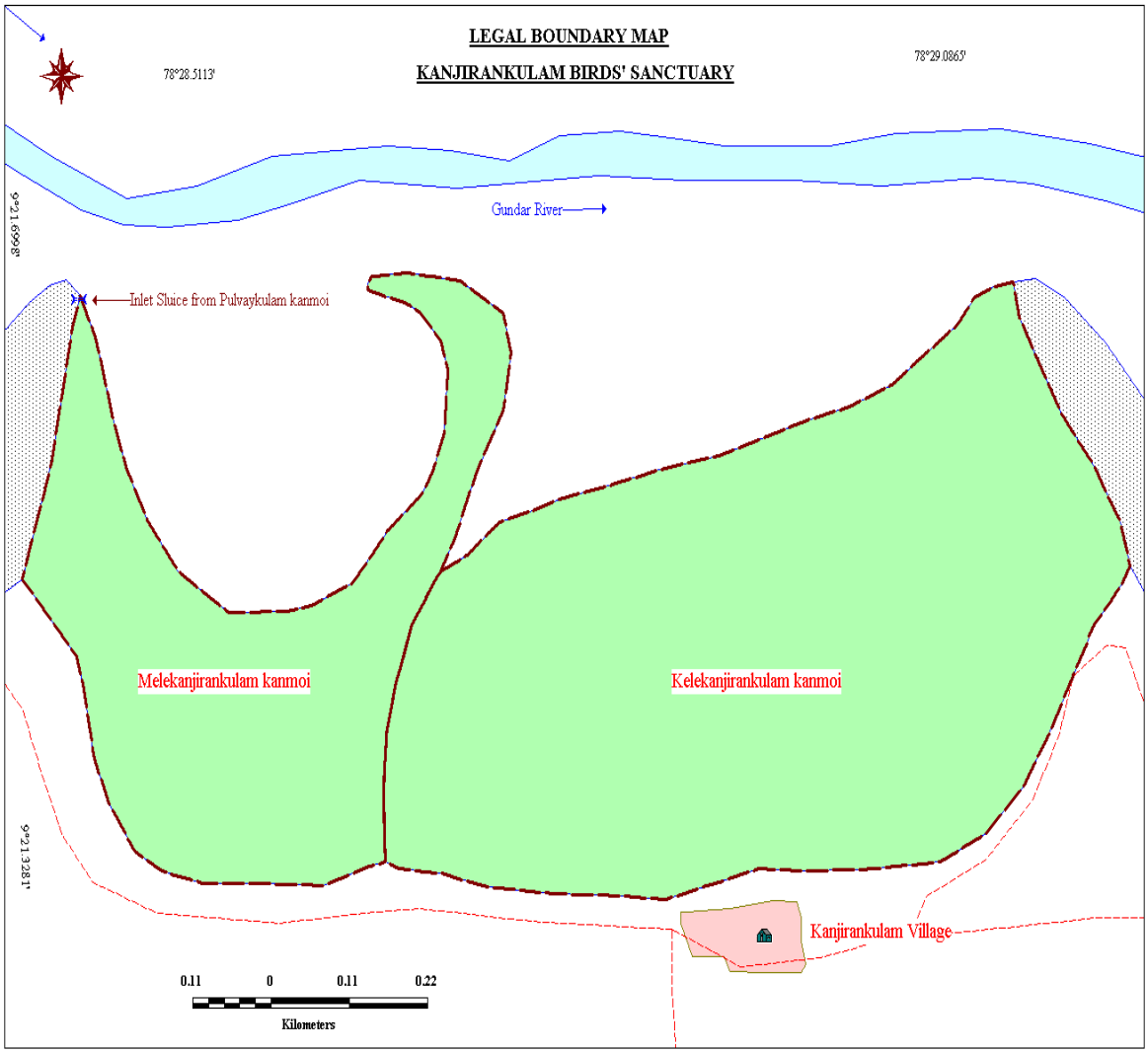
North - Starting from tri junction point of SF.Nos.142, 71 and 313 all of No.45 Pulvaykulam village, the boundary runs centrally towards east along southeastern and western sides of SF.No.142 till it meets the tri junction point of SF.Nos.123, 142 and 129 of the said Pulvaykulam village.

East - Thence, the boundary runs generally towards south along the western side of SF. Nos. 129,111,130 all of the said Pulvaykulam village

South - Thence, the boundary runs generally towards west along the northern side of SF.Nos.128,110,124,125,72, and 73 all of the said Pulvaykulam village.

West - Thence, the boundary runs generally towards north along northern, eastern and Northern side of SF.Nos..142, eastern side of SF.No.312 southern, western, southern and eastern side of SF.No.313 of the said Pulvaykulam village to the starting point.

MAP 2 : LEGAL BOUNDARY MAP



2.1.2. Ecological boundaries

Man made boundaries are of least concern for the birds as they fly across nations and oceans to reach the sanctuary that has been declared so to conserve the natural breeding and feeding place for winter migratory birds from far and wide. These traditional nesting grounds, even though is the home for a considerable number of these much delightful feathered visitors, not all of them are restricted to the sanctuary or its immediate surroundings for food and nesting materials. One reason for being so is the yearly diminishing water-level and the limited availability of food and nesting material to cater to a large number of birds. The resultant search of food and materials lead to the natural stretch of the legal boundaries of the sanctuary, forcing to define an ecological boundary. Adjoining village tanks and ponds, locally known as 'Kanmois' and 'Ooranis', they are provide an ecologically continuous ecosystem for the healthy survival of the birds. A study carried out around the sanctuary within a radius of two kms from the sanctuary as part of the management plan preparation for potential feeding grounds and areas that offer nesting materials provided the following list of village tanks and ponds **[*Annexure II (a) & (b)*]**, which could be considered as an ecological continuation of the Kanjirankulam Birds Sanctuary (***Map 3***). There are nine Kanmois found in the ecological boundary of which Mudukulathur kanmoi is the only perennial kanmoi found in the region. Wide spread nesting was reported in Veppankulam kanmoi in the year 2003. Field observation revealed that, the numerous nests and egg shells in ecological boundaries areas. The kanmoi is vegetated only with Prosopis and birds' nests are seen as low as one meter from the ground. Nesting was seen in very little numbers in other smaller kanmois' as well.

It is to be noted that, The Ecological boundary will not have any legal sanctity. It is only a management entity and classification to take up management interventions. There would be no restriction or regulation what so ever over the existing rights, activities and ongoing practices. The 2 Km boundary around the sanctuary is an imaginary boundary, which also nearly encircles the proposed eco-sensitive zone.

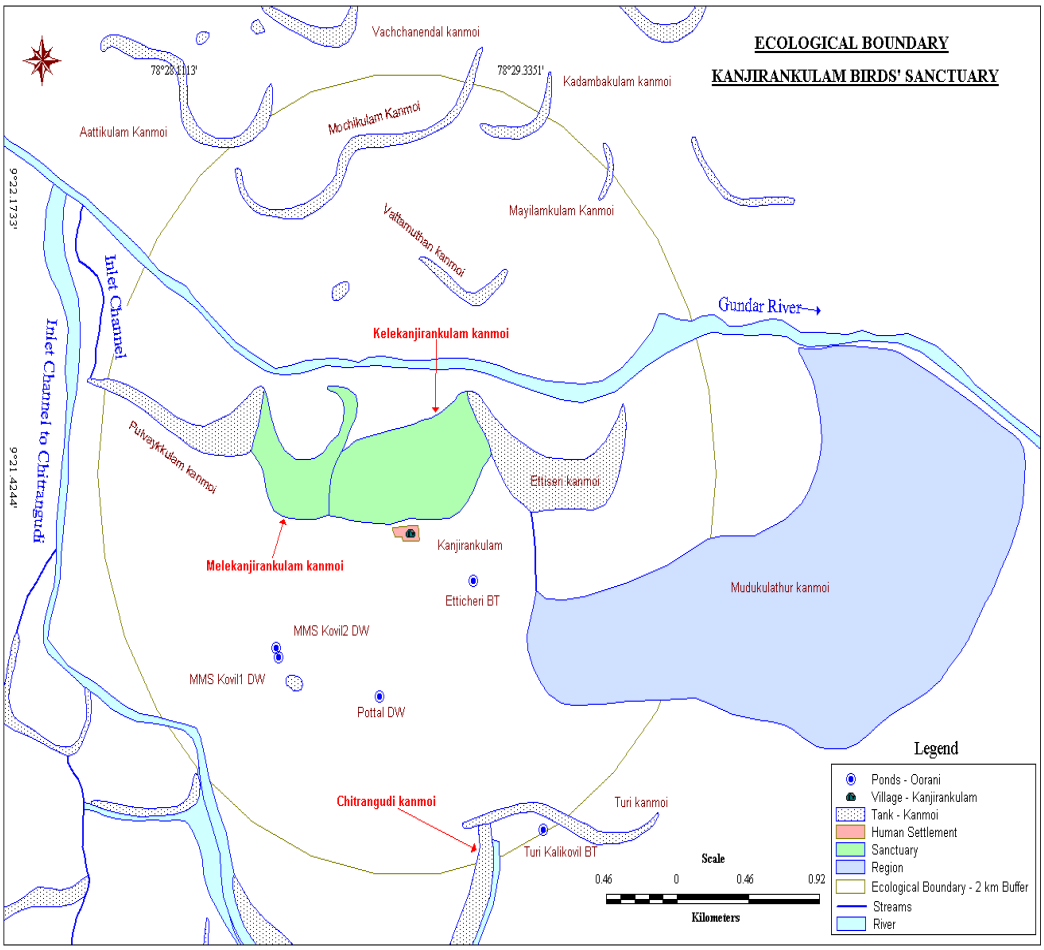
2.2. Geology, rock and soil :

The sanctuary falls in an area geologically considered a pediment of recent origin. Though fluvial processes have resulted in the present morphological features of the area, human interference has greatly altered the natural conditions of erosion. Gneisses underlying the alluvium largely deposited by the Vaigai River are

very deep seated. Calcium carbonate underlines the soil strata, leading to bore wells yielding brackish water.

The area has black soil with excellent water retentivity. As one digs deep, the soil retains its colour but tends to be clayey in nature. They are generally alkaline soils. The district soil Atlas classifies the soil of the region as Typic Ustipsamments and Vertic Haplustalfs + Ustropepts capable of supporting Palmyra, Coconut and pulses respectively. The soil productivity map in the atlas classifies Typic Ustipsamments to be of extremely poor productivity whereas that of Vertic Haplustalfs + Ustropepts to be of good productivity. Soil samples were collected systematically using a stratified sampling method devised for the purpose. The method covered all possible vegetative combinations in the sanctuary area, namely, Babul rich area, Prosopis rich area, Prosopis and Babul rich area, Babul and Prosopis rich area, Neer karuvai rich area, tail of the sanctuary, area adjacent to the patta lands, at the water inlet into the tank and at the deepest sluice gate of the tank.

MAP No. - 3. ECOLOGICAL BOUNDARY AROUND THE BIRD SANCTUARY



2.3. Terrain :

Kanjirankulam Birds Sanctuary is situated in a plain country of elevation of 30m to 100m. The sanctuary is a flat piece of seasonally water holding community tank. It is in general 1m to 3m deep from the tank embankments. Between the embankments and the vegetated area there is approximately a 25 meter wide water holding region, deepened and maintained by Forest Department and Tamil Nadu PWD. Agricultural lands are surrounded the sanctuary and it marks the northern boundary of the sanctuary. There is no striking altitudinal difference as far as the horizons towards all directions from the sanctuary. The only obstacle for ones clear vision is the small community forests grown over the earthen embankments of adjoining village tanks and Palmyra trees surrounded by open Prosopis growth. From a visual observation, it is very evident that, the tank is built according to the contour alignment. An aerial view of the sanctuary gives out a crescent or fish tail shape. The kanmoi starts at a northern point where a channel from the Gundar flows into the kanmoi through an aqua duct (***Map 2***). Total length of the embankment is 6.2 kms. There are 2 sluices that drain water to the agriculture lands. Excess water is let out during flood conditions through a sluice gate hardly 0.5 km from the inlet aqua duct towards Kanjirankulam village (***Map 2***). During flood season excess water is not allowed to reach the tank's storage portion thereby avoiding any risk of tank breach.

2.4. Climate :

Due to the unique and unfortunate relative position of this country side in the dry south east sheltered by the cardamom hills from the south west monsoon, of the main track of the advancing Bay of Bengal branch and to a larger extent loosing the full effect of any cyclones of the retreating monsoon by reason of its position in relation to the Cauvery delta bulge and Ceylon, this area receives very low rainfall. The area can be classified as a semi arid desert for all practical purposes.

Three distinct seasons are experienced in the sanctuary area. The winter starts from November and lasts till middle of February. After that, summer season starts and it continues up to middle of June. This is followed by scanty rains up to September and thereafter it is followed by monsoon rain up to first fortnight of the December.

2.4.1 Rainfall pattern and distribution :

The area receives an average rainfall, varying between 350mm to 900mm annually. Most of the water collected in the tank is from the North East monsoon. A

period from mid February to whole of August receives practically minimum rain fall, though occasional showers might result due to local climatic manifestations. For a period of 12 years starting from 2000 to 2011 **[*Annexure III (a,b,c) - Graph 1*]** shows two peaks of rainfall availability in the region, they being May and October. Moreover, summer season receive minimum rainfall in the sanctuary.

2.4.2. Temperature; a summary of year round pattern

Mudukulathur, the nearest town and taluk headquarters to the sanctuary do not register the daily temperature and humidity readings. The next nearest data available is for Ramanathapuram town. Although it is evident from field experience that, the sanctuary experiences temperatures higher than the district capital, non availability of data forces the management plan team to utilize the data from the district capital for all practical purposes of climatic estimations. Mean Monthly temperature (*Graph 2*) and humidity data of the district capital is provided in **[*Annexure IV (a & b)*].** July registers the highest maximum temperature of 34.9°C whereas May registers the highest minimum temperature of 28.3°C.

2.4.3. Humidity; a summary of year round pattern :

The sanctuary areas average maximum relative humidity 89% and minimum 56% for all the months, except January for which the numbers are 86.1% and 54.2%.

2.4.4. Wind Speed: a summary of year round pattern:

Average wind speed of the sanctuary areas are recorded between 3.40 to 30.00 km/h.

2.4.5. Drought and its periodicity:

Drought in Ramanathapuram district is common due to the inadequate and lack of rain fall. However, the sanctuary areas were fully affected by droughts during 1972-1976. In these time agricultural crops plants were heavily affected. Drought also creates the problem of unemployment of villagers residing in an around the sanctuary.

2.5. Water sources:

The sanctuary is mostly rainfed. It is housed in a traditional irrigation tank fed by a distributory channel of Vaigai, named Gundar. Gundar is highly seasonal. Water flow is restricted to the few months of rainfall and if and only if considerable water flows through Gundar, the Sanctuary receives any water. Water, if collected to its full capacity is sufficient enough for the following 7 months. Locals reported of a small seasonal stream that used to carry water from those regions north of the tank,

beyond Muthukulathur-Kamuthi road. The stream is blocked by the road and thus large quantity of water that should have drained into the sanctuary is not reaching there. The channel that carries water from Gundar is deeper at many locations than the kanmoi. So also, land owners on either side of the channel between Gundar and the kanmoi tend to drain considerable quantity of water to their fields, which leads to reduced inflow into the sanctuary.

The sanctuary has six ponds in the sanctuary area. Both the kanmoi were dug to provide slight longevity to the water holding of the tank. Both are to the north of the sanctuary nearer to the patta lands. Both the kanmoi, even though shallow serves their purpose to certain extent by providing extended water availability for a month more after the north east monsoon months.

2.6. Flora :

The sanctuary vegetation is mostly Tropical Dry Deciduous type. It is dominated by Babul (*Acacia nilotica*) along with *Prosopis Juliflora* and grasses such as *Cynodon Dactylon* and *Eremopogan Faveolatus*. Prosopis is slowly encroaching large extent of the sanctuary area and is retarding the growth of Babuls. The irrigation land and the outside tank areas have variety of grasses and medicinal plants *viz., Adhatoda vasaka, Sesbania grandiflora, Aloe indica, Phylanthus emblica, Phaseolus roxburgii, Citrus medica, Moringa oleifera, Cynodon dactylon, Pongamia glabra* and *Azadirachta indica. Besides trees like Tamarindus Indica*, *Ficus Spp, Thespesia Populnea, Albizzia amara,* and *Palmyra (Borassus flabellifer)* are also found. A Babul plantation was planted in 1979 by Farm forestry division. The invasive Prosopis is slowly encroaching on much of the sanctuary area, retarding growth of Babuls. Cascuta creepers are also growing widely in the sanctuary and many a times retarding the growth of Prosopis. In addition the medicinal plants such as *Ocimum Sanctum, Gloriosa superba*, etc. are also found in the area. Check list of flora is provided in **Annexure *VI***

2.7. Fauna :

The sanctuary offers ideal habitat for winter migratory birds with considerable diversity in nesting and feeding behavior for breeding and feeding. It is one of the preferred nesting sites for heronry species and colonial birds migrating to South India. The feathered visitors flock the sanctuary from October to February. The wetland is irregular in depth and retains water for 3 to 5 months if rain is normal. Few names of fishes are called by local names Jilebikendai, Kendai, Keluthi and Ayirai etc. Separate lists of amphibians, mammals, reptiles and carnivores are not available as efforts to such end have never been initiated in this sanctuary. More

than 5 near threatened species such as Pelican, Painted stork, Eurasian Spoon bill, White ibis, Darter and 9 water birds such as common teal, Pin tail, Gargeny, Green Shank, Common sand piper, Green sand piper, Little ring plover, Little stint, Red shank and 68 common birds are already documented. *Category wise check list of birds are provided in* ***Annexure VII*** *and the list of mammals, Amphibians and Reptiles is given in* ***Annexure VIII*** based on the data provided by Bombay Natural History Society and the data sourced from wetland action plan prepared under the TBGP during 2013-14. Local names of few of these birds were also collected for the preparation of this plan which is also provided in a separate column.

Nine species of birds are known to breed in the Kanjirankulam BS and they are: the Spotbilled Pelican, Little Cormorant, Little Egret, Grey Heron, Purple Heron, Black crowned Night Heron, Painted Stork, Oriental White Ibis and Black Ibis. Although not validated, there are studies by Kannan and Manakadan that the Spot billed Pelican nesting colonies may have originated from Kanjirankulam and Kanjirankulam wetlands of Ramnathapuram, before moving on to wetlands such as Koonthankulam.

Kanjirankulam in conjunction with Chitirangudi also qualifies as an Important Bird Area (IBA) as the threatened Spot-billed Pelican is known to breed here. A maximum of 100 birds reportedly breed, i.e 2.5% of the species bio-geographic population at the 1% level of 40 birds (Wetlands International 2002). In January 1988, in Kanjirankulam Sanctuary, 934 Pelicans and 100 nests were found (BirdLife International 2001). Johnson et al. (1993) have seen 700 pelicans in January 1989 and 286 in 1991 in the same tank. Besides the Spot-billed Pelican, the Asian Open-bill, Little Egret, Large Egret, Grey Heron, Purple Heron, and Indian Pond Heron are known to breed in both villages. In Kanjirankulam, Abraham (1973) found Painted Stork breeding on the same trees as pelicans. During his visit, the nesting colony was on 60 trees, mainly *Ficus religiosa*, *Thespesia populnea* and *Acacia nilotica*. He also found nesting colonies of Oriental White Ibis and Black Ibis, about 1.6 km away from Kanjirankulam.

2.8. Habitats :

There are no diverse habitat types like islands, mounds, emergent vegetation in the sanctuary. The sanctuary is a near homogenous tank like structure with dense overgrowth of *Prosopis* (Seema Karuvel) and intermittent plantations of *Acacia nilotica*. The North West part of the wetland retains a bare amount of water even during summer. The habitat type is classified as a wetland with submerged trees.

2.9. Flagship Species of Kanjirankulam Bird Sanctuary :

Spot billed Pelican is considered to be the flagship species of bird sanctuary. The sanctuary was historically known for being a significant breeding site for the Spot billed Pelican.

2.10. Hydrology :

Wetlands are unique hydro-systems where water level varies seasonally and this annual fluctuation of water is known as wetland hydro period which is the length of time and portion of the year the wetland holds water. Hydro-period integrates various aspects of wetland like rainfall, evapo-transpiration runoff from adjacent areas, flooding, net seepage of groundwater, etc. and regulates the functional and structural characteristics of the wetland.

Kanjirankulam is part of the Gundar River Basin of Southern Tamilnadu. The basin is spread over a geographical area of 5660 sq. km in parts of five districts, 12 taluks, 22 blocks and 760 revenue villages. River Gundar originates from Saptur reserve forest in Varushanadu hills (the eastern slope of the Western Ghats) and runs over a length of 150 km before it joins the sea. It is situated in between Vaigai basin in the north and Vaippar basin in the south. The general slope is Northwest to Southeast. The slope is less than one percent in most parts of the basin providing scope for forming channels wherever needed to feed the tanks constructed, and this is one of the major contributing factors for the well entrenched tank based irrigation in the district of Ramanathapuram.

The basin receives annual average rainfall in the range of 550 to 900 mm and variations of rainfall are high in the tail reaches of the river, within which Kanjirankulam is located. The middle and lower reaches of the basin are mostly devoid of forests. The proximity of River Vaigai and existence of a low ridge dividing Vaigai and Gundar basins has made it possible for trans-basin water from Vaigai River to Gundar basin from time immemorial. There are around 2,276 tanks with a registered ayacut of 72,000 ha, irrigating mostly a single crop of paddy.

Conflicts exist among various villages between tanks in a cascade or in an anicut fed tank system. About 150 chains of tanks are spread over the basin. The number of tanks in each chain of tanks varies from 3 to 120. There are two types of chain/ group of tanks based on their functions, flood moderator and flood absorber. The flood moderator group checks the run off before it reaches the River and flood absorber group draws the water from the River during the flood and feed several

tanks to get the water stored. These chains have been delinked due to the encroachments, siltation, breaches and other manmade activities.

The Gundar River has the following tributaries:

1. Therkaar and Goundanadhi in the upper reaches
2. Girudhamal and Kanal Odai in the middle reaches and
3. Paraiyar and Palar in tail reaches

Raghunatha Cauvery and New Narayana Cauvery area the man made canals that are part of the system in the lower reaches of the river. The river is called Gundar prominently in the middle reaches of the basin, notably near Arupukkottai and Kamudi, while beyond Kamudi, it is given the name of Malattar since it is perceived to be sterile and of low use. The most critical component is that in the upper reaches, the Gundar is about 10 m width but as it flows towards the Bay of Bengal, it widens to 100 m in a meandering manner. It is this meander that local communities have traditionally capitalised to create a series of inters connected ox bow shaped water bodies.

The two canals discussed are in the tail region of Gundar basin, and were excavated during pre-British period by the Sethupathis (Marava Kings) of Ramanathapuram. Of the two, the Raghunadha Cauvery Canal is of relevance to the current project. The canal has been formed by creating a regulator at Kamudhi across Gundar and excavating a dedicated channel to finally drain into a wetland on the North-East, close to the coast, by Raghunatha Sethupathi, after whom it is named. It is oriented towards the left of the river, and passes through Mudukalathur, Kumarkurichi and Karumal villages of Mudukalathur taluk, finally draining into the Kalari Tank. Around 17928 acres of ayacut were benefited from this canal,through an interconnected system of 71 tanks. These tanks, yet again, on the basis on the feeder canal from Raghunadha Cauvery were organised into sub groups.

One such sub group is the Aappanur Group of Tanks that are part of the Kadaladi taluk at the tail end of the Gundar basin, of which Kanjirankulam wetland is a part.That Chitirangudi and Kanjirakulam are part of a single wetland complex is one of the planning errors that have been made in the management of the Bird Sanctuaries of Ramanathapuram.

The Aappanur feeder channel, the third feeder canal of Raghunadha Cauvery, is located in the conjunction of Mudukalathur and Kadaladi taluks and feeds the following tanks (West to East):

1. Mangasonai

2. Kanjirankulam
3. Nellathi
4. Karisalkulam
5. Veppankulam
6. Enadhi
7. Kalachinapadari
8. Kidathirukkal
9. Koovarkottam
10. Pothikulam
11. Pidariendal and
12. Aapanur

Evidently, Aappanur tank is the last wetland of the series, but the village has historical significance as the headquarters of Appanadu, which was adminstred by the Pandya Kings and Ramnad Kings. Historically the landscape was known as the 'Marava Country'. Discussions with the local communities and officials of the State Departments of Public Works and WRO reveal the following:

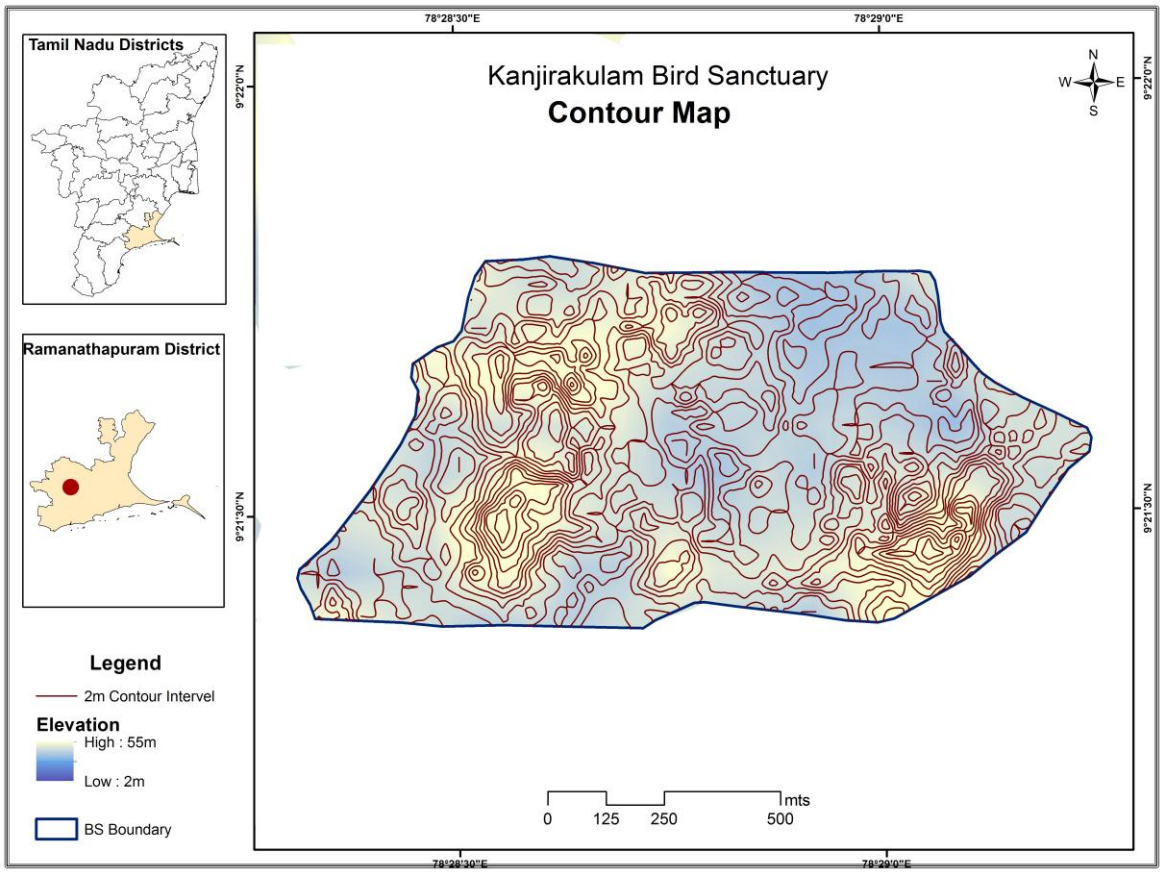
1. The water sharing systems are influenced locally by caste groups, with the Maravas dominating the water sharing decisions. Conflicts within and across the caste groups is very common, notably in and around the lower reaches of the system.
2. The water diversion structures in the upper reaches, which are to be maintained by PWD and WRO are not well maintained and hence supply of water is severely curtailed.
3. Due to deliberate change in water courses, branch channels at varying heights are in existence whereby the capture of water by Aappanur wetland is facilitated.
4. The reverse flow from the feeder channel to the wetlands is not being addressed, especially at Enadi.
5. The surplus weir at Pothikulam was lowered and hence the wetlands in the upper reaches do not capture water.
6. Heavy siltation along the tank bends and non-functioning of the feeder channels.

7. Intense water conflicts amongst the ayacutdars, notably between the Maravars and the Scheduled Caste population. The conflict had led to some of the households leaving the landscape permanently, which affected the maintenance of water bodies.
8. Intense encroachment along the feeder canals and tank periphery, combined with manmade damages to water diversion structures have also contributed to water stress.
9. Yet another point of conflict is the practice of fishing in the channel. There was a historical system of fish capture called Bathakattai and Banappari in the region, practised largely by people from the village of Enadhi. Since the practice entails manipulation of the water body, it was stated to affect the SC population and thereby led to conflict and poor management of the water bodies.
10. Loss of water in the Kamudi regulator due to poor maintenance, encroachment, and adhoc diversion and misuse by local people.

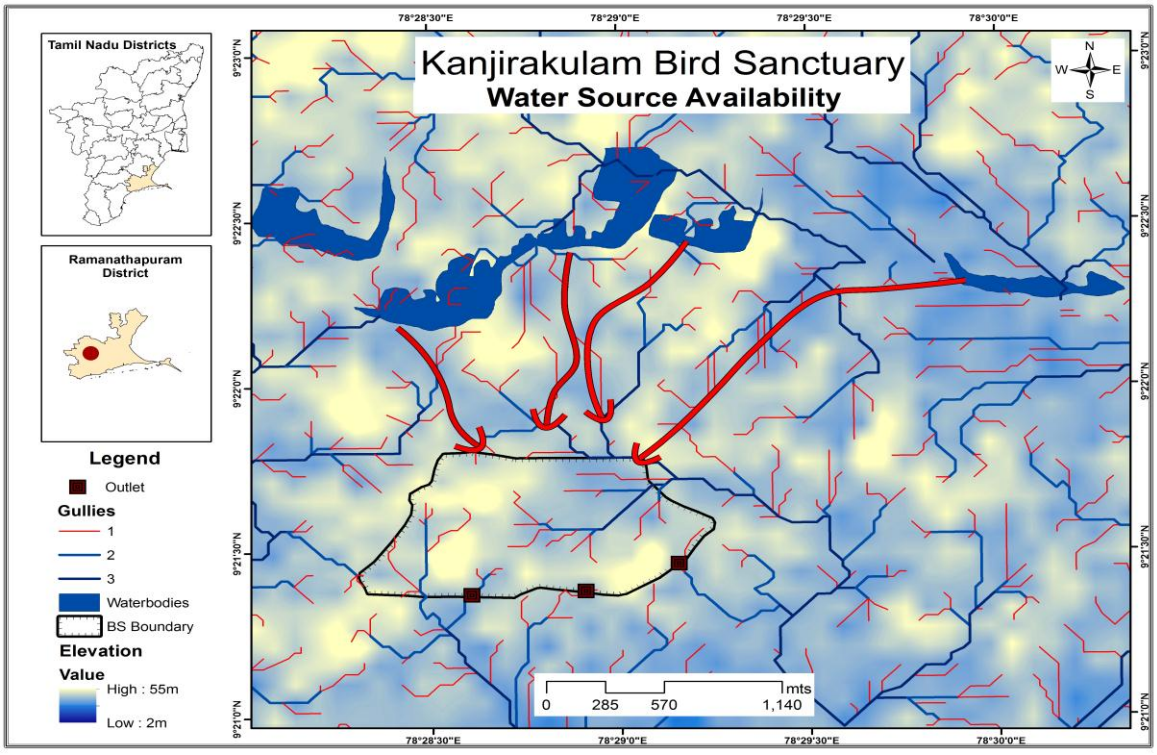
2.11. Drainage :

A Major part of Ramanathapuram district falls in Gundar-Vaigai river basin. Vaigai and Gundar are the important rivers and in addition, Virusuli, Kottakariyar and Uppar rivers drain the district. The drainage pattern, in general, is dendritic. All the rivers are seasonal and carry substantial flows during monsoon period. Vaigai, which is one of the important rivers of the district, flows and drains the Paramakudi, Bogalur, Tirupullani and Mandapam blocks. Gundar river originates in Kottamalai hills in the Saptura forest and enters the district near Anankulam and flows in a south-eastern to due south direction and enters the Bay of Bengal near Mukaiyur. The Kottakarai, Virusuli and Uppar are other rivers flowing in south easterly direction and entering the Bay of Bengal. The chief irrigation sources in the area are the tanks, wells and tube/bore wells.

MAP 4. CONTOUR MAP OF THE KANJIRANKULAM BIRD SANCTUARY



Map 5. Water source availability around the sanctuary



2.11.1. Local knowledge systems of drainage patterns :

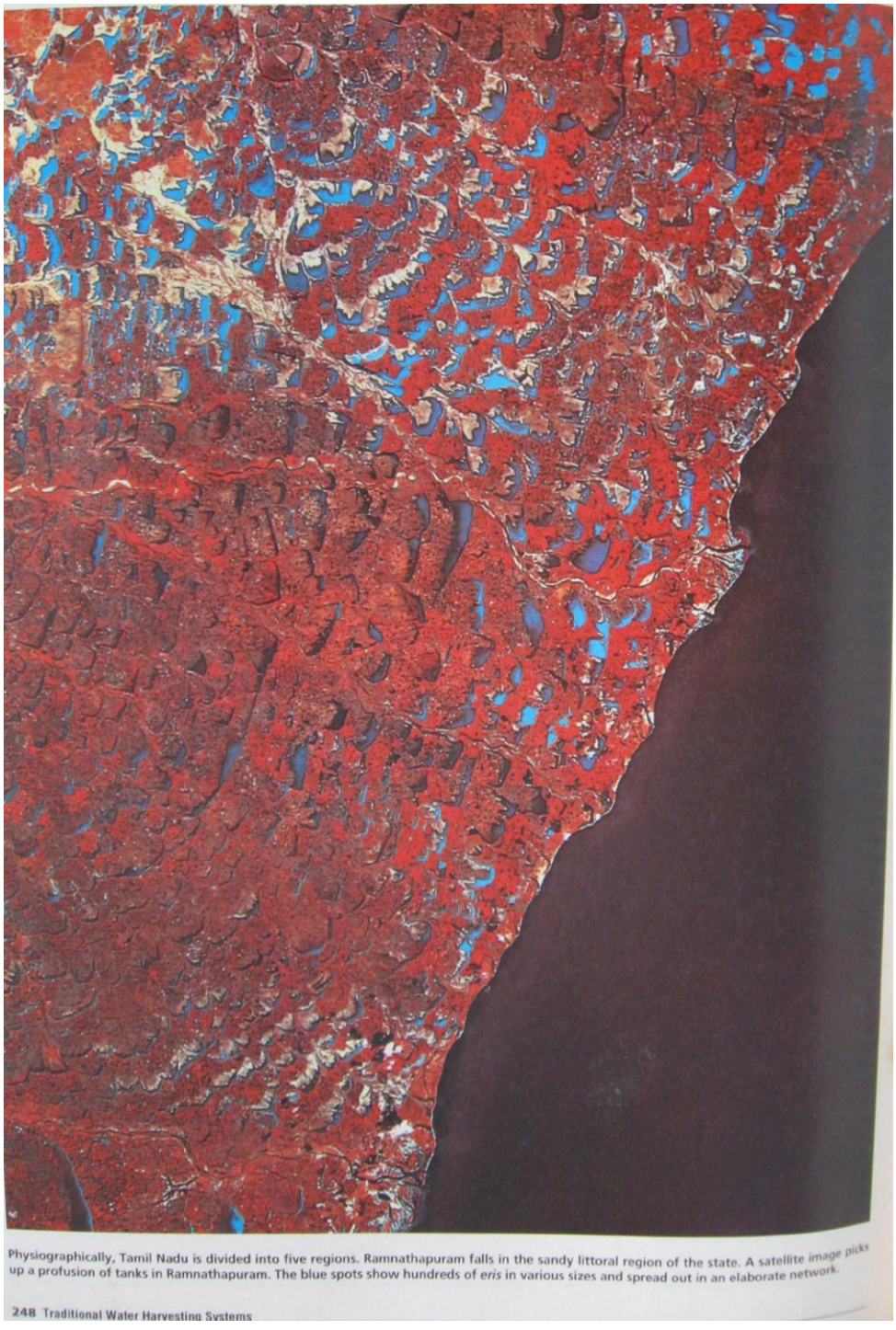
It is well known that Ramanathapuram, Kancheepuram and Tirunelveli are districts with the highest number of wetlands in the State of Tamilnadu, and consequently are districts which are significantly dependent on wetland irrigation systems for agriculture. It is also well known that the state of Tamilnadu has a recorded history of over 2000 years of settled agriculture, with a well-established system of manmade tanks and supportive water bodies. The state has also had a historical system of tank maintenance and upkeep, with a dedicated group to forecast rainfall patterns known as "Kudimaramathu". Interestingly, the district of Ramanathapuram is historically well known for its tradition of understanding and managing water resources in a prudent and sustainable manner, reminding one of states like Gujarat which is yet again a water deficit state. The system of having inter-connected and mutually dependent water systems is well captured by Fig which is low-resolution satellite imagery (*Dying Wisdom*). Of the many interesting highlights in the picture, the most striking is the manner in which the wetlands are shaped and organised in Ramanathapuram district. Oriented West to East, the wetlands are shaped like ox-bows and arranged in a series of parallel sequences. An oxbow wetland is formed when a river creates a meander, due to the river's eroding the bank through hydraulic action, abrasion and erosion. After a long period of time, the meander becomes curved, and eventually the neck of the meander will become narrower and the river will cut through the neck at a time of flood, cutting off the meander and forming an oxbow lake. When a river reaches a low-lying plain, often in its final course to the sea or a lake, it meanders widely. In the vicinity of a river bend, deposition occurs on the convex bank (the bank with the smaller radius).

In contrast, both lateral erosion and undercutting occur on the cut bank or concave bank (the bank with the greater radius). Continuous deposition on the convex bank and erosion of the concave bank of a meandering river cause the formation of a very pronounced meander with two concave banks getting closer. The narrow neck of land between the two neighbouring concave banks is finally cut through, either by lateral erosion of the two concave banks or by the strong currents of a flood. When this happens, a new straighter river channel is created and an abandoned meander loop, called a cut-off, is formed. When deposition finally seals off the cut-off from the river channel, an oxbow lake is formed. This process can occur over a time scale from a few years to several decades and may sometimes become essentially static.

That the local communities had an understanding of this hydrological process, and were able to capitalize on the knowledge is extremely significant as is

the absolute decimation of the well established systems leading to a condition of water stress, drought and despair.

FIGURE - 1 : SATELLITE IMAGERY OF RAMANATHAPURAM DISTRICT SHOWING THE NETWORK OF OXBOW SHAPED TANKS



Physiographically, Tamil Nadu is divided into five regions. Ramnathapuram falls in the sandy littoral region of the state. A satellite image picks up a profusion of tanks in Ramnathapuram. The blue spots show hundreds of *eris* in various sizes and spread out in an elaborate network.

248 Traditional Water Harvesting Systems

CHAPTER - III

HISTORY OF MANAGEMENT AND PRESENT PRACTICES

3.1. General :

Kanjirankulam Birds' Sanctuary that forms part of the Kanjirankulam Kanmoi is named after the Kanjirankulam village. The exact year or period of construction of the Kanmoi is not available, however respondents of the key informant questionnaire survey dates it to as early as 1850's. Elderly respondents confirm that the importance of the tank as a bird habitat was identified in 19th century, since then the protection used to be provided to the birds that nest in the tank. It is evident that birds' took advantage of the village tank that was constructed for the purpose of irrigating agricultural fields. The villagers are more supportive to protect the birds as the water enriched (Guano) with the droppings of these birds were of considerable fertility value to the adjoining agricultural fields. Villagers of Kanjirankulam are traditionally protective about the birds. Understanding the importance of the area, Tamil Nadu Forest Department declared it as a birds' sanctuary in the year 1989, which took effect from 1992. Since 1993, the sanctuary is managed scientifically under the consistent and clear interests of Tamil Nadu Forest Department. The sanctuary was under the control of Sayalgudi Forest Range which falls under Ramnad Sivaganga territorial Forest Division till 1992. Later, the administrative and protection charges were transferred to the Wildlife Warden, Gulf of Mannar Marine National Park. By the Wildlife Warden's Office proceedings currently the sanctuary is under the field control of Range Forest Officer, Ramanathapuram Range.

3.2. Review of Management Plans :

The first management plan for the sanctuary was written for a period of 5 years from 1993-94 to 1997-98. A second plan was written for a period of another 5 years starting from the expiry of the first management plan in 1997-98 to 2001-02 and third plan period 2005-06 to 2009-10. The current management plan is for a period of 5 years from 2016-17 to 2020-21. During the periods not covered under the management plan, the Bird Sanctuary has been managed as per the approved Annual Plan of Operations.

3.3. Infrastructure facilities available :

The Bird Sanctuary has been provided with basic minimum infrastructure facilities. However full-fledged elaborate facilities could be created in due course of time. The sanctuary is connected by road to the Mudukalathur – Kamuthi highway. It has established quarters for Forest Guard and Forest Watcher at a nearby village

called Chitrangudi. Besides there is one watch towers constructed with iron. Apart from the above there is an outdoor interpretation facility in the form of chain of boards. The interpretation facility has been developed under the Tamil Nadu Biodiversity and Greening Project during 2014-15. Apart from the above there is an information center building available which is in a dilapidated condition. However the bird sanctuary lacks facilties for visitors like walking pathway or foot path, toilets shelters etc.,

Iron Watch Tower

Outdoor Interpretation Center

Information Center

3.4. Holistic Approach to intervention :

Even though considerable recommendations are provided in the overall management of the sanctuary only few have been implemented. Tarmacing of the road leading to the sanctuary was done by PWD. From the recommendations in the first management plan only planting works were carried out. The de-silting work recommended in the consecutive management plans was carried out by the PWD.

Lack of funds is sited as a reason for not carrying out the uprootal activity. It is reported in the management plan that *Acacia nilotica* plantations were raised in 1979 by Farm Forestry Division to fill big gaps and vacant patches that prevailed in the sanctuary then.

Previous plans were meticulously prepared but were not approved to undertake and carry out the work plans recommended in them. Chronic shortage of funds and lack of necessary number of staff resulted in the sanctuary being left out without serious attention.

3.5. Live stock grazing :

The sanctuary does not possess any great resources for supporting grazing except for babul, prosopis, grasses and other herbs. However the resource surrounding the sanctuary itself is devoid of any vegetation suitable for grazing, the sanctuary is under the pressure of being utilized for grazing. There is constant pressure of livestock grazing from cattle and goats. After arriving at a consensus with the local community, measures to control and permanently check grazing is recommended.

3.6. Invasive alien species :

The sanctuary is affected by the invasion of *Prosopis Juliflora* to a major extent and *Ipomea* cornea to a very little extent. Prosopis has invaded the sanctuary area both in open areas and also under the babul tress where ever there is opening. Uprootal is the primary activity as far as the sanctuary's health is concerned. Removal and uprootal of prosopis is being taken regularly by the forest department but on a piece meal basis. Since the area of invasion is vast it is not enough that small portion of the sanctuary is tackled as the area abutting the sanctuary in patta lands and also in paramboke lands is also under the cover of this invasive species.

The details of removal of invasive alien species carried out in the past 5 years is given in the table below

Year	Extent in Ha.	Expenditure (Rs. In Lakhs)	Remarks
2010-11	-	-	
2011-12	-	-	
2012-13	10	1.10 Lakhs	Funds received under the CSS for Bird Sanctuaries
2013-14	3	0.37	
2014-15	5	0.60	

3.7. Forest Protection :

3.7.1. Legal status :

The Kanjirankulam tank was declared as a bird sanctuary in the year 1989, with an estimated area of 66.66 Ha in Keela Kanjirankulam and 37.55 Ha in Mela Kanjirankulam. It is notified as a sanctuary with the meaning and scope of Section 18 (1) of Wildlife Protection Act 1972, through the G.O Ms. No 684, Environment and Forest Department (FRV) dated 21.09.89 and appeared in the Gazette Part II on Page No. 774 on 28.10.89 (***Annexure 1***). The tank which is declared as sanctuary is a PWD owned tank.

3.7.2. Hunting :

There are no hunting activities reported. The illegal activities are being monitored vigilantly both within the sanctuary and also in the ecological boundary of the bird sanctuary. There are exclusively four watchers who are involved in full time protection of the Sanctuary.

3.7.3. Other illegal activities :

3.7.3.1. Illegal cutting of Trees :

The sanctuary is devoid of highly valuable timber species or secondary timber species except for babul tress. Therefore there is no issue with regard to felling of trees. However lopping for fodder is found to exist.

3.7.3.2. Illegal removal of NWP :

The villagers collect Babul pods for their cattles.

3.7.4. Encroachment :

There is an issue of settlement which is done within the sanctuary area. An area of around 7 hectares in the western portion of the MelKanjirankulam Kanmoi abutting the Pulvaykulam Kanmoi is said to have been assigned Patta by the Tahsildar Mudukalathur. The land has resurveyed and subdivisions have been made during the year 1992. The legal claims have to be verified with the revenue department and accordingly necessary steps have to be taken to rectify the same.

3.7.5. Wild and Man Made Fires

So far no wild or anthropogenic fires are reported in the sanctuary area.

3.7.6. Insect attacks and Pathological problems:

Not noticed in the sanctuary areas.

3.7.7. Wildlife Health :

There has been no incidence of occurrence of bird flu in the past within and in and around the sanctuary.

3.8. Zonation :

For effective management of the sanctuary, the area had been divided into three major zones viz., core zone, buffer zone and tourism zone using a time controlled floating model. The existing zones were revised based on a qualitative estimation of vegetation profile and logical ease of management. The zonation is illustrated in ***Map 6 a & b***.

Floating Model Zonation :

A floating model approach was suggested for zoning the sanctuary on a seasonal basis based on which:

A) The entire sanctuary will be a core zone throughout the time period that migratory birds arrive, nest and depart. This time period for all practical purposes may be called the ***North East Monsoon Season*** (NEMS hereafter) as the bird visits are in conjuncture with the monsoon and any period whenever Birds roost and use. Buffer zone of the sanctuary during this period will spread out for around half (0.5) a kilometer from the sanctuary boundaries, enclosing the village area and inlet channel. Tourism zone will be restrained to the main water holding region, bunds, inlet channel, roads and the mud track that is used as short cut between the village and Mudukulathur town. Refer **Map 6 a**.

B) Rest of the year, when the sanctuary is devoid of birds, the north western part, west of the walk track that leads from the village to Mudukulathur town, dominated by Acacia trees is considered as core zone. This period can be called the **Lean Season** (LS hereafter). Area east of the track and the inlet channel will be considered as buffer zone and tourism zone will remain the same as during the North East Monsoon Season. Refer **Map 6 b**.

3.8.1. Core Zone :

General constitution :

NEMS Core Zone :

The entire sanctuary is considered as core zone during this period. Most of the tank bed and plants will be underwater during this season except for the Acacia trees. Colonial water birds prefer to nest along the fringes and shallow regions and heronry species on the trees. This demands the entire sanctuary to be considered as

a core zone during this season. The power for declaring the whole sanctuary as core zone on the arrival of birds and close the inner sanctuary areas for public use shall be vested with the Wild Life Warden, GOMNP, Ramanathapuram. He may also be empowered to decide on the period when the order may be relaxed every year, without affecting the bird life.

LS Core Zone :

The area west of the Village – Muthukulathur track will be considered core zone as most of the resident birds tend to nest in the trees towards this region. Acacia trees are also seen dominant towards this region, where as the eastern portion is dominated by Prosophis plants. Moreover, innumerable tracks intersperse the sanctuary area towards east of the track thereby exposing it to considerable human interference.

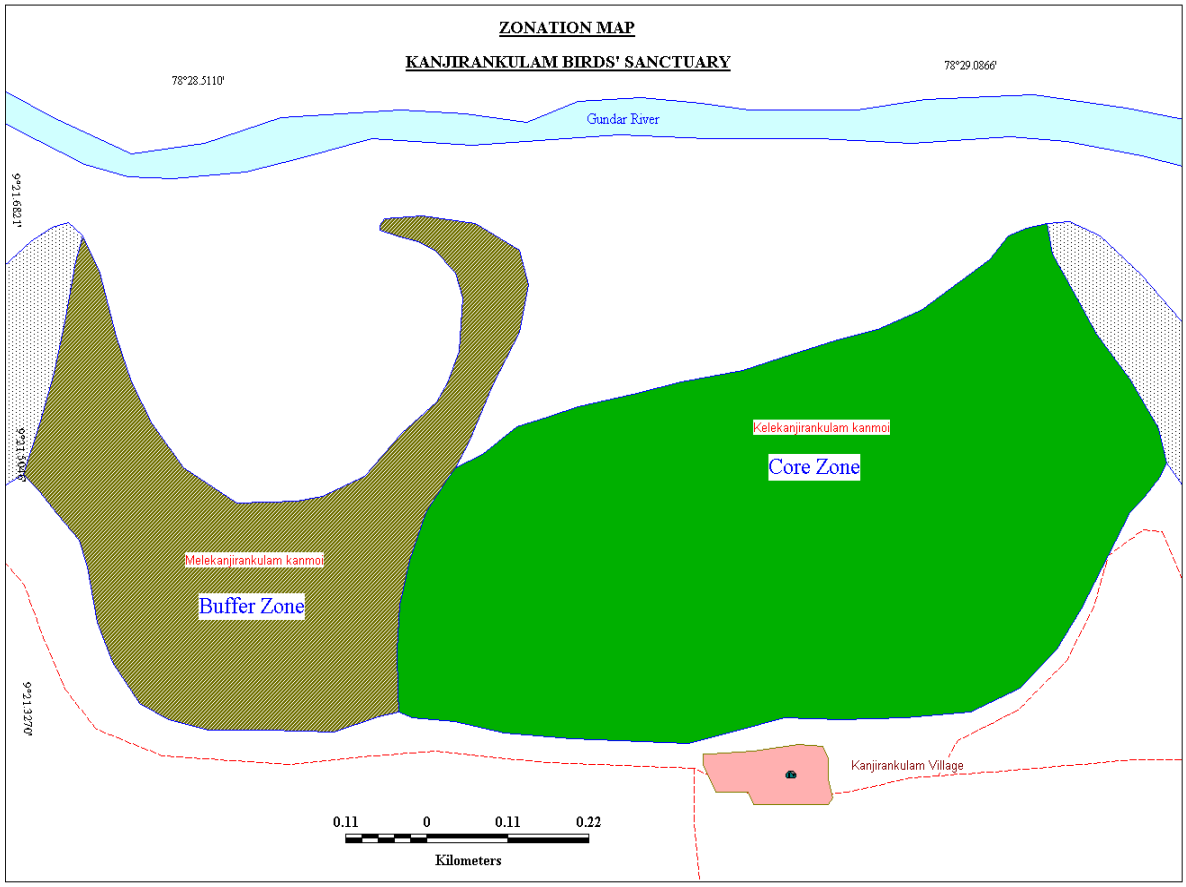
Objective of management :

The objective of management of the core zone is to preserve it as undisturbed natural habitat by ensuring total protection and provide better habitat environment for the Avian visitors of the area.

Activities permitted :

1. Total protection against all forms of biotic interferences may be ensured.
2. Only scientific studies and research activities with proper sanction without destructive sampling techniques may be permitted.
3. The core zone will be free from forestry operations other than Habitat improvement works. Similarly, grazing, fuel wood collection and NWFP collection are prohibited.
4. Only regular habitat Improvement/protection works like maintenance and digging of water holes, soil and moisture conservation works, creation of mound and islets, total uprootal of prosopis plants and planting of Acacia saplings, apart from monitoring activities may be permitted.
5. A watch tower equipped with a spotting scope may be constructed at the north-west corner of the sanctuary inorder to have a bird's eye blanket view of the core zone to enable better monitoring of the area.

MAP NO.6 : ZONATION MAP



3.8.2. Buffer Zone :

General constitution :

NEMS Buffer Zone :

A 0.5 km buffer area around the sanctuary boundary will be considered buffer zone during this period. It will include the village and parts of adjoining kanmois.

LS Buffer Zone :

The region east of the walk track that leads from village to Mudukulathur town will be considered as buffer zone during this season.

Objectives of Management :

Buffer zone will be managed for improving the habitat with rigid protection so that they support better floral and faunal diversity. The LS Buffer Zone may be upgraded into core zone in a phased manner after achieving the desired level of diversity and to enhance the nesting habitat available for avian visitors.

Activities permitted :

1. Fishing, feeding and bathing of cattle should be discouraged and suitable action may be taken to promote stall feeding.
2. Fuel wood requirements of local population may be met from this zone at present but efforts may be made to gradually wean them away from such dependency.
3. Certain portions of this zone may be opened for tourism.
4. Inlet channel connecting the seasonal river 'Gundar' to the sanctuary may be given a suitable gradient either by desilting or by deepening at selected places.
5. Inlet channel may be monitored to prevent possible draining of water by agriculturists to the fields on either side of the channel.
6. A plan and methodology to desilt the tank may be devised so as to increase open surface of water and to reduce too much variation in depth.
7. Selected regions may be left out for prosopis to grow to its maturity as evidences of birds using them too as nesting trees are available.
8. Grasses may be planted on slopes of bunds facing towards tank. Local varieties such as *Cynodon dactylon* and *Eremopogan Fevealatus* may be preferred.

3.8.3. Tourism Zone :

General constitution :

This zone consists of the main water holding region, bunds, inlet channel, roads and the mud track that is used as short cut between the village and Mudukulathur town.

Objectives of management :

This zone may be managed to provide educative experience regarding nature and wildlife conservation to the discerning tourists.

Activities permitted :

1. Restricted and Regulated Movement of tourists without jeopardizing the conservation concern of the sanctuary may be permitted.
2. Concrete / wooden benches may be provided to visitors to sit and watch the birds from various locations on the bund.

3. Tourists found behaving indifferent to the conservation objective of the sanctuary or teasing wildlife may be immediately taken action against the provisions of Amended Wildlife protection act 2002.
4. Bund management may be carried out after arriving at consensus with PWD officials.
5. Bunds, adjoining available open land and buffers of the main road may be planted with *Syzygium Cumini, Ficus species, Mangifera Indica, Thespeia populnea* and *Azadirachta Indica. Dendrolalamus strictus etc.*
6. A meteorological station with wet and dry bulb thermometer, and a rain-gauge, Anemometer, etc may be established to monitor the *metrological factors* influencing Avain fauna.
7. The watch tower currently in decrepit condition may be renovated, and equipped with spotting scopes.
8. One country boat may be provided to reach the watery areas in rainy season.
9. One new watch tower in the tank boundary and 2 hide towers in 2 locations inside the sanctuary to facilitate Wild Life photographers.
10. Habit of using toilet for day to day ablutions may be promoted through awareness programmes jointly organized with health department. The non-hygienic habit of using sanctuary grounds as defecation grounds may slowly be weaned away.

3.8.4. Status and Issues :

i. Core Zone :

Core zone is area comprising of deep water and entire water spread area of the tank. The deep water area is devoid of any of trees either babul or prosopis. It is being maintained free of invasion from any of tree species so as ensure clear spread of water uninterrupted with trees. However only 30 mts width in the deeper regions adjacent to the tank embankment is available clear of vegetation. The western and the northern portion of the sanctuary or the tank is invaded with prosopis. Babul trees are found to be spread across the southern and eastern portion of the tank.

Issues which are of concern in the core zone are as follows,

- Rampant encroachment of the tank water spread area by prosopis – an invasive alien species.

- The tank fore shore areas is devoid of well interspersed nesting trees mainly like babul.
- Dense concentration of babul in the southern region of the tank which need to be regulated so as to open it for birds for clear flight
- Consistent and prolonged drought is rendering the core zone devoid of water

ii. **Buffer Zone :**

Villages comprising of both backward and schedule caste communities, situated inside and outside the sanctuary, traditionally dependent on the resources of the sanctuary. The residents of these villages have their subsistence economic activities extending to forests inside & outside the sanctuary as well. Such extent of area has been taken as maximum 0.5 km away from the sanctuary border. Villagers of the Zone of Influence suffer a lot due to loss of job opportunities following stoppage of almost all forestry operations within the sanctuary viz. timber coupe working, collection of NTFP by different lessees and restriction in fishing.

Villages inside and outside the protected area, Ethnic identity and customs :

There is one Revenue villages around the sanctuary. The total human population in Revenue villages is 1055 (535 men and 520 women) and corresponding cattle population including cows, Bull, goats and sheep comes to 1,625 (Table. 6). Most of the people depend upon Rain fed agriculture while the rest earn their livelihood as daily wage labourers. The people belong to marvar and pallan respectively. The ethnic identity is thus varied, tradition and customs also vary accordingly. There is no major rift between communities and they mostly live in harmony with existing socio-political scenario.

The Development programmes and conservation issues :

A few developmental works have been taken up in and around the sanctuary by the Tamil Nadu Forest Department, which are quite insignificant for the villagers in the process of their economic upliftment. Mostly the works are implemented through Panchayat funded.

The interplay of market forces has its impact on the subsistence economy of the local people. Taking the poor condition of the people living inside the sanctuary area certain external market forces have come in to prominence. For cultivation of Brinjal, tomato, the cultivators have been encouraged by outside market forces providing loan facilities to purchase hybrid seeds, insecticide and Chemical fertilizers. . There has been a good development in dairy sector around the sanctuary area by way of loan for hybrid varieties of cows, opening of milk points for

purchase of milk from the farmers. Also the people are encouraged to rear more cattle.

(a). Traditions, Customs and Relationship with the Protected Area :

Traditionally, Kanjirankulam villagers have protected birds as they have realized the importance of bird droppings in agriculture and thus their economy. Sentiments associated with the bird protection have been observed across all class and caste barriers in the village. Within the immediate periphery of the sanctuary, there is an old Amman temple used for worshipping by the villagers. A small temple dedicated to human being deity was also observed in the vicinity of the sanctuary.

Impact of people on the sanctuary :

Considering the relatively low dependency of the villagers on forest resources, following are the impacts of people on the sanctuary.

- The first threat is from the unscientific and unsustainable ways of collection of NWFP including *prosopis* cutting and fishing during rainy season. This sometimes destroys the resource completely or maims it beyond recuperation.
- Fuel wood collection is another area of concern. Though they are permitted to collect only dry and fallen twigs for their bona fide purposes, but they sometimes collect more than they require and go for poles and cut down entire prosopis plants.
- Domestic cattle and goats of the villagers are less productive and are a burden on the fodder resources of the sanctuary. Since they are not stall fed, they enter sanctuary area and mutilate the ground vegetation.
- The domestic cattle also pose another threat of spreading prosopis in the sanctuary. In it mostly through the Droppings of these animals that treated prosopis spreads across the sanctuary.
- Using sanctuary as defecation grounds is prevalent among the locals. This habit can turn the sanctuary soil into a store house of deadly viruses and bacteria which may inturn affect birds and chances are there that these birds acts as carriers for some of these viruses in spreading them even across continents.

Impact of sanctuary on the people :

Till recently, when rainfall was sufficient sanctuary meant a lot to the villagers as it used to be their irrigation storage. Recent days have seen a decreasing value

for the sanctuary among the people, a fact evident from early incidents of felling Acacia trees and lack of maintenance to the sluice and weir gates. An apprehension is also prevailing among the villagers after the declaration of the sanctuary as they are not clear of its protective status.

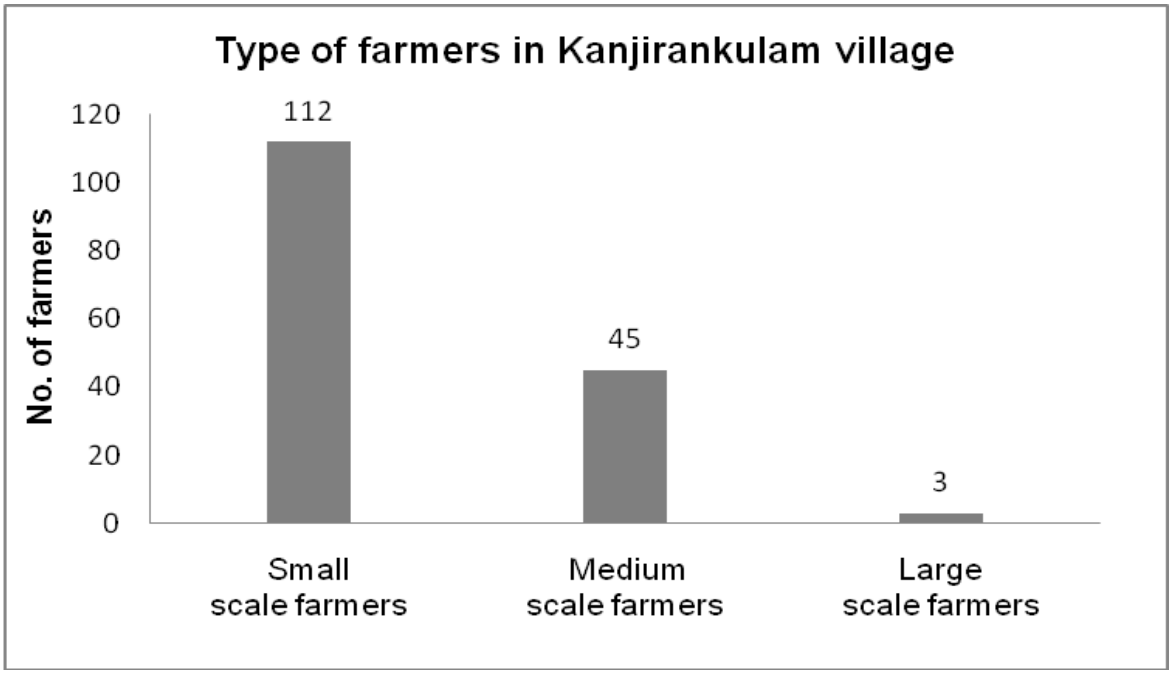
The scope of alternative employment generation activities such as ecotourism has not been explored till date, assuming that departmental protection will be sufficient to keep people away from the sanctuary. Ecotourism can revitalize value for the sanctuary in the minds of locals and thereby reduce pressure on it from grazing and other means, in the meantime provide an additional income source for the villagers.

(b). Economic Status and Occupations :

Agriculture is primary land-use type around the bird sanctuary. The total area under agriculture is 343 acres. While this whole area is under rain-fed irrigation during the monsoons, nearly 243 acres of land is cultivated using tank irrigation during the non-monsoon period. Use of groundwater for irrigation is not viable due to brackish conditions. The patterns are supportive of the overall historical profile of the landscape.

It is of interest to learn that the BS and the wetland itself were used as village commons for cultivation and grazing by local people. Local communities would use the subsistence mode of cultivation, focussing on growing pulses and associated vegetables and spices in these patches, while the sparsely dense trees would function as the heronry. The association of local communities to the birds has therefore not only been one of reverence but is deeply connected to the livelihoods and coping mechanisms. Local folklore of the landscape has narratives wherein the arrival of birds is equated with good fortune, while a change in their arrival patterns is compared to a home being deserted. This historical association has not been mainstreamed into the management of the Bird Sanctuary and is perceived as a short fall by the local communities.

The major crop cultivated is rainfed- paddy (short duration) during the period of October to December. Minor crop such as chilly and pulses are cultivated when there is not enough water to irrigate paddy. Weeding is done twice or thrice from seedling till harvest stage and no chemicals are used for weeding. In Kanjirankulam number of families holding large farms is very low (3), whereas there are around 112 small scale farmers owning 1 or 2 acres and 45 medium scale farmers (VAO records for the year 2009).



There are no fishing families in the village, however, nearly all households engage in opportunistic fishing. Catla, Tilapia, Uluvai, Tin fish (Ira) and Catfish are the commonly harvested species. No specialized fishing gear is used for fishing.

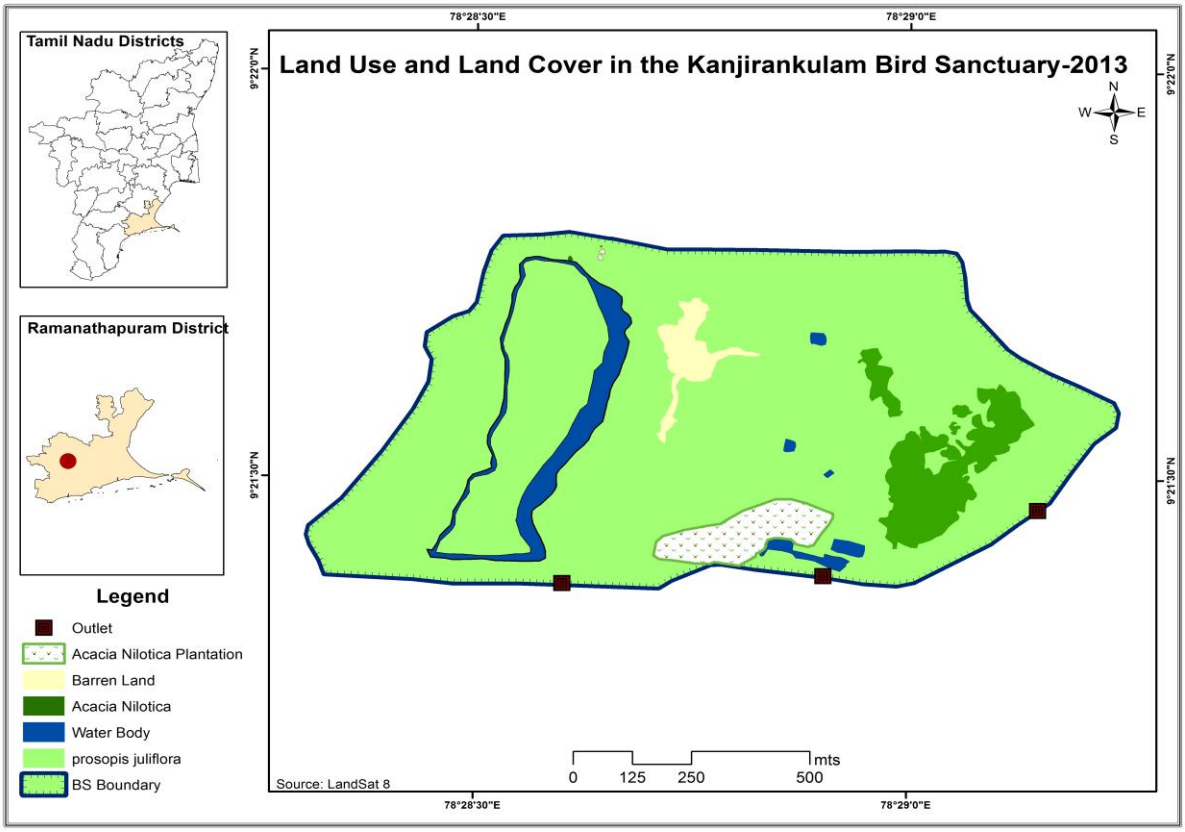
(c). Land use :

The study of Land Use and Land Cover Change (popularly referred to as the LUCC process), is known to have a significant bearing on the management of protected entities such as Bird Sanctuaries. This is especially relevant for identifying the proximate and distal anthropogenic pressures on the habitat and its resources, notably water. It is also a critical issue in involving local communities in conservation efforts – for instance a programme planned to improve local livelihoods may lose relevance rather suddenly when the household decides to sell their land to a commercial enterprise.

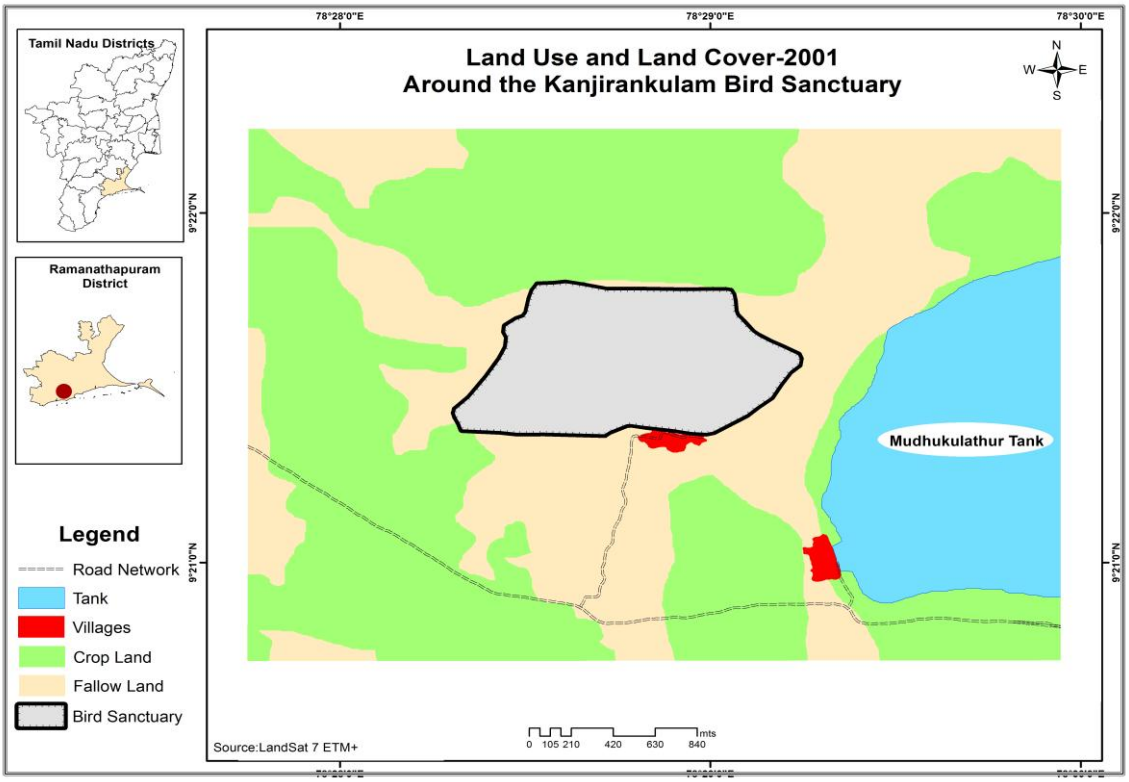
The study of land use land cover change around Kanjirankulam BS over the time frame 2001 and 2013 (approximately a decade) is interesting for it reveals no discernable change in land use or land cover, including an addition of human infrastructure. Extent of land under permanent fallow and human habitation remains static, with a marginal increase in land under crops, which may be reflecting a seasonal crop. Interestingly though, the increase is on the western side of the sanctuary and not on the side which has the outlets indicating other sources of irrigation.

In terms of infrastructure development, school, dharamsala and artificial ponds have been constructed in the village around the bird sanctuary. Many small-scale charcoal industries are present around the sanctuary which supports the local economy of villagers when low rainfall does not permit agriculture.

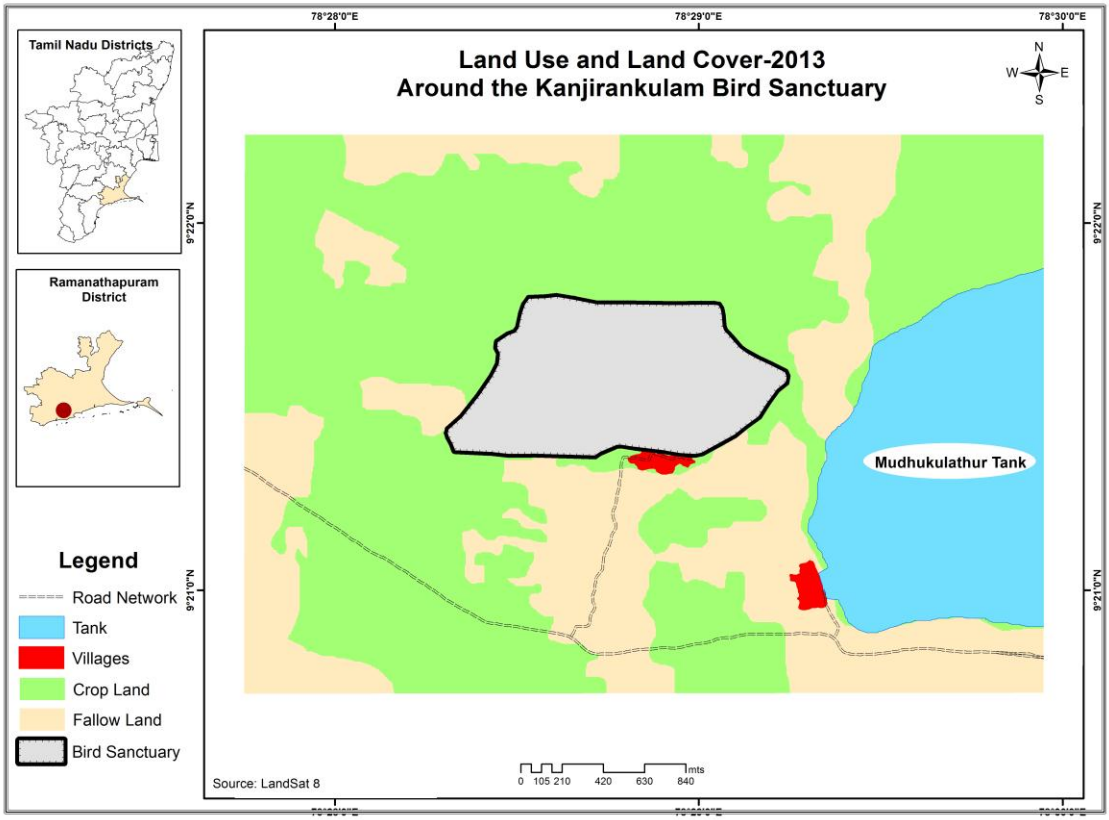
MAP : 7 CURRENT LAND USE AND LAND COVER INSIDE THE SANCTUARY



MAP : 8 LAND USE AND LAND COVER CHANGE IN 2001 AROUND THE SANCTUARY



MAP 9 : LAND USE AND LAND COVER CHANGE IN 2013 AROUND THE SANCTUARY



(d). Demographic details of the landscape :

Kanjirankulam wetland is located in the Mudukulathur block of Ramanathapuram district. Kanjirankulam is the only village located in the vicinity of the sanctuary and is under the jurisdiction of Peraiyur Panchayat. The total population of the village consists of 660 males and 640 females. There are 160 households in Kanjirankulam village and nearly half of the total households were observed to be below poverty line.

The landscape is mainly agrarian and the economy of the village is primarily dependent on agriculture. However, water stress and prolonged periods of drought has driven the villagers to pursue other sources of livelihood like working as porters (coolies). As a consequence a high rate of migration has also been observed in the surrounding areas in tune with the profile of the district. Livestock rearing such as goats, sheep, cow and poultry also supports the economy of the village. The village has an approximate number of 30 cattle, 40 goats/sheep and 100 poultry (information provided by the Keela Kanjirankulam farmers).

Few villagers are also engaged in manufacturing charcoal to supplement their income during the lean season of agriculture. And charcoal making by allowing the proliferation of an Invasive Species viz. *Prosopis* is one of the most contentious issues. The issue of contention is as follows: while *Prosopis* has been a life saver for local communities by providing fuel wood, fencing material etc, in the absence of alternatives or the degraded nature of the landscape, it has been highly detrimental to issues of reforestation and afforestation. Secondly, this is also an issue for which local specific interventions rather than generic programmes need to be developed and implemented.

The average annual income of the villagers was recorded to be quite low (Rs. 20, 000) which could also be one of the reasons forcing external migration. Despite the presence of a school in the village, literacy rate is quite low in the village (390 literates). One Public health centre, Village forest committee and Self Help Group are present in village however; no bank is located here.

(e). Infrastructure developments :

There is minimal developments has happened in the village. There is a metal Road which is the only approach to the village and the Sanctuary. Connectivity to nearest major town is 120 km i.e to Madurai, 45 km from Ramanathapuram and 6 km from Mudukulathur town. Nearest Railway station is Paramakudi 25 km. Small scale charcoal industries are present around the bird sanctuary, which supplement the income of the local villagers.

iii. Eco – Tourism Zone :

In the recent past due to prolonged periods of drought in the area, not many water birds have been visiting this sanctuary and hence tourism has been low. The tourists can visit the sanctuary without paying any fee and the sanctuary is open throughout the year. Tourism is high in the month of Dec-Jan and low in the month of May-Sep. The best time to visit the Sanctuary is December-January.

(a). Existing Facilities :

The sanctuary has a small interpretation facility in the form of outdoor network of boards, but no accommodation facilities. The infrastructure is very poor and at the best of times there is only a single daily bus trip from Mudukulathur to this village. It is not a part of eco-tourism programme. There is a watch tower at the sanctuary for observing birds. The interpretation facility has been developed under the Tamil Nadu Biodiversity and Greening Project. The Sanctuary does not have basic amenities to the visitors.

(b). Focus : Policies :

The focus on eco-tourism in Kanjirankulam Bird Sanctuary is largely to make it a regional learning centre and a place for educating students, rural youth and villagers. It is an endeavor to make it as regional attraction towards avian fauna conservation. A team of youth may be trained as eco-tourism guides to enable guided avian tourism to be in place and also to provide additional income to the locals. The major focus towards eco-tourism in Kanjirankulam would be to attract the school and college students to create awareness about avian fauna conservation and its importance. Since the sanctuary does not fall in any of the tourism network, it would be difficult to attract the visitors from far flung places.

3.9. Research Monitoring and Training :

3.9.1. Research :

The forest department sometimes engages with the academic institutions like colleges for carrying out research studies. The sanctuary offers wide opportunities for ornithologists in studying various aspects of birds' life. Efforts may be made to promote local research organizations, colleges and universities interested in undertaking habitat, floral or faunal studies in the sanctuary. Possible assistance by all means may be extended to such organizations.

Publications of significance for Kanjirakulam BS are as follows:

1. Abraham, S. (1973) The Kanjirankulam breeding bird sanctuasry in the Ramnad District of Tamil Nadu. J. Bombay Nat. Hist. Soc. 70: 549-552.
2. Johnson, J. M., Perennou, C. and A. Crivelli (1993) Towards the extinction of the Spot-billed Pelican (Pelecanus philippensis), 92-94. In: Wetland and Waterfowl Conservation in south and west Asia (Eds. M. Moser and J. Van Versem). IWRB Spec. Publ. No. 25: AWB Publ. No. 85.
3. BirdLife International (2014) Important Bird Areas factsheet: Chitrangudi and Kanjirankulam Bird Sanctuary. Downloaded from http://www.birdlife.org on 31/01/2014.
4. Kannan, V. and Manakadan, R. The status and distribution of Spot-billed Pelican *Pelecanus philippensis* in southern India. FORKTAIL 21 (2005): 9–14.
5. Bhushan, S. In press. Kanjirankulam tank, Ramanathapuram, Tamil Nadu. Case study in Pathak, N., Choudhary, S., and Bandekar, R. (eds). In Press. Community Conserved Areas in India: Analyses and Case Studies. Kalpavriksh, Pune/Delhi.

3.9.2 Monitoring :

There is no systematic methodology for monitoring being followed in the sanctuary. However regular monitoring on the arrival and diversity of birds is being done on daily basis by the in house Bird watchers engaged in the Sanctuary. Scientific and Systematic monitoring like, Habitat monitoring, monitoring for, pollution, water quality etc., except for disease is not carried out in the sanctuary. In any good season when the tank is inundated due to good rains, the water would be retained for not more than six months and rest of the year the sanctuary is dry.

3.9.3. Human Resource Development - Training :

Training to staff is being given every year regarding bird identification and population estimation. Besides training is given to field staff on importance of wetlands and its ecosystem. But as such there is no formalized protocol of training the field staff deputed to the sanctuaries. The field staff are not professional trained to manage the wetlands except for short term training programmes organized under the plan schemes.

3.10. Administrative setup :

The administrative control of Kanjirankulam Sanctuary is with the Wildlife Warden, Gulf of Mannar Marine National Park. Under the Wildlife warden's control,

Forest Range Officer, Ramanathapuram is having the field control. A forester and a forest guard have the immediate protection responsibility of the sanctuary. Four daily wages Bird watchers are also posted for field assistance and protection. At present there is no separate management team exclusively responsible for the sanctuary.

3.11. Communication :

The present antipoaching watchers employed may be equipped with walkie-talkie besides, a wireless housed in the watch shed, which can serve as a dedicated and secure communication means between the headquarters and the sanctuary. Such a wireless system can also be useful for field patrolling during the north east monsoon season. The details of wireless sets available in this sanctuary are given below. They are used by the field staff and office staff.

S.NO	Type of Wireless Set	Total No of Sets
1.	Base sets	11
2.	Mobile sets	9
3.	Walkie-talkie	32
Total		**52**

CHAPTER-IV

DEVELOPMENT PROGRAMS AND CONSERVATION ISSUES

4.1. SWOT Analysis :

4.1.1. Strengths :

- Watchers with thorough knowledge of terrain
- No human habitation within the sanctuary
- Limited disturbance within the core area
- Legal and Policy support
- Healthy support from dependent community, local self-governments, media and NGOs
- No tourism activity in the core
- Highly motivated community which is thriving through the hard days with their hope of better tomorrow.
- The rural enticement and serenity of the sanctuary.
- Excellent chances of sighting vibrant bird life in the sanctuary during Bird visiting season.
- Availability of many educated youth, who can be groomed as eco-guides.
- Consistent funding support from Government of India
- Excellent network of feeder channel

4.1.2. Weaknesses :

- Inadequate infrastructure
- Inadequacy of staff
- Exotic weeds invasion
- Delay in settlement of community rights
- Insufficient young field officials
- The sanctuary is in isolated place not falling within the tourist attraction zone
- Failure of monsoon leading to scarcity of water
- The Kanjirankulam tank or Kanmoi, which is also a sanctuary, has got the priority to meet the water requirements for agricultural purposes

- Ownership of the land is not with the forest department
- Exotic invasive weed species is grown in large scale in private patta lands as income source and therefore eradication is a great challenge
- Remoteness, poor communication facilities and lack if infrastructure for keeping families demoralize the staff

4.1.3. Opportunities :

- Social Fencing through Eco-development Committees
- Avenue for education and interpretation
- Avenue for scientific studies
- Support from stakeholders including media
- Community is oriented towards conservation of avian fauna
- Closeness to the Taluq headquarters i.e Mudukulathur
- Various line department having a stake in the Tank – Sanctuary

4.1.4. Threats :

- Potential threat of poaching
- Grazing
- Conflict among communities in adjacent villages claiming for rights in the tank/sanctuary
- Invasion by invasive alien species
- Increased interference in sanctuary management
- Poor knowledge of wild animal biology among sanctuary staff
- Consistent drought conditions
- Lack of clear boundary demarcation
- Lack of resident forest department staff
- Lack of communication network
- Chronic shortage of funds

4.1.5. Critical review and result of past intervention :

Majority of the interventions carried out within the sanctuary as well as some eco-development activities is with the assistance of funds from Govt. of India

under the Centrally Sponsored Scheme for 'Integrated Development of Wildlife Habitats'. There has always been shortage of funds to take up holistic management interventions. In the following paragraphs critical review and result of past intervention is dealt with,

Consistently the management authorities have been carrying out removal of invasive alien species from the sanctuary area, but the area of removal is meager and inadequate to create an impact in short run or in a long run. Removal needs to be carried out by way of uprootal otherwise the stump is going to coppice and occupy in due course. Also the sanctuary has lacked inundation under water for past few years so as to naturally control the prosopis which do not survive inundation.

Grazing could not be controlled as a result of which the spread of prosopis is consistently a problem. The sanctuary is getting invaded by prosopis under the influence of grazing.

Desilting has been an activity consistently being carried out in the sanctuary however due to lack of adequate rainfall so that excess water flows through the channel has rendered the works ineffective.

Tank deepening works have been carried out in the past by way of either deepening in the water holding area or by way of cutting ponds inside the tank. This activity has been effective for the fact that the water is retained for longer duration of time as dead water which avoids the sluice. This activity needs to be carried out regularly so that adequate quantity of water is stored in the tank as dead water which would the sluice and thereby draining out of the sanctuary. This activity has ensured that even during monsoon failure times there is some quantum of water for the visiting as well as resident birds.

Plenty of information boards have been erected in and around the sanctuary. Besides adequate publicity has also been made through these information boards. But it is critically felt upon review that over the years the new information boards are largely erected but the maintenance part is neglected. Therefore besides erecting new boards, the maintenance of older boards already erected has to be taken up.

As part of the habitat improvement programme babul trees have been planted within the sanctuary. It is observed that dense patches of trees planted have occupied in a larger blocks, instead the tree planting should in small patches of 100-200 trees. So that there is adequate spacing between two patches of tree blocks interspersed well with water spread area.

The facilities created so as to provide visitor amenities are very meager within the sanctuary. Except for construction of watch tower and an interpretation centre there exists no much facilities. There needs to be a holistic plan for visitor amenities creation, so that even if the funds are received in short, the amenities could be planned in accordance to the master plan.

With regard to the eco-development initiatives, the forest department has been carrying out largely entry point and other rapport building kind of activities. The Eco-development Committee has been formed but is defunct and needs to be formally made functional and also needs to be strengthened by way of getting it registered under Societies Act.

4.1.6. Challenges and way forward :

The sanctuary faces numerous challenges which need to be tackled for healthy existence of the bird sanctuary in perpetuity. Some of the challenges are discussed below:

a. Multiple control of the sanctuary poses a perpetual challenge towards sanctuary maintenance
b. Controlling grazing pressure with no other natural resources in around the villages
c. Water management – so as to maintain a minimum level of water during the winter migratory season
d. To develop the Kanjirankulam bird sanctuary as tourist and visitor destination
e. To solicit concerted support from the villagers towards avian fauna conservation
f. Revive the bird sanctuary to its previous glory of being acclaimed as best site for migratory birds nesting area.
g. To maintain the tempo of village people and local community towards avian fauna conservation.

CHAPTER - V

PROPOSED MANAGEMENT

5. The Vision, Objectives and problems :

5.1. Vision :

'Develop and maintain Kanjirankulam Bird Sanctuary as a well-managed wetland ecosystem harbouring avifaunal diversity within the wetland complexes of Tamil Nadu and acts as an important centre for conservation education and ecotourism with the active involvement of local communities and other stakeholders.'

5.2. Goal :

The goal towards management of Kanjirankulam Bird Sanctuary is to *"Maintain viable habitat for both the resident and migratory bird population to nest and breed with active participation of the local community and with minimal human interference"*

5.3. Objectives :

The objectives drafted with a long term perspective of creating a healthy and conducive environment for the visiting birds are as follows,

- To improve and ensure ideal wetland habitat for the avian fauna
- To ensure prolonged and requisite quantum of water availability in the tank to the extent possible
- To ensure better management inputs to the satellite wetlands around Kanjirankulam tank making an ideal continuum of habitat
- To evolve a systematic practice of scientific monitoring of population
- To create awareness and education towards conservation of avian fauna
- To ensure minimal disturbance and greater protection to the birds.
- To ensure better protection to the sanctuary by way of proper boundary consolidation and settlement of rights
- To promote Kanjirankulam Bird Sanctuary as a centre for conservation education, research and ecotourism
- To manage Kanjirankulam Bird Sanctuary with active participation of local villagers and ensure alternate livelihood benefits through management.

5.4. Problems in achieving the objectives :

The problems in achieving the above mentioned objectives are listed below,

a) The most important problem faced by this sanctuary is the prevailing drought conditions owing to reduced rainfall in the region as well as in the catchments of Vaigai reservoir from where water has to flow in through Gundar to the sanctuary.

b) Multiple control of the tank that houses the sanctuary by various departments poses critical challenges to effective management.

c) The inlet channel walls are weak and are prone to be wrecked during rainy season by agriculturists on the banks of the channel thereby not letting the entire water flow into the tank.

d) Natural regeneration is hampered to a great extent by lack of water, soil moisture and grazing.

e) Lack of accessible sources of water also reduces the viability of carrying out artificial regeneration activities.

f) Prosopis weeds are haunting the sanctuary in a considerable manner thereby reducing the water holding capacity of the tank and also soil quality of the area.

g) Siltation in the inlet channels and tank bed is another reason for reduced water holding.

h) Lack of systematic monitoring and apprehension among the villagers about the sanctuary as a protected area veil any incidents of poaching.

i) The ambiguity in the boundary description of sanctuary given in the GO poses difficulties for tracing it on the field.

j) Summer months worsens water scarcity forcing villagers to encroach into the sanctuary to defecate, thereby reducing the plausibility of the place for tourists. Possibilities of human induced pathogens being transmitted to the birds are high, increasing risk of detrimental effects on the avian health.

k) To encourage eco-tourism in the sanctuary, sufficient accommodation facilities are not available. Maintenance of the existing facilities also suffers due to lack of adequate funds. Non-availability guides and an additional vehicle make conducting guided tourism impossible.

l) Though several research programmes have been carried out in the past, documentation and compilation of the results are lacking. Since these projects originate in the respective research institutions without consulting the sanctuary authorities, most of them do not have practical utility for the sanctuary management. Lack of coordination between the forest department and the research institutions leads to research programmes that are impractical and the sanctuary is seen treated as just another study site for the researchers.

m) Lack of basic training in wildlife management, remoteness of the place of posting and insufficiency of basic amenities and infrastructure, proper orientation and motivation are some of the factors responsible for low output of the staff.

n) Due to chronic shortage of funds, sanctuary's protective infrastructure is poor. Creation of essential accommodation facilities suffers due to the same reason.

CHAPTER - VI

FUTURE STRATEGIES

6.1. Strategies :

The Kanjirankulam Bird Sanctuary is a PWD tank falling within the highly well inter-connected and mutually dependent water systems in the Ramanathapuram district. Ramanathapuram being a water scarce region because of the scanty rainfall, managing the wetland in such a water stressed landscape is a greater challenge. The Kanjirankulam Bird Sanctuary in the past has been playing a vital role in attracting the winter migratory birds for meeting their requirements of nesting, breeding and roosting apart from being a source of food. Therefore the broader strategies in managing the wetland would be

i. Creating an environment to attract the migratory birds by way of ensuring the availability of water
ii. Retaining water for prolonged period of the migratory season
iii. Improving the habitats for birds so as to ensure conducive environment for their breeding
iv. To derive community participation in conservation and management of the bird sanctuary
v. To create awareness and educate the importance of conservation of avian fauna to the people of the region
vi. To scientifically manage the sanctuary through scientific research and monitoring

6.1.1. Boundaries :

6.1.1.1. Legal Boundaries :

The boundaries of Kanjirankulam Birds Sanctuary, though very clearly defined in the boundary description, have not been demarcated properly on the ground hence leading to confusion. The contradiction yet to be rectified prevails about the Western Boundary of the Sanctuary along the earthen bund. Knowledgeable villagers and locals claim that there is Patta assigned in the Mela-Kanjirankulam Tank,

6.1.1.2. Ecological Boundary :

Man made boundaries are of least concern for the birds as they fly across nations and oceans to reach the sanctuary that has been declared so to conserve

the natural breeding and feeding place for winter migratory birds from far and wide. These traditional nesting grounds, even though is the home for a considerable number of these much delightful feathered visitors, not all of them are restricted to the sanctuary or its immediate surroundings for food and nesting materials. One reason for being so is the yearly diminishing water-level and the limited availability of food and nesting material to cater to a large number of birds. The resultant search of food and materials lead to the natural stretch of the legal boundaries of the sanctuary, forcing to define an ecological boundary. Adjoining village tanks and ponds, locally known as 'Kanmois' and 'Ooranis', they are provide an ecologically continuous ecosystem for the healthy survival of the birds. A study carried out around the sanctuary within a radius of two kms from the sanctuary as part of the management plan preparation for potential feeding grounds and areas that offer nesting materials provided the following list of village tanks and ponds **[*Annexure II (a) & (b)*]**, which could be considered as an ecological continuation of the Kanjirankulam Birds Sanctuary (***Map 3***). There are nine Kanmois found in the ecological boundary of which Mudukulathur kanmoi is the only perennial kanmoi found in the region. Wide spread nesting was reported in Veppankulam kanmoi in the year 2003. Field observation revealed that, the numerous nests and egg shells in ecological boundaries areas. The kanmoi is vegetated only with Prosopis and birds' nests are seen as low as one meter from the ground. Nesting was seen in very little numbers in other smaller kanmois' as well.

A radius of 2 km is identified as humdrum distance from the sanctuary for identifying and locating other kanmois and ooranis that would perhaps serve as source of food and nesting materials for the visiting birds. This may be considered as the immediate ecological boundary for all practical purposes. Refer ***Annexure II a & b*** and ***Map 3***. The kanmois and ooranis within this region may be considered as one ecological continuum of Kanjirankulam Bird Sanctuary.

It is to be noted that, The Ecological boundary will not have any legal sanctity. It is only a managemental entity and classification to take up management interventions. There would be no restriction or regulation what so ever over the existing rights, activities and ongoing practices. The 2 Km boundary around the sanctuary is an imaginary boundary, which also nearly encircles the proposed eco-sensitive zone.

Measures may be devised to ensure protection and availability of food for birds that visit these kanmois and ooranis. Few suggestions are:

i. Educative lectures and camps for local population may be organized on the importance of visiting avian fauna.

ii. Display boards indicating possible visiting birds and the importance of them may be installed at each of these kanmois and ooranis.

iii. Awareness materials such as stickers, posters, pamphlets, handouts, guide booklets may be supplied to these villages too.

iv. A core team of youngsters may be organized as bird protection force to ensure local protection.

v. A team of youth may be trained as eco-tourism guides, to enable guided Avian tourism, which would also provide additional income to the locals.

vi. Incentives and awards may be declared to individuals providing crucial information on poaching, committed protection, and those who are doing commendable deeds in order to enhance bird habitat and bird diversity.

vii. Regular protection patrolling organized by the department may cover these villages and surrounding kanmois too.

6.1.2. Zonation :

For effective management of the sanctuary, the area has been divided into three major zones viz., core zone, buffer zone and tourism zone. The existing zones are revised based on logical ease of management. The new zonation which is illustrated in ***Map 7***.

Core Zone :

The entire sanctuary except the embankment or the tank bund will be the core zone. The deep water spread areas and the tank foreshore areas which form the feeding, roosting and nesting ground for the birds may be classified under the core zone. This zone would be the rigorous manipulation zone for the purpose of habitat improvement. Refer ***Map 7***.

Objective of management :

The objective of management of the core zone is to preserve it as undisturbed natural habitat by ensuring total protection and providing better environment for the avian visitors of the area.

Activities prescribed in the Core Zone:

1. Total protection against all forms of biotic interferences may be ensured.

2. Only scientific studies and research activities with proper sanction without destructive sampling techniques may be permitted.
3. The core zone will be free from forestry operations other than Habitat improvement works. Similarly, grazing, fuel wood collection and NWFP collection are prohibited.
4. Only regular habitat Improvement/protection works like maintenance and digging of water holes, soil and moisture conservation works, creation of mound and islets, total uprooted of prosopis plants and planting of Acacia saplings, apart from monitoring activities may be permitted.

Buffer Zone :

The tank bund or the embankment and area surrounding 2.0 km buffer area around the sanctuary boundary will be considered buffer zone. It will include the village and parts of adjoining kanmois. Refer ***Map 10***. This zone is categorized in such a manner that it is in synchronous and encircles the Eco-sensitive zone proposal submitted for approval for the Bird Sanctuary. Besides, the buffer zone except for area falling in the Bird Sanctuary notification does not have any legal sanctity and is classified for managemental intervention and planning. Therefore, all the existing right, claims, activities and practices would continue without any hindrance

Objectives of Management :

Buffer zone will be managed for improving the habitat with rigid protection so that they support better floral and faunal diversity. The area is brought under the management so as to ensure a holistic habitat for the migratory birds enabling a conducive environment around the sanctuary.

Activities prescribed in Buffer Zone :

1. Fuel wood requirements of local population will be met from this zone at present but efforts may be made to gradually wean them away from such dependency from the core zone.
2. Portions of this zone will be opened for tourism, like the areas on the bunds and embankments.
3. Inlet channel connecting the seasonal river 'Gundar' to the sanctuary will be given a suitable gradient either by desilting or by deepening at selected places.
4. Inlet channel will be monitored to prevent possible draining of water by agriculturists to the fields on either side of the channel.

5. A plan and methodology to desilt the tank will be devised so as to increase open surface of water and to reduce too much variation in depth.
6. Grasses will be planted on slopes of bunds facing towards tank. Local varieties such as *Cynodon dactylon* and *Eremopogan fevealatus* may be preferred.
7. Educative lectures to conduct camps for local population will be organized on the importance of visiting avian fauna.
8. Display boards indicating possible visiting birds and the importance of them will be installed at each of these kanmois and ooranis.
9. Awareness materials such as stickers, posters, pamphlets, handouts and guide booklets will be supplied to these villages too.
10. A core team of youngsters will be organized as bird protection force to ensure local protection.
11. A team of youth will be trained as eco-tourism guides, to enable guided avian tourism, which would also provide additional income to the locals.
12. Incentives and awards will be declared to individuals providing crucial information on poaching, committed protection, and those who are doing commendable deeds in order to enhance bird habitat and bird diversity.
13. Regular protection patrolling organized by the department will cover these villages and surrounding kanmois too.

Tourism Zone :

This zone consists of the main water holding region (upto 100 mts from the embankment), bunds, inlet channel, roads and the mud track that is used as short cut between the village and Mudukulathur town. The zone is overlapping with the buffer zone. The tourism zone is a managemental classification, which would have no implication on the existing right, claims, activities and practices in the buffer zone.

Objectives of Management :

This zone may be managed to provide educative experience regarding nature and wildlife conservation to the discerning tourists.

Activities prescribed in the Tourism Zone :

1. Restricted and Regulated Movement of tourists without jeopardizing the conservation concern of the sanctuary may be permitted.

2. Concrete / wooden benches may be provided to visitors to sit and watch the birds from various locations on the bund.
3. Bund management may be carried out after arriving at consensus with PWD officials.
4. Bunds, adjoining available open land and buffers of the main road may be planted with *Syzygium cumini, Ficus species, Mangifera indica, Thespeia populnea, Azadirachta indica* and *Dendrolalamus strictus etc.*
5. One new watch tower in the tank boundary of the sanctuary to facilitate Wild Life photographers.
6. Habit of using toilet for day to day ablutions may be promoted through awareness programmes jointly organized with health department. The non-hygienic habit of using sanctuary grounds as defecation grounds may slowly be weaned away.

6.2. Harmonization :

Though the tank has been declared as Bird Sanctuary but the control over the water management still remains with the PWD. Water as a resource is the major force of attraction for the birds to flock to the sanctuary.

6.3. Management of admitted rights :

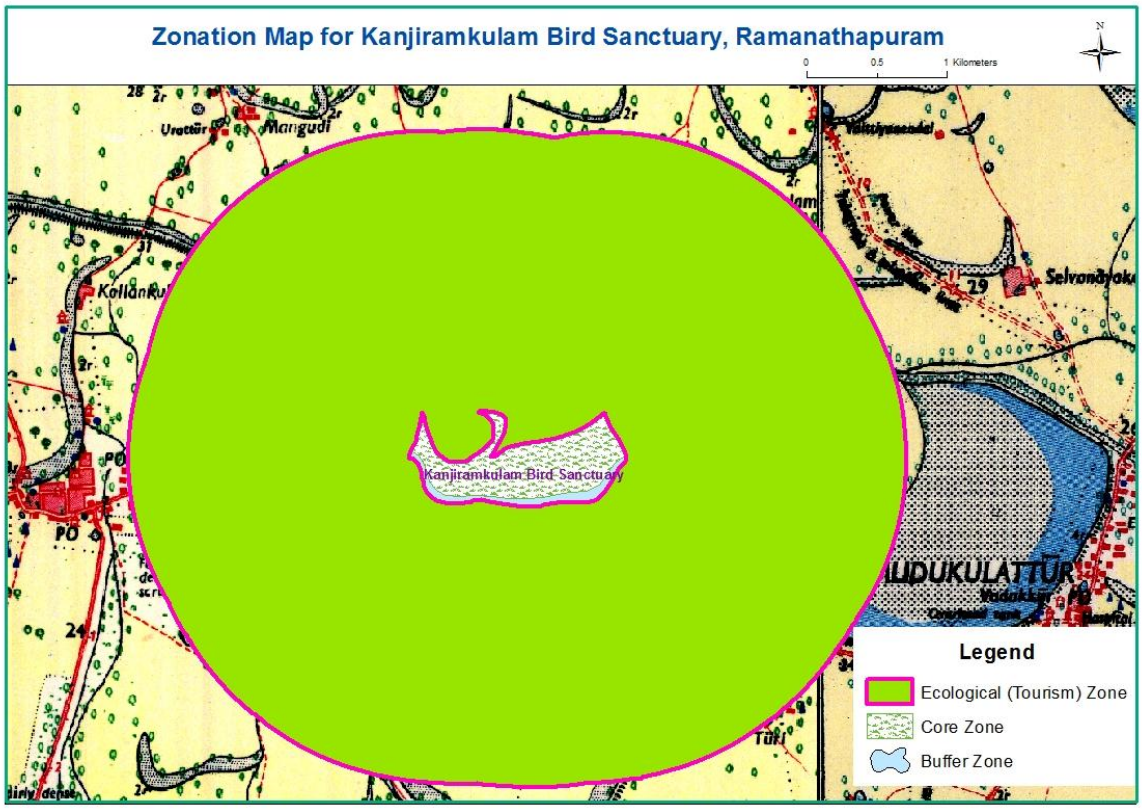
There are no rights as of now admissible within the sanctuary. Only the downstream farmers are benefitted with the irrigation from the tank. The sanctuary has already been declared under section 18(1) of the Wildlife Protection Act 1972, The Sanctuary has been notified prior to the 1991 amendment of the Wildlife Protection Act 1972. However as per the provisions of section 19 to 25, the District Collector, Ramanathapuram has to pass orders on the rights and claims permitted over the Bird Sanctuary. Therefore attempt will be made to obtain the admitted rights under the said sections during the current plan period.

There has been a controversy with regard to the boundary and notification of the Bird Sanctuary. Villagers from Pulvaikulam Village claim that there is a Patta assigned to an extent of 7 Ha in the western portion of the Melakanjirankulam Tank. It is claimed that the patta were given during 1984 to about 21 claimants. Besides in the mentioned area there exists a temple which is worshiped by the Pulvaikulam village people. Therefore the genuinity of the claims have to be verified with the revenue records and accordingly the boundaries have to be reworked in consultation with the PWD and Revenue department.

6.4. Human disturbances causes, its effects and management :

Villagers generally engage in collection of firewood and fibre in areas in and around the sanctuary which have profuse growth of *Prosopis juliflora* and *Acacia nilotica*. During the dry seasons villages graze their cattle in and around the sanctuary. Management of the issue is discussed in the subsequent chapters.

MAP NO. – 10 : MAP SHOWING CORE, BUFFER & TOURISM ZONES OF KANJIRANKULAM BIRD SANCTUARY



CHAPTER-VII

PROTECTION PLAN

Kanjirankulam bird sanctuary is surrounded by only one village on the southern side of the tank. The villagers depend on the tank mainly for irrigation purpose for the agriculture fields. Besides they also rely for small scale needs of firewood and grazing on the sanctuary. The sanctuary as such does not has any protection wall or fencing to ensure strict protection. Following is the protection plan devised for enhancing protection to the sanctuary.

7.1. Protection strategies and action plan :

7.1.1 Boundary Demarcation :

The declared area as sanctuary is 104.21 Ha. The area needs to be demarcated as there is no demarcation done on ground. There is always a threat of certain activities happening along or on the bund of tank, which could be tackled only with demarcation. Besides the tank is surrounded by patta lands where there is no delineation of boundaries. This activity would ensure total protection to the land area of the sanctuary.

7.1.2. Sanctuary Headquarters – Range Office and Staff Requirements :

One of the major reasons for lack of effective patrolling and monitoring of the region is its distance from the headquarters. Kanjirankulam is under the control of Range Officer, Ramnad, whose office is at Ramanathapuram town, around 60 km away from the sanctuary. A dedicated Forest Guard may be deputed for the protection of the Sanctuary. Already there exists Forest Guard quarters in nearby Chitrangudi village. Apart from it presently there are four bird protection watchers (Anti-poaching Watchers) being engaged using the funds of Government of India under the Centrally Sponsored Scheme. The watchers may continue to remain to assist the Forest Guard in protection to the bird sanctuary as well as the peripheral habitat of the birds.

The present set up of control of the Sanctuary with Range Officer, Ramanathapuram may have to be done away with and the Bird Sanctuary should be brought under the administrative control of Range Officer, Paramakudi under the direct supervision of District Forest Officer, Ramanathapuram.

7.1.3. Local Protection Force :

Villagers of Kanjirankulam are traditionally famous for protection that they extent to the birds. A core team of youngsters may be organized as protection force

by the EDC to ensure total protection to birds during the breeding season. During peak season the team has to undertake patrolling visits to various surrounding villages, kanmois and ooranis and ensure that offensive activities are not carried out in these villages. The force may hand over an offender to the coordinating forest staff in case of encountering such people. Legal action may be carried forward by the department and representatives of the protection force can be witnesses in court.

7.1.4. Anti-poaching Watch towers and Sheds :

There is only one watch tower presently available for bird monitoring & visitors in Southern region of the tank. There is necessity for construction of one more watch tower towards the northern side. The watch tower may be equipped with spotting scopes and binoculars.

7.1.5. Nature trails :

The sanctuary has a number of walk tracks laid mostly by the villagers for collection of fire wood. A few may be maintained as Nature trails interspersing the sanctuary. If maintained regularly, this network will suffice for effective patrolling and monitoring of the sanctuary. Maintenance of trek paths includes operations such as (i) clearing weeds to a width of 1.5 m and (ii) scrapping and such necessary earth work. These works may be carried out during March to May.

7.1.6. Fencing :

Complete fencing all along the boundary of the sanctuary will be explored and carried out during the current plan period so as to maintain the sanctity of the area and also to enable better monitoring of the area and to regularize activities as per plan.

7.1.7. Intelligence Gathering :

For local informers in sensitive matters, to gather intelligence pay rewards to the informers may be considered. Sufficient funds may be kept at the disposal of the Wildlife Warden, GOMMNP, Ramanathapuram.

7.1.8. Promotion Materials :

Pamphlets and wall posters showing the importance of the birds in our daily life have to be printed and depicted in all villages around the sanctuary. Warning posters depicting the Wildlife Act (1972) regarding the punishment for harming birds have to be pasted in all these villages.

7.1.9. Patrolling of Peripheral habitats :

An ecological boundary of 2 kms notionally has been devised to be followed in the management plan. Hence the habitats falling within the 2 km may be listed like the tanks, ooranis, marsh lands etc., These areas may be allocated among the existing anti-poaching watcher or the bird watchers for ensuring protection to the migratory birds which flock to these peripheral habitats. Routine perambulation of these areas is necessary to enforce wildlife protection act.

7.1.10 Advisory Committee :

The Advisory committee as envisaged under section 33 B of the Wildlife (Protection) Act, 1972 shall be constituted for a holistic management of the Birds Sanctuary and to ensure people's participation in Biodiversity Conservation.

CHAPTER-VIII

MANAGEMENT INTERVENTIONS

8.1. Conservation and Restoration of degraded habitat :

The sanctuary is being infested by prosopis species in an increasing manner year after year. Prosopis retards growth of other plants as the beans of this plant are acidic and as they shed it to the soil, the soil acidity also tends to increase thereby exceeding optimal levels of soil acidity for plant growth. Alongside implementing the exotic removal plan the Afforestation plan may be implemented to increase the number of nesting trees in the sanctuary and its boundaries. Mature *Acacia nilotica* trees of the sanctuary are more or less of the same age and size. This demands planting of tree saplings to create a vegetative strata in the sanctuary.

The preferred planting method is as follows: Saplings may initially be planted in the Core Zone in the monsoon season, where clearances are made as a result of weeding. Every sapling must be planted at least 10 meters from the nearest tree. Sapling may be planted to the slope niche of the square grid. Planting pits need to be 45 cm^3 and may be back-filled with good soil collected elsewhere from the sanctuary. The final soil level in the planting pit should be 5-10 cm below the surrounding level. The soil around the planted seedling may be mulched with a layer of leaves, hay, straw etc to reduce evaporation. The 10 meter grid area around each sapling may be sloped towards the planted pit, in order to increase rainwater harvesting *Hocking (1993)*. Every sapling may be surrounded by the belly pots planted in the same manner recommended for the soil moisture conservation. Refer ***Sketch 1*** for an illustration.

The saplings demand watering, weeding and protection. For the first three months of planting the rain will provide sufficient water for the plants to establish, following which efforts may be taken up to inspect each of the pot in alternate weeks and fill them to the neck with fresh or kitchen waste water collected from the village. The 10 meter grid has to be kept free of weeds and this may to be coupled with the water refilling visits. Every sapling may have a thorny fence of 2 meter height inorder to prevent animals from maiming the saplings.

The most critical intervention that is needed is to create a diversity of habitats within the wetland once there is an assured supply and retention of water. Other interventions would involve the development islands and perches within the wetland. In addition to the above listed actions, the following interventions can help in restoring the bird sanctuary as a critical water bird habitat,

- Replacing dead Acacia nilotica trees with saplings
- Thinning and pruning of overgrown trees
- Maintaining mature trees around the wetland to provide habitat for birds and small animals. A number of water birds utilize tree hollows or forks for nests.
- Providing for a range of water depths. Link shallow mudflats to an island rather than the shore to provide secure habitat for waders.
- Stacking water-washed rocks underwater to provide habitat for small animals and fish that provide food for birds.
- Leaving some logs and rocks protruding from the water for water birds to roost on.
- Placing branches and large logs around the edge of the wetland at varying heights, to provide roosting and nesting sites.
- Using natural edges with slopes rather than steep banks. The provision of vegetated banks and some bare areas will provide birds with access in and out of the wetland and will allow them to see predators.
- Eradicating aquatic weeds as they can spread rapidly in and around wetlands and have the potential to degrade water bird habitat and reduce food resources.
- Fencing can be used to limit access to livestock, and thus reduce bank erosion and disturbance to fringing vegetation. This will also allow natural regeneration in disturbed areas.
- Emergent plants like Typha, Arundodonax, Ipomea aquatic, Hygrophila auriculata, Polygonum glabrum, Oryza rufipogon, Saccharum sp, etc., can be introduced on the edges of shore area
- Gentle slopy slopes should be provided at the shores to facilitate growth of aquatic vegetation to promote the use of this area by shore birds like stilts, shanks, sandpiper, etc.
- Dead trees are to be retained as snags and should not be removed

SKETCH 1 : PROPOSED PLANTING METHOD

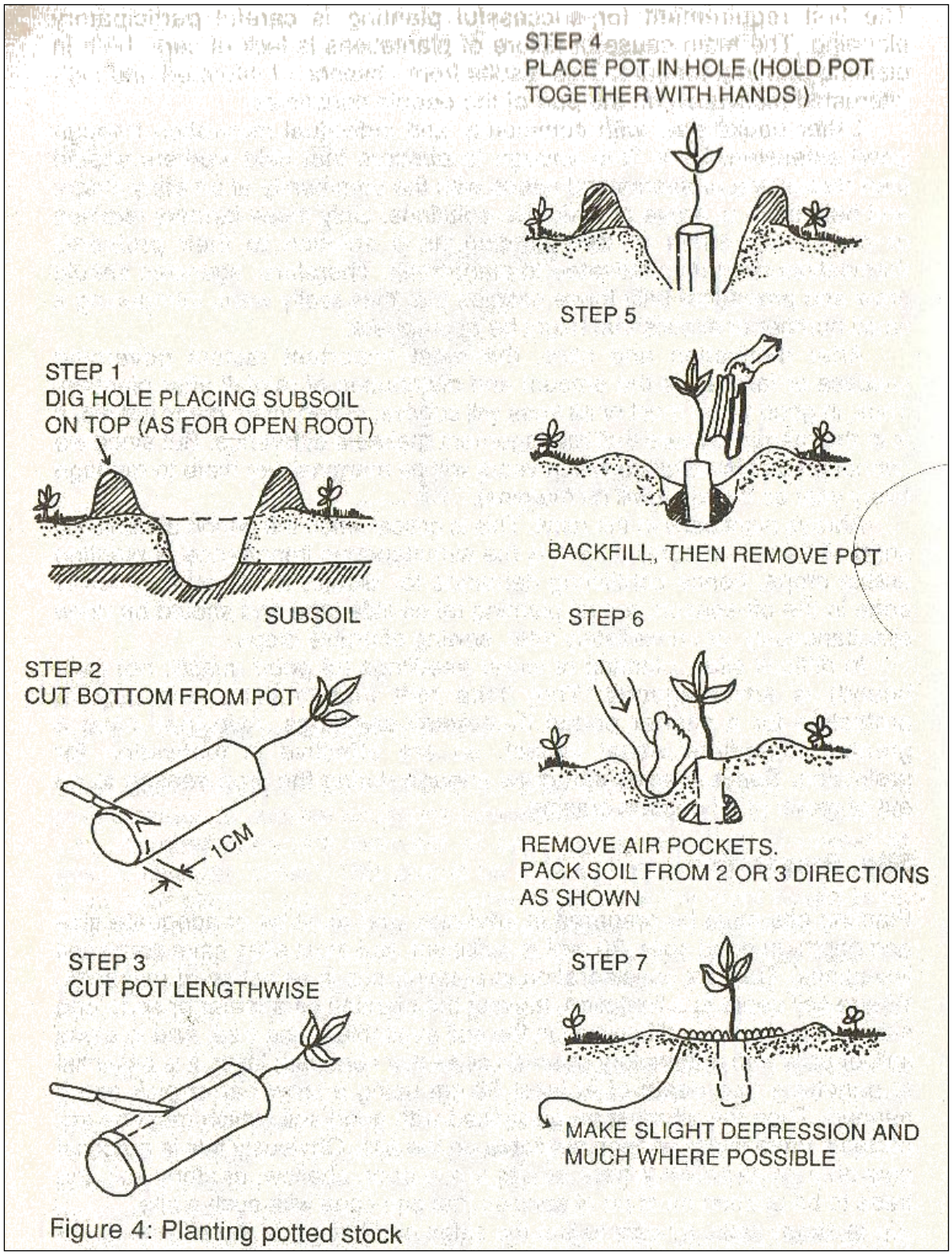


Figure 4: Planting potted stock

8.2. Landscape Management for Habitats :

Wetlands are of one of the most productive ecosystems, and thereby support a diverse range of organisms. Of the many organisms that wetlands harbour, birds are the most significant, and often serve as indicators of the wetland's health. There should be greater emphasis on protecting, restoring and conserving habitat diversity of wetlands in order:

(i) To facilitate an increase in the overall species diversity of the wetland, across life forms

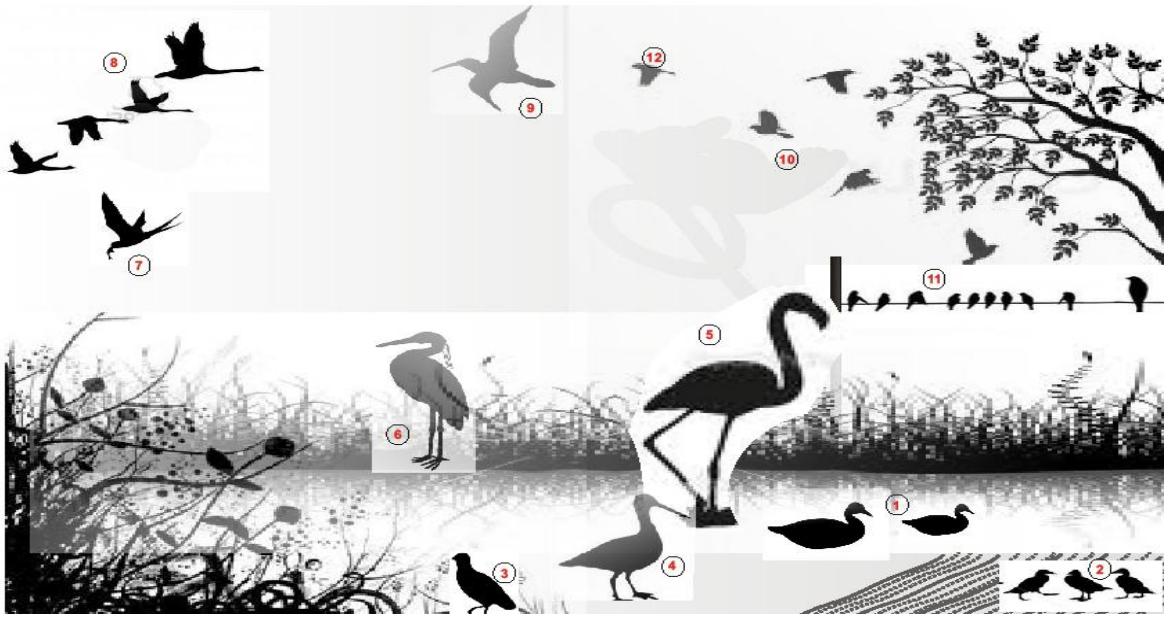
(ii) To ensure that the ecological processes are set in place and functional and

(iii) To support the nesting, breeding and feeding habits and preferences of birds and other faunal groups.

Bird communities need to be understood more holistically. Ecologically, birds are classified as land birds and water birds. Land birds are of three broad types: those that feed and nest above ground (example sunbirds), birds that feed on ground but nest above ground (example pigeons) and birds that feed and nest on ground (example larks). Then there are land birds like swallows, finches, drongos and wagtails that are often found in wetlands. Water birds are generally categorized as swimming (ducks, pelicans), diving (cormorants, grebes) shorebirds (wading birds), storks and herons and lilly-trotters (jacanas). Each bird has a different food and micro-habitat choice. It is only when these differences are appreciated that we can manage wetland bird sanctuaries efficiently such that the overall species richness of the bird community in focus is not compromised. Water birds have specific adaptations which enable them to exploit particular niches within a wetland and limit direct competition with others. For example, certain water birds feed on shallow flooded areas and mudflats, while others graze upon submerged and floating plants or dive to catch aquatic invertebrates in deeper water. It is hence important to create conducive features within the wetland to support the diversity. Following is a list of different habitat types utilized by water bird species:

(i) Islands
(ii) Deep open waters
(iii) Shallow waters
(iv) Mudflats
(v) Emergent sedges, reeds and grassy banks
(vi) Flooded live and dead timber

- **Islands** are used as breeding sites for a number of species that nest on the ground. Waders and terns also commonly use these areas as roosts for 'loafing'.
- **Mudflats** and shallow water are rich feeding areas for a range of migratory waders such as the Stint, Curlew Sandpiper, etc. which probe the water and flats for tiny animals. Larger water birds with long legs and bills such as the egret, pelican, spoonbill, avocet, stilt, heron, curlew and the oystercatcher can be found in the shallows probing, spearing, sieving and scooping for food.
- **Emergent sedges, rushes and grassy bank** areas attract many wading birds. Vegetation of this type provides cover for water birds and nesting sites. Crakes, rails and various song birds are attracted to the rushes in freshwater swamps near estuaries. Ducks, swans, moorhens and coots use open water for loafing and feed in emergent vegetation and grassy bank areas. Ibis, herons and swamp-hens are also attracted to fringing vegetation as feeding areas.
- **Deep open water** attracts diving waterbirds such as swans, coots, cormorants, grebes and some ducks which dive for bottom-dwelling animals or aquatic vegetation. Other waterbirds such as terns feed on fish close to the surface.



Schematic diagram

Typical Community of Wetland Birds

1. Swimming birds like ducks feed on insects, crabs, fish and plants
2. Swimming birds need rocks or mudflats to rest
3. Land birds like Quails and Francolins use grass along the banks

4. Wading birds need shallow water and mudflats
5. Flamingo is a filter feeder – it feeds on small invertebrates and seeds
6. Storks and Herons, feed in shallow water or along edges. They eat small aquatic animals
7. Flying birds like swallows feed on insects
8. Some birds may just been seen flying over the wetland
9. Waders like Snipes tend to hide, best seen while flying
10. Land birds like Weavers, Finches and Buntings use wetlands
11. Starlings, Mynas, Drongos perch around wetlands
12. Bee-eaters are insect eaters that use wetlands

Kanjirankulam Bird Sanctuary has a habitat that has been described as a water body having trees within and around the boundary, which is one of the least preferred habitat types for a heronry. The most critical intervention that is needed is to create a diversity of habitats within the wetland once there is an assured supply and retention of water. The most pressing issue is the removal of the standing trees including some of the Acacia plantations to create 'tree islands' that can function as perches.

Deep water habitats can be created if a deep trough can be created on the north-east portion of the wetland. Yet another intervention that is proposed could be the development and installation of floating islands and man-made perches within the wetland which would effectively insure against hydrological limitations.

Planting Date palms and other Palms along the bund will provide shade during the different times of the day and reduce surface evaporation. The planting of palms will also add to the habitat quality by providing nesting sites for birds especially the Baya or weaverbird. The hanging nests of these birds add to the aesthetics of the wetland.

The dead tree-trunks should be retained as they are ideal perches for birds like herons, cormorants, darters and pelicans. Some hole-nesting birds like the Indian Roller may also breed in these trunks. If some of the trunks are sturdy, they may be used to erect nesting platforms that may attract more water birds to build nests. Submerged water plants including *Ottelia alsimoides* may be introduced in the moat as these are food for coots, moorhen and other plant-eating water birds. Lotus is not suited as it rapidly desiccates shallow water and leads to siltation.

Structural interventions to include the following: Ensuring that the shape of mounds is circular, to avoid water resistance. The composition of mounds to only of sand and be devoid of gravel. Local sand composition would provide a substratum for root systems of vegetation. Deepening of one third of the sanctuary ground level by one and half foot to create habitats for coots and ducks is yet another suggested intervention.

Bunds can also be planted (enriched) with *Saccharum spontaneum* (naanal) and Vettiver grasses. Enhanced storage of water will improve the vegetation succession. Care should be taken only in preventing invasive plants like the water hyacinth from entering the water body. As water is the primary limiting factor, planting broadleaved species like *Colocasia* spp, Lotus, etc should be avoided. *Pongamia pinnata* can be planted on the bunds. *Ficus religiosa* will also be an ideal tree on the small islands.

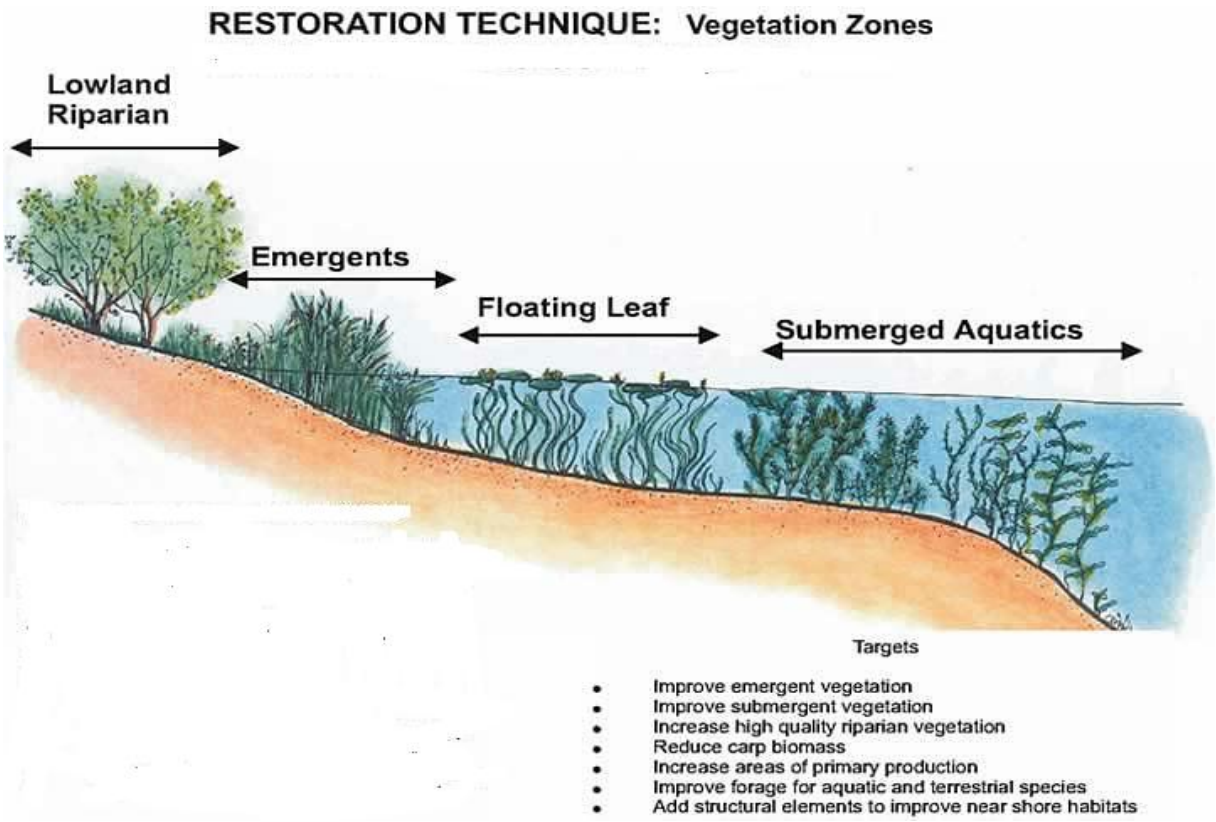
The following table depicts the aquatic plants that can be planted in Kanjirankulam BS.

Table : Aquatic plants suitable for Kanjirankulam Bird Sanctuary

S. No	Family	Species	Tamil Name
1	Acanthaceae	***Hygrophila schulli*** (Hamilt.) M.R.Almeida	Neermulli
2	Apiaceae	***Centella asiatica*** (L.) Urban	Vallarai
3	Aponogetonaceae	***Aponogeton natans*** (L.) Engler	Kottikkizhangu
4	Commelinaceae	***Commelina benghalensis*** L.	Kanaangozhai
5	Cyperaceae	***Cyperus difformis*** L.	Korai Pull
6	Cyperaceae	***Cyperus distans*** L.	Korai Pull
7	Cyperaceae	***Fimbristylis dichotoma*** (L.) Vahl	Korai Pull
8	Cyperaceae	***Fimbristylis tetragona*** R. Br.	Korai Pull
9	Cyperaceae	***Kyllingia nemoralis*** Dandy	Korai Pull
10	Cyperaceae	***Schoenoplectus littoralis*** (Schrad.) Palla	Thakkai
11	Fabaceae	***Aeschynomene aspera*** L.	Attrunetti
12	Hydrocharitaceae	***Hydrilla verticillata*** (L. f.) Royle	
13	Hydrocharitaceae	***Nechamandra alternifolia*** (Roxb.) Thw.	

14	Lythraceae	***Ammania baccifera*** L.	Kallurvi
15	Marsileaceae	***Marsilea quadrifolia*** L.	Aarakeerai
16	Oxalidaceae	***Biophytum sensitivum*** (L.) DC.	
17	Nymphaeaceae	***Nymphaea pubescens*** Willd.	Alli, Vellambal
18	Nymphaeaceae	***Nymphaea rubra*** Roxb. ex Salisb.	Sivappu Alli, Sevvambal
19	Oxalidaceae	***Oxalis corniculata*** L.	Puliyarai
20	Onagraceae	***Ludwigia perennis*** L.	
21	Poaceae	***Eragrostis japonica*** (Thunb.) Trin.	
22	Poaceae	***Saccharum spontaneum*** L.	Naanal, Dharbai
23	Poaceae	***Vetiveria zizanioides*** (L.) Nash	Vettiver, Virkel, Vizhal
24	Polygonaceae	***Polygonum glabrum*** Willd.	Aattralari
25	Verbenaceae	***Phyla nodiflora*** (L.) Greene	Poduthalai

The following figure depicts the restoration technique to be followed and the desired goals for revegetating the wetland and its immediate environs.



In addition to the above listed actions, the following interventions can help in restoring the KBS as a critical waterbird habitat.

- ✓ Stacking water-washed rocks underwater to provide habitat for small animals and fish that provide food for birds, notably the two flagship species of the BS.
- ✓ Leaving some logs and rocks protruding from the water for waterbirds to roost on.
- ✓ Placing branches and large logs around the edge of the wetland at varying heights, to provide roosting and nesting sites.
- ✓ Providing for a range of water depths. Link shallow mudflats to an island rather than the shore to provide secure habitat for waders.
- ✓ Using natural edges with slopes rather than steep banks. The provision of vegetated banks and some bare areas will provide birds with access in and out of the wetland and will allow them to see predators.
- ✓ Eradicating aquatic weeds as they can spread rapidly in and around wetlands and have the potential to degrade waterbird habitat and reduce food resources.
- ✓ Fencing can be used to limit access to livestock, and thus reduce bank erosion and disturbance to fringing vegetation. This will also allow natural regeneration in disturbed areas.
- ✓ Maintaining mature trees around the wetland to provide habitat for birds and small animals. A number of waterbirds utilise tree hollows or forks for nests.

The Southern and South-Eastern portion of the sanctuary is the deepest part of the tank. Maintaining the depth of this region is crucial to provide an optimal condition for sustenance of colonial birds such as stints, sandpipers, plovers, shanks and lapwings and heronry species such as egrets, storks and ibises which prefers water depths varying from 10 cm to 10 ft. This area may be leveled and depth may be maintained through locals through EDC by way of desilting during summer when it is dried up. This may be carried out by using bulldozers. But care must be taken to have a natural 'draw down' system. There may be a systematic plan of desilting instead of maintaining a standard depth, a gradient of depths be maintained along the deeper regions of the tank i.e along the tank embankment in the south of the sanctuary which is the water holding area of the tank. It is witnessed that there is clear water spread area of upto 100 – 150 mts from the bund devoid of any trees planted or interspersed and is also the deep water area. This region during summer needs to maintained by way of desilting. But the desilting may be done in such a manner that there is gradient of varying depths as it moves away from the bund/embankment. Therefore deepening may be made as follows,

i. Initial 30-40 m – deepening upto a depth of 1.5 m

ii. Next 30-40 m – deepening upto a depth of 1.0 – 1.25 m

iii. Next 30-40 m – deepening upto a depth of 0.6 to 0.75 m

It may be seen that a gradient is followed and the natural 'draw down' system is ensured. As far as possible it is prescribed that, the desilting and the bund management will be made in active consultation with all the stakeholders.

The Core Zone may be speckled with mounds and islets created in a diameter of 10 - 20 meters and with a height of 1.5 to 3 meters depending on the increasing distance from the bund. As far as possible circular bunds would be the best and could be followed or even rectangular and square shape can also be followed depending upon the need and ease of execution. This will help the birds for resting, roosting and feather maintaining activities.

8.3. Removal of Invasive species :

Total uprooted of *Prosopis juliflora* from selected regions and selective removals from certain other regions are recommended. Prosopis may be totally uprooted from the Core Zone and from the bunds of the buffer zone. Whereas those in the buffer zone, steps may be taken to educate the farmers and villagers about the ill effects of the species. Thereby, the villagers may be influenced to take up prosopis eradication measures. The selected number of prosopis plants may be retained (> 25cm GBH) in this region to grow to its maturity until suitable acacia trees have been planted and grown so as to serve as nesting and roosting place. *Ipomea cornea* may be eradicated throughout the sanctuary.

Prosophis juliflora – Removal may be done in a phased manner. Complete uprootal is recommended during the first year of plan period if possible followed by subsequent removals of regenerating saplings every year during the lean season. Uprootal work may as far as possible be allotted to the village or panchayat committees and Fire wood yield from uprooted activity may be allotted to the village EDC or the panchayat if interested for the bonafide use of the village and the villagers and in accordance to the existing rules and regulations and guidelines issued by Ministry of Environment, Forests & Climate Change, New Delhi.

Ipomea cornea – Must be eradicated during rainy season to provide more water holding space for the birds nesting and breeding. The EDC may also be roped in to perform the activity.

8.4. Grazing Management :

There are domestic cattle and goats being reared by the villagers. The existing practice is to let the cattle freely roam in the sanctuary and they return to respective homes by themselves in the evening. The harmful effects of this practice are:

- Contagious diseases like Foot and Mouth, Render pest and Anthrax may spread to birds' from these cattle if not vaccinated effectively in time.
- Damage to young natural regeneration of grass, medicinal plant and planted seedlings of indigenous species cannot be ruled out since they roam around freely.
- Dispersal of treated seeds of Prosopis and another weed plants through excreta.
- Soil compaction due to cattle movement hampers natural regeneration.

To reduce this negative impact on the sanctuary, the following prescriptions are made, which will be implemented in stages based on the availability of funds.

- The cattle will be vaccinated against all contagious diseases every year.
- Practice of stall feeding will be promoted with incentives. Free roaming may be restricted inside the sanctuary.

Till such self-restrictions are imposed by the villagers themselves, the present practice of free roaming of cattles have to be restricted. Mainly the feeding of cattles on prosopis pods needs to be restricted as it is the main reason for spread of the species. In a long run providing fencing to the sanctuary would also ensure protection from grazing.

8.5. Water Management :

Major source of water is the inlet channel that carries water from Gundar which in turn receives water from Vaigai River. Vaigai itself is highly seasonal in recent days and rarely water does reach the plains sufficient enough to fill the sanctuary. Measures may be adopted to convince higher officials in irrigation, PWD and other departments, about the importance of the water to this sanctuary and its importance in maintaining the global population of heronry species and colonial water birds. Workshops and seminars may be organised by the Wildlife Warden towards this topic. Necessary measures also need to be taken up to line up support to the cause from the local MP and MLA in order to effect immediate necessary

measures to release water atleast in alternate years for favour of maintaining a healthy habitat to this globally important site.

Measures may be adopted to maintain culvert across the Mudukulathur-Kamudi road to restore the earlier status of a contour stream that used to flow from the north of the road to the sanctuary. This stream may be identified in the field and deepened upto the sanctuary for unobstructed inflow.

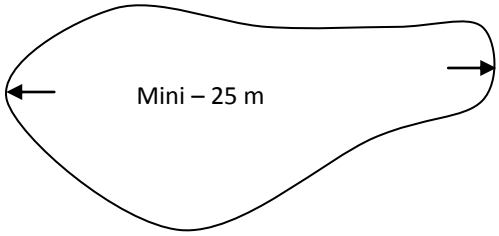
The inlet channel may be deepened alternate years and its edges, strengthened in order to avoid any wreckage or spill over to the adjoining agricultural fields. Steps may be taken up to prevent any agriculturists from draining water from the inlet channel. Such agriculturists may be offenders under Wildlife Protection Act, 1972 and be penalized.

There are six ooranis dug in the sanctuary so as to extend the storage of water for birds. These ooranis are of a meter deep from the ground level. Both are silted due to high sedimentation levels in the sanctuary. Measures may be adopted to deepen it to a depth of 2 meters.

A network of small water holes and ditches of 1.2 m to 2 m depth and 6 meter diameters may be constructed at selected points around the oorani in the LS Core Zone. Refer ***Sketch 2*** for three designs proposed for the water holes. All these ditches may have irregular edges. All these waterhole designs are to be equally considered. For example it waterholes are to be made 2 No. of 1st design, 2 No. of 2nd design and 1 No. of 3rd design here to be made. Once the stagnant water levels of the master oorani is clearly assessed after the water spread retreats to the main water holding area and that the tank bed is exposed in the first year of digging/desilting it, few water holes near the water holes may be linked to it with small artificial channels constructed for the purpose. The channel may start at a depth of 0.5 meter for every 1 meter deep water hole so that the water level in the master oorani will be maintained for a certain extended period by virtue of the inflow from the stored water in each of these water holes owing to their varying relative altitude from the master oorani and the local ground level wherever they are dug. Ditches may be dug every year during the month of August at randomly chosen sites in the Core Zone, every year. These ditches with irregular surfaces will serve as soil moisture conservation pits in addition to small storages of water for an extended period.

SKETCH 2 : DESIGN OF WATER HOLE

i. irregular



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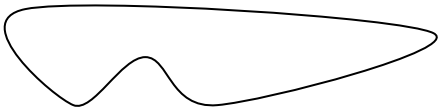
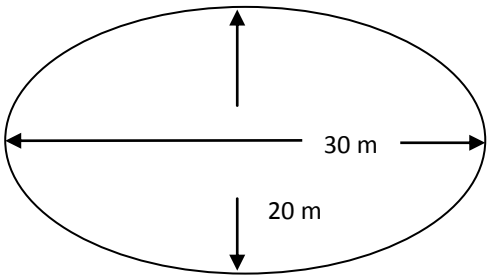


Undulating

ii. Elliptical



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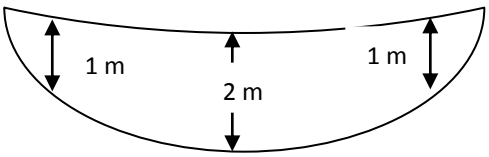
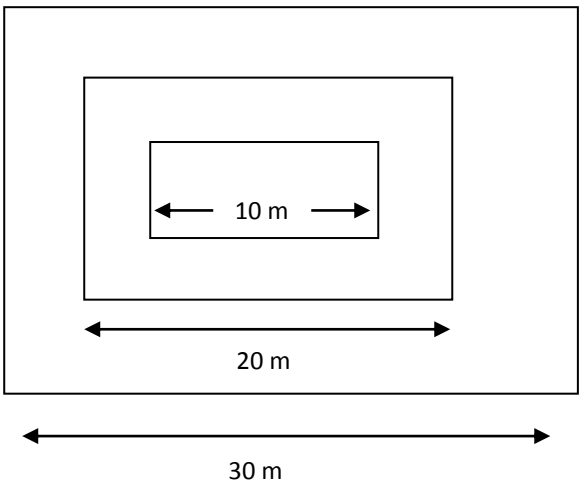


iii. Rectangular :



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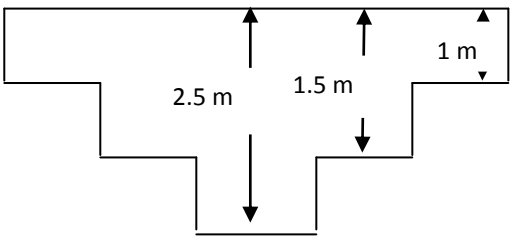


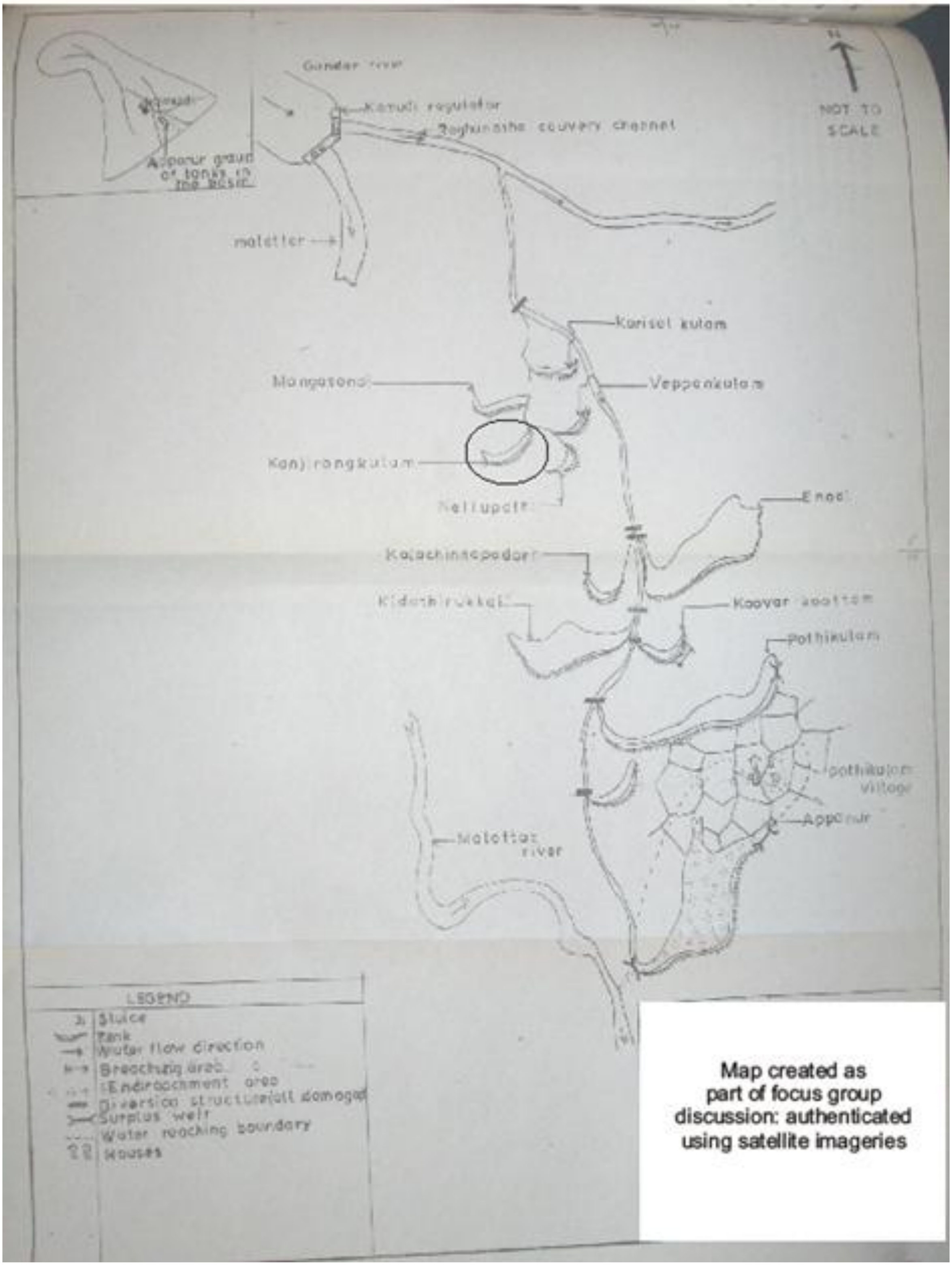
8.5.1. Short Term Component of Hydrological Management :

Evidently, the primary focus is to 'water the Kanjirankulam wetland' and therefore apart from the above, following may be additional recommendations for water management in the bird sanctuary,

1. A revival of the historical water supply mechanism by collaborating with the Public Works Department (WRO) to a) repair and improve the feeder systems at Kamudhi regulator b) remove or redress encroachments within the reservoir / water spread area (encroachments are for seasonal agriculture) and c) undertake maintenance works of the Raghunadha Cauvery Channel and its channels. Restoration of the Raghunadha Cauvery Channel is one of the most critical steps in ensuring water to Kanjirankulam. A special project could be formulated and implemented for re-linking all the de-linked channels of the defective chains in the basin, by removing the encroachments in their course.
2. This is to be followed by a) addressing maintenance and conservation issues of the water bodies on the upper reaches of the Aappanur group; so that assured water flow could be maintained. Since Kanjirankulam is on the upper reaches of the group, it is expected that benefits would be accrued by the tail reach tanks as well. The strategy could be to focus on the chain of tanks/ cascade as micro hydrological unit for rehabilitation at a time, so that the synergised effect could be realised over a period of time with better performance of tanks and channels.
3. The most critical intervention is the repair and maintenance of the breach (man-made) at the point where the feeder channel bifurcates into two to drain into the upper segment water bodies such as Karisalkulam and Mangasonai, and the lower segments of Enadi and Aappanur. It is this breach which is preventing inflow of adequate amount water into Kanjirakulam.
4. Means by which water sharing arrangements within and between the wetlands, its ayacutdars and the Panchayats may be harmonized, could also be explored. In addition to the east- west drainage into the wetland through the feeder channel which is of Stream order 3, other options such as tapping water from the other wetlands of Mangasonai and Veppankulam could also be explored as part of eco-development programmes (Eco development link discussed in detail in subsequent sections).
5. The landscape is characterised by a significant presence of stream orders 1, more like gullies, which because of their inherent nature would rapidly dissipate or discharge water. In addition, the geo morphological conditions of the landscape itself favour meandering and rapid discharge of water. Hence it would be ideal

to convert some of the gullies within the wetland into deeper trough/ox bow shaped water bodies. The recommended portion is the center of the wetland, and not the corner as it is being currently implemented.

6. Interventions until now to capture and retain water have been based on considerations other than contouring or drainage patterns. This is evidenced by the fact the water harvesting structure has been created in the zone which is not only high, but is quite away from the feeder systems. The natural drainage into the wetland is from the North-Eastern part of the wetland to drain out through wetlands on the southern boundary.
7. Based on the contour mapping, it is evident that the North-West and South-East extremity of the wetland are higher in altitude and must be retained thus to capture water in the adjoining patches of the wetland.
8. The most problematic issue with Kanjirankulam is the 'near homogenous' consideration of the terrain and its attributes in past interventions. Based on the drainage map, it is also evident that deeper (at 2m – 4m ASL), ox-bow shaped wetland retain their integrity in the landscape, as compared to spread out areas, which foster rapid draining.
9. Although the major habitat type in Kanjirakulam is fresh water, seasonal trends in salinity are observed, mostly higher in the dry season. This along with the brackish water quality of ground water, and a straight line distance of only 20 km to the sea, necessitates a review of the categorisation of Kanjirankulam as an inland, freshwater wetland.
10. Yet another feasible option would be to extract ground water in the non-freshwater aquifers in the immediate vicinity of the BS (those installed by the Panchayat have been abandoned due to the brackish nature of water) and treat them through a series of micro-desalination units that could play the twin role of providing a continuous supply of water to at least parts of the wetland as well as providing potable water to the local communities, and adjoining villages as part of the water sharing arrangement.



Map created as part of focus group discussion: authenticated using satellite imageries

8.5.2. Medium to Long Term Component of Hydrological Management :

One of the best known functions of wetlands is to provide a habitat for birds. Wetlands are important bird habitats, and birds use them for breeding, nesting, and rearing young. The highest number of waterbirds is often found in wetlands which also have the greatest diversity of plant species and vegetation types, or where there is permanent water. Birds also use wetlands as a source of drinking water and for feeding, resting, shelter, and social interactions. Some waterfowl, such as Grebes, have adapted to wetlands to such an extent that their survival as individual species depends on the availability of certain types of wetlands within their geographic range. Other species, such as the Northern Pintail use wetlands only during some parts of their lives.

Wetlands provide a variety of habitats and food sources for birds to live and reproduce. Many waterbirds move regularly to newly flooded habitats to feed and/or breed before a wetland dries down. Some semi-permanent, permanent and coastal wetlands can provide refuge for species when wetlands in other regions are dry for long periods. Many species depend on particular wetlands, for refuelling and resting, during their long migrations between wetlands.

The relationship between the wetland and waterfowl populations depends on the following attributes:

1. Number of wetlands in the area
2. Wetlands' size and water depth
3. Whether the wetlands hold open water in the desired seasons
4. Climate
5. Species of bird and the bird's adaptations to wetlands

Prescription for Long Term Hydrological Management :

Managing wetlands in water-stressed landscapes is a major challenge. The Kanjirankulam BS has the potential of playing twin-roles; 1) providing a great diversity of land birds that contribute to the ecosystem and 2) providing nesting habitat for important large wetland birds that breed in colonies. These two attributes can make the sanctuary attractive to tourists and bird watchers throughout the year if carefully managed. Key issues that need to be addressed in this regard include:

- A prohibition of interventions that decreases the water spread area of the wetland (including those that are perceived as green initiatives such as plantations) within the wetland.

- This entails the removal of the *Prosopis* trees that have invaded the wetland (covering 90 percent of the total area) using mechanical means. The possibility of linking this initiative with the removal of Invasive Alien Species component of the TBGP could be explored.
- There is also a need to prune the standing *Acacia nilotica* plantations which are contributing to the water stress of the sanctuary – ideally, the standing dead trees could be removed and replaced with artificial perches of varying heights. The artificial perches could be based on the species composition of the sanctuary.
- In addition to enhancing and retaining the water holding capacity of the wetland, it needs to be realised that human-centric water requirements also need to be addressed. This requirement is largely for the office of the staff, and visitors (washrooms, drinking water etc). Currently, the requirement is being met through *ad hoc* means.
- The strategy and action for ensuring availability of fresh and potable water to the KBS is to first conduct a realistic, time bound assessment of the water requirement of the sanctuary in terms of litres/ day, estimate current availability and thereby calculate the shortage on a per day basis.
- The assessment is to be followed up with the design and installation of a composite water harvesting structure that would capture rainfall both directly and indirectly (through percolation and recharge) within the sanctuary, and maximise availability of water for human-centric uses.
- It is further prescribed that this initiative could be developed as a pioneering, low water use mode of managing a wetland for the state. Features such as a) dry-toilets, b) sprinkler systems for watering the plantations c) a recycling facility that can convert sullage and sewage for watering the green area etc. could be some of the key features that could be installed in the BS.
- Improving the quality of water within the wetland is an important issue. Stagnant water that is warm and contaminated with bird excreta and other organic wastes (example dried plant material) can soon become eutrophied. Also, chemicals and sediments that move from agricultural areas into wetlands, as in the case of KBS, are two of the most pervasive sources of degradation. Due to the high Biological Oxygen Demand (BOD) such water will turn foul and also eliminate most of the aquatic organisms including fish.

- As a strategic intervention, preventing fouling due to bird excreta and other biomass load is rather difficult since the only available option is to allow the water to flush through the outlets so that it could benefit the adjoining farms. The difficulty is in a) have enough water within the wetland to enable flushing or discharge and b) continued use and relevance to the farmers which is under threat if land use trends convert large tracts into fallow land or other use categories.
- In comparison, water enrichment due to agricultural runoff can be managed since rain-fed paddy does not entail alarming use of chemical fertilizers and pesticides.

8.6. Soil – Sedimentation, Erosion, Moisture Control and Quality Monitoring :

a. Sedimentation – Water holding capacity of the tank is reduced every year due to sedimentation. Measures may be taken up annually to desilt the tank and preserve the original water holding capacity.

b. Erosion - Soil erosion in the sanctuary happens mostly on the bunds. Both inner side and outside of the bunds are prone to erosion from winds and rains. Humans and animals are also causing erosion, when they walk on the bund. Presently, the bund is under the control of PWD and they undertake much of the repair and maintenance work. Due to the erosion bunds may be planted with *Syzygium cumini, Ficus species, Mangifera indica, Thespeia populnea and Azadirachta indica.*

c. Moisture – Owing to the prevailing drought conditions, the sanctuary's soil moisture levels are considerably low, jeopardising symbiotic processes in the soil and nutrient carrying capacity of it, thereby retarding plant growth. Measures may be adopted to maintain the soil moisture conditions by certain traditional techniques listed below:

i. The ditch method: Ditches of irregular shapes with 0.5 meter depth may be dug at randomly chosen locations during the month of August thereby rainwater during the following rainy season collected in these ditches will be retained for an extended period and the slow percolation through these ditches will continually recharge the soil. Refer ***Sketch 2*** for details.

ii. The pot method: Belly pots with mouth of approximately 20 centimetres wide and 30 to 40 centimetres depth may be buried in the ground with its mouths aligned to the ground level. Pot mouths may be covered with metal wire mesh to prevent any leaf litter, stones or twigs go into them. The pots may be arranged in triangular fashion and should be planted more towards the LS Core Zone.

Rainwater collected in these pots will act as slow recharge reservoirs which will maintain soil moisture content to an extended period. Refer ***Sketch 2*** for details.

d) Soil Quality Monitoring – The micro and macro nutrient status and physico - chemical properties of the soil may be monitored on alternate years. Parameters mentioned in ***Annexure V a & b*** may all be analysed for and compared with the values of previous analysis. Institutions listed in the Annexure may be approached for analysis.

8.7. Management intervention for availability of food :

Wetlands provide food for birds in the form of plants, vertebrates, and invertebrates. Some feeders forage for food in the wetland soils, some find food in the water column, and some feed on the vertebrates and invertebrates that inhabit submerged and emergent plants. The number of algae and invertebrates in wetlands depends on quality of water, its temperature and amount of sunlight reaching the wetlands.

Waterbirds depend on free-standing water to feed – by swimming, wading or diving – or to establish nesting sites. These include waterfowl (ducks, geese, and swans), grebes, pelicans, cormorants, ibis, egrets, herons and shorebirds (or waders). Waterbirds use a range of wetland habitats to source a variety of food. This helps meet the specific dietary needs for different waterbird species, with many being either fish-eaters, herbivorous, or invertebrate feeders. Fish-eating birds include some of the larger waterbirds such as pelicans, cormorants, herons and egrets.

Wetlands with deep, open water attract diving ducks. These birds feed on aquatic plants and animals, particularly freshwater shellfish and mussels. Grazing waterfowl are often found roosting on grassy banks of a wetland or feeding on wetland plants. Reeds and sedges provide cover for shoreline foragers like swamp-hens. Mudflats and shallow water are rich feeding areas for invertebrate feeders such as spoonbills, ibis, stilts and sandpipers.

The strategy and prescribed action for this component is focused on improving the productivity of the wetland, especially fish. Wetlands in south India are seasonal. They come to life after the monsoons and dry up in part or full, during the summer months. Seasonal wetland dynamics are synchronized with the breeding of resident and locally migrating birds (example the large wetland birds). The wet-dry dynamics of the habitat are also synchronized with the inter-continental migrants such as many species of ducks, teals, and population of geese, terns and waders. Of these, majority of the birds that breed in the sanctuary are fish-eating. Due to prolonged drought conditions, the local faunal seeds have not remained active any

more. Hence, connectivity of the waterbody with the watershed is essential to bring in organic content and fish diversity.

Wetland vegetation provides shelter from predators and from the weather. The presence or absence of shelter may influence whether birds will inhabit a wetland or a nearby upland area. Wetlands form an important buffer or barrier to land-based predators and reduce the risk of predation to nesting or young birds. Many bird species that are highly adapted to feeding in a wetland environment also have adaptations that lower their risk of becoming prey.

The sanctuary or the tank remains dry for most of the months i.e from May to October or November. There is hardly any influx of water from any other source apart from rain water. Therefore whenever there is receipt of rains the tank get water impounded and to support the migratory population with adequate water, it would take 2-3 months i.e by month of December-January. As the migratory birds stay upto the month of April – May, there is inadequate time for build up of phytoplankton and benthic flora and fauna, which support as feed for the migratory species. Therefore in order to augment the availability of food it is essential to supplement the tank with release of fish fingerlings by the month of November - December so that it would serve the purpose for winter migratory birds.

Fish is sourced from hatcheries maintained by the Department of Fisheries. Stocking density normally recommended for fisheries varies from 300-1000/ha depending on the size of the species involved. As the fisheries department is focused on food-fish especially of large carps and cat fishes, the recommended densities are lower. For enhancing the food availability to the birds, smaller fish should be sourced and stocked at densities of 700-1000/ha. Smaller fish that are useful as food-fish for birds are often described as 'weed fish' in fisheries and mostly include small cyprinid fishes. The list of fishes is only indicative and of only native species. Fingerlings can be sourced from the Department of Fisheries or locally with the help of artisanal fishermen and released into the tank.

The following table provides a list of fish that can be introduced.

Species	Tamil Name	Habit
Puntius conchonius	Kendai	Prolific breeder
Puntius sophore	Kulla kendai	Prolific breeder
Puntius ticto	Pulli kendai	Prolific breeder

Puntius vittatus	Kendai	Prolific breeder
Esomus danricus	Mesa paravai	Surface swimming
Rasbora daniconius	Ovaree kendai	Prolific breeder
Lepidocephalus thermalis	Asaree	Bottom dweller
Mystus gulio	Irung kelutti	Catfish
Mystus vittatus	Kelaru	Catfish
Heteropneustes fossilis	Theili	Air-breathing
Hyporamphus limbatus	Kola	Surface swimming
Ambassis commersoni	Selanthan	Prolific breeder
Pseudambassis ranga	Sonnel	Prolific breeder
Etroplus maculates	Buroti, Challai	Prolific breeder
Etroplus suratensis	Karimeen	Prolific breeder
Glossogobius giurus	Uluvai	Bottom dweller
Anabas testudineus	Panankottai	Air-breathing
Macropodus cupanus	Pauni ,Vannati	Air-breathing
Colisa lalia	Gowra	Air-breathing
Channa orientalis	Para koravai	Air-breathing
Channa punctatus	Koravai	Air-breathing

8.8. Peripheral Habitat Management :

The notional ecological boundary or the buffer zone of 2 Kms around the sanctuary is considered to be the peripheral habitat for the migratory birds apart from the sanctuary alone for the purpose of management interventions. Though the radial distance is small enough for the migratory birds but is essentially devised from effective management perspective. The suitable habitat like the earthen tanks, ooranis, marshes, other wetlands may be listed and may be ensured with certain amount of managemental interventions like the ones done in the core zone of the sanctuary. The various interventions that could be taken up in the peripheral habitat of the buffer zone is as follows,

i. Desilting of the inlet channels of the tanks, ooranis

ii. Deepening of the water holding areas of the earthen tanks

iii. Removal and uprootal of invasive alien species.

iv. Improving the roosting, nesting habitat by way of planting of trees like Acacia nilotica or Baringtonia acutangula

v. Supplying or planting of fruit bearing and mutlipurpose tree species in the village household areas.

vi. Planting of taller trees supporting bird nesting or roosting in the community lands, panchayat lands, common public lands, along the roads etc., to increase the green cover around the vicinity of the sanctuary.

All the management intervention in the ecological boundary or the buffer zone as far as possible would be done in a participatory approach with active involvement of villagers and various stakeholders

8.9. Kanjirankulam Bird Sanctuary Wetland as part of the migration path :

In general, billions of birds travel between continents twice a year in only a few weeks. The geographic location of a wetland may determine how and when birds will use it or use the adjacent habitat. Some wetlands are on the migration path of waterfowl and other migratory birds and provide stopover locations for migratory birds. In the event of the wetland being part of an agrarian landscape, such as KBS, the birds might feed in agricultural fields during the day and return to the shelter of wetlands during the night. While KBS, in view of its isolation and absence of dense canopy in large tracts, would not support peak populations and interior species, would continue to be an important stop over for generalist species and birds that are found of grass land habitats and are omnivorous in their feeding habits.

The buffer zone around the wetland needs to be surveyed to document the land-cover for the extent of each type of cropland. Periodical surveys to be carried out by the staff for documenting species-wise data on direction of bird movement for understanding the preferred feeding sites. Open-bill storks as well as Little, Median and Large egrets could go to the paddy fields to feed on fish and snails. Cattle egrets could frequent the dry croplands to feed on insects. A Species-wise data on morning departure direction and evening arrival direction have to be recorded. As the wetland is only rain-fed, the water is not retained throughout the year due to which submergent and aquatic vegetation is not found here. The surrounding area is covered with *Prosopis* thickets and croplands. No satellite

wetlands are present in the buffer zone except for Mookaiyur wetland and Valinokkam saltpans which are accessible and ideal feeding sites for birds nesting in the three sanctuaries in Ramanathapuram district. Pelicans, Painted storks, Grey herons and Egrets can go to the nearest natural coastal wetlands, saltpans within 15 km radius. Kanjirankulam and Kanchirankulam birds can go to nearest inland wetlands Chakrakottakanmai, Periakanmai and Uthragoshamanga wetlands for feeding. Not being a permanent wetland, nesting has not occurred in the past few years, to promote breeding it is extremely essential to acquire and retain water for five months from November to March by implementing the recommendations given for watershed management on priority basis.

Staff can be instructed to collect data on species-wise morning departure and evening arrival to understand the preferred feeding sites. Periodical monitoring to identify the feeding and roosting sites as well as movement of congregations in buffer zone.

The functions being provided by the wetlands to the migratory birds for nesting, feeding, resting, and roosting to be identified and documented for each species. The *Acacia* tree canopies need to be strengthened along with replacing the stunted trees. Important feeding sites identified in the buffer zone to be monitored for biodiversity of food plants including crops along with invertebrate and vertebrate fauna that primarily constitutes the diet of colonially nesting birds. Locals need to be hired during the nesting season to provide protection for the nesting habitat and monitor safety of the nesting and feeding habitats.

8.10. Medicinal plants conservation plan & Avid zone horticulture plan :

The villagers confirm that the sanctuary is a store house of medicinal plants that are known only for few of those who practice traditional medicine in the village. A detailed survey is required to know the actual status of medicinal plants in this sanctuary. The following interventions are suggested for conservation of medicinal plants.

vii. Detailed survey of medicinal plants may be carried out and an inventory of medicinal plants is prepared, utilizing the indigenous knowledge of local tribes.

viii. Areas rich in medicinal plants may be delineated and earmarked for complete protection. Care may be taken not to damage the medicinal plants during other forestry operations as well.

ix. The village poramboke, Panchayat lands may be utilized for creating an avid zone orchard with Guava, Sapota, Amla etc., few horticulture seedlings may be supplied to each house hold @ 5 / house.

x. Raising a nursery of medicinal plants / horticulture plants and planting can form part of regeneration augmentation activities in the natural forests and plantations.

xi. Activities to create mass awareness regarding the importance of medicinal plants may be taken up to spread conservation message. The medicinal plants interpretation centre and demonstration garden may be established.

8.11. Rescue and Rehabilitation Plan

The staff (Forest Guard and Bird Protection Watchers) of the sanctuary is stationed at Kanjirankulam Village and in any emergency situation, the staff is readily available to attend to it. Any trapped or injures bird or animal will be rescued and the services of the Veterinarian at Mudukalathur will be utilized.

CHAPTER - IX

ECO – TOURISM, ECO-DEVELOPMENT, INTERPRETATION AND CONSERVATION EDUCATION

9.1. Eco-Tourism :

Eco-tourism is defined as purposeful travel to natural areas to understand the cultural and natural history of environment, taking care not to alter the integrity of the eco-system, while producing economic opportunities that make conservation of natural resources beneficial to the local people. In a nutshell a tourism programme, which is nature based, ecologically sustainable, where education and interpretation are the major components and where local people are benefited, can be called eco-tourism. Kanjirankulam Bird Sanctuary with its wealth of bird life is one of the most captivating places in south India. Hence, this sanctuary possesses the best eco-tourism opportunity. With properly oriented and supportive staff and necessary funds this place can be transformed into the best and most viable eco-tourism spot.

9.1.1. Objectives :

- To ensure the participation of local communities in eco-tourism as guides and interpreters.
- To facilitate low impact ecotourism to benefit the local livelihood
- To develop Kanjirankulam as attractive ecotourism site.
- To provide conservation education about avian fauna to visitors.

9.1.2. Constraints :

Following are the constraints identified in achieving the objectives.

- The present staff strength is not sufficient to manage tourism. Even the available staffs lack orientation and proper training.
- There is shortage of qualified and trained eco-guides who can cater to the needs of even foreign tourists.
- Limited accommodation facilities, lack of decent canteen and uncertain communication infrastructure are the major deterrents for the visitors.
- Despite the available potential there is no attractive package of engagements offered to the visitors.
- Lack of frequent public transport system is another impediment to be addressed.

- The remoteness of location and not falling within the tourism network.

9.1.3. The Strengths :

Following are the strengths available with the sanctuary to encourage tourism

- The rural enticement and serenity of the sanctuary.
- Excellent chances of sighting vibrant bird life in the sanctuary during Bird visiting season.
- Excellent water spread in the eve of strong monsoon offers plenty of scope for boating by close watch of Birds.
- Availability of many educated youth, who can be groomed as eco-guides.

9.1.4. The Management prescriptions :

Based on the above-mentioned strengths and constraints the following management prescriptions are laid down.

9.1.4.1. Identification of tourism zone :

Though tourism zone is identified and delineated in the previous chapter, the areas falling under the zone are listed below for reference.

- The main road and the mud track that leads from the village to Mudukulathur town.
- Earthen bund and the main water holding region (upto 100-150 mts).
- The village and the buffer zone

9.1.4.2. Development of tourism infrastructure :

The sanctuary lacks basic infrastructure for the visitors who come to the sanctuary. Though the visitation is poor to the sanctuary, but in years to come with anticipation of good monsoon and in turn the arrival of birds the visitation is expected to increase. Following are some of the infrastructure facilities which needs to be created for the sanctuary,

1. A walk way path along the Bund of the tank. Since the area is made of black soil, it creates inconvenience to walk along the bund. Hence it would be worthwhile to make a foot path over the bund. 2-3 Km stretch of walk way path may made up of stone pavement with revetment walls along the bund so that there is no slip of the bund.

2. Along the pathway or walk way shelter sheds with seating arrangements may be made for visitors to take shelter and rest. This could be designed at intermittent distance of every 500 meters.
3. The sanctuary already has one watch tower in the southern region. Similar watch tower may be provided at the eastern most portion of the tank so that it gives an advantage for sighting.
4. The visitors needs to be provided with basic amenities like restrooms, drinking water facilities etc.,
5. A parking area needs to be allocated at the entrance to the village so that in case of future congestion of vehicles during season may be avoided.
6. There may be upgradation in the existing interpretation centre. This would be dealt in the subsequent chapters.

9.1.4.3. Requirement of staff :

Additional staff requirements for conducting the Eco-Tourism in Kanjirankulam would definitely be felt. A changed administrative setup has been proposed in the plan (Chapter XII), if approved then as per proposal the setup of one Forester, one Forest Guard and One Forest Watcher (to be deputed) is felt enough from the regular establishment, but there is necessity of additional temporary staff. Around 4 bird watchers will be engaged during the tourist season so that there is smooth functioning in the sanctuary.

9.1.4.4. Public Transport :

Discussions with the Road Transport Office may be initiated to extend few buses from various towns that terminate at Mudukulathur to Kanjirankulam village such that a bus will reach and leave Kanjirankulam village every 2 hours. This may be initiated with the start of bird arrival season from November onwards till the migratory birds depart i.e till May.

9.1.4.5 Guided tourism plan :

Under this plan, creation of a cadre of trained eco-guides and guided safari programmes are envisaged.

Eco-guides training programmes: Reasonably educated and disciplined youth may be selected from among the villagers. They may be trained in the natural history of the Sanctuary, nature interpretation, and art of communication, manners and etiquettes. For imparting this training resource persons from external agencies

and competent organizations (e.g. KITS, Thiruvananthapuram, Email: kitts@vsnl.com) may be engaged. To give these guides necessary authenticity, they may be provided with a kit containing identifying badge, olive green trousers and shirt, trekking shoes, cap, binoculars, etc. The duties of these guides will be to accompany the tourists inside the sanctuary, present the tourists with the interpretation of various components of nature that they come across and appraise them of their conservation importance. Remuneration for the same may be fixed from time to time by the EDC.

9.1.4.6. Boating plan :

This sanctuary is endowed with excellent water spread during the monsoon season. This provides the hitherto unexplored and unique opportunity of boat ride for the tourists. Two fiberglass boats with the seating capacity of 4 persons may be made available with the sanctuary. Boat landing can be near the village just aside the village temple abutting the bunds. Boat ride duration and suitable charges may be decided by the Wildlife Warden in the capacity of EDO as accepted by the EDC.

9.1.4.7. Guided trekking plan :

The richness and diversity of habitats and the plenitude of bird life make this sanctuary ornithologists' paradise. Hence, offering the genuine tourists opportunity for Nature trailing guided by the staff and eco-guides, will not only increase revenue from tourism but also strengthen the motivated protection. Interested individuals may be accompanied by the guides through various patrolling tracks in the sanctuary.

The size of trailing group may be limited to 5-10 members, at least one forest guard and an eco-guide may accompany them. If the group is more than 10, an additional eco-guide may be hired. During the trek, knowledge regarding the biodiversity of the area and its conservation importance may be imparted to the trekkers by the eco-guides. The trekkers may be apprised of the discipline and code of conduct to be followed inside the forest before the trek begins and the same may be enforced till the end of trekking

9.1.5. Conduct of eco-tourism, regulation and monitoring :

The main objective of eco-tourism is that the benefits will flow to the local communities. Since, the management plan prescribes for strengthening of the eco-development and formally functioning of the Eco-Development Committees, the responsibility of conducting eco-tourism may also be entrusted with these committees.

9.2. Eco-development :

The Kanjirankulam village largely surrounds the sanctuary. The irrigation tanks supply water to ryots of Kanjirankulam village. The villagers have their patta lands and other related activities nearer to the sanctuary apart from sending their cattle to the sanctuary for grazing. These villagers have their rights over the tank for the collection of water, fuel, small timber, medicinal plants, soil, green manure, cutting of Prosophis for fuel etc from time immemorial for their own use. After declaration of the birds sanctuary, the villagers have to necessarily sacrifice the customary usage of resources from the sanctuary area, especially for the conservation of the birds in future. Hence it became the primary responsibility of the managers to compensate their loss apart from making them as friends of nature, so that the objective of conservation is achieved. The Eco-development is not only for improving the habitat conditions of the sanctuary but also for meeting the local people needs to some extent.

9.2.1. Objectives :

1. To mitigate biotic pressure and to reduce the resource dependency of local communities on the sanctuary.
2. To improve the Bird Sanctuary by soliciting co-operation of the local communities in order to enhance conservation efforts in the Sanctuary.
3. To generate alternate livelihood option for the local communities.
4. To build effective local institutions for proper implementation of eco-developmental activities through participatory approach.

9.2.2. Specific Issues :

1. Illegal cattle grazing in sanctuary.
2. Scarcity of water in the villages.
3. Lack of alternative livelihood options.
4. Low agricultural productivity.
5. Lack of effective community institutions.
6. Inadequately trained and over burdened staff.
7. Inadequate funds.

9.2.3. Prescription and Activities :

1. Raising farm forestry and grazing land on revenue and private land to get fuel and fodder.
2. Enhance irrigation potential for productive agriculture.
3. Supply of agricultural inputs on subsidy.
4. Promotion of eco –tourism.
5. Promotion of traditional knowledge on handicrafts, herbal medicine and pharmacy.
6. Supplying raw materials for traditional handicraft and artisans.
7. Improve marketing linkage.
8. Creation of employment opportunities.
9. Awareness education.
10. Capacity building of all the stakeholders
11. Health camps for man and their domestic animals.
12. Building of effective local institutions.

9.2.5. Eco – Development Approach :

The Approach proposed is the Eco-development approach, which laid a success mile stone in kalakad Mundanthurai Tiger Reserve, Tamilnadu. The Eco development here aims at conserving Biodiversity by addressing both the impact of local people on the PA and the impact of PA on local fisher populations. It demands collaboration between Forest department, local Communities, Scientific Institutions and Non-governmental Organizations. To achieve Socio-economic development in the villages, it is essential to improve the current practices and also develop ecologically sustainable & economically viable package of alternatives that are acceptable to people, Self Sustaining, Compatible with the Sustainable use of resources and are very helpful in minimizing the pressure on the bird sanctuary. For Successful Eco development, willing participation of the local public and mutual trust between Managers and people are the vital elements in the process.

The guidelines prepared by the Ministry of Environment and Forests describes Eco development as a package of Programme that will demonstrate the concern of the forest department for the socio-economic development of the fringe PA dependent population leading to promotion of cooperation of the villagers in

the conservation and the Management of wildlife EDC in the most important local Institute to achieve this objective.

1. The EDC will be formed for the village consisting of about 150-200 households. The Ranger will convene a general meeting of all households. The Quorum will be aimed at identifying fully, partially and non dependent populations.
2. After explaining the duties and Responsibilities, the Ranger will constitute an EDC with in the frame work of the following rules and regulations.
3. Every household living in the chosen area is entitled to become a member of the EDC. Any two members could represent the household atleast one of them being a women.
4. The Forester concerned, shall be the ex-officio secretary of the EDC.
5. Each EDC shall have an Executive Committee whose tenure shall be one year.
6. The composition of the Executive Committee shall be as follows.
    i) Not more than 6 elected representatives from EDC where in half of them being women as members.
    ii) Forester Concerned - Member Secretary
    iii) Forest Guard concerned - Member
    iv) One Representative of local NGO (Not Mandatory) - Member
7. The Executive Committee will elect its own chair person who shall also be the chairperson of the EDC.
8. Ranger, Forester, Forest guard & Representatives from NGO shall have voting rights to avoid the influence of external forces in the functioning of EDC.

9.2.6. Approval by the Eco-development Officer :

The Wild Life Warden, Gulf of Mannar National Park shall be the Eco-Development Officer. Upon the receipt of the proposal from the secretary of the EDC, the EDO may accord recognition to it after due examination of its merit. Only such recognized Committees are entitled to operate under these rules.

9.2.7. Duties and Responsibilities of the EDC :

i) A General body meeting of the EDC shall be held once in every 4 months to review the activities and functioning of the executive Committee. All members are required to attend the meeting.

ii) The members of the EDC individually and collectively shall

a) Ensure protection against Entry, Grazing, Fuel wood collection, pollution etc., in the bird sanctuary.

b) Make other Villagers aware of the importance of Birds in Agriculture, Pest control, Eco-tourism etc.,

c) Assist the Forest department functionaries in carrying out sanctuary development works in accordance with the approved activities

9.2.8. Duties and Responsibilities of the Executive Committee :

i) The Committee will be Constituted at the Commencement and at the end of every term with Range officer concerned acting as a Returning officer or Forester if so authorised by him for filling the quota of elected members.

ii) The Executive Committee shall meet at least once a month or often if need be.

iii) The Member secretary shall be responsible for convening the meetings and maintaining the records of Proceedings. He shall send one copy of the proceedings to the Range Officer to keep him informed and obtain necessary guidance.

iv) The EDO or the Range officer may give directions from time to time for smooth and proper functioning of the Committee, which will be binding on the Committee.

v) If any member of EDC is found indulging in acts against Forest laws or sound principles of conservation of Bird Sanctuary, such member may be removed from EDC taking in to consideration, the recommendations of the Executive Committee. An appeal in this regard lies with the EDO. The EDO for sufficient reasons to be recorded in writing may supersede an Executive Committee or the EDC and his decision is final.

9.2.9. Role of the Range Officer :

(i) The Range Officer concerned will have the freedom to attend the EDC, general body and Executive Committee meetings to participate in the discussions and to render advice.

ii) If any member EDC is found indulging in acts against Forest laws of sound principles of the bird sanctuary conservation, such member may be removed from EDC taking in to consideration, the recommendations of the Executive Committee. An appeal in this regard lies with the EDO. The EDO for sufficient

reasons to be recorded in writing may supersede an Executive Committee of the EDC and his decision is final.

iii) Range Officer shall ensure that the meeting is conducted according to prescribed norms.

9.3. Education and interpretation :

These activities include conducting nature education camps, awareness campaigns, workshops, seminars, etc. School and college students may be given preference for attending the nature education camps followed by nature clubs and other genuinely interested groups. Necessary financial allotments may be made to support the modernization of the village school and also to promote nature education in the school. Conduct of paid nature education camps for interested groups can be entrusted to the eco-development committees. Nature education camps may consist of the following activities viz.

- Lecture on nature and wildlife conservation by identified resource persons
- Video and slide shows on conservation education and
- Voluntary labour from the participants for maintaining the cleanliness of the sanctuary.

CHAPTER - X

RESEARCH, MONITORING AND EVALUATION

10.1. Research :

In order to improve the status of the wetland a good scientific research and monitoring needs to be put in place in the wetland. The research and monitoring activity should look into the various aspects of reliable baseline data collection, water quality, biodiversity values, and siltation and its impact, abundance of various species, ecosystem response monitoring and evaluation, consistent documentation, archiving and referral system and interaction with national and international forums for collaboration of technology transfer.

The Kanjirankulam Bird Sanctuary has no in house research being conducted. However certain Research Scholars do approach the Wildlife Office for grant of permission for conducting research works largely as part of completion of Thesis or M.Sc. project report. The sanctuary offers wide opportunities for ornithologists in studying various aspects of birds' life and birds. Efforts may be made to promote local research organizations, colleges and universities interested in undertaking habitat, floral or faunal studies in the sanctuary.

Since specialized field staff may not be adequate, help of other institutions like BNHS, SACON, NGOs and Universities will to be sought. A gap analysis has to be performed to find out the areas in which the basic data is lacking. As a subsequent step, a research priority matrix has to be prepared. Management should provide the necessary financial and logistic help to the institutions or individuals who are interested in carrying out research works in the fields that are a priority for the sanctuary.

10.2. Prioritization of Research :

Tamilnadu has a large number of renowned research institutions, which may be requested to conduct research and help forest department in the management of Sanctuary in a more scientific manner. Some of the research areas, which are more relevant to this wetland and could help in generating baseline data, which can be well utilized, are as follows:

1. Study to update and generate data on impact of wetland degradation on migratory and resident bird species found in the KBS.
2. Studies on integrations of wetland complexes in the vicinity of the Sanctuary, since Kanjirankulam is a small protected area and larger area of birds foraging and resting lies outside the Sanctuary too.

3. Studies on population trends and migratory pattern both spatially and temporal and studies on factors affecting the migratory pattern locally and regionally
4. Valuation studies on the ecosystem services provided by the sanctuary.

10.3. Monitoring :

The department should regularly monitor the water and the soil quality, the status of aquatic vegetation and water-bird diversity. Forest department conducts water-bird count every year in the winters when migration is at its peak.

Habitat monitoring, which includes study of faunal diversity, need to be undertaken regularly. It is prescribed to have permanent protocols for the monitoring of the habitat and key faunal elements. Where ever possible and needed, help and support from various institutions and organizations should be requested to carry out these programs.

Techniques and methodologies used in monitoring different events will be utilized efficiently. This will involve different stages from actual field work to record keeping. The value of the current monitoring activities for management will be assessed and documented. The activities to be monitored are given below.

10.3.1 Biodiversity Monitoring

Forest department with the help of few organizations working in the area conducts water bird count every year in the month of December - January. Being a Bird Sanctuary, migratory water birds should be monitored every year to understand the population trend of migratory water birds. Monitoring of breeding of different resident species, impact of wetland degradation on bird species is also needed to be done.

Monitoring of birds population and their health.:

- Line transect method is statistically used in the sanctuary.
- Time of census will be in January every year as all the birds are equally distributed all over the sanctuary due to availability of water everywhere.
- Study on biology and behavior of birds will be carried out with the help of scientists of BNHS or such other research organizations working on avian fauna.
- The bird's census has to be done twice in a year, once in summer and another after rainy season.

10.3.2 Habitat Monitoring :

BS has a mosaic of habitats that is responsible for a rich avifauna. There is a need to monitor these habitats for long-term protection and conservation of various groups of flora and fauna in the Sanctuary. Permanent plots may be laid out in the bund areas and islands, which form the terrestrial habitat in the Sanctuary. These should be monitored regularly for vegetation, which would help in detecting change and so help in studying succession.

Monitoring of wetland habitat may also be carried out through interpretation of satellite imageries. The spatial study has helped us to present the status of the Sanctuary and its surrounding landscape for the present year. Regular study of the satellite imageries will provide useful information regarding the dynamic changes in the river course, siltation, change in habitat and the surrounding landscape.

Vegetation Monitoring :

- Growth and abundance of trees, shrubs, grasses, palatable for herbivores which provide cover, shelter will also be monitored.
- Estimation of ground cover percentage to be made every year after rainy season.
- Monitoring of Tree cover and its regeneration rate will be carried out every alternate year.
- Photographic record provides all time series of habitat factors undergoing change. Every year photographs should be taken from a particular vantage point.

10.3.3 Environmental Monitoring :

10.3.3.1 Water and Soil Quality :

The sanctuary receives larger portion of water from the rainfall and has limited or no chances of receiving discharges what so ever from any of the industries or factories etc. therefore the need for rigorous monitoring is not warranted. However as part of monitoring exercise the water and soil has to be tested to have an information on the quality of the same. The samples has to be analyzed at a standard water quality testing lab for the following parameters: Temperature, Conductivity, Ph, DO, Salinity, Turbidity and Ammonia, and Phosphorous.

10.3.3.2 Bathymetry :

It is prescribed that a bathymetric exercise may be carried out every two years to know about the siltation profile of the reservoir in future. The department may consider procuring an electronic echo-sounder for regular and easy bathymetry of the reservoir or such exercises could be outsourced to research institutions. Besides promoting research projects under such heads to various research scholars of various institution would also be viable option.

10.3.4. Wildlife Heath Monitoring :

There is a need to regularly monitor the health of the resident fauna including the migratory birds visiting the sanctuary. The blood samples of the migratory birds should be checked regularly for any kind of disease threat especially bird-flu. On the onset of every winter a joint monitoring team (along with the Veterinary Departments) should conduct a systematic disease surveillance to detect any possibilities bird-flu in the region. Cattle Egrets are a potential target species in this matter.

CHAPTER - XI

MISCELLANEOUS REGULATIONS

11.1. Disease Management :

Disease is a natural component of population ecology and ecosystems and is one mechanism by which population numbers are regulated. However, anthropogenic activities can often create novel disease problems or increases in prevalence and frequency of existing disease tipping a 'balanced' system into one where losses are increased. A broad range of proactive and reactive strategies and practices are available to the wetland managers and other wetland stakeholders to achieve or maintain the health of the ecosystem.

11.2. Strategies :

1. Targeting the environment and land use *e.g.* healthy habitat management including wise use; maintaining appropriate water quality and quantity; reducing risk from pollutants and toxicants; and manipulation of habitat to reduce disease agents or their invertebrate vectors.
2. Targeting host populations *e.g.* maintaining good nutritional status; reducing stressors; managing density of domestic animals and wildlife; reducing contact between domestic animals and wildlife (including zoning); and vaccination or veterinary treatment.
3. Targeting pathogens and parasites *e.g.* managing bio-security; hygiene, disinfection and sanitation; and interrupting transmission by exploiting weaknesses in a parasite's life cycle, such as targeting intermediate hosts and/or their preferred habitat.

11.3. Interventions :

The appropriate approach to disease management will depend on the characteristics of the problem and, when dealing with an infectious disease, on the correct identification of reservoirs, hosts and vectors of infection. Management measures may target the pathogen, host, vector, environmental factors or human activities. Ultimately, an integrated approach involving several complimentary measures is likely to be most successful in managing diseases in wetlands.

- Disinfection and sanitation procedures target pathogens and can be very effective at controlling spread of infection but must be used with caution in wetland situations to avoid negative impacts on biodiversity.

- Animal carcasses represent a significant potential source of infection and require rapid and appropriate collection and disposal. Disposal options are varied and again need to be used with caution in wetland situations to reduce risks of pollution of water courses or further spread of infection.
- Targeting vectors in integrated disease control strategies can be effective and usually take the form of environmental management, biological controls and/or chemical controls, or actions to reduce the contact between susceptible hosts and vectors. To reduce negative impacts on biodiversity caution must be used when using these measures within wetlands.
- Vaccination programmes, often supplemented by other disease control measures, can help control and even eliminate diseases affecting livestock. Vaccination of wildlife is feasible but it is often complex - other management strategies may be of greater value.
- Habitat modification in wetlands can eliminate or reduce the risk of disease, by reducing the prevalence of disease-causing agents, vectors and/or hosts and their contact with one another, through the manipulation of wetland hydrology, vegetation and topography and alterations in host distribution and density.
- Movement restrictions of animals and people, usually imposed by government authorities, can be an effective tool in preventing and controlling disease transmission through avoiding contact between infected and susceptible animals.
- Complete eradication of a disease requires a thorough understanding of its epidemiology, sufficient political and stakeholder support and thorough resourcing. Elimination of disease from an area is a more likely outcome although this depends on measures to prevent re-emergence being taken. 'Stamping out' (involving designation of infected zones, quarantine, slaughter of susceptible species, safe disposal of carcasses and cleaning and disinfection) is a management practice used for rapidly reducing the prevalence of a disease during an outbreak situation.

CHAPTER - XII

ORGANIZATION, ADMINISTRATION AND HUMAN RESOURCES DEVELOPMENT

12.1. Structure and responsibilities :

Presently the sanctuary is under the overall jurisdiction of the Wildlife Warden, Gulf of Mannar Marine National Park. Range Officer, Ramnad is under the control and management of the Bird Sanctuary and he is assisted by one Forester, Ramnad and one Forest Guard.

The present setup may have to be modified as the sanctuary is more than 50 Km from the Range Headquarters. Therefore, it is suggested during the current plan that the Bird Sanctuary be under the control of Forest Range Officer, Paramakudi under the overall jurisdiction of District Forest Officer, Ramnad. By this arrangement the Range office having control will be 20 Kms away. Forester, Mudukalathur Section of Paramakudi Range may have the immediate command next to Range Officer, thereby higher level of supervision is ensured under the stationed Forester at Mudukulathur than under the Forester, Ramnad of Wildlife Division, Ramnad. Steps may have to be taken to transfer the Forest Guard to Range Office, Paramakudi. Besides on additional Forest Watcher may be deputed to Kanjirankulam. The Forest Guard and Forest Watcher would be incharge of Kanjirankulam and Kanjirankulam Bird Sanctuaries. The flow chart showing the proposed administrative setup is as follows,

Proposed Administrative setup

District Forest Officer, Ramnad

↓

1 Range Officer, Paramakud

↓

Forester, Mudukalathur Section

↓

Forest Guard, Kanjirankulam - Kanjirankulam

↓

Forest Watcher

12.2. Staff amenities :

Basic amenities like quarters for Forest Guard and Forest Watcher exists in the Kanjirankulam Village itself, which is just 2-3 Km from Kanjirankulam village. All seasonal staff is to be provided with 2 pairs of khaki or camouflage uniform in a year.

Accessories like torch, batteries, water bottle, lathi, hunter shoes and walkie talky with solar chargers to a squad will be supplied.

12.3. Human Resources Development :

Staff entrusted with management of the sanctuary needs to be trained about the wildlife management. Staff at the level of Forest Guard, Forester and Antipoaching watchers or the Bird Watchers will be given informal training by the respective Wildlife Warden or the District Forest Officer by sending them to other Bird Sanctuaries in Tamilnadu or other states to have first-hand information and knowledge about management. Besides short lectures, seminar and workshop has to be organized for the field staff on various issues of management. Officers at the executive level like the Forest Range Officer and District Forest Officer or Wildlife Warden may be offered certificate training on wildlife management at reputed institutes like Wildlife Institute of India, Dehradun or similar other institutes with same capacities.

Human beings in various positions and capacities form the most important resource for any organisation. For the success of organisation and achievement of organisational goals, a leader with vision, properly motivated staff with commitment to organisational goals, transparency in the system, accountability and a healthy work culture is essential. Due to its remoteness, the motivation levels of staff, especially the field staffs are very low which affects their performance drastically. Even though providing every facility in the remote outposts may not be possible, the following points are suggested to ameliorate their hardship.

i. As soon as a person is posted in the sanctuary, the Wildlife Warden may pay attention to give him/her proper orientation regarding the sanctuary, its significance, goals and expected role of the person posted.

ii. During this discussion, the strengths and weaknesses of the person can be assessed and a profile can be prepared for future guidance and counselling.

iii. For the field staff, wildlife management training, Avi Faunal diversity related, special skill improvement trainings and any other training required may be arranged as soon as possible.

iv. To break the monotony, staff can be taken on tours to other Protected Areas to learn experiences from other areas and to improve their performance.

v. Special lectures on several subjects relating to not only forestry and wildlife but also to social issues will be arranged inviting prominent persons. This will

help them sharpen their professional skills and also improve their personality traits.

vi. Functions on forestry, Environment and wildlife issues will be arranged for the staff locals to improve their professional sharpness and to keep them motivated and attached to their task.

vii. Periodical (Once in 3 months) open meetings with the entire sanctuary staff can be arranged by the Wildlife Warden to have their feedback on several aspects, to listen to their grievances and to do the needful to the maximum extent possible.

By taking care of their personal wellbeing, the staff can be motivated well and their commitment to the job can be ensured and this will be the foundation stone for a successful organisation.

12.3.1. Training :

Training is a very important tool for capacity building and improving the professionalism of the staff. The staff, while carrying on their normal duties, also needs to develop an understanding of various issues related to management at a professional level. Capacity building in this regard can best be achieved through trainings designed for this purpose.

Improving the knowledge and capacity of staff has several benefits. It helps them to carry out their duty with an increased understanding and awareness and hence with increased dedication. It gives them more confidence in their work. This helps them to deal with various stakeholder groups, such as local people and tourists, with more confidence. Improved skills and knowledge will improve their productivity and quality of output. Some areas where training will benefit the staff are as follows:

i. Knowledge and identification of bird species found in the sanctuary, Habits of species, biology and ecology of important species

ii. Elementary knowledge of reptile, amphibians, lepidoptera species found in the sanctuary

iii. Knowledge and identification of plants, including medicinal plants found in the area

iv. Wetland ecology, interdependence of plant and animal species

v. Monitoring methods, population estimation methods

vi. Anti-poaching skills and documentation of offence cases

vii. Conflict resolution skills for dealing with local people

viii. Weapon training

ix. Use of instruments such as compass, binoculars, digital camera, GPS

x. GPS skills

xi. Computer literacy

Field staff will be given small projects on which they should collect information from the field such as information on bird or plant species. Training should also be imparted to local people, particularly eco-guides and tour operators with the intention of upgrading their skills for tourism.

Some important training subjects are:

i. Wildlife (Protection) Act, 1972

ii. Skills of dealing with tourists

iii. Interpretational skills

iv. Skills on identification of bird species

v. Basic wetland ecology.

Professional organizations should be involved in developing and conducting training programmes. Officers of the department should also be involved in training programmes.

CHAPTER - XIII

ECO SENSITIVE ZONE

The Indian board for Wildlife in its 'Wildlife Conservation Strategy-2002' envisaged 'lands falling within 10 km of the boundaries of National parks and sanctuaries should be notified as eco-fragile zones under section 3 (v) of the Environment (Protection) Act and Rule 5 Sub rule (vii) & (x) of the Environment (Protection) Rules'. With concerns over applicability of the 10 km range, the National Board for Wildlife decided that 'delineation of eco-sensitive zones would have to be site specific and relate to regulation, rather than prohibition, of specific activities'.

The purpose of declaring Eco-sensitive zones around National Parks and sanctuaries is to create some kind of **'Shock Absorber'** for the protected areas and they would also act as a transition zone from areas of high protection to areas involving lesser protection.

Accordingly a draft proposal has been prepared and submitted to government for approval, which is pending. An area of 651.06 Ha. around the sanctuary which includes bunds, agriculture lands, peripheral Kanmois or Tanks and roads has been proposed for the Eco-sensitive Zone from ecological and environmental point of view.

Proposed Area of Eco-sensitive Zone :

Area of the Birds Sanctuary	104.21 ha
Area of the Eco-Sensitive zone totalling to an area of 651.06 Ha. around the sanctuary which includes bunds, agriculture lands, peripheral Kanmois or Tanks and roads)	651.06 ha
Total area of Eco-Sensitive Zone	**651.06 ha**

The status of lands proposed to be included in the Eco-Sensitive Zone are of the nature like, Patta Lands, Revenue Lands, Parambokes etc.,

CHAPTER - XIV

BUDGET

14.1. Financial Forecasting :

The financial implications of the Management Plan for the period 2013-2014 to 2017-2018 are as detailed in following paragraphs. The financial projections have been made for the following management prescriptions which are to be carried out during the plan period.

The Budget requirement for the proposed activities is given below in phased manner (annual) in the chapter.

14.2 Summary of Prescriptions :

14.2.1. Deepening of tank :

Kanjirankulam Bird Sanctuary is one of the renowned in the state with a very unique history. The local people have been protecting the Sanctuary for centuries because they have realised that the bird droppings falling into the tank create a liquid guano effect. Thus the water when used to irrigate crop fields increases the agricultural productivity greatly and saves the cost of fertilizers. Kanjirankulam displays one of the most concentrated populations of different species of birds in a compact area and thus it is an ornithologist's paradise. In order to increase the capacity and duration of water storage in the tank it is necessary to deepen the tank. This will in turn attracts more birds and will prolong their stay for a longer period of time.

14.2.2. Desilting and Cleaning of the channels :

Water from the Reghunatha Cauvery Channel comes into Kanjirankulam tank. Hence the channels carrying water from Reghunatha Cauvery Channel to Kanjirankulam need to be desilted to enable Kanjirankulam tank to be filled up during north east monsoon.

14.2.3. Uprootal / removal of Prosopis, *Ipomea carnea, etc., :*

The tank is partly rainfed and partly fed by feeder channels. There is lot of evapo-transpirational loss of water due to the presence of Prosopis found inside the tanks. *Ipomea carnea* is a fast invader and will replace other native vegetation from the site. Hence, the invasive species should be removed in order to prevent loss of water and destruction of habitat.

14.2.4. Planting of Acacia nilotica :

Acacia nilotica is the main species on which the birds roost in the Kanjirankulam Bird sanctuary. Of late some trees have wilted and died and they need to be replaced. Taller seedlings can be planted and provided with inputs like farm yard manure, VAM etc., Tree guards or fencing the entire block need to be provided to prevent damage. If only all these components and the amount indicated are given in entirety a successful plantation can be raised which would serve as a habitat to the birds.

14.2.5. Planting taller seedlings around the vicinity of the Bird Sanctuary and supply of multipurpose and fruit bearing seedlings in the ecological boundary :

The sanctuary surrounding is devoid of evergreen trees and vegetation except for the *Prosopis juliflora.* Planting taller seedlings would create a microclimate conducive for birds.

14.2.6. Creation of Ponds :

The sanctuary falls within the arid zone and the tank is being used for irrigation purpose as well. Though there is a general conservation feeling among the villagers towards avian fauna conservation but when it comes to livelihood of the villagers then agriculture takes the upper hand. Thereby during the post rainy season the water is drawn from the tank for irrigating the agriculture fields. Thus the water storage is hindered from prolonging it to be stored upto May – June. Therefore in order to retain water within the tank for a prolonged period, small ponds are essential so that they are below the level of sluice gates so that the water is not drained out. This would render prolonged stay of the winter migratory birds and in turn helps in breeding.

14.2.7. Creation of Mounds / Islands :

The sanctuary being a earthen pond or a tank, does not provide great diversity in terms of the habitat types likes the deep waters, shallow waters, mud flats, islands, shallow slopes etc., in order to provide variation in the habitat types so as to invite bird diversity it is essential to create such structures so as to attract bird diversity.

14.2.8. Releasing fish fingerlings :

Fingerlings must be released in the tank annually to ensure steady food supply for the birds coming to the Sanctuary.

14.2.9. Conducting periodical bird census :

The bird population can be monitored by conducting periodical i.e. monthly bird census for a period of six months starting from October to March. This will help us study the trends in bird arrival, bird stay, feeding and breeding.

14.2.10. Introduction of emergent plants on the edges of shore area :

Emergent plants like Typha, Arundodonax, Ipomea aquatic, Hygrophila auriculata, Polygonum glabrum, Oryza rufipogon, Saccharum sp, etc., can be introduced on the edges of shore area. Gentle slopy slopes should be provided at the shores to facilitate growth of aquatic vegetation to promote the use of this area by shore birds like stilts, shanks, sandpiper, etc.,

14.2.11. Conducting anti poaching camps during the season with the help of anti poaching watchers :

Around 4500 birds visit Kanjirankulam Bird Sanctuary every year. These birds need to be protected from poaching. Hence, anti-poaching watchers are necessary to patrol the area and protect the birds from poaching.

14.2.12. Creation of fodder banks away from the tank :

Occasional grazing is found in the sanctuary and this will have a negative impact on the dynamics of the wetland ecosystem by way of creating opening in the vegetation, soil disturbances, invasion of weeds and other alien species. Complete control of grazing will have a negative impact on the livelihood of the adjacent villagers as well as in the rapport of the department with the people. hence, it is proposed to create fodder banks of preferred species in an area away from the tank in order to cater to the needs of the villagers while protecting the tank from grazing.

14.2.13. Eco awareness camps :

With the introduction of environment studies as a compulsory subject in the school and college curriculum many students are willing to visit Kanjirankulam Bird Sanctuary. This apart a lot of visitors are also coming to Kanjirankulam Bird Sanctuary. To create the right kind of awareness regarding Wildlife and Bio-diversity conservation Eco camps must be conducted every year.

14.2.14. Improvement of signages, boards and interpretation center :

To create the awareness about the importance of Wildlife and Bio-diversity conservation and to highlight the role of Kanjirankulam Bird Sanctuary in

conservation of birds, the interpretation facilities at Kanjirankulam Birds Sanctuary has to be improved.

14.2.15. Construction and improvement of viewpoints, watch towers :

Watch towers need to be constructed and improved so as to have a better vision of birds by public and to enable efficient and better monitoring by department staff.

14.2.16. Improvement of visitors facilities such as walk paths, rest sheds, toilets, drinking water facilities, benches, etc., :

Kanjirankulam Birds Sanctuary being one of the most important wetland, large number of visitors come to see the migratory birds and to study the eco system. It is required to provide them with better staying facilities and toilets etc., so that more visitors can be attracted and the importance of sanctuary highlighted. Visitor amenities like sitting benches, shelter sheds, drinking water facility should be provided for visitors who come to watch birds and to take rest in the sanctuary.

14.2.17. Purchase of books, journals, etc., on Water Birds, Wetlands and publicity and printing of brochures :

Water Birds books, journals etc. need to be purchased and the available checklist of water birds and brochures on the sanctuary needs to be reprinted. Awareness can be created by preparing publicity material and distributing among the Visitors, Public and school children's. For preparing publicity material, computer, camera, projector etc., needs to be purchased.

14.2.18. Providing fencing to prevent trespassing into Kanjirankulam Bird Sanctuary :

The Kanjirankulam Bird Sanctuary is abutting the Kanjirankulam village. The sanctuary is under the constant threat of grazing and hence it is proposed to create fencing around the boundary so that the livestock and cattles be kept away.

14.2.19. Research / ecosystem study and monitoring works :

Periodical studies have to be undertaken during the duration of this Management Plan in Kanjirankulam to fill up the gaps in research and monitoring. Similarly, an inventory of vegetation including micro flora, inventory / checklist of species which serve as food to the birds, population dynamics of various species of birds, inter and intra species relationship, ecological niche of each species, specific habitat requirements etc., are some of the fields of research which should be undertaken. The work is proposed to be undertaken through part time research scholars interested in wildlife, with each study for duration of one year.

14.2.20. Skill Development Training and Exposure Visit to field staff :

Training needs to be provided to the field staff on habitat management and on birds to guide the visitors. To ensure successful implementation of wildlife management proposals, on-the-job training for 15 days needs to be given to watcher, guides and mazdoors locally by officers of Deputy Conservator of Forests rank, already trained in wildlife. The watchers have lot of knowledge and so training can be directed for training them on how to document the data collected and also on presentation skills to act as tourist guides. Exposure visits to other protected areas will supplement the knowledge and attitude of field staff.

14.2.21. Eco Development Works :

To elicit the co-operation of people in protecting the birds, eco development activities need to be undertaken. The road abutting the sanctuary has to be repaired for easy communication of villagers.

14.2.22. Vaccination of livestock around the Bird Sanctuary :

Disease is a natural component of population ecology and ecosystems and is one mechanism by which population numbers are regulated. However, anthropogenic activities can often create novel disease problems or increases in prevalence and frequency of existing disease tipping a 'balanced' system into one where losses are increased. Vaccination programmes, often supplemented by other disease control measures, can help control and even eliminate diseases affecting livestock.

14.2.23. Eco Tourism :

It is proposed to develop Eco Tourism in the Kanjirankulam Bird Sanctuary, Visitor Amenities, interpretations facilities, signages, information boards reading material etc., have to be provided. Eco Tourism should be taken up involving EDC. This component would include publicity, nature camps, learning gardens, improved interpretations center, Environment education techniques, nature trails etc.,

14.3. Non Recurring Expenditure :

(Rupees in Lakhs)

S. No.	Description of Work	2016-17	2017-18	2018-19	2019-20	2020-21
1	**Habitat Management**	(Rupees in lakhs)				
a	Raising Babul Plantation	0.40	0.44	0.48	0.52	0.57
b	Release of fish fingerlings to enrich the feeding ground for the birds	0.65	0.71	0.78	0.85	0.93
c	Formation of water hole inside the Sanctuary	3.00	-	3.33	-	3.66
d	Desilting water way for the tank (feeder channel)	-	3.00	3.30	3.60	4.00
e	Deepening of Tank to improve eco system	2.50	3.00	3.30	3.33	3.66
f	Providing mounds inside the tank	-	3.00	3.30	3.33	3.66
g	Clearing of invasive growth of Prosopis juliflora	1.80	2.00	2.20	2.22	2.44
H	Supply of multipurpose tree species to villages in and around the sanctuary	2.00	2.2	2.4	2.7	3.0
I	Planting taller seedlings in and around the sanctuary	1.0	1.1	1.2	1.3	1.4
2	**Protection**					
a	Maintenance and improvement of Watch Tower	0.50		0.60		0.72
b	Engaging birds Protection watcher	3.24	3.60	4.0	4.4	4.8
c	Survey for boundary demarcation and laying of survey stones.	2	2	-	-	-
d	Construction of Cairns	-	2	2	-	-
e	Fencing along the peripheral boundary of the Bird sanctuary	-	-	20	10	10

f	Maintenance of sanctuary interpretations centre facility	0.50	0.55	0.60	0.66	0.72
g	Awards to committed field staff	0.25	0.25	0.25	0.25	0.25
3	**Awareness and Publicity**					
a	Conducting nature camps to College, School students and EDC members	1.50	1.65	1.81	1.99	2.2
b	Awareness creation and publicity board	1.00	1.10	1.21	1.33	1.46
c	Maintenance of older boards	0.50	0.55	0.60	0.66	0.72
d	Printing publicity materials such as stickers, Pamphlets, booklets etc.,	1.00	1.10	1.21	1.33	1.46
e	Education and training to staff	1.00	1.10	1.21	1.33	1.46
4	**Eco Development Activities (Community based works)**					
a	Entry Point activities community based work	5.00	5.50	6.05	6.65	7.35
b	EDC formation	0.10	0.11	0.12	0.13	0.15
c	Creation of fodder banks in the community lands and government paramboke lands of the village	4.0	4.0	4.0	4.0	4.0
d	Supply of cooking vessels for community function	0.25		0.30		0.36
e	Supply of school bags to school children	0.50	0.55	0.60	0.66	0.72
f	Adjoining school improvement		1.0		1.00	
5	**Eco - Tourism**					
a	Wildlife Week Celebration	0.50	0.66	0.73	0.80	0.88
b	Nature trails	1.00	1.00	1.00	1.00	1.00
c	Providing drinking water facilities	2.00	1.00			

d	Engaging Tourist guides/training Eco guides	0.75	0.75	0.75	0.75	0.75
e	Improvement of visitors facilities \ amenities, watch towers, providing exhibits, etc.,	10.00	5.00	5.00	5.00	5.00
6	**Research**					
a	Habitat & Ecosystem study in Kanjirankulam Bird Sanctuary	2.00	2.00	2.00	2.00	2.00
7	**Village Development**					
a	Community Development Works within the village	5.00	2.00	2.00	2.00	2.00
b	Sport articles to youth of villages	0.25		0.30		0.50
c	Supply of Horticulture saplings to families @ 20 / land owner	0.60	0.75	0.80	0.90	1.00
8	**Monitoring**					
a	Sanctuary Monitoring committee	0.50	0.55	0.60	0.65	0.71
b	Census (Birds Population Estimation) once in month for 6 months	0.75	0.83	0.91	1.00	1.1
	Total	**54.04**	**51.05**	**56.94**	**56.34**	**64.63**

14.4. Fund Flow

The funds for carrying out the prescription of this Management Plan will be secured through Centrally Sponsored/Shared Schemes of the Government of India which are likely to be continued in the XIII Plan. Support of funding that may be possible by other agencies like Dept. of Environment, Corporate Social Responsibility and others will be attempted to be secured and works will be implement keeping the broad strategies/prescription highlighted in this Management Plan.

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GLOSSARY

ACFs – Assistant Conservator of Forests

CF – Conservator of Forests

CSMCRI – Central Salt Marine Chemical Research Institute

DFO – District Forest Officer

EDC – Eco Development Committee

EDO – Eco Development Officer

G.O – Government order

GIS - Geographical Information System

GOMMNP – Gulf of Mannar Marine National Park

GPS – Global Positioning System

LS Core Zone – Lean Season

MLA – Member of Legislative Assembly

MP – Member of Parliament

NEMS – North East Monsoon

NGO – Non Governmental Organization

PA – Protected Areas

PWD – Public work department

TWAD – Tamil Nadu Water and Drainage Department

WII – Wildlife Institute of India

WLW – Wildlife Warden

ZI – Zone of Influence

ANNEXURE – I

DISTRICT GAZETTE NOTIFICATION

DECLARATION OF CERTAIN AREAS IN RAMANTHAPURAM DISTRICT TO BE "THE KANJIRANKULAM BIRDS SANCTUARY" AND "THE CHITRANGUDI BIRDS SANCTUARY" UNDER WILDLIFE PROTECTION ACT.

(G.O.Ms.No.684 ,Environment and Forests,(FRV) 21st September 1989)

No.II (2) \EFR\6167\89- IN exercise of the powers conferred by sub section (I) of section 18 of the Wildlife (Protection) Act 1972 (Central Act 53 of 1972) the Governor of Tamilnadu hereby declared the areas described in the schedules I and II below to be the sanctuaries called "The Kanjirankulam birds sanctuary" and " The Chitrangudi birds sanctuary" respectively for the protection of birds in the area with effect from the date of publication of the notification in the Tamilnadu Government Gazette.

SCHEDULE.I

Ramanthapuram district, Mudukulathur taluk No.45, Pulvaykulam village

Name of the sanctuary – Kanjirankulam Birds sanctuary

S.F. Nos and area of the sanctuary- 71, Melakanjirankulam Kanmoi.

37.55 hectares. No.123, Keelakanjirankulam Kanmoi, 66.66 hectare.

BOUNDARIES

North - Starting from trijunction point of SF.Nos.142, 71 and 313 all of No.45 Pulvaykulam village, the boundary runs centrally towards east along southeeastern and western sides of SF.No.142 till it meets the trijunction point of SF.Nos.123,142 and 129 of the said pulvaykulam village.

East - Thence, the boundary runs generally towards south along the western side of SF.Nos. 129,111,130 all of the said pulvaykulam village

South- Thence, the boundary runs generally towards west along the northern side of SF.Nos.128, 110, 124, 125, 72, and 73 all of the said pulvaykulam villagae.

West- Thence, the boundary runs generally towards north along northern, eastern and Northern side of SF.Nos..142, eastern side of SF.No.312 southern, western, outher and eastern side of SF.No.313 of the said pulvaykulam village to the starting point

SCHEDULE.II

Ramanathapuram district, Mudukulathur taluk, No.52 Chitrangudi village.

Ramanthapuram-cum-Pasumpon Thevar Thirumagan, Sivaganga Forest division.

Name of the sanctuary - Chitrangudi Birds sanctuary

SF. Nos. and area of sanctuary – No.159 Chitrangudi Kanmoi (47.63 hectares)

Latitude –	78	28 minute
Longitude-	9	20 minute

BOUNDARIES

North - Starting from trijunction point of SF.Nos.154, 159 all of No.52. Chitrangudi Village , the boundary runs generally towards east along southern side of SF.No. 151, Southern, eastern and southern side of SF.No.152, southern side of SF.Nos.153, 154,155,156,157 southern and western side of SF.Mo.158 and common boundary of village No.51 Mela Mudukulathur village and SF.No.159 of No.52 Chitrangudi village till it meets the trijunction point of village No.51 Mela Mudukulathur village SF.Nos.150 and 159 of No.52 Chitrangudi village

East - Thence, the boundary runs generally towards south along the western side of SF.Nos. 150,161,162,169,170,171 and 174 all of the said chitrangudi village

South - Thence, the boundary runs generally towards west along northern side SF. Nos. 176,177,178,189,190, 204 and northern side of SF.No.205 all of the said Chitrangudi Village

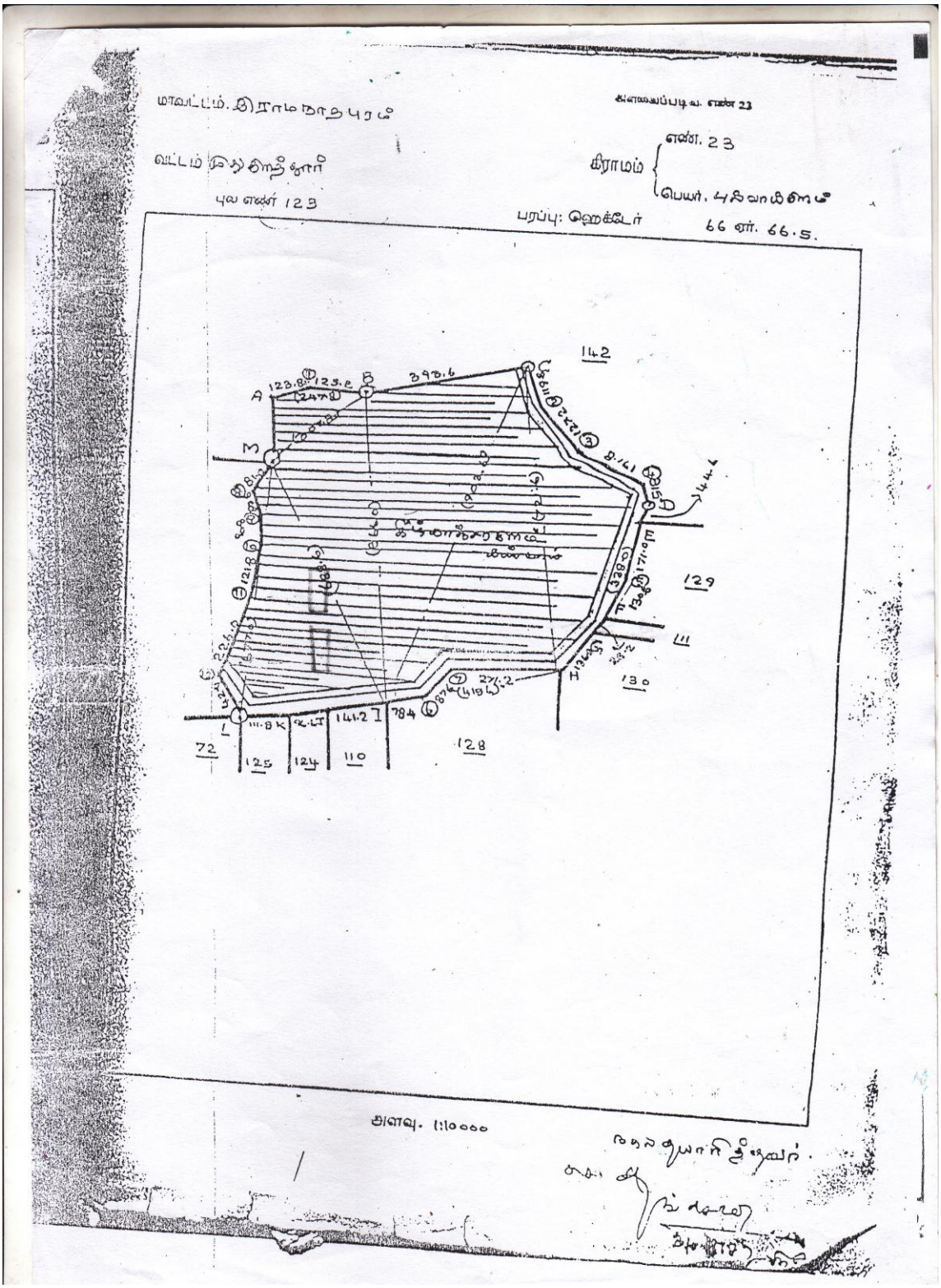
West - Thence, the boundary runs generally towards north along eastern side of Sf.No.154 of the said Chitrangudi village to the starting point.

D. SUNDARESAN,

SECRETARY TO THE GOVERNMENT.

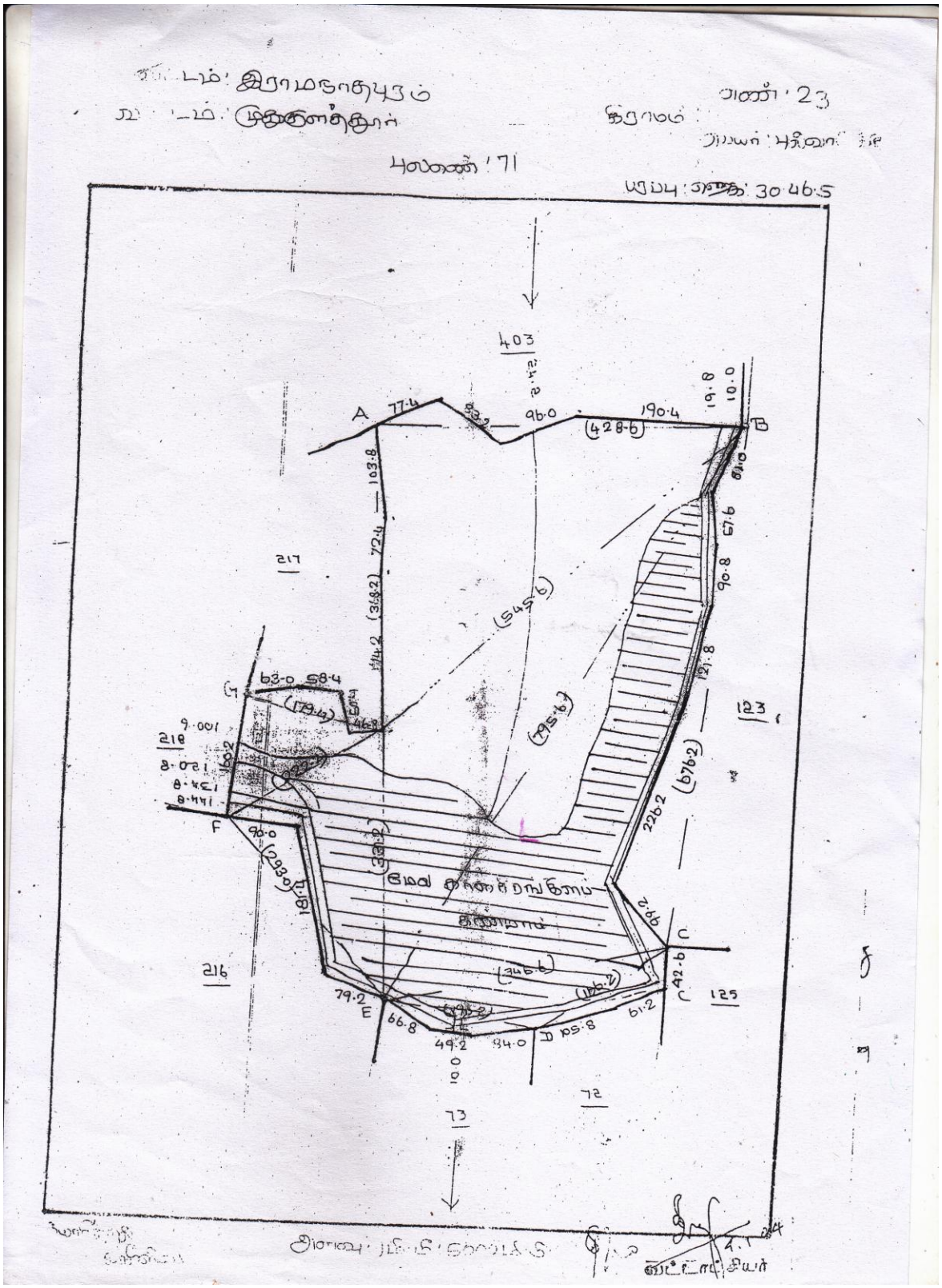
ANNEXURE - IA

FIELD MEASUREMENT BOOK & EXTRACT OF KEELA -KANJIRANKULAM TANK



ANNEXURE - IB

FIELD MEASUREMENT BOOK & EXTRACT OF MELA -KANJIRANKULAM TANK



ANNEXURE II (a & b)

LIST OF TANKS AND PONDS WITHIN 2 KM AROUND KANJIRANKULAM BIRD SANCTUARY

II (a) – Tanks (Locally called Kanmois)

Sl. No	Name	Remarks
1	Mayilamkulam Kanmoi	--
2	Kadambankulam Kanmoi	Good Condition; Recently
3	Mudukulthur Kanmoi	The only perennial kanmoi in the region
4	Enadi Kanmoi	--
5	Vachaendal Kanmoi	--
6	Aathikulam Kanmoi	--
7	Mochikulam Kanmoi	--
8	Vattamuthan Kanmoi	--
9	Chitrangudi Kanmoi	This tank houses Chitrangudi Birds' Sanctuary

II (b) - Ponds – Locally called Oorani

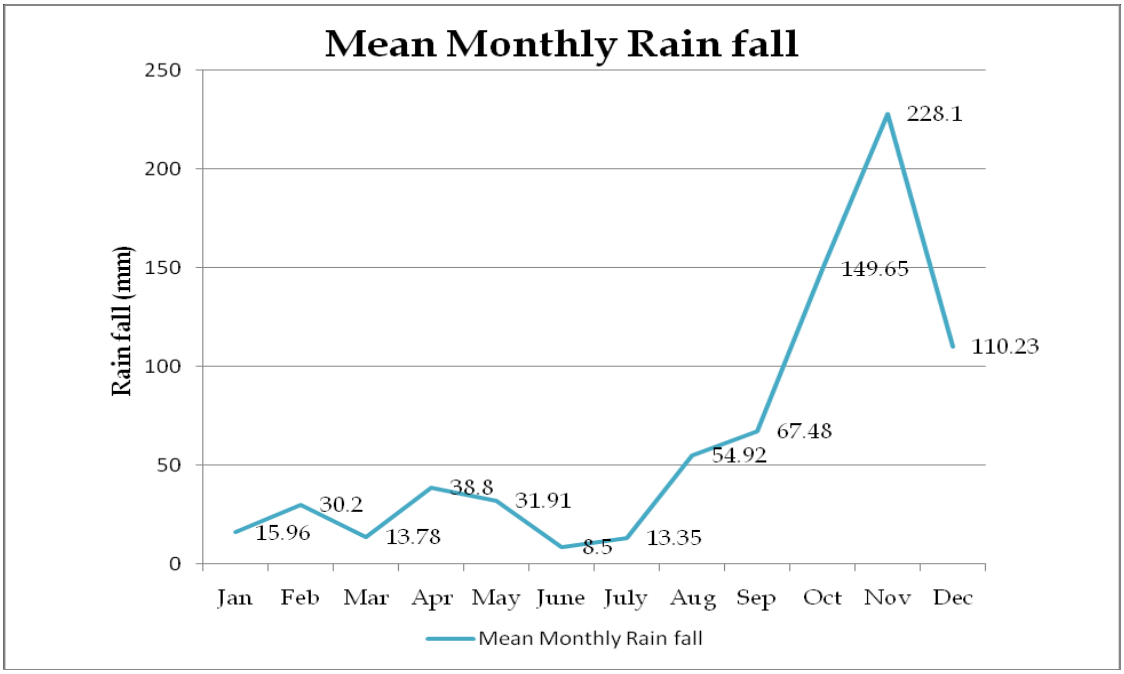
S. No	Name	Graticule (in decimal degrees)	Elevation (meters)	Remarks
1.	Mahadevar Muniappa Swamy Koil Oorani 1	09° 20' 56.1" N 78° 28' 28.3" E	26	Drinking Water
2.	Mahadevar Muniappa Swamy Koil Oorani 2	09° 20' 57.6" N 78° 28' 27.9" E	26	Drinking Water
3.	Pottal Oorani - Vallakulam	09° 20' 49.9" N 78° 28' 49.8" E	27	Drinking Water
4.	Etticheri Oorani	09° 21' 08.5" N 78° 29' 09.8" E	27	Drinking Water
5.	Etticheri Muniappa Swamy Koil Oorani	09° 21' 25.0" N 78° 29' 16.6" E	28	Day today ablutions
6.	Aacikulam Oorani	78° 28' 23.8" E 09° 22' 44.2" N	35	Day today ablutions
7.	Karishal Oorani	09° 21' 58.5" N 78° 28' 36.4" E	33	Irrigation, Drinking water
8.	Kurakanjiramkulam Oorani	09° 21' 22.5" N 78° 28' 41.4" E	35	Day today ablutions

ANNEXURE III (a, b & c) – RAINFALL

III (a) - Monthly Average Rainfall from 2000 to 2011

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2000	0	0	0	17	70	18	11	69	40	169	31	78	503
2001	9	0	5	2	0	5.2	18.2	0	56	97	195.8	167.8	556
2002	26	0	0	0	113.5	0	76	55.3	90.6	45	253.2	194.8	854.4
2003	0	85.2	0	4.4	19.8	18.9	0	75.6	33.6	217	58.4	21	534.5
2004	89.6	94.2	30	51.8	0	10.2	0	0	197.6	91.6	137	139	841
2005	8.7	25.5		93		10.7	5	23.6	171.6	171	117.7	16.4	643.2
2006	0	138.4	0	0	91	0	0	29	26	226.6	113.6	48.1	660.7
2007	0	0	59	38.6	33	39	4	0	21	209	170.4	1	575
2008	18.1	6.2	0	0	13.2	0	12.3	62.3	13.8	123.9	482.2	185.2	917.2
2009	22.3	0	57.6	149.1	10.6	0	0	67.1	91.9	12.2	565.7	194.4	1170.9
2010	17.9	0	0	0	0	0	33.7	182.2	67.3	283.9	385.2	128.9	1099.1
2011	0	12.9	0	109.7	0	0	0	95	0.4	361.1	227	148.2	954.3
Average R.F	**15.96**	**30.2**	**13.78**	**38.8**	**31.91**	**8.5**	**13.35**	**54.92**	**67.48**	**149.65**	**228.1**	**110.23**	**775.77**

III (b) - Graph I



III (c) – Number of Rainy days in every season

Sl. No	Season	Months	Rainfall	
			Normal (mm)	**Number of Rainy days**
1	Winter	January and February	67.4	4
2	Summer	March, April and May	122.6	6
3	South West Monsoon	June, July, August and September	135.4	16
4	North East Monsoon	October, November and December	501.6	28
	Total		**827.0**	**54**

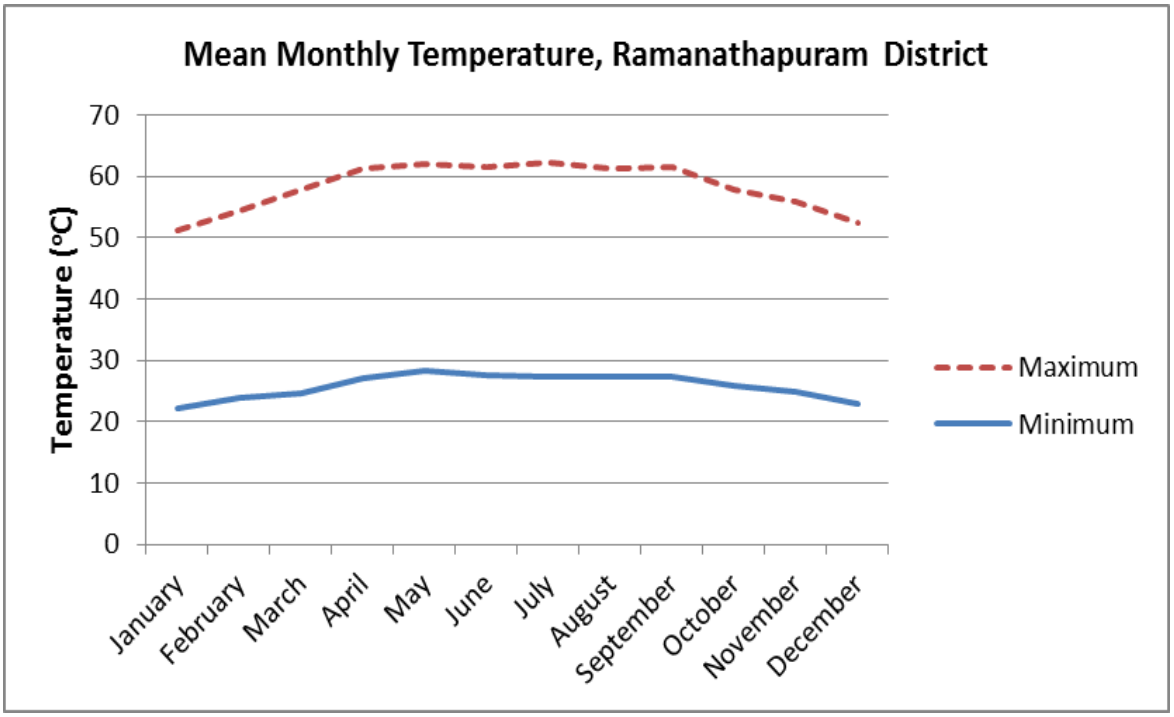
ANNEXURE IV (a & b)

Monthly Average Temperature and Relative Humidity, Ramanathapuram District

IV (a) - Table

Month	Temperature ºC		Relative Humidity %	
	Minimum	Maximum	Maximum	Minimum
January	22.1	29.1	86.1	54.2
February	23.8	30.6	89.0	56.0
March	24.7	33.1	89.0	56.0
April	27.1	34.1	89.0	56.0
May	28.3	33.6	89.0	56.0
June	27.6	33.8	89.0	56.0
July	27.3	34.9	89.0	56.0
August	27.3	33.9	89.0	56.0
September	27.3	34.1	89.0	56.0
October	25.9	31.9	89.0	56.0
November	24.8	31.0	89.0	56.0
December	23.0	29.5	89.0	56.0

IV (b) - Graph – II


Mean Monthly Temperature, Ramanathapuram District
Temperature (°C)
70
60
50
40
30
20
10
0
January
February
March
April
May
June
July
August
September
October
November
December
Maximum
Minimum

ANNEXURE V (a & b)

PARAMETERS TO BE ANALYSED FOR SOIL SAMPLE ANALYSIS

V (a) – Physico-Chemical Parameters and Macro and Micro Nutrients

S. No.	Name of the Parameters
1	Texture
2	Lime Status
3	Ph
4	EC (m.mho/sec)
5	Macro Nutrients (Kg/ha) – N, P, K
6	Micro Nutrients (Kg/ha) – Cu, Mn, Fe, Zn

V (b) - Microbial Load

S. No.	Name of the Parameters
1	E.*coli* MPN/10g
2	THB cfu log
3	TFC cfu log

Contact addresses of Monitoring institutions:

1. Soil Testing Laboratory, Paramakudi - Physico-Chemical Parameters and Macro and Micro Nutrients
2. Suganthi Devadasan Marine Research Institute (SDMRI), Tuticorin, Email-sdmri1@sancharnet.in, Phone: 0461-2325692 – Microbial Studies

Contact Address of Organizations for conducting Population Surveys:

1. Bombay Natural History Society, Hornbill House, S.B. Singh Road, Mumbai 400 023. Tele: 022-2821811
2. Salim Ali Centre for Ornithology & Natural History, Kalayampalayam, Coimbatore - 641 010. Tele: 0422 - 2807973, 2807983, E-Mail : centre@sacon.ernet.in

ANNEXURE VI

FLORA OF KANJIRANKULAM BIRD SANCTUARY

S. No	Family	Species	Tamil Name
1	Amaranthaceae	***Achyranthes aspera*** L.	Nayurivi
2	Arecaceae	***Borassus flabellifer*** L.	Panai
3	Asclepiadaceae	***Calotropis gigantea*** (L.) R.Br.	Erukku
4	Caesalpiniaceae	***Senna auriculata*** (L.) Roxb.	Avaram, Avaarai
5	Caesalpiniaceae	***Tamarindus indica*** L.	Puliya maram
6	Capparidaceae	***Cleome viscosa*** L.	Nai kadugu, Nai vaelai
7	Combretaceae	***Terminalia catappa*** L.	Natvadumai, Naattu Badaam
8	Convolvulaceae	***Ipomoea carnea*** Jacq.	Neivelikatamanakku
9	Cyperaceae	***Cyperus arenarius*** Retz.	
10	Euphorbiaceae	***Croton bonplandianum*** Baill.	Rail poondu
11	Euphorbiaceae	***Phyllanthus reticulatus*** Poir.	Inki pazham
12	Euphorbiaceae	***Euphorbia hirta*** L.	Ammanpacharisi
13	Euphorbiaceae	***Tragia involucrata*** L.	Chenthatti, Kaanjori
14	Euphorbiaceae	***Phyllanthus amarus*** Schum. & Thonn.	Kizha-nelli
15	Euphorbiaceae	***Chrozophora rottleri*** (Geiseler) Juss.	
16	Fabaceae	***Alysicarpus monilifer*** (L.) DC.	
17	Fabaceae	***Tephrosia purpurea*** (L.) Pers.	Kozhinji, Kollukaai vaelai
18	Fabaceae	***Pongamia pinnata*** (L.) Pierre	Punga maram
19	Malvaceae	***Abutilon indicum*** (L.) Sweet	Thuthi, Nalla thuthi
20	Martyniaceae	***Martynia annua*** L.	Thael Kodukku
21	Meliaceae	***Azadirachta indica*** A. Juss.	Vaembu, Vaeppam
22	Mimosaceae	***Prosopis juliflora*** (Sw.) Dc.	Seemakkaruvai

23	Mimosaceae	***Acacia leucophloea*** (Roxb.) Willd.	Velvelam
24	Mimosaceae	***Acacia nilotica*** (L.) Willd. ex Del.	Karuvelam
25	Mimosaceae	***Acacia planifrons*** Wight & Arn.	Kodaivelam, Udai maram
26	Molluginaceae	***Glinus oppositifolius*** (L.) A. DC.	
27	Nyctaginaceae	***Boerhavia diffusa*** L.	Mookarattai
28	Poaceae	***Eragrostis viscosa*** (Retz.) Trin.	
29	Poaceae	***Cynodon dactylon*** (L.) Pers.	Arugam pullu
30	Poaceae	***Perotis indica*** (L.) Kuntze	Narival pullu
31	Rubiaceae	***Morinda pubescens*** J.E. Smith	Manjanatti
32	Sapindaceae	***Cardiospermum halicacabum*** L.	Mudakatthan
33	Scrophulariaceae	***Scoparia dulcis*** L.	Sarakkotthini
34	Solanaceae	***Datura innoxia*** Mill.	Oomatthai
35	Verbenaceae	***Phyla nodiflora*** (L.) Greene	Poduthalai

ANNEXURE VII

ANNOTATED CHECKLIST OF BIRDS IN KANJIRANKULAM SANCTUARY

Common name	Scientific name	Conservation Status	Status in Sanctuary	Migratory Status
Grebes	Podicipedidae			
Little Grebe	*Tachybaptus ruficollis*	Least Concern	C	R, B
Pelicans	Pelecanidae			
Spot-billed Pelican	*Pelecanus philippensis*	Near Threatened	C	R,B
Cormorants	Phalacrocoracidae			
Little Cormorant #	*Phalacrocorax niger*	Least Concern	C	R,B
Great Cormorant	*Phalacrocorax carbo*	Least Concern		
Darters	Anhingidae			
Darter #	*Anhinga melanogaster*	Near Threatened	U	R,B
Herons, Egrets & Bitterns	Ardeidae			
Little Egret	*Egretta garzetta*	Least Concern	C	R,B
Grey Heron	*Ardea cinerea*	Least Concern	C	R,B
Purple Heron	*Ardea purpurea*	Least Concern	U	R
Large Egret	*Casmerodius albus*	Least Concern	U	R,B # M
Median Egret	*Mesophoyx intermedia*	Least Concern	U	R,B
Cattle Egret	*Bubulcus ibis*	Least Concern	C	R,B
Indian Pond-Heron	*Ardeola grayii*	Least Concern	C	R,B
Black-crowned Night-Heron	*Nycticorax nycticorax*	Least Concern	C	R,B
Yellow Bittern	*Ixobrychus sinensis*	Least Concern	R	R
Storks	Ciconiidae			
Painted Stork #	*Mycteria leucocephala*	Near Threatened	C	R,B
Asian Openbill-Stork	*Anastomus oscitans*	Least Concern	C	R,B
Ibises & Spoonbills	Threskiornithidae			
Oriental White Ibis #	*Threskiornis melanocephalus*	Near Threatened	C	R,B
Glossy Ibis	*Plegadis falcinellus*	_	U	R,M
Eurasian Spoonbill	*Platalea leucorodia*	Least Concern	C	R
Geese & Ducks	Anatidae			

Northern Pintail	*Anas acuta*	Least Concern	C	M
Common Teal	*Anas crecca*	Least Concern	U	M
Garganey	*Anas querquedula*	Least Concern	C	M
Hawks, Eagles, Buzzards, Vultures, Kites, Harriers	Accipitridae			
Black-shouldered Kite	*Elanus caeruleus*	Least Concern	U	R,B
Black Kite	*Milvus migrans*	Least Concern	U	R,B
Brahminy Kite	*Haliastur indus*	Least Concern	U	R,B
Pallid Harrier	*Circus macrourus*	Least Concern	U	M
Pied Harrier	*Circus melanoleucos*	Least Concern	U	M
Shikra	*Accipiter badius*	Least Concern	C	R,B
Falcons	Falconidae			
Common Kestrel	*Falco tinnunculus*	Least Concern	U	M
Pheasants, Partridges, Quails	Phasianidae			
Grey Francolin	*Francolinus pondicerianus*	Least Concern	M	R,B
Indian Peafowl	*Pavo cristatus*	_	C	R,B
Rails, Crakes, Moorhens, Coots	Rallidae			
White-breasted Waterhen	*Amaurornis phoenicurus*	Least Concern	C	R,B
Common Coot	*Fulica atra*	Least Concern	U	R
Lapwings	Charadriidae	Least Concern		
Red-wattled Lapwing	*Vanellus indicus*	Least Concern	C	R,B
Sandpipers, Stints, Snipes, Godwits & Curlews	Scolopacidae			
Common Snipe	*Gallinago gallinago*	Least Concern	U	M
Common Greenshank	*Tringa nebularia*	Least Concern	R	M
Wood Sandpiper	*Tringa glareola*	Least Concern	U	M
Green Sandpiper	*Tringa ochropus*	Least Concern	U	R
Little Stint	*Calidris minuta*	Least Concern	U	M
Ruff	*Philomachus pugnax*	Least Concern	U	M

Stilts	Recurvirostridae			
Black-winged Stilt	*Himantopus himantopus*	Least Concern	C	R #M
Gulls &Terns	Laridae			
Whiskered Tern	*Chlidonias hybridus*	Least Concern	U	M
Pigeons & Doves	Columbidae			
Blue Rock Pigeon	*Columba livia*	Least Concern	C	R,B
Little Brown Dove	*Streptopelia senegalensis*	Least Concern	C	R,B
Spotted Dove	*Streptopelia chinensis*	Least Concern	C	R,B
Eurasian Collared-Dove	*Streptopelia decaocto*	Least Concern	C	R,B
Parakeets	Psittacidae			
Rose-ringed Parakeet	*Psittacula krameri*	Least Concern	C	R,B
Cuckoos, Malkohas & Coucals	Cuculidae			
Pied Crested Cuckoo	*Clamator jacobinus*	Least Concern	U	R,B
Brainfever Bird	*Hierococcyx varius*	Least Concern	C	R,B
Indian Plaintive Cuckoo	*Cacomantis passerinus*	_	U	P
Asian Koel	*Eudynamys scolopacea*	Least Concern	C	R,B
Small Green-billed Malkoha	*Phaenicophaeus viridirostris*	_	U	R,B
Greater Coucal	*Centropus sinensis*	Least Concern	C	R,B
Barn Owls	Tytonidae			
Barn Owl	*Tyto alba*	_	U	R,B
Owls	Strigidae			
Spotted Owlet	*Athene brama*	Least Concern	C	R,B
Nightjars	Caprimulgidae			
Indian Jungle Nightjar	*Caprimulgus indicus*	_	U	R,B
Common Indian Nightjar	*Caprimulgus asiaticus*	_	U	R,B
Swifts	Apodidae			
Asian Palm-Swift	*Cypsiurus balasiensis*	Least Concern	M	R,B

House Swift	*Apus affinis*	Least Concern	U	R
Kingfishers	Alcedinidae			
Small Blue Kingfisher	*Alcedo atthis*	Least Concern	U	R,B
White-breasted Kingfisher	*Halcyon smyrnensis*	Least Concern	C	R,B
Lesser Pied Kingfisher	*Ceryle rudis*	Least Concern	U	R,B
Bee-eaters	Meropidae			
Small Bee-eater	*Merops orientalis*	Least Concern	C	R,B
Blue-tailed Bee-eater	*Merops philippinus*	Least Concern	C	M
Rollers	Coraciidae			
Indian Roller	*Coracias benghalensis*	Least Concern	C	R,B
Hoopoes	Upupidae			
Common Hoopoe	*Upupa epops*	Least Concern	C	R,B
Barbets	Capitonidae			
Brown-headed Barbet	*Megalaima zeylanica*	Least Concern	U	R
Coppersmith Barbet	*Megalaima haemacephala*	Least Concern	C	R,B
Woodpeckers	Picidae			
Lesser Golden-backed Woodpecker	*Dinopium benghalense*	_	C	R,B
Yellow-crowned woodpecker	*Dendrocops mahrattensis*	_	U	R,B
Pittas	Pittidae			
Indian Pitta	*Pitta brachyura*	_	C	P
Larks	Alaudidae			
Singing Bush-Lark	*Mirafra cantillans*	Least Concern	U	R
Ashy-crowned Sparrow-Lark	*Eremopterix grisea*	Least Concern	C	R
Swallows & Martins	Hirundinidae			
Common Swallow	*Hirundo rustica*	Least Concern	C	M
Red-rumped Swallow	*Hirundo daurica*	Least Concern	U	M
Wagtails & Pipits	Motacillidae			
Large Pied Wagtail	*Motacilla maderaspatensis*	Least Concern	U	R

Forest Wagtail	*Dandronanthus indicus*	_	C	P
Richard's Pipit	*Anthus richardi*	Least Concern	C	R
Paddyfield Pipit	*Anthus rufulus*	Least Concern	C	R,B
Woodshrikes	Campephagidae			
Common Woodshrike	*Tephrodornis pondicerianus*	_	U	R
Bulbuls	Pycnonotidae			
Red-vented Bulbul	*Pycnonotus cafer*	Least Concern	C	R,B
Ioras	Irenidae			
Common Iora	*Aegithina tiphia*	_	U	R
Shrikes	Laniidae			
Brown Shrike	*Lanius cristatus*	Least Concern	C	M #P
Bay-backed Shrike	*Lanius vittatus*	_	U	R,B
Thrushes, Robins,	Turdinae			
Oriental Magpie-Robin	*Copsychus saularis*	Least Concern	C	R,B
Indian Robin	*Saxicoloides fulicata*	Least Concern	C	R,B
Babblers	Timaliinae			
Common Babbler	*Turdoides caudatus*	_	U	R,B
White-headed Babbler	*Turdoides affinis*	_	C	R,B
Prinias, Warblers	Sylviinae			
Jungle Prinia	*Prinia sylvatica*	_	C	R,B
Ashy Prinia	*Prinia socialis*	_	C	R,B
Blyth's Reed-Warbler	*Acrocephalus dumetorum*	Least Concern	M	M
Paddy field Warbler	*Acrocephalus Agricola*		U	M
Common Tailorbird	*Orthotomus sutorius*	Least Concern	C	R
Greenish Leaf-Warbler	*Phylloscopus trochiloides*	Least Concern	C	P
Cisticola	Sylviinae			
Zitting cisticola	*Cisticola juncidis*		U	R
Flycatchers	Muscicapinae			

Asian Brown Flycatcher	*Muscicapa dauurica*	_	C	M
Brown-breasted Flycatcher	*Muscicapa muttui*	_	U	P
Paradise-Flycatchers	Monarchinae			
Asian Paradise-Flycatcher	*Terpsiphone paradisi*	_	C	M
Flowerpeckers	Dicaeidae			
Tickell's Flowerpecker	*Dicaeum erythrorhynchos*	_	C	R
Sunbirds	Nectariniidae			
Purple-rumped Sunbird	*Nectarinia zeylonica*	Least Concern	C	R
Purple Sunbird	*Nectarinia asiatica*	_	C	*R*
Loten's sunbird	*Nectarinia lotenia*		U	R
Munias (Estrildid Finches)	Estrildidae			
White-throated Munia	*Lonchura malabarica*	_	C	R
Spotted Munia	*Lonchura punctulata*	_	U	R
Black-headed Munia	*Lonchura malacca*	Least Concern	U	R
Sparrows	Passerinae			
House Sparrow	*Passer domesticus*	Least Concern	C	R
Weavers	Ploceinae			
Baya Weaver	*Ploceus philippinus*	Least Concern	U	R
Starlings & Mynas	Sturnidae			
Brahminy Starling	*Sturnus pagodarum*	_	C	M
Common Myna	*Acridotheres tristis*	Least Concern	M	R,B
Rosy Starling	*Sturnus roseus*	Least Concern	A	M
Orioles	Oriolidae			
Eurasian Golden Oriole	*Oriolus oriolus*	Least Concern	U	M
Drongos	Dicruridae			
Black Drongo	*Dicrurus macrocercus*	Least Concern	C	R
Ashy Drongo	*Dicrurus leucophaeus*	_	C	M
Woodswallows	Artamidae			

Ashy Woodswallow	*Artamus fuscus*	_	U	R
Crows, Treepies	Corvidae			
Indian Treepie	*Dendrocitta vagabunda*	Least Concern	C	R
House Crow	*Corvus splendens*	Least Concern	M	R,B
Jungle Crow	*Corvus macrorhynchos*	Least Concern	C	R,B

RB= Resident and breeding, R= Resident but breeding not noticed in this area, SM= Local or short distant migrants, W= Wintering Migrants, C=common. UC=uncommon, Ra= Rare, V=vagrant

Source: Dr. Balachandar, BNHS.

Key: Status in Sanctuary

A: Abundant, M: Most Common, C: Common, U: Uncommon, R: Rare, H: Historical records, V: Vagrant

Status	Near- Threatened	Least-Concerned
Abundant	>1000	>5000
Most-Common	>500	>1000
Common	50-500	100-1000
Un-common	10-50	10-100
Rare	<10	<10

Migratory Status: R: Resident, M: Migratory, P: Passage Migrant, B: Breeding

ANNEXURE VIII

CHECK LIST OF MAMMALS, AMPHIBIANS AND REPTILES IN KANJIRANKULAM BIRD SANCTUARY

S. No.	Common name	Scientific name	IUCN Status
Mammals			
1	Indian Grey Mongoose	Herpestes edwardsii	LC
2	Indian Palm Squirrel	Funambulus palmarum	LC
3	Golden Jackal	Canis aureus	VU
4	Black -naped Hare	Lepus nigricollis	LC
5	Bandicoot Rat	Bandicota bengalensis	LC
Reptiles			
1	House Gecko	Hemidactylus frenatus	
2	Spotted Indian Gecko	Hemidactylus brookii	
3	Garden lizard	Calotes versicolor	
4	Green lizard	Calotes calotes	
5	Monitor lizard	Varanus bengalensis	
6	Common Indian Skink	Eutrophis carinata	
7	Olive Keelback	Atretium schistosum	
8	Checkered Keelback	Xenochrophis piscator	
9	Common Vine Snake	Ahaetulla nasuta	
10	Indian Cobra	Naja naja	
11	Indian Black Turtle	Melanochelys trijuga	
Amphibians			
1	Common Indian Toad	Duttaphrynus melanostictus	
2	Ornate Narrow mouthed frog	Microhyla ornata	
3	Common Skittering frog	Euphlyctis cyanophlyctis	