

# ECOSYSTEM SERVICES - LIVELIHOOD LINKAGES OF POINT CALIMERE WILDLIFE AND BIRD SANCTUARY, TAMIL NADU

AN ASSESSMENT FOR INTEGRATED MANAGEMENT



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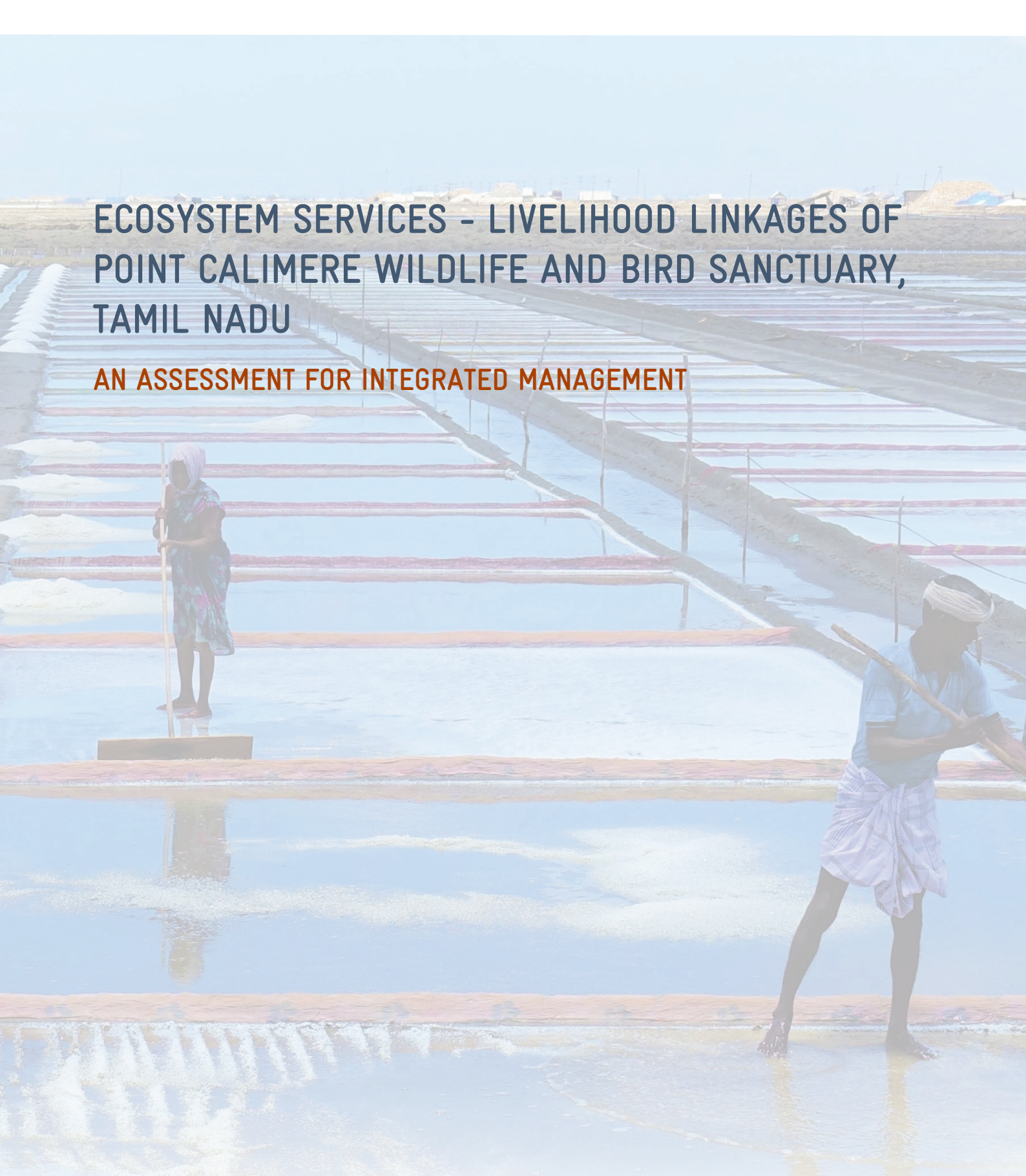
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New Delhi, 2023



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# 1 POINT CALIMERE WETLAND COMPLEX

## 1.1 Introduction

Wetlands are among the most productive ecosystems and provide crucial ecosystem services. India has a wealth of wetland ecosystems that support diverse habitats and has recently designated its 75th Wetland of International Importance (Ramsar site). Wetlands have been under constant threat of environmental degradation due to natural as well as anthropogenic activities. The wise use of rapidly depleting wetland resources is a global concern today. During the past few decades, many efforts have been made world over to prevent exploitation of these ecosystems. Holistic and integrated planning for the conservation and preservation of wetland resources is gaining momentum. Being diverse, the conservation measures for each wetland vary accordingly. The Ramsar Convention and the Convention on Biological Diversity (CBD) are the two global landmark initiatives for wetland conservation.

Despite their values and the potential policy synergies, wetlands have been, and continue to be, lost or degraded by various factors. It is estimated that nearly one-third of Indian wetlands have been lost and converted to alternate uses in the last three decades. This has triggered biodiversity loss, changes to ecological functions and changes to ecosystem service flows, with subsequent impacts on the health, livelihoods and well-being of communities and economic activity. An integrated wetland management plan balances ecosystem conservation with supporting livelihoods of wetland-dependent communities.

Point Calimere Wildlife and Bird Sanctuary (henceforth called Point Calimere Wetland Complex), in Tamil Nadu, is one of the coastal wetlands designated a Ramsar site in 2002. The GIZ (Indo-German Biodiversity Programme, Wetland Management for Biodiversity and Climate Protection) has extended support to DHAN Foundation for taking up a detailed study for the Point Calimere wetland to support the site managers in the preparation of an integrated management plan.

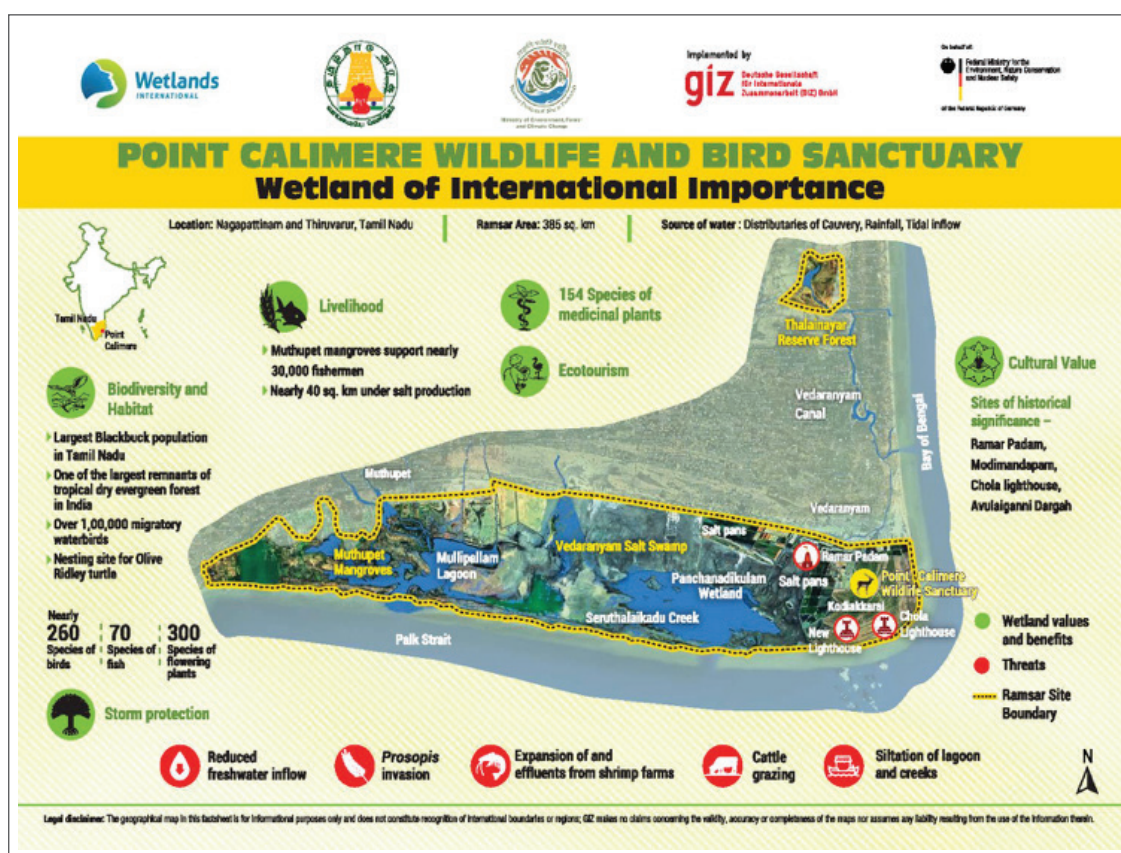
## 1.2 Point Calimere Wetland Complex

Coastal wetlands are among the most pristine ecosystems on earth. They support many ecosystem services for coastal protection and play an essential function in climate change adaptation. One such coastal wetland is Point Calimere, in Tamil Nadu. Point Calimere Wildlife Sanctuary (10° 18' N; 79° 51' E) (established in 1967), along with the Great Vedaranyam Swamp, was declared a Ramsar Wetland Site (No. 1210) at the eighth meeting of the Conference of the Parties (COP 8). The total area of the Point Calimere Wetland Complex is 38,500 ha. It is situated in Nagapattinam, Thiruvarur and Thanjavur districts. The sanctuary gets its name from Point Calimere, the spot in the sanctuary where the coast takes a 90° turn from the Bay of Bengal towards the Palk Strait, in southern India. The Point Calimere Wetland comprises Point Calimere Wildlife Sanctuary (2250.17 ha), the Muthupet mangroves (11885.91 ha), the Panchanathikulam wetlands (8096.96 ha), the un-surveyed salt swamps (15030.19 ha) and the Thalainayar Reserve Forests (1236.77 ha) (TNSWA, 2020). The Point Calimere Wetland Complex is a mix of Tropical Dry Evergreen Forests (TDEF), tidal mudflats, tidal creeks, lagoons, swamps, backwaters and mangroves. Point Calimere Wildlife Sanctuary forms the eastern limit of the Ramsar site. This Tropical Dry Evergreen Forests of the sanctuary are considered to be the best in the country, both in terms of species richness and conservation status. The Muthupet area, within the wetland complex, is the largest mangrove wetland in Tamil Nadu, with an area of 11,900 ha, including a 1700 ha lagoon. It constitutes the western limit of the Ramsar site. *Avicennia marina* is the dominant mangrove species in the Muthupet mangrove forest. PCWC acts as a bio-shield against natural disasters, tsunamis, storm surges, floods and cyclones.



The Ramsar Convention recognises the dependence of people on wetlands for their important economic, cultural, scientific and recreational values. A growing understanding of the economic benefits of wetlands has resulted in significant expenditure in some countries on wetland restoration and rehabilitation of lost or degraded hydrological and biological functions of wetlands. However, concerted action at the global scale will be needed if we are to avert the worst consequences of global climate change and increased pressure on water resources. The wetland ecosystem of Point Calimere provides many services to the people living in that area. The wetlands act as a habitat for many birds and animals and breeding ground for fishes and protect the coastline from soil erosion and other natural disasters. People practice many livelihood activities such as inland fishing, agriculture, aquaculture, herb collection and salt production.

### 1.3 The Biodiversity of the Point Calimere Wetland Complex



Map 1 Point Calimere fact sheet illustrating wetland values and threats

Point Calimere's biodiversity is rich due to the diversity of its ecosystems. About 317 species of plant have been recorded in the dry evergreen forest (48% herbs, 33% climbers and shrubs, 19% arborescent species) (Map 1). The seashore hosts 28 species of herb, of which nine species are grasses, five are sedges and 16 are herbs. The commonly found species are *Cynodon dactylon*, *Cyperus species* and *Sporobolus tremulus*. In the small islets present within the Seruthalaikadu Lagoon, three tree species, 12 shrub species and 21 species of herb are found. *Salvadora persica*, *Prosopis juliflora*, *Suaeda maritima*, *Salicornia branchiata*, *Sporobolus tremulus* and *Cyperus bulbosus* are common plants. In the mangrove forest, nine tree species and seven shrub species are found. *Avicennia marina* is the dominant species of this area. The other two common mangrove species are *Excoecaria agallocha* and *Aegiceras corniculatum*. Seventy fish species are found in the wetland. A total of 257 species of bird

have been recorded, of which 119 are waterbirds. Every year around 1,00,000 waterbirds migrate to the site during winter. Globally threatened species can be spotted in the wetland areas of the sanctuary. Every year, large numbers of Greater and Lesser Flamingos visit the wetland. This wildlife sanctuary harbours 14 mammal species and one of the largest populations of Blackbuck in south India. The other mammal species found are Spotted Deer, Wild Boar, Jackal and Flying Fox. The wetland in the sanctuary is a breeding ground for many species of prawn, crab and fish. The Point Calimere coast is a nesting site for Olive Ridley Turtles. Apart from this, around 50,000 families are directly dependent on wetland-based livelihoods such as fishing, salt production, shrimp farming, agriculture and allied activities.

## 1.4 Relevance of the Study

The Point Calimere wetland Complex provides various ecosystem services, but due to a variety of factors the significance of the wetland is deteriorating. Aquaculture farms, saltpans, encroachments, industrial salt production, in the Great Vedaranyam Swamp, exploitative fishing, cattle grazing, collection of firewood, poaching and agriculture are some of the activities that have led to a decline in the population of migratory birds, as their habitat and diversity have been affected (Prabhadevi & Reddy, 2012). On the other hand, the site is prone to natural disasters such as tsunamis, storms, cyclones, and floods. The project area is highly sensitive to human activities and climate change.

Livelihoods such as fishing, saltpan operation, agriculture and aquaculture are highly dependent on the Point Calimere wetland ecosystem. Therefore, it is important to involve the wetland-dependent community in protecting the wetland and its ecosystem. It is essential to have an integrated and systematic management plan for the Point Calimere site to secure the sustainability of the wetland.

With the overall goal of securing and enhancing wetland biodiversity and ecosystem services, DHAN Foundation, initiated the study titled “Assessment of Ecosystem Services of Point Calimere Ramsar Site and People’s Interdependence on Them, and to Recommend Management Measures for Sustaining the Wetland-Dependent Livelihoods and Maintaining Ecological character of Point Calimere Ramsar Site.”



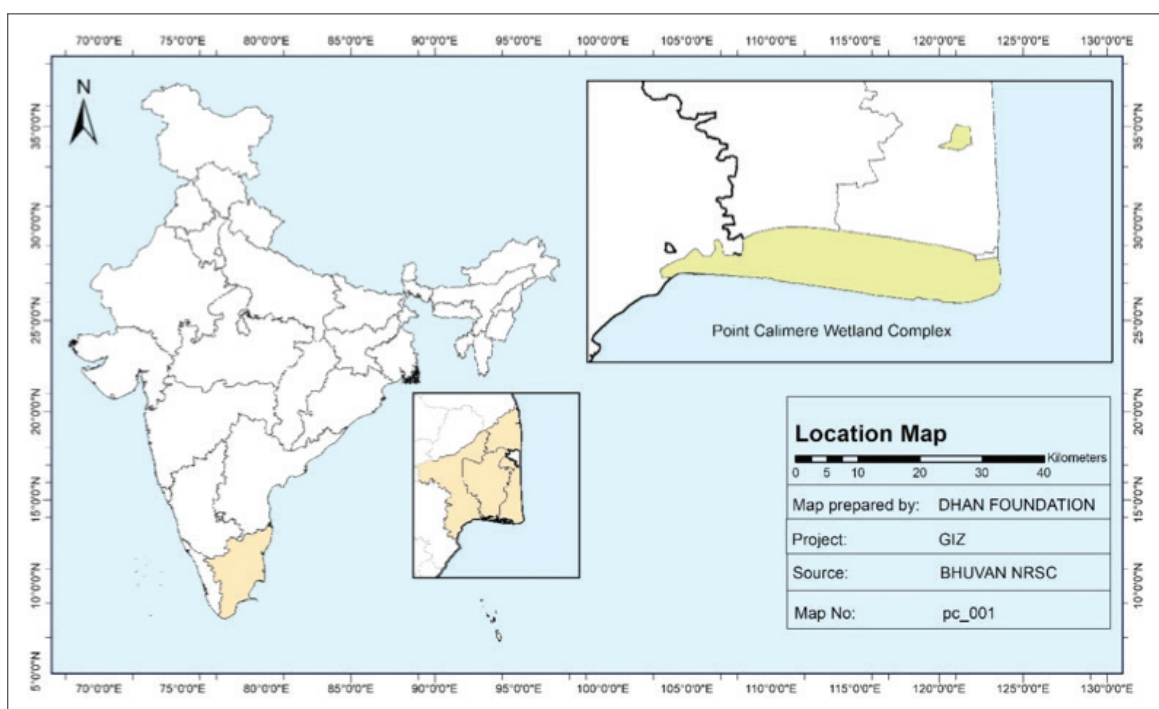
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## 2 STUDY AREA AND STUDY DESIGN

### 2.1 Study Area

The study was carried out in the Point Calimere Wetland Complex, which spreads across three districts, three administrative taluks and four development blocks along a 60 km stretch of Palk Bay coastline, from Adirampattinam to Kodiakarai and extends up to Thalainayar (Map 2).



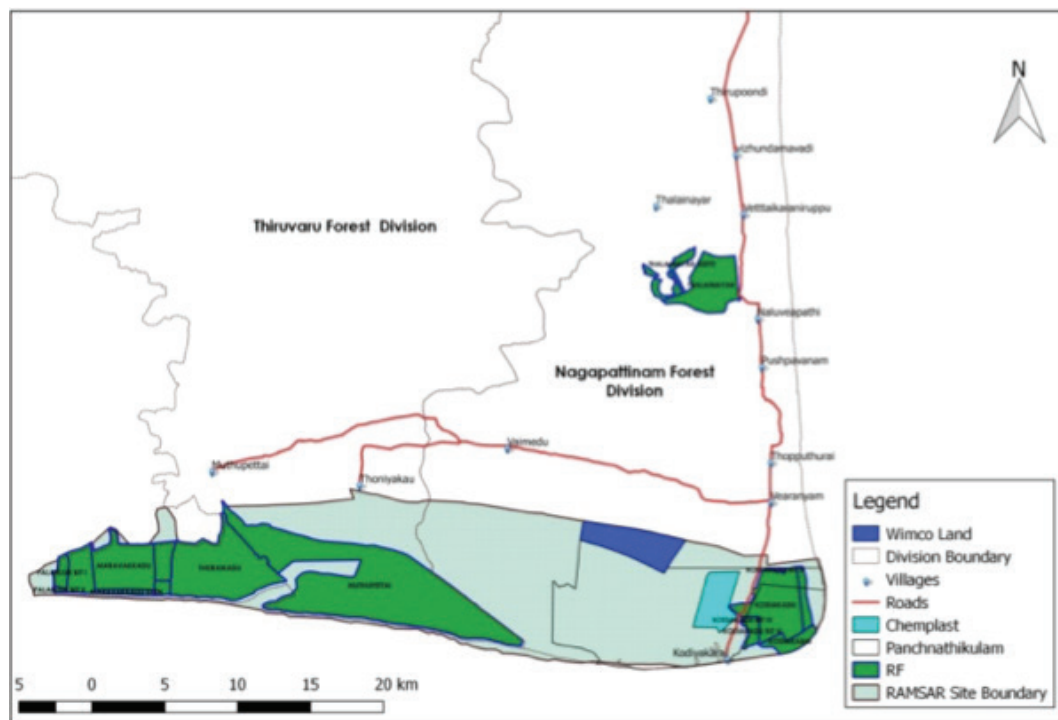
**Map 2** Map of study area

The Point Calimere Wetland Complex has two protected areas, designated Block-A and Block-B. Block-A is located within Thanjavur and Thiruvarur districts, and Block-B is in Nagapattinam district. A part of Block-A (the Palanjur, Maravakadu, Thambikottai Vadakadu and Thamarankottai reserve forests) is located in Pattukkottai taluk and in Pattukkottai Development Block, of Thanjavur district. The other part (the Muthupet, Thuraikadu and Thondiyakadu reserve forest areas) is located in Thiruthuraipoondi taluk and in Muthupet Development Block, of Thiruvarur district. Block-B, including Point Calimere Wildlife and Bird Sanctuary, is located in Vedaranyam taluk, of Nagapattinam district, covering both Vedaranyam Development Blocks. The Thalainayar reserve forest is not a contiguous part of the Point Calimere Wetland Complex but is located 18 km north of Block-B, in the Adappar estuarine region. Apart from these protected areas, the Point Calimere Wetland Complex also has many other components, including an extensive mudflat.

#### 2.1.1 Block-A – Muthupet Mangroves

The sanctuary was notified in 2013, with a total area of 11,885.91 ha. Of this, 9304.73 ha is located in Thiruthuraipoondi taluk, of Thiruvarur district, and an area of 2581.18 ha is in Pattukkottai taluk, of Thanjavur district. The salient feature of Block-A is Mullipallam lagoon (henceforth Muthupet lagoon), surrounded by mangroves. Block-A receives fresh water from the distributaries of Cauvery River, Nasuviniyar, Pattuvanachiyar, Paminiyar, Koraiyar, Kilaithangi, Marakakorayar, Kanthapirichan channel and Valavanar and creates an interface of saltwater

and fresh water to maintain the ecological balance of the sanctuary. According to Champion and Seth's classification of forests, Block-A of Point Calimere Wildlife Sanctuary falls into two categories, viz, 4B/TS1 Mangrove Scrub and 4B/TS2 Mangrove Forest, under 4B Tidal Swamp Forest. 4B/TS1 is dominated by halophytes and the others by mangrove species. The sanctuary is an important feeding ground for migratory waterbirds that come from different parts of the world. Every year the sanctuary attracts more than 70 species of waterbirds from September to February. In the first half of the migratory period, i.e., from October to December, the population of smaller birds like teals and ducks is large as the water is deeper. As water starts receding from December onwards, larger birds such as Painted Storks and Openbill Storks start congregating in Block-A. Rare migratory waterbirds visit this part of the sanctuary and roost here, while certain species also breed. Map 3 shows Block-A and Block-B of the Point Calimere Wetland Complex.



**Map 3** Forest division and Ramsar boundary map (Source: Forest Department)

### 2.1.2 Point Calimere Wildlife Sanctuary and Block-B

The sanctuary was created in 1967 and Block-B was notified in 2013. The salient features of Point Calimere Wildlife Sanctuary and Block-B are the Tropical Dry-Evergreen Forest (TDEF) and the grasslands. There is a small patch of mangrove forest, fringing Muniappan Lake, within the sanctuary. Nearly half the sanctuary is under TDEF and thickets, which have nearly 300 species of flowering plant, including 198 species of medicinal plant (TNSWA 2020). The sanctuary is home to the largest population of the endemic Blackbuck (*Antelope cervicapra*) in south India. Point Calimere Sanctuary is also famous for large congregations of waterbirds, particularly the Greater Flamingo.

## 2.2 Study Villages

A total of 32 Gram Panchayats, two Town Panchayats (Thalainayar and Muthupet) and a Municipality (Vedaranyam) are dependent on the various ecosystem services of the Point Calimere Wetland complex. They fall in four development blocks in three districts. The names of the districts, blocks and gram panchayats are given in Annexure I.

A detailed study was conducted in the selected blocks in 15 sample villages mentioned in Table 1, in which the ecosystem-based services were assessed along with the dependence of livelihoods on them and their impact on the wetland. In some cases, the entire gram panchayat was selected, whereas in some cases, small settlements or hamlets were selected. The selection criteria for the sample villages included the dependence of the villages on the wetlands. Livelihood dependence was particularly given priority. These villages are also diverse as they are adjacent to different ecosystems and habitats present in the wetland, and thus the livelihood practices also differ.

**Table 1** Villages and hamlets selected for detailed study (wherever a hamlet is selected for detailed study, the name of the gram panchayat to which it belongs is given in parentheses)

Forest Division	District	Block	S.No.	Village
Block-A	Thanjavur	Pattukkottai	1	Manganankadu (Soundaranayakipuram)
			2	T. Maravakadu
	Thiruvarur	Muthupet	3	Akkaraikadu (Jambuvanodai)
			4	Sengangkadu (Thillaivilagam)
			5	Thondiyakadu
			6	Karpaganatharkulam
Block-B	Nagapattinam	Vedaranyam	8	Annapettai
			9	Chinthamani Kadu (Voimedu)
			10	Sakkaranpettai(Pannal)
			11	Seruthalaikadu (Panchanathikulam Middle)
			12	Agasthiyampalli (Vedaranyam)
			13	Kodiyakkadu
			14	Kodiyakarai
		Thalainayar	15	Vandal (Thalainayar)

## 2.3 Study Design

The PCWC serves as an important habitat for the existing flora and fauna and serves the local communities living in the bordering villages. Moreover, the site provides many ecosystem-based services to the people in and around the area. Over the decades it has been affected by various natural and anthropogenic factors. Hence, it is important to protect this biodiversity-rich site with the involvement of all the stakeholders. 'Assessment of Livelihood-Ecosystem Interdependencies for Integrated Management of Point Calimere Ramsar Site, Tamil Nadu, India' is a detailed study that includes different components such as ecosystems, livelihoods, stakeholders, drivers of change, trends, and the socio-economic status of the dependent community. A clear study design has been prepared to collect various



socio-economic status of the dependent community. A clear study design has been prepared to collect various primary and secondary data and review the literature to bring out a comprehensive study report on integrated management and sustainable development of the site and the dependent community.

## 2.4 Objectives of the Study

The following are the objectives of the present assessment.

- Assessment of ecosystem services provided by the Point Calimere wetland
- Documenting the socio-economic profile of communities dependent on the Point Calimere wetland
- Assessment of governance and institutional arrangements in the selected villages
- Assessment of the interlinkages between ecosystem services and livelihoods, trends in livelihood and ecosystem interlinkages (last 20 years) and impacts on the livelihoods due to changes in the wetland and the ecological character of Point Calimere
- Identifying drivers of changes impacting wetland-dependent livelihoods
- Making recommendations for integrated management and making institutional arrangements for effective management of the Point Calimere Ramsar site

## 2.5 Study Methodology

During the study (December 2019 to December 2020) the following tools and techniques were involved.

- (a) Exploration of the Point Calimere wetland landscape
- (b) Stakeholder Mapping & Future search conference for wetland
- (c) Understanding the landscape and its dependence: Focus group discussions (FGD), transect walks, identifying key informants, stakeholder interactions
- (d) Rapid assessment of ecosystem services (RAWES)
- (e) Participatory ecosystem services assessment (PESA)
- (f) Secondary data collection, sample survey
- (g) Case studies
- (h) Participatory GIS (PGIS)
- (i) Data analysis and report preparation

### 2.5.1 Exploring the Point Calimere Wetland Landscape

In the beginning, the study team had a very limited understanding of the PCWC and its boundary. Later, while reviewing the literature, going through maps and holding consultations with Forest Department and GIZ, the understanding developed. One of the assignments of this study was to fix the wetland boundary in Muthupet and the Great Vedaranyam Swamp for the assessment. Initially, the Ramsar boundary was defined up to Adirampattinam. The inception document was submitted. After that GIZ organised a consultation meeting. This enabled the team to have a clear understanding of the boundary and the selection of sample villages. Finally, the sample villages were selected, in Thanjavur, Thiruvarur and Nagapattinam districts.

## 2.5.2 Stakeholder workshop



*Image 1 Muthupet stakeholders' workshop*

As per the commitment of the study, two stakeholders' workshops were organised, at Vedaranyam and Muthupet. The participation of all the stakeholders in the workshops was good, which helped us align our study with the objectives.

### **(a) Vedaranyam and Muthupet stakeholders' workshops**

A stakeholders' workshop was organised at Vedaranyam, Nagapattinam district, on 13 February 2020 at Vedaranyam Block Development office in which 33 stakeholders participated. The Vedaranyam stakeholders' workshop was attended by participants from Vedaranyam and Thalainayar blocks of Nagapattinam district. In Muthupet another stakeholders' workshop was organised on 18 February 2020, in which 93 representatives of stakeholders from Pattukkottai block, of Thanjavur district, and Muthupet block, of Thiruvarur district, participated.

The key stakeholders in these workshops were members and leaders of the fisherfolk community, farmers, elected people's representatives of gram panchayats, block panchayats and district panchayats, members of Village Forest Committees, representatives of Uzhavar Mamanrams (farmers' clubs) and Women SHG Federations and officials from line departments such as the Forest, Fisheries, Agriculture, Coast Guard and Public Works departments. Professionals and staff members of DHAN Foundation also participated in these workshops. Annexures II and III provide lists of participants of the stakeholders' workshops.

### **(b) Future Search Conference for Wetland**

The three-day 'Future Search Conference for Point Calimere Wetland Complex' was organised by DHAN Foundation. Various stakeholders who are directly dependent on the PCWC were involved. The conference was organised in Muthupet, of Thiruvarur district, from 14 to 16 March 2020.



**Image 2** Future Search Conference

Future Search Conference is a participative, collaborative, strategic planning method that enables people to create a plan for the most desirable future of their community. It is a plan by the people and for the people and is held at the villages where the people reside, and the process takes 24 hours over 3 days. The Future Search Conference is a practical way of building communities who step up to the challenges faced during turbulent times and take responsibility for directing changes in a responsible manner. As the world becomes more and more unstable, there is an increased need for people to form communities to search for desirable futures together.

The purpose of the FSC was to establish a common ground for the development of new strategies that are:

- Pro-active, creative, effective and collaborative
- Vigilant, responding flexibly and adequately to changes in the environment

This FSC was facilitated by Mr. Frank Heckman and Mr. Peter from Embassy of Earth, The Netherlands. In addition, Tamil Nadu Forest Department and GIZ, New Delhi also extended their support.

The participants of the conference were fringe fishermen, marginal farmers, Panchayat Presidents, leaders of fishermen's associations, members of women's SHGs, officers and staff members of the marine police, officers of the Tamil Nadu Forest Department and DHAN Foundation. Besides, students from the National Institute of Rural Development (NIRD), Hyderabad and the DHAN Academy, Madurai, also participated in the conference, along with Ms Avantika and Mr. Xavier Francis from GIZ, New Delhi. Annexure IV: Proceedings of FSC



### 2.5.3 Understanding the landscape and its dependence: FGD, transect walk, identifying key informants, stakeholder interaction



**Image 3** FGD in Vandal village

On the basis of the leads from the stakeholders' workshops and Future Search Conference, transect walks, along with focus group discussions (FGDs), were organised to understand the villages, communities, livelihoods, resources, ecosystems, etc. Further, key informants from each village were consulted to further the stakeholders' interaction with Panchayat Presidents, staff members of the Forest Department and Fisheries Department, leaders of fishermen's associations and salt producers' associations, etc.

#### **RAPID ASSESSMENT OF WETLAND ECOSYSTEM SERVICES (RAWES)**

The ecosystem services in the selected study areas were assessed using the Rapid Assessment of Wetland Ecosystem Services (RAWES) approach, which was adopted under Ramsar Resolution XII.17 (Ramsar Convention 2018) as a rapid and cost-effective method for systematic assessment of ecosystem services provided by wetlands. As per the recommendation of the GIZ technical team and consultant, the RAWES tools were used, and data were collected for the sample villages. This process broadened the idea to design the Participatory Ecosystem Services Appraisal (PESA) tool to gather rich knowledge from the community. Annexure V: The Consolidated RAWES Sheet-4

#### **PARTICIPATORY GEOGRAPHIC INFORMATION SYSTEM (PGIS)**

GIS platforms were created to link the technical team of DHAN Foundation with the community and the Forest Department to prepare a GIS map for the Point Calimere Wetland Complex. Relevant data and research studies were referred for better understanding by the technical team. The reference points cover the entire landscape and ecosystems. Based on this, LULC, NDVI, fishing route, saltpan and boundary maps were prepared.

## Participatory Ecosystem Services Appraisal (PESA)



**Image 4** PESA process in Manganankadu Village

Having three decades of experience of working with communities, DHAN evolved the concept of PESA to collect primary information from communities. Applying the PESA techniques, information was collected in an interactive manner. The collected information was very helpful for the team to prepare a detailed study report. The Participatory Ecosystem Services Appraisal was developed based on the RAWES sheet provided by GIZ. This helped develop an understanding of the Point Calimere wetland ecosystems from an international perspective along with our experience in the Participatory Learning Method, involving the community, to understand village ecosystems.

### **COLLECTION OF SECONDARY DATA, SAMPLE SURVEY AND SECONDARY DATA**

To strengthen the study, primary and secondary data were collected by members of the field staff and the study team from VAOs, village panchayats, the Forest Department, the Fisheries Department, the Census of India website, Human Development Index, etc. This provided additional information about the socio-economic status of people who depend on the PCWC.

### **CASE STUDIES**

Case studies were prepared for the different ecosystem-based livelihoods by covering the entire landscape and community. Further, these case studies refine our understanding of wetland-dependent livelihoods.

### **DATA ANALYSIS AND REPORTING**

Using the aforesaid tools, primary and secondary data and maps, were collected, analysed, consolidated and interpreted. The study report was then discussed the DHAN Advisory Committee. A report was prepared on the basis of the reflections of the seniors and GIZ consultants at the meeting. The objective was to provide sustainable livelihoods and achieve integrated management of the Point Calimere Wetland Complex by integrating the recommendations from various key stakeholders and study output.

## THE CONSULTATION AND DELIBERATION WORKSHOP

A consultation workshop was organised on the basis of suggestions, feedback and support from the GIZ technical team and DHAN Foundation at an advisory committee meeting to get expert recommendations and opinions to finalise the study and submit the final report.

# 3 SOCIO-ECONOMIC STATUS OF COMMUNITIES DEPENDENT ON POINT CALIMERE WETLAND COMPLEX

## 3.1 Introduction

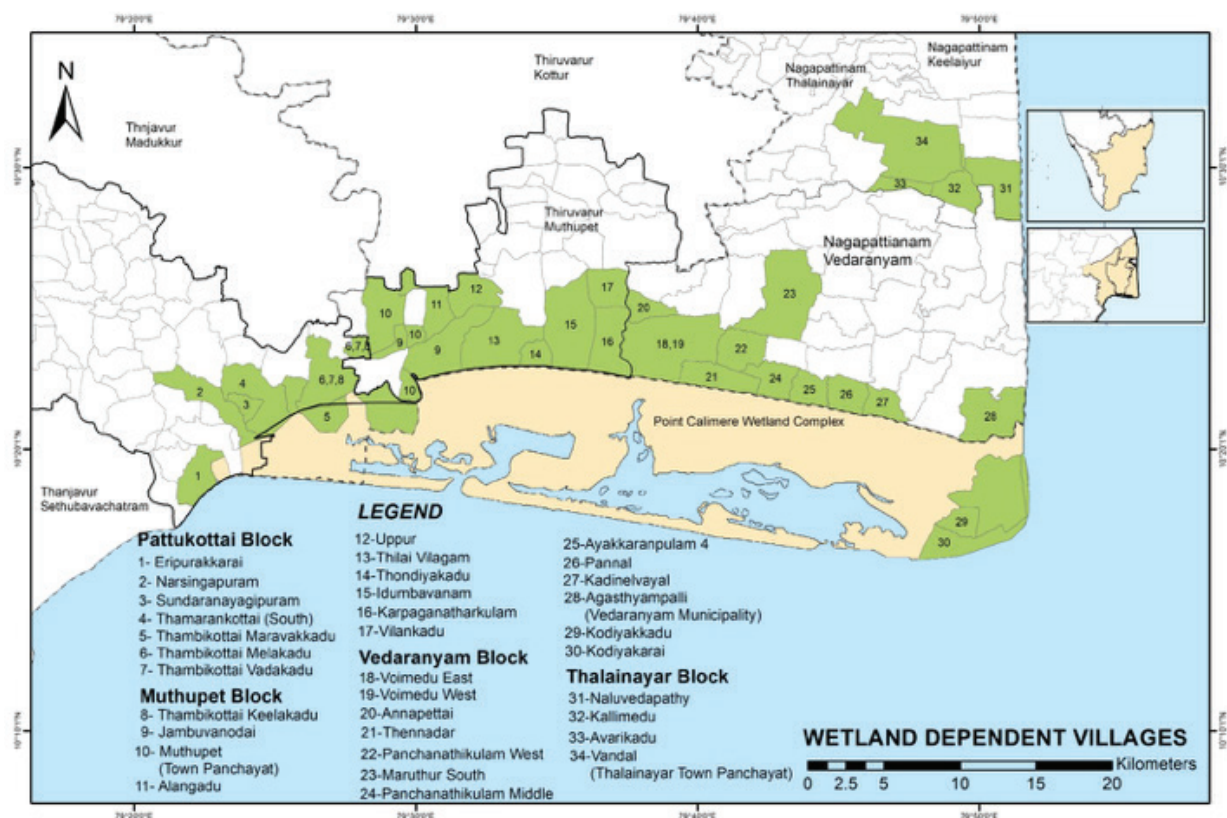
Around 34 villages are dependent on PCWC for various services. Of these, 15 highly dependent villages were taken as sample villages for the study (Table 2). From the available and collected data, inferences are made to understand the socio-economic status of the community of these sample villages. The dependent gram panchayats and town panchayats are shown in Map 4.

**Table 2** Villages and hamlets selected for detailed study (wherever a hamlet was selected for a detailed study, the name of the gram panchayat to which belongs to is given in parentheses)

Forest Division	District	Block	S. No.	Hamlet (gram panchayat)	Existing Ecosystem	Major Livelihoods
Block-A	Thanjavur	Pattukkottai	1	Manganankadu (Soundaranayakipuram)	Mangroves, creeks and agriculture	Fishing
			2	T. Maravakadu	Mangroves, creeks, aquaculture and agriculture	Fishing and agriculture
	Thiruvarur	Muthupet	3	Akkaraikadu (Jambuvanodai)	Lagoon, thottam (pits and puddles in the mudflats), mangroves, aquaculture and agriculture	Fishing and agriculture
			4	Sengankadu (Thillaivilagam)	Lagoon, thottam, mangroves and aquaculture	Fishing
			5	Thondiyakadu	Thottam, mangroves and agriculture	Fishing and Agriculture
			6	Karpaganatharkulam	Thottam and agriculture	Fishing and agriculture
Block-B	Nagapattinam	Vedaranyam	8	Annapettai	Thottam, valavanar and Agriculture	Fishing and agriculture
			9	Chinthamani Kadu (Voimedu)	Thottam, valavanar and agriculture	Fishing and agriculture
			10	Sakkaranpettai (Pannal)	Thottam, Saltpan and agriculture	Fishing and agriculture



Forest Division	District	Block	S. No.	Hamlet (gram panchayat)	Existing Ecosystem	Major Livelihoods
Block-B	Nagapattinam	Vedaranyam	11	Seruthalaikadu (Panchanathikulam Middle)	Thottam, Chellakanni Creek and Saltpan	Fishing
			12	Agasthiyampalli (Vedaranyam)	Saltpan	Salt production
			13	Kodiyakadu	Forest, thottam, Saltpan, bird sanctuary and agriculture	Fishing and agriculture
			14	Kodiyakarai	Forest and wildlife sanctuary, thottam and sea	Fishing
			15	Vandal (Thalainayar)	Mangroves, river and backwater	Fishing and agriculture



Map 4 The 34 gram panchayats and town panchayats along the periphery of the Point Calimere wetland

## 3.2 Demographic details of the wetland-dependent gram panchayats

In the buffer zone of the Point Calimere Wetland Complex, 34 gram and town panchayats are dependent on the wetland for their livelihoods. The basic demographic details of these villages are given in Table 3.

Table 3 Demographic details of dependent gram panchayats and town panchayats of Point Calimere wetland (the sample panchayats have been highlighted)

S. No.	District	Block	Gram Panchayat	Total Number of Households	Total Population of Village	Total Male Population of Village	Total Female Population of Village	Total Scheduled Caste Population of Village	Total Scheduled Tribe Population of Village
1	Thanjavur	Pattukkottai	Eripurakarai	995	4285	2047	2238	1093	0
2			Narasingapuram	479	1848	867	981	337	0
3			<b>Soundaranayakipuram Managanankadu</b>	379	1371	586	785	4	0
4			Thamarankottai South	922	3120	1373	1747	319	8
5			Thambikottai Maravakad	728	2721	1312	1409	308	0
6			<b>Thambikottai Melakkadu</b>	722	2613	1227	1386	68	4
7			Thambikottai Keelakadu	728	2721	1312	1409	308	0
8			Thambikottai Vadakadu	941	3338	1623	1715	283	29
9	Thiruvarur	Muthupet	Alangadu	923	3364	1603	1761	427	0
10			Uppur	807	2793	1330	1463	184	0
11			<b>Jambuvanodai</b>	1104	3839	1812	2027	1016	0
12			<b>Thillaivilagam</b>	1928	6803	3275	3528	1057	0
13			<b>Thondiyakkadu</b>	487	1607	769	838	164	0
14			<b>Karpaganatharkulam</b>	657	2112	952	1160	0	0
15			<b>Idumbavanam</b>	2127	7345	3615	3730	1397	0
16			Vilangadu	559	1946	914	1032	7	0

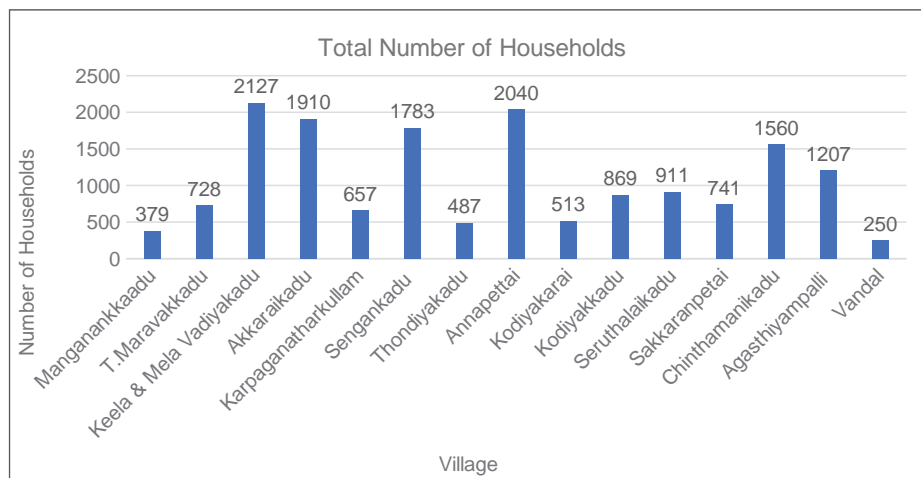
S. No.	District	Block	Gram Panchayat	Total Number of Households	Total Population of Village	Total Male Population of Village	Total Female Population of Village	Total Scheduled Caste Population of Village	Total Scheduled Tribe Population of Village
17	Thiruvarur	Muthupet	Muthupet town panchayat	5102	21722	10585	11137	1939	96
18	Nagapattinam	Vedaranyam	<b>Annapettai</b>	2040	7384	3609	3775	966	4
19			<b>Voimedu East</b>	994	3751	1898	1853	889	6
20			<b>Voimedu West</b>	566	2006	983	1023	252	0
21			<b>Panchanathikulam Middle</b>	911	3115	1522	1593	457	0
22			Pachanathikulam West	770	2833	1390	1443	1151	0
23			Pannal	741	2523	1261	1262	541	0
24			Kadinelvayal	448	1594	816	778	479	0
25			Marudur Therku Sethi	1240	4350	2180	2170	1103	0
26			Thennadar	498	1774	875	899	645	0
27			Ayakkaranbulam IVth Sethi	581	2016	1043	973	387	0
28			<b>Kodiyakkadu</b>	869	3085	1489	1596	194	0
29			<b>Kodiakarai</b>	513	2128	1152	976	615	0
30		Thalainayar	Kallimedu	215	801	402	399	227	0
31			Avarikadu	181	676	339	337	191	0
32			Naluvadapathi	1418	4819	2447	2372	208	0
33		Vedaranyam	<b>Agasthiyampalli of Vedaranyam Municipality</b>	1110	4386	2122	2264	653	8
34		Thalainayar	<b>Vandal of Thalainayar Town Panchayat</b>	337	1251	613	638	425	2
			<b>Total</b>	<b>33,020</b>	<b>12,2040</b>	<b>59,343</b>	<b>62,697</b>	<b>18,294</b>	<b>157</b>



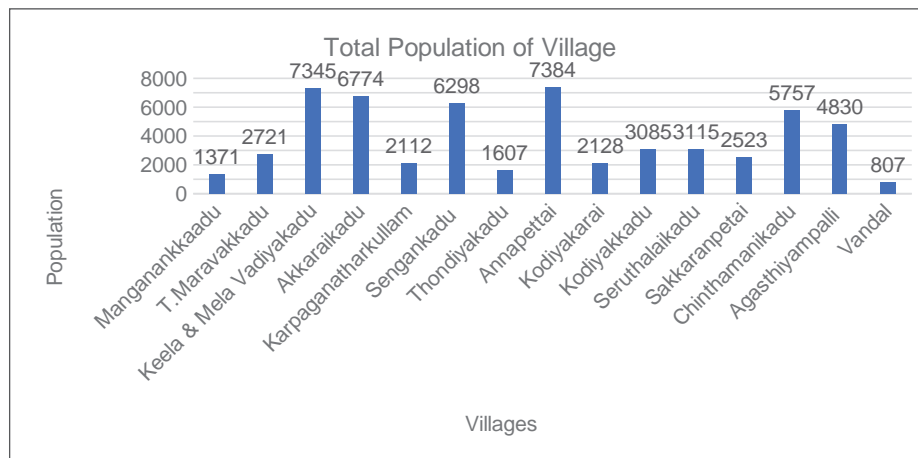
According to the 2011 census, the 34 gram and town panchayats have around 33,000 households with a population of 1 lakh, which includes 59,343 males and 62,697 females. The female-to-male ratio is more than the state average of 996 females per 1000 males. Of the 1 lakh population, 18,294 people (approximately 15%) belong to scheduled castes, while nearly a hundred belong to scheduled tribes. The average household size is 3.5, which is less than the national average of 4.5 (2011 census). Map 4 shows 34 gram panchayats and town panchayats along the periphery of the Point Calimere wetland. (Note: Data are shown for 33 gram and town panchayats excluding Muthupet town panchayat.)

#### DEMOGRAPHIC DETAILS OF SAMPLE VILLAGES

Some of the sample villages selected for the detailed study were entire gram panchayats, whereas in some cases, small settlements or hamlets were selected. The 2011 census was taken as the base for consolidating the demographic details, which were rechecked against the primary data collected in the PESA. There were slight variations among the sources, and the 2011 census data were considered for the interpretation of data. The sample panchayats alone have 14,750 households in 15 village panchayats. Agasthiyampalli is in Vedaranyam municipality (ward numbers 9, 10 and 11), and Vandal is in Thalainayar town panchayat (ward number 5). Among the sample villages, Idumbavanam has the highest number of households (2127) and a population of 7345. It is followed by Annapettai, with 2040 households (refer Figure 1) and a population of 7384 (refer Figure 2). Jambuvanodai and Thillaivailagam have 1104 and 1928 households, respectively. In the entire PCWC, these four villages need the most attention because of their large geographic area and population.



**Figure 1** Number of households in the sample villages



**Figure 2** Total populations of the sample villages

**Table 4** Male and female populations in the sample villages

Village	Total Population of Village	Total Male Population of Village	Total Female Population of Village	Total Scheduled Caste Population of Village
T. Maravakadu	2721	1312	1409	308
Keela and Mela Vadiyakadu	7345	3615	3730	1397
Akkaraikadu	6774	3236	3538	1285
Karpaganatharkulam	2112	954	1160	0
Sengankadu	6298	3045	3253	1057
Thondiyakkadu	1607	769	838	164
Annapettai	7384	3609	3775	966
Kodiyakarai	2128	1152	976	615
Kodiyakkadu	3085	1489	1596	194
Seruthalaikadu	3115	1522	1593	457
Sakkaranpettai	2523	1261	1262	541
Chinthamanikadu	5757	2881	2876	1141
Agasthiyampalli	4,830	2,318	2,512	170
Vandal	807	398	407	280
<b>Total</b>	<b>57,857</b>	<b>28,147</b>	<b>29,710</b>	<b>8579</b>

The sex ratio in each of the sample villages is higher than the state average, except in Kodiyakarai and Chinthamani Kadu, where the sex ratio is below 1000 (Table 4). The PESA and FGD indicate that in the sample villages more girls are going to school than are boys. This is one of the key development indicators of the villages, reflecting the perspectives of the community on the importance of the girl child and education for the girl child.

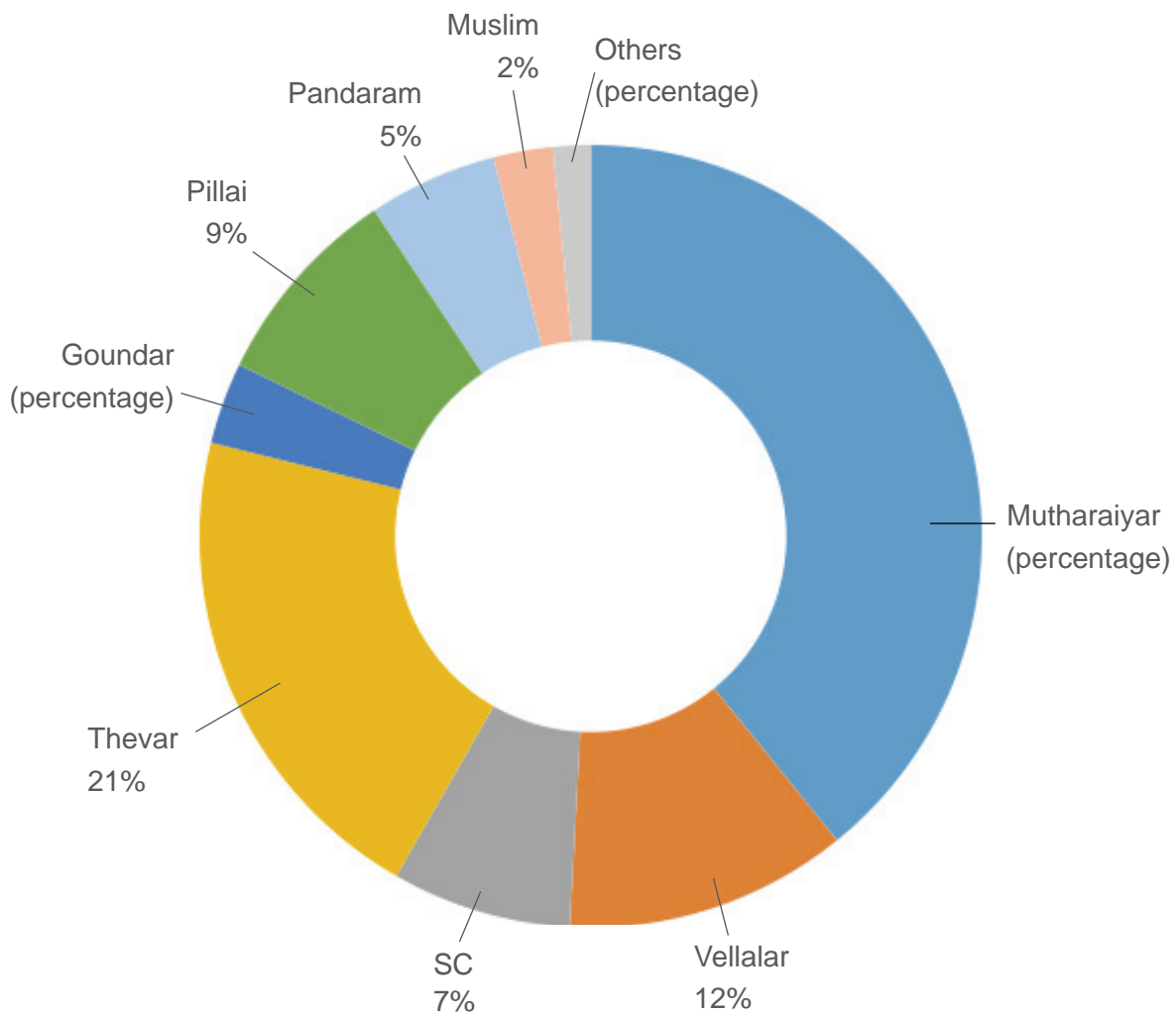
## CASTE-WISE POPULATIONS IN THE SAMPLE VILLAGES

### Scheduled Caste and Scheduled Tribe Populations

There are considerable SC populations in the sample villages. Out of the total population of 57,857, 8579 people belong to scheduled castes, i.e. almost 15% of the total population. They are mostly working as agricultural labourers, construction labourers and MGNREGA labourers. Villages such as Manganankadu and Karpaganatharkulam have no SC families. The SC population is higher in Idumbavanam, Jambuvanodai and Thillaivilagam compared with the other villages. However, the population of scheduled tribes is negligible.

### Others

According to the primary data sources, people of 17 communities (Ambalakarar/Mutharaiyar, Thuluva Vellalar/Kara Kara Pillai, Konar, Pallar, Nadar, Parayar, Thevar, Chettiyyar, Koliyar, Gounder, Aasari, Thattar, Ambattar, Agamudayar, Pillai, Veera Kodi Vellalar, Vera Saiva Pandaram) and Muslims reside in the sample villages. Overall, the Ambalakarar, Parayar, Pallar, Koliyar, Gounder, Thevar and Pillai communities are dominant in the PCWC region (Figure 3). The Mutharaiyar community is mostly dependent on fishing. In a few villages, the Thevar and Agamadayar communities are considered wealthy families. The Thevar and Gounder communities are politically active, especially in Jambuvanodai, Thambikottai, etc.



**Figure 3** Caste-wise presence in the sample villages

Of the major communities, the Mutharaiyar community has the largest population, with 4084 families out of 10,430 households. The Agamudayar and Thevar communities consist of 1412 and 733 households, respectively. Further, 920 Thuluva Vellalar and 881 Pillai households are spread across the entire wetland stretch. Other than this, the Nadar, Koliyar, Chettiyar, Ambattar, Pattar and Konar communities together have a total of 162 households living in the sample villages, which is a very small part of the total population of the area.

### 3.3 Education

The importance of education is recognised well in different communities in the sample villages. All the communities give importance to education. The Mutharaiyars especially emphasise providing education to girls. In the sample villages, the enrolment of girls is better than that of boys since the boys are pushed into their traditional occupation or are forced to move to foreign countries. The availability, accessibility and affordability of schools and colleges are excellent, influencing the parents to provide better education for their children. There are a good number of government schools and colleges in and around Muthupet, Adirampattinam, Voimedu, Vedaranyam, Thiruthuraipoondi, Kodiakarai and Ayakkaranbulam villages, with good roads and transport. The literacy rate of the population is shown in Table 5.



**Table 5** Literacy rate in the 33 gram panchayats and town panchayats

S. No.	District	Block	Gram Panchayat / Town Panchayat	Literacy				Literacy Rate
				Total Population	Total Literacy	Male Literacy	Female Literacy	
1	Thanjavur	Pattukkottai	Eripurakarai	4285	2780	1466	1314	64.88%
2			Narasingapuram	1848	1245	648	597	67.38%
3			Soundaranayakipuram	1371	925	435	490	67.47%
4			Thamarankottai South	3120	1373	508	416	44.01%
5			Thambikottai Maravakad	2721	1980	1035	945	72.77%
6			Thambikottai Melakkadu	2613	2007	1028	979	76.81%
7			Thambikottai Vadakadu	3338	2490	1333	1157	74.6%
8			Thambikottai Keelakadu	2721	1980	1035	945	72.77%
9			Alangadu	3364	2556	1406	1150	75.99%
10			Uppur	2793	2014	1082	932	72.11%
11			Jambuvanodai	3839	2857	1478	1379	74.43%
12	Thiruvarur	Muthupet	Thillaivilagam	6298	4598	2410	2188	73.01%
13			Thondiyakkadu	1607	1118	610	508	69.58%
14			Karpaganatharkulam	2112	1469	779	690	69.56%
15			Idumbavanam	7345	4937	2648	2289	67.22%
16			Vilangadu	1946	1483	748	735	76.21%
17			Muthupet TP	21722	1900	983	917	87.5 %
18	Nagapattinam	Vedaranyam	Annapettai	7384	5313	2839	2474	71.96%
19			Voimedu East	3751	2729	1494	1235	72.76%
20			Voimedu West	2006	1524	838	686	75.98%

S. No.	District	Block	Gram Panchayat / Town Panchayat	Literacy				Literacy Rate
				Total Population	Total Literacy	Male Literacy	Female Literacy	
21	Nagapattinam	Vedaranyam	Panchanathikulam Middle	3115	2473	1288	1185	79.4%
22			Pachanathikulam West	2833	2158	1187	971	76.18%
23			Pannal	2523	1917	1059	858	75.99%
24			Kadinelvayal	1594	1235	682	553	77.48%
25			Marudur Therku Sethi	4350	3308	1826	1482	76.05%
26			Thennadar	1774	1415	739	676	79.77%
27			Ayakkaranbulam IVth Sethi	2016	1689	927	762	83.78%
28			Kodiyakkadu	3085	1955	1027	928	63.38%
29			Kodiakarai	2128	1714	978	736	80.55%
30			Vedaranyam Municipality	4386	3157	2254	903	71.98%
31		Thalainayar	Kallimedu	801	452	276	176	56.43%
32			Avarikadu	676	340	156	184	50.3%
33			Naluvadapathi	4819	3672	2019	1653	76.2%
34			Thalainayar town panchayat	1251	901	477	424	72.03%

### 3.4 Agriculture and Land-holding

In the selected villages, scheduled castes and the Muthuaraiyar community have the minimum land-holdings. On an average, the land-holding size in most of the villages is 1–2 acres. In some villages, the Thevar community holds an average of 3 acres of land, mostly cultivating coconut, with a few families cultivating paddy. The total land-holdings in all the dependent gram panchayats are mentioned in Table 6 and Table 7.

Interestingly, most of the land in Agasthiyampalli, Idumbavanam and Annapettai belongs to Vedaranyam and Idumbavanam temples. Karpaganatharkulam and parts of Thondiyakkadu belong to the Karpaganatharkulam temple. In Thillaivilagam, 2 acres of land was given to landless families by the government in 1976. In Maravakadu and Manganakadu, the villagers were once a part of the Indian National Army under Netaji Subash Chandra Bose, and therefore, as a symbol of respect, the government gave 2 acres of agricultural land to each of the people who served in the INA. In Annapettai, people do not have ownership of the land on which they have built their homes since it belongs to the Idumbavanam temple; as per government policy, pattas cannot be given to any individuals who occupy temple land. The people in the area are fighting for their rights over the land.

In Idumbavanam, Jambuvanodai, Thillaivilagam and Puhukottagam, most of the agricultural lands were sold to outsiders for shrimp farming at very low prices in the 1980s. The buyers of these lands are from Thoothukudi, Chennai and Dindigul. There was a clear shift in land use pattern over time, from (mudflats) to agriculture land, from agriculture to aquaculture, from aquaculture to abandoned or decommissioned farms. Saltpans and forest land of Manganakadu, Maravakadu, Thambikottai, Jambuvanodai and Thillaivilagam were once occupied for aquaculture; later, these ponds were decommissioned due to heavy losses and encroachment and were removed by legal enforcement by the Salt and Forest departments.

**Table 6** Agricultural land-holding in the dependent gram panchayats. (Gol, 2011)

S. No.	Block	Village	Agricultural Land-holding (ha)
1	Pattukkottai	Eripurakurai	198.38
2	Pattukkottai	Narasingapuram	26.15
3	Pattukkottai	Soundaranayakipuram	180.48
4	Pattukkottai	Thamarankottai South	309.53
5	Pattukkottai	Thambikottai Maravakad	416.72
6	Pattukkottai	Thambikottai Melakkadu	422.43
7	Pattukkottai	Thambikottai Keelakadu	425.56
8	Pattukkottai	Thambikottai Vadakadu	416.72
9	Muthupet	Alangadu	321.44
10	Muthupet	Uppur	396.53
11	Muthupet	Jambuvanodai	820.44
12	Muthupet	Thillaivilagam	982.01
13	Muthupet	Thondiyakkadu	417.31

S. No.	Block	Village	Agricultural Land-holding (ha)
14	Muthupet	Karpaganatharkulam	454
15	Muthupet	Idumbavanam	1458.6
16	Muthupet	Vilangadu	451.31
17	Vedaranyam	Annapettai	955.94
18	Vedaranyam	Voimedu East	570.54
19	Vedaranyam	Voimedu West	661.58
20	Vedaranyam	Pachanathikulam Middle	491.28
21	Vedaranyam	Pachanathikulam West	573.62
22	Vedaranyam	Pannal	456.38
23	Vedaranyam	Kadinevayal	283.56
24	Vedaranyam	Marudur Therku Sethi	629.11
25	Vedaranyam	Thennadar	525.26
26	Vedaranyam	Ayakkarambulam IV Sethi	357.03
27	Vedaranyam	Kodiakkadu	72.29
28	Vedaranyam	Kodiakarai	3.78
29	Vedaranyam	Agasthiyampalli	141
30	Thalainayar	Kallimedu	685.3
31	Thalainayar	Avarikadu	685.3
32	Thalainayar	Naluvadapathi	616.86
33	Thalainayar	Vandal	81
		<b>Total</b>	<b>15,487.44</b>

In the 33 dependent villages, a total of 15,487.44 ha of agricultural land is owned by different communities. Among these villages, Idumbavanam and Thillaivilagam have the greatest extent of agricultural land, 1458 ha and 988 ha, respectively. The least extent of agricultural land (26 ha) was found to be in Narasingapuram, where there is little land available due to its proximity to the reserve forest. On an average, every village holds 450 ha of land.



**Table 7** Community-wise land-holding in sample villages

[illegible]

### 3.5 Irrigation Source and Primary Produce

In the Point Calimere wetland region, villages are dependent on the water of the Cauvery, which is the main source of irrigation for paddy cultivation as the groundwater is saline. The major crop cultivated is paddy (with the region being in the Cauvery delta), followed by coconut. Out of the total agricultural land of 15,487.44 ha, 4725.27 ha (wetlands, locally called as *nanjai*) is irrigated by the distributaries of the Cauvery, and the remaining 10,762.17 ha of land is rain-fed (locally called *punjai*). Even though the water table is good, it is not useful for agriculture due to its salinity. Only 285.31 ha of land is irrigated by wells (Table 8).

Apart from this, a government-supported lift irrigation system is being adopted in some villages (Thennadar, Annapettai, Karpaganatharkulam, Voimedu, Idumbavanam, etc.) wherein water from the Valavanar river is pumped using pumping stations at different locations.

**Table 8** Total agricultural area and irrigated area of the dependent villages (Gol, 2011)

S. No.	Block	Major Crop Cultivated (ha)	Total Land under Cultivation (ha)	Area Irrigated by Canals (ha)	Area Irrigated by Wells/Tube Wells (ha)	Area of Rain-fed Land (ha)
1	Eripurakurai	Paddy	198.38	155.37	12.11	30.9
2	Narasingapuram	Coconut	26.15	0	11.47	14.68
3	Soundaranayakipuram	Paddy	180.48	59.89	53.52	67.07
4	Thamarankottai South	Paddy	309.53	138.57	90.2	80.76
5	Thambikottai Maravakad	Paddy	416.72	67.42	0	228.42
6	Thambikottai Melakkadu	Paddy	422.43	105.87	0	178.13
7	Thambikottai Keelakadu	Coconut	425.56	139.17	118.01	168.38
8	Thambikottai Vadakadu	Paddy	416.72	67.42	0	228.42
9	Alangadu	Paddy	321.44	252.94	0	68.5
10	Uppur	Paddy	396.53	229.47	0	167.06
11	Jambuvanodai	Paddy	820.44	296.56	0	523.88
12	Thillaivilagam	Paddy	982.01	270.17	0	711.84
13	Thondiyakkadu	Paddy	417.31	386.62	0	30.69

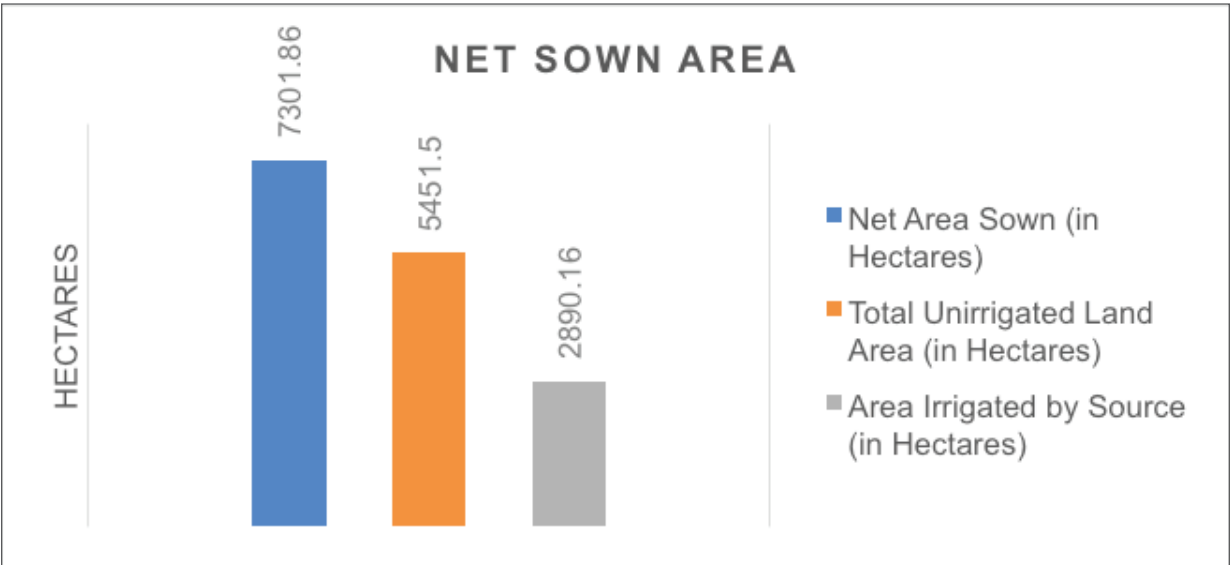
S. No.	Block	Major Crop Cultivated (ha)	Total Land under Cultivation (ha)	Area Irrigated by Canals (ha)	Area Irrigated by Wells/Tube Wells (ha)	Area of Rain-fed Land (ha)
14	Karpaganatharkulam	Paddy	454	454	0	0
15	Idumbavanam	Paddy	1458.6	795.57	0	663.03
16	Vilangadu	Paddy	451.31	451.31	0	0
17	Annapettai	Coconut	955.94	81.56	0	874.38
18	Voimedu East	Paddy	570.54	0	0	568.47
19	Voimedu West	Paddy	661.58	0	0	653.8
20	Pachanathikulam Middle	Paddy	491.28	0	0	491.28
21	Pachanathikulam West	Paddy	573.62	0	0	545.1
22	Pannal	Paddy	456.38	0	0	430.02
23	Kadinevayal	Paddy	283.56	0	0	283.56
24	Marudur Therku Sethi	Casuarina	629.11	0	0	600.84
25	Thennadar	Paddy	525.26	5.47	0	519.79
26	Ayakkarambulam IV Sethi	Paddy	357.03	0	0	357.03
27	Kodiakkadu	Groundnut	72.29	0	0	72.29
28	Kodiakarai	Not available	3.78	0	0	3.78
29	Agasthiyampalli	Paddy	141	0	0	141
30	Kallimedu	Paddy	685.3	2.84	0	682.46
31	Avarikadu	Paddy	685.3	2.84	0	682.46
32	Naluvedapathi	Coconut	616.86	3.71	0	613.15
33	Vandal	Paddy	81	0	0	81

Various crops are cultivated in the Point Calimere-dependent villages according to the water availability and soil conditions.

The agriculture is largely rain-fed, and the main sources of irrigation are canals. The total area sown in all the sample villages was around 7301.86 ha according to the 2011 census (Figure 4). Of this, only 2890 ha is irrigated land, and the remaining 5450 ha is rain-fed land. Canals, which are fed by water released from the Vennar, were found to be the major source of irrigation.



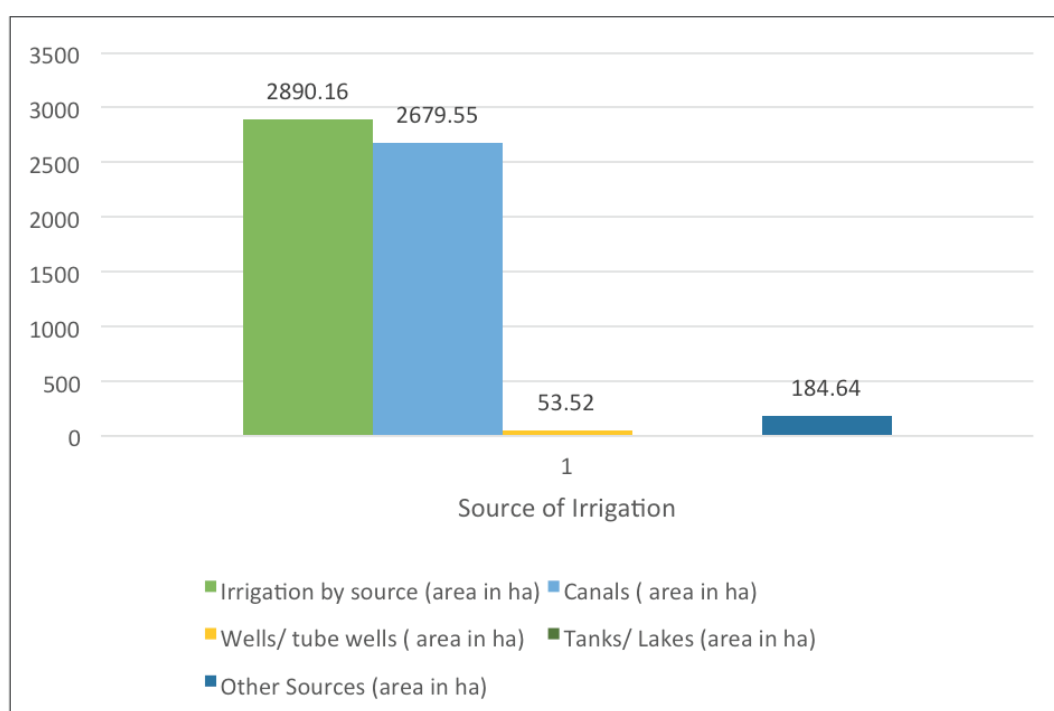
*Image 5* Lift irrigation – pumping station at Annapettai



*Figure 4* Total net sown area in sample villages

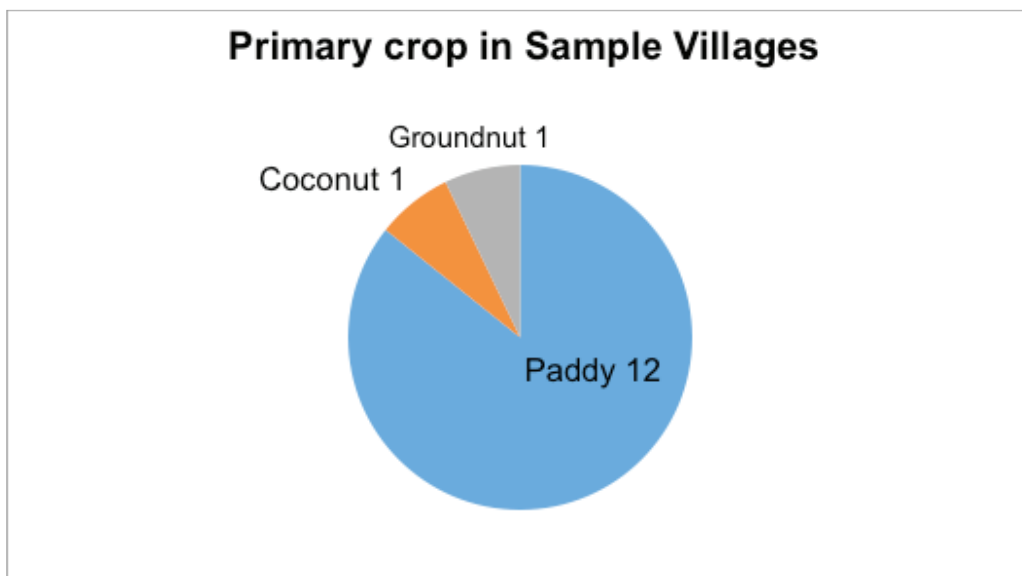


The net sown area is higher in Thillaivilagam, Idumbavanam, Jambuvanodai and Annapettai: it is almost close to 1000 ha in these villages. Except in Kodiakarai, Kodiakadu, Agasthiyampalli and Vandal, the average net sown area in the rest of the villages is close to 500 ha. Very little land has a source of irrigation. The details of irrigation are given in Figure 5. The total number of rain-fed lands is higher than the number of irrigated lands. Out of the irrigated area of 2890 ha, almost 2679 ha is covered by canals. Water from other sources is minimal. For example, wells cover only 53 ha, which is not even 5% of the total land with irrigation sources. This may be due to the salinity of the groundwater. Although these areas have numerous tanks and ponds, surface water irrigation is negligible. These surface water bodies are mainly used to recharge the groundwater and reduce the water salinity in the local catchment area.



**Figure 5** Irrigation sources in sample villages

The fringe villages in Point Calimere cultivate paddy, coconut, groundnut, black gram, tobacco and sesame. Pulses are the main crops, with jasmine being cultivated in a few pockets. Paddy is the primary agricultural crop, while coconut and pulses are secondary produce. Agriculture is not practiced in two of the 15 sample villages, Kodiakarai and Seruthalaikadu. Agriculture is the primary livelihood in the village Panchanathikulam Middle. Twelve villages cultivate paddy as a primary crop, as shown in Figure 6. The remaining two villages cultivate coconut and groundnut, respectively.



**Figure 6** Primary agricultural produce in the sample villages

### 3.6 Source of Domestic Water

Due to the increasing salinity of the groundwater, the dependent villages employ the age-old practice of constructing ponds in the village for domestic usage. For drinking water, people depend on the Cauvery–Kollidam Combined Water Supply Scheme, which is administered by the Tamil Nadu Water Supply and Drainage Board (TWAD Board). The supply is through gram panchayats. Occasionally, during festivals and functions, fresh water is supplied by or purchased from Chemplast, GHCL and other private companies. The groundwater at depths more than 15–20 feet is saline and non-potable. Most of the dependent villages have hand pumps, mainly for domestic use and livestock. The depth of these hand pump bore wells was within 10 feet up to 2015. The water sources and their numbers in all the dependent gram panchayats are mentioned in Table 9.

**Table 9** The water bodies in the dependent gram panchayats (Kodiyakkadu, Kodiyakarai and Seruthalaikadu lie within the Ramsar boundary)

S. No.	Gram Panchayat	Tank	Pond	Common Well	Bore Well
1	Eripurakarai	1	10	2	2
2	Narasingapuram	2	10	1	1
3	Soundaranayakipuram	2	2	1	1
4	Thamarankottai South	4	5	2	2
5	Thambikottai Maravakadu	1	12	2	2
6	Thambikottai Melakadu	2	29	1	1
7	Thambikottai Kelakadu	2	11	1	1
8	Thambikottai Vadakadu	4	9	3	3
9	Alangadu	2	2	1	1
10	Uppur	0	39	0	5

S. No.	Gram Panchayat	Tank	Pond	Common Well	Bore Well
11	Jambuvanodai	2	44	1	4
12	Thillaivilagam	1	73	1	3
13	Thondiyakkadu	2	24	2	3
14	Karpaganatharkulam	2	9	1	3
15	Idumbavanam	2	12	1	3
16	Vilangadu	0	3	0	1
17	Annapettai	0	16	1	7
18	Voimedu East	0	17	1	2
19	Voimedu West	0	19	1	2
20	Panchanathikulam Middle	0	9	3	0
20.1	Seruthalaikadu (within PCWC)	0	6	0	2
21	Panchanathikulam West	0	20	0	0
22	Pannal	1	17	0	0
23	Kadinelvayal	1	19	0	2
24	Maruthur	1	23	2	0
25	Thennadar	2	23	12	2
26	Ayakkarapulam	2	17	2	3
27	Kodiyakadu (within PCWC)	0	19	10	2
28	Kodiyakarai (within PCWC)	0	8	18	2
29	Agasthiyampillai	0	4	0	0
30	Kallimedu	0	2	0	1
31	Avarikadu	1	3	2	1
32	Naluvedapathi	0	0	2	3
33	Vandal	0	0	0	0
	<b>TOTAL</b>	<b>37</b>	<b>516</b>	<b>74</b>	<b>65</b>

### 3.7 The Occupation and Income of the Villagers

Most of the villagers are involved in both fishing and farming. In a few villages, such as Kodiakarai, Kodiyakkadu and Seruthalaikadu, all the families are involved in fishing. Around Vedaranyam, many villages, especially Agasthiyampalli and Kadinelvayal, are involved in salt production. The average monthly income varies from Rs.8000 to Rs.18,000 according to the occupation and season (Table 10). Details of the income source and income were collected at the FGDs and the stakeholder interactions conducted at the ground level and analysed.

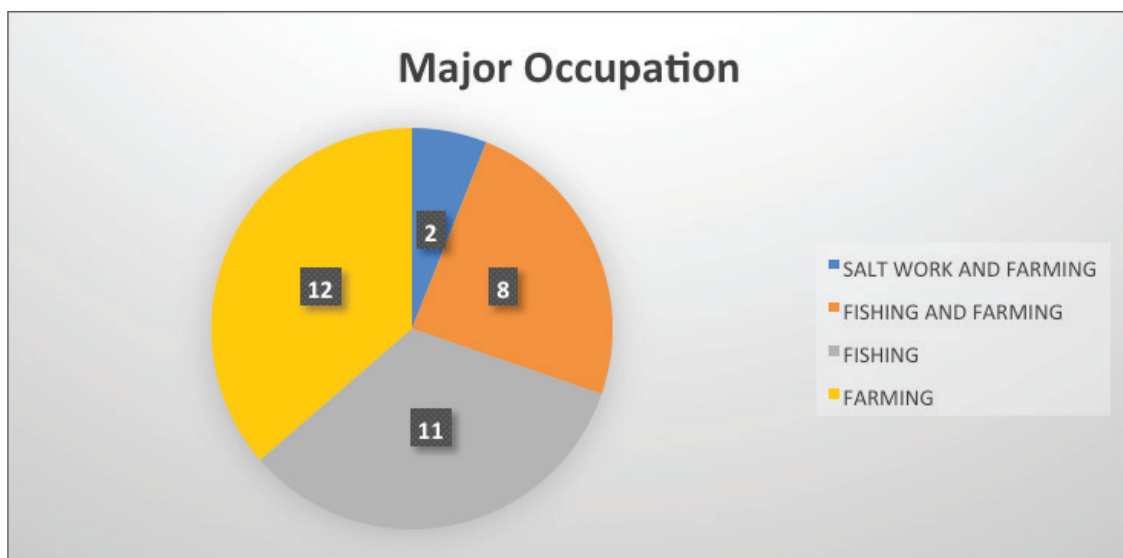
**Table 10** Income profile and major occupation of dependent gram panchayats

S. No.	Village	Annual Income (INR)	Monthly Income (INR)	Major Occupation
1	Eripurakarai	2,05,000	17,083	Fishing
2	Narasingapuram	1,16,000	9,667	Fishing
3	Soundaranayakipuram	1,28,000	10,667	Fishing
4	Thamarankottai South	1,44,000	12,000	Fishing & Farming
5	Thambikottai Maravakad	1,38,000	11,500	Fishing
6	Thambikottai Melakkadu	2,76,000	23,000	Fishing
7	Thampikotai Kelakadu	1,57,000	13,083	Fishing
8	Thambikottai Vadakadu	2,19,000	18,250	Fishing & Farming
9	Alangadu	1,63,000	13,583	Fishing & Farming
10	Uppur	1,65,000	13,750	Farming
11	Jambuvanodai	1,51,000	12,583	Fishing & Farming
12	Thillaivilagam	1,20,000	10,000	Farming
13	Thondiyakkadu	1,77,000	14,750	Fishing
14	Karppaganatherkulam	1,76,000	14,667	Fishing
15	Idumbavanam	1,80,000	15,000	Fishing & Farming
16	Vilangadu	1,18,000	9,833	Farming
17	Annapettai	1,22,000	10,167	Farming
18	Voimedu East	1,15,000	9,583	Farming
19	Voimedu West	1,43,000	11,917	Fishing
20	Pachanathikulam Middle	1,34,000	11,167	Farming
21	Pachanathikulam West	1,45,500	12,125	Fishing
22	Pannal	1,61,000	13,417	Farming
23	Kadinelvayal	1,30,000	10,833	Salt work and farming
24	Marudur Therku Sethi	1,45,000	12,083	Farming
25	Thennadar	1,55,000	12,917	Farming
26	Ayakkaranpulam IV Sethi	1,54,000	12,833	Farming
27	Kodiakkadu	1,61,000	13,417	Fishing
28	Kodiakarai	2,24,500	18,708	Fishing
29	Agasthiyanpalli	1,45,000	12,083	Salt work and farming
30	Kallimedu	1,03,000	8,583	Fishing and farming
31	Avarikadu	1,15,000	9,583	Fishing & Farming
32	Naluvadapathi	2,15,000	17,917	Farming
33	Vandal	1,04,500	8,708	Fishing and farming



Other than agriculture and fishing, people in these villages are also involved in milk production, producing thatching material from coconut fronds, salt production, prawn farming, tobacco cultivation and pottery. The major occupations in the 33 dependent gram panchayats and town panchayats are shown in Figure 7.

Salt manufacturing is the primary occupation in three of the 15 sample villages, thatching material production and milk production are the primary occupation in two villages, respectively, and pottery and tobacco cultivation are the primary occupation in one village each.



**Figure 7** Major occupation in 33 dependent gram panchayats

### 3.8 Livestock

In addition to agriculture and fishing, a lot of people are dependent on livestock-based livelihoods. Considerable income is generated through livestock rearing in the area. The livestock population details collected from the FGDs and stakeholder interactions indicate that the dependent villages have a total of 12,696 cattle and 32,171 goats. The cattle and goats of each dependent gram panchayat are mentioned in Table 11. These numbers may vary from the numbers of the government livestock census.

**Table 11** Livestock population in dependent gram panchayats.

S. No.	Gram Panchayat	Tank	Pond
1	Eripurakarai	149	299
2	Narasingapuram	144	287
3	Soundaranayakipuram	114	227
4	Thamarankottai South	369	738
5	Thambikottai Maravakad	291	582
6	Thambikottai Melakkadu	253	758
7	Thambikottai Keelakadu	218	437
8	Thambikottai Vadakadu	282	565

S. No.	Gram Panchayat	Tank	Pond
9	Alangadu	554	1108
10	Uppur	484	1453
11	Jambuvanodai	552	1656
12	Thillaivilagam	925	2776
13	Thondiyakkadu	292	877
14	Karpaganatharkulam	394	1183
15	Idumbavanam	1170	2925
16	Vilangadu	319	797
17	Annapettai	959	2876
18	Voimedu East	596	1789
19	Voimedu West	340	1019
20	Pachanathikulam Middle	364	729
21	Pachanathikulam West	462	1386
22	Pannal	445	889
23	Kadinelvayal	269	806
24	Marudur Therku Sethi	744	1488
25	Thennadar	299	896
26	Ayakkarampulam IV Sethi	349	1394
27	Kodiakkadu	217	435
28	Kodiakarai	103	205
29	Agasthiyampalli	222	444
30	Kallimedu	129	258
31	Avarikadu	54	109
32	Naluvadapathi	567	681
33	Vandal	67	101
	<b>Total</b>	<b>12,696</b>	<b>32,171</b>

(Source: primary survey)

A few decades ago, the livestock population was high, but in recent years, the livestock population has decreased due to change in land use patterns, reduced grazing lands and strict forest regulations. The shift in occupation at the micro and macro levels made people neglect livestock due to the drudgery of the work and social status involved. In Thondiyakkadu and Karpaganatharkulam, collective livestock rearing is practiced by the villagers in the post-harvest period. The details of the livestock-based livelihoods and impacts are given in the livelihood chapter.

### 3.9 Fishing

In all the sample villages, fishing is the primary occupation of the community. Various fishing techniques and methods are practiced in different landscapes and ecosystems. The fishers' population varies according to the fishing place and method as shown in the following. A total number of 9453 fishermen were recorded in the 33 dependent gram panchayats (refer Table 12). Most of the fishermen have registered themselves with the government as marine fishermen, and accordingly, they have identity cards. The fishers residing in Vandal and Avarikadu have registered themselves as inland fishers. Both the registered marine and inland fishers have identity cards issued by the Fisheries Department, Government of Tamil Nadu. Most of them belong to government-supported fishermen's associations, and thus they are entitled to fishing ban period allowances, insurance, purchase of boats, etc.

**Table 12** Fisher's populations and fishing type (Source: Primary survey)

S. No.	Village	Total Fishing Population	Fishing within the Wetland				Sea (Near Shore)
			Canal	Thottam	Lagoon	Backwater/River	
1	Eripurakurai	1159		120			1039
2	Narasingapuram	241	15	15		30	181
3	Soundaranayakipuram	115	50	30			35
4	Thamarankottai South	405	40	32		12	321
5	Thambikottai Maravakad	192	70	60		10	52
6	Thambikottai Melakkadu	191		50		15	126
7	Thambikkotai Keelakadu	192		50		11	131
8	Thambikottai Vadakadu	368		45		15	308
9	Alangadu	405			335	3	67
10	Uppur	158			130	2	26
11	Jambuvanodai	405			376		29
12	Thillaivilagam	517		34	406		77
13	Thondiyakkadu	194		128			66
14	Karppaganatherkulam	304		223			81

S. No.	Village	Total Fishing Population	Fishing within the Wetland				Sea (Near Shore)
			Canal	Thottam	Lagoon	Backwater/River	
15	Idumbavanam	251		212			39
16	Vilangadu	37		25			12
17	Annapettai	521		345		2	174
18	Voimedu East	302		254			48
19	Voimedu West	450		376			74
20	Pachanathikulam Middle	310		276			34
21	Pachanathikulam West	192		154			38
22	Pannal	177		132			45
23	Kadinevayal	0					0
24	Marudur Therku Sethi	287		188			99
25	Thennadar	90		90			0
26	Ayakkarambulam IV Sethi	76		54			22
27	Kodiakkadu	937		105		130	702
28	Kodiakarai	450		100			350
29	Agasthiyampalli	0					
30	Kallimedu	97				90	7
31	Avarikadu	70				70	0
32	Naluvedapathi	287					287
33	Vandal	73				73	0
	<b>Total</b>	<b>9453</b>	<b>175</b>	<b>3098</b>	<b>1247</b>	<b>463</b>	<b>4470</b>

(Source: Primary survey)



Except for sea fishing, fishing in the wetland is restricted from September to January. The ban on fishing in the sea is from April to May, while fishing within the wetland continues during this period, but the catch is low. The Fisheries Department is responsible for enforcing the ban. The fish catch may vary from day to day for each fisherman, and the income thus also varies according to the season. This fisher population data were collected from the FGDs and stakeholder interactions in the primary survey.



**Image 6** Fishing family in Kodiyakadu

There are 128 fishing canals that are owned individually by fishers who have been traditionally fishing in the Muthupet mangrove forest areas. The details are mentioned in Table 13. These fishers belong to the villages Maravakadu, Manjavayal, Manganankadu and Karisaikadu, of Thanjavur district (TNFD, 2018). They fish in the fishing canals of Palanjur and Thamarankottai mangroves using the indigenous fishing method of *pari-sar*. Many of the canals became defunct due to the cyclone Gaja and other factors such as a lack of financial resources for maintenance, migration of fishers and changes in the livelihoods of traditional owners. The Tamil Nadu Forest Department has recognised the rights of the canal fishers and allows them to fish in the canals throughout the year.

**Table 13** Status of fishing canals in Muthupet mangroves (Source: Primary survey)

S. No.	Village	Name	Father's Name	Length of the Fishing Canal	Status
1	Maravakadu	M.K. Mahalingam	Kamatchi	1.5 km	Not maintained
2		M. Selvaraj	Maruthaiyan	1.4 km	Not maintained
3		P. Suntharaj	Piramaiyan	2 km	1 km maintained
4		M. Ballusamy	Maruthaiyan	1 km	Not maintained
5		K. Maarriyappan	Kathaiyan	2 km	Not maintained

S. No.	Village	Name	Father's Name	Length of the Fishing Canal	Status
6	Maravakadu	P. Chinnappa	Balaiyan	1.4 km	Not maintained
7		V.Pitchaimuthu	Vadiveal	1.6 km	Not maintained
8		N. Paneerselvam	Nagalingam	1.7 km	Not maintained
9		P. Suresh	Ballusamy	1.3 km	Not maintained
10		P. Ramaiyan	Podhiyappan	1.5 km	Not maintained
11		S. Nagarajen	Sankeran	1.1 km	Not maintained
12		M. Balasubramaniyan	Maruthaiyan	1 km	100 m maintained
13		M. Vadivealan	Maruthaiyan	1 km	Not maintained
14		M. Muruganantham	Murthy	1.5 km	Not maintained
15		M. Jaganathan	Murugaiyan	1.7 km	Not maintained
16		S. Jeevanantham	Subramaniyan	1.5 km	Not maintained
17		K. Sivakumar	Kanthasamy	1.5 km	Not maintained
18		R. Suntharaman	Ramaiyan	1. 6 km	Not maintained
19		B. Paneerselvam	Ballusamy	2 km	Not maintained
20		B. Basker	Ballusamy	1.5 km	Not maintained
21		V. Paneerselvam	Veerariyan	1.5 km	Not maintained
22		P. Murugeasan	Podhiyappan	1.5 km	Not maintained
23		P. Sudhager	Palaneveal	1.5 km	Not maintained
24		K. Veerasegeran	Ganesan	1.1 km	Not maintained
25		M. Thiruganam	Marriyappan	1.5 km	Not maintained
26		P. Veadhareathinam	Planeveal	1.5 km	Not maintained
27		S. Balakrishnan	Sellaiyan	1.5 km	Not maintained
28		S. Murugeasan	Subramaniyan	1.3 km	Not maintained
29		V. Sivakasi	Veeraiyan	1.5 km	Not maintained
30		S. Subramaniyan	Singaram	1.4 km	Not maintained
31		K. Kalliyamurthy	Ganapathy	1.5 km	Not maintained
32		V.R. Murugaiyan	Rengasamy	1.7 km	Not maintained
33		P. Paneer	Pallaiyan	1.2 km	Not maintained
34		C. Ballaiyan	Chelladurai	1.3 km	Not maintained
35		K. Balasubramaniyan	Ganesan	1.5 km	Not maintained
36		S. Subramaniyan	Chelladurai	1.5 km	Not maintained
37		L. Suntharaj	Ladamuthu	1.7 km	Not maintained

S. No.	Village	Name	Father's Name	Length of the Fishing Canal	Status
38	Maravakadu	S. Sivakumar	Subramaniyan	600 m	Not maintained
39		A. Arunacheallam	Ayyakannu	1.5 km	Not maintained
40		R. Murugaiyan	Rengaiyan	1.9 km	Not maintained
41		K. Ballusamy	Kathaiyan	2 km	1 km maintained
42		P. Govindaraj	Piramaiyan	1.5 km	Not maintained
43		N. Jaganathan	Nateasan	1 km	Not maintained
44		P. Ladamuthu	Podhiyappan	1.6 km	Not maintained
45		M. Shanker	Mariyappan	1.5 km	Not maintained
46		M. Basker	Murugaiyan	1.7 km	Not maintained
47		K. Ramalingam	Kunchu	1.7km	Not maintained
48		A. Kittu	Aadhiyappan	1.6 km	Not maintained
49		A. Maruthamuthu	Aadhiyappan	1.8 km	Not maintained
50		P. Rajendiran	Podhiyappan	1.5 km	Not maintained
51		A. Balasubramaniyan	Arunachallam	2 km	Not maintained
52		S. Archunan	Subramaniyan	1.5 km	500 m maintained
53		M. Kallimuthu	Mariyappan	1.5 km	Not maintained
54		R. Ramalingam	Ramasamy	1.5 km	Not maintained
55		S. Veeramani	Subramaniyan	1.1 km	Not maintained
56		M. Ballu	Marimuthu	2 km	Not maintained
57		K. Veeramuthu	Kallimuthu	1.3 km	Not maintained
58		V. Subramaniyan	Veerappan	1.5 km	Not maintained
59		C. Balasubramaniyan	Chinnadurai	1,7 km	Not maintained
60		L. Nagaraj	Ladamuthu	1.5 km	100 m maintained
61		Annadurai	Subramaniyan	1.2 km	Not maintained
62		Veeramani	Sanmugam	1.5km	Not maintained
63	Manjavayal	T. Govindaraj	Durairaj	1.8 Km	Not maintained
64		M. Subramaniyan	Mannikam	1.4 Km	Not maintained
65		B. Thiravidasalliyar	Ballaiyan	1.5 Km	Not maintained
66		J. Ballasubramaniyan	Jaganathan	1.6 Km	Not maintained
67		P. Saragunam		1.6 Km	Not maintained
68		L. Keasavan		1.5 Km	Not maintained
69		R. V. S. Ramasamy		1.7 Km	Not maintained
70		S. Ravichandran		1.4 Km	Not maintained

S. No.	Village	Name	Father's Name	Length of the Fishing Canal	Status
71	Karisalkadu	M. Mahendiran	Marriyapan	1.7 km	Not maintained
72		K. Balasubramaniyan	Kathamuthu	2 km	Not maintained
73		R. K. Ramachanran	Kallimuthu	2 km	Not maintained
74		G. Mahendran	Ganesan	2 km	Not maintained
75		M. Shakthiveal	Marriyappan	2 km	Not maintained
76		M. Palaneveal	Mannikam	2 km	Not maintained
77		N. Marrimuthu	Natesan	2 km	Not maintained
78		K. Ganesan	Kathamuthu	2 km	Not maintained
79		S. Balusamy	Shanmugam	2 km	Not maintained
80		M. Karthekayan	Maruthakannu	2 km	Not maintained
81		R. Shanker	Ramasamy	1.7 km	0.7 km maintained
82		V. Sager	Veeraian	1.9 km	Not maintained
83		M. Chandrasager	Maniyan	2 km	Not maintained
84		K. Ravichandran	Katherasan	2 km	Not maintained
85		K. Pallaneveal	Kunchu	2 km	Not maintained
86		D. Vettriveal	Durairaj	2 km	Not maintained
87		S. Muthumanikkam	Shanmugam	2 km	Not maintained
88	Manganankadu	N. Marrimuthu	Nagalingam	1.5 km	Maintained
89		G. Mohan	Ganesan	No canal	Not maintained
90		S. Subramaniyan	Singaram	1.5 km	0.5 km maintained
91		M. Rajendiran	Muthusamy	2 km	Maintained
92		A. Subramaniyan	Ayyavu	1.5 km	0.7 km maintained
93		B. Murugeasan	Balasubramaniyan	1.5 km	Not maintained
94		K. Mani	Kanni	1.5 km	Not maintained
95		A. Murugaiyan	Ayyavu	No canal	Not maintained
96		K. Marimuthu	Kunchu	1.5 km	Not maintained
97		P. Balasubramaniyan	Peramaiyan	1.6 Km	Not maintained
98		S. Rajalingam	Subramanyan	1.7 km	Not maintained
99		S. Ragupathy	Chinnaiyan	1.5 km	0.7 km maintained
100		S. Dharmraj	Subramaniyan	No canal	Not maintained
101		S. Laxumanan	Singaram	No canal	Not maintained
102		K. Sager	Karupaiyan	1.5 km	Not maintained
103		M. Nagarajan	Marimuthu	No canal	Not maintained



S. No.	Village	Name	Father's Name	Length of the Fishing Canal	Status
104	Manganankadu	K. Balasubramaniyan	Kunchu	1.5 km	Not maintained
105		G. Chandrasekaran	Ganesan	1.5 km	0.7 km maintained

(Source: Primary survey)

In order to ensure better livelihood opportunities and better mangrove health and regeneration, these fishing canals need to be renovated jointly by the Forest Department and canal fishers. The different fishing types, seasons and average income generated from each fishing type are given in Table 14.





**Table 14** Fishing type, season and income

Fishing Type	Favourable Season	Fish Catch during Season (kg/day)	Income during Favourable Season (INR/day)	Boat Type	Fishing Ban Period	Commonly Used Net Type	Normal Mesh Size	Most Common Species
Canal fishing	September to January	5 -10	300 - 1500	FRP boats (generally, they do not depend on any boats)	-	<i>Madi valai/ yenthu valai</i>	16 mm	<i>Pala Kendai, Madavai, Keluthi, Kadi Nandu, White Prawn</i>
<i>Thottam</i> fishing	October to February	5 - 20	500 - 1500	Partially FRP boats	-	<i>Pothukannu valai/ narambu valai</i>	30 mm, 34 mm	<i>Seriyakendai, Madavai, White Prawn, Seethunandu, Sambha nandu</i>
Lagoon fishing	October to February	5 - 20	500 - 1500	Partially FRP boats	-	<i>Eral valai</i> (prawn net)	32 mm	<i>White Prawn</i>
Backwater/ river fishing	July to January	1 - 3	100 - 200	Generally, they do not depend on any boats.	-	<i>Viral valai</i>	32 mm	<i>Viral, Kendai</i>
Sea fishing	Whole year	15 - 30	2000 - 2500	Fishing canoes (vallams), three-masted plank-built canoes and FRP boats	15 April to 14 June	<i>Narambuvalai, kala valai, thangish Valai, salangai valai, nandu valai, mudlish valai</i>	28 mm	<i>Panna, Sheela Kala, Vaval, Shankara, Koimeen, Vellampodi</i>

The main fish species available in the Point Calimere area are listed in Table 15. The fishers catch fish, crabs and prawns. The fish catch depends on the type of fishing and season. For each fish species and season, they use different kinds of nets with varying sizes. The average life of a net is 6 months to 1 year, depending on the usage. The fish and its catch are detailed in the livelihood chapter. The fish catch commonly includes *Keluthi, Koduva, Vellampodi, Madava Kenndai, Panna* and White Prawn.

**Table 15** Major fish species available in the Point Calimere Wetland Complex

Local Name	Common Name	Scientific Name
<b>Common Fish Species</b>		
Madava	Mullet	<i>Mugil cephalus</i>
Kendai	Mullet	<i>Liza dussumeri</i>
Koduva	Sea Bass	<i>Lates calcarifer</i>
Motta Kendai	Mullet	<i>Liza tade</i>
Visha Kedutha	Catfish	<i>Tachysurus thalassinus</i>
Panni (Kalava)	Reef Cod	<i>Epinephelus malabaricus</i>
Pengyalai	Mackerel	<i>S. cavalla</i>
Keluthi, Mandai	Catfish	<i>Mystus gulio</i>
Kural	Young Sea Bass	<i>Lates calcarifer</i>
Vilangu	Eel	
Seleppi	Mangrove Red Snapper	<i>Ambassis sp.</i>
Tokapodi	Anchovy	<i>Stolephorus sp.</i>
Tolipodi	Anchovy	<i>Stolephorus sp.</i>
Seraiyakendai	Mullet	<i>Liza sp.</i>
Palakendai	Milkfish	<i>Chanos chanos</i>
Kadavakendai	Mullet	<i>Liza sp.</i>
Pullavalai	Threadfin Bream	<i>Nemipterus sp.</i>
Kathazhai	Mula (Emperor)	<i>Sillago sihama</i>
<b>Common Shrimp/Prawn Species</b>		
Vella Eral	White Prawn	<i>Penaeus indicus</i>
Karunvandu Eral	Tiger Prawn	<i>Penaeus monodon</i>
Sivappu Ral	Brown Shrimp	<i>Aletapenaeus monoceros</i>
Manguni Eral	Pink Shrimp	<i>Metapenaeus spp.</i>
Thazhai Eral		
<b>Common Crab Species</b>		
Seethunandu or Sambha Nandu	Mud Crab	<i>Scylla serrata</i>
Thillai Nandu	Mangrove Crab	<i>Scylla oceanica</i>
Nedunkal Nandu	Sea Crab	<i>Portunus pelagicus</i>

Local Name	Common Name	Scientific Name
<b>Common Crab Species</b>		
Kadukka Nandu	Sea Crab	<i>Portunus sanguinolentus</i>
Neela Kaal Nandu		
Mukkan Nandu		
Neruppu Nandu		
Kolukkattai Nandu		
Aakaalai Nandu		
Thoppi Nandu		
Kaatu Nandu		
Kadi Nandu		

### 3.10 Floriculture

In addition to fishing, floriculture is also practiced as a key livelihood. Areas under floriculture in some of the dependent gram panchayats are mentioned in Table 16. This helps the families maintain their income during the functions and festival season. Due to poor market facilities, the floriculture farmers find it difficult to get a fair price, and most of the profit goes to merchants and middlemen.

**Table 16** Area and household involved in floriculture in the sample villages

S. No.	Gram Panchayat	Hectare	No. of Households Involved
1	Kadinelvayal	4.84	65
2	Pannaal	12	210
3	Panchanathikulam Middle	8.23	70
4	Panchanathikulam West	9.47	120
5	Ayakaranpulam 4	5.80	60
6	Thennadaar	5.07	50
7	Maruthur South	10.26.5	160
8	Voimedu East	1.76.5	20
9	Voimedu West	2.58	30
	<b>Total</b>	<b>60.01</b>	<b>785</b>

Floriculture is practiced in about 60 ha. This activity is more common where there is sandy soil. AFloriculture is rigorously practiced in the villages around Vedaranyam. Well water is the primary source of irrigation. There will be considerable scope for expanding this activity among the dependent villages of the PCWC if water sources such as wells and ponds are augmented.

There are around 45,000 workers in total in the 33 villages, of which 31,328 are classified as main workers, working for the whole year. The working population of each of the dependent villages is indicated in Table 17. The main workers consist of 8221 cultivators, 12,883 agricultural labourers, 337 household industry workers and 9888 other workers (Gol, 2011). The other workers include labourers of salt works, aquaculture and the fishing industry.

**Table 17** *The working population in the dependent gram panchayats*

S. No.	Village	Total Number of Workers	Main work Population	Main Cultivators Population	Main Agricultural labourers	Main Household Industry Workers Population	Main Other Population
1	Eripurakarai	1548	1479	12	300	8	1159
2	Narasingapuram	918	754	13	496	4	241
3	Soundaranayakipuram	677	671	50	505	1	115
4	Thamarankottai South	1986	1649	414	826	4	405
5	Thambikottai Maravakad	1291	503	100	211	0	192
6	Thambikottai Melakkadu	1024	993	347	399	56	191
7	Thampikotai Kelakadu	1291	503	100	211	0	192
8	Thambikottai Vadakadu	1239	1142	329	405	40	368
9	Alangadu	2027	1649	414	826	4	405
10	Uppur	1388	537	235	128	16	158
11	Jambuvanodai	1807	1649	414	826	4	405
12	Thillaivilagam	2563	2382	923	924	18	517
13	Thondiyakkadu	998	439	134	110	1	194
14	Karpaganatharkulam	1057	522	145	70	3	304

S. No.	Village	Total Number of Workers	Main work Population	Main Cultivators Population	Main Agricultural labourers	Main Household Industry Workers Population	Main Other Population
15	Idumbavanam	4038	1493	285	877	80	251
16	Vilangadu	1112	1103	489	577	0	37
17	Annapettai	3385	2044	727	787	9	521
18	Voimedu East	1552	1519	518	653	46	302
19	Voimedu West	817	478	4	22	2	450
20	Pachanathikulam Middle	1428	1291	440	540	1	310
21	Pachanathikulam West	1329	503	100	211	0	192
22	Pannal	1119	1059	417	462	3	177
23	Kadinelvayal	631	164	1	77	0	86
24	Marudur Therku Sethi	1658	955	373	291	4	287
25	Thennadar	808	145	54	0	1	90
26	Ayakkarambulam IV Sethi	1006	423	75	267	5	76
27	Kodiakkadu	1294	1142	56	140	9	937
28	Kodiakarai	806	478	4	22	2	450
29	Agasthiyampalli	1817	1649	414	826	4	405
30	Kallimedu	498	219	67	55	1	97
31	Avarikadu	456	429	120	293	2	14
32	Naluvadapathi	1492	955	373	291	4	287
33	Vandal	409	407	74	255	5	73
	<b>Total</b>	<b>45,469</b>	<b>31,328</b>	<b>8221</b>	<b>12,883</b>	<b>337</b>	<b>9888</b>



### 3.11 Basic Infrastructure

All the Point Calimere wetland-dependent villages are equipped with basic infrastructure facilities (health, sanitation, education, cyclone shelters, veterinary services, etc.). According to the 2011 census, Idumbavanam, Kodiyakarai, Voimedu and Naluvadapathi have Primary Health Centres (PHCs). Primary Health Sub Centres exist in 22 villages, but in 11 villages, no health service provision has been made by the government. The details are mentioned in Annexure VI.

#### DRAINAGE AND WASTE MANAGEMENT STATUS IN THE DEPENDENT VILLAGES

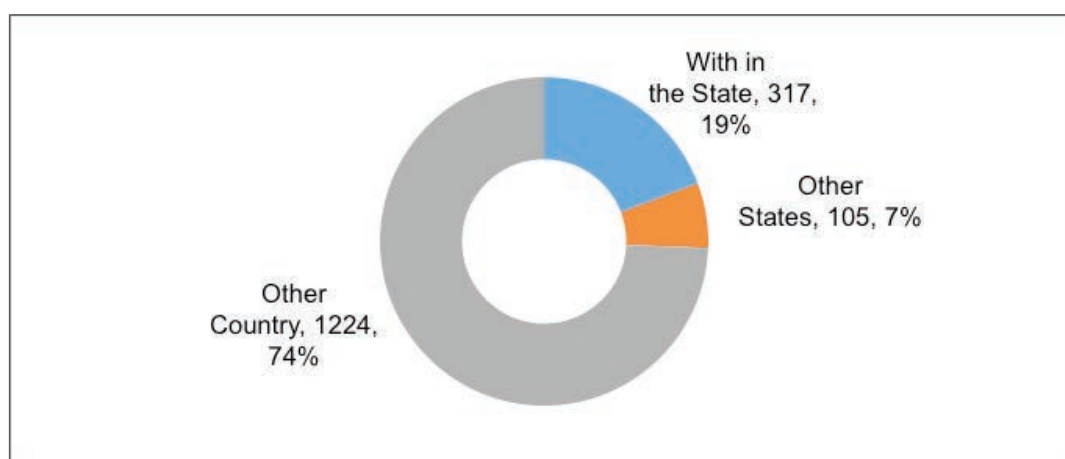
In most of the villages, drainage and waste management facilities are available and are functional. The gram panchayats and municipalities maintain them. In almost all the villages, the waste is being collected by the gram panchayat and municipality workers. There is minimum threat for the wetland on disposal of solid waste and sewage. Gram panchayats at the periphery of the Ramsar site have the pit system for toilets. The sewage waste from Muthupet drains into the Koraiyar and that from Adirampattinam is directly drained into the sea.

#### COMMON PROPERTY RESOURCES

In villages such as Thennadar, Panchanathikulam West and Middle, Ayyakaranpulam IV, Pannal and Kadinelvayal, large extents of arable lands are available between the village and the wetland. These lands have been invaded by Prosopis. The natural common property resources available in the fringe villages is very limited due to the unique landscape. The area borders a reserved forest adjacent to the sea. The existing revenue land is either used for infrastructure development (graveyards, drying fish, etc.). In Sakkarapettai and Pannal, the common property land has been taken by the Tamil Nadu Forest Department for management as most of the land has a growth of Prosopis. The common infrastructure is effectively used in these villages except water bodies (tanks, ponds, rivers and canals).

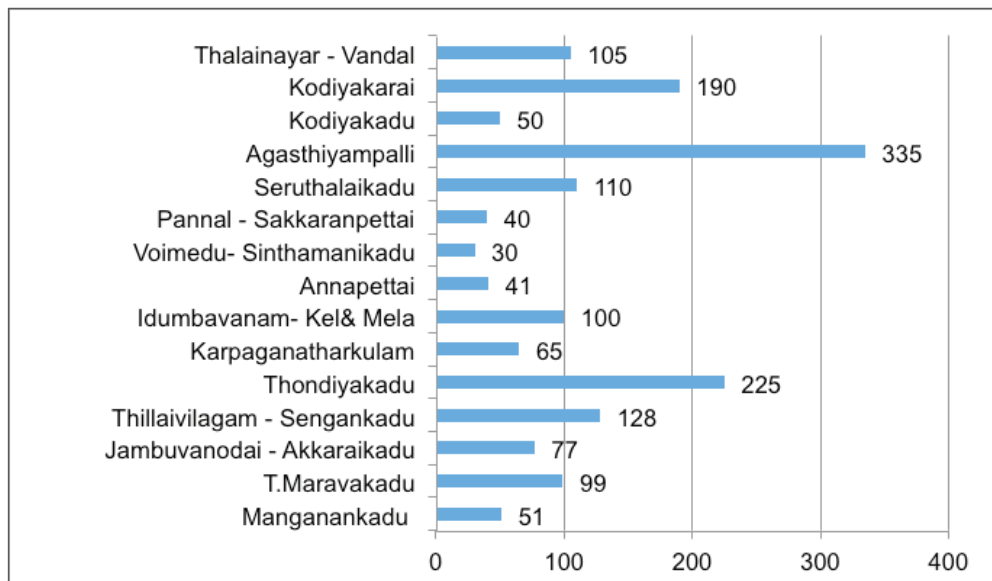
### 3.12 Migration

Migration is common in the wetland-dependent villages. Most of the villagers, especially the men, migrate to the Gulf countries as labourers. They are dependent on agents from Muthupet, Adirampattinam and Vedaranyam for completing the formalities relating to immigration. The expenses relating to immigration are met using money obtained from money lenders and other informal resources. An internal study in sample villages found that 1646 villagers from these villages have either migrated to other regions within the state or other states or left for other countries in search of better livelihood opportunities. They often migrate as semi-skilled or unskilled labourers. Migration to Gulf countries is common in the area. Details of this migration are provided in Figure 8.



**Figure 8** Details of migration in sample villages

It was observed that most men in their twenties and forties leave for Gulf countries and work there for 3–6 years. After returning home, they settle their debts and construct a house or purchase a boat to secure their family's future. The village-wise migration status of the 15 hamlets is given in Figure 9.



**Figure 9** Village-wise migrants' status

Their monthly income is mostly between Rs.20,000 and Rs.50,000. Approximately 420 persons have migrated to other districts and states as unskilled labourers in construction or service industries. A detailed study of this migration needs to be carried out to understand the dynamics of the migration and its impacts. More than 100 people have migrated from Agasthiyampalli, Thondiyakkadu, Kodyakarai, Seruthalaikadu, Idumbavanam, Vandal and Sengankadu to different places. The reason for migration is mainly better employment opportunities and better labour rates. However, the FGDs and stakeholder interaction showed that the rate of migration is gradually reducing.



Photo credit: Prasanth Prakhathan

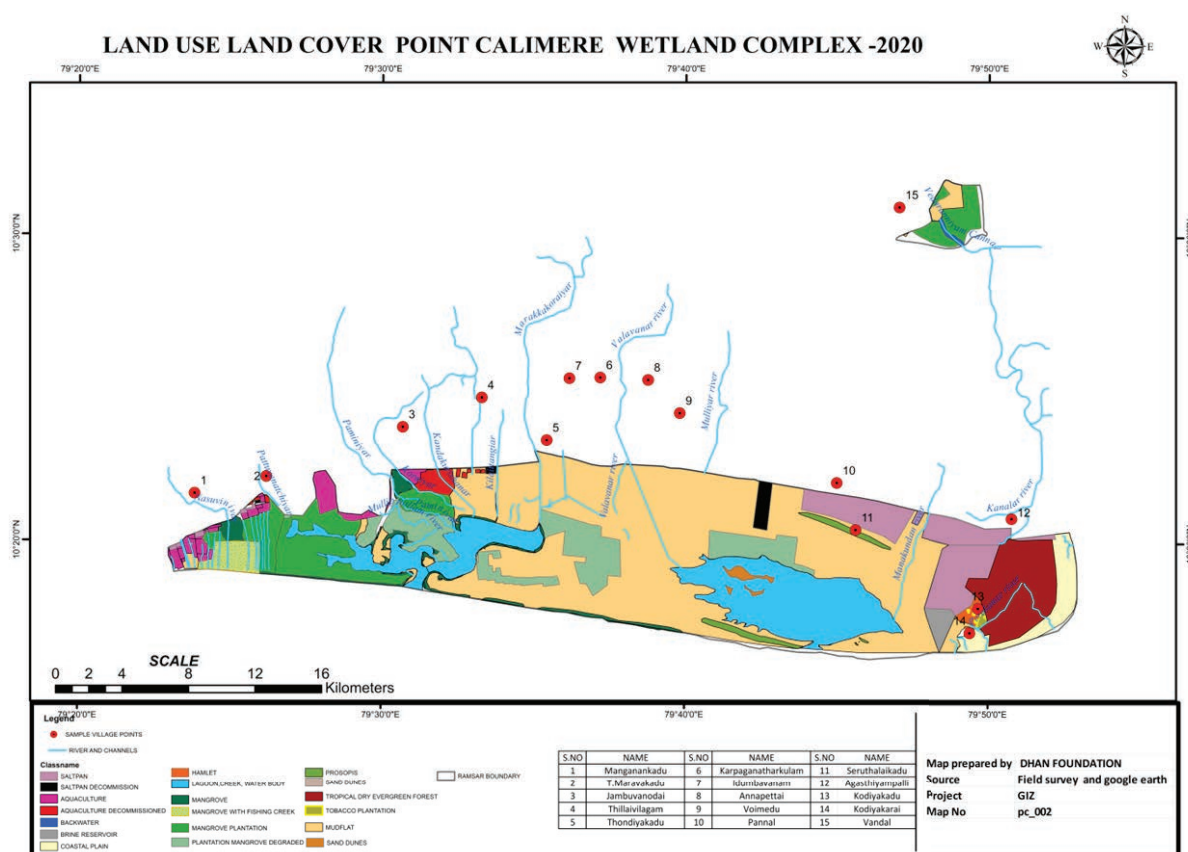
## 4 LAND USE, LAND COVER AND ECOSYSTEM SERVICES

### 4.1 Mapping and Description of Ecosystems of Point Calimere Wetland Complex

#### WETLAND ECOSYSTEM IN POINT CALIMERE WETLAND COMPLEX

The Point Calimere wetland Complex has a wide range of ecosystems and habitats, such as mudflats, swamps, mangroves, tidal creeks, lagoons, dry evergreen forests, grasslands and sand dunes. In some parts of the PCWC, the land cover has changed to man-made fishing canals, salt pans, shrimp farms, brine reservoirs and saltwater channels over several decades. These wetland habitats – both natural and man-made - provide various services to the wetland-dependent local communities and to regional and global communities.

Before exploring the spatial extent of the ecosystems, the services provided by them and their influence, it is important to understand the zonation of the wetland complex as perceived by the wetland-dependent communities. In each of the 15 sample villages, social mapping was done along with mapping of the geography with the help of the community. The wetland-dependent communities categorise the PCWC into four major zones as shown in Map 5.



**Map 5** Land use land cover of the Point Calimere Wetland Complex, 2020

### ZONE 1 – ALAM (MUDFLATS)

Alam is an extensive mudflat in the northern Point Calimere Wetland Complex, located adjacent to agricultural lands. Some of the drainage arteries of the Cauvery delta empty their water directly in the mudflats. These drainage arteries are part of the Vennar sub-basin, in which there are seasonal flows. These mudflats remain dry except when the seawater inundates them during the apogee high tide, which happens during the peak summer month of May (locally called *Vaikasi Visagam*) and when there is a flow in the river during the north-east monsoon. The depth of water in the alam during the wet period varies from 0.1 m to 1 m. During summer, when the high tides wet the mudflats, salt gets deposited. These deposited salts are handpicked by the communities for their consumption. The soil salinity increase during this season is diluted by the fresh water draining during the monsoon.

The mudflat spreads over Muthupet Reserve Forest, Panchanathikulam wetland and Thalainayar Reserve Forest. The alam from Adirampattinam to Vedaranyam receives saltwater during the days of southern winds (*thenngkaathu*), and the alam in Thalainayar receives saltwater from the backwaters when there are eastern winds (*keezhakaathu*). Over many decades, the mudflats have undergone several land use land cover changes such as conversion to saltpans, shrimp farms and agricultural lands.

The mixing of fresh water and seawater creates a brackish zone that favours proliferation of mangroves. The stronger the fresh water–seawater interaction is, the better is the mangrove establishment. This is reflected in the presence of mangroves in Muthupet and the Thalainayar region and not in the swamps located in the Vedaranyam region.

### ZONE 2 – THOTTAM/KOTTAGAM (PITS AND PUDDLES IN MUDFLATS)

The trough-shaped portion of the mudflats, next to alam in a falling gradient towards the shoreline, is called *thottam* or *kottagam*. In the Forest Department working plans, they are referred to as pits and puddles. Their size from a few square feet to a few hundred acres. During the spring high tides, the depth of the water in the thottam varies from 0.3 m to 1 m. The water level in the *thottam* is high during the monsoon and when there are southern winds. In the past this zone was densely populated with mangroves. But due to coupe felling and damming of rivers, the mangrove regeneration in this zone was severely affected, turning the soil and water highly saline. This retarded the regeneration of mangroves further in the degraded zone. Local people consider lagoons, tidal creeks and canals, fishing canals and other water bodies as part of the *thottam*.

### ZONE 3 – SHORELINE

Next to the *thottam*, there is a long shoreline from Adirampattinam to Kodyakkarai, which is linear and has vegetation (mangroves in some areas and *Prosopis* in some sandy areas). This shoreline has natural creeks such as Mullipallam creek and Chellakkani creek, which connects the sea and Muthupet (Mullipallam) and Seruthalaikadu lagoons. Kaluvapaththai, Manavaikkal, Siththankoyil *vaikkal* and Pudhu *vaikkal* are minor creeks in this shoreline. The community locally calls these minor creeks *udavu* (breach, a gap).

### ZONE 4 – COASTAL DUNES AND ASSOCIATED LANDFORMS

The coastal sand dunes and associated landforms in and around Point Calimere are demarcated by the shoreline, which turns approximately 90°, connecting the Bay of Bengal and the Palk Strait. It has a mixture of tropical dry evergreen forest, mudflats, grasslands and storm water drains, which act as backwater channels and sand dunes. This part of the coastal plain serves as the habitat for some of the endangered bird species, the blackbuck and the Olive Ridley Turtle.

## 4.2 Description of the Land Use and Land Cover

### ALAM – MUDFLATS

As the mudflats are saline in nature, many saline-tolerant plants are found growing in them. The names of the mudflats, coined by the local community, indicate the dominant vegetation of these mudflats.

- The mudflats in the Muthupet region are called *putharkaadu/umurikaadu*. They are named after the halophytic shrub *Suaeda* (Umuri).
- The mudflats of Pannal are called *karuvakkaadu* and are named after the invasive *Prosopis*, which was introduced in the 1960s to meet the household firewood demand.
- The mudflats of Panchanathikulam are called *seruthalaikadu*. They are 'swamp forests'.
- The mudflats of Vedaranyam are called '*kallikaadu*, named after cactii.
- The mudflats of Thalainayar are called *sambalam* and *allialam* after the Sambu (reed) and Alli (Water Lily), respectively.

Only very few ultra-poor communities are involved in hand fishing in the mudflats of the Great Vedaranyam Swamps and that too only during the wet season. But this is not the case in the Avarikadu–Vandal and Kallimedu areas of the Thalainayar Reserve Forest. Around eight communities are directly involved in fishing in the *alam* zone. People around the Vedaranyam canal are involved in hand fishing in the low-flow season and in net fishing during the high-flood season. Prawn is predominant in the catch in this zone.

Regarding conversion of mudflats to other land uses, it is to be mentioned that about 10,000 acres of the Point Calimere Wetland Complex has been converted into saltpans, which is a significant percentage of the total area.

### AGRICULTURAL LAND

During the 1960s, some of the mudflat areas adjacent to the villages of Maravakadu, Jambuvanodai, Thillaivilagam and Karpaganatharkulam were distributed to soldiers of the Indian National Army, refugees from Burma and other poor fishing families to convert these lands into agricultural land. Each family was given 2 acres of mudflats with the condition that the allocated mudflat should be brought under cultivation within 3 years. These lands used to be flooded by fresh water during the north-east monsoon and by saline water during summer. The families that received the lands protected them from saline water inundation by constructing earthen bunds. Since the productivity of the land was poor and it was always subjected to flooding by monsoon rains and seawater, many of the beneficiaries of this land distribution scheme sold their land to others, who converted them into aquaculture farms.

### SALTPANS

On the western side of the PCWC, saltpans are predominantly found in Maravakkadu and Thambikottai Vadakadu and are owned by the Salt Commissionerate, Government of India. Leasing of the saltpans to private parties was stopped since it was found in 2004 that in most of the leased saltpans had been converted into shrimp farms. In this regard, there was a case in the High Court.

According to news reports, salt was produced only in about 50 acres in the Adirampattinam area in 2020. On the eastern side, saltpans are present south of the villages Pannal, Panchanathikulam Middle, Kadinelvayal and Agasthiyampalli.

Till the 19th century, salt production was done by using tidal water brought in by the southern winds (*thennangkaathu*), from March to June. The salt production was done only during this summer period. In the 19th century, saltwater canals were created for connecting the mudflats to the sea. In Agasthiyampalli, the Visagam canal was created in such a way that it carries seawater during the high tide during the periods of the southern (*thennangkaathu*) and eastern winds (*keezhakathu*). The saltpans received saltwater during March–June from the



Palk Strait due to southern winds and during July–September from the Bay of Bengal due to eastern winds. The lateral channels from the *Visagam* channel filled up the saltpans of Agasthiyampalli. In some cases, water is lifted from the canals to the saltpan using traditional methods. In the 20th century, the British Government invested in salt production by establishing pumping stations in the seawater channel. This extended the salt production period by more than six months.

In the 1980s, bore wells powered by diesel motors were used to fill the saltpans with saltwater, and this was the beginning of using saline groundwater aquifers for salt production. This practice was predominantly adopted by a private company called SKSP Pvt. Ltd.

In the first decade of the 21st century, the saltpan producers shifted towards bore wells powered by electric motors. Even small-scale salt producers have electric motor-driven bore wells, individually or as a collective. The supplementary saline groundwater extended the salt production throughout the year except for the rainy season (October–December).

Presently a total of 10,054 acres of wetland is under saltpans in the Point Calimere Wetland Complex. The total production, employment and lease periods of each type of ownership are given in the following.

1. Gujarat Heavy Chemicals Ltd (GHCL) – the total area covered is 3200 acres, the total production is 80,000 metric tons per year to 1.5 lakh metric tons per year, and the total staff strength is 710.
2. Chemplast Sanmar Ltd – the total area covered is 3350 acres, the total production is 80,000 metric tons per year to 1.5 lakh metric tons per year, and the total staff strength is 760.
3. Small-scale salt producers – the total area is 3504 acres, the total production is 1–1.5 lakh metric tons per year, and the dependent families number 7000–9000. The lease period is 20 years, and the current lease came to an end in 2020. The process of renewing the lease will start in May 2021.

### AQUACULTURE – SHRIMP FARM

It was only after the 1990s that shrimp farming entered the PCWC. Availability of tidal saltwater and groundwater of low salinity favoured the conversion of agricultural lands, saltpans and government poromboke lands into shrimp farms. The agricultural lands of Thambikottai, Jambuvanodai and Thillaivilagam, saltpans and poromboke lands (waste lands owned by the Revenue Department) of Adirampattinam and Maravakadu were converted into shrimp farms. Similarly, the agricultural lands of Avarikadu and Vandal were also converted into shrimp farms.



**Image 7** Aquaculture farm close to mangrove forest in Adirampattinam

Apart from the natural canals, canals that carried saltwater for salt pans are being used by the shrimp farmers. Saltwater is pumped into a reservoir, which is established near the canals for storage. As the sill level of the saltwater canals is below the shrimp farms, diesel or electric motors are used to pump the saltwater from the canal to fill the farm. Separate drainage canals are provided to dispose of the effluents, which are suspected to be highly polluted, rich in nutrients and pesticides, into the lagoon or sea.

The total area of the shrimp farms in the Point Calimere Wetland Complex is about 3130 ha, of which 7.5% (235 ha) is located in the Avarikadu–Vandal region and the remaining area (2896 ha) is located near the Muthupet mangroves, from Adirampattinam to Sengangkadu. Among these shrimp farms, about 25% remain non-operational, and an extent of a few acres of encroached farms near Manganankadu remains defunct.

## MANGROVES

Mangroves, locally called *Alaiyathikadu* (meaning forests that treduce the force of the sea waves), is characterised by the presence of Ven Kandal (*Avicennia marina*), Nari Kandal (*Aegiceras corniculatum*) and Thillai (*Excoecaria agallocha*). The dominant species is *Avicennia marina*. Pei Kandal (*Rhizophora mucronata*) and Theparathai (*Lumnitzera racemosa*) are considered to have been introduced to this ecosystem from the Pichavaram mangroves. Neer Umuri (*Suaeda maritima*), Kal Umuri (*Suaeda monoica*) and Poo Umuri (*Salicornia brachiata*) are commonly found associate halophytic species.



**Image 8** Associate species of mangroves

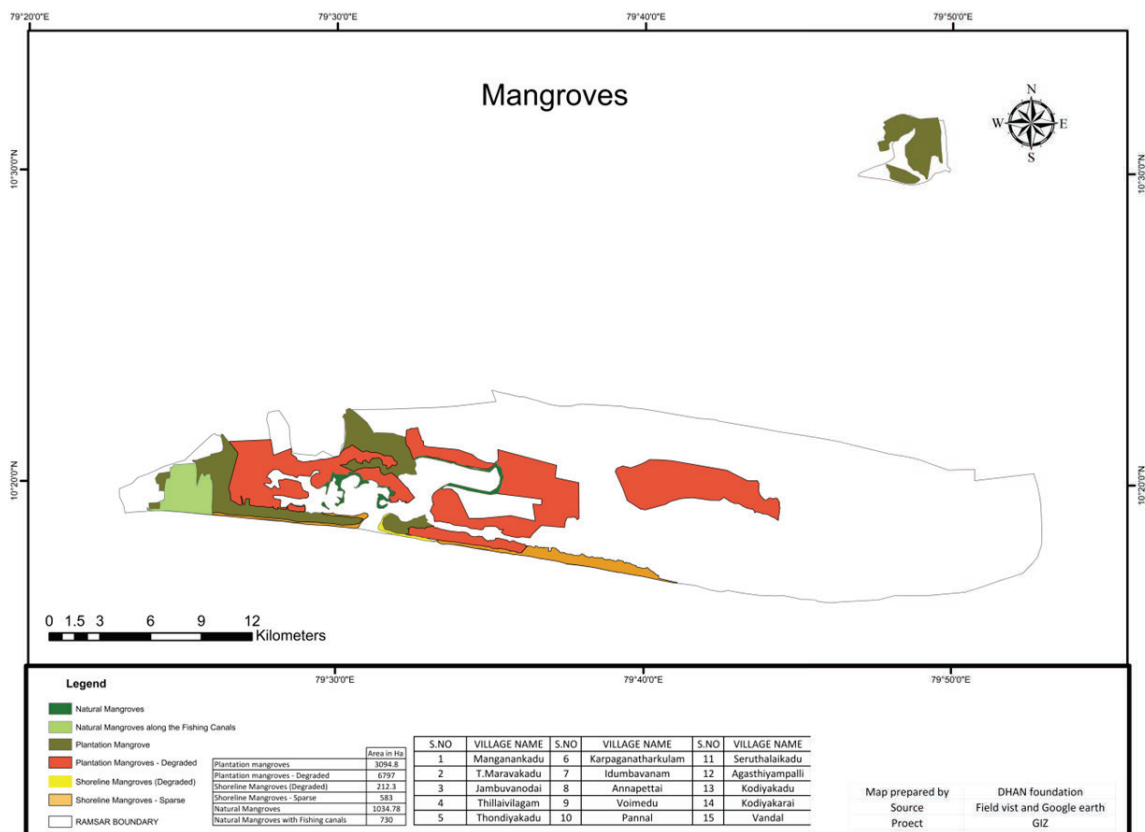


The mangrove-associated mudflats host lakhs of migratory birds, both terrestrial and aquatic. The mangrove ecosystem serves as the breeding and feeding grounds for many marine fish, crabs and shrimps.

The mangroves, especially *Avicennia marina*, are found growing densely on the marshy mudflats between lagoons, drainage channels, fishing canals and boating canals, where the interface between the fresh water and seawater is better.

Regarding the management of mangroves, the revenue generated by clear felling of the mangrove forest was utilised by the then Chatram Department, which built and maintained several rest houses (*chatrams*) for north Indian pilgrims who visited Rameswaram, in the south. Since clear felling was carried out in coupes. The local people call this system of management *Koopu*. In the 1900s, the British authorised the Chatram Department to clear-fell the mangrove forest for revenue generation. This practice continued till 1912, when the first working plan for Muthupet was prepared. The working plan prescribed clear-felling with rotation over 12 years, and this continued till 1936. Later, the Muthupet mangrove forest was handed over to the Forest Department, which also clear-felled the mangrove trees but with rotation over 20 years. This practice continued till 1971.

Damming of rivers to meet the growing water demand of the urban settlements and the intensive irrigation-based agriculture practiced in the Cauvery delta adversely affected the regeneration of the mangroves in the clear-felled areas, which have already been affected by stagnation of tidal water. As the flow of fresh water into the marshy zone reduced and stagnant tidal water evaporated, the salinity of the zone increased to a greater extent (45–125ppt), which resulted in poor regeneration of mangroves in the clear-felled areas and large-scale mortality of trees adjacent to the clear-felled areas. Subsequently, the clear-felling of mangrove forests was stopped due to the large-scale degradation and poor regeneration.



**Map 6** Mangrove distribution in Point Calimere Ramsar Site

### **THOTTAM**

The degraded mangrove areas and natural pits and puddles, which are common in coastal wetlands, are locally called *thottams*, which are the fishing grounds of the marginal fishers from Thondiyakkadu, Idumbavanam, Karpaganatharkulam, Voimedu, Annapettai, Maruthur South, Thennadar, Pannal, Kodiyakadu, Kodiyakarai, Panchanathikulam, Maniyantheevu and Agasthiyampalli. These fishermen travel a distance of 10–30 km a day on foot or by cycle, motorcycle or boat, according to their economic situation, to reach the *thottam* for fishing.

### **LAGOON**

There are two lagoon formations in the Point Calimere Wetland Complex. The Muthupet lagoon (locally called Mullipallam) is present in the Muthupet Reserve Forest and the Seruthalaikadu lagoon (which is locally called as Chellakkani) is present within the *thottam* of the Vedaranyam swamps.

The Muthupet lagoon, which is about 1700 ha in area, supports fishing communities from Thillaivilagam, Muthupet, Jambuvanodai, Thuraikadu, Pudhukottagam, Uppur, Aalangkaadu, Veeranvayal, Maravakadu, Thambikottai Vadakadu and Thambikottai Melakkadu. The eastern portion of the lagoon is very shallow, and the average depth is about 0.3 m. The western portion of the lagoon and a newly formed portion located to the west of the lagoon are 0.5 to 1.0 m deep. In the mouth region of the lagoon, the depth ranges from 1.0 to 2.0 m in some places.

The Seruthalaikadu lagoon, with an area of around 3800 ha, supports fishing communities from Thondiyakkadu to Kodiyakarai. Due to poor or no inflows from the three distributaries of the Vennar (the Valavanar, Mulliyar and Manakondanar), the *thottam* around the lagoon has lost its green cover completely. The only green cover left in this lagoon is the trees thriving in the sand dunes. These sand dunes are called *theevu* (islands) as they are surrounded by the water of the lagoon. The depth of the lagoon ranges from 0.2 to 1.5 m. The depth of the lagoon increases towards Chellakkani Creek. As there is no freshwater flow into the lagoon, the salinity of the lagoon water is greater than 45 ppt. As a result, the salt producers pump the saline water from the lagoon for their salt production. GHCL uses the Seruthalaikadu lagoon as one of the sources of saline water. This company has dug a canal on the north-western side of the Seruthalaikadu lagoon and established a pumping station at the end of canal. This pumping station is located within Seruthalaikadu village.

### **MAN-MADE FISHING CANALS**

Man-made fishing canals (*pari madai vaikkal*) are unique traditional structures that exhibit the ingenuity of the indigenous communities and the symbiotic relationship between the mangroves and their livelihood. The reliable flow of fresh water from the Nasuviniyar and Pattuvanachiyar drainage canals and the presence of the sea in the vicinity are the key factors for the creation of these fishing canals in the mudflats. This landscape architecture in the mangrove mudflats is sustainable. It has been designed well, utilising the interface between the fresh water and seawater. There are about 128 fishing canals that have been created and maintained by the communities of Maravakadu and Manganankadu.

Fishers from the villages of Manganankadu, Karisaikkadu, Manjavayal and Maravakadu (Veerankoil) are active in these canals, fishing intensively from November to March (from the monsoon to the post-monsoon season). The canals are about 1–3.5 km long, 2–3 m broad and 1–1.5 m deep. Seawater, along with fishes, prawns and their juveniles, enters these canals during high tide. During low tide, the mouth of the canal is fitted with a locally developed fish pen called *saar*. Fishes and prawns that try to move out into the sea are caught in a trap called *pari*. The trapped fishes and prawns are harvested using a scoop net locally known as *kachchavalai*.

Saltwater rises through the channel during diurnal high tides, wets the mudflats and increases the salinity of the soil around the channel. During the monsoon, the canal acts as a drainage that drains the salt along with the freshwater flow and thus reduces the salinity of the soil. This system helps the mangroves to thrive.

### **MANGROVE PLANTATION**

Though the clear-felling system of management was stopped in 1971 to address the extensive degradation, it took 15 years to invest in the restoration of the mangroves. The canal bank planting technique had been adopted in the earlier days for artificial regeneration of mangroves. In this technique, canals were first laid in selected areas to allow tidal water to leach excess soil salinity and create conditions conducive for the establishment of mangrove propagules. Until 1997, restoration was carried out only in small extents, say about 50–100 ha, as demonstrations, by M S Swaminathan Research Foundation, in partnership with the local community and the Tamil Nadu Forest Department. Only after 2000 was large-scale mangrove afforestation undertaken directly by the Forest Department under centrally sponsored schemes of the Government of India.

The canal bank plantation technique is but an adaptation of the traditional fishing canal technique, which utilises the interface between the fresh water and seawater. The box-design of the canal formation has undergone several modifications to develop the current modified fishbone technique. The improved survival of mangroves in the fishbone canals in Muthupet region motivated the Forest Department to scale it up in the Vedaranyam swamps. But the low flow of fresh water and high degree of salinity of Seruthalaikadu lagoon resulted in failure of the mangroves planted in this region.

### **FISHING BOAT CANAL**

Traditionally the drainage canals and backwater (salt) canals have been used by the fishermen to gain access to the lagoon, creek or sea. A group of fishermen travel together in a boat through this canal and get down wherever they wish to fish. After they catch fish, they board the boat again and return. A share of 1% of the fish catch is given to the owner of the boat as a travel charge.

A 3-km long fishing boat canal that connects Seruthalaikadu village with Chellakkani Lagoon is one of the traditional fishing boat canals created by the local communities to gain access to the lagoon.

When the flows in the Valavanar and Manankondan rivers reduced from low levels to nil, the fishermen from Thondiyakkadu to Kadinelvayal lost their access to the Chellakkani lagoon, creek and sea completely. This led to a loss in livelihood. To revive their access, the fishermen communities, especially the boat owners, contributed Rs.5000 per boat and created an 8 km long new fishing boat canal from Thondiyakkadu to Chellakkani Lagoon. The canal created by the fishermen was 15 m wide and 1 m deep. Other than this, the Pattuvanachiyar, Kathaparichan and Korayar also used as fishing routes to reach the thottam, lagoon and sea.

### **BRINE RESERVOIR**

Brine reservoirs are the seawater reservoirs that are constructed in the mudflats for salt production. The saltwater pumped from the sea or a lagoon (such as the Seruthalaikadu lagoon) is stored in the brine reservoirs to increase the salinity of the water from 30 ppt and 100 ppt (3o to 10o Be). Once the water reaches 10° Be, it is pumped to the condensers and then to the salt pans.





**Image 9** Chemplast brine reservoir in Kodiyakarai

When the saltwater is pumped from the sea or the lagoon, it is pumped along with the juvenile prawns and fishes. Prawns, locally called vellaraal and manguni, are abundantly available in this brine reservoir. Economically downtrodden communities from Maniyantheevu, Kodiyakadu and Kodiyakarai indulge in hand fishing in these brine reservoirs.

Currently, Chemplast pumps seawater directly into its brine reservoirs, located near Kodiyakarai village, and GHCL pumps water from the Seruthalaikadu lagoon and stores it in the brine reservoirs located north of Seruthalaikadu village.

### **SETHUGUDA**

Sethuguda is a small bay (about 30–40 ha) where the Koraiyar meets the lagoon. It is bordered by thick mangroves. Fishes, prawns and crabs are trapped in Sethuguda using a pen. They are allowed to grow and as and when they reach marketable size, they are harvested periodically. This practice is similar to traditional canal fishing. This traditional practice of fishing in Sethuguda later fell into the hands of rich and politically influential people. These families restricted the entry of any fishermen into the areas. Later, during the 1950s, a fishermen's co-operative society was formed to break this tradition. The society took these areas on lease from the government and opened them to all fishermen. Currently, fishers are paying Rs.2 per member to the association as a lease amount. However, the fishery resources of Sethuguda have drastically reduced due to siltation and poor exchange of tidal water.

### **SHORELINE**

The Point Calimere Wetland Complex has a 65 km long shoreline, starting from Adirampattinam in the west to Point Calimere in the east. The shoreline had dense mangroves from Adirampattinam to the Muthupet lagoon mouth, which was severely affected by the cyclone Gaja. The shoreline from Mullipallam Creek to Chellakkani Creek has sparse mangroves, but *Prosopis* has invaded extensively. A thick *Prosopis* patch is found along the shoreline over a stretch

of 5 km. The shoreline from Chellakkani Creek to Point Calimere has sparse *Prosopis*, and the coastline from Point Calimere to Vedaranyam has sand dunes lining coastal plains. Blackbuck and Spotted Deer travel from the tropical dry evergreen forest to Chellakkani Creek along the shoreline.

All the fishers, except those of Avarikadu–Vandal, are sea fishers. Till the year 2000, fishers from Koraiyur, Manganankadu and Maravakkadu accessed the shoreline through the fishing canals or the saltwater canals. Fishermen from Maniyantheevu, Kodyakadu and Kodyakarai accessed the shores adjoining their villages. As the distance to be covered to access the sea is less than 3 km, fishers from both these regions indulge in individual shoreline fishing.

This is not possible for the fishers from other villages. Therefore, such fishers practice 'group fishing'. Crabs, fishes and prawns are the major harvest in the nearshore fishing.

### **CREEKS**

There are six natural creeks on the shoreline from Adirampattinam to Kodyakarai. The Mullipallam creek breaches the shoreline at Muthupet, and Chellakkani Creek breaches the shoreline near Seruthalaikadu village. Apart from these two large creeks, minor creeks such as Kaluvapaththai, Manavaikkal, Siththankoyil and Pudhuvaikal are found near Kodyakarai.

Seawater enters into the lagoon through these creeks during high tide (*vellam*) and flows back to the sea during low tide (*vadu*). Fishers understand that the vellam is the right time to enter the creek. Entering the creek during low tide is a risk since the speed of the low tidal current is greater than those of the tidal currents experienced during high tide. Prawns are the major target of the fishers fishing in the creeks.

Though fishing in the creek is riskier than fishing in the thottam or lagoon, some fishermen prefer creek fishing due to the huge harvest. While fishing in the Mullipallam creek is open for all, Chellakkani Creek is open only for Seruthalaikadu fishers. They had to fight a legal battle to restore the traditional rights over the creeks. Similarly, the fishers of Kodyakarai are the only people involved in fishing at the Kaluvapaththai, Manavaikkal, Siththankoyil and Pudhuvaikal creeks.

### **ISLANDS IN THE CREEKS AND ALONG THE SHORELINE**

More than 10 small islands with sand dunes (locally called *theevu*) are present in the creeks and along the shoreline. Ayyanar Theevu, Salli Theevu, Muniyan Theevu, Naran Theevu, Nedun Theevu, Onaan Theevu, Kuttiniyakkaadu and Melakadaisi Theevu are some of the islands with sand dunes. The fishers involved in group fishing, or collective fishing, stay in temporary sheds established on these islands. The fishers have traditionally allocated the islands among themselves, where they stay and cook using dry twigs or dead branches of the trees in the sand dunes. The groundwater lenses occurring at shallow depths in the sand dunes are used for drawing drinking water. The freshwater lenses float on the underground saline water and get recharged during the monsoon rains. Goats and cows are also carried to the shoreline, Mannavaram Theevu, for grazing. More than 200 cows and 500 goats graze in this theevu and drink the water in the shallow pits.

### **TROPICAL DRY EVERGREEN FOREST**

The tropical dry evergreen forest is home to one of the largest populations of the Blackbuck in southern India. The forest, declared a wildlife sanctuary, hosts more than 1000 Blackbucks, 154 species of medicinal plant, two species of insectivorous plant and 260 species of migratory land bird.



*Migratory birds at Thondiyakkadu*

The sanctuary and its surrounding wetlands are important wintering grounds for waterbirds from the north. Nearly 100 species of migratory waterbird, including the Greater Flamingo, arrive at the sanctuary and its surroundings from September onwards and stay on till January before their return to the north. The sanctuary coast has been a regular nesting site of the endangered Olive Ridley Turtle. Dolphins are frequently sighted along the sanctuary coast and stranding of whales has also been reported.

Several sites of historical importance such as Ramarpadam, Modimandapam and the old Chola lighthouse are located inside the sanctuary. The local communities, especially in the Athivasi colony of Kodyyakadu, are highly dependent on the TDEF for their food and nutritional security.

## 4.3 Ecosystem Services Provided by the Point Calimere Wetland Complex

The study of the wetlands and their dependent livelihoods reveals that the PCWC provides multiple ecosystem services. At the same time, the land use and land cover changes in the wetland positively and negatively influenced several components of the wetlands and their services. Details of the services provided by the ecosystems and other features of the wetland, their significance, their prioritisation, and the spatial distribution of the ecosystem services are given in the following.

### 4.3.1 Provisional services

Fresh water, food, fuel, genetic resources and natural medicines from plants are the current provisional services provided by the ecosystems of the PCWC. Though oyster reefs and shells were collected by the people of Koraiyur in the past to manufacture lime, this activity has been banned now by forest regulations due to over-exploitation. Similarly, harvesting mangrove wood has also been stopped since 1971 due to the ban on felling. A few families from Nagapattinam collected ornamental shells from the shores of Kodyyakarai in the past, but they have also stopped this practice. The contribution of PCWC towards the provisional services is depicted in Table 18.

**Table 18** Contribution of the PCWC towards provisioning services

Ecosystems and other features	Provisional service				
	Fresh water	Food	Fuel	Genetic resources	Natural medicine
Salt pans	--	++			
Mudflats	+	+	++		
Pits and puddles in the wetland		++			
Mangrove forest			+	+	+
Mangrove plantation					
Fishing canal		++			
Lagoon		++			
Brine reservoir		++			
Sand dunes/islands	++	++	++		+
Shoreline	+	++			
Creeks		++			
Dry evergreen forest	++	+	+	++	++

Local	
Regional	
Global	

*The services at the regional level also offer benefits locally, and the ones at the global level also offer benefits locally and regionally.*

**Legend**

--	-		+	++
Highly negative contribution	Moderately negative contribution	No contribution	Moderately positive contribution	Highly positive contribution

**FRESH WATER**

The limited fresh water in the PCWC and adjacent areas is confined to a shallow aquifer found between 10 and 15 feet below the ground. Such shallow aquifers are found in sand dunes, on sandy islands, in the TDEF areas and in areas close to hamlets. Traditionally, the hamlets of Pannal, Seruthalaikadu, Kodyakadu and Kodyakarai were dependent on the ponds and open wells within the wetland complex for drinking water. The Seruthalaikadu communities have created seven ponds to meet their drinking and domestic water needs. The community wells of Sakkaranpettai, Kodyakadu and Kodyakarai were operational up to the late 1990s. Now the communities are highly dependent on the Kollidam Integrated Drinking Water Supply Scheme, which supplies water once in 15 days in summer.



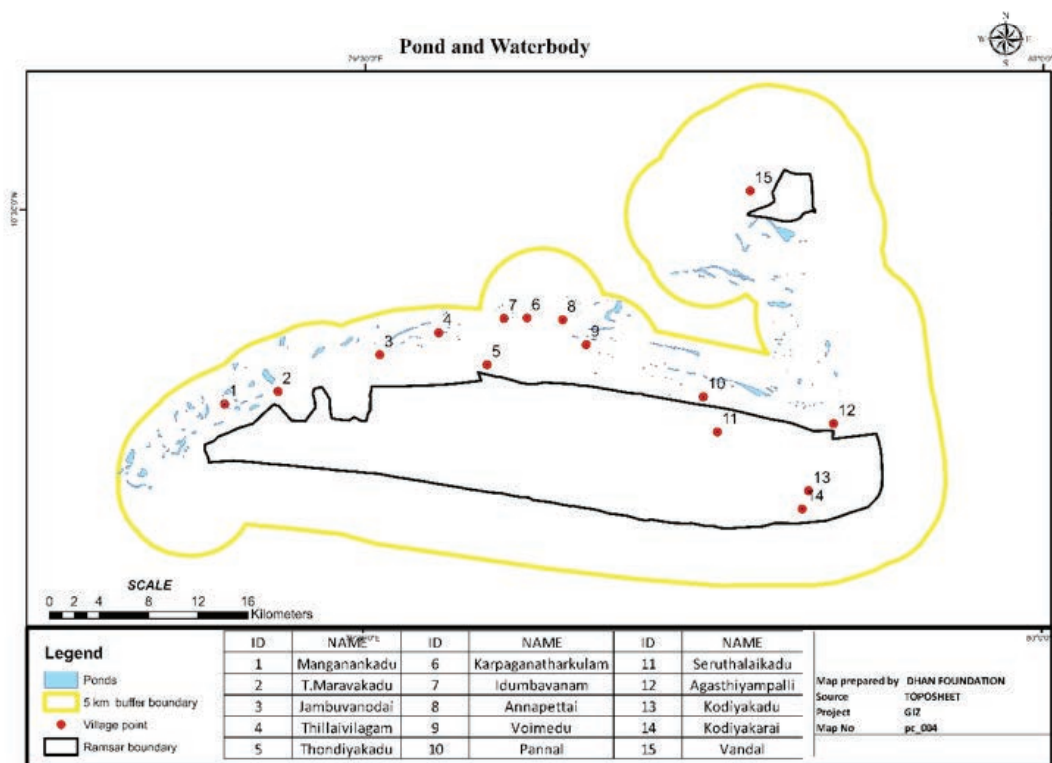


**Image 10** Drinking water source at Kadinelvayal

The presence of a saltpan and its brine reservoir adjacent to the hamlets and pumping of saltwater from aquifers are the major reasons highlighted by the communities for the depletion of the shallow freshwater resources. The communities correlate the invasion of the saline- and drought-resistant *Prosopis* in the mudflats with the depletion of freshwater aquifers.

The freshwater lenses in the sand dunes meet the drinking water needs of not only the communities but also the livestock. Thazhai-adi-kulam, of Sallitheevu, is a dug-out pond in one of the sand dunes accessed by Annapettai fishermen. As the sea winds silt the pond every year, fishers desilt it. Plants such as the Thazhai (*Pandanus*), Othiyam (*Lansea coromandelica*), Neem and Tamarind trees are found in the sand dunes on the islands, indicating the presence of shallow freshwater aquifers. Fishers involved in collective, or group fishing rely greatly on these sand dunes for drinking water. The sand dunes and depressions in the coastal plain serve as the source of fresh water for the wildlife in the sanctuary.

The members of the Konar community of Pannal and Kadinelvayal who are involved in livestock rearing shift their livestock using boat or *thottam* to Mannavaram Theevu, near the shoreline. Just after the monsoon showers, the grass cover of the island increases, and depressions and dug-out ponds are filled with fresh water. Cows and goats graze in these lands for more than 3 months, after which they are brought back to the villages. The communities believe that this practice makes the animals healthier. All these services benefit the local communities living in the buffer area of the wetland. This practice is also responsible for spreading *Prosopis* in the islands and along the sandy shoreline. Cattle relish mature fruits of *Prosopis*, and their dung contains well-processed seeds, which sprout quickly and successfully.

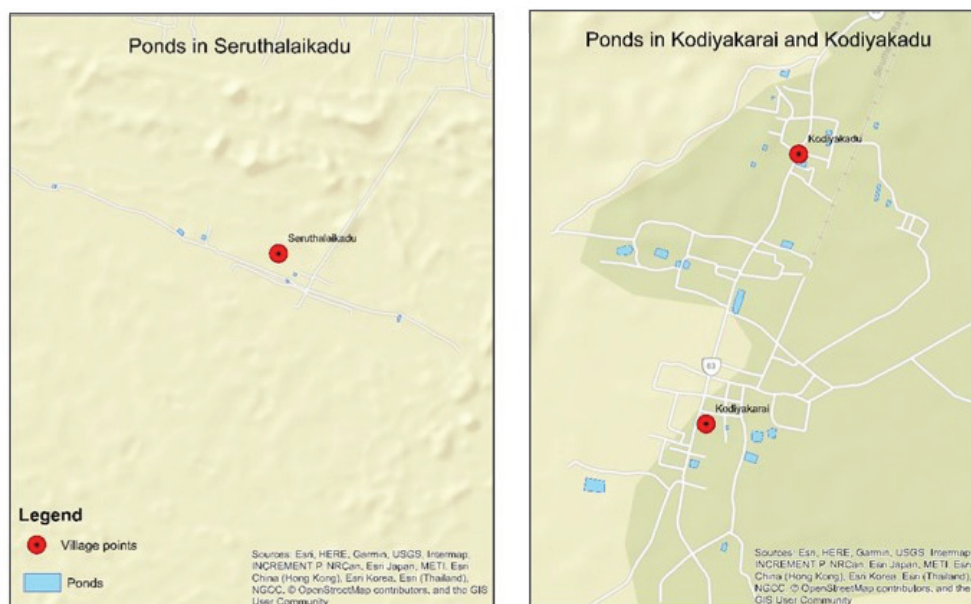


**Map 7** Ponds, tanks and other water bodies in the buffer zone of the PCWC

Water is pumped from shallow groundwater aquifers to dilute the salinity of the brackish water in the aquaculture farms. Shallow bore wells are used by farmers to pump the water, which leads to seawater intrusion in the groundwater aquifers.

About 4725 ha of cultivable land is irrigated land in the villages adjacent to the wetland. Nearly 3966 ha of cultivable land is irrigated by canals, 285 ha is irrigated by tube wells, and 473 ha is irrigated by farm ponds and tanks. But none of the irrigated lands fall inside the wetland complex. The farmlands in Vandal and Kodiyakadu are rain-fed. Farmers cultivating tobacco in Kodiyakadu are dependent on groundwater for irrigation

#### PONDS INSIDE RAMSAR BOUNDARY



**Figure 10** Ponds inside Ramsar site boundary



## FOOD

Paddy is the dominant crop in the PCWC-dependent gram panchayats. As mentioned previously, the lands in which paddy is grown were distributed to families under various schemes. Common salt, fish, prawns, crabs, shrimps, fruits and vegetables are the major food items produced in the wetland.

**Paddy:** Paddy was cultivated inside the wetland complex in the past, particularly in Seruthalaikadu, Agasthiyampalli and Kodyakarai villages. After the storm surge in 1952, cultivation was stopped, and these lands have now been invaded by *Prosopis*.

**Capture fishery:** Since Point Calimere is an intertidal wetland complex, fishers heavily rely on the ecosystems of the wetlands for food and livelihoods. Apart from traditional fishers, the other communities from the 33 dependent gram panchayats are also involved in fishing as full-time or part-time fishers. The entry of fishes, prawns and their juveniles into the wetland complex through creeks, salt channels and fishing canals makes the food resources available abundantly.

While prawns are the major catch in the alam, brine reservoirs and creeks, fish of table size less than 500 g are caught in the *thottam*, backwaters and fishing canals, and fish of table size up to 10 kg are caught in the lagoon and the sea. The crabs are also a major part of the catch of the shoreline fishing. The catch from the shoreline, creek and lagoon reaches the regional markets of Tamil Nadu and neighbouring states, and a part of the catch satisfies the local demand.

**Shrimp culture:** *Vannamei*, the White-Legged Shrimp, is the major shrimp variety cultured in the aquaculture farms of this wetland. If number of shrimps is between 30 and 45 per kg, they are exported to the global market; if it is between 60 and 100 per kg, they are sold in the regional market. Shrimps with an average weight of 25–35 g are considered to be of export quality.

**Fruits and vegetables:** The tropical dry evergreen forest provides fruits (*Kovai*, *Vaasam*, *Korattai*, *Kizha*, *Varpula*, *Paala*, *Noval*, *Ilanthai*, *Soorampalam*, *Kaaramplam*, *Thuvaraipalam*, *Konji/Unji*, *Kodukapuli*), greens and vegetables (*Paasuthi*, *Musutai*, *Umuri*, *Thuthi Leaves*, *Pazhupavakkai*). Communities from the Athivasi colony of Kodyakadu and Kodyakarai were highly dependent on these resources in the past. They even collected the fruits, leaves and vegetables and sold them in the Vedaranyam market. In recent years, due to the ban on collecting forest produce, the communities are less dependent on the forest for food.

Edible *Suaeda*, locally called *Poo Umuri*, was widely consumed by all the fisher communities, especially during the famine, when no other food was available. This tradition of consuming *Poo Umuri* is almost extinct among the people, except in Kodyakarai.

**Salt:** Common salt is produced widely in the wetland complex. The intertidal zone favours the salt production process. About 9 lakh tonnes of common salt is produced every year from the saltpans of Adirampattinam and Vedaranyam, which is supplied to all the states of India. Karnataka is the major market for the salt produced in this region. Though the saltiness of this salt is higher, the market price is low due to its pale colour. The age-old Vedaranyam saltpans have had political importance since the freedom struggle.

## FUEL

The communities are allowed to collect only fallen dry wood and twigs from the tropical dry evergreen forests for their firewood. In earlier days, dry wood was collected and sold in the local market and for restaurants. But due to the stringent action taken by the Forest Department, very few communities of Kodyakadu and Kodyakarai are involved in collection of firewood.



**Image 11** Charcoal-making in Seruthalaikadu

*Prosopis* is used in Seruthalaikadu mainly for making charcoal. In the mudflats of Thondiyakkadu, Pannal and Kadinelvayal, it is used either as firewood or for charcoal making. The *Prosopis* in the poromboke lands of Seruthalaikadu is leased by the village administration, and the income generated is used as a common village fund. *Prosopis* in individual 'patta' lands is leased by individuals. Charcoal-making generates an income of Rs.45,000 per acre once in 5 years since only 5-year-old *Prosopis* trees are used for charcoal-making.

#### NATURAL MEDICINES

Herbs such as Milaguseranai (*Polygala arvensis*), Thuthuvaalai (*Solanum tribolatum*), Pirandai (*Cissus quadrangularis*), Sangumulilai (*Clitoria ternatea*), Vaagai (*Albizia lebbek*), Kaatunaathi, Aavarampoo (*Senna auriculata*), Poonakaachi Kottai (*Mucuna pruriens*), Nannari (*Hemidesmus indicus* var. *indicus*), Avuri (*Indigofera tinctoria*), Aathandai (*Capparis sepiaria*), Oomathai (*Datura metel*), Kacha Komatti (*Citrullus colocynthis*), Neer Mulli (*Hygrophila schulli*), Thillai, Karthigaikilangu (*Gloriosa superba*), Thannivittankilangu (*Asparagus racemosus*) are used locally as medicines.

Milaguseranai, Thuthuvaalai and Avuri are widely used for treating fever. Thillai and Vaagai are used for healing wounds. Kacha Komatti is used for controlling hair fall, and Oomathai is used for treating indigestion in livestock. Karthigaikilangu is used as a biopesticide. Very few families (fewer than 20) are involved in medicinal-plant collection. The herbs are collected and sold through agents to the regional market. The fishers have a practice of drinking hot mangrove leaf tea to arrest diarrhoea when affected during group fishing.

#### 4.3.2 Regulatory services

The Point Calimere Wetland Complex has an estuarine environment, with lagoons, backwaters of the Cauvery's distributaries and intertidal zones of creeks. The PCWC plays a crucial role in protecting the communities during disasters. The regulatory services provided by the PCWC are shown in Table 19.

**Table 19** Regulatory services of PCWC

Ecosystems and other features	Regulatory service									
	Air quality regulation	Local climate regulation	Global climate regulation	Water regulation	Flood hazard regulation	Disaster regulation	Erosion regulation	Water purification	Salinity regulation	Noise and visual buffering
Saltpan		+							--	
Mudflats	-	+		+	++					
Thottam		++			++					
Mangrove forest	++	++	++			++	++	++		
Fishing canals				++	+				++	
Fishing boat canals					+				+	
Lagoons		++			++					
Brine reservoirs		++			--				--	
Sand dunes/islands				++						
Shoreline										
Creeks							--			
Dry evergreen forest	++	++		+		++				

Local	
Regional	
Global	

**Legend**

--	-		+	++
Highly negative contribution	Moderately negative contribution	No contribution	Moderately positive contribution	Highly positive contribution

The services at the regional level also benefit locally, and the ones at the global level also benefit locally and regionally.

**AIR QUALITY REGULATION**

The wetland complex has both landscapes that cause air pollution and absorb air pollutants. During summer, dry mudflats act as a source of silt laden with salt (particulate matter), which is carried inland by the southerly sea winds (*thennangkaathu*). The silt = and salt-laden particles affect the air quality and cause respiratory issues among the communities in the buffer zone. Seruthalaikadu is highly affected by these silty winds. Such salt-laden winds (salt attached to silt particles) deposit salt on crops, vegetation and properties.

Though a similar condition is found in Sakkarapettai, of Pannal, the *Prosopis* growth in the mudflats acts as a buffer against the silt winds and protects the communities from its effects.

Generators and back-up generators used to run the aerators in shrimp farms are another major source of pollution. Though electric connections are provided to the farms, power is available only for 10–12 hours per day. Therefore, generators are used to run the oxygenation units. As these generators are powered by diesel, the smoke pollutes the environment. There are more than 1500 generators running inside this wetland, releasing smoke almost 12 hours every day.

## LOCAL CLIMATE REGULATION

The flow and stagnation of water plays an important role in regulating the local climate by increasing the air humidity through high evapotranspiration. The salt pans, aquaculture farms, thottam, lagoons and brine reservoirs are the important sources of evaporation. Mangrove forest, dense *Prosopis* and tropical dry evergreen forest are the sources of evapotranspiration. Almost the entire wetland contributes to the evapotranspiration in the non-monsoon season and thus regulates the local climate. An increase in humidity and the cool sea breeze are the climatic regulatory parameters perceived by the communities.

## GLOBAL CLIMATE REGULATION

**Carbon Sequestration:** The mangroves and tropical dry evergreen forest support and contribute to carbon sequestration and thereby play an important role in regulating global climate change. The mangroves are among the most carbon-dense forests in the tropics, with an average value of 1023 Mg of carbon per ha (in carbon sequestration, Mg means megagram or ton), which is exceptionally high compared with the mean carbon storage values of the other forest types (Donato, et al., 2011). For example, the total estimated carbon stock of tropical forests in Brazil is only 267 Mg of carbon per ha (Terra, Dantas, Pinto, Calegario, & Maciel, 2021). The carbon sequestration potential of the tropical dry evergreen forest is high due to high biomass. A recent study conducted in four sacred groves, which are rich in TDEF in Ramanathapuram district, indicates that the above-ground biomass ranged from 56 to 93 tons per ha, whereas the below-ground biomass varied from 16 to 24 ton/ha. The carbon accumulation in these sacred groves is in the range of 35–58 Mg of carbon per ha.

## WATER REGULATION

The sand dunes are the ecosystem that regulate water in the PCWC. They regulate the water by harvesting rainwater during the monsoon and storing it below the surface. Water from the sand dunes is extracted in summer for drinking by digging small ponds. Muniappan Lake, in Kodiankadu, is an important flood-regulating water body that stores fresh water during high floods and recharges freshwater lenses.

Wetting the mangrove root zone in summer and flushing away the salinity of the soil in the mangrove root zone during the monsoon by facilitating the river flow is mandatory for the survival of the mangroves. The fishing canal is the only wetland component that facilitates this process. It regulates the water (both brackish and fresh) by connecting the brackish water environment with the sea.

River flow in the drainage canals plays a critical role in resisting the intrusion of saline water into the river plains. As the flow in the drainage arteries is reduced due to damming, salinity intrusion into the agricultural plains is increasing over time. This is further aggravated by the erratic rainfall, resulting in the conversion of cultivable land to fallow land.

## FLOOD HAZARD REGULATION

Mudflats (*alam*) and pits and puddles (*thottam*) in the intertidal zone serve as flood regulators, which absorb large quantities of water during peak flood flows. The water bodies created in the mudflats, such as Muniappan Lake and Thondiyakkadu Lake, also act as flood regulators. The lake in Thondiyakkadu, which was initiated by the then District Collector of Thiruvavur, is yet to be completed.

The bunds and brine reservoirs created in the mudflats for salt pans affect the natural drainage capacity of the wetlands. While the low-rise bunds of the salt pans have a minimal effect on the drainage capacity of the mudflats, the high-rise bunds in the aquaculture farms have adverse effects during floods, causing inundation upstream. The brine reservoirs and brackish reservoir channels used by the salt pans and aquaculture farms further reduce the natural drainage as they always remain full.

## DISASTER REGULATION

The Point Calimere Wetland Complex is a disaster-prone zone that has faced several cyclones and a tsunami. The cyclones that changed the landscape of the wetlands include the Dhanushkodi cyclone of 1952 and the 2018 Gaja cyclone. The wetlands faced a tsunami in 2004. The mangrove forests in the shoreline act as the frontline buffer, and the mangroves in the lagoon area act as the second buffer to cyclones and storm surges. It is common to hear from the community that the mangroves sacrificed themselves to protect the villages. Similar are the sentiments of the communities in Kodyyakadu. According to them, the tropical dry evergreen forest acts as a cyclone buffer when the cyclone hit from the east.

## EROSION REGULATION

Erosion, siltation and deposition are widespread in the intertidal wetland complex. The rivers flowing into the estuaries deposit alluvium on the mudflats. The tidal flow during high tide brings silt from the sea to the mudflats through the tidal canals and creeks. During the low tide, water currents that move towards the sea erodes the silt deposited on the mudflats.

Mangroves and their associates, through their unique root system, arrest the erosion in the intertidal zone both due to tides and the river flow. Mangroves and *Prosopis* present at the shoreline reduce the shoreline erosion. Trees on the dunes arrest the sand erosion to a certain extent. The mangroves in Avarikadu-Vandal provide further evidence for the erosion control service of the mangroves.

The tropical dry evergreen forest acts as an erosion regulator in the coastal plains. As the coastal plains receive an average of 1100 mm of annual rainfall, there is a high possibility of erosion due to storm water run-off. The dense evergreen forest and the grassland play an important role in controlling the erosion of the plains. The communities of Kodyyakarai have also cited that the *Adappan Kodi* (*Ipomoea pes-caprae*) and the *Ravanan Meesai* (*Spinifex littoreus*) of the sand dunes also control soil erosion caused by winds in the dry season.

## WATER PURIFICATION

The intensive use of fertilisers and pesticides in the shrimp farms and disposal of the effluents into the drainage canals without any treatment is an important concern in terms of water pollution. The water is released from the shrimp farm once in 40 days, on the basis of the colour and turbidity of the water. Intensive feeding and use of probiotics, pesticides and fertilisers all worsen the water and soil quality. Fishers are sensing that the movement of aquatic life towards upstream areas has been affected due to the effluent discharge. They have also noticed incidences of floating of dead fishes whenever effluents are discharged.

## SALINITY REGULATION

In the PCWC, the soil salinity and groundwater salinity are reduced only by the freshwater flow and rainfall. As the freshwater flow is reduced due to upstream activities, the soil and water salinity has increased over the period. The fishing canals and drainage arteries are the salinity regulators.

In saltpans, the residue remaining after the extraction of various salts, called bittern, has a very high level of salinity (more than 300 ppt). This residue is allowed to stand in a sink and to seep into the soil. Sometimes the bittern overflows into the neighbouring area. It is the seepage of the high-salinity bittern that has increased the salinity of freshwater aquifers in Kodyyakarai and Kodyyakadu. This must be a recent development, probably after the mudflats were given on lease, first to WIMCO and then to Chemplast and GHCL.

The partially completed lake in Thondiyakkadu, the bunds constructed across the mudflats to arrest the entry of the high tide, Muniappan Lake and ponds (Uppukulam and Vettukulam) in the villages are the artificial structures created by the local community to protect the water and soil quality against the salinity.



## NOISE BUFFER

The diesel-powered generators, running 10–12 hours a day in shrimp farms, are an important source of noise pollution. They affect the communities and the fauna of the wetland habitat. Though there are indications that the noise created by the fibre boats also affects the birds, the communities respond to this statement, saying that the birds have already become accustomed to the situation.

### 4.3.3 Cultural services

The Point Calimere Wetland Complex is an emerging tourism centre. Local, regional and international tourists visit the wetland to enjoy the mangroves, lagoons, wildlife sanctuary and various religious centres located within and around the wetland. The cultural services provided by the PCWC are mentioned in Table 20.

**Table 20** Cultural services provided by the PCWC

Ecosystems and features	Cultural service					
	Cultural heritage	Recreation and tourism	Spiritual and religious value	Inspirational value	Social relation	Education and research
Mudflats		+				
Mangrove forest		++				++
Lagoons		++			++	++
Sand dunes/ islands		+	+			
Shoreline	+		++		++	
Creeks					++	
Dry evergreen forest		++	++		++	++

Local	
Regional	
Global	

#### Legend

--	-		+	++
Highly negative contribution	Moderately negative contribution	No contribution	Moderately positive contribution	Highly positive contribution

*The services at the regional level also benefit locally, and the ones at the global level also benefit locally and regionally.*

## CULTURAL HERITAGE

The ruins of an old Chola lighthouse are found in the place where the Bay of Bengal meets the Palk Strait. Here the coast turns west and runs along the Palk Strait towards the Muthupet mangroves. This 1000-year-old Chola lighthouse at Point Calimere once stood well removed from the beach, but today it stands submerged. During the tsunami of 2004, the top portion of this structure was broken off and thrown a distance of about 100 m, where it can be seen today, partly submerged in the beach sand. Though it is yet to be recognised as an archaeological site, it is one of the archaeological structures found at Point Calimere.

## RECREATION AND TOURISM

Tourists, especially nature lovers, visit the mangrove forest and lagoon in the Muthupet region. The number of people visiting these areas is increasing day by day. A shed and the wooden boardwalk are the special arrangements made specially by the Forest Department to attract tourists. These facilities are now in a dilapidated condition. Though fishers were allowed to take tourists in the past, after the Korankani fire accident, only the Forest Department hosts tourists for boat rides.

Similarly, the wildlife and bird sanctuary of Point Calimere is one of the hotspots for wildlife lovers and bird watchers. The peak season for tourists is from October to February.

Performing rituals for the ancestors and dead ones of families at Kodiyakarai during *Aadi ammavasai* and *Thai ammavasai* (new moon day of July and January) is a religious tradition among Hindu communities. During these days, more than 15,000 devotees come to the seashore of Kodiyakarai to perform the rituals. More than 5000 tourists visiting the Muthupet mangroves, lagoon and tropical dry evergreen forest every month. As the Muthupet mangroves are a favourite wintering ground for more than a hundred species of migratory water and land birds, the increase in the number of tourists to about 15,000 per month is a concern.

## SPIRITUAL AND RELIGIOUS VALUE

Ramarpadham, Rama's feet, is an important religious point that associates Point Calimere with the Ramayana, the Hindu epic. It is located at the highest point of the cape. A stone slab bears the impressions of two feet and is believed to be the place where Rama stood and reconnoitred Ravana's kingdom in Sri Lanka. A large number of Rama devotees gather during the second week of April to celebrate the festival of Ram Navami.

Modi Mandapam is another important shrine located near Ramarpadam. According to mythology, Lord Vedaraneswarer spends a night here with his consort, Modi Amman, during January - February every year. In the first week of March, Manjal Neeraattuvizha, a major festival, is celebrated in this temple. More than 10,000 people participate in this event. Lord Vedaraneswarer is carried in a palanquin that weighs 5 tonnes by 20 villagers of Agasthiyampalli. The villagers who carry the palanquin fast for 10 days as a ritual. Apart from this, *paalkaavadi*, *paneerkaavadi*, *sevalkaavadi*, *paraakavadi*, *pushpakaavadi* and *velkaavadi* are carried as an expression of devotion to God. Kavadi or kavad is a ritual practised in many parts of India.

Sanyasi Munieeswarar Kovil is a shrine located between the eastern bank of Muniappan Lake and Kodikkarai road. It is visited by devotees on all auspicious occasions. On March 20 every year, a special puja is celebrated here.

Mattumunian Kovil (*mattu*, cow) is a small temple south of the sanctuary where people worship and offer prayers throughout the year. A major festival is celebrated here on the third Friday of September every year. It is a belief of the communities in Kodiyakadu, Kodiyakarai and Agasthiyampalli that the cattle left inside the forest are protected by Mattumunian and will return safely whenever they pray to him.

Avulaiganni Dargah is the grave of a Muslim saint located near the road close to Ramarpadam. His death anniversary is observed by the Islamic communities here at the end of November.

Shervarayan Kovil is a local temple to the deities Shervarayan and Soni, located deep in the forests of the northern part of the sanctuary. There was a small village near this shrine, which has now been relocated to the Athivasi colony. It was relocated after the sanctuary was established. The people of Kodiyakadu believe that Servarayan guards the forest, moving around on a horse. There is a myth that one can see him in the forest if she or he goes alone to the forest. Lord Soni is widely worshiped by salt workers and producers. Before the start of the salt production season in mid-January, they offer liquor to Soni, from the pan itself, looking in the direction of this temple. Large congregations of devotees from Aaduthurai celebrate a special festival here during June - July every year.

Kuzhagar Kovil is a Shiva temple in Kodyakarai. The temple was constructed by various Chola kings who ruled from the seventh century to the 10th century. The deity is Kuzhagar. Live goats were offered to the temple, as the temple administration was run through the income generated from goat rearing during the Chola period.

Bathing in the sea at Point Calimere is considered sacred by Hindus. People from Tanjore, Thiruvavur and Nagapattinam districts visit this area on *Adi amavasai* (new moon day in the Tamil month of Adi) and Thai amavasai (new moon day in the Tamil month of Thai) to pay their respect to the departed souls of relatives. Navagodi Sithar, on the shore of Kodyakarai, is worshipped by these people. It is believed that couples without babies will have a baby if they pray to this sithar.

Karuppanasamy, Kaathavarayan and Gomathiamman are the main deities worshipped locally. As these deities have a small temple for them, *Vanadhurgai* has only a small idol and a single tree for worship. This is a traditional form of the sacred groves maintained by the communities dependent on the forest.

Kaattumuni, Vaalmuni and Perumuni are the three male deities who are believed to be the protectors of the *alam* in Avarikadu-Vandal.

Animal sacrifice (goats and hens) is widely practised for the local deities, with or without offering alcohol. The festivals are celebrated with fireworks and folk music.

Maniyan, in the Chellakkani mouth region of Seruthalaikadu lagoon, is an important deity worshipped by the fisher communities of this Ramsar site. A small idol installed below the centuries old *Othiyam* tree is worshipped as Muni. *Samivalai*, a traditional custom of offering a complete day's catch to this deity, is practised by every boat-owning fisher. On one of the days during the prawn-fishing season (October–December), nets are placed in the water in the name of Muni. The fish/prawn caught is sold in the market without any shares being taken by boat owners and others. With the revenue from this catch, flower garlands and pongal (sweet porridge) are offered to Muni.

*Mann Thaali* is a unique custom practised by the Kodyakarai fisher communities. A *thaali* is a sacred thread worn around the neck by married women. The poor fisher who cannot purchase a golden *thaali* ties a *mann thali* around his wife's neck as a marriage ritual. *Mann thaalis* are collected from the seashore. There is a belief that every grain of the soil of Vedaranyam is 'shivalingam'.

## HERITAGE SITE

The Salt Satyagraha of Vedaranyam is an important historical event in the Indian freedom struggle. Sir Vedarathinam Pillai was an important Gandhian Congress leader who organised a salt satyagraha at Vedaranyam, similar to the Dandi march, led by Mahatma Gandhi. This salt satyagraha march was led by Rajagopalachari (Rajaji). He was arrested on 30 March 1930 and jailed. The salt corporation office of Vedaranyam still preserves the jail room where Rajaji was temporarily imprisoned before being taken to Tiruchirappalli for trial. As a remembrance of this historical event, a memorial pillar has been erected. On April 30 every year, leaders from political parties, salt workers and the public organise a march from Vedaranyam town to the memorial pillar and pay their respects to Mahatma Gandhi and other freedom fighters.

## EDUCATION AND RESEARCH

The intertidal zone of the wetland complex, the mangrove forest, the marine resources of the wetland, the wildlife and bird sanctuary and the tropical dry evergreen forest are hotspots for the research community. Research focusing on the wildlife, the flora and fauna of the mangroves, the mangrove management, the migratory birds, the impact of the salt pans, the trends in the aquatic resources, the coastal erosion and shoreline changes and socio-development is conducted. Hundreds of research papers have been published by researchers from regional, national and international institutions. Being a Ramsar site, the PCWC has attracted the attention of the international research community as well as development institutions since the late 1990s.

#### 4.3.4 Supporting services

##### SOIL FORMATION

Deposition of alluvium by the river arteries, sedimentation by tidal action (sea silt) and decomposition of the organic components of fallen wood of the mangroves and tropical dry ever green forest might result in soil formation. Sedimentation in the lagoon and waterways causes siltation, which in turn affects the free flow of tidal and flood water. But the community says that the oyster reef in the intertidal zone is growing at a considerable rate. Different supporting services provided by the PCWC are mentioned in Table 21.

**Table 21** Scale and contribution of ecosystems to supporting services

Land use land cover	Supporting service		
	Supporting service	Nutrient cycling	Provision of habitat
Mangrove forest	+	+	++
Lagoons		+	
Dry evergreen forest			++
Shrubs on mudflats			++
Sand dunes/islands			++
Shoreline	+		++
Creeks		+	++

Local	
Regional	
Global	

##### Legend

--	-		+	++
Highly negative contribution	Moderately negative contribution	No contribution	Moderately positive contribution	Highly positive contribution

*The services at the regional level also serve locally, and the ones at the global level also serve locally and regionally.*

##### NUTRIENT CYCLING

Sewage from Muthupet and effluents discharged by shrimp farm are the point source pollutants entering the wetlands. The agricultural pollutants entering the wetlands via the river flow are non-point source pollutants. A study of the bioremediation or regenerative capacity will reveal the nutrient cycling capacity of the wetlands.

##### PROVISION OF HABITAT

The wetland complex serves as a habitat for 260 bird species, 70 fish species and 300 floral species, including the Blackbuck, Wild Boar, Wild Cat, Spotted Deer and Olive Ridley Turtle. Degradation of the wetland directly affects the migratory pattern of the birds. The waterbirds in the Vedaranyam swamps use the shrubs on the mudflats as their habitat, and the waterbirds and bats of the Muthupet region are dependent on the mangroves for their habitat. The land birds in the wetland complex use the tropical dry evergreen forest as their habitat.

## 5 LIVELIHOOD DEPENDENCE ON THE POINT CALIMERE WETLAND COMPLEX

### 5.1 Agriculture

Seruthalaikadu, Kodyakkadu, Kodyakara and Vandal are the villages that had agricultural land within the wetland complex. The rest of the villages that predominantly cultivate paddy and coconut are adjacent to the wetland. Agriculture is practised only in Kodyakkadu and Vandal.



*Image 12 Tobacco cultivation in Ayakkaranbulam*

Tobacco is the major crop cultivated in the rain-fed lands of Kodyakkadu, and well water is mainly used for irrigation. The lands are leased for Rs. 35,000 per cultivation.

The Vandal area, being an alluvium plain, is often affected by floods and backwaters. The flows of the Nallaru and Adappar are the major sources of fresh water for the farmers of this area. Paddy is the major crop grown in this region. Most of the farmers cultivate their own lands and a very few lease their lands to others.

#### 5.1.1 Seasonal dependence of farming

Tobacco is a six-month crop, and generally, it is cultivated only once in a year. Very rarely, a few farmers cultivate twice in a year, the first crop on dry land and the second crop on the paddy-harvested field. The tobacco-cultivating families invest their family's labour in it throughout the year. Since people of the Athivasi colony were traditionally dependent on the forest and backwater fishing, the emerging farmers (three families) from these communities are partly involved in fishing during the monsoon.



In Vandal, about 300 families own less than 1 ma (0.33 acres) of land each, 40 families own 1–2 ma and 10 families own more than 2 ma of cultivable land. Paddy is the major crop cultivated in the rain-fed land. As the seawater inundates the floodplain zone through the Vedaranyam canal during the monsoon season, the water in the drainage arteries (Nallaru and Adappar) becomes brackish. The water remains fresh just for a month. Therefore, the paddy cultivation is dependent on the local rainfall. Since only one crop of paddy is possible in Vandal, the farmers work as saltpan workers or labourers in shrimp farms during the non-cultivable period. The favourable period for paddy cultivation is September–January. Saline-resistant paddy is preferred in this region.

### 5.1.2 Temporal dependence of farming

Currently, the agricultural lands of Seruthalaikadu and Kodyakarai are not under cultivation and are being invaded by *Prosopis*. The Pillai community (locally called Karakaraipillai) is essentially a farming community. A long time back, farming communities from adjacent villages cleared the forest on mudflats and coastal sandy areas to establish agricultural lands.

Seruthalaikadu was created by reclaiming the swampy mudflats for agricultural land, and Kodyakarai was created by clearing the Kaasaan Kadu (forest of *Memecylon umbellatum*), a forest of the Kaasaan tree, which is widely used as a prop for the *kalasams* of temples.

The communities of Seruthalaikadu and Kodyakarai cultivated paddy, chili, vegetables, small millets, pulses and oil crops in their rain-fed lands. The establishment of salt pans and brine reservoirs upstream of the cultivable area, erratic rainfall and the salty slurry brought in during storm surges and cyclones forced the communities to abandon cultivation. The farmers turned into full-time fishers, and some even own boats. The lands have been invaded by *Prosopis*. Some of the land is leased to communities who convert it into charcoal. The lease price ranges from Rs.10,000 to Rs.30,000 per acre, depending on the age of the *Prosopis*. The older the *Prosopis* is, better is the price.

In the Vandal area, higher returns from shrimp farming and mixing of fresh water from the Adappar river and backwaters from Vedaranyam channel motivated the farmers to convert their agricultural lands to aquaculture farms. As the saline leachate from aquaculture farms affected the adjacent farmlands, the owners of these lands also converted their lands into shrimp farms. In the last 20 years, more than 50 acres of agricultural land has been converted into shrimp farms. Most of these farms are owned by the villagers themselves, and a very few farms are run by people from Nagapattinam on lease. All the shrimp farmers of Vandal village are small-scale shrimp farmers.

### 5.1.3 Resource utilisation for farming activities

Soil and fresh water are the primary resources utilised by the farmers, who are predominantly paddy cultivators. In the past, mudflats were distributed to the landless and were reclaimed as cultivable land. Fresh water from the surface and groundwater sources makes the farming viable. Since the farming in Kodyakkadu and Vandal is primarily dependent on rainfall, the groundwater abstraction for farming is minimal or negligible.

In the villages adjacent to the PCWC, electrified motors pump the groundwater from just 15–20 feet below the ground level. Apart from this, barrages and earthen bunds are constructed to protect the fresh water from the increased salinity caused by seawater incursion. These barrages and earthen bunds also help improve the groundwater aquifers by building a freshwater head and storing the fresh water in the wetlands.

### 5.1.4 Land ownership

All the cultivable lands have 'pattas', issued to individual farmers or temple (HR&CE). The farmlands are either directly cultivated by the owners or leased to other villagers.

### 5.1.5 Seasonal and temporal trends of freshwater resources

Farming is dependent on freshwater sources such as rainfall, the freshwater flow in irrigation canals and groundwater. Farmers rely on the north-east monsoon showers. The command area of the Vennar Irrigation System relies heavily on the flow of the Cauvery, which directly depends on the rainfall during the south-west monsoon season in the upper catchment area of the Cauvery basin. The groundwater reserve supplements the farming activity whenever there is a shortage in rainfall.

Since the retreating monsoon (north-east monsoon) is highly erratic in nature, the farmers either depend on groundwater or leave the farms fallow. Damming of rivers upstream of the river Cauvery has reduced the flow in the arteries. This has added pressure on the irrigation-dependent farmers. Therefore, more and more cultivable land is becoming fallow. In the past, there were more than 500 active open wells in the villages adjacent to Point Calimere Wildlife sanctuary, which helped irrigate the tobacco fields.

### 5.1.6 Competing use of farming resources

Aquaculture-shrimp farms are the only competing users of the groundwater reserves. The salinity of the water stored in the channels or ponds in the wetland complex is higher than that of seawater (>35 ppt). Such high salinity is not suitable for shrimp farming. Therefore, fresh water from groundwater reserves is pumped into the farms to dilute the saline water. The reduced groundwater recharge is attributed to poor rainfall and increased groundwater abstraction by shrimp farmers. This depletes the groundwater reserve and allows seawater intrusion into the shallow aquifers. Though the competing use is not direct, it has direct implications on the agricultural livelihood as well as the ecosystem. It is to be mentioned that as per the guidelines issued under the Coastal Aquaculture Authority Act, 2005, the use of groundwater is banned in coastal aquafarming.

### 5.1.7 Impact of natural disasters on farming

While the coastal plains of the Palk Strait are highly prone to cyclones, sometimes they are also subjected to the impacts of tsunamis. During storm surges and tsunamis, the bottom sediment of the nearshore areas is brought inland and deposited on agricultural land, on farm ponds and in the wetland. This increases the soil salinity and makes the soil less fit for agriculture. It is important to note that the disastrous cyclone of 1952 turned the agricultural lands of Kodyakara and Seruthalaikadu fallow by depositing a large amount of marine sediment. This converted the agrarian community (Karakaraipillai) to fishing. A minimum of Rs.20,000 was spent per acre of cultivable land to remove the marine sediment deposited by the tsunami and the cyclone Gaja.

### 5.1.8 Existing market for resources

Apart from the agricultural land in the vicinity of the shrimp farms, the land in the wetland has no demand in the market. Most of the land near the shrimp farms has already been converted into aquaculture ponds.

## 5.2 Livestock Rearing

Livestock rearing is an important livelihood activity of the Konar communities in the villages adjacent to the wetlands. These communities rear both cows and goats in large numbers. Families from other communities are also involved in livestock rearing, but they rear only small numbers of animals. These communities are dependent on the wetland (grassland) for meeting their livestock-fodder needs. The mangroves near Adirampattinam, the TDEF in Kodyakkadu and Mannavaram Theevu are the major grazing lands in this region.

### 5.2.1 Seasonal dependence of livestock rearing

Just after the monsoon showers, the paddy fields are brought under cultivation. To meet the livestock-fodder needs, the livestock are taken to Mannavaram Theevu. They are taken by boat, or the cattle swim and reach the islands. They are allowed to graze the fodder available on the island and drink the fresh water available in the shallow ponds (*kuttai/pallam*). Once the harvest is done in the paddy fields, the cattle are shifted back to the villages. The cattle left in the forest are marked by their owners for identification.

### 5.2.2 Temporal dependence of livestock rearing

In the past, livestock were left to graze in the mangrove forest, tropical dry evergreen forest and the island with a mark on them. The animals fed on the leaves of the trees in the forest. After a span of six months, they were brought back. Overgrazing of the mangroves led to degradation of the forest and an invasion of *Prosopis*. Therefore, the Forest Department has restricted grazing inside the forest area.

The number of people dependent on Mannavaram Theevu is also reducing because of the animal deaths during cyclones and non-availability of fresh water and fodder grass due to the *Prosopis* invasion. According to the local people, Mannavaram Theevu augments the freshwater resources, but over the years this has reduced as salinity intrusion into groundwater has increased. The freshwater aquifers that were available a decade ago are slowly drying up.

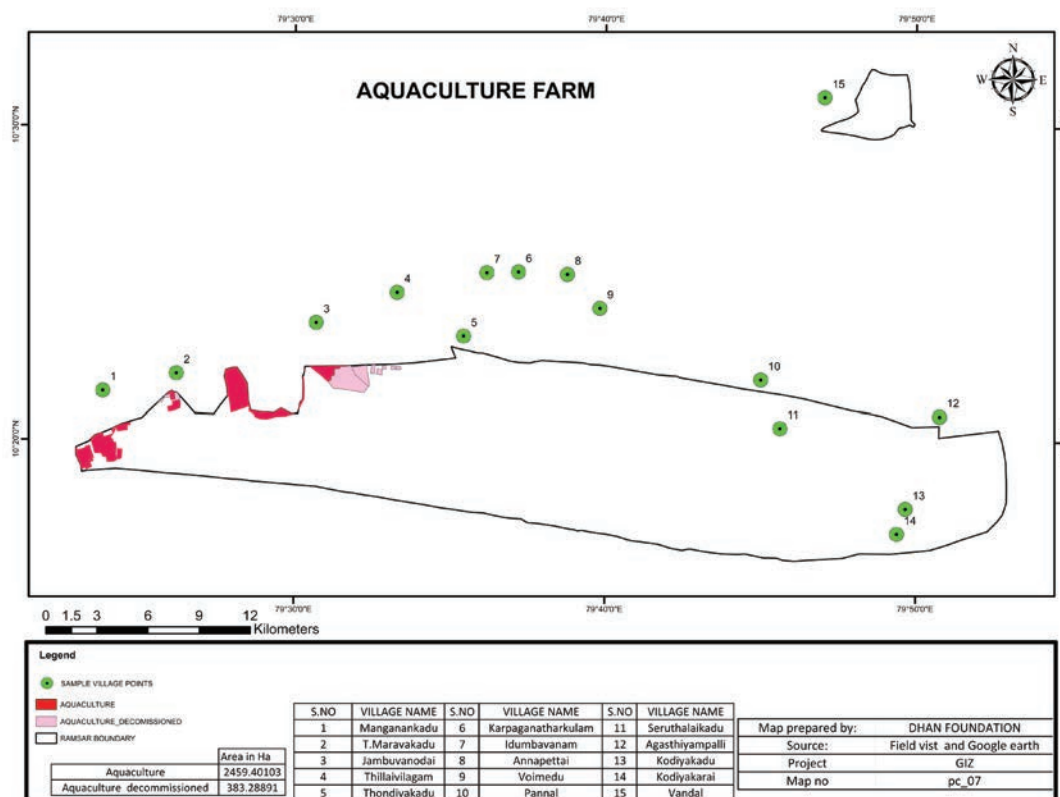
## 5.3 Aquaculture

Aquaculture started in the wetland ecosystem during the early 1990s. The higher rates of return from shrimp farms resulted in the conversion of agricultural lands, salt pans and mudflats into aquaculture farms (refer Map 5). Economically sound communities in Adirampattinam, Muthupet, Thambikottai, Jambuvanodai, Thillaivilagam and Vandal entered shrimp farming. The high profits from the shrimp farms motivated relatively poor communities to take up farms on lease. These lease farmers were supported by debt-based input suppliers (backward linkages) with an agreement that the harvested shrimps should be sold only to these suppliers. The backward linking suppliers pay the shrimp farmers as per the market price.

In this wetland complex, there are about 4000 shrimp farms. Most of the labourers are from the adjacent villages. It is mandatory for the aquaculture labourers to stay in the farm throughout the season. They are paid Rs.15,000 per month, with only six days' leave during the crop period of 120 days. One labourer is employed per farm, who looks after the feeding, liming and application of medicines, pesticides and fertilisers. Most of these labourers are either landless or marginal farmers.



Photo credit: GIZ\_Neha A.Owaisy



**Map 8** Location of aquaculture farms adjacent to Point Calimere Wetland Complex

### 5.3.1 Seasonal dependence in aquaculture

In a year, shrimps are cultured twice for four months in each cropping season. Fog in winter creates unfavourable conditions for shrimps. Thus, the winter, i.e., October–January, remains the off-season. Since winter in this region coincides with the north-east monsoon, shrimp-farm labourers and shrimp farmers engage in agriculture.

### 5.3.2 Temporal dependence in aquaculture

As stated previously, after the 1990s, even saltpans taken on lease from the Salt Department, Government of India, by private players were converted into aquaculture farms. Later, this practice was banned by the Salt Department. Similarly, aquaculture farms were created in the area that belonged to the Muthupet reserve forest. These aquaculture farms were banned through legal interventions, and lands were taken back by the Forest Department.

Till 2013, the Tiger Prawn was the major shrimp cultured in this area. Due to its poor survival rate and extended growth period, shrimp farmers started preferring the white-legged Vannamei shrimps. As shrimps are highly vulnerable to diseases, shrimp farming remains a gamble. It might either generate huge profits or a great loss. Disasters such as cyclones add more uncertainty to the shrimp farmers' incomes. Shrimp farming saw an increasing trend till 2010, after which it declined till the introduction of Vannamei in 2013. This was then followed by an increasing trend till 2018, until the cyclone Gaja. There was a fall after the cyclone, and now the trend is stagnating. The fall in the price of shrimps in the global market and cost of reclamation post-Gaja were the reasons behind the non-operational aquaculture farms. The uprising market price for shrimps might motivate shrimp farmers to get back to this occupation.



### 5.3.3 Resource utilisation in aquaculture

Saltwater and fresh water are the two important resources extracted by the shrimp farms from the wetland complex. The natural drainage canals, traditional saltwater canals and newly created canals are used as conveyance structures that deliver saltwater during high tides. Electric motors are now used to pump saltwater from the canals/channels and fresh water from groundwater aquifers. To maintain the water quality, the water is changed every 40 days, three times in a cropping period. Separate drainages were created to dispose of this aquaculture effluent in the lagoon.

#### RESOURCE EXTRACTION TECHNIQUES IN AQUACULTURE

In these farms the modified extensive system is followed. All these farms draw water either from the sea through canals or from the mangrove wetland. In the modified extensive farms, water exchange is performed once in 40 days. The water level maintained in the farms is about 110–115 cm.

During the post-monsoon season, the salinity in the lagoon is relatively lower in the upstream and high in the mouth region of the lagoon. This is the reason behind the pumping of saline groundwater for shrimp farming. Since the salinity of the lagoon is higher than 32 ppt during the summer months, groundwater from aquifers is pumped into the farms to dilute the salinity of the water stored there.



**Image 13** Water extraction for aquaculture and salt farms at Adirampattinam

In the Muthupet region (Block A), arteries of the Cauvery, their natural drainages and saltwater canals are used to transfer the incoming saltwater from the sea or lagoon to aquaculture ponds. In the Avarikadu-Vandal region, brackish water in the Vedaranyam canal is used for filling up the ponds. The effluents are released in the drainage channels, canals, backwater canals or arteries without any treatment.



### 5.3.4 Access for livelihood

Shrimp farming is practiced in the individual agriculture lands that were converted into aquaculture farms. These lands are either owned by the shrimp farmers or are leased from others. Very few farms were established in the poromboke (waste land owned by the Revenue Department) or forest land. These farms were considered as encroachments and remain defunct due to regulatory measures. The shrimp farmers have to obtain approvals from the Coastal Aquaculture Authority of India for establishing shrimp farms in the coastal zone.

### 5.3.5 Seasonal and temporal trends in ecosystem services

During the shrimp farming season, farmers capitalise on the high tides to pump saltwater to the ponds. The saltwater resource is abundant in the sea, the lagoon and the saline aquifers. But heavy groundwater abstraction and poor freshwater recharge reduce the freshwater column in the aquifers.

### 5.3.6 Competing uses of resources

Shrimp farmers dominate over the salt producers in abstracting saltwater flowing through the canals, particularly in the areas near Adirampattinam. They also compete with the farmers in groundwater abstraction and dominate over the canal fishers by diverting the flow of fresh water away from the fishing canal. Among these groups, canal fishers are the most affected and salt producers are the least affected.

As shrimp farms reduce the quality of the adjacent land by increasing the soil salinity, there is a strong conflict between farmers and shrimp farmers. In Sengangkadu, of Thillaivilagam, the communities protested against the establishment of shrimp farms to protect their agricultural land. Even some of the agrarian families regret selling their agriculture land to shrimp farmers.

### 5.3.7 Impact of disasters on ecosystem and wetland-dependent livelihoods

Most of the shrimp farms that remain defunct currently are the ones affected by the cyclone Gaja. During the cyclone, the bunds were breached, and marine sediments and twigs and branches from the forest were deposited in the farms. It cost more than Rs.50,000 to restore a pond for aquaculture. Only very few farmers got involved in the restoration process.

It was a huge loss for the shrimp farmers who stocked during this period. Many farmers who leased the farms for culturing left the farms unaddressed. A few shrimp farmers who were unable to repay the debts or make further investments moved away from shrimp farming and took up agriculture or fishing as their major occupation or migrated to foreign countries as labourers.

### 5.3.8 Existing market for shrimps produced

Fluctuations in the market price and erratic production make this investment-intensive farming a gamble. The average price of 30 shrimps per kg is Rs. 600, that of 45 shrimps per kg is Rs.400, that of 60 shrimps per kg is Rs.300, that of 80 shrimps per kg is Rs. 200, and that of 100 shrimps per kg is Rs.150. Most of the shrimp farmers sell their shrimps to the merchants who provide credit-based backward support. The sales are according to the market price. In the last 5 years, the market price of shrimps has not been rising as expected by the farmers. After the COVID lockdown, shrimp farmers are slowly investing more in aquaculture as the price in the market is increasing due to increased global demand.

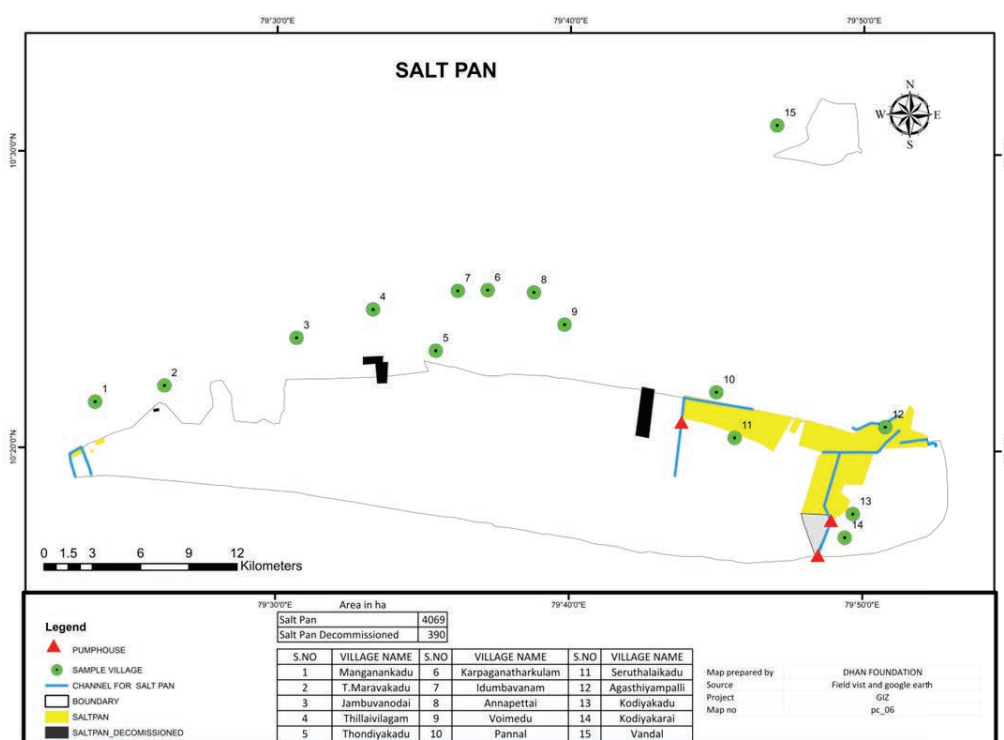
## 5.4 Salt production

Salt pans in Adirampattinam were leased by KTK Pvt. Ltd., a Tuticorin-based salt-producing company from the Salt Department, Government of India. Villagers of Maravakadu, Karisaikadu and Manganankadu are employed as workers in this saltpan. The wages of these saltpan workers vary from Rs.300 to Rs.500 per day. The work timings are usually from 4 am in the morning till 10 am.

The salt pans in the Vedaranyam swamp are owned by the Salt Department, Government of India (Map 9). About 3000 ha of saltpan under the Central Government is leased to 10,000 small scale salt producers, and the remaining 450 hectares was leased to a company owned by Gurukulam. The Tamil Nadu Revenue Department has leased mudflats in Kadinelvayal and Agasthiyampalli to two corporates, Gujarat Heavy Chemicals Limited (GHCL) and Chemplast Sanmar Pvt. Ltd., respectively. The lease amount amounts to Rs.135 per acre per year. These salt pans employ their workers from the neighbouring villages of Kadinelvayal, Pannal, Seruthalaikadu, Agasthiyampalli and Kodyakkadu. Most of the small-scale salt producers are from Agasthiyampalli. The Salt Department, Government of India provides licenses to these producers. The lease price per acre per year varies from Rs.400 to Rs.760, depending on the block (A, B, C, Y) in which the saltpan is located. The lease period is 20 years. The price paid to transfer the lease contract for an acre of saltpan varies from Rs.2 lakhs to Rs.4 lakhs, depending upon its location.

Unlike the wage salt workers who are working in the small-scale salt pans, there are two or three permanent saltpan workers in the corporate companies from each of the adjacent villages, who gets a monthly salary of Rs.12,000–15,000. The only service provided by these corporates to these villages is supplying drinking water for village functions/festivals.

There are about 100 'palm leaf collectors' in Karayankadu, Karpaganatharkulam, Naluvadapathi and Vellappallam. They are the off-site marginal communities who provide palm leaves for making sheds for the harvested salt heaps. The cost per palm leaf is Rs.6. These communities were earlier involved in making toddy from palm trees.



Map 9 Location of salt pans in the Vedaranyam region

### 5.4.1 Seasonal dependence of salt works

Salt production in this wetland starts from mid-January and ends with the onset of northeast monsoon (mid-October). As the water level in the mudflats rises more than a foot, it becomes impossible for the salt producers to produce salt during the monsoon season. During this off season, the saltpan workers are involved in fishing in both the saltpans and the brine reservoirs and in working as agricultural labourers.

### 5.4.2 Temporal dependence of salt works

While the extent of saltpans in Adirampattinam is reducing, it is increasing in the Vedaranyam Swamp. Therefore, the number of people dependent on the salt production is also increasing in Vedaranyam. The introduction of electricity-driven bore wells was behind this expansion of saltpans.

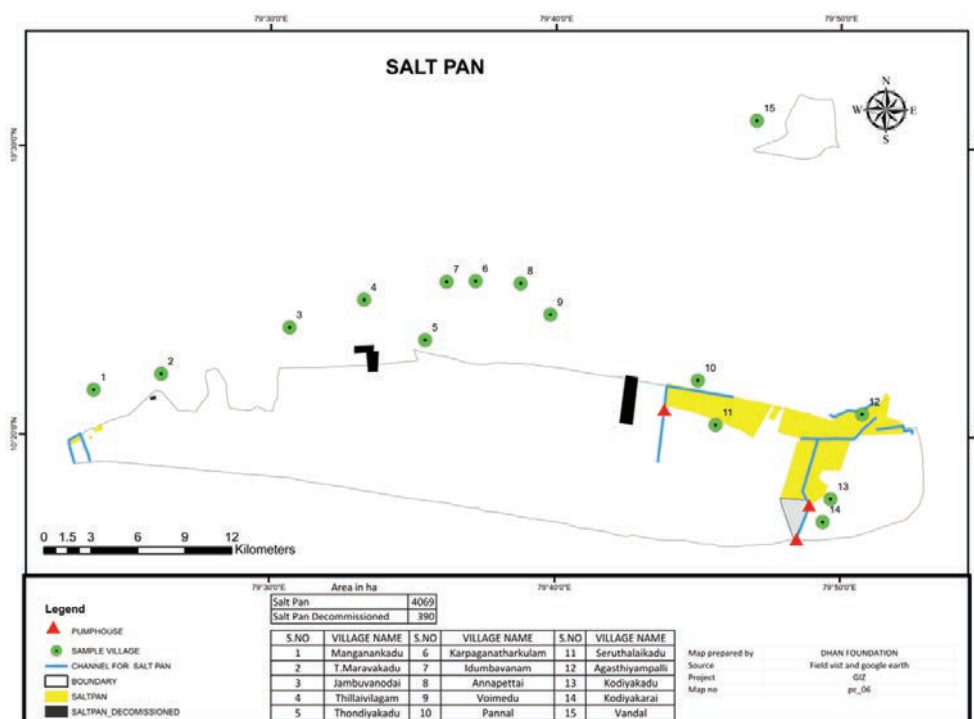
A saltpan was established in Thillaivilagam by the Crystal Salt Company, but it was closed due to poor production.

### 5.4.3 Resource utilisation in salt works

Saltwater canals are the major conveyance structures of seawater for the saltpans. In Adirampattinam, saltwater canals running parallel to the fishing canals, starting from the sea, supply seawater to the saltpans. Salt producers either pump this canal water directly into the pans or transfer it first to a saltwater reservoir and then to the pans.

In Kadinelvayal, saltwater is pumped from the canal created by the saltpan industry (GHCL). The pumped water is stored in the brine reservoir created between Kadinelvayal and Seruthalaikadu. This canal carries saltwater from the Chellakkani Lagoon/Creek to the pumping station. Since the salinity of the water in the lagoon is higher than that of the sea (>40 ppt), the salt should be harvested quickly.

In Agasthiyampalli, saltwater is pumped from the Visagam canal that links the Coromandel coast with the Palk Strait. This canal connects the east coast with the south coast and runs in a north-east to south-west direction. The water level in the canal naturally rises due to the eastern sea winds in May and the southern sea winds in August. Water is supplied to the saltpans using the distributary that connects with the Visagam canal (Map 10).



**Map 10** Saltpans and canals involved in salt production (line with two pumphouses indicates Visagam canal, and line with one pumphouse indicates canal dug by GHCL for its use)

Chemplast, one of the biggest producers of salt in Vedaranyam, pumps saltwater directly from the sea and stores it in the brine reservoirs (*kottagam*) before pumping it into their pans. As the seawater flow in the canal is low during the low tidal season, saltwater from aquifers is pumped using electric motors. The saltwater is pumped from aquifers that are 30 to 50 feet deep just below the pans.

#### 5.4.4 Resource extraction techniques in salt works

Salt is produced by gradually increasing the salinity level of seawater in a series of reservoirs until salt is extracted. Seawater is first stored in reservoirs called brine reservoirs and is allowed to stand till the salinity level reaches around 10° Be, i.e., a specific gravity of 1.04–1.05. The salinity of normal seawater varies from 35 ppt to 68 ppt. Once the water attains the desired level of salinity, it is pumped to smaller reservoirs called condensers. There are three types of condensers, where the salinity level is maintained at 10–15° Be, 15–23° Be and 23–24° Be for eliminating unwanted chemicals and impurities and precipitating calcium sulphide. In the third stage, the concentrated brine is drawn into crystallisers, in which edible salt starts crystallising between 24° Be and 29° Be (specific gravity 1.25–1.27, i.e., 300–325 ppt). The prescribed salinity level for extraction of edible salt is 24° Be. The extracted salt is removed, allowed to dry, stored and later transported.

Though common salt (sodium chloride) is the major product produced by the small-scale and large-scale salt producers, other salts such as sodium sulphate and soda ash (carbonates), which are important industrial raw materials, are also extracted from the brine.

#### 5.4.5 Access to livelihood

The salt pans were leased out by the Central and State salt corporations to small-scale salt producers and the corporate giants, respectively. Since the lease period is 20 years, the small-scale salt producers (lessee) of Agasthiyampalli renew their licenses through their small-scale salt producers' association. This association facilitates the process of lease transfer within the same family generation after generation.

Since the small-scale producers showed less interest in the salt pans of Adirampattinam, they were leased to a Tuticorin-based private company (KTK Pvt. Ltd.).

On the other hand, the salt pans regulated by Tamil Nadu Salt Corporation auctions the lease contract every 20 years. Since both Chemplast and GHCL are machinery-based companies, they employ fewer labourers compared with KTK.

Though fish culture in the salt pans during the rainy season has been restricted, fishing in the brine reservoirs and canals is allowed. People from Maniyantheevu, Kodyakkadu and Kodyakurai catch fish in this brine reservoir throughout the year without any restrictions. But their use of the boat deck located near the pumping station at the saltwater canal in Seruthalaikadu has been treated as trespassing by GHCL. The fishers from Pannal have been requesting for an access road on the bund created for the saltwater channel, which would ease their movement during the rainy season. During showers, the current mud road becomes swampy and creates trouble for the fishing community. The demand for the road has been put down by the GHCL and the line departments since the road is inside the Salt Corporation land.

#### 5.4.6 Seasonal and temporal trends in ecosystem services

Salt production starts in January and ends with the onset of the north-east monsoon. The salt production is relatively better in summer than in any other season. Since saltwater is abundantly available in the sea as well as in the saline aquifers, the production of salt has been increasing over the decades.

### 5.4.7 Competing use of resources

In the past, there were several conflicts regarding the rights over the Visagam saltwater canal between small-scale salt producers and the larger SKSP Salt Company. Later the saltwater canal became common to all. There is an intense legal battle between small-scale salt producers and the Salt Corporation of India regarding the renewal of the license for the next lease period. The Salt Corporation (Salt Department, GOI) prefers to give it to a single private party (like Chemplast) rather than to multiple small-scale producers.

There is also another competition between the fishing communities and the avian species over the fishes and prawns in the brine reservoir during the monsoon, when the salinity in the salt pans is lower.

### 5.4.8 Impact of disasters on salt production

Cyclones have breached pan bunds, deposited sea slurry and thrown broken branches of *Prosopis* into the pans. Removing the *Prosopis* and sea slurry was expensive. Every salt producer invested more than Rs.20,000 per acre to restore the pans and restart the salt harvest after disasters.

### 5.4.9 Existing market for salt produced

Though the salt market is steady throughout the nation, the salt produced in this wetland is exported mostly to Karnataka. Salt producers highlight the fact that despite the higher saltiness of Vedaranyam salt compared with Thoothukudi salt, it has a lower market price compared with Thuthukudi salt. The major reason is the pale colour of Vedaranyam salt, compared with which the Tuticorin salt is whiter.

## 5.5 Fishing

Based on the fishing ground, the fishers can be categorised into the following:

- Canal fishers, who fish traditionally in the man-made fishing canals
- *Thottam* fishers, who travel on foot or by bicycle to fish in the *thottam* and *alam*
- Lagoon and creek fishers, who fish in the Muthupet lagoon, the Seruthalaikadu lagoon and Chellakkani Creek.
- Backwater fishers, who fish in the backwater channels, saltwater canals and brine reservoirs.



**Image 14** Fishing in Seruthalaikadu



### 5.5.1 Canal fishing

There are about 128 fishing canals in the estuaries of the Nasuviniyar and Pattuvanachiyar arteries. These fishing canals, dug and established by the communities residing near these arteries (Soundaranayakipuram and Maravakadu), are traditionally maintained and have been used by fishing families, generation after generation. These man-made fishing canals lie within the reserve forest of Muthupet. The fishing rights were transferred to the families who practiced fishing in the respective channels. These fishing canals got heavily damaged by the tsunami. Though most of these canals were retrieved with the support of NGOs, they were again damaged by the cyclone Gaja.

#### SEASONAL DEPENDENCE OF CANAL FISHING

The favourable months for canal fishing are from September to January, when there is a flow of water in the rivers. During this season, marine fishes move upstream through these fishing canals for breeding. During their return, fishes are caught using locally made tools called *pari-sar*. The fish catch in this season varies from 5 kg to 15 kg per day, which has a market value of Rs.500 to Rs.3000. But this is not the case in summer, when there is no flow in the rivers and their drainage arteries. The average fish catch in summer is less than 2 kg, which can meet only the household food-and nutritional requirements. Therefore, the fishers engage in seashore fishing or sea fishing during this season. They go along with the other boat-fishers for fishing.

#### TEMPORAL DEPENDENCE OF CANAL FISHING

The drudgery of reaching the fishing canals, the constraints involved in crossing the aquaculture farms, inaccessible canals due to fallen trees (during cyclones), siltation of canals during disasters, lower market prices for the canal fish catch, the reducing flow of fresh water in the river arteries and siltation of the Veraguvetti canal pushed the canal fishers to taking up alternative livelihoods or alternative fishing grounds. These canals used to provide livelihoods to approximately 200 fishers, but today fewer than 20 fishers are involved in canal fishing. They have moved towards sea fishing or work as labourers abroad and in non-fishing occupations.

### 5.5.2 *Alam* and *thottam* fishing

Individual marginal fishers from almost every village adjacent to the wetland are involved in *thottam* fishing throughout the year. As the water level rises in the *alam* during the monsoon, they prefer to fish directly in the *alam* instead of going to the *thottam*. Meanwhile, sea fishers also fish in the *thottam* during this season. Boat fishers who go to the Valavanar use the *thottam* portion ahead of the Chellakkani Creek for fishing.

As the *thottam* holds water throughout the year, it becomes a ground for fishing. Fishes and prawns enter the *thottam* during high tides via the creek. They are caught by the marginal fishers throughout the year in the *thottam* and seasonally in the *alam*.



**Image 15** *Thottam fishing in Maruthur South*

Fishers who neither own boats nor engage in group fishing move to the *thottam* early in the morning (around 2 am or 3 am) or in the evening (around 5 pm 6 pm). Individual fishers reach the *thottam* on foot from their hamlet or use bicycles up to the furthest accessible point and then proceed by walk to the *thottam*. They carry an aluminum pot (*kundan*) of 20–30 litres' capacity, a *chippivalai* scoop net and an inflated car/bike tube.

### SEASONAL DEPENDENCE

As the *alam* fishing is seasonal, unlike the *thottam* fishing, fishing in the *alam* of Avarikadu-Vandal starts when the backwater rises in the Vedaranyam canal due to the eastern winds (July). Prawn fishing is most common in this portion of the *alam*. Though freshwater fishes are caught when there is a river flow (monsoon), their market value is poor as they are not preferred by the coastal communities. The *alam* fishers work as aquaculture labourers and salt labourers when the *alam* is dry. The women of Avarikadu- Vandal are involved in hand fishing of prawns, especially when the water level in the *alam* is less than 2 feet.

Though almost all the fishes caught in the sea and lagoon are also caught in the *thottam*, their table size is smaller and so the market value is also less compared with that of fishes caught in the sea and lagoon. Generally, the *thottam* fishers sell their fish catch in the local market. Very few, who own motorcycles, sell their fishes directly to households going door to door. Since the monsoon and winter are the favourable periods for *thottam* fishing, the daily income generated during this period ranges from Rs.700 to Rs.1500. During the rest of the season, the average daily income ranges from Rs.200 to Rs.350.

### TEMPORAL DEPENDENCE

Till the start of the 21st century, most of the fishers in this wetland complex were involved only in *thottam* fishing. After the introduction of motorised fibre boats, the number of fishers involved in *thottam* fishing is reducing day by day. Fishers prefer lagoon fishing by boat to *thottam* fishing because of the drudgery involved in the latter. The *thottam* fishing potential of the Thalainayar reserve forest is reducing day by day due to the poor backwater flow into the *alam*. This is essentially due to the construction of barrages across the Adappar river by the Public Works Department.



### 5.5.3 Lagoon and creek fishing



**Image 16** Lagoon fishing in Muthupet

Fishers from the Maravakadu–Thillaivilagam stretch enter the Muthupet lagoon through different arteries close to them. While fishers from Maravakadu, Pudhukottagam, Thuraikaadu and Thambikottai villages using fibre boats reach the lagoon via Pattuvanachiyar and the Paamani river, fishers from Muthupet, Alangkadu, Uppur, Pettai and Jambuvanodai reach it via Korayar. Fishers from Thillaivilagam and Veeranvayal reach it via the Kanthaparichan river, and fishers from Idumbavanam reach it via Kilaithangi and Marakakorayar arteries.

Fishers from the Thondiyakkadu–Chinthamanikadu enter the Seruthalaikadu lagoon through Valavanar, the only artery that connected to the lagoon in the past. Fishers of Pannal reach it through the saltwater channel created by GHCL, and fishers of Seruthalaikadu reach it through the fishing canal created by them.



**Image 17** Valavanar fish route and landing centre



Fishing in the mangrove lagoon and tidal creeks is open to fishers with non-motorised and catamarans (except Chellakkani Creek). There are no curbs on fishing areas or fishing days. Fishing routes are shown in Map 11. A group of fishers and the boat owner sail towards the lagoon, indulge in group fishing, sell the fish catch in the local market and divide the proceeds amongst themselves. These are divided in two ways: (1) one share of the fish catch of the non-owner is given to the boat owner as rent, and (2) 'n' fishers take a boat, the catch is divided into n+1 shares, and two shares are given to the boat owner. The income of a lagoon fisher varies between Rs.500 and Rs.1500.

### SEASONAL DEPENDENCE

As the lagoon provides fish throughout the year, the practice of fishing changes only during the prawn season. During the peak season for prawn fishing (November–December), a rotational policy is followed. During this season, around 150–200 fishers go for prawns during the day – from 6 am to 6 pm. At night, the fishing is reserved for another group of fishers, who vacate the place the next morning in favour of a third batch of fishers. This practice of rotation goes on till the end of the prawn fishing season; after that, there are no restrictions on the fishing time, day or area. The fishers who were interviewed said that the rotation system ensures that all the fishers share the available prawn resources equally during the peak season.

### Temporal Dependence

The number of fishers fishing in the lagoon is increasing. Though the Mutharaiyar are the traditional fishers in this region, people from other communities and religions and from far-away hamlets have entered the lagoon fishing. There is no resistance on the part of the community towards the entry of non-fisher communities into the lagoon fishing.

### 5.5.4 Backwater fishing

Fishing in the backwater channel is common on the coast that borders Nagapattinam district. The Vedaranyam canal is the main backwater channel. Both men and women engage in fishing prawns and fishes in this canal. Villages in the Thalainayar block have a large number of backwater fishers. The average daily income of these backwater fishers is Rs.200 in summer and Rs.500 in the monsoon. More than 100 families in Kodyakkadu, Maniyantheevu and Kodyakkarai engage in hand fishing in the brine reservoirs of Chemplast and the backwaters in the tropical dry evergreen forest. The average daily income varies between Rs.150 and Rs.250. Fewer than 20 aged, marginalised men and women are involved in fishing in the saltwater channels and storage pits. They fish mostly for subsistence.



**Image 18** Hand fishing in backwater near Kodyakkadu

Hand fishing in the backwaters and depressions in the coastal plains of Kodyakkadu is a traditional fishing practice of the Athivasi colony families. Paravaikocham, Olakocham, Munaivaikal, Kodimarathuvaikal, Palayanthunduvaikal, Kaathanodai, Keechanodai, Narikaathanodai, Koyanadappu, Muniyankoyilvaikal, Kumaladivaikal are some of the fishing backwater channels in the forest. *Peralam, Nandu Pallam, Kaathuvaripallam, Onanthikulam, Chinna Peralam, Irattai Pallam, Nallathaneer Pallam, Silamburani Kulam, Puliyanannu Kulam, Manora Pallam* and *Anai Viluntha Pallam* are some of the depressions where hand fishing is practiced during the monsoon.

Scoop fishing is a traditional practice followed by a very few poor fishers. Small twigs of *Avicennia marina* are bundled, tied in the live branches of mangrove trees adjacent to the waterways. These bundles are tied so that they drop into the water. This attracts fishes and prawns and acts as a trap. The fishes and prawns assembled around these twigs are scooped in a net. One could observe such traps when sailing towards the lagoon. But this practice is slowly reducing over time.

### SEASONAL DEPENDENCE

In Vedaranyam swamps, as the salt industry fills the brine reservoir throughout the year, both men and women engage in hand fishing except in the rainy season. As the water level in the reservoir is more than 3 feet during the rainy season, only men are involved in fishing, and that too only with the *veechuvalai* (cast net). Almost every family in the Athivasi colony of Kodyakkadu engages in backwater fishing in the monsoon, when the water level rises. In Thalainayar, the prawn season is the most favourable season, and it gives an income of more than Rs.300 per day. These fishers work as labourers in saltpans, shrimp farms and other non-farm sectors in summer.

### TEMPORAL DEPENDENCE

The number of fishers involved in backwater fishing shows a slightly declining trend. This is essentially due to better employment opportunities such as in ice factories, seafood export factories, saltpans and shrimp farms. The increase in number of boats has pulled many fishers towards sea fishing.

As the four backwater channels or creeks (Kaluvapaththai, Manavaikkal, Siththankoyil and Pudhu) have been blocked due to siltation, the fishers of Kodyakarai who were dependent on it have become fishing labourers. The creeks were silted only after the establishment of the brine reservoirs, in the opinion of the local community. The fishing labourers are paid wages of Rs.700 per day, with a bonus when the catch is good.

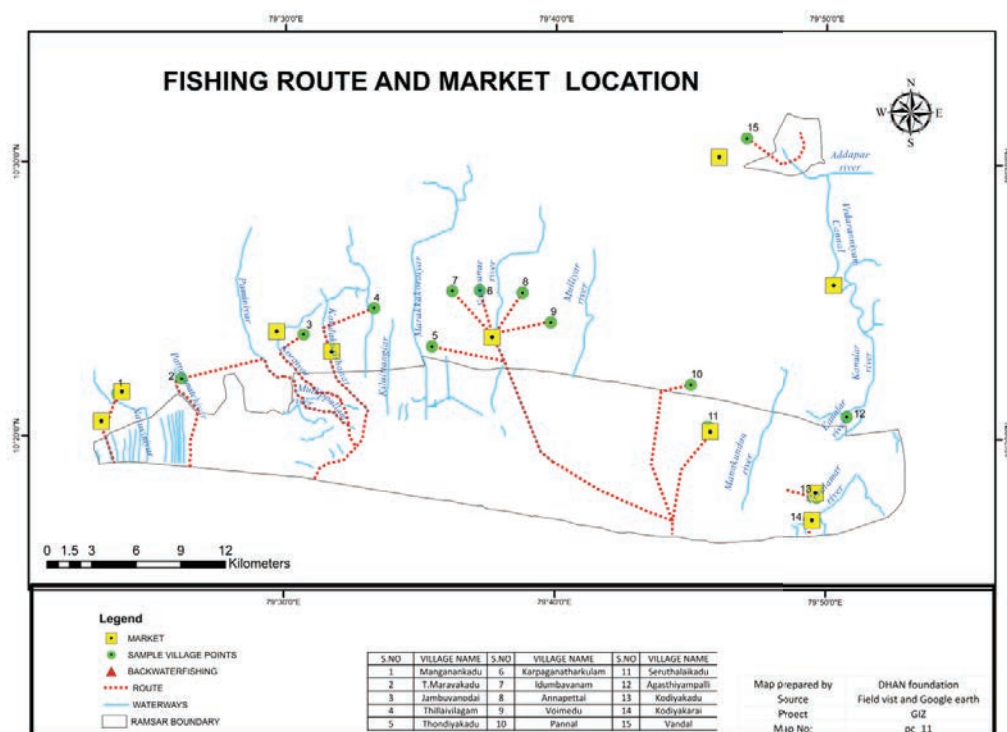
## 5.5.5 Resource utilisation for fishing

'Wherever there is seawater, there are fishermen'. This is a statement told by the fishers during the participatory ecosystem appraisal. This statement reveals that fishing activities take place in every region that brackish water enters, i.e., fishing canals, backwater channels, the *thottam*, lagoons, creeks, the seashore and the sea.

The fresh water entering the intertidal zone via the river arteries is well utilised by the Veraguvetti channels created perpendicular to the flow. The fresh water carried by this channel is distributed through the lateral canals running along the flow direction connecting the sea. Thus, the flowing fresh water is well utilised in the lateral canals that are used as fishing canals. The effective interface between the river water and seawater allows the fishes to move upstream. This creates opportunities to catch the fish during their return to the sea.

Fishes, crabs and prawns entering the intertidal zone (the *thottam*, lagoon, creeks) are harvested by the fishers using different techniques that have been evolved over generations.





Map 11 Fishing routes and locations of markets

### 5.5.6 Resource extraction techniques in fishing

Fishing techniques vary widely with the location of fishing, season of fishing and target fishing group. While the *pari-saar* technique is used by the canal fishers, hand fishing is adopted by the *alam* and backwater fishers, and various types of nets are used by the lagoon and creeks fishers.

#### PARI-SAAR TECHNIQUE

*Pari* and *saar* are the two types of gear used by canal fishers for harvesting fishes and prawns from the canals. The *pari* is a basket-type gear made of cane. One end of the *pari* has two openings that are specially designed so that fishes and prawns can enter but cannot come out. The other end of the *pari* remains closed during the catch. Once the catch is over, the *pari* is tilted and opened to collect the catch.



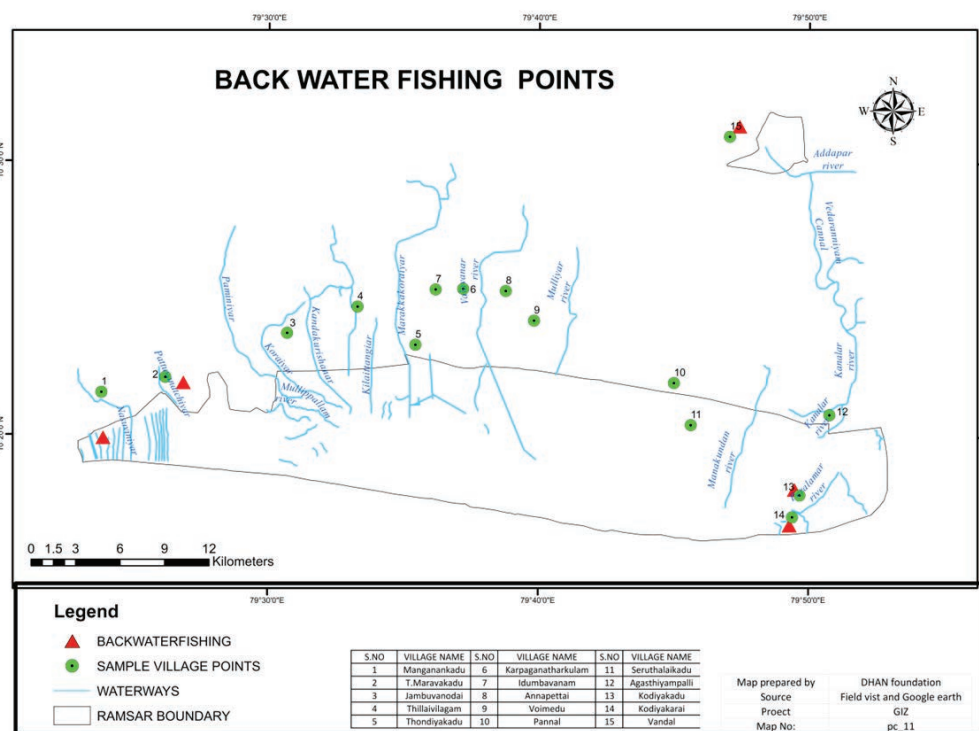
Image 19 *Pari-saar* fishing in canal

The *saar* is nothing but a pen made of cane. It is about 1.5 m high and 2.5–3.0 m long. The size of the pen depends on the size of the canal. The *saar* is fixed across the canal, from a point 100 m from the shore. *Mooku-saar* is another pen that is used in river flows. This pen allows fishes and prawns to move from the sea to the river during high tide but not in the reverse direction during low tide. A *kann* is a curved canal that starts from the fishing canal just ahead of the *saar* and ends up again in the same fishing canal a little upstream (5-8 m). This is where the *pari* is fixed for trapping fishes and prawns.

During low tide, water from the wetland starts draining into the sea, along with fishes and prawns. These fishes and prawns are trapped in the *pari*. The *pari* is removed during high tide or early in the morning. All the fishes and prawns trapped in the *pari* are segregated. The fingerlings are thrown back into the canal that meets the sea. The marketable catch is transferred to the aluminium pot and taken to the market. A small scoop net is also used to collect the trapped fishes and prawns circling in the *kann*.

### HAND FISHING

Groping is a method of fishing that aims to capture prawns in shallow water (the *alam*, brine reservoirs, backwaters) during the low tide. Kneeling in the canal, the fishers keep their heads above the water level. Holding a pouch made of cloth or a plastic bag, the women move their hands on the surface to catch the prawn. The pouch has to be kept submerged in the water so that the catch is not spoiled. The women repeat this laborious process until they get a desirable prawn catch, say a catch worth Rs.200. The backwater fishing areas are marked in Map 12.



Map 12 Backwater fishing points

### FISHING NETS

The following are the gear commonly used by fishers for fishing in the mangrove waters -

**Adappuvilai:** This net is operated in the lagoon, tidal creeks and mouths of canals. This is a type of gill net used in the mangrove water, mainly to fish for Seraiyakendai and Keduthai. It is about 18 m long and 2–2.5 m broad. The mesh size is about 2 cm. Since Seraiyakendai have a habit of moving towards the shore for feeding, they are easily caught in these nets during the low tide. The net is put up in the water around 8 pm, 10 m away from the shore, where it is left undisturbed. The catch is collected the next morning.

**Koduvavalai:** This is another kind of gill net that is used exclusively for fishing for sea bass (Koduva). It is operated in the lagoon and creeks. It is about 30 m long and 4.5 m broad, with a mesh size of 8-10 cm. The net is erected on the muddy bottom using wooden poles. It is normally put up around 6 pm and left undisturbed. The sea bass moving along with the incoming tide are caught in the net and are collected the next morning. The *koduvavalai* operation requires four to 10 persons.

**Izhuppuvalai:** This is a small-sized dragnet used mainly for prawns. It is 30-40 m long, with a mesh size of 2-3 cm. During fishing operations, two persons hold opposite ends of the net and move slowly towards each other, marking a rough circle as the net moves towards the shore. The fishes and prawns entangled in the net are collected.

**Chippi valai:** This is the most common gill net. It is used to catch a variety of small fish such as Tholli, Vallaipodi, Vellampodi, Thogaipodi and Soodapodi and prawns. It is about 20 m long, with a mesh size varying from 2 cm to 4 cm, while the *oonu chippivalai* is a stake net deployed across the lagoon using wooden poles. The *vazhichippivalai* is allowed to float along with the water current. *Chippi valai* operations start around 4 am or 5 am and end around 10 am or 11 am.

**Nandukachcha valai:** This is specially designed to catch crabs, particularly the Samba Crab. It is about 8-10 m in length, and mesh size varies from 7 cm to 9 cm. It is deployed across the water current. The *nandukachcha valai* operation starts by 5 pm. The net is left undisturbed in the water overnight, and the catch is collected the next morning. It is used mostly in the creek where the seawater enters the lagoon.

**Yendhu valai:** The *yendhu valai* is a scoop net used in the mangrove waters by poor fishers. The scoop net consists of a round wooden frame with a handle and a net with a mesh size of 1-2 cm. It is used near the stagnant water near mangrove trees. In these areas, a small branch of *Avicennia marina* is dropped into the water. Fishes and prawns attracted by these branches are trapped and scooped using the *yendhu valai*.

### 5.5.7 Access for livelihood

Almost every portion of the intertidal zone, including the *alam*, *thottam*, lagoon, creek, *kottagam* and backwaters, is open to all. Even non-fishers can catch fish in this region.

Fishing canals are used only by the families who have the traditional rights over the particular canals. Other families are allowed to fish in the canals only when it is leased. A record has been maintained by the Forest Department of the families that have traditional rights over these fishing canals.

As stated previously, Sethuguda is leased out by the Fisheries Department, and the lease amount is paid in advance by the fishermen's cooperative society. Every fisher pays an amount of Rs.2 for taking up this lease for a year.

Though fishing in the Seruthalaikadu lagoon is open for all, fishing in the creek (mouth) portion is a traditional right of Seruthalaikadu fishers. Therefore, other fishers are restricted from fishing in the mouth, but they are allowed to pass through the creek.

### 5.5.8 Seasonal and temporal trends in fishing

The favourable fishing period for the entire wetland complex is between September and January. This is the season when the river flows into the intertidal zone and the southern winds blow. October–December is the best season for prawn and crab fishing. Fishers are permitted to fish in the wetland even during the fish-ban period.

According to the intertidal fishers, none of the fish varieties have gone extinct, but their numbers have come down drastically. This might be due to unsustainable fishing practices adopted by bottom trawlers in the nearshore waters. The fishers also highlight the fact that the number of fishers fishing in the wetland has increased over the last two decades, especially after the introduction of motorised fibre boats.

### 5.5.9 Competing uses of resources

Since the wetland is open for all fishers, there is no big competition amongst them in fish catch. There is a common system that exists among the fishers that ensures everyone should be benefitted from the fishing.

### 5.5.10 Impacts of disasters on fishing

Cyclones in the Palk Strait have changed the shoreline by breaching it. They have created new creeks and widened the mouth of the lagoon. A new submerged portion, called Sethuguda, has been formed, some of the creeks have been blocked or silted, and the currents in the Palk Bay (*neerottam*) have changed.

Mangrove trees falling due to the cyclone have made fishing canals completely inaccessible. This has also resulted in siltation of the fishing canals since the storm surge associated with the cyclone Gaja brought a large amount of sediment into the wetland. This reduced the fresh water-saltwater interface, resulting in more dying of mangroves. After Gaja, fewer than 20 fishers are involved in canal fishing, which was once practised by more than 180 fishers.

In Avarikadu-Vandal, large-scale mortality of mangrove trees during the cyclone Gaja resulted in erosion of soil. This has resulted in an increase in the *alam* portion and reduced the extent of the mangrove portion.

The increased growth of oyster beds in the lagoon and creeks of the wetlands is another significant impact of the tsunami that was highlighted by the fishers. It is well known that a higher salinity favours proliferation of oysters, resulting in the formation of extensive oyster beds.

#### EXISTING MARKET FOR FISH

As the demand for seafood is growing day by day both locally and regionally, the market value of the resources is very good. The market value of a fish, crab or prawn depends on factors such as table size, taste, nature of the bone, freshness of the catch and season.

## 5.6 Forest Collection

Herbs, fruits and honey are important produce collected by the local communities. Since the TDEF areas serve as an important source of herbs, a few families gather these herbs and sell them to local traders. Fruits, honey and herbs were collected from the tropical dry evergreen forest by the communities of Kodiyakkadu and sold in the local market. Thannivittan Kilangu is widely collected by one or two families in each village. Paala and Thazahii trees are the primary hosts for on which honeybees build their combs. Families from the Athivasi Colony of Kodiyakkadu collect this honey and sell it in the local market.

### 5.6.1 Seasonal dependence of forest collection

Since the availability of these herbs is seasonal, the dependent families are also involved seasonally. The post-monsoon season is the most favourable period for herb collection. On average, Rs.250 to Rs.400 is earned from this activity every day. Herb collectors are involved in this activity for fewer than 120 days. For the rest of the year, these families are involved in fishing or agriculture.

Similarly, there are fruit collectors who collect Naaval Pazham, Kaarm pazham, Soora pazham and Paala Pazham fruits from the forest. The average daily income during the fruiting season varies from Rs.200 to Rs.300.

### 5.6.2 Temporal dependence of forest collection

The number of people involved in forest produce collection has reduced day by day to almost nil. Restrictions imposed by the Forest Department on the collection of fruits, as they attract the avian population, a reduction in the numbers of fruits borne and of host trees due to disasters and the invasion of *Prosopis* are the reasons behind this falling trend.



### 5.6.3 Resource utilisation for livelihood

Families of the Athivasi colony are the major forest product collectors. They collect fruits, vegetables, pulses, herbs and honey mostly for their food security. The surplus is for the market.

The fruits collected from the forest are Paala (*Manilkara hexandra*), Naaval (*Syzygium cumini*), Korattai (*Passiflora edulis*), Kadukka (*Terminalia chebula*), Thovaran (*Cajanus cajan*), Kizhaa (*Carissa carandas*), Varppula (*Securinega leucopyrus*), Veeram (*Drypetes sepiaria*), Magilam Pazham (*Mimusops elengi*), Soora Pazham (*Ziziphus oenoplia*), Elanthai (*Ziziphus jujube*), Eecchai (*Phoenix sylvestris*), Kovai (*Coccinia grandis*), Vaagai (*Albizia lebbbeck*) and Kaara Pazham. Paasuthi, Musutai, Umuri, Thuthi, Athandangai, Perandai and Thuthuvalai are some of the leaves collected and consumed by the local communities.

Pazhu Pavai is a type of Bitter Gourd. It is an important item in the cuisine of some of the communities. Pazhu Pavai is cooked along with prawns.

Poonakachikottai, Kaatumochai and Kozhiavarangkottai are the pulses collected from the forest. These nuts are boiled, crushed and washed till the colour changes to white. It takes more than 16 washes to remove the bitterness. Then they are mixed with Moringa leaves, cooked and consumed. These nuts were considered life saviours for the community during famines.

Sangu Ilia, Milagusaranai, Paanaiaidaippan, Kaatunaathi, Aavarampoo, Nannari, Avuri, Komatti and Thannivittankilangu and the barks of Vathaam, Kaipaala and Perumbala are used as herbal medicines traditionally to cure some of the diseases and heal wounds. These forest products are collected for self-consumption as well as for selling in the market.

### 5.6.4 Resource extraction techniques and access for livelihood

The forest products are collected directly by the communities living around it. Since the Athivasi colony people are the traditional users of the forest, they are permitted to enter the forest, abiding by the rules and regulations of the department. Whenever they breach the law, they are warned and fined.

### 5.6.5 Seasonal and temporal trends in ecosystem services

While most of the resources are perennial, the fruits are seasonal. The monsoon is the fruit-bearing season for the majority of the trees in this forest.

Since the native trees are being replaced by the invasive *Prosopis*, the produce from the forest is also reducing. The forest cover protects the community well from the cyclones and tsunamis. The seasonality of the wetland-dependent livelihoods is shown in Table 22.

### 5.6.6 Competing use of resources

Like other forests, the tropical dry evergreen forest of the Point Calimere Wetland Complex is also facing competition between wild and domestic animals for the use of resources. Cattle grazing is one of the most serious problems of the forest. Around 400–500 cattle graze every day inside the sanctuary. As the surrounding areas are mostly swamps and salt pans, very little grazing land is available for the local cattle. This leads to competition over water and food between the Blackbuck and the cattle.

The birds and bats feed on the fruits that are harvested by these local communities. Though the Forest Department restricts the collection of fruits from the forest in order to provide them to the bird population, villagers still harvest the fruits.



### 5.6.7 Impacts of disasters on ecosystem and wetland-dependent livelihoods

The forests along the shoreline and on the coastal plains act as the frontline barrier against cyclones and tsunamis, and thus they are the most affected ones. Since mangroves are highly sensitive to cyclonic winds, they get damaged. Many of the native trees have been replaced by the invasive *Prosopis*. This has reduced the services provided by the forests, which has directly affected the forest-dependent communities.

**Table 22** Seasonality in wetland-dependent livelihoods

Wetland dependent Livelihood	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agriculture - Tobacco	Crop 1						Crop 2					
Agriculture - Paddy								Crop 1				
Salt Production												
Aquaculture - Shrimp Farming	Crop 1				Crop 2							
Canal Fishing												
Thottam Fishing												
Lagoon and Creek Fishing												
Backwater Fishing												
Forest Collection												

	Peak Season
	Favourable season
	Low Season
	Non season

## 6 IMPACTS OF MAJOR LIVELIHOODS ON WETLANDS

### 6.1 Impacts of Agriculture on the Wetlands

#### INCREASED EXTENT OF THOTTAM

The area of the *thottam* (pits and puddles) in the Point Calimere Wetland Complex has increased over the years, and one of the main reasons for this is the degradation of the mangroves. The agriculture in the Cauvery basin is irrigation-intensive. The freshwater flow in the tributaries of the River Cauvery is diverted for agriculture by constructing dams. This has caused a reduction in the flow of water into the Point Calimere Wetland Complex. This reduced freshwater flow has affected the mangroves and their regeneration, which are already under stress due to past unscientific management policies, such as clear-felling. The degradation of the mangroves and the subsequent changes in the soil conditions have led to an increase in the area of the *thottam* (pits and puddles). This change was observed in both the Muthupet and Thalainayar regions.



*Image 20 Shutter construction on the Valavanar river at Munnangadu*

## 6.2 Impacts of Saltpans on the Wetlands

### 6.2.1 Increased salinity

The establishment of brine reservoirs and pumping of saltwater from underground are the major reasons cited by the communities for the increased salinity of the soil and the aquifers.

Till the 1990s, dug-out community wells in Sakkarapettai were the primary drinking water source of the communities. Till the 1950s, farming was the primary occupation of Seruthalaikadu, which was established by clearing the swampy forest a long time ago. Currently, the dug wells are ignored because of their higher salinity levels, and the agricultural lands remain fallow due to increased salinity. The saline farmlands have been invaded by the invasive exotic *Prosopis*. Local people explained that the expansion of saltpans by GHCL and the establishment of a brine reservoir between Sakkarapettai and Seruthalaikadu are the reasons for this impact.

On the other hand, farmers of Agasthiyampalli, Kodyakkadu and Kodyakarai identify the practice of pumping saltwater from aquifers to produce salt as the primary reason for the intrusion of seawater and depletion of fresh water. There were more than 5000 active dug wells irrigating the rain-fed fields, in which paddy, pulses and millets were cultivated. Currently, many of the wells are inactive due to increased salinity,

Muniyappan Lake and its dependent habitats have been completely lost due to increased soil and water salinity. The mudflats of Agasthiyampalli, which were once occupied by cactus (Kalli Kadu), have now turned into a land of *Prosopis*.



*Image 21 Chemplast pumping station*

### 6.2.2 Siltation of creeks

Kaluvapaththai, Mana Vaikkal, Siththankoyil and Pudhuaaru were the four creeks between Chellakannai Creek and the Point Calimere Wildlife Sanctuary. These creeks were visited by the fishers of Kodiyakarai and Kodiyakadu for fishing. But the Pudhuaaru creek was later converted into a pumping station for Chemplast and the water stored in the brine reservoir. The other three creeks were also silted and blocked. Currently fishers are not visiting this portion of the wetland. The impact of the shoreline changes has to be researched deeper.

Some studies also highlight positive impacts of brine reservoirs. Since the water is stagnant in the brine reservoirs through the year and it contains a variety of organisms, these reservoirs support wetland-dependent migratory birds.



*Image 22 Chemplast brine reservoir in Kodiyakarai*



### 6.2.3 Poor drainage

Altering the landscape of mudflats by constructing bunds for saltpans and brine reservoirs has an implication for the drainage capacity of the wetlands. After the damming of the rivers, floods are not a major concern in this region. Due to erratic rainfall, they might become an important concern in the future.

### 6.2.4 Replacement of animals and plants

After various salts are extracted, the saltwater residue, called bittern, has a very high level of salinity (more than 30° Be, approximately 300 ppt). This residue is allowed to stand in a sink and seep into the soil. Sometimes the bittern will overflow into the tropical dry evergreen forest. It is the seepage of the highly saline bittern, along with extraction of saline groundwater, that is primarily responsible for the increasing salinisation of the soil and the groundwater. This is one of the reasons for the alteration of the flora and fauna of the forest itself. People of the Athivasi colony indicate that the increase in salinity is one of the reasons for the loss of native trees and the spread of *Prosopis*.



*Image 23 Excoecaria agallocha in the dense mangrove forest in Maravakadu*

## 6.3 Impacts of Shrimp Farms on the Wetlands

### 6.3.1 Degradation of soil and water

The mudflats, which were converted into agricultural lands, were later converted into shrimp farms. When the land is used for agriculture, it is exposed to fresh water and has fewer chemical inputs. On the other hand, when it is used for shrimp farming, it is filled with saline water. Normally, 25 kg of prawn feed is used per 0.5 ha of the pond. About 250-350 kg of lime is used per 0.5 ha of pond to increase the soil pH. A variety of antibiotics, such as oxytetracycline, wolmid and muzophore, and germicides are used to control diseases (Selvam et al., 2002). All these intensive chemical applications not only degrade the soil but also the water.



**Image 24** Aquaculture effluents are discharged near the mangroves in Thillaivilagam

As the effluents are released into the wetland without any treatment, they might adversely affect the wetland-dependent flora and fauna. Fishers have cited incidences of dead fishes floating near the canals where effluents from shrimp farms are discharged. Reclamation of the defunct shrimp farms for agriculture is another big challenge. The average lifetime of a shrimp pond ranges between 7 years and 15 years. However, abandoning of ponds is common in this locality. The restoration of abandoned shrimp ponds is difficult because many of the environmental conditions that originally fostered the growth of mangroves or supported agriculture have been altered. The ability of the substratum to support vegetation has been destroyed due to increased soil salinity and deposition of the chemical inputs used in the farm over a period. This complicates the rehabilitation of abandoned shrimp farms.

### 6.3.2 Impact on drainage system

Saltwater canals created by the aquaculture farms to pump seawater for their ponds also convey seawater to the mangroves even during low tides. This improves the growth of the mangroves and their associate species in the channel bunds. This is in fact a positive impact on the mangrove ecosystem.

Regarding the drainage of fresh water during floods, aquaculture farms have had adverse impacts. The huge bunds constructed across the natural drainage obstructs the flow of floodwater. This might lead to inundation in the buffer villages.

Alteration of the Veraguvetti canals to aquaculture shrimp farms to tap the flowing river water leads to a reduced freshwater flow into the fishing canals. This adversely affects the mangrove growth between the fishing canals, which was degraded after the cyclone Gaja.

### 6.3.3 Mangrove deforestation

Shrimp farms were once established deep in the reserve forest by clearing the mangroves. These shrimp farms in the mangrove region were encroachments. While some of the shrimp farm owners have obtained pattas for these lands in the later period, some have remained encroachments. These lands were retrieved by the Forest Department after a legal battle. However, the mangroves have not been restored in this portion.



### 6.3.4 Light and noise pollution

Shrimp farms are aerated and illuminated by electric lines. Since most of these lines face a power shutdown 10-12 hours a day, diesel-powered generators are used for running the aerators. More than 1500 generators are running in the wetland complex. This not only releases diesel emissions but also creates noise pollution. This noise pollution impacts the birds and bats hosted by the mangrove wetlands. The illumination system in the bunds of the shrimp farms might lead to light pollution, which might impact the aquatic life and migratory birds. Further research on this aspect has to be undertaken.

## 6.4 Impacts of Fishing on the Wetlands

### 6.4.1 Increase in mangroves due to canal fishing

Traditional canal fishing keeps the fresh water–saltwater interactions alive in the intertidal zone. The canal fishers desilt the canals at regular intervals, which facilitates better flows of fresh water and seawater. This leads to better mangrove growth. The dense mangrove growth in this locality is evidence of the symbiotic relationship between the canal fishers and the mangroves.

### 6.4.2 Defunct fishing canals

Mangrove trees that fell during the cyclone Gaja made the fishing canals inaccessible. The sea slurry carried by the storm surge and the silt carried by the river flow silted the fishing canals. The situation favoured the growth of *Suaeda*, an associate of mangroves, along the bunds of the fishing canals and between the canals. Ultimately, the fishing canals have become defunct. More than 100 fishing families depended on these canals for their livelihoods before the cyclone. They were self-sustaining, with an average income of Rs.300 in the off-season and Rs.1500 during the peak fishing season. The fishers who are dependent on the traditional fishing canals are now moving to sea and lagoon fishing.



**Image 25** A defunct fishing canal in Manganankadu

### 6.4.3 Reduction in fish resources

Unethical practices such as the use of bottom trawlers, purse seines and bag nets (Surukkuvalai and Rettaimadi) adopted by nearshore fishers affect the aquatic life in the sea. This, in turn, affects both the quality and quantity of fish entering the wetland complex. Unanimously, all fishers said that the quantum of fish in the wetland complex has reduced over the years and indicated that fish such as *Kaala*, *Kathalai*, *Serayakendai*, *Thirukkai* and *Koduva* are the major species facing declines. In addition, the quantities of Mangrove Crab (Kazhinandu) and Tiger Prawn harvested have also reduced.

### 6.4.4 Changes in oyster bed

The growth and degradation of oyster beds in some parts of the lagoon and *thottam* is a major concern for lagoon and creek fishing communities. The oyster beds hurt their feet when they try to get down into the *thottam*. The oyster bed growth also changes the flow of tidal water and the fishing route. A study on the significance of the oyster bed will be of value.

## 6.5 Impacts of Livestock Rearing on the Wetlands

### DEGRADATION OF MANGROVES, FOREST AND SHORELINE VEGETATION

The mangroves on the western side of the Muthupet reserve forest, Mannavaram Theevu, the shoreline of Chellakkani Creek and the wildlife sanctuary are the major grazing areas of the Point Calimere Wetland Complex.

The two primary reasons why livestock rearing communities rely on this wetland are:

- Scarcity of grazing lands during the cropping season (September-January)
- Reduced availability of poromboke land in and around the villages

While the first reason applies to grazing in Muthupet and Mannavaram Theevu, the second reason applies to grazing in the wildlife sanctuary.

In the Muthupet mangroves, livestock from Adirampattinam and Karisaikkadu graze in the peripheral regions of the mangrove wetlands. Cattle consume leaves, propagules and seedlings of *Avicennia marina*, causing stunted growth of mangroves and poor establishment of seedlings in the peripheral regions. This is the region where the freshwater flow is greater during the monsoon and the post-monsoon season, and thus it is most suitable for mangrove regeneration. Grazing might also be a factor in the dispersal of *Prosopis* inside the mangrove region.

The livestock shifted to Mannavaram Theevu during the cropping season feed on the fresh grass sprouting after the showers. The livestock forage on other trees along the shoreline region. The shoreline was once rich in Thazhai (*Pandanus fascicularis*), but now the species is almost extinct due to the grazing by the livestock. The faeces of the livestock, which carries the seeds of *Prosopis*, is the main reason for the *Prosopis* invasion along the shoreline. *Prosopis* has not only invaded native habitats but also depleted the freshwater lenses in the sand dunes of the shoreline.

As the surrounding areas are mostly under swamps and salt pans, very little grazing land is available for the local cattle. Therefore, local villagers have left more than 600 cattle in the Point Calimere Wildlife Sanctuary. The ownership markings on the cattle indicate that these are not feral in nature. The cattle compete with the Blackbuck for fodder and water. The competition becomes especially acute during the dry summer. Each cow consumes twice the amount consumed by an average Blackbuck. The pressure on the grassland is further aggravated by the feral horses. There is also the incidental risk of transmission of diseases from the domestic livestock to the wild population.

On the other hand, the accretion of minor creeks in Kodyakarai has reduced the fishing zone of the artisanal Kodyakarai fishermen. The fishers who fish along the shoreline, and in the minor creeks and the inundated *kottagam/thottam* have become wage labourers in fishing boats. In the past, these fishers would start their day at 3.00 am and travel two hours on foot along the shoreline or the *thottam* to reach the seashore by 5 am. If there was a good

catch (September- January is the favourable fishing period), they would return by 4.00 pm or stay out the whole night and return the next morning at 4 am. The average fish catch expected by these fishers is 4-5 kg. They process the spoilt fish into dry fish. Now, these fishers are employed by the local and migratory fishers for wages of Rs.600 per day for day fishing and Rs.700 for night fishing.

## 6.6 Impact of Siltation of Drainage Canals

Valavanar is the major drainage canal, and Manangkondan is a minor artery draining into the Seruthalaikadu lagoon. Fishers from the Thondiyakkadu–Pannal region used Valavanar as the entry point of the Seruthalaikadu creek and the sea. The flow of fresh water is greatly reduced in Valavanar. As a result, the natural connection to Seruthalaikadu lagoon has been lost. To overcome this problem, the fishers established a new canal (vettu vaikal) that is 8 km in length. Every boat fisher contributed Rs.5000 to establish this canal. The width of the canal can accommodate two boats at a time, which makes it easy for incoming and outgoing boats to cross each other without any trouble. Though the canal connects Valavanar with the creek, it needs regular investment from the fishers in the form of desilting.

Veraguvetti Vaikal and Parimadai Vaikal (fishing canals) of Maravakadu are dependent on the freshwater flow from the Pattuvanachi river. Siltation of this drainage river affected the flow of fresh water through the fishing canals. This was further aggravated by the cyclone Gaja. The fishers dependent on these fishing canals have shifted to sea-lagoon fishing or non-fishing activities.



**Image 26** *Narrow mouth and siltation of Pattuvanachi river*



## 7 TREND ANALYSIS

### 7.1 Spatio-temporal Trend in Resource Availability for Livelihood

Natural conversion and anthropogenic activities keep modifying the ecosystem and its services. Some of the trends need to be noted and documented to minimise the future pressure on the ecosystem and the dependent livelihoods of the local community. A community-centric spatio-temporal analysis of the information collected from the sample villages was performed. This trend analysis was done for the different livelihoods that directly depend on the wetland, such as fishing, salt extraction, aquaculture farming and agriculture.

**Table 23** *Spatio-temporal trends in resource availability for wetland-dependent livelihoods*

Livelihood	Past	Present	Future
<b>Agriculture</b>	<ul style="list-style-type: none"> <li>• Completely canal-based irrigation</li> <li>• Usage of groundwater and surface water</li> <li>• Multiple crops and multiple seasons</li> <li>• Agriculture as livelihood</li> <li>• Only food crops such as paddy and vegetables</li> <li>• Use of manual lift irrigation</li> <li>• Native paddy variety</li> <li>• Agriculture only in the agricultural land</li> <li>• Limited usage of chemicals, pesticides and fertilisers</li> <li>• Very limited role of middleman</li> <li>• No insurance coverage</li> <li>• Enough water released from Cauvery distributaries and small number of shutters and barrages</li> <li>• No intrusion of saline water into agricultural land</li> <li>• No deposit of sea sludge into agricultural land by cyclone and tsunami</li> <li>• The soil salinity was low</li> </ul>	<ul style="list-style-type: none"> <li>• Shift to commercial crops such as tobacco, tapioca, coconut and Casuarina and to floriculture and horticulture</li> <li>• Use of motorised lift irrigation according to the economic status</li> <li>• Use of farm ponds</li> <li>• Use of bore wells</li> <li>• Lift irrigation with the support of the PWD</li> <li>• Hybrid paddy seed variety</li> <li>• Use of large quantities of chemicals, pesticides and fertilisers</li> <li>• Market support by the government</li> <li>• Insurance coverage by government programmes</li> <li>• Less water released from the Cauvery; many shutters and barrages constructed</li> <li>• Severe intrusion of saline water</li> <li>• Deposition of sea sludge into agricultural land by cyclone and tsunami</li> <li>• Increasing trend of soil salinity</li> <li>• Changes in the agricultural land use</li> <li>• Agricultural land was sold out for aquaculture</li> <li>• Due to aquaculture nearby, agricultural lands</li> </ul>	<ul style="list-style-type: none"> <li>• High possibility of having more barren land</li> <li>• Agriculture will be carried out as a commercial livelihood</li> <li>• Only wealthy people can practise agriculture</li> <li>• Possibility of revival of aquaculture ponds in agriculture</li> <li>• Saline-resistant crop can be introduced</li> <li>• New agricultural technology can be introduced.</li> </ul>

Livelihood	Past	Present	Future
<b>Fishing</b>			
<b>Canal Fishing</b>	<ul style="list-style-type: none"> <li>• More than 180 fishing canals were used by villagers of Manganankadu, Maravakadu, Karisalkulam and Manjavayal</li> <li>• Very effective freshwater and brackish water flows into the canal</li> <li>• Normal tidal movement in Palk Strait</li> <li>• Mangrove forests were widespread and diverse, and the trees were bigger in size.</li> <li>• Many fish species were available.</li> <li>• Less drudgery</li> <li>• All the family members were involved in this type of fishing.</li> <li>• The Nasuvini river flows into the fishing canal.</li> </ul>	<ul style="list-style-type: none"> <li>• The entire mangrove vegetation was impacted by the cyclone Gaja</li> <li>• Fish variety is getting reduced due to bottom trawling and fishing using purse seine and bag nets</li> <li>• Very few of the family members are involved and the youth are completely moving away from this livelihood.</li> <li>• More drudgery.</li> <li>• Only 20 canals are functional.</li> <li>• The canals are entirely silted, and the waterways have become obstructed by the fallen mangrove trees.</li> <li>• The Nasuviniyar river has been blocked due to siltation.</li> <li>• The footpath used to reach the fishing canal has been encroached on by aquaculture owners.</li> <li>• In and around Adirampattinam and Maravakadu the aquaculture wastes are damaging the fishing canals.</li> </ul>	<ul style="list-style-type: none"> <li>• There is a good possibility of reviving all the fishing canals with the involvement of the fishers and the Forest Department</li> <li>• If the present status continues, the entire livelihood will be destroyed.</li> <li>• These fishermen become fishing labourers in Kodyakarai.</li> </ul>
<b>Lagoon Fishing</b>	<ul style="list-style-type: none"> <li>• Small number of villagers were involved in this fishing.</li> <li>• Lagoon fishing was done by only country boats</li> <li>• Many fish species were available.</li> <li>• The lagoon was deep, and it received enough fresh water from the distributaries.</li> </ul>	<ul style="list-style-type: none"> <li>• The lagoon fishing population has increased significantly because of the entry of non-traditional fishermen.</li> <li>• More aquaculture effluents is being directly discharged into the lagoon, which is affecting the entire habitat.</li> </ul>	<ul style="list-style-type: none"> <li>• Strict regulation of lagoon fishing</li> <li>• Serious threat due to poor freshwater flow and reduced lagoon depth</li> <li>• High pressure on lagoon fishing by variety of fishing gear and fishers</li> </ul>



Livelihood	Past	Present	Future
<b>Lagoon Fishing</b>	<ul style="list-style-type: none"> <li>• Non-fisher population was not involved in fishing.</li> <li>• They got good catches, but the price was low.</li> <li>• Minimal use of simple type of nets</li> </ul>	<ul style="list-style-type: none"> <li>• The <i>Prosopis</i> invasion in the lagoon area has increased drastically.</li> <li>• The sewage effluents from Muthupet are directly discharged into the Korayar, which is affecting the lagoon habitat and reducing the number of fish species and the catch.</li> <li>• The lagoon became shallow, and the catch declined.</li> <li>• The fishers are using different kinds of fishing nets, and they have started overexploiting the resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Strict regulation of lagoon fishing</li> <li>• Serious threat due to poor freshwater flow and reduced lagoon depth</li> <li>• High pressure on lagoon fishing by variety of fishing gear and fishers</li> </ul>
<b>Thottam/Alam Fishing</b>	<ul style="list-style-type: none"> <li>• The drudgery was more due to the poor connectivity of roads and waterways.</li> <li>• Fish catches and fish variety were high.</li> <li>• They used to stay and do fishing in Maanavaram Theevu.</li> <li>• The thottam depth was high.</li> <li>• The accessibility was good.</li> </ul>	<ul style="list-style-type: none"> <li>• Many changes in the seashore affect their livelihoods.</li> <li>• The groundwater lenses in the sand dunes have reduced.</li> <li>• The thottam fishing is less profitable, and the drudgery of walking and reaching the fishing areas</li> <li>• The thottam area is getting reduced.</li> <li>• Cyclone Gaja filled the thottam with silt and dried the <i>Prosopis</i> and mangrove, which impacted the lives and livelihoods of fishers.</li> <li>• Development of oyster bed in the <i>thottam</i> area disturbs fishing</li> <li>• The changes in the six creeks mouth directly impact the livelihoods by reducing the inflow and fish movements</li> <li>• The <i>thottam</i> area and alam are being converted to agriculture, aquaculture and brine reservoirs.</li> </ul>	<ul style="list-style-type: none"> <li>• Severe threat and possibility of fishers shifting to other means of livelihood.</li> <li>• It has slowly come under the control of few larger players due to their marketing power.</li> <li>• The fishers themselves can renovate the fishing routes and waterways and lay down roads collectively through mutual contributions</li> <li>• Strong possibility of becoming a complete commercial activity since the dependent village and population are large.</li> </ul>

Livelihood	Past	Present	Future
<b>Sea Fishing</b>	<ul style="list-style-type: none"> <li>• Only by the native fishers</li> <li>• Fishing was done within 5 nautical miles</li> <li>• Simple and minimal nets</li> <li>• Large-scale fishing was practiced only in Kodyakurai and Kodyakadu</li> <li>• Self-regulated fishing</li> <li>• Fishing by a few communities</li> <li>• There was not much support from the Fisheries Department.</li> </ul>	<ul style="list-style-type: none"> <li>• Fishing by fishers from neighbouring districts</li> <li>• Local fishers have become labourers</li> <li>• Fishing by even non-fishing community</li> <li>• Considerable support is being ensured by the Fisheries Department through entitlements and other services</li> <li>• Use of banned nets and banned fishing methods</li> <li>• No concern regarding marine species such as Olive Ridley, dolphins, Dugong, etc.</li> <li>• More boats and high-powered engines</li> </ul>	<ul style="list-style-type: none"> <li>• The Vellapallam port is going to be established, which will significantly impact the sea fishing .</li> <li>• The deep-sea fishing concept is improving, and different kinds of sea fishing method will be introduced.</li> </ul>
<b>Saltpan</b>	<ul style="list-style-type: none"> <li>• Very regulated salt production by natural process</li> <li>• Shifting in the land lease ownership to different corporate</li> <li>• Use of diesel engines for extraction of saltwater</li> <li>• Use of Visagam canal</li> <li>• Only edible salt production</li> <li>• Introduction of electric connection for bore well</li> </ul>	<ul style="list-style-type: none"> <li>• In Adirampattinam and Thambikottai areas most of the salt pans have been decommissioned</li> <li>• Some parts of the thottam area have been converted a brine reservoir to store seawater.</li> <li>• More bore wells</li> <li>• Production of industrial salt</li> <li>• Use of machinery</li> <li>• Establishment of strong small-scale producers' association and entitlement support</li> <li>• More labourers are dependent on this livelihood seasonally</li> </ul>	<ul style="list-style-type: none"> <li>• Possibility of shifting the small-scale saltpan land to corporate and others</li> <li>• Possibility of introducing more technologies</li> <li>• Possibility of expanding the unused salt land</li> <li>• Impact on the lives of salt worker through loss of wages</li> </ul>

Livelihood	Past	Present	Future
<b>Aquaculture</b>	<ul style="list-style-type: none"> <li>• Aquaculture was practised by only the economically well-off people.</li> <li>• The tiger prawn variety was cultured</li> <li>• Heavy profit or loss</li> <li>• High usage of chemicals</li> <li>• Marketing facility was poor</li> <li>• No generator facility</li> <li>• Usage of groundwater as saltwater</li> <li>• Conversion of agriculture land, saltpan land and forest land</li> <li>• Water was extracted by establishing exclusive canals</li> <li>• The dependency on consultants was more</li> </ul>	<ul style="list-style-type: none"> <li>• Vennamei is cultured</li> <li>• Agitation by the community in several villages</li> <li>• Aquafarms established in the Forest Department and Salt Department lands have been demolished now, and these departments have got their lands back.</li> <li>• Judgement regarding ban and regulation of aquaculture farms by Supreme court</li> <li>• Less profit</li> <li>• Even the marginal farmers are into this livelihood</li> <li>• The aquaculture farmers are becoming expert in this livelihood by not depending on the consultant</li> <li>• Better marketing</li> <li>• Increasing trend of using leased pond rather than own pond</li> <li>• More bore wells have been introduced</li> </ul>	<ul style="list-style-type: none"> <li>• There is good scope for expansion of aquaculture owing to enhanced profit</li> <li>• High technology and less expensive</li> <li>• Strict regulation as per the CRZ and ESZ notifications</li> <li>• Strict regulation by CAA by licensing and renewing the license</li> <li>• Monitoring and regulation by the State Pollution Control Board</li> <li>• More opportunities for aquaculture labour force with standard wages</li> </ul>
<b>Livestock</b>	<ul style="list-style-type: none"> <li>• More in number – it was around 30,000 cattle and 65,000 sheep approximately</li> <li>• Grazing in forest, mangroves and poromboke land (common land)</li> <li>• Less regulation by the Forest Department</li> <li>• Grazing in Mannavaram Theevu (using boats)</li> </ul>	<ul style="list-style-type: none"> <li>• Common grazing grounds have vanished.</li> <li>• The cattle population has been reducing.</li> <li>• Collective grazing is practised in a few villages.</li> <li>• Good infrastructure for animal husbandry</li> <li>• Hybrid varieties</li> </ul>	<ul style="list-style-type: none"> <li>• Possibility to intervene through stall feeding by Forest Department as experimentation</li> <li>• Scope for growing green fodder in the agricultural land</li> </ul>

Livelihood	Past	Present	Future
<b>Tourism</b>	<ul style="list-style-type: none"> <li>• Less scope and implementation</li> <li>• Only pilgrims visited</li> </ul>	<ul style="list-style-type: none"> <li>• The tourism potential is better.</li> <li>• More local and international tourists are coming.</li> <li>• Improvement of the infrastructure.</li> <li>• The interest and involvement of the people is positive.</li> </ul>	<ul style="list-style-type: none"> <li>• Considerable scope and possibility of promoting tourism-based livelihoods.</li> <li>• Considerable scope for attracting more tourists by the Forest and Tourism departments</li> <li>• Possibility of strengthening the infrastructure</li> <li>• Possibility of grooming community-based responsible tourism</li> </ul>



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## 8 DRIVERS OF CHANGE

### 8.1 Social Justice: Distribution of Land for Landless

The 1960s were an important decade for the landless tenants of the Cauvery delta districts. The socio-political agitations of the Communist and Dravidian movements resulted in various reforms that favoured the strangled tenants who were under the control of the landlords. The Tamil Nadu Cultivating Tenants (Special Provisions) Act, 1968, Tamil Nadu Agricultural Lands (Record of Tenancy Rights) Act, 1969 and Conferment of Ownership of Homestead Act, 1971 were passed, resulting in distribution of land among the landless. During this period, *patta* lands were issued to the landless fisher communities and families of soldiers of the Indian National Army (INA). About 2–3 acres of *alam* (mudflats) were provided to the families residing along the Point Calimere Wetland Complex. Earthen bunds were created along the wetlands to prevent the entry of saline water during high tides and storm surges. The lands were reclaimed to cultivate rain-fed crops. Paddy was the main crop cultivated in this delta region. Only the agrarian community used the arteries of the Cauvery well to stabilise their cultivation. Agriculture remained a supporting livelihood for these fishing communities rather than becoming the primary livelihood. The *alam* between the Nasuviniyar and Valavanar rivers was the land that was distributed to the landless fisher communities. The fishers of Maravakadu, Manganankadu and Sengangkadu still remember this land distribution and express their gratitude to the political leaders who were involved in the process.

### 8.2 Intensive Agriculture

Until the late 1960s the government largely concentrated on expanding the farming areas (conversion of *alam* into agricultural land). But the population explosion and prevailing food insecurity called for an immediate and drastic action to increase yield. The action came in the form of the Green Revolution. In the 1970s, Green Revolution initiatives were taken up with the agenda of changing India's status from a food-deficient country to one of the world's leading agricultural nations. Rivers were dammed by major irrigation projects, single cropping was converted into double cropping, rain-fed lands were converted into irrigation command areas, high-yield varieties were introduced, agriculture was intensified by introducing inorganic chemical fertilisers and pesticides, and technology and machinery were introduced for improving efficiency. This intensive agriculture resulted in a reduced river flow in the tail reach of the Cauvery delta. This low flow in the tail reach reduced the flow of fresh water into the wetland complex in terms of both duration and quantum. This affected the degree of salinity in the mudflats as reflected in the poor mangrove proliferation and regeneration. The reduced flow also pushed cultivable lands to remain fallow or to be converted into aquaculture farms.

### 8.3 Centralisation and Urbanisation

Centralisation of the service and production sectors (both public and private) induced infrastructure establishments (check dams) in the Cauvery delta. Urbanisation of the state and district capitals due to centralisation of the administrative, governance and judiciary systems created greater opportunities for the emerging rural communities. Urban agglomeration necessitated the establishment of a centralised water distribution system and sewer system, which required large quantities of water. The dam across the river Cauvery turned into a drinking water source for the urban fabrics. The increased urban water demand further reduced the flow in the arteries of the river Cauvery into the wetlands.

The smaller towns have become potential sources of solid and sewage, which are disposed of into the arteries and pollute the intertidal wetland complex.

### 8.4 Mechanisation

The surface-water-based civilisation that accessed shallow aquifers only during dry seasons via dug wells started to abstract deep aquifers after the use of motor pumps began. The abstraction turned into overexploitation, affecting the groundwater cycle. This effect was seen not only in urban and agrarian regions but also in the coastal aquifers. Both the salt producers and shrimp farmers used pumps to pump saltwater from the sea or from deep saline aquifers.



Diesel motors were used to pump saltwater directly from the sea or from creeks and backwater channels during high tides. Later, electric motors were used by small-scale salt producers to pump saltwater from deep aquifers. This resulted in seawater intrusion as well as pollution of fresh water in shallow aquifers.

Outboard motors fixed on fibre boats eased fishing both within the wetland and at sea. Before motorisation of fishing boats, fishers used sails (*paai maram*) to drive their boats. Since a *paai maram* capitalises 'the nature of wind', sailing was labour-intensive. If the sea was rough due to high wind speeds, the fishers used to wait till the wind speed decreased. In most cases, the fish catch got spoilt before it reached the market. This spoilt fish catch was preserved as dry fish and later sold in the market for lower prices.

## 8.5 Migration

Migrating to countries such as the UAE, Singapore and Malaysia is a common socio-economic practice among the fishing and agrarian communities in the region. Youth of age 20-28 years work as unskilled, semi-skilled or skilled labourers in these countries. Most of them work till the age of 45-50 years, and some even work beyond 60 years.

These migratory labourers invest in fishing boats after returning abroad for higher returns. This has been one of the important reasons behind the increased number of motorised fibre boats fishing in the wetland and seashore zone. Another reason is that immediately after the 2004 tsunami, large numbers of boats were distributed to fishers by international organisations, NGOs and the government.

## 8.6 Demand for Firewood: Introduction of Invasive Species

*Prosopis juliflora*, a non-native species was introduced in the villages adjoining the wetland complex to meet the firewood demand of the communities. In the 1960s, *Prosopis* seeds were sown in the grazing land (*meichal poramboke*) under initiatives of the government. Initially, as expected, this exotic species served the purpose of providing abundant firewood for cooking to the local communities. But later, it turned invasive. It invaded all the fallow cultivable lands and intruded into the mangrove ecosystem, replacing almost 90% of the Thillai (*Excoecaria agallocha*), a native mangrove species, in the intertidal zone. The Thillai is a fresh water-loving species. As the periodicity and quantum of freshwater flow reduced and the salinity level increased, the population of this species got drastically reduced. It has even invaded the deep mangrove ecosystem, in the brackish water region.

The cattle entering the mangroves for grazing and the fresh water flowing through the coastal plains are the major carriers of the *Prosopis* seeds. The seeds floating in the flowing fresh water get deposited on the bunds of the fishing canals and *alam* and remain dormant. The seeds germinate under favourable situations and establish themselves.

A 250 m wide buffer of *Prosopis* has formed in the periphery of the mudflat from the estuary of the Valavanar river till the salt pans of Agasthiyampalli (a stretch of about 20 km). The *Prosopis* has completely invaded Seruthalaikadu village and became one of the major sources of income through charcoal making. The *Prosopis* has invaded Muniappan Lake and intruded into sand dunes in the lagoon/creeks, the shoreline of Mannavaram Theevu and the tropical dry evergreen forest.

Cattle grazing and feral horses are the major dispersal agents of *Prosopis* seeds in these sand-rich regions. The freshwater lenses in these sand-rich regions are favourable for the proliferation of *Prosopis*. This invasion of *Prosopis* has adversely affected the freshwater sources in the shallow aquifers of the coastal region.

The invasion of *Prosopis* has completely altered the native ecosystem not only in the tropical dry evergreen forest but also in the mangrove ecosystem. This has seriously affected the aquatic and terrestrial avian populations that were dependent on the native trees for nesting as well as food. The number of fruit-bearing trees is reducing day by day due to the domination of *Prosopis*. The decline in the population of fruit-bearing native trees is accelerated by the impact of cyclones, which alter the ecosystem in favour of the *Prosopis* invasion.

## 8.7 Tourism

The Muthupet mangroves and lagoon, the wildlife sanctuary in Kodyakkadu, the bird sanctuary in Kodyakarai and temples throughout the stretch from Adirampattinam to Vedaranyam attract local and regional tourists.

The wildlife sanctuary in Kodyakkadu has been regularly attracting fairly large numbers of domestic tourists from neighbouring areas, especially during weekends and holidays. The Blackbuck, Spotted Deer, Common Dolphin, Olive Ridley Turtle and Indian Star Tortoise attract the tourists to the Sanctuary. The mudflats of Vedaranyam swamp, which host waterbirds from different parts of the world, attract bird watchers, researchers, photographers and domestic tourists. Since the wildlife and bird sanctuary are well protected and visited by eco-sensitised communities, they are well maintained.

The local community celebrates festivals for deities such as Muniappan, Mattumunian, Servarayan, Soni and Kaathavarayan inside the TDEF. The local rituals lead to noise and air pollution and to improper disposal of plastic and glass bottles. Though the rituals are traditional, the containers and materials that are used in the rituals have changed from degradable to non-degradable. This will have implications for the tropical dry evergreen forest and its dependent habitat.

Performing rituals for the ancestors and dead ones of the family at Kodyakara during Aadi Amavasai and Thai Amavasai (new moon days of July and January) is a religious tradition among Hindu communities. On these days more than 15,000 devotees come to the seashore of Kodyakara and perform the rituals. A lot of materials (clothes, bananas, coconuts, ceramic pots, plastic carry bags and other materials used in the rituals) are disposed of along the seashore. The disposal not only affects the marine life along the shoreline but also enters the intertidal zone through backwaters occasionally.

Ramarpadam, one of the importance religious sites of Hindus, in the Vedaranyam forest, is visited by thousands of tourists every day. A new culture of feeding the monkeys with bananas is growing among the devotees. This newly introduced feeding habit will affect the diet of the monkeys and influence the food chain of the forest. More than 5000 tourists visit the Muthupet mangroves and lagoon every month. As the Muthupet mangroves are a favourite wintering ground for more than a hundred species of migratory water and land bird, the number of tourists shoots up to 15,000 each month.

Wooden boat jetties, tourist shed complex, wooden boardwalk and other structures are emerging to attract tourists in large numbers and to boost the eco-tourism economy. If the eco-tourism in this region gets appropriate visibility, it could attract more infrastructure in Muthupet. Maintaining a balance between tourism and ecosystem conservation in the sensitive mangrove zone is very important.

## 8.8 Livestock Rearing

Livestock rearing is one of the supporting livelihoods of the wetland-dependent communities. Though the level of this livelihood dependence is higher among the Konar community, who are traditionally known for livestock rearing, other communities also rear small numbers of livestock. The grazing wastelands (meichal poramboke), mangroves adjacent to the hamlets and grasslands of the tropical dry evergreen forest and sand dunes are the primary grazing grounds of the cows and goats that are reared.

Though grazing has been restricted after the notification of the reserve forest, it was imbibed by community only through continuous sensitisation programmes and regulatory measures taken up by the Forest Department and non-government organisations. Grazing in the forest zone not only destroys the germinating mangroves and native plants but also spreads the invasive species in the native ecosystem. This has done serious damage to the native ecosystem as well as freshwater reserves in the shallow aquifers. Grazing has drastically reduced the mangrove zone except in the tropical dry evergreen forest zone. The cattle, with marks for identification, compete for food with animals such as the Blackbuck and Spotted Deer in the tropical dry evergreen forest zone. The same stands true for drinking water. The Forest Department makes arrangements to provide water for the wildlife. The water provided is also consumed by the cattle population.

The practice of taking cow in boats to the Mannavaram Theevu, shoreline sand dunes, has reduced due to the low availability of grass during the monsoon. The dunes are now dominated by *Prosopis*. Cattle that died in the sand dunes due to cyclone is also another reason for the reduction in this practice. The damage has already been done by the *Prosopis* invasion, which has covered almost 1700 ha of the ecosystem.

## 8.9 Market Forces

The market forces of shrimp farming, salt production, paddy cultivation, sand mining and fishing practice have played a vital role in impacting the wetland and its dependent livelihoods.

### 8.9.1 Boom in shrimp market

In the 1970s, fishers started concentrating on catching prawns, more commonly known as 'shrimps,' because of the high profits associated with them on account of their export value. In the Fifth Five-Year Plan, the Central government provided support organisations such as the Fish Farmers Development Agency and the Brackish Water Fish Farmers Development Agency to develop aquaculture techniques and practices. Brackish water prawn farming started in a big way during 1991–94, especially in the coastal districts of Andhra Pradesh and Tamil Nadu.

The 1990s were boom time for shrimp farming in the Point Calimere Wetland Complex. Shrimp farms were established on a war footing in the coastal region by converting agriculture lands, salt pans, poramboke wastelands and forest lands. Big and small companies partnered with major international importers to make profits. But as more investment flowed into the shrimp farming business, along with government incentives, resistance to shrimp farming also increased. But the business suffered a setback due to poor quality seeds, disease outbreaks and poor environmental management. The 2004 tsunami added to the problem. Major importers, such as the United States and the European Union, cut down on import volumes, citing the presence of veterinary medical products and pathogenic microorganisms in shrimps imported from India. The business resurged with the introduction of Vannamei, or the White-Legged Shrimp, in 2009. Vannamei accounts for 80% of all shrimp exports and close to half the shipment value of all outbound marine products. Since Vannamei culture began, the export value of the variety has multiplied almost six times, according to data from the Marine Products Exports Development Authority. The increased demand for shrimps in the global market and higher value of the shrimp have motivated economically sound farmers and investors to enter the sector.

The expansion of shrimp farms and illegal shrimp farm establishments led to a reduction in forest cover and grazing waste land. Some of the illegal establishments have been legalised, and some have been retrieved by the Forest Department. These retrieved forest lands remain degraded and have to be treated for regeneration of mangroves. The conversion of grazing waste land into shrimp farms has added pressure on the mangroves to meet the grazing demand. The conversion of agriculture land into shrimp farms was either 'pulled' by the higher returns of aquaculture farms or 'pushed' by the reduction of yield in paddy fields adjacent to shrimp farms. The increase in groundwater salinity and soil salinity owing to aquaculture over a period of 15 years has reduced the paddy yield.

Artificial ponds are made on plots of land surrounded by raised bunds for aquaculture. Small channels lead the fresh water and brackish water through an inlet valve to these ponds where the shrimp are grown. This affects the natural flow of fresh–brackish water in the intertidal zone. The saltwater that flows into the farm is mixed with medicines to keep the shrimp disease-free, and these seep into the groundwater and often contaminate drinking water sources. Additionally, the salinity of the topsoil is irreversible, and the land cannot be used for agriculture once the shrimp culture season is over.

As the return over investment in shrimp farming in a successful season ranges from 60% to 105%, people who have the financial capacity to invest Rs.25,00,000 per hectare convert the agriculture land into shrimp farms. But in the case of an outbreak of any disease, there is complete loss. Therefore, shrimp farming becomes a gamble. A shrimp farmer who has suffered a huge loss invests again to get back the investment made earlier, exactly like a gambler, who keeps on gambling.

### 8.9.2 Increasing demand for salt

Salt manufacturing is carried out in the mudflats of the wetland complex. Though salt deposits are collected by the villagers adjacent to the alam, salt production for commercial purposes was done in the Adirampattinam and Vedaranyam regions. The very short distance between the sea/creek and the mudflats (alam), the existence of barren mudflats, the high salinity of the brackish water and the reduced dilution by the freshwater sources are the factors behind the existence of salt pans in these pockets. The salt-producing area in Adirampattinam is very small compared with that of Vedaranyam. Construction of backwater channels that draw water from the sea or creek, establishment of brine reservoirs and pumping of saline water directly from the sea and aquifers alter the land use land cover and the functions of the intertidal complex. An increase in the market demand for commercial and domestic salt triggered mechanisation in salt production in the corporate-leased salt pans. Further salt pan establishment was explored at sites around Thondiyakkadu, but the initiative failed due to poor returns. The salt production in this region contributes 18% of the total salt production of Tamil Nadu. It is next only to Thoothukudi. The increase in demand as well as

availability of potential areas led to the expansion of the salt pans in the Vedaranyam at the cost of forest cover and intertidal swamps that were the habitat of aquatic and terrestrial avian species.

### 8.9.3 Low-profit paddy cultivation

As most of the cultivable lands are rain-fed in nature, the return from paddy cultivation is poor. The paddy cultivation in the coastal plains has been tested by climatic factors such as erratic rainfall, cyclones and sea winds. Increased water and soil salinity reduced the paddy yield. The poor profits from paddy cultivation triggered farmers to sell/lease their land to shrimp farmers or to be directly involved in shrimp farming. A farm turned into a shrimp pond can never be reversed to cultivable land. Therefore, it is left fallow for a longer period.

## 8.10 Hosting Migratory Sea Fishers

Kodiyakarai turned into a marketplace when the communities collectively decided to host the migratory fishers coming from the rest of the coastal districts of Tamil Nadu. As their seas are rough, these coastal fishermen migrate seasonally towards the Palk Strait, where the sea is calm. The communities of Kodiyakarai meet all the requirements of these fishers, from temporary shelter houses to groceries, fuel, drinking water, electricity, cooking items, fish markets and netting centres. More than 200 families are dependent on these migratory fishermen directly and indirectly. They not only provide supplies but also work as wage fishers in their deep-sea fishing boats. The dynamics of the village economy has improved after hosting of these fishers began, but it has highly affected the local boat fishers involved in sea fishing. The Kodiyakarai village committee collects 1% of the total fish catch towards a common fund from these migratory fishers. Though the income generated from these migratory fishers is seasonal, it is considerably high and reliable.

## 8.11 Coupe Felling

In this mangrove wetland, a system of management called the coupe-system was followed from the early 1900s to 1970. Under this system of management, a healthy mangrove forest was clear-felled in coupes by rotation every 20-25 years for revenue generation. This clear-felling of mangrove trees exposed mangrove soil. Since nearly 80% of the volume of the mangrove soil is water, exposure to the sun caused evaporation of soil water. This in turn led to subsidence of sediments in the clear-felled area, on account of which the topography of the coupe-felled area became trough shaped. As a result, tidal water entering the troughs during the high tide became stagnant. Evaporation of stagnant tidal water led to an increase in salinity to a level that is not tolerated by any mangrove plant. An estimate indicates that coupe felling is responsible for nearly 80% of loss in Muthupet mangroves.

## 8.12 Social Dimensions

### 8.12.1 Fishing is open for all

In the coastal belt from Tuticorin to Kanyakumari, only the traditional fishing community, called Paravar, are allowed to fish in the sea. There is only the concept of collective fishing and no concept of wage fishing among these fishing communities. Women operate vibrantly in preparing nets, drying fish and marketing the fish catch.

On the other hand, the wetland and sea fishing in the Point Calimere wetland region is open for all. Except the Chellakkani Creek mouth, which is a right of Seruthalaikadu fishers, the brackish water area is open for all. The entry of non-fishers into the fishing activity has increased the number of boats in the wetland zone.

Sethuguda, one of the prawn-rich wetland areas, was once restricted to the families who leased the area. Later, the fishermen's society leased it and opened it for all fishers. It was an achievement for the collective protest of the fishermen.

During the prawn season, there is social regulation among the fishing community through the practice of a rotational fishing method. It is adopted so that every fisherman gets an equal opportunity to catch prawns during the season. This equitable fishing practice makes the fishing in the wetland more viable and sustainable. Wage fishing is practiced only by the migratory fishers whom the local fishers accompany. Other fishers practice collective fishing.

### 8.12.2 Traditional fishing rights

Though the brackish water zone is open for all, it is restricted in a few zones. One is traditional user rights relating to the fishing canal, and the other is the fishing rights of Seruthalaikadu fishers relating to the Chellakkani Creek mouth. Traditional fishing canals, the lifelines of the mangrove forest, are maintained well by the fisher families who have the rights. The rights relating to these canals are recorded by the Forest Department for better regulation. The fishers who hold the fishing rights, but no rights relating to the land, transfer the rights to other fishers on lease.

Next-generation fishers are moving away from the traditional fishing canal for the following reasons:

- Restoring the cyclone-affected canal needs huge investments.
- Fishing in these traditional canals is more tiresome compared with sea fishing.
- The income generation is highly fluctuating as the fish catch varies with the season.
- Other opportunities such as migration abroad are available.

This traditional fishing practice was the key to the effective interface between brackish water and fresh water in the wetland complex. If the fishers stop using the canals, they will be silted and the fresh–brackish interface will be cut off. Therefore, bringing canal fishing into operation is non-negotiable for enriching the mangrove growth in the intertidal zone.

### 8.12.3 Unscientific myths

Bird poaching is a serious issue in the wetland dependent villages. Migratory birds are poached by the villagers both for their own consumption and for selling in the local market. The birds are sold in the local market for Rs.1000–3000 on the basis of weight. The Forest Department is taking serious action against the poachers by the numbers of increasing guards, watchers and anti-poaching committees. Despite their attempts, poaching is still going on in some places during winter. The basic reason for the poaching is a lack of awareness about the importance of conserving endangered migratory species and beliefs in unscientific myths about birds. It is widely and strongly believed by the local communities that these birds are the best medicines for increasing 'potency'. This belief drives the demand in the market in spite of serious punishments imposed by the Forest Department on the poachers.

The fishers know the importance of dolphins, Finless Porpoises and whales and do not hunt them. Stranded mammals were even rescued by them, as well as by the Forest Department. Necropsy reports of carcasses reveal that the mammals were injured by the propellers of boats and were not hunted.

This was not the case with turtles. There is a myth amongst the fishers that taking turtles on board boats might lead to reduced fish catches in the future. Therefore, they never get involved in rescuing stranded turtles or injured turtles. Only the Forest Department rescues turtles and releases them back into the sea.

### 8.12.4 Zero flow into sea: An effective water harvest

Intensive agriculture in the monsoon-dependent Tamil Nadu has created a psychological social narrative among the agrarian communities that 'the river water draining into the sea is water wasted'. This narrative has gained momentum among the public, with regard to the farmers over the ignorance on importance of intertidal ecosystem and its sensitivity towards river flow. It triggered interest among the public in damming rivers and constructing barrages even across the arteries.

## 8.13 Extreme Events

The landscape of the Point Calimere Wetland Complex has undergone a lot of changes as it is prone to extreme events. A total of 11 extreme events have been recorded in the past 7 decades, of which six were cyclones, two were floods, one was a storm surge, one was heavy rainfall, and one was a tsunami.

Time of incidence	Nov-52	Dec-67	Nov-77	Dec-84	Nov-91	Dec-93	Dec-04	Nov-08	Nov-10	Dec-11	Nov-18
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The storm surge of 1952 and Gaja (2018) are the most disastrous of these events. They altered the landscape of the ecosystem to a great extent. The storm surge was the driving factor behind the conversion of agricultural lands in Seruthalaikadu and Kodyakarai into uncultivable land. The sea slurry deposits increased the salinity of the soil and made it unfit for agriculture. This storm surge resulted in widening of the creek mouth, which allowed higher intertidal flows. It is also believed by the fishermen that the oyster reef formation has grown only after this storm surge.

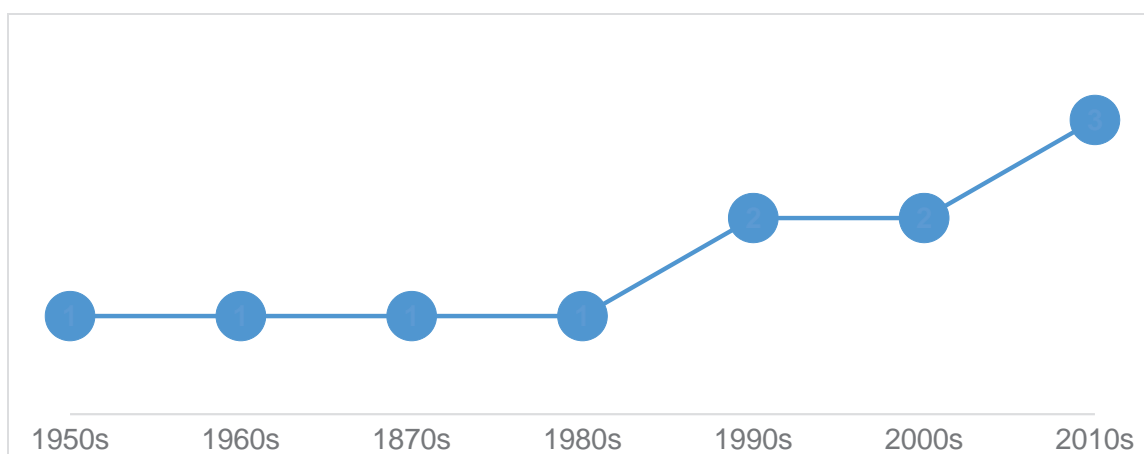
Later cyclones and floods resulted in the formation of a new prawn-rich area called 'Sethuguda' and in minor shoreline changes. Sludge deposits in the brackish water channel/canals are the only recorded effects of the tsunami in this region.

Gaja, the most disastrous cyclone, with a wind speed of 130 kmph, destroyed the mangroves and killed wildlife and birds in large numbers. Large number of migratory birds' carcasses were found in huge heaps in the roosts of the mudflats and mangrove forest. Even animals such as Spotted Deer and Blackbuck were reported to have died in the wildlife sanctuary. The native trees and mangroves were twisted, uprooted and thrown away by the cyclonic winds.



**Image 27** Mangroves at Muthupet destroyed by cyclone Gaja

It can be observed that the number of extreme events has increased over the decades. Increased incidences of extreme events are one of the impacts of climate change. Therefore, it is important to adapt livelihood practices accordingly.



**Figure 11** Number of extreme events in a decade

## 8.14 Erratic rainfall

An increase in the erratic nature of the rainfall in the Cauvery basin has led to crop failures. Farmers were highly reliant on the shallow aquifers for meeting their irrigation needs. The water table (freshwater) in the shallow aquifers has drastically fallen due to intense abstraction using pumps. This in fact has led to saltwater intrusion in the shallow aquifers, increasing the salinity of the water. These saline aquifers have no potential benefits for the wetlands as well as for the wetland dependent communities.

## 8.15 Environmental Regulations: Reserve Forest, CRZ and ESZ

Until 1892, the Point Calimere Wetland Complex was under administration of the Revenue Department as well as temple authorities. They allowed local people to collect firewood, fish and minor forest produces, and thus it was continuously exploited. Though the formal protection of this forest has begun during 1892 with the creation of Kodyakkadu Reserve Forest, the British Government later cleared some of this forest for a hunting ground and later established Eucalyptus and Casuarina plantations for firewood. Since independence, the reserve forest has been under the control of the Tamil Nadu Forest Department. The coupe system of tree felling was also followed in the tropical dry evergreen forest, but it was stopped in the 1970s, when felling of trees was banned.

In 1967, Point Calimere Wildlife Sanctuary was formed, including parts of the Kodyakkadu Reserved Forest and its extension. In 1970, amendments to the rules were made that prohibited shooting, which was being practised by landlords, hunting of birds and animals, collection of MFP such as fruits and herbal produce and fishing in the backwater channels and depressions and restricted grazing of livestock.



**Image 28** Medicinal species in Muthupet mangroves

The recently notified Block (A) (the Muthupet mangrove wetland and Thalainayar reserve forest) also restricts the fisher communities from collecting mangrove wood and leaves for cattle, grazing animals and cooking in the notified area.

Poaching of birds was common among the villages in the wetland complex. The imposition of Reserve Forest-regulations has restricted the poaching activities. Stringent action and punishments serve to deter poachers.

Anti-poaching Committees, Village Forest Councils and Ecotourism Development Committee are some of the village committees promoted by the Forest Department to reduce violation of forest-regulations and enhance alternative livelihoods. A lack of continuous funding and sustained approach have led to many such committees becoming defunct.

In 2018, an Eco-sensitive Zone was declared around Point Calimere Sanctuary (including Block-B) to help scientific conservation of the ecosystems. ESZs act as shock absorbers of protected areas. The basic aim is to regulate certain activities around wildlife sanctuaries, so as to minimise the negative impacts of such activities on the fragile ecosystem. With the ESZ boundary going up to 6 km from the boundaries of protected areas, Point Calimere Sanctuary is adequately protected. As per the ESZ notification, Point Calimere has a protected area of 22.51 km<sup>2</sup> and an ESZ area of 88.93 km<sup>2</sup>. The notification will help protect the sanctuary from future exploitation as it has categorised developmental activities as permitted, regulated and prohibited.

Point Calimere Wetland Complex has almost all the zones of Coastal Regulation Zone (CRZ). Most of the villages adjacent to the wetland complex fall under CRZ 3. In this zone, an area up to 200 m from the high tide line (HTL) on the landward side in the case of a seafront and 100 m along tide-influenced water bodies or the width of the creek, whichever is less, is to be treated as a 'No Development Zone (NDZ)'. Many industrial activities have been restricted in this zone. A foundation stone was laid for a textile park in the Ayakkaranbulam IV Sethi' village panchayat of Vedaranyam block, in the NDZ. The effects of this textile park on the wetland complex have to be examined and appropriate policy decisions have to be taken to avoid the negative impacts on the wetlands.

In 2019, a fisheries harbour was announced at Vellappallam, Nagapattinam. Thalainayar reserved forest and Kodyakarai sanctuary are two of the ecosystems located on the coast within a 10 km radius of the proposed site of development. The planning process should take into account the proximity of these locations to ensure that the proposed fishery harbour development is in accordance with the stipulations and guidelines laid out for such projects. The harbour is a threat to some of the endangered marine species, such as whales, dolphins and turtles, frequenting the sanctuary coastline. The coastline of Point Calimere, running north–south, acts as the nesting grounds of the Olive Ridley Turtle, one of the five endangered sea turtles of the Indian Ocean. Three hatcheries were set up, at Kodyakarai, Arukattuthurai and Vanavanmahadevi, to compensate the hatchling failure caused primarily by predation by Jackals, Wild Boars, mongooses and Brahminy Kites. Establishment of a harbour will affect the route of these turtles that move in a bale, which would directly affect their nesting and thereby the population.

### 8.15.1 Fisheries regulation and entitlements

The marine fishers who also fish in the wetland habitats are supported by the Fisheries Department through various entitlements of the central and state governments. The National Fishermen Saving cum Relief Scheme, Tamil Nadu Fisher Women Savings cum Relief Scheme, Fishing Ban Period Relief, Lean Period Relief Assistance, High-Speed Diesel Scheme, subsidised motorisation of boats, insurance and other assistance help the fishers during economic difficulties. These entitlements reduce pressure on the wetland in the lean season and ban season and at the same time attract non-fishers to fishing.

The Marine Police and Coast Guard play an important role in regulating operations in the sea and intertidal zone. This zone was known for smuggling of goods even during the British period. One of the sand dunes in the Seruthalaikadu creek is called Mootai Avilthaan Theevu, which means 'dispersal of packages'. As Sri Lanka is nearby, even now a few incidences of smuggling happen, as recorded by the Coast Guard. The smuggled goods include illegal drugs. A close watch maintained by the Coast Guard helps ensure that the regulations are followed in the sea.



### 8.15.2 Aquaculture regulations

The brackish water aquaculture activities are governed by the Coastal Aquaculture Authority (CAA) Act, 2005, and its Rules and Guidelines (for sustainable, eco-friendly shrimp farming). One of the major tasks accomplished by the CAA was the registration of shrimp farms on the recommendations of the State- and District-Level Committees constituted for this purpose. It is mandatory that all persons carrying on coastal aquaculture shall register their farms with the Coastal Aquaculture Authority. Registration is made for a period of five (5) years, which can be renewed further. The registration process will be continued in respect of new farms as well as farms that may be renovated for taking up coastal aquaculture activities in the future. The act mandates the Central Government to take all such measures as it deems necessary or expedient for regulation of coastal aquaculture by prescribing guidelines to ensure that coastal aquaculture does not cause any detrimental impact on the coastal environment and that the concept of responsible coastal aquaculture given in the guidelines shall be followed in regulating coastal aquaculture activities to protect the livelihoods of various sections of people living in the coastal areas.

The introduction of Vannamei was another initiative of the CAA that accelerated the shrimp farm expansion. Shrimp farms were decelerating after severe losses after the Tiger Shrimp culture was found to be vulnerable to diseases. They are booming again with the introduction of the White-Legged Prawn.

Out of the 3130 ha of aquaculture farm in the wetland complex, only 1222 ha is owned by registered owners (103 owners). The remaining members (454 members), holding 1065 ha of aquaculture farms, have not been renewed their registration (CAA, 2020). This serves as evidence that the aquaculture farms are regulated very little. The farms use chemicals heavily to protect their shrimps from diseases and infections. The effluents are discharged into the wetlands and backwaters without any treatment. These adversely affect the biota and the marine life in the intertidal zone.

The Supreme Court judgement on a public interest petition filed by S. Jagannathan, Chairman, Gram Swaraj Movement, on the enforcement of the Coastal Zone Regulation Notification, dated 19 February 1991, issued by the Government of India, resulted in stopping of intensive and semi-intensive prawn farming in the ecologically fragile coastal areas, prohibition of the use of the wastelands and wetlands for prawn farming and the constitution of the National Coastal Management Authority to safeguard the marine life and coastal areas. Subsequently, in 2005, the Coastal Aquaculture Authority (CAA) was established, and the Coastal Aquaculture Act was enacted the same year. The CAA regulates all the shrimp farming activity. The shrimp farms that violate or contravene the provisions of the CAA, 2005 and its rules and regulations are deregistered and closed by the CAA. Though such rules and regulations exist, their implementation and the monitoring of the activities of the shrimp farms remain poor.

### 8.15.3 Salt regulations

Salt extraction is one of the primary economic activities of the Vedaranyam region of Nagapattinam district. In the Vedaranyam region, salt is produced on about 10,400 acres, of which 7000 acres is controlled by two big companies that have taken land (mudflats) on lease from the Revenue Department, Government of Tamil Nadu, while the remaining 3400 acres is used by about 700 small-scale producers (holding 5–10 acres each) under leases from the Salt Department, Government of India. The Salt Commission issues leases, renews the leases every 20 years, ensures that the salt pans are used exclusively for salt production and restricts illegal expansion of salt pans that encroach on the wetlands. The regulations on using bore wells to extract sub-soil brine from shallow aquifers are critical in regulating the seawater intrusion in the aquifers. Though most of the salt producers use the saltwater canals to fill their pans, during the low flow season, they use bore wells to fill the pans. The salt commission should adopt scientific methods to regulate the usage of these bore wells for production of salt.

During the boom of aquaculture farms, some of the salt pans leased from the Salt Department, Government of India in Adirampattinam were converted into aquaculture farms and used for shrimp farming. After the judgement on the petition of S. Jagannathan, shrimp cultivation in those aquaculture ponds was banned. The Salt Department, Government of India

terminated the lease agreements with salt producers who converted salt pans into aqua farms. Details can be seen in Writ Petition No. 39588 to 39595 of 2004 and Writ Petition No. 2475 of 2005, High Court, Chennai. The converted farms remain non-operational for salt production. The Salt Corporation restricts the salt producers from producing shrimp and any aquaculture production even during the rainy season.

## 8.16 Change in land ownership and administration

Handing over of revenue lands from Vedaranyam swamps to the Forest Department has been taking place in bits and parcels. The portion of 'un-surveyed swamp' that belongs to the Revenue Department has been monitored and regulated by the Forest Department, Nagapattinam. The change in land ownership has restricted the free access of the local communities and ensures better protection of the wetlands. Mangrove plantation has also been attempted in this un-surveyed swamp.

Similarly, the panchayat lands of Sakkarapettai and Chinthamanikadu have also been transferred to the Forest Department. But this is not the case with the other adjacent villages.

Vandal, one of the isolated villages in Thalainayar reserve forest, surrounded by water in all directions, has been included in Thalainayar town panchayat. This has affected the remote village from getting the benefits of rural schemes such as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA) and National Rural Livelihood Mission. The villagers have also not benefitted from town panchayat amenities such as roads and infrastructure. Inclusion of such villages into town panchayats shatters the development of the poor rural communities.

# 9 ROLE AND INTEREST OF GOVERNANCE AND INSTITUTIONAL FRAMEWORK IMPACTING WETLAND-DEPENDENT LIVELIHOODS

## 9.1 Forest Department

The Forest Department is the key stakeholder. It is legally empowered to conserve and develop the PCWC. The Nagapattinam and Thiruvarur District Forest Department plays a crucial role in managing and protecting the Point Calimere Wetland Complex, through its three administrative divisions namely, Muthupet, Vedaranyam and Thalainayar forest ranges. The management and protection of the Muthupet mangroves, the bird sanctuary and the wildlife sanctuary and protecting the existing ecosystems and biodiversity are the key functions of the Forest Department. In the context of the PCWC, the Forest Department does the following activities.

### 9.1.1 Protection and conservation

The Forest Department is involved in the protection and conservation of forest areas, wildlife and bird sanctuaries covered by laws such as the Indian Forest Act, 1927, The Tamil Nadu Forest Act of 1882, Wildlife Protection Act, 1972 (Central Act) and Wetlands (Conservation and Management) Rules, 2017. Many culturally rich heritage sites are also protected by the Forest Department in the PCWC, such as Muniyappan Temple, Mattumai Temple, Modi Mandapam, Ramar Padam, Servarayan Temple and Avuliakani.

### 9.1.2 Regulation and enforcement

The Forest Department enforces rules and regulations to prevent the general public from cutting mangroves, grazing cattle and poaching animals and controls wildfires. It also regulates fishing in the lagoon/thottam and mangroves.



### 9.1.3 Awareness building

In addition, the Forest Department also plays a crucial role in building awareness among the community on the importance of the wildlife and bird sanctuary, protection of Olive Ridley Turtles and mangroves, etc. Annually, considerable numbers of schools and college students and visitors come to the sanctuary. They are given orientation about the importance of the forest, the sanctuary, the Olive Ridley Turtle, wild animals, etc. Likewise, such orientation is also given by the Forest Department in the fringe villages of the PCWC.

### 9.1.4 Development and management

Above all, the Forest Department performs development interventions for the dependent community, such as providing alternative livelihoods, building skills, extending credit support for needy people and promoting Village Forest Committees, Ecotourism Development Committees, etc.

## 9.2 Fisheries Department

Like the Forest Department, the Fisheries Department is also empowered to carry out regulation and enforcement activities. The Fisheries Department regulates both inland and marine fishing by enforcing rules, regulations and laws relating to the fishing activities both inland and in the sea. In addition, it is empowered to enforce punishments for illegal fishing, violation of rules and regulations, etc. Overall, it ensures that the fishing is sustainable by allowing approved fishing vessels and gear and that the fishing is within the limits. The Government has newly created an exclusive marine enforcement wing for conservation of fishery resources and effective implementation of the Tamil Nadu Marine Fishing Regulation Act (TNMFR), 1983.

The major functions of the Fisheries Department are:

- Implementing various social security welfare schemes
- Regulation and enforcement of Fisheries Acts and Rules
- Conservation and management of fishery resources
- Implementing rescue and rehabilitation measures during natural calamities and disasters and ensuring the safety of fishermen at sea
- Development of infrastructure with a livelihood focus
- In the Point Calimere Wetland Complex there are different kinds of fishing and fisher. They are supported by the Fisheries Department through fishermen's cooperatives.

### KEY INTERVENTIONS

- i. Fishing ban period relief assistance to fishers: In order to conserve the marine fishery resources, a seasonal fishing ban is imposed every year (since 2001). The fishing ban period is from April 15 to June 14 in the East Coast region. The fishers who are members of fishermen's cooperatives hold licenses and get relief assistance of Rs.5000 during the fishing ban period.
- ii. Registration of fishing boats: Registration and licensing of fishing boats is done by the department after inspection as per the Tamil Nadu Marine Fisheries Regulation Act, 1983.
- iii. Issue of identity cards to fishermen: Monitoring of fishing is done by Fisheries, Coast Guard and Police officials. They issue individual ID cards to fishers.
- iv. National Fishermen cum Relief Scheme: This scheme supports the fishers financially during the fishing off-season. Members of the fishermen's/fisherwomen's co-operative societies who are below the poverty line and are engaged in full time fishing and are aged between 18 and 60 are eligible.
- v. Supply of outboard engine to traditional fishing boats at subsidised rate (motorisation of traditional craft): Traditional fishing boats that are registered and licensed through the Department are eligible for the subsidy for outboard engine purchase (50% level).

The fishing lease rights in different parts such as the lagoon, *thottam* and adjacent areas are laid down by the Forest, Fisheries and Revenue departments. Fishing is free in the lagoons of the Muthupet reserved forest, and in the Kodyakkadu reserved forest the fishing right is sold by the District Forest Officer along with other minor forest produce.

The aquaculture farms are registered with the Coastal Aquaculture Authority. The Fisheries Department facilitates the registration of farmers with the Coastal Aquaculture Authority.

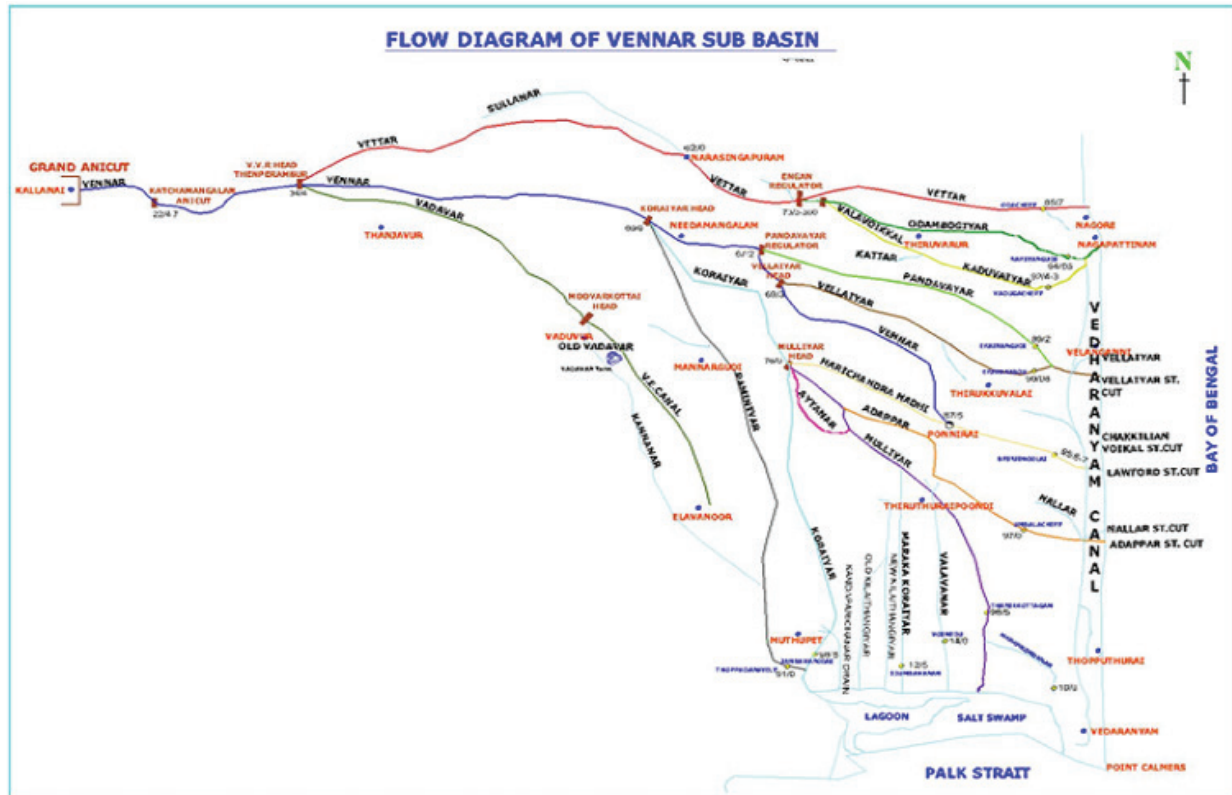
## 9.3 Coastal Aquaculture Authority

The Coastal Aquaculture authority (CAA) was established under the Coastal Aquaculture Authority Act, 2005. The main objective of the Authority is to regulate coastal aquaculture activities in coastal areas in order to ensure sustainable development without causing damage to the coastal environment. The Authority is empowered to make regulations for the construction and operation of aquaculture farms in coastal areas, inspection of farms to ascertain their environmental impacts, registration of aquaculture farms, fixing standards for inputs and effluents, removal or demolition of coastal aquaculture farms that cause pollution, etc. One of the major tasks accomplished by the CAA is registration of shrimp farms on the recommendations of the State- and District-Level Committees constituted for this purpose. It is mandatory that all persons carrying out coastal aquaculture register their farms with the Coastal Aquaculture Authority. Registration is for a period of five (5) years, which can be extended. Many of the farms in the study area are not registered. Moreover, they have not properly renewed the registration as per the stipulated time. In Nagapattinam, Thanjavur and Thiruvarur districts, Vannam aquaculture farming is done by the farmers. CAA also provides technical inputs, especially on antibiotic-free shrimp cultivation.

## 9.4 Public Works Department – Water Resources Department

The Tamil Nadu PWD plays a crucial role in the management of the PCWC since it is at the tail end of the Cauvery distributaries. The PWD is involved in the construction and maintenance of irrigation structures. The project area includes many rivers/drains, namely, Nasuvini, Pattuvanachi, Pamini, Koraiyar, Kanthaparichan, Maraikoraiyar, Kilathangi, Harichandranathi, Adappar, Pandavayar, Vellaiyar, Valavanar Drain and Vedaranyam Canal, in the Agni and Vennar irrigation system. The WRD undertakes reconstruction, repair, desilting, standardisation of riverbanks, construction of new tail end regulators, dredging, etc.

However, these sub-basins lie in a semi-arid region where the availability of water resources is limited and variable. Therefore, the water supply and all water-using sectors need to be very efficient. The agricultural sector accounts for almost all the water use in the sub-basin, but the irrigation and drainage systems are very old adaptations of natural drainage systems, particularly in the delta. According to government tests, bed losses in the rivers and main canals are typically 55%. The consequences of these environmental and infrastructure factors include low agricultural productivity due to water shortages, insecure rural livelihoods, high vulnerability to natural disasters such as floods, droughts and tidal surges due to limited and only partially maintained defences, inefficient water use, over-abstraction of groundwater and disturbed ecosystems.



**Map 13** Vennar Sub-basin (Source: PWD)

Therefore, many water storage, conservation and regulation structures have been built across these rivers and drains, giving priority for drinking, domestic and agriculture purposes. This has led to water flows into the lagoon, thottam, mangroves and sea. Due to the lack of freshwater flows into the wetland, canals and Muthupet mangroves, the habitat and its dependent flora and fauna have been affected directly.

The long-term goal of efficient water resource management, including agriculture development, biodiversity development and conservation of coastal wetland ecosystems, is necessary in the Cauvery sub-basin. The PWD plays a crucial role in the conservation and development of the wetland ecosystems and the welfare of dependent communities.

The Harichandra, Adappar, Pandavayar and Vellaiyar rivers serve the dual purpose of conveying irrigation supplies and removing drainage and floodwater. But the Valavanar drain and the Vedaranyam canal are single-purpose drains and therefore do not have to cope with a wide range of flows. The rivers follow natural courses, with appurtenant structures such as embankments, regulators (including tail end regulators), irrigation sluices, drainage inlets, drainage sluices and bed dams/low weirs added to them. These six river channels are unable to cope with the larger floods resulting from the present climatic conditions, and the delivery of irrigation flows is compromised by the old structures, many of which are in chronic need of repair or replacement. The main work of the PWD in the is improvement and maintenance of irrigation structures and other irrigation components, augmentation of water resources, formulation of new additional schemes and improvement and maintenance of water courses and drainage systems. The PWD has very close interactions with farmers, especially the Farmers Committee of Vennar Sub-basin.

## 9.5 TWAD Board

The Tamil Nadu Water Supply and Drainage Board (TWAD Board) is a statutory corporate body constituted under the TWAD Board Act, 1970 on 14 April 1971. TWAD Board is entrusted with the development of water supply facilities in the state of Tamil Nadu.

The people of Thanjavur, Thiruvarur and Nagapatinam districts are dependent on the Kollidam Kootu Kudineer Thittam as a major source of their drinking water due to groundwater salinity and a poor surface water system. Hence, the TWAD Board plays a crucial role in meeting the basic needs of the wetland-dependent communities.

## 9.6 Railway Department

There is a railway line from Muthupet to Adirampattinam in the PCWC, and this track connects Mayilduthurai to Karaikudi. The railway track comes near the RF boundary and passes the Pattuvanachi and Nasuvini rivers, viz., the Muthupet mangroves. Recently there was a plan to construct a bridge from Maravakadu to Adhirampattinam. This proposal was stopped by legal proceedings in which the Forest Department was involved since the entire stretch is a part of Muthupet mangroves.

In 1936, the British had laid a railway line for transportation of salt from Vedaranyam and for fostering trade with Sri Lanka. The train services were terminated in 1988, and the railway line was subsequently dismantled in 1995. There is a plan to extend the railway track beyond Agasthiyampalli to Kodiyakarai. Therefore, if any development happens in the RF, the Forest Department and fringe villagers should be consulted.

## 9.7 Village/Town/Municipality

Owing to the enormous power vested in rural local bodies, they can be significant in conservation efforts. The environmental dictum “Think globally and act locally” can well be applied to village panchayats. Reserved forests are protected by Forest Departments in every state, but unclassified wastelands and unreserved forests belong to the panchayats. The panchayats have the authority to evolve a code of conduct and regulations for rearing livestock, anti-poaching activities, effective usage of wetlands, common property resources protecting sacred groves, disposal of solid waste, etc.

The local bodies can also play a part in the prevention and control of environmental degradation in their respective areas. They are responsible for approval of layouts and building plans and can enforce moves to prevent pollution. Establishment of factories and industries can be done only with the approval of local bodies. Apart from panchayats, there is another effective organ in the form of village administration, namely, the grama sabha. All the voters in the village panchayat are members of the grama sabha of the village. It meets once in a quarter and on other occasions as necessary. The Panchayat President is the Chairman of the grama sabha. All the members participate in the meetings, and issues common to the village are discussed. The gram sabha is also a forum where specific issues detrimental to the village are discussed openly. Such meetings can always be used as platforms for bringing in wetland conservation practices.

These grass-root institutions can become the pillars of sustainable development by assisting with the revival of wetland ecosystems and conserving them.

In many of the villages all the development work is carried out by the village panchayat. Therefore, being the frontline institution, it must play a very active role in protecting and developing wetland ecosystems. The MGNREGA works especially can be tapped for effective wetland management and development (plantation of tree saplings, renovation of water bodies, etc.).

## 9.8 Marine Police/Coast Guard/Indian Navy

Since Sri Lanka is very close to Kodiyakarai, there is high possibility of migration of people and exchange of goods. A large number of cases have been registered over a period of time for smuggling prohibited products and highly valuable products to Sri Lanka. The role of the uniformed service departments is very relevant and needed for protecting this wetland. A lot of illegal activity take place along the coastal, such as drinking and dumping plastics and wastes. This can be stopped by the Marine Police.

Illegal and exploitative fishing in the sea and close to the seashore through regular and keen patrolling by the Coast Guard and Navy, which will help the local country fishers. Strict enforcement of the Maritime Zone of India (Regulation and Fishing by Foreign Vessels) Act, 1980 and Territorial waters, continental shelf, Exclusive Economic zone and other Marine Zone Act, 1976 can be ensured.

## 9.9 Animal Husbandry

Next to fishing and farming, livestock rearing is the key livelihood in the fringe villages of the Point Calimere Wetland Complex. Therefore, the services of the Animal Husbandry Department are highly significant for the dependent community.

## 9.10 Agriculture Department

Agriculture is the main livelihood of the people of the Point Calimere wetlands in addition to fishing. There is close connectivity between the alam/saltpan/aquaculture and agriculture because there is clear shift from one to the other. Moreover, there is very strong connectivity between irrigation sources, changes of crops and cultivation practices, shifting to other livelihoods, moving to Gulf countries, etc.

The changes taking place in the agriculture will, in turn, support or affect the wetland-dependent livelihoods. For example, in Jambuvanodai, Muthupet and Seruthalaikadu, those who were involved in agriculture have left the occupation and switched to fishing. Due to a lack of fresh water, surface water and rainwater, people are shifting to other livelihoods. This is bringing changes to the lifestyles of wetland-dependent communities.

The following are the major schemes of the Agriculture Department for disseminating improved production technologies to increase the productivity of agricultural crops:

- Pradhan Manthri Fasal Bhima Yojana (PMFBY), a new crop insurance scheme
- Collective farming to increase the income of small and marginal famers
- National Mission on Sustainable Agriculture (NMSA) for soil health improvement through the use of bio-fertilisers (including green manure and adoption of Integrated Nutrient Management (INM))
- National Agricultural Development Programme (NADP) for paddy, millets, pulses, oilseeds, sugarcane, coconut and green manure
- National Food Security Mission (NFSM) for Paddy, Pulses and Commercial crops
- Coconut Development Board (CDB) schemes
- Sub-mission on Seeds and Planting Materials (SMSP) for paddy, pulses and oilseeds
- Special schemes on Kuruvai and Samba packages
- Support to State Extension Programmes for Extension Reforms Scheme (SSEPERs)
- Agricultural Technology Management Agency (ATMA), technology support, farmers' linkage and demonstration, etc.
- Tamil Nadu Irrigated Agriculture Modernisation and Water-Bodies Restoration and Management (TN-IAMWARM) is a multidisciplinary project funded by the World Bank
- National Mission on Sustainable Agriculture (NMSA) – integrated farming system
- Sub-mission on Seeds and Planting Materials (SMSP) – paddy, millets, pulses and oilseeds – certified seed distribution
- Pradhan Manthri Krishi Sinchayee Yojana (PMKSY) – micro-irrigation in agricultural crops
- Collective farming – establishing FPOs



## 9.11 Horticulture Department

In and around Vedaranyam block, considerable number of families are involved in floriculture and orchards. The production and the number of producers are increasing day after day. Moreover, the agro-climatic conditions are supportive of horticulture crops and floriculture.

Especially in the wetland-dependent coastal blocks the Horticulture Department supports the following schemes:

- National Agriculture Development Programme (NADP) - financial support for cultivation of organic vegetables and greens
- Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) – financial assistance for micro-irrigation facilities
- Integrated Horticulture Development Scheme (IHDS) - flower crop cultivation
- Pradhan Mantri Fasal Bima Yojana (PMFBY) – tapioca crop in Nagapattinam and Thiruvavur districts covered under crop damage due to natural calamities
- State Horticulture Farms (SHFs) - supplying *Trichoderma viride* and *Pseudomonas fluorescens*, supplying farm tools, distribution of seed balls, supporting coconut seedlings, etc.

## 9.12 Revenue Department

In almost all the villages close to the wetland, a considerable extent of land falls under the Revenue Department. If a part of the land is given for any development intervention, the Revenue Department must protect the wetland and its dependent people. The land should not be given for any activities prohibited and regulated under the CRZ. Development should not take place by exploiting the natural resources and the flora and fauna.

## 9.13 Tourism Department

At present, the role of Tourism Department is limited, but there is scope for developing tourism activities in the Point Calimere Wetland Complex. There are significant cultural, heritage and religious sites that could be promoted. Further the mangrove-, beach- and birdwatching-related activities have great potential to attract visitors. The community can be trained and promoted in ecotourism with collaboration with the Forest and Tourism departments. Environment-friendly and eco-sensitive tourism can be promoted in and around Point Calimere.

## 9.14 Hindu Religious and Charitable Endowment Department (HR &CE)

Like the Revenue Department, the HR & CE Department also owns a large portion of the land around the wetland, including the Vedaranyam temple and Idumbavanam temple lands. The villages of Annapettai and Idumbavanam completely belong to the Idumbavanam temple. Karaganatharkulam belongs to the Karpaganathar temple. All the land around Vedaranyam belongs to the Vedaranyam temple. In future, if any development is planned around the wetland, the role of HR & CE Department will be important. Even the land on which the houses are built belong to temple in addition to agriculture land.

## 9.15 Agriculture Engineering

Through Agri-engineering Department many interventions are made in the fringe villages like, land development schemes using agricultural implements and machinery, minor irrigation schemes, rainwater harvesting and runoff management under soil conservation scheme, construction of farm ponds, percolation ponds, check dams etc. These interventions need to be strengthened to reduce the pressure on the wetlands.

The major interventions ensued through the Agriculture Engineering Departments are:

- Construction of percolation ponds for groundwater recharge and prevention of flash floods
- Tank ayacut, construction of threshing floors and introduction of rotational water supply systems
- Training youths to handle, maintain and manage agricultural machinery
- Relief works during natural calamities such as floods and cyclones
- Support with agricultural machinery such as tractors, transplanter and combined harvesters, tractors, power tillers, transplanters, power threshers, power weeders, rotavators, laser land levelers and sprayers to carry out farm operations.
- Creation of farm ponds and harvesting rainwater to recharge groundwater to prevent soil erosion and to provide supplementary irrigation

The aforesaid interventions are implemented by the following schemes of the Agriculture Engineering Department:

- Land development schemes
- Minor irrigation schemes
- Rainwater Harvesting and Runoff Management Under Soil Conservation Scheme
- Demonstration of agricultural implements
- Micro-irrigation scheme (drip and sprinkler irrigation systems)
- Training in the use of agricultural implements
- Sub-mission of Agricultural Mechanisation (SMAM) and National Agricultural Development Programme (NADP)

## 9.16 Pollution Control Board

The Tamil Nadu Pollution Control Board enforces the provisions of the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the rules made under other relevant acts. Effluents flow into Point Calimere. Especially in Muthupet town, drains connect to the Koriyar. There is no proper disposal system for solid waste management, and many farm and aquaculture effluents drain into rivers and wetlands. This affects the habitat and its rich biodiversity. The Pollution Control Board, being the statutory body, could play a major role in controlling the air and water pollution.

## 9.17 Disaster Management Authority

Nagapattinam district has been exposed to natural calamities for a long time, particularly storms, cyclones, storm surges and tsunamis. More damage has been caused by cyclones than by any other natural calamities. The District Disaster Management Unit needs to be integrated with the Forest Department and other line departments to protect social and natural resources since the PCWC is in a disaster-prone area.

**Table 24** History of natural calamities

S. No.	Date of occurrence	Calamity	Damage caused
1	30.11.1952	Storm surge (up to 5 miles inland)	Damage caused to country crafts, FRP vessels and shoreside structures
2	8.12.1967	Cyclone	Seven lives and 15,000 rendered homeless
3	12.11.1977	Cyclone	560 lives, 196 missing, damage to port, irrigation systems, roads, power supply, communication system and large number of houses
4	1.12.1984	Floods due to heavy rain	Large-scale crop damage, normal life affected by heavy floods
5	15.11.1991	Heavy rainfall	Crops damaged

S. No.	Date of occurrence	Calamity	Damage caused
6	4.12.1993	Cyclone speed 188 kmph	Livelihoods of 1100 people lost, heavy damage to crops
7	26.12.2004	Tsunami	6065 lives lost, 12,821 cattle lost, 791 people missing, 1922 injured. Houses lost, damage to shops and buildings
8	27.11.2008	Cyclone Nisha (80 kmph)	20 lives lost, 1174 cattle lost, three persons injured, 4,58,949 houses damaged
9	November - December 2010	Heavy rainfall	10 lives lost, 1492 cattle lost, 56,025 huts and pucca and katcha houses damaged. Paddy (76,419 ha), horticultural crops (461 ha) and groundnut (28 ha) also damaged
10	31.12.2011	Cyclone Thane	1468 huts damaged partly, 24 huts damaged fully, 49 cattle lost Crops (paddy, sugarcane, banana, groundnut) in 50,931.58 ha lost

## 9.18 Coastal Zone Management Authority (CRZ)

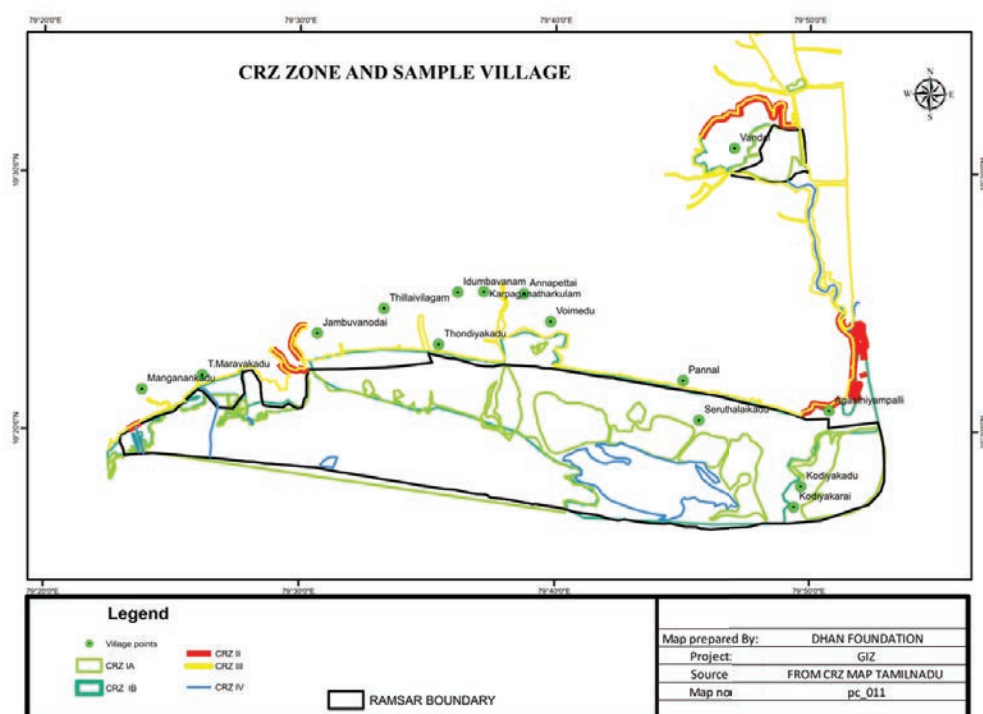
The entire Point Calimere site, being a coastal wetland, falls within the CRZ boundary. The Government of India issued the Coastal Regulation Zone Notification in 2011 under the Environment (Protection) Act, 1986 to protect the coastal environment and to regulate development activities along coastal areas, thereby aiming to provide livelihood security to the fishing communities and other local communities living in coastal areas, to conserve and protect coastal stretches and to promote sustainable development in coastal areas. As per this notification, coastal areas have been classified into four zones.

The Environment (Protection) Act, 1986 has had a crucial role in the conservation and management of mangrove ecosystems. It restricts industrial and other activities such as discharging untreated water and effluents, dumping waste, reclaiming land and construction of bunds to protect the coastal environment. The Coastal Regulation Zone Notification, 2011 ensures (i) protection of livelihoods of traditional fisher folk communities, (ii) preservation of coastal ecology and (iii) promotion of economic activities that have to be necessarily located in coastal regions. As per CRZ 2011, mangrove swamps are Ecologically Sensitive Areas and are protected under Coastal Regulation Zone I, where no construction activities are allowed.

The Authority takes decisions on the basis of whether the areas are high-, medium- or low-eroding and on the basis of sediment cells and shoreline maps prepared as a part of the development of a Coastal Zone Management Plan. For example, Vellapallam fishing harbour is being planned by the Fisheries Department. There are significant ecosystems within a 10 km radius of the proposed harbour, such as the Nallar river, Thalainayar reserved forest and Kodyakarai Sanctuary. The possibility of these ecosystems being affected is high. Moreover, the aquatic species of the particular area and the nesting of Olive Ridley Turtles will be affected.

Due to the usage of motorised boats, there is a high possibility of having impacts on the air quality, noise level, surface water, groundwater, soil, seawater, seabed sediments, and biodiversity and the socio-economic status of the people within 10 km.

Therefore, the CZMA is considered the key stakeholder for protecting the wetland, dependent resources and community from any development interventions that are planned by relevant departments for the coastal areas of Nagapattinam, Thanjavur and Thiruvarur.



**Map 14** CRZ Zone and sample villages

Classifying the Point Calimere Wetland Complex in CRZ category V (like the Gulf of Mannar) could be proposed by this study. Areas such as the PCWC require special consideration for the purpose of protecting the critical coastal environment. The difficulties faced by local communities and other should be identified and managed with the involvement of coastal communities including fisherfolk.

**Table 25** Villages ESZ in Block-A

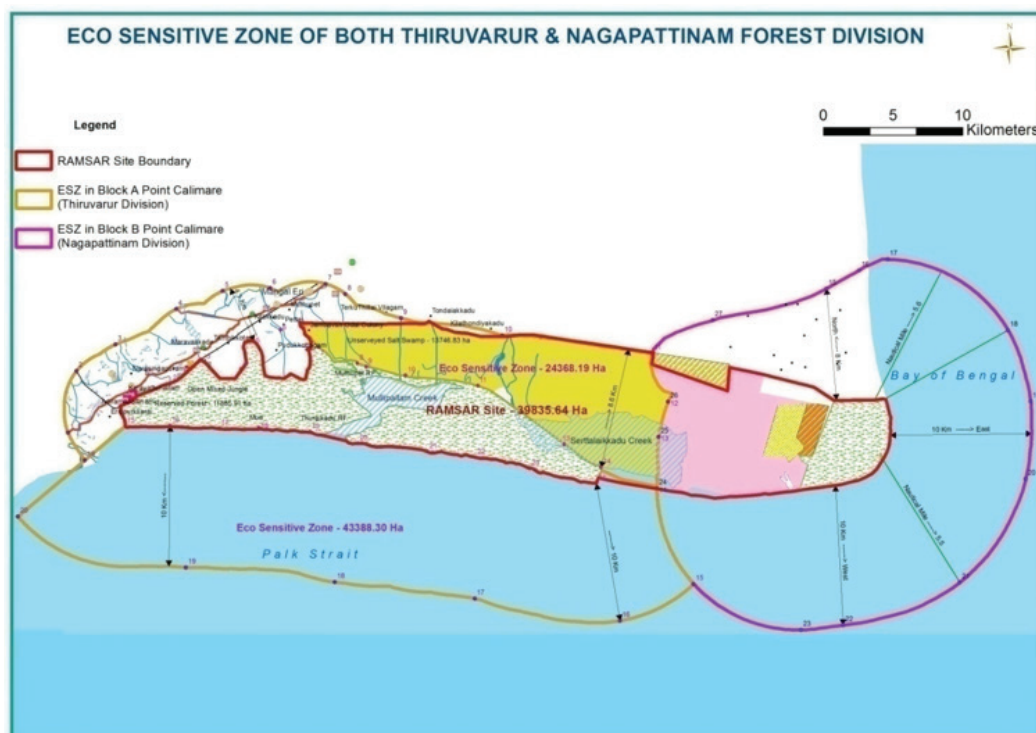
S. No.	Village	Direction from Protected Area	Whole	Part
1	Earikulakarai	N		✓
2	Athirampattinam	N		✓
3	Karisakadu	N	✓	
4	Maravakkadu	N	✓	
5	Thuraikadu	N	✓	
6	Muthupet	N		✓
7	Veeranvayal	N	✓	
8	Jambuvanodai	N	✓	
9	Thillaivilagam	N	✓	
10	Mangal	N		✓
11	Edumbavanam	N	✓	
12	Kaluvankadu	N		✓
13	Kelanammankurichi	N		✓
14	Thondiyakkadu	N	✓	
15	Karppaganatharkulam	N		✓

S. No.	Village	Direction from Protected Area	Whole	Part
16	Vilangady	N		✓
17	Melakkadu	N	✓	
18	Kelathodiyakadu	N	✓	

All villages other than those specified are in Pattukkottai taluk, Thanjavur district (1 to 4) and Muthupet block, Thiruthuraiipoondi taluk, in Thiruvavur district (5 to 18).

**Table 26** Villages of Block-B in the ESZ

S. No.	Village	Direction from Protected Area	Whole	Part
1	Agasthiyampalli	N		✓
2	Kodiyakarai	W	✓	
3	Kodiyakadu	W	✓	
4	Vedaranyam	N		✓



**Map 15** Eco-sensitive Zone of PCWC (Source: Forest Department)

## 9.19 Central Salt Corporation

The Great Vedaranyam Swamp (GVS) has a long history of salt works. A number of domestic and industrial salt works operate in the swamp. There have been demands from different quarters to set up more salt works. Though salt works on waterbirds can be beneficial for some species, the overall impact of a salt complex of such a magnitude will definitely alter the ecosystem, affecting the flora and fauna of the GVS, besides having possible impacts on the fisheries.



The Salt Corporation is one of the key stakeholders of Point Calimere since they own a large part of the land in and around the wetland, and they support the national salt production and 20,000 families. There is a close connectivity between the forest, fisheries, agriculture, aquaculture farms, revenue panchayat and salt department in the PCWC. The Salt Corporation workers are spread in and around Kodiyakkadu–Thennadar and Athirampattinam - Thambikottai Maravakadu.

## 9.20 Academic and Research Institutions

Many academic and research institutions are conducting studies and research at the Point Calimere site, especially AVC College, Anna University, Sathyabama University, IRMA, Bharathidasan University, Annamalai University, BNHS, MSSRF and State and Central research institutions. The findings and recommendations of these institutions can be incorporated in the development and integrated management of the Point Calimere site.

### CHEMPLAST AND GHCL

Chemplast and GHCL are the private companies who produce salt in the Vedaranyam area. These companies own 3000 acres. They occupy a large portion of the wetland for salt production. They provide drinking water for schools and for households when they are in need, especially for functions such as marriages. Further, they support nearby schools through their CSR activities. Chemplast partnered with the Bombay Natural History Society (BNHS) in setting up a study centre at Kodiyakarai. The BNHS–Sanmar centre is a boon for birdwatchers who gather to watch migratory birds from across the globe swarming the swamps of Vedaranyam, during the north-east monsoon. The centre, spread across 2.5 acres of land purchased by BNHS, is the first of its kind in the country.

On the other hand, lots of ecological changes have occurred due to the salt production, especially increases in the salinity of the soil and water. The natural-water flow areas such as the *thottam* and *alam* have been encroached by these companies, which is affecting the natural water flows and their dynamics. Further, the villagers in Pannal and Thennadar get affected by these companies when their fishing routes are disturbed, etc.

Therefore, these companies are very important as both positive and negative stakeholders who impact the wetland.

### ELECTED REPRESENTATIVES, PRESIDENTS, UNION AND DISTRICT COUNCILLORS, MLAS, MPS

Across the PCWC there are many elected representatives, such as ward, union and district councillors, Panchayat Presidents, Union Chairmen, District Chairmen, MLAs and MPs, who play crucial roles in policy and decision making. The Vedaranyam, Thiruthuraipoondi and Pattukkottai MLAs and the Nagapattinam and Thanjavur MPs represent the PCWC. As of now they are not very aware about the site and its ecology, biodiversity, ecosystems, etc., and they will be involved in preparing the integrated management plan.

### NGOS

There are a good number of NGOs working in the PCWC, such as LAFTI, MSSRF, SIFFS, BEDROC, DHAN and OMCAR, focused on the environment, water, coastal conservation, livelihoods, etc. Their experience and knowledge could be tapped as they are involved in development interventions. LAFTI, led by Krishannamal Jeganathan, fought and got a judgement against aquaculture farming. DHAN did lots of water conservation work such as farm pond and tank renovation. SIFFS works closely with the fisherfolk by providing backward and forward support for fishers.

### SCHOOLS AND COLLEGES

There are many government schools and government-supported colleges in the PCWC. Though schools and colleges are not directly dependent on or impact the wetland, this younger generation must know the importance of mangroves, wetlands, swamps and lagoons for the future. Further, they may bring awareness among the community and family on the importance of the site. Hence, they could be involved in the preparation of the wetland management plan so that there is integrated management of the site.

Apart from the above stakeholders the following community-based formal institutions are functioning in this wetland: fishermen's welfare societies, eco-development committees, village forest committees, the Vennar Sub-basin Farmers Committee, the small-scale salt producers' association, the salt workers' association.

In addition, there are a few informal institutions also, such as traditional village panchayats, traditional community associations, aquaculture owners' networks, fish vendors' associations, women SHGs and their federations, farmers' federations and fishermen's federations.

The other key individual stakeholders are bird poachers, birdwatchers, tourists and pilgrims. They play considerable roles that impact the wetland in different ways.

Regulations and programmes in the context of wetland conservation include the following:

- Coastal Regulation Zone Notification of 2011 under the Environment (Protection) Act, 1986
- ESZ Notification, 2020 under the Environment (Protection) Act, 1986
- Environmental (Protection) Rules, 1986 (EPR)
- Coastal Zone Management Plan
- National Wetland Conservation Programme (NWCP), 1985
- Wetlands (Conservation and Management) Rules, 2010
- Wetlands (Conservation and Management) Rules, 2017
- The Tamil Nadu Forest Act of 1882
- Regulations of Tamil Nadu State Wetland Authority, 2016
- The Indian Forest Act, 1927
- Forest Conservation Act, 1980
- Wildlife Protection Act, 1972
- Water (Prevention and Control of Pollution) Act, 1974, 1980
- Maritime Zone of India (Regulation and Fishing by Foreign Vessels) Act, 1980
- Territorial Waters, Continental Shelf, Exclusive Economic Zone and Other Marine Zone Act, 1976
- ST and Other Traditional Forest Dwellers (Recognition of Forest Right Act, 2006)
- Wildlife and forest protection laws
- Environmental Protection Act, 1986
- The Indian Fisheries Act, 1857
- Tamil Nadu Marine Fishing Regulation Act (TNMFR), 1983
- Coastal Aquaculture Authority Act, 2005
- TWAD Board Act, 1970
- Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981

**Table 27** Power and influence matrix of formal institutions in the PCWC

S. No.	Village	Formal						
		Fisheries Association	Salt Producers' Association	Salt Workers' Association	Eco-development Committee	Eco-tourism Management Committee	Village Forest Committee	Gram Panchayat
1	Manganankadu	Low power-high impact-low influence -high interest	NA	NA	NA	NA	NA	High power- low impact- low interest - low influence
2	T. Maravakadu	Low power-high impact-low influence -high interest	NA	NA	NA	NA	Low power- low impact- high interest -low influence	High power-low impact-low interest -low influence
3	Jambuvanodai-Akkaraikadu	Low power-high impact-low influence -high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence
4	Thillaivilagam-Sengankadu	Low power-high impact-moderate influence-high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence
5	Thondiyakkadu	Low power-high impact-moderate influence-high interest	NA	NA	NA	NA	Low power-low impact-high interest -low influence	High power-low impact-low interest -low influence
6	Karpaganatharkulam	Low power-high impact-low influence -high interest	NA	NA	NA	NA	NA	High power- low impact-low interest -low influence
7	Idumbavanam	Low power-high impact-low influence -high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence
8	Annapettai	Low power-high impact-moderate influence -high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence
9	Voimedu-Chinthamanikadu	Low power-high impact-low influence -high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence

S. No.	Village	Formal						
		Fisheries Association	Salt Producers' Association	Salt Workers' Association	Eco-development Committee	Eco-tourism Management Committee	Village Forest Committee	Gram Panchayat
10	Pannal–Sakkaranpettai	Low power - high impact - low influence - high interest	NA	NA	Low power- low impact- low influence- high interest	NA	NA	High power- low impact- low interest - low influence
11	Seruthalaikadu (Panchanathikulam Middle)	Low power - high impact - high influence - high interest	NA	NA	NA	NA	NA	High power-low impact-low interest -low influence
12	Agasthiyampalli (Vendranyam)	NA	Low power - high impact- high influence - low interest	Low power- low impact- low interest - low influence	Low power- low impact- low influence - high interest	NA	NA	High power-low impact-low interest -low influence
13	Kodiyakadu	NA	Low power - high impact- high influence- low interest	Low power- low impact- low interest- low influence	Low power- low impact	NA	NA	High power-low impact-low interest -low influence
14	Kodiyakarai	Low power- high impact	NA	NA	Low power- low impact	NA	NA	High power-low impact-low interest -low influence
15	Thalainayar–Vandal	NA	NA	NA	Low power- low impact	NA	NA	High power- low impact-low interest -low influence

**Table 28** Power and influence of informal, government and private institutions in the PCWC

S. No.	Village	Informal			Government Institutions							Private		
		Traditional Village System	SHGs	Society	Forest Dept.	Fisheries Dept.	TWAD	PWD	Coast Guard	Revenue Dept.	Salt Corporation	Chemplast /GHCL	Individual Owners /Trust	Aquaculture Owners
1	Manganankadu	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	Low power-high impact-low interest-high influence
2	T. Maravakadu	NA	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	Low power-high impact-low interest-high influence
3	Jambuvanodai-Akkaraikadu	Low power-high impact-High interest - low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-High influence-Hight Interest	High power-low impact-High influence-low interest	High power-low impact-low influence-low interest	High power-high impact-High influence-l ow interest	High power-high impact-High influence-High Interest	High power-low impact-High influence-low interest	NA	NA	NA	Low power-high impact-low interest-High influence
4	Thillailagam-Sengankadu	Low power-high impact-high interest-moderate influence	Low power-low impact-low interest-low influence	NA	High power-high impact-High influence-hight interest	High power-low impact-high influence-l ow interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	Low power-high impact-low interest-high influence



S. No.	Village	Informal			Government Institutions							Private		
		Traditional Village System	SHGs	Society	Forest Dept.	Fisheries Dept.	TWAD	PWD	Coast Guard	Revenue Dept.	Salt Corporation	Chemplast /GHCL	Individual Owners /Trust	Aquaculture Owners
5	Thondiyakkadu	Low power-high impact-high interest-moderate influence	Low power-low impact-low interest-low influence	NA	High power-high impact-High influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	NA
6	Karpaganatharkulam	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	NA
7	Idumbavanam	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	NA
8	Annapettai	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	NA

S. No.	Village	Informal			Government Institutions							Private		
		Traditional Village System	SHGs	Society	Forest Dept.	Fisheries Dept.	TWAD	PWD	Coast Guard	Revenue Dept.	Salt Corporation	Chemplast /GHCL	Individual Owners /Trust	Aquaculture Owners
9	Voimedu-Chinthamanikadu	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	NA
10	Pannal - Sakkarapettai	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-high impact-low influence-low interest	Low power-high influence-high impact-low interest	NA	NA
11	Seruthalaikadu (Panchanathikulam Middle)	Low power-high impact-high interest-moderate influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-high impact-low influence-low interest	Low power-high influence-high impact-low interest	NA	NA
12	Agasthiyampalli (Vendranyam)	Low power-high impact-high interest-low influence	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low influence-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-high impact-low influence-low interest	Low power-high influence-high impact-low interest	NA	NA

S. No.	Village	Informal			Government Institutions							Private		
		Traditional Village System	SHGs	Society	Forest Dept.	Fisheries Dept.	TWAD	PWD	Coast Guard	Revenue Dept.	Salt Corporation	Chemplast /GHCL	Individual Owners /Trust	Aquaculture Owners
13	Kodiyakadu	NA	Low power-low impact-low interest-low influence	NA	High power-high impact-High influence-High Interest	High power-low impact-High influence-low interest	High power-low impact-low interest	High power-high impact-High influence-low interest	High power-high impact-High influence-High Interest	High power-low impact-High influence-low interest	High Power-high impact-low influence-low interest	Low power-High influence-high impact-low interest	NA	NA
14	Kodiyakarai	Low power-high impact	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-high impact-low influence-low interest	Low power-high influence-high impact-low interest	NA	NA
15	Thalainayar–Vandal	NA	Low power-low impact-low interest-low influence	NA	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	High power-low impact-low interest	High power-high impact-high influence-low interest	High power-high impact-high influence-high interest	High power-low impact-high influence-low interest	NA	NA	NA	Low power-high impact-low interest-high influence

# 10 RECOMMENDATIONS

## 10.1 Livelihood

### 10.1.1 Fishing

- Desilting and deepening of 128 traditional fishing canals managed by fisher families of the villages Maravakadu, Karisalkadu, Manjavayal and Manganakadu. These traditional fishing canals are located in the Palanjur, Thamarankottai and Maravakadu reserve forests.
- Permission can be granted to fishers to grow fish in *maalam* in the Vandal area, in Thalainayar Reserve Forest, to ensure that fishing can be carried on throughout the year. This can be achieved through proper scientific interventions and the establishment of a proper regulatory system by the Forest Department.
- Renovation of Viraku Vaikal, in Thamarankottai Reserve Forest, and the Nasuvini river to allow a free flow of fresh water to the mangroves and fishing canals.
- Renovation of Valavanar (Vettu Vaikal), Maraikoraiyar and Chinthamanikadu (Kenndi Vaikal) to increase the flow of fresh water into the wetland as well as to reduce the drudgery of fishers who fish in the lagoons and the sea.
- Granting rights to fish in the lagoons and *thottam* only to the traditional fishing communities to avoid increasing the number of fishers, particularly from non-fishing communities. This will help ensure that the fishery resources of the Point Calimere Wetland Complex are utilised sustainably.
- There are extensive oyster beds in many places in the lagoon. Some of the beds are already dead due to various reasons. These beds can be mapped and removed after feasibility and environmental impact assessment studies are conducted.
- Policy guidelines can be established to protect small-scale fishing by the fishing communities fishing in the *thottam*, the *alam*, the creeks and the mangroves.
- Providing support for marketing, storage and drying (cement floor) at Thondiyakkadu, Sengangakadu, Seruthalaikadu, Jambuvanodai, Maravakadu, Thambikottai and Avarikadu.
- Stringent measures can be taken up to stop illegal forms of fishing such as bottom trawling and the use of purse seine and bag nets in the nearshore waters of the Palk Bay and Palk Strait.
- Fisher Producers' Institution (FPI), on the line of Farmers Producer Organisation, can be promoted to support the entire fishing value chain. Through these institutions, timely credit can be provided for the purchase of fishing gear and craft.
- Provision of insurance coverage for fishermen's lives and assets (disaster mitigation).
- Disaster Risk Reduction and Management Centres can be established in selected villages to reduce the risks associated with major disasters.
- Activities that improve the income derived from current fishing activities and interventions that provide additional income to fishing families can be identified and implemented.
- Awareness about Biodiversity Management Committees can be increased, and BMCs can be instituted in selected villages sustaining ecosystem services apart from biodiversity conservation.

### 10.1.2 Agriculture

In the villages adjacent to the Point Calimere Wetland Complex, there are many surface water conservation structures such as ponds and tanks. They need to be managed and maintained properly to harvest rainwater. Groundwater can be recharged and saline water intrusion avoided.

- Construction of farm ponds is a successful intervention by the government, and it is effective in water harvesting. This scheme can be extended to villages located around the wetland with the support of the Agriculture Department.
- Scaling up of floriculture activities in the villages of Kadinelvayal, Pannal, Ayakaranpulam, Voimedu, Karupanpulam, Karpaganathrgulam and Panchanathikulam with the support of the Horticulture Department.
- A proper drainage system can be developed and implemented in Vandal, Thondiyakkadu, Thillaivilagam, Voimedu, Maruthur, Panchanathikulam and Pannal villages to avoid flooding
- In the village of Seruthalaikadu village, about 300 acres of land has been fully invaded by *Prosopis*. Some of this land belongs to individual farmers; the rest belongs to Panchayati Raj Institutions. Interventions can be taken up to clear the *Prosopis* and bring back agriculture in these lands with appropriate crop and farming technology.
- The lift irrigation method and indigenous knowledge related to it can be documented. Wherever possible, it can be replicated to ensure that water is available for farming.
- Salinisation of groundwater and soil is a major problem. Appropriate saline-tolerant varieties of paddy, and other crops, can be introduced to sustain agriculture in the villages located close to the wetland.
- Growing integrated and multi crops farming, especially millets and pulses, can be promoted.
- Fruit orchards can be developed in sandy soils with the support of the Horticulture Department.
- Farmer Producers Organisations can be promoted to ensure backward and forward support.
- Training can be provided to farmers in good and sustainable coastal agriculture practices.

### 10.1.3 Salt Production

The Salt Corporation should enforce strict monitoring, regulation and enforcement regarding the source of saltwater for salt production, especially dug wells and bore wells.

- The wetland in Kodyakarai, Kodyakkadu, Seruthalaikadu, Pannal and Sakkaranpettai is used to store the saltwater that is pumped by GHCL and Chemplast Sanmar Ltd. from the sea. Seepage of saltwater into adjacent agricultural lands as well as into the wildlife sanctuary poses many issues. The storage of seawater should be strictly monitored and regulated by the Salt Corporation and the district administration to avoid these issues.
- Alternative livelihoods can be provided for the salt workers during the rainy season, especially through skill development.
- An occupational safety wing/centre can be opened in Vedaranyam GH with a fully qualified staff to deal with the whole range of occupational diseases of salt workers. This could be done in a private–public partnership mode, with leading salt manufacturers of the region contributing towards the setting up of this centre.
- Strict regulation and enforcement of the rules by the Salt Department in relation to encroachment of salt land and being vigilant about conversion of saltpans to other land uses such as aquaculture, as noticed in the Adirampattinam region.
- Avoiding the establishment of new canals for drawing seawater for saltpans and ensuring that existing canals are maintained and used properly, especially in Kodyakarai, Sakkaranpettai and Adirampattinam.
- Creating awareness about the use of Personal Protective Equipment and providing PPEs to all the salt workers through salt producers and labour associations.

### 10.1.4 Aquaculture

- All the rules and regulations of the Coastal Aquaculture Act, 2005, which are formulated on the basis of the 1996 Supreme Court judgement on shrimp farming, should be implemented strictly.
- The district-level committee that recommends applications for setting up shrimp farms should be made responsible for monitoring the functioning of these farms, particularly with reference to extraction of groundwater, discharge of effluents, pollution, etc. Currently, this function is performed by the Coastal Aquaculture Authority, but due to a paucity of staff members and the location of the farms in remote areas, the CAA ineffective in monitoring.



- Providing licenses to new farms and renewal of the licenses of existing shrimp farms should be done strictly on the basis of compliance with various rules and regulations of by the Coastal Aquaculture Act, 2005.
- Wherever lands of the Forest Department and Salt Department are illegally used for aquaculture, these should be immediately taken over by the respective departments.
- The local self-government can be empowered to monitor and control the aquaculture farms because in many of the villages the community highly resists the aquaculture farms since they are directly affecting the entire ecosystem and their livelihoods.

## 10.2 Ecosystems

### 10.2.1 Mangroves

- Plantation of mangroves can be carried out along the bunds of 128 traditional fishing canals, and the responsibility of maintaining them can be given to the respective fishing families.
- *Prosopis* that has invaded mangrove areas should be removed with the participation of the local community, and appropriate mangrove species can be raised in these areas.
- During the cyclone Gaja, mangrove trees were completely damaged in many places. Twisted and broken branches of these trees can be removed so that the mangroves can grow better.
- More village-level institutions can be formed in the villages adjacent to the Point Calimere Wetland Complex for better protection and management of mangroves.
- Community-led and collective restoration campaigns can be launched, and they could involve various stakeholders for fund mobilisation and for protection and restoration of mangroves.
- Establishing salt pans and aqua farms near and around mangrove forests should be strictly regulated as per the existing laws.
- Strict prohibition of pollution and disposal of sewage, waste and plastic in the mangrove environment and enforcement of the associated rules by the nearby gram panchayats.
- A detailed study needs to be commissioned on the impact of aquaculture and salt pans on mangrove wetlands to formulate better management policies relating to the associated livelihood activities.
- Plantation of mangroves and maintaining them through community involvement using improved technology.
- Collective monitoring of mangrove health and restoration activities with the involvement of the community and other stakeholders should be promoted.
- There is considerable potential to develop Thondiakkadu as a tourist place, and boating can be arranged to visit the mangroves.

### 10.2.2 Lagoon and *Thottam*

- Drainage canals, namely, Pattuvanachi, Pamini, Kanthaparichan, Maraikoriyar, Kilathangi, Koraiyar and Valavanar, should be desilted and deepened. The banks should be strengthened to ensure that there is a flow of fresh water to the lagoon and *thottam*.
- The freshwater flow in these drainage canals should be increased to meet the environmental requirements of the mangroves, lagoon and associated wetlands.
- Disposal of waste and domestic sewage, especially from Muthupet town, into the wetland, including the lagoon and *thottam*, should be prohibited.
- Only those local fishers who hold fisheries license for longer periods may be permitted to fish in and around the lagoon.

- Rigorous monitoring of aquaculture farms which dispose of effluents into the lagoon
- No permissions needed to start salt production industries and aquaculture farms near the wetland.
- Ecotourism is good for the village economy, but it must be properly managed. The lagoon should not be harmed. Throwing plastic, flammable goods and liquor especially into the lagoon should be prohibited.
- Consultations and awareness-raising programmes on the importance of protecting the lagoon may be organised for stakeholders and other government agencies.

### 10.2.3 Rivers/Estuary

- The Agni river estuary, in Keelathottam, where there is a good patch of mangroves, is completely silted. It needs to be desilted and deepened for so that tidal water can flow freely and fishing boats can move to the sea.
- Construction of shutters and check dams in the drainage canals near the wetland needs to be avoided to ensure that sufficient freshwater flows into the lagoon and thottam.
- Dumping domestic and industrial waste and sewage discharges in the rivers and drainage canals that drain water into the wetlands need to be monitored and regulated.
- Renovation of main rivers and sub-canals by desilting, clearing the scrub and Prosopis and strengthening the bunds by planting native trees.
- Renovation of drainage canals must be carried out as a community practice rather than as a one-time event. According to the local people, desilting once in two years is necessary to avoid accumulation of silt in these canals and to ensure a free flow of fresh water.
- Gram panchayats must be empowered and made accountable to maintain and renovate rivers and canals with necessary policy and financial support.
- A policy framework may be developed for water management in the Vennar sub-basin, considering the needs of the human population and ecological demands.



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## ANNEXURE I – List of coastal villages under the selected blocks (sample villages are highlighted)

S. No.	District	Block	Panchayat	S. No.	Future
1	Thanjavur	Pattukkottai	Eripurakkarai	1	Eripurakkarai
2			Narasingapuram	1	Melamanganankadu
3			Narasingapuram	2	Mudukkukkaadu
4			Narasingapuram	3	Peikkaalikkaadu
5			Narasingapuram	4	Vallikollaikkaadu
6			Narasingapuram	5	Narasingapuram
7			Sundaranayagipuram	1	Kovilthooppu
8			Sundaranayagipuram	2	Manganankkaadu
9			Sundaranayagipuram	3	Sundaranayagipuram
10			Thamarankottai (South)	1	Karisakkaadu
11			Thamarankottai (South)	2	Karunkulam
12			Thamarankottai (South)	3	Manakkollai
13			Thamarankottai (South)	4	Manjavayal
14			Thamarankottai (South)	5	Manjavayalvadakku
15			Thamarankottai (South)	6	Sengapaduthankkaadu
16			Thamarankottai (South)	7	Thamarankottai (south)
17			T. Maravakkadu	1	Burma Tamilar Colony
18			T. Maravakkadu	2	T.maravakkadu
19			T. Melakkadu	1	T.Melakkadu
20			T. Vadakadu	1	Chetikuttaikalany
21			T. Vadakadu	2	Pudukottagam

S. No.	District	Block	Panchayat	S. No.	Future
23			T. Vadakadu	4	Sundaram Colony
24			T. Vadakadu	5	T. Vadakadu
25			T. Vadakadu	6	Mariyamankovil Colony
26	Thiruvarur	Muthupet	T. Keelakadu	1	T. Keelakadu
27			Alangadu	1	Alangadu
28			Alangadu	2	Airakkani
29			Alangadu	3	Sirupatakkarai
30			Idumbavanam	1	Adanjavilagam
31			Idumbavanam	2	Idumbavanam
32			Idumbavanam	3	Karpaganatharkulam Kaduvetti
33			Idumbavanam	4	Idumbavanam Kalani
34			Idumbavanam	5	Karpaganatharkulam Kalani
35			Idumbavanam	6	Kelavadiyakkadu
36			Idumbavanam	7	Mangalanayagipuram
37			Idumbavanam	8	Melavadiyakkadu
38			Idumbavanam	9	Sarvamanyam
39			Jambuvanodai	1	Ambattankollai
40			Jambuvanodai	2	Chinnankollai
41			Jambuvanodai	3	Dargha Serif
42			Jambuvanodai	4	Kalladikkollai
43			Jambuvanodai	5	Jambuvanodai
44			Jambuvanodai	6	Kollaikadu
45			Jambuvanodai	7	Melakkadu
46			Jambuvanodai	8	Thandankollai
47			Jambuvanodai	9	Therkukadu



S. No.	District	Block	Panchayat	S. No.	Future
48			Jambuvanodai	10	Vadakadu
49			Jambuvanodai	11	Veeranvayal
50			Jambuvanodai	12	Vellathikadu North
51			Jambuvanodai	13	Munnal Ranuva Colony
52			Karpaganathar kullam	1	Karpaganathar kullam
53			Thilai vilagam	1	Aramankadu
54			Thilai vilagam	2	Kaluvankadu
55			Thilai vilagam	3	Namachikadu
56			Thilai vilagam	4	Sengankadu
57			Thilai vilagam	5	Therkukadu
58			Thilai vilagam	6	Thuraihoppu
59			Thilai vilagam	7	Thilai Vilagam
60			Thilai vilagam	8	Kelakkarai
61			Thondiakkadu	1	Melathondiyakadu
62			Thondiakkadu	2	Munankadu
63			Thondiakkadu	3	Pudukkudi
64			Thondiakkadu	4	Thondiakkadu
65			Uppur	1	Gopalamuthram
66			Uppur	2	Kasadikkollai
67			Uppur	3	Vadakku uppur
68			Uppur	4	Uppur
69			Vilankadu	1	Karayankadu
70			Vilankadu	2	Karpaganatharkulam Koviladi
71			Vilankadu	3	Vilankadu
72	Nagapattinam	Vedhranyam	Annapettai	1	Annapettai

S. No.	District	Block	Panchayat	S. No.	Future
73	Nagapattinam	Vedhranyam	Annapettai	2	Rajankattalai
74			Annapettai	3	Thirukuvalai Kattalai
75			Ayakkaranpulam 4	1	Kovilkulam Therkku
76			Ayakkaranpulam 4	2	Kovilkulam vadakku
77			Ayakkaranpulam 4	3	Thimmappanayakkam Kuthakai
78			Kadinelvayal	1	Naduk Kadu
79			Kadinelvayal	2	Keelak Kadu
80			Kadinelvayal	3	Melak Kadu
81			Kodiyakkarai	4	Kodiyakkarai
82			Kodiyakkadu	5	Kodiyakkadu
83			Maruthur South	1	Andiyappankadu
84			Maruthur South	2	Chidhambarampillai Kadu
85			Maruthur South	3	Keelakkadu
86			Maruthur South	4	Namasivayapuram
87			Maruthur South	5	Poovanthevankadu
88			Maruthur South	6	Kunju Kakka Sevanthankadu
89			Maruthur South	7	Thiruvē Kadu
90			Maruthur South	8	Kottavelli Kadu
91			Maruthur South	9	Andan Kadu
92			Panchanathikulam Middle	1	Avudaikon Kadu
93			Panchanathikulam Middle	2	Ganapathidevan Kadu
94			Panchanathikulam Middle	3	Koolaiyathevan Kadu
95			Panchanathikulam Middle	4	Seruthalai Kadu
96			Panchanathikulam Middle	5	Perumaikon Kadu
97			Panchanathikulam West	1	Chellaiyan Kadu

S. No.	District	Block	Panchayat	S. No.	Future
123	Nagapattinam	Vedhranyam	Voimedu	11	Onthankadu and Kuunjudhavankadu
124			Vedhranyam ( Municipality)	1	Agasthiyampalli
125	Nagapattinam	Thalainayar	Avarikadu	1	Avarikadu
126			Avarikadu	2	Vairavan Pettai
127			Avarikadu	3	Avarikadu West
128			Avarikadu	4	Avarikadu East
129			Kallimedu	1	Kallimedu
130			Kallimedu	2	Palan Kallimedu
131			Naluvedapathy	1	Goundar Theru
132			Naluvedapathy	2	Mookkachi Theru
133			Naluvedapathy	3	Nadutharu
134			Naluvedapathy	4	Sanjadi Theru
135			Naluvedapathy	5	Ulakanathan Theru
136			Naluvedapathy	6	Naluvedapathy
137			Naluvedapathy	7	Naidu Theru
138			Naluvedapathy	8	Sinnankudikadu Arakkarai
139			Thalainayar town panchayat	1	Vandal Ward

## ANNEXURE II – List of participants of the Vedharanyam stakeholders' workshop

S. No.	Name	Designation	Place	Phone Number
1	R. Natesaraja	Inspector of Fisheries	Vedharanyam	9843492889
2	K. Arivanantham	Panchayat Secretary	Kodiyakarai	9786107514
3	K. Muthuraja	Forester	Kodiyakarai	6383943095
4	T. Sathishkumar	Forester	Kodiyakarai	9518241286
5	N. Jothibasu	Assistant Director of Agriculture	Vedharanyam	9655983523
6	R. Vignesh	Supervisor, Marine Fisheries	Vedharanyam	8122694151
7	V. Jeyachithra	Village Administrative Officer	Kodiyakarai	8778123191
8	R. Rajasekaran	Union Councillor	Kadinelvayal	9943432222
9	S. Tamilarasi	Panchayat President	Ayyakaranpulam Sathi-4 Panchayat	9585119747
10	K. Shanthi	Panchayat President	Pannaal Panchayat	9092246428
11	A. Neelavarnam	Panchayat Vice President	Panchanathikulam	9442476307
12	N.Ponnuthurai	Leader, Fishermen's Association	Seruthalaikadu	6384354478
13	P. Chinnapillai	Fisherman	Seruthalaikadu	9751742339
14	T. Saravanan	Fishermen	Panchanathikulam	9751742339
15	L. Naguran	Village President	Seruthalaikadu	9095720592
16	R. Janaki	SHG Member	Thethakudi	8270383842
17	Malarkodi	SHG Member	Periyakuthagai	8940694035
18	S.R. Annadurai	President, Vedhanyam Uzhavar Mamandrum	Vedharanyam	9524006643
19	Balasubiramanian	Treasurer, Vedhanyam Uzhavar Mamandrum	Vedharanyam	8838120751
20	Selvaraju	Secretary, Vedhanyam Uzhavar Mamandrum	Vedharanyam	8608469807
21	M. Vasanthi	Farmer	Pushpavanam	9786385619
22	K. Surya	Farmer	Thennampulam	6383521702

S. No.	Name	Designation	Place	Phone Number
23	T. Kalaiselvi	Farmer	Thennampulam	9655431965
24	V. Menaga	Farmer	Thennampulam	8098235174
25	V. Aananthi	Farmer	Thalainayar	7845405371
26	S. Subhashini	Farmer	Thalainayar	9787461675
27	P. Rangeela	Farmer	Thalainayar	9344621336
28	R. Rajmohan	Farmer	Yathavapuram	9965207298
29	M. Kandasamy	Farmer	Ayyakaranpulam Sethi-1	8760446266
30	S. Padmavathy	Farmer	Pushpavanam	9751899981
31	T. Anusiya	Farmer	Pushpavanam	9843773043
32	A. Rajalingam	Farmer	Thalainayar	9751141817
33	P. Gunasekaran	Farmer	Vellapallam	9843336127
34	Malarkodi	Cluster Associate	Periyakuthakai	8940694035
35	Latha	Cluster Associate	Thethakudi	9159721532
36	P. Sudha	Cluster Associate	Vedharanyam	9655142046
37	A. Kanagavalli	Cluster Associate	Vedharanyam	9786581308
38	R. Parvathi	Cluster Associate	Vedharanyam	9943406427
39	S. Indirani	Cluster Associate	Vedharanyam	9843199420
40	B. Hemalatha	Cluster Associate	Vedharanyam	7094211675
41	N. Shanthi	Cluster Associate	Thalainayar	9629177925
42	S. Nithya	Cluster Associate	Thalainayar	6385612885
43	S. Singarayar	Programme Leader, DHAN Foundation	Madurai	9443832322
44	T. Asaithambi	Team Leader, DHAN Foundation	Madurai	9488464575
45	Sivasubiramanian	Regional Coordinator, DHAN Foundation	Cuddalore	9943441918
46	N. Saravanan	Regional Coordinator, DHAN Foundation	Nagapattinam	7871653988
47	Abraham Stanley	Federation Coordinator	Keelaiyur Uzhavar Mamanram	8830211950



S. No.	Name	Designation	Place	Phone Number
48	Balasubiramanian	Federation Coordinator	Thirunallar Mahalir Vattara Kalanjiam	8940241754
49	Kalpana	Federation In-charge	Sethubavachtram Vattara Meenavar Kalanjiam	9488069261
50	S. Senthilkumar	Federation In-charge	Vedharanyam Uzhavar Mamanram	8778263547
51	Mohan	Documenter	Centre for Development Communication, Madurai	9894090767

## ANNEXURE III – List of participants of the Muthupet stakeholders' workshop

S. No.	Name	Designation/Occupation	Village	Phone Number
1	R. Rajesh	AD Fisheries, Thiruvarur	Muthupet	8825760988
2	S. Rahupathi	Coastal Sub-inspector	Muthupet	9080980180
3	Kalaivannan	Coastal Sub-inspector	Muthupet	9944569977
4	B. Sivaneshan	Forester Guard	Muthupet Range	6379200890
5	L. Chandirasekaran	Supervisor, PWD, Vennaru river sub-basin	Muthupet	8526240432
6	S. Ganeshan	Forester Guard	Muthupet	9095593838
7	U. Balu	District Councillor	Maravakadu	8489991010
8	Karunanidhi	President, Jambavan Odai Meenavar Sangam	Jambavanodai	8524095167
9	Selvaraj	President, Karpaganatharkulam Meenavar Sangam	Karpaganatharkulam	9715351306
10	Muniyandi	President, Thambikottai Meenavar Sangam	Thambikottai	9751716345
11	Thangaraj	President, Thondiyakkadu Meenavar Sangam	Thondiyakkadu	9788049742
12	Sakthi	Panchayat President	Eripurakarai	9715425530
13	Selvakumar	Panchayat President	Mankanakadu	9385769734
14	Pothiyappan	Panchayat President	Karpaganatharkulam	9976094034
15	Poomala Poovanam	Panchayat President	Thondiyakkadu	9842193058
16	Sankar	Joint Mangrove Management Committee	Maravakadu	9791545687

S. No.	Name	Designation/Occupation	Village	Phone Number
17	Ravichandran	Marine Fishermen	Eripurakarai	9080045974
18	G. Chandirasekaran	Fishermen	Sirupattakarai	7094806297
19	R. Devi	Farmer	Uppur	9626799968
20	Sumathi	Farmer	Uppur	7639175875
21	S. Jeya	Fishermen	Uppur	9159367186
22	N. Usharani	Fishermen	Uppur	8682817242
23	N. Jeyalakshmi	Farmer	Uppur	9626799968
24	M. Mala	Farmer	Uppur	9940734091
25	M. Rani	Farmer	Athirampattinam	7708803461
26	Sabir	Fishermen	Athirampattinam	9363149599
27	B. Usha	Farmer	Thillaivillakam	7639413750
28	K. Vasantha	Farmer	Uppur	8682817223
29	P.M. Murugapandian	Fishermen	Melakaddu	9786847993
30	R. Senthamilselvi	Fishermen	Athirampattinam	6955622869
31	G. Gyanambaal	Farmer	Alankadu	
32	S. Banumathi	Farmer	Thillaivillakam	7639413750
33	R. Siyamala	Farmer	Uppur	9159367186
34	S. Santhi	Farmer	Uppur	8682817223
35	M. Valli	Farmer	Uppur	9159367186
36	R. Chithra	Farmer	Uppur	8940756679
37	Alagumenaka	Farmer	Uppur	8682817223
38	V. Yegambaal	Farmer	Uppur	9159367186
39	A. Malathi	Farmer	Uppur	9047189224
40	J. Kalpana	Farmer	Uppur	9843563976

S. No.	Name	Designation/Occupation	Village	Phone Number
41	V. Punitha	Farmer	Uppur	8489552693
42	Janaki	Farmer	Uppur	6384113941
43	K.M. Vadivelu	Farmer	Melakaddu	9159367305
44	T. Kavitha	Farmer	Thambikottai	7094562490
45	Suganthi	Farmer	Uppur	8220899109
46	R. Vasuki	Farmer	Thambikottai	8056449114
47	T. Selvi	Farmer	Uppur	8220899109
48	V. Balu	Fishermen	Thambikottai	8489991010
49	G. Kannan	Fishermen	Thambikottai	9791595689
50	V. Sudha	Fishermen	Athirampattinam	6955622869
51	S. Vasantha	Fishermen	Sembarakadu	8940452415
52	S. Nagarathinam	Fishermen	Sembarakadu	9626780625
53	R. Jeyalakshmi	Fishermen	Sembarakadu	7868030335
54	V. Sumithra	Farmer	Thillaivillakam	7639413750
55	P. Davamani	Farmer	Melakaddu	8940223653
56	T. Vasantha	SHG Member	Uppur	8220899109
57	M. Vasantha	Farmer	Maravakadu	9498209245
58	S. Banumathi	Farmer	Karayankadu	9715351306
59	S. Vasuki	Farmer	Karpaganatharkulam	9940916420
60	B. Chithra	Farmer	Thondiyakkadu	9842193058
61	M. Kamatchiu	Farmer	Thondiyakkadu	8883602258
62	S. Vijayarani	Farmer	Karayankadu	8428184940
63	S. Vimala	Farmer	Karayankadu	9578493855
64	R. Chithra	SHG Member	Athirampattinam	6955622869

S. No.	Name	Designation/Occupation	Village	Phone Number
65	Kadharmani	Fishermen	Melakaddu	8524095167
66	Illaiyaraja	Fishermen	Melakaddu	9655462681
67	M. Ulaganathan	Fishermen	Thondiyakkadu	9942211632
68	M. Sudha	Fishermen	Melakaddu	8940223653
69	M. Vasiyammal	Fishermen	Melakaddu	8524095167
70	A. Kalaiselvi	Fishermen	Melakaddu	9344166300
71	R. Shanmugam	Fishermen	Sembarakadu	7868030335
72	T. Rajikayal	Fishermen	Melakaddu	8524095167
73	P. Murugesan	Fishermen	Sembarakadu	
74	P. Kamala	Fishermen	Sembarakadu	7868030335
75	A.K. Shanmugam	Fishermen	Melakaddu	8940223653
76	T. Karunanidhi	Fishermen	Melakaddu	8524095167
77	V. Shanmugam	Fishermen	Melakaddu	9159367305
78	V. Thetchinamoorthy	Fishermen	Vadakkuvetriyur	7373239524
79	Rajeshwari	SHG Member	Uppur	8940409587
80	Manimegalai	Farmer	Uppur	9159367186
81	Sekathambaal	Farmer	Uppur	8682817223
82	L. Selvarani	SHG Member	Uppur	7639510909
83	A.Rajakumari	SHG Member	Uppur	9159367186
84	D. Pushpanathan	Fishermen	Uppur	8682817223
85	T. Veeraselvi	Farmer	Karayankadu	Not Available
86	B. Sumathi	Farmer	Uppur	8110844822
87	Ravi	Fishermen	Maravakadu	9942634945
88	Sakthivel	Fishermen	Maravakadu	9715425530

S. No.	Name	Designation/Occupation	Village	Phone Number
89	N. Suresh	Fishermen	Maravakadu	9787512692
90	Ravi	Fishermen	Thambikottai	9715351306
91	S. Ravichandiran	Fishermen	Thiallaivilakam	9080045974
92	V. Bala	Fishermen	Keelathottam	8489991010
93	G. Kannan	Fishermen	Thillaivillakam	9791545687
94	Anusiya	Cluster Development Associate	Thondiyakkadu	6379567602
95	Shakila	Cluster Development Associate	Eripurakarai	9786358703
96	Punitha	Cluster Development Associate	Maravakadu	9751632844
97	Solaiyammal	Cluster Development Associate	Muthupet	7825940176
98	S. Singarayar	Programme Leader, DHAN Foundation	Madurai	9443832322
99	T. Asaithambi	Team Leader, DHAN Foundation	Madurai	9488464575
100	S.P. Madanmohan	Team Leader,DHAN Foundation	Madurai	9842179883
101	Sivasubiramanian	Regional Coordinator, DHAN Foundation	Cuddalore	9943441918
102	N. Saravanan	Regional Coordinator, DHAN Foundation	Nagapattinam	7871653988
103	Kalpana	Community Accountant	Sethubavachathiram Vattara Kalanjiam	9488049261



## ANNEXURE IV – Proceedings of FSC

### Introduction

The Ramsar Convention was signed in 1971. It is a global treaty focusing on the management and protection of important wetlands. India is among 170 signatory countries that agreed to pay notice and implement measures towards conservation of wetlands. Globally, so far over 2300 wetlands have been identified as Ramsar sites. In 2020, the total number of Ramsar wetlands in the country was 37, with an extent of about 10,679.39 km<sup>2</sup>, in 15 Indian states and two union territories (UTs). The main purpose of the workshop is to achieve and maintain the ecological character of the wetlands and facilitate sustainable use for the benefit of people and the environment.

Point Calimere is the only site in Tamil Nadu. It was declared a Ramsar site on 19 August 2002. It is located along the Palk Strait in Nagapattinam, Tiruvarur and Thanjavur districts and has an area of 38,500 ha. It is situated at the southern end of Nagapattinam district, Tamil Nadu. Point Calimere is actually a complex wetland composed of creeks, forests, swamps and intertidal mudflats. This site includes Point Calimere Wildlife Sanctuary, the Muthupet mangroves, Panchanadikulam Wetland, Unsurveyed Salt Swamp and Thalainayar Reserved Forest. This site is known for waterbirds, the Blackbuck and the Olive Ridley Turtle. It is a breeding ground for many fish, crab and prawn species. More than 35,000 families are directly dependent on this wetland site for their livelihoods, such as farmers and fishermen.

### NEED FOR SEARCH CONFERENCE FOR POINT CALIMERE

Point Calimere is an internationally important biodiversity-rich site. The salt industry, aquaculture, urbanisation, climate change, pollution and other human activities affect the site. Directly and indirectly, more than 90 villages are dependent on this site for their livelihoods. Hence, it is time for protect the site through its primary stakeholders with the support of relevant stakeholders. In this context, DHAN Foundation organised a 3-days future search conference for the Point Calimere wetland site by involving various stakeholders who are connected with the site.

### BRIEF OF FUTURE SEARCH CONFERENCE

The Search Conference is a participative, collaborative, strategic planning method that enables people to create a plan for the most desirable future of their community, a plan they carry out themselves. The process takes 24 hours over three days. It establishes a learning–planning community of the people that will plan for the people and provide an experience of participative democracy. The search conference is a practical way of building communities of people who step up to the challenges of our turbulent times and take responsibility for making change happen in a purposeful way. As the world becomes more and more turbulent, the need is great for people to form communities to search for their desirable futures together.

The Search Conference means a collaborative method, enabling people to create a plan for their most desirable future of their area and community. The plan will be carried out by the participants / practitioners themselves.

### PURPOSE OF SEARCH CONFERENCE

- Establishing common ground for the development of new strategies
- Pro-active, creative and effective collaboration



Against this backdrop, the three-day future search conference was started in Muthupet, of Thiruvallur district, during 14–16 March 2020 with the involvement of the community members of the Point Calimere wetland site.

This three-day process was organised by DHAN Foundation, and it was facilitated by Mr. Frank Heckman and Mr. Peter from Embassy of Earth, The Netherlands, as well as the Tamil Nadu Forest Department and GIZ, New Delhi, who extended their support. The process was successfully completed.

#### **THE PARTICIPANTS**

The participants of the three-days process were fringe fishermen, marginal farmers, the Panchayat President, leaders of fishermen's associations, women SHG members, Marine Police officers, staff members and officers of the Tamil Nadu Forest Department and staff members of DHAN. In addition, students from NIRD, Hyderabad and the Dhan Academy, Madurai were also part of the conference. Mrs. Avantika and Mr. Xavier Francis, from GIZ, New Delhi took part in this three-day process.

#### **PROCEEDINGS OF DAY-1 (14 MARCH)**

The first day of the future search conference started with a grand inauguration ceremony with cultural folk music with parai, a traditional prayer with fire and a pooja for Mother Earth and the sun that involved all the stakeholders. In the ceremony, community representatives of different livelihoods of the wetland area offered Muthupet lagoon water to the holy fire. Mr. Frank Heckman participated in it.

The inauguration ceremony moved forward with the lighting of a lamp by distinguished guests: Dr. Arivoli, District Forest Officer, Mr. Raghupathi, Marine Police, Mr. Frank Heckman and the community representatives. Mr. T. Asai Thambi started the event by addressing the gathering and welcoming the guests. Subsequently he briefed the audience about the future search conference.



#### **DR. ARIVOLI – DISTRICT FOREST OFFICER**

He described the contemporary problems and threats faced by the wetlands. According to him, these issues will be sorted out only if they are voiced. He appreciated the efforts of the state government to conserve the wetland ecosystem and encouraged NGO participation in the same. He presented an example of how wetlands are being conserved in the Netherlands and other countries.

#### **Mr. Raghupathy – Inspector of Police (Coastal)**

He described the ill-effects of natural disasters such as heavy rains and unpredictable seasons. He stated that these disasters cannot be prevented. But their impacts can be reduced through certain sustainable measures. He suggested that the community create awareness about reducing solid waste and aquaculture.

#### **MR. FRANK HECKMAN**

He told the gathering about the importance of conserving the mangrove forest in Muthupet Lagoon. According to him, the Netherlands is a delta region and does not have the diversity of the wetland in India. So wetland conservation should be the foremost duty of the people in this region. He said that the three days of the future search conference needed everybody's involvement and participation for the conservation of the ecosystem.

#### **AGENDA**

Mr. Lokesh is an environmental engineer working for DHN Foundation. He facilitated the entire event along with Mr. Frank. He explained the agenda of the three days, and he pointed out that the conference would become successful only if the people participated and shared their voice and knowledge. He stated that a clean sea would help healthy fishes to grow, which would benefit the fishermen. Rejuvenation of the lagoon and estuaries are necessary because most of the people are reliant on fishing. He said that the people of the area are experts because they have live experience from their lives.

The search programme was initiated with the quotation “Hearing many voices of knowledge, experience and wisdom from the experts”.

### **ACTIVITY – 1: EXPECTATIONS**

After the inauguration ceremony, Mr. Frank and Mr. Lokesh started explaining the whole process and its functioning. They explained the metaphors in the chart that covered the social ecosystem (learning, planning and acting in the community, the search conference method and the first day’s agenda). Mr. Frank the shared ground rules.

### **GROUND RULES FOR A SEARCH CONFERENCE**

- All perceptions are valid.
- Participation is equal and open, regardless of status or position.
- People’s perceptions are spoken and written on flip-chart paper
- No presenters, no speeches, keynote addresses, games, ice breakers or training sessions
- People are self-managing and responsible for tasks and outcomes.
- Rationalisation of conflict (seeking common ground in disagreement)

After the explanation of the ground rules, the people were divided into six sub-groups. They were asked to write down their expectations of the three-day workshop. They noted down the points on the chart after discussions and shared these in the forum.

### **THE MAIN EXPECTATIONS SUGGESTED BY THE SIX GROUPS**

1. Take necessary measures to reduce soil salinity, mainly on agricultural land.
2. Reduce the salinity of the groundwater and improve the water table.
3. Tackle the poor-practices of aquaculture farming (shrimp cultivation).
4. Implement community-led afforestation and conservation measures.
5. Find out the possible means of reducing the solid and plastic waste which is affecting marine biodiversity and livelihoods.
6. Evolve new policies and enforce the present guidelines for protection of freshwater sources such as ponds, lakes, estuaries and lagoons through the community themselves.
7. Conserve the agricultural land and enhance its productivity along with sustainable farming.
8. Improve and protect the existing forest area, planting more tree saplings to increase the rainfall.
9. Desilt existing creeks and estuaries by involving the beneficiaries and villagers.
10. Promote awareness about the wetland ecosystem and its importance through different kinds of participatory training and event.
11. Take the necessary steps to manage the encroachment of existing industries, which are spoiling the agricultural land and water table.
12. There are many channels of Cauvery tributaries that need renovation.
13. Exclusive interventions on promotion of mangroves and its conservation
14. Find out the possible ways to remove the silt that has accumulated because of the operations of the big industries and take steps.
15. Try to improve the diversity of the fish and the catch by suggesting fishing methods and practices.



## ACTIVITY – 2: CHANGES IN THE WORLD IN THE LAST 10 YEARS

The second activity was to learn about the changes that have happened around the world in the past 10 years. The participants were divided into two groups, and each group discussed the positive and negative changes that have taken place in the past 10 years. They noted down the following points and made their presentation at the plenary.

### POSITIVE CHANGES IN LAST 10 YEARS

1. The vacant land areas are covered with forests, green trees and mangroves. Moreover, people have been sensitised to protect the forest and its ecosystem.
2. Self-employment opportunities have increased and are generating new jobs.
3. The need and consumption of fresh water became sustainable.
4. Information and communication technology has improved, and even laymen have access to technology.
5. The availability and accessibility of health services have improved significantly.
6. The status of education (primary education to higher education) has improved. It gives better space for girl children.
7. The transportation and road facilities have improved significantly.
8. Women have been empowered significantly in society.
9. The housing and sanitisation facilities have improved greatly at the village level.

### NEGATIVE CHANGES IN THE LAST 10 YEARS

1. The frequency of disasters has increased. Disasters affect not only the livelihoods but also the natural resources.
2. Degradation of natural resources has increased, and deforestation is experienced
3. The groundwater has been depleted, and freshwater sources have reduced.
4. There is a significant increase in the usage of plastics, and this is adversely affecting the environment, especially marine resources.



5. There has been an increase in the radiation of radio waves and the associated adverse effects.
6. Individual incomes have decreased and demonetisation has directly impacted the lives of poor people.
7. The air, water, soil and pollution are increasing.
8. There is a reduction in the rainfall due to climate change.
9. There are serious health impacts due to lifestyle changes.
10. There are considerable changes in the marine resources and their diversity, especially the fish catch.

A fisherman, Mr. Palanivelu from Chenganankadu, stated that a reduction in the average rainfall and variations in temperature are the major changes and that human actions are the main factor for the changes. The rise in the sea level in Antarctica, climate change and global warming are related to each other. Further, he insisted that mangrove forests should be preserved to avoid such problems. The participants expressed the sentiment that the communities are optimistic about the development of the younger generation, mainly thanks to education.



### ACTIVITY – 3: FACTORS AFFECTING THEIR LIVELIHOOD

Mr. Frank stated that the focus of the FSC is directly on the wetland. The decrease in rainfall and increase in the area under invasive species are some of the factors that are affecting the wetlands. The participants were asked to sit in their respective groups, formed initially, and they were given 30 minutes to discuss key factors affecting their livelihoods.

### THE SUB-GROUPS CAME OUT WITH THE FOLLOWING POINTS

1. Seawater intrusion – the salinity of the soil has increased.
2. Reduction in the extent of mangroves, which is affecting the fish catch and fish breeding.
3. Natural disasters that affects both livelihoods and natural resources
4. Aquaculture and chemical residues affect the soil, groundwater, lagoon and flora and fauna.

5. Improper maintenance of estuaries, creeks and canals
6. Fresh water has been depleted due to many factors such as rain, sedimentation and encroachment.
7. Cyclones are affecting coconut plantation and other crops.
8. Fish species are getting affected because of the shrimp cultivation, which is negatively affecting their livelihoods.
9. An increase in the invasive species (*Prosopis juliflora*) is depleting the water table. Native species are not allowed to grow. *Prosopis juliflora* holds more water vapour and makes the area so hot that only it can grow there.
10. Widespread use of plastics and its adverse effect on the aquatic ecosystem.
11. Trawling, gillnet fishing and other unethical fishing practices affect the fish resources.
12. The soil fertility is decreasing because more chemicals are used in agriculture, aquaculture and cattle grazing.

#### **ACTIVITY - 4: ENVIRONMENTAL IMPACT SCAN**

Selected members from each group came together to map the main issues listed in the third activity according to its intensity. The following are the final impacts mentioned. The first three impacts got the highest grading in terms of intensity.

1. Aquaculture and released chemicals are affecting farms and aquatic livelihoods.
2. Desiltation practices are not managed properly. Solid waste has accumulated in estuaries and creeks.
3. Natural disasters are having greater impacts because of the reduction in the extent of the mangrove forest. Also, there is more water intrusion into the land.
4. Changes in land use pattern (agricultural land to housing/industries) and reduction of extent of forest.
5. Usage of plastics
6. Illegal fishing practices such as trawling and gillnet fishing are affecting small animals such as fishes and plankton. There are changes in the fish catch and its variety, which are directly affecting the livelihoods of the seashore fishermen.
7. A decrease in the annual rainfall and groundwater level.
8. Livestock-related activities such as open grazing are affecting the wetland.
9. Inorganic agriculture is reducing the soil fertility.

These points were presented at the end of the session, and overall, the first day's event was successful, with the active cooperation of the community and the management of DHAN Associates and professionals.

#### **PROCEEDINGS OF DAY - 2 (15 MARCH)**

The second day of the future search conference started with a prayer, and Mr. Asai Thambi introduced the day's guests to the community: M.P. Vasimalai, Executive Director of DHAN Foundation, Mr. Praveen Kumar Water Engineer, from DHAN Foundation, Mr. Xavier Francis and Mrs. Avanthika, from GIZ, and Forest Department officials. Mr. T. Saravana Kumar (TDA) recapitulated the discussions of Day 1 of the future search conference. He also described the second day's agenda.

#### **SECOND DAY'S AGENDA**

1. Environment impact scans need to be discussed and explored in depth.
2. Discussion for bringing more understanding.
3. Story narration – previous happenings in the Point Calimere area.
4. Aspects of livelihoods that have to be kept, created and dropped.
5. Sub-group discussions on Vision 2030 and finalisation.

Mr. Frank Heckman and Mr. Lokesh took over the forum with the scheduled agenda.

### Activity - 1: Environment impact scan discussions

Important points of Day 1 were taken as the lead points for the day's beginning. The main points of the discussions included:

1. Aquaculture and released chemicals are affecting farm and aquatic livelihoods.
2. Desiltation practices are not properly managed. Solid waste has accumulated in estuaries and creeks.
3. Natural disasters are having greater impacts because of the reduction in the extent of the mangrove forest. Also, there is more water intrusion into the land.
4. Pollution

The participants were asked to explain and substantiate their stated problems and what actions could be taken to tackle these problems. Everybody pooled in their knowledge and mentioned the following points.

#### 1. Most of the shrimp cultivation is carried on by local people, and they are polluting the freshwater bodies.

- a. The issue has already been taken to the gram panchayat, and the community claims that the actions taken were not sufficient to stop the pollution.
- b. The shrimp cultivation is carried on in private lands, but the sewage from the shrimp farms is drained into the fresh water, affecting all the livelihoods depending upon it.
- c. Since the negative impacts of the shrimp cultivation are severe, people started to protest against it. Because of that more than 70 people were arrested by the police.
- d. Natural breeding of prawns is very low, and the shrimp cultivators are carrying out artificial breeding to get high profits, which again is causing health hazards.
- e. Fishermen who engage in backwater fishing are affected, and they are not able to get better catches.

#### 2. SILTATION

- a. Cyclone Gaja impacted the natural resources very seriously, especially the excessive sediments and depositions on agricultural land, common lands, canals, estuaries and creeks. No steps have been taken by the government.

#### 3. NATURAL DISASTERS AFFECTING MANGROVES

- a. Aquaculture sewage should be treated before discharge.
- b. Renovation of water bodies.

#### 4. INCREASE IN THE USE OF PLASTIC

- a. Plastic and dumped waste are disturbing the ecosystem, and fishermen face difficulties.

### ACTIVITY – 2: SUB-GROUP DISCUSSION ON 'KEEP, CREATE AND DROP'

People were divided into three groups, and they were assigned the theme “**keep, create and drop**”. Under the theme “**Keep**”, people were supposed to keep/maintain something as it was. Under “**Create**”, new things are to be done. Under “**Drop**”, things have to be stopped. On the basis of this assignment, the groups came up with interesting points such as the following.

#### ASPECTS DISCUSSED UNDER THE THEME 'KEEP'

1. Agriculture
2. Livestock
3. Forests
4. Conservation of water and renovation of tanks and ponds
5. Provision of favorable conditions for growth of diversified fish species
6. Collaboration with SHG activities and NGOs for development of sustainable water conservation structures



#### ASPECTS DISCUSSED UNDER THE THEME 'CREATE'

1. Enforcing proper fishing methods to protect marine resources (for example, some people are using banned nets; instead, they should use the traditional nets, which are useful for the fishes and the community)
2. Initiating some schemes and credit facilities for carrying on fishing activities
3. Restoration of backwater channels – helpful for the fisherman
4. Construction of check dams, which can provide upstream water to the agricultural fields
5. Creating primary producer groups for marginal farmers and fishermen
6. Creating alternative livelihood activities for self-employment (during the off-season) such as preparation of healthy nutrition powder, pickle making, production of dairy products, poultry farming
7. Spirulina and alga production and confining the shrimp catch to the seas
8. Creating mangrove nurseries and promoting mangrove forests
9. Planting more casuarina trees, other soil-binding trees and mangroves to prevent seawater intrusion and shore erosion

#### ASPECTS DISCUSSED UNDER THE THEME 'DROP'

1. Alcoholism
2. Ban on cutting trees and grazing, particularly in forests
3. Avoiding banned nets
4. Banning the use of plastics
5. Aquacultural discharge should not be released in residential and agricultural areas and water bodies
6. Improper uprooting of invasive species such as *Prosopis*



### ACTIVITY – 3: STORY TELLING BY PARTICIPANTS

The story telling activity started with an ancestral and nature prayer by lighting a lamp. Memories about the Point Calimere area, both positive and negative, were discussed by the participants. They exchanged stories about how the tsunami and cyclone affected them, their losses and how they overcame the problems.

They talked about how their houses got ruined and their livestock and livelihood loss. The fishermen talked about the problems they faced because of damage to boats. The participants also mentioned how the DHAN members and other people helped them in their crisis. They also wished to get disaster-resilient building interventions in all the villages.

### ACTIVITY - 3: VISION 2030

The community listed out that the changes that they wanted to see in the world during the year 2030.

1. Transformation of the coastal village shoreline into mangrove forests.
2. Improved fish resources. Illegal aquaculture farms eradicated.
3. Reduction of salinity of groundwater through desiltation of existing water bodies and creation of new water bodies.
4. Plastic- and pollution-free villages.
5. Natural farming and sustainable fish practices towards a self-reliant village.
6. *Prosopis juliflora* eradicated. Native trees planted for ecological enhancement.

### PROCEEDINGS OF DAY-3 (16 MARCH)

The third day of the future search conference started with a prayer. Ms. Amrutha Krishnan recapitulated the findings of Day 2 and presented the agenda of the third day.

1. Orienting the previous findings and substantiating them with valid reasons.
2. Grouping the members according to their perceptions of the previous day's findings.
3. The strategy and methods adopted to achieve the goals
4. Group discussion (issue-wise)

Mr. Frank Heckman and Mr. Lokesh took over with the scheduled agenda.





### ACTIVITY – 1: ACTION PLAN

Sub-groups were formed according to the previous day's findings:

1. Transformation of coastal village shoreline into mangrove forest.
2. Improved fish resources and eradication of illegal aquaculture farms.
3. Reduction of salinity of groundwater through desiltation of existing water bodies and creation of new water bodies.
4. Plastic- and pollution-free villages.
5. Natural farming and sustainable fish practices towards a self-reliant village.
6. Eradication of *Prosopis juliflora* and planting of native trees for ecological enhancement.

The people gathered in their respective groups, and they started to prepare the action plans. Each group got a theme. The steps to be taken and an action plan were to be decided. The participation and involvement of everyone was needed. Accordingly, after completing the planning, the villagers were to pass a resolution at their gram sabha.

### THE DETAILED ACTION PLAN

#### I) Transformation of coastal village shoreline to mangrove forest

1. Protection of mangrove forests.
2. Creating and managing proper channels for the backwaters, canals and rivers
3. Collaboration between the Forest Department and the community

##### Protecting the mangrove forest

- a. Highly inflammable material should not be taken into the forests.
- b. Protection from cattle grazing – going in for stall feeding
- c. Prohibition of plastics inside the forests

##### Creating channels and ponds and renovating estuaries

- a. Creating a large number of new backwater channels and avoiding sedimentation
- b. Planting new mangrove saplings in new and existing areas
- c. Saplings must be planted near brackish water areas

##### Collaboration with Forest Department and community

- a. Mobilising funds from outsiders
- b. Protection and management of forests
- c. Extending the forest area

#### II) Improving fish resources and eradicating illegal aquaculture farms

1. The waste discharged from aqua cultural ponds should not mix directly to lagoon and sea without proper treatment
2. Renovation of ponds, channels and water sourced areas.
3. Initiate alternative livelihoods in off season of farming and fishing period.

##### The waste discharged from aqua cultural ponds should not go directly to sea without treating

- a. Each shrimp cultivator should have wastewater purifiers; Government should enforce it by strict monitoring and enforcing the law and rules.
- b. The aqua cultural farms should be controlled and monitored under pollution control board.

### **Renovation of ponds, channels and water sources**

- a. Renovation catchment area and water harvesting resources like ponds and channels in periodical interventions.
- b. Create concrete check dams near shoreline and adjacent to river channels to avoid inundation and seawater intrusion.

### **Initiate alternative livelihoods during the fish breeding period**

- a. Every fisherman should get alternative employment opportunities.
- b. Create trainings and job opportunities mainly on off season
- c. Collaboration of panchayat and community for regulating the laws

### **III) Desalination**

1. Increase the forest area and plant mangroves and other native trees.
2. Construction of water harvesting structures and renovation of existing ponds and channels.
3. Filtration of water from effluents and chemical wastes.

### **Increasing the forest areas and trees**

- a. Each house should plant and grow at least 5 plants
- b. Tree saplings should be planted near river and pond channels
- c. Regular and proper maintenance of plants with adequate water

### **Construction of water-harvesting structures and renovation of existing ponds and channels**

- a. Every house should have roof water harvesting structures and others
- b. Collective rainwater harvesting by the village by using the common property management.
- c. The farm pond/other water harvesting structure must be technically managed and measured

### **IV) Plastic- and pollution-free villages**

1. Avoid the use of plastics in packaged edible foods, containers and water bottles.
2. Awareness and regulation to avoid plastics at the gram panchayat level
3. Avoid burning plastic materials (if necessary, recycle them).
4. Establishing proper plastic and solid waste management practices to improve
5. The water table, agriculture and fish.

### **The action plan is directed at individuals, families, streets and villages.**

- a. People awareness (September 2020)
- b. Reducing the use of plastics in collaboration with the local government (March 2021 to 2023)
- c. Increasing the use of cloth bags (September 2020 to March 2022)
- d. Finding alternatives to plastics (leaf plates, cloth bags, paper bags) (September 2020 to March 2022)
- e. Replacement of water bottles (silver bottles, copper vessels) (September 2020)
- f. Collaboration with government (January 2020 to February 2022)
- g. Reduction of plastic residues (June 2020 to August 2021)

### **V) Natural farming and sustainable fish practices for a self-reliant village**

1. Entire villages should go in for integrated farming.
2. Replacement of chemical fertilisers with green manure like cow dung and vermi-compost.
3. The fish ban period should be extended for the fish to breed better.
4. Cultivation of sea grass and spirulina in brackish water regions.
5. Avoiding the use of banned nets.
6. Avoiding the intrusion of wastewater and conservation of marine fish resources.

**The village should adopt integrated farming.**

- a. Improving awareness and giving training, input materials and credit facilities through societies.
- b. Each family should engage in agriculture practices by creating some primary producer groups for their backward and forward linkages.
- c. Farmers should engage in integrated farming and relevant training, and exposure can be given.
- d. Conduct peoples' conferences for profitable organic farming with regular discussions (5 years),

**Avoid using banned nets.**

- a. Create awareness about the ill effects of using them among all fishing communities.
- b. Formation of village marine resource councils.
- c. Create stringent laws and policies at the village level.
- d. Each panchayat and district government department should enforce the law against the use of banned nets (2 years).

**Avoiding wastewater intrusion and conservation of marine fish resources**

- a. Creating awareness at the village level about the impact of sewage wastes
- b. Treatment of wastewater before it flows into the seas and creating separate wastewater channels.
- c. Renovation of backwaters and channels and allowing fresh water to pass for mangroves to grow properly (2 years).

**VI) Eradicate *Prosopis juliflora* and plant native trees for ecological enhancement**

1. Uprooting of *Prosopis*, which has spread widely
2. Planting native species in all villages
3. Community participation in the uprooting of *Prosopis* and planting native trees

**Uprooting of *Prosopis* in a vast area**

- a. Creating awareness about the negative effects of *Prosopis* to the community through gram sabhas (April 2020)
- b. Awareness through schools and colleges

**Planting native species in all villages**

- a. Planting native species such as Vengai (ornamental plant), Teak, Tamarind, Neem and Saffron (January 2021 to February 2022)

**Community participation in uprooting and planting of trees**

- a. Use of technologies at the government level for protecting unused land (December 2020 to 2022)

**Concluding address of Forest Range Officer**

The Muthupet Forest Range Officer delivered his concluding address. The Forest Department is only working for the management of the site, but for the people it is their lives and livelihoods. Therefore, you must take more responsibility to protect the site, and the Forest Department will extend their best services by joining hands with the people of the site.

Finally, the deliberations of the three-day process needs to reach all the villages of the Point Calimere wetland site. Hence, for each major task, a council has been formed.

**The way forward**

The proceedings of the entire FSC will be taken to all the relevant villages. Councils have been formed for the six major issues. Each council includes representatives of the community, officials and DHAN members. In the near future through this council all the action will be ensured in the villages of the Point Calimere wetland site with the support of the community and other stakeholders.

## THE MEMBERS OF THE COUNCILS

1. Mangrove Restoration Council
2. Improving Fishing Reserves Council
3. Plastic and Pollution Free Village Council
4. Prosopis Free Village Council
5. Organic Farming Council
6. Salinity Reduction Council

Overall, guidance and support will be facilitated by DHAN Foundation, Mr. Frank Heckman and his team. They will extend the action plan to all the villages with the support of the councils. With this, the future search conference for Point Calimere was successfully concluded with a vote of thanks, and the work began



Photo credit: Dhan Foundation

## ANNEXURE V – The consolidated RAWES sheet

Name of the village	Siruthalaikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	Due to the presence of saltpans, the salinity has increased.	--	Y	Y		Freshwater lenses were the source in the past, which were totally affected by the saltpans.
	Food	Fish, prawn, livestock fodder	++	Y	Y		Livestock is brought from various neighbouring villages to graze on Mannavaram Island.
	Fuel	<i>Prosopis</i> charcoal and firewood	+	Y	Y		
	Fibre		0				
	Genetic resources	Sea Fly (name should be identified)	??				
	Natural medicine	Medicinal Plants are collected and used	+	Y			
	Ornamental resources	Presence of seashells	0				
	Clay, mineral, aggregate harvesting		0				
	Energy harvesting from air and water	Sail boats (Pai Mara Kapal), use winds and reduce fuel consumption of fishing boats	++	Y			



Name of the village	Siruthalaikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Air quality regulation	Floating sea silt particulates, especially in dry season	--				
	Local climate regulation	Evapotranspiration in <i>thottam</i> and <i>Prosopis</i>	+	Y			
	Global climate regulation		0				
	Water regulation	Pillaiyar Koyil and Amman Koyil ponds reduce the salinity.	+	Y			
	Flood hazard regulation	Presence of <i>thottam</i> reduces the effect of high tides.	+	Y			
	Storm hazard regulation	Presence of <i>thottam</i> reduces the effect of storms.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	<i>Prosopis</i> reduces erosion in the island.	+	Y			
	Water purification	Saltpan has affected the freshwater source.	--	Y			
	Pollination	No agriculture at present	0				There was agriculture before 30 years
	Salinity regulation	River drains regulates the salinity close to <i>alam</i>	+	Y			
	Fire regulation		0				
	Noise and visual buffering	Motor boats create noise pollution, which affects incoming birds	--				

Name of the village	Siruthalaikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	Mannavaram Island – folklore rituals	++	Y	Y		
	Recreation and tourism	Mannavaram Island – recreation for regional communities	+	Y	Y		
	Aesthetic value		0				
	Spiritual and religious value		0				
	Inspirational Value	Folk stories about Sellakanni Aaru	+	Y			
	Social relation	The hamlet was established on the island based on the wetland services	++	Y			
	Education and research		0				
Supporting Service	Soil formation	Cyclone Gaja and the tsunami led to sludge deposition in the <i>thottam</i>	--	Y	Y		Affects other fishermen too
	Primary production	Alagal wetland and <i>Prosopis</i>	+	Y			
	Nutrient cycling	Deposition of salty silt by the wind reduces the soil fertility by increasing the salinity	-	Y			
	Water recycling	Because of the saltpan, there is no freshwater source.	--	Y			
	Provision of habitat	Presence of reefs attracts fishes to the <i>thottam</i> , which attracts birds too. Due to sludge deposition, the aquatic life in the <i>thottam</i> is reducing. <i>Prosopis</i> is invading over a period of time.	+/--	Y	Y		Affects other fishermen too

Name of the village	Vandal	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	After the shutter construction in Kallimedu Bridge, the back-water flow has been stopped. Therefore, the wetland is filled with fresh water for 3–4 months. This water is used for agriculture and groundwater recharge.	++	Y	Y	N	It is like an island in a low-lying area filled with fresh water from the rivers Nallaru and Adappar.
	Food	Fish, prawn, livestock fodder	++	Y	N	N	After the shutter construction, the back-water flow has been cut off. Therefore there is a declining trend in the fish production in the wetland.
	Fuel	People are not collecting firewood.	0				
	Fibre	NA	0				
	Genetic resources	No rare species	0				
	Natural medicine	Some plant species were used as medicines in the past, but they are not used at present.	0				
	Ornamental resources	NA	0				
	Clay, mineral, aggregate harvesting	NA	0				
	Energy harvesting from air and water	NA	0				

Name of the village	Vandal	Description of benefit	Scale of benefit	REMARKS
			How important? Local Regional Global	
Regulatory Service	Air quality regulation	NA	0	
	Local climate regulation	Standing water is present in the wetland along with the mangrove forest.	++ Y	Y The mangrove forest has been affected after the cyclone Gaja, and the arresting of the back-water flow has led to poor growth of mangroves.
	Global climate regulation	The presence of mangroves in the wetland is minimal and decreasing.	0	
	Water regulation	Standing water is present in the wetland, and shutters where constructed to improve the groundwater quality.	++ Y	Y
	Flood hazard regulation	The wetland acts as a flood moderator.	++ Y	Y
	Storm hazard regulation	The wetland with mangroves act as a storm regulator (e.g. cyclone Gaja)	++ Y	But since the mangroves are reducing, the wetland might lose this character.
	Pest regulation		??	
	Disease regulation- human		??	
	Disease regulation- livestock		??	
	Erosion regulation	The presence of mangroves in the wetland is minimal.	+ Y	

Name of the village	Vandal	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Water purification	The inflow of seawater has been reduced, and so the water quality is slowly improving, but there is considerable inflow of aquaculture effluents.	+	Y	Y		
	Pollination		??				
	Salinity regulation	The inflow of seawater has been reduced, and so the water quality is slowly improving.	++	Y	Y		A man-made barrier is present in the form of shutters.
	Fire regulation	No fire-related activity around the wetland	0				
	Noise and visual buffering	No potential source of noise or light pollution	0				
Cultural Service	Cultural heritage	Mannavaram Island – folklore rituals	0				
	Recreation and tourism		0				
	Aesthetic value		0				
	Spiritual and religious value		0				
	Inspirational Value		0				
	Social relation	The Vandal island communities established settlements based on the wetland resources of the past.	++	Y			
	Education and research		0				



Name of the village	Siruthalaikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Supporting Service	Soil formation	The wetland is at the tail end of the river and is close to the sea. Therefore it helps the sedimentation, and the existing mangroves add organic carbon to it and help soil formation.	+	Y			
	Primary production	Sparse presence of vegetation	+	Y			
	Nutrient cycling	Aquaculture effluents are discharged in the wetland, which results in changes in the nutrient value of the water.	-	Y			
	Water recycling	Improvement of groundwater recharge	+	Y			
	Provision of habitat	Decrease in incoming migratory birds due to reduction in aquatic life and increase in <i>Prosopis</i> (invasive species)	+/-	Y	Y		Affects other fishermen too
Name of the village	Kodiyakaadu						
Provisional Service	Fresh water	Because of the salt pans, there is no reliable source of fresh water. The people are dependent on the Kollidam.	--	Y	Y		Freshwater lenses were the source in the past, and these have all been affected by the salt pans.
	Food	Fish, prawn, fruits, livestock fodder	++	Y	Y		People collect forest produce
	Fuel	Fallen dry firewood collected	+	Y			
	Fibre		0				

Name of the village	Kodiyakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Genetic resources		??				
	Natural medicine	Though medicinal plants ( e.g., Pungai Ver, Sangu Ilai, Milagukaaram) were used in the past, because of the regulatory measures related to the forest, the people are not using it at present.	0				
	Ornamental resources		0				
	Clay, mineral, aggregate harvesting		0				
	Energy harvesting from air and water		0				
Regulatory Service	Air quality regulation	Obstructs inflow of salt laden winds	++	Y			
	Local climate regulation	Presence of tropical dry evergreen forest	++	Y	Y		
	Global climate regulation	Presence of tropical dry evergreen forest	++	Y	Y	Y	
	Water regulation	The only source of fresh water is rainfall.	0				
	Flood hazard regulation	Reduced flow of surface sea water intrusion into land	+	Y			
	Storm hazard regulation	The tropical dry evergreen forest acts as a storm regulator (e.g., cyclone Gaja, tsunami)	++	Y			
	Pest regulation		??				
	Disease regulation- human		??				

Name of the village	Kodiyakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Disease regulation- livestock		??				
	Erosion regulation	The presence of the tropical dry evergreen forest reduces erosion.	+	Y			
	Water purification		0				
	Pollination		??				
	Salinity regulation	Saltpan in the vicinity	--	Y	Y		
	Fire regulation	No potential source of fire and no historical record of fires	0				
	Noise and visual buffering	The sound of sea waves has been reduced by the forest.	+	Y			
Cultural Service	Cultural heritage	Strong relationship with forest and village deity in the forest	++	Y			
	Recreation and tourism	Wildlife sanctuary, bird sanctuary	++	Y	Y		
	Aesthetic value	Forest, wild animals and birdwatching	++	Y	Y		
	Spiritual and religious value	Ramarpaadham	++	Y	Y		
	Inspirational Value	Kodiyakaadu has many stories and myths.	++	Y	Y		
	Social relation	The settlement is only due to the presence of the forest.	++	Y			
	Education and research	It is a hotspot research area.	++			Y	

Name of the village	Kodiyakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Supporting Service	Soil formation	Formation of organic carbon	+	Y			
	Primary production	Presence of tropical dry evergreen forest, bird sanctuary	++	Y			
	Nutrient cycling	Presence of tropical dry evergreen forest, bird sanctuary	++	Y			
	Water recycling		0				
	Provision of habitat	Presence of tropical dry evergreen forest, bird sanctuary. At the same time, <i>Prosopis</i> is increasing day by day.	++/-	Y	Y	Y	Affects other fishermen too
Name of the village	Pannal - Sakkarapettai						
Provisional Service	Fresh water	Degraded groundwater due to saltpans.	--	Y	Y		
	Food	Fish, prawn	++	Y			
	Fuel	<i>Prosopis</i> - firewood	+	Y			
	Fibre		0				
	Genetic resources		0				
	Natural medicine		0				
	Ornamental resources		0				
	Clay, mineral, aggregate harvesting		0				
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use sea winds and reduce the fuel consumption of fishing boats.	++	Y			

Name of the village	Pannal - Sakkarapettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Air quality regulation	<i>Prosopis</i> acts as a barrier against salt laden winds from the sea	++	Y			
	Local climate regulation	Saltpans, <i>thottam</i>	??				
	Global climate regulation		0				
	Water regulation		??				
	Flood hazard regulation		0				
	Storm hazard regulation	The <i>Prosopis</i> and <i>thottam</i> act as barriers against storms.	+				
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	<i>Prosopis</i> regulates erosion.	+				
	Water purification	Seawater intrusion	--				
	Pollination	Jasmine cultivation	+				
	Salinity regulation	Intrusion has been affected	--				
	Fire regulation	No potential fires	0				
	Noise and visual buffering	No potential noise or light pollution	0				



Name of the village	Pannal - Sakkaranpettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	Ayyanarkoyil–Sakkaranpettai	++				
	Recreation and tourism		0				
	Aesthetic value		0				
	Spiritual and religious value		0				
	Inspirational Value		0				
	Social relation		0				
	Education and research		0				
Supporting Service	Soil formation	Cyclone Gaja and the tsunami led to sludge deposition in the <i>thottam</i>	--	Y	Y		Affects other fishermen too
	Primary production	<i>Prosopis</i>	+	Y			
	Nutrient cycling		0				
	Water recycling	Because of the saltpans, there is no source	--	Y			
	Provision of habitat	<i>Prosopis</i> invasion	--	Y	Y		

Name of the village	Voymedu– Sinthamanikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Food	Fish, prawn	++	Y	Y		
	Fuel	<i>Prosopis</i> - firewood	+	Y			
	Fibre	NA	0				
	Genetic resources	NA	0				
	Natural medicine	NA	0				
	Ornamental resources	NA	0				
	Clay, mineral, aggregate harvesting	NA	0				
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) uses sea winds and reduce the fuel consumption of fishing boats	++	Y			
Regulatory Service	Air quality regulation	Scope to regulate salt laden winds from sea	+	Y			
	Local climate regulation	<i>Thottam</i> regulates air temperature	+	Y			
	Global climate regulation		0				
	Water regulation	When water from the Valanaaru drains into the <i>alam</i> , the agriculture improves	+	Y			
	Flood hazard regulation	The <i>alam</i> and <i>thottam</i> regulate floods.	+	Y	Y		
	Storm hazard regulation	The <i>alam</i> and <i>thottam</i> regulate storms.	++	Y	Y		

Name of the village	Voymedu– Sinthamanikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Since the agricultural land is close to the <i>alam</i> , there is erosion at the interface.	-	Y			
	Water purification	Almost 150 wells were used in the past, but they have become saline. Now farmers are using lift irrigation, which is improving the groundwater.	+	Y			
	Pollination	Floriculture in the backyards, paddy in the fields	+	Y			
	Salinity regulation	When water from the Valanaaru drains into the <i>alam</i> , the salinity is reduced.	+	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage	Poojai in the islands in the wetland (Kallitheevu)	+	Y			
	Recreation and tourism		0				
	Aesthetic value		0				
	Spiritual and religious value		0				

Name of the village	Voymedu– Sinthamanikaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Inspirational Value		0				
	Social relation	The village is predominantly reliant on fisheries	+	Y			
	Education and research		0				
Supporting Service		Silt deposits from Vallanar aaru in the <i>alam</i> .	+	Y			
	Primary production	<i>Prosopis</i> presence in RF	+	Y			
	Nutrient cycling	Agricultural runoff into the <i>alam</i>	-	Y			
	Water recycling	When water from the Valanaaru drains into the <i>alam</i> , water stored at the surface is recycled.	+	Y			
	Provision of habitat	The Valavanaaru helps the breeding of fishes and prawns.	+	Y			
Name of the village	Annapettai						
Provisional Service	Fresh water	The groundwater salinity had increased in the past 10 years, but after the construction of shutters in the Valavanaaru, the groundwater is improving.	+	Y	Y		

Name of the village	Annapettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Food	Fish, prawn, livestock	++/-	Y	Y		The Valavanaaru helps the fishing, but the islands that supported cattle feeding are not used anymore because of the invasion of <i>Prosopis</i> .
	Fuel	<i>Prosopis</i> - firewood	+	Y			
	Fibre	NA	0				
	Genetic resources	NA	0				
	Natural medicine	NA	0				
	Ornamental resources	Thalampoo and Thaalai Kaai were integral parts of the culture, but they have become extinct due to the invasion of <i>Prosopis</i> .	-				
	Clay, mineral, aggregate harvesting	NA	0				
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	++	Y			
Regulatory Service	Air quality regulation	Scope to regulate salt laden winds from sea	+	Y			
	Local climate regulation	The <i>thottam</i> regulates the air temperature.	+	Y			



Name of the village	Annapettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service			0				
	Water regulation	When water from the Valanaaru drains into the <i>alam</i> , the agriculture is improved.	+	Y			
	Flood hazard regulation	The <i>alam</i> and <i>thottam</i> regulate floods.	+	Y	Y		
	Storm hazard regulation	The <i>alam</i> and <i>thottam</i> regulate storms.	+	Y	Y		
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Slurry from the <i>thottam</i> reduces the depth in the channel. Islands has been eroded and have sunk due to various disasters.	--	Y	Y		More than 1000 people resided on the island and were involved in sea fishing for more than a month, and they marketed directly via the sea, but now the islands are not suitable.
	Water purification	The Valavanaaru improves the salinity-degraded groundwater.	+	Y			
	Pollination	There are many orchards.	0				

Name of the village	Annapettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Salinity regulation	When water from the Valanaaru drains, the salinity is improved.	+	Y	Y		
	Fire regulation	No potential source of fire	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage	Poojai on the islands in the wetland (Erukan Theevu, Ayyanarkoyil Theevu, Podi Kaivutheevu, Kutiyakaadu Theevu)	+	Y			
	Recreation and tourism		0				
	Aesthetic value		0				
	Spiritual and religious value		0				
	Inspirational Value		0				
	Social relation	The village is predominantly reliant on fisheries.	+	Y			
	Education and research		0				
Supporting Service	Soil formation	Erosion of island and siltation in <i>thottam</i> and channel	--	Y			
	Primary production	<i>Prosopis</i> has replaced Thalampoo in the island.	-	Y			
	Nutrient cycling	There is no potential application of fertilisers because there are only orchards.	0				

Name of the village	Annapettai	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Supporting Service	Water recycling	The <i>Prosopis</i> invasion has affected the water recycling in the islands.	--	Y			
	Provision of habitat	There are considerable changes in the habitat of the island and in the fish breeding due to shutter construction. The Vallanaru once reached the thottam. It has been silted, and so the connection has been disrupted. So there is no flow into the <i>thottam</i> . As a result, the fish breeding activity is low.	-	Y			
Name of the village	Agasthiyampalli						
Provisional Service	Fresh water	Village surrounded by saltpans. Maanankondan Aaru is not connected to the alam, and the flow in the river is also deteriorating.	--	Y	Y		
	Food	Salt production	++	Y	Y	Y	The existing ecosystem helps the production of salt by increasing the saline density of the brine.
	Fuel	<i>Prosopis</i>	+	Y			
	Fibre		0				
	Genetic resources		0				
	Natural medicine		0				

Name of the village	Agasthiyampalli	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Ornamental resources		0				
	Clay, mineral, aggregate harvesting	The salt produced is used in chemical industries.	++	Y	Y	Y	
	Energy harvesting from air and water		0				
Regulatory Service	Air quality regulation	The forest and salt pans help regulating salt-silt waves.	+	Y			
	Local climate regulation	Increase in temperature due to salt pans	-	Y			
	Global climate regulation		0				
	Water regulation	The salt pans increase the salinity.	--	Y	Y		
	Flood hazard regulation	Since the <i>alam</i> has been converted into salt pans, the drainage has reduced.	-	Y			
	Storm hazard regulation	The salt pans reduce the impact of storms.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Salt pan bunds leads to poor drainage	0				
	Water purification	The salt pans reduce the freshwater quality	--	Y	Y		
	Pollination		0				

Name of the village	Agasthiyampalli	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Salinity regulation	Saltpans	--	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage	Connected with Kodyakarai and Kodyakadu	+	Y			
	Recreation and tourism	Connected with Kodyakarai and Kodyakadu	+	Y			
	Aesthetic value	The saltpans attract tourists and photographers.	+	Y			
	Spiritual and religious value		0				
	Inspirational Value	Historically connected with the Dandi March	++	Y			
	Social relation	Saltpan-dependent communities	+	Y			
	Education and research	Research on the saltpans and saltpan workers	+	Y	Y	Y	
Supporting Service	Soil formation		0				
	Primary production	<i>Prosopis</i> and scrub. Tobacco cultivation	+	Y			
	Nutrient cycling	The soil nutrients have been reduced because of the saltpans.	-	Y			



Name of the village	Agasthiyampalli	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Supporting Service	Water recycling	The saltpans reduce the recharge of fresh water into shallow aquifers.	--	Y			
	Provision of habitat	Birds are attracted towards saltpans in the rainy season.	+	Y	Y	Y	
Name of the village	Thondiyakkadu						
Provisional Service	Fresh water	improved water resources due to construction of shutters and decommissioning of saltpans, but still water is saline	+	Y	Y		The Marakakoraiyaru, Vettaru and Vallavanaru support the freshwater inflow.
	Food	Fish, prawn	++	Y	Y	Y	
	Fuel	NA	0	Y			
	Fibre		0				
	Genetic resources		0				
	Natural medicine		0				
	Ornamental resources		0				
	Clay, mineral, aggregate harvesting	The salt produced is used in chemical industries.	++	Y	Y	Y	
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	+				

Name of the village	Thondiyakkadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Air quality regulation	The large <i>thottam</i> helps regulate salt-silt waves.	+	Y			
	Local climate regulation	The large <i>thottam</i> reduces the air temperature.	+	Y			
	Global climate regulation	Presence of large <i>thottam</i>	+	Y			
	Water regulation	Presence of large <i>thottam</i> helps regulate water flows, and the Valavanar check dams regulate the seawater inflow.	+	Y	Y		
	Flood hazard regulation	Large <i>thottam</i> acts as a barrier	+	Y			
	Storm hazard regulation	Large <i>thottam</i> acts as a barrier	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Cyclone Gaja increased the mud in the <i>thottam</i> . This has directly affected the livelihoods.	--				
	Water purification	The salt pans reduce the freshwater quality.	--	Y	Y		
	Pollination	There are many orchards.	0				

Name of the village	Thondiyakkadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Salinity regulation	The people succeeded in having the salt pans closed. They are the major contributor to the salinity.	+	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage	Connect with island for their local festival	+	Y			They contribute only their fishing income to this festival. This is their practice.
	Recreation and tourism	The government is trying to promote tourism based on a large <i>thottam</i> .	+	Y			
	Aesthetic value	Large <i>thottam</i> and its geographical features have created the potential to invite tourists and photographers	+	Y			
	Spiritual and religious value		0				
	Inspirational Value	NA	0	Y			
	Social relation	Several local associations for farmers and fishermen.	+	Y			
	Education and research	NA	0	Y	Y	Y	
Supporting Service	Soil formation	Transfer of mud from <i>thottam</i> to agricultural lands leads to increased soil salinity.	-				

Name of the village	Thondiyakkadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Supporting Service	Primary production	Paddy and vegetable cultivation	+	Y			
	Nutrient cycling	The runoff from the agricultural lands carries fertilisers.	-	Y			
	Water recycling	Presence of large amount of the mud leads water stagnation	-	Y			The water storage is up to 1 or 2 feet.
	Provision of habitat	Birds are attracted towards the thottam in the rainy season.	+	Y	Y	Y	
Name of the village	Karpaganaatharkulam						
Provisional Service	Fresh water	The water resources have improved due to the construction of shutters and the freshwater inflow of the Marakakoraiyaru, Vettaru and Vallavanaru. Still the people are using open wells.	+	Y	Y		The Pudhu Aaru helps the freshwater inflow significantly.
	Food	Fish, prawn	++	Y	Y	Y	
	Fuel	NA	0	Y			
	Fibre		0	Y			
	Genetic resources		0	Y			
	Natural medicine		0	Y			
	Ornamental resources		0	Y			
	Clay, mineral, aggregate harvesting		0	Y			
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	+				

Name of the village	Karpaganaatharkulam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Air quality regulation	The <i>thottam</i> and mangroves help regulate salt laden winds	+	Y			
	Local climate regulation	The <i>thottam</i> and mangroves help regulate the air temperature.	+	Y			
	Global climate regulation	Presence of <i>thottam</i> and mangroves	+	Y			
	Water regulation	The Marakakoraiyaru, Vettaru and Vallavanaru help water regulation.	+	Y	Y		
	Flood hazard regulation	The <i>thottam</i> and mangroves acts as a barrier.	+	Y			
	Storm hazard regulation	The <i>thottam</i> and mangroves acts as a barrier.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Cyclones lead to sediment deposits in the <i>thottam</i> and waterways.	-				
	Water purification	Rains lead to stagnant fresh water.	--	Y	Y		
	Pollination		0				
	Salinity regulation	Rains lead to stagnant fresh water.	+	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				

Name of the village	Karpaganaatharkulam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	Connect with island for their local festival	+	Y			They contribute only fishing income to this festival as a practice.
	Recreation and tourism	NA	0	Y			
	Aesthetic value	NA	0	Y			
	Spiritual and religious value	NA	0				
	Inspirational Value	NA	0	Y			
	Social relation	Several local associations for farmers and fishermen.	+	Y			
	Education and research	NA	0	Y	Y	Y	
Supporting Service	Soil formation	Transfer of mud from <i>thottam</i> to agricultural land leads to increased soil salinity.	-				
	Primary production	Paddy, vegetable, sesame, millet and pulse cultivation	+	Y			
	Nutrient cycling	The runoff from agricultural land has fertilisers.	-	Y			
	Water recycling	NA	0	Y			
	Provision of habitat	Freshwater inflows improve the breeding potential.	+	Y	Y	Y	



Name of the village	Idumbavanam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	Improved water resources due to construction of shutters and the Marakakoraiyaru, Vettaru and Vallavanaru. These river supports the freshwater inflow. Still, the peoples use <i>kenis</i> (open wells).	+	Y	Y		The Pudhu Aaru helps the freshwater inflow significantly.
	Food	Fish, prawn	++	Y	Y	Y	
	Fuel	Extraction of crude oil in the area leads to destruction of the environment.	-	Y			The Kariyankaddu area is vulnerable to extraction
	Fibre		0	Y			
	Genetic resources		0	Y			
	Natural medicine		0	Y			
	Ornamental resources		0	Y			
	Clay, mineral, aggregate harvesting		0	Y			
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	++	Y			

Name of the village	Idumbavanam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Air quality regulation	The <i>thottam</i> and mangroves help regulate silt waves.	+	Y			
	Local climate regulation	The <i>thottam</i> and mangroves help regulate the air temperature.	+	Y			
	Global climate regulation	Presence of <i>thottam</i> and mangroves	+	Y			
	Water regulation	The Marakakoraiyaru, Vettaru and Vallavanaru help the water regulation.	+	Y	Y		
	Flood hazard regulation	The <i>thottam</i> and mangroves acts as a barrier.	+	Y			
	Storm hazard regulation	The <i>thottam</i> and mangroves acts as a barrier.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Cyclones lead to sediment deposits in the <i>thottam</i> and waterways.	-				
	Water purification	Rains lead to stagnant fresh water.	--	Y	Y		
	Pollination		0				
	Salinity regulation	Rains lead to stagnant fresh water.	+	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				

Name of the village	Idumbavanam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	Connect with island for their local festival	+	Y			They contribute only fishing income to this festival as a practice.
	Recreation and tourism	NA	0	Y			
	Aesthetic value	NA	0	Y			
	Spiritual and religious value	NA	0				
	Inspirational Value	NA	0	Y			
	Social relation	Several local associations for farmers and fishermen.	+	Y			
	Education and research	NA	0	Y	Y	Y	
Supporting Service	Soil formation	Transfer of mud from <i>thottam</i> to agricultural land leads to increased soil salinity.	-				
	Primary production	Paddy, vegetable, sesame, millet and pulse cultivation	+	Y			
	Nutrient cycling	The runoff from agricultural land has fertilisers.	-	Y			
	Water recycling	NA	0	Y			
	Provision of habitat	Freshwater inflows improve the breeding potential.	+	Y	Y	Y	

Name of the village	Thillaivilaagam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	Increased salinity due to aquaculture	--	Y	Y		Yet aquaculture is in increasing, and people are agitated about the saltpans, against which there are legal cases.
	Food	Fish, prawn, food for livestock (minor grasses)	++	Y	Y	Y	
	Fuel	<i>Prosopis</i> as fuel	+	Y			
	Fibre		0	Y			
	Genetic resources		0	Y			
	Natural medicine	Umiri and other plants	+	Y			
	Ornamental resources		0	Y			
	Clay, mineral, aggregate harvesting		0	Y			
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	+	Y			
Regulatory Service	Air quality regulation	The lagoons and mangroves help regulate silt waves.	+	Y			
	Local climate regulation	The lagoons and mangroves help regulate the air temperature.	+	Y			
	Global climate regulation	Lagoons and mangroves	+	Y			

Name of the village	Thillaivilaagam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Water regulation	The Kanthaparichayan Aaru helps water regulation.	+	Y	Y		Below 70 feet, there is only saline water.
	Flood hazard regulation	The lagoon and mangroves act as barriers.	+	Y			
	Storm hazard regulation	The lagoon and mangroves act as barriers.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	The mangroves and scrub help stabilise the soil.	+				
	Water purification	Whenever the freshwater flows in the Kanthaparichyan river and the shutter is closed, it enhances water purification	+	Y	Y		
	Pollination	Presence of numerous scrub	+				
	Salinity regulation	Rains are helpful. Freshwater inflows from the Kanthaparichyan river and the shutter construction have decreased the salinity.	+	Y	Y		
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	The use of motorised boat has led to fewer migrant birds arriving.	-				

Name of the village	Thillaivilaagam	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	Celebration of local god of Munikoyil in the wetland, located at the meeting of the river and the lagoons.	+	Y			Celebrated once a year
	Recreation and tourism	Ecotourism managed by TNFD	+	Y			
	Aesthetic value	Landscape has aesthetic value.	+	Y			
	Spiritual and religious value	NA	0				
	Inspirational Value	Entire ecosystem provides inspirational value.	+	Y			
	Social relation	Several local associations for farmers and fishermen.	+	Y			
	Education and research	This wetland falls within the Muthupet lagoon.	++	Y	Y	Y	
Supporting Service	Soil formation	NA	0				
	Primary production	Mangroves, Umiri, <i>prosopis</i>	+	Y			
	Nutrient cycling	The runoff from agricultural land has fertilisers.	-	Y			
	Water recycling	NA	0	Y			
	Provision of habitat	Degradation of aquatic habitat due to aquaculture and runoff from agricultural land.	-	Y	Y	Y	



Name of the village	Jambavaanodai - Akkarakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	Koriyaru discharges wastewater from several towns	--	Y	Y		Aquaculture has a strong impact.
	Food	Fish, prawn, food for livestock (minor grasses)	++	Y	Y	Y	
	Fuel	<i>Prosopis</i> as fuel	+	Y			
	Fibre		0	Y			
	Genetic resources		0	Y			
	Natural medicine	Umiri and other plants	+	Y			
	Ornamental resources		0	Y			
	Clay, mineral, aggregate harvesting		0	Y			
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	+	Y			
Regulatory Service	Air quality regulation	Presence of lagoons and mangroves help regulate silt waves.	+	Y			
	Local climate regulation	The lagoons and mangroves help regulate the air temperature.	+	Y			
	Global climate regulation	Presence of lagoons and mangroves	+	Y			

Name of the village	Jambavaanodai - Akkarakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Water regulation	The Koraiyaru helps water regulation.	+	Y	Y		The Koraiyaru is highly vulnerable to the urban effluents which flow into the lagoons.
	Flood hazard regulation	The lagoon and mangroves act as barriers.	+	Y			
	Storm hazard regulation	The lagoon and mangroves act as barriers.	+	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	The mangroves and scrub help stabilise the soil.	+				
	Water purification	Aquaculture increases the salinity and pollutes the water of the lagoon.	--	Y	Y		
	Pollination	Presence of numerous scrub	+				
	Salinity regulation	Aquaculture increases the salinity and pollutes the water of the lagoon.	--	Y	Y		Day by day increase in the salinity of the lagoon and groundwater.
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	The use of motorised boat has led to fewer migrant birds arriving.	-				

Name of the village	Jambavaanodai - Akkarakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Cultural heritage	NA	+	Y			Celebrated once a year
	Recreation and tourism	Presence of holistic overall ecosystem.	++	Y			
	Aesthetic value	Presence of holistic overall ecosystem.	++	Y			
	Spiritual and religious value	NA	0				
	Inspirational Value	Presence of holistic overall ecosystem.	+	Y			
	Social relation	Several local associations for farmers and fishermen.	+	Y			
	Education and research	Yes	++	Y	Y	Y	
Supporting Service	Soil formation	NA	0				
	Primary production	Mangroves, Umiri, <i>prosopis</i>	+	Y			
	Nutrient cycling	The runoff from agricultural land has fertilisers.	-	Y			
	Water recycling	NA	0	Y			
	Provision of habitat	Degradation of aquatic habitat due to aquaculture and runoff from agricultural land.	--	Y	Y	Y	

Name of the village	Maravakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	The Paatuvanachi river is recharging the water resources. Ponds and lakes provide more fresh water.	++	Y	Y		
	Food	Fishes and prawns harvested from artificial Creeks and backwater channels. Livestock fodder from mangroves	++	Y			
	Fuel	<i>Prosopis</i>	+	Y			
	Fibre		0				
	Genetic resources	Mangroves, scrub, some specific species such as snakes and insects	++	Y			
	Natural medicine		0				
	Ornamental resources		0				
	Clay, mineral, aggregate harvesting	Small-scale salt production	+	Y	Y		
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	++	Y			
Regulatory Service	Air quality regulation	The mangroves help regulate the air quality.	++	Y	Y		
	Local climate regulation	The mangroves help regulate the climate.	++	Y	Y		
	Global climate regulation						

Name of the village	Maravakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Water regulation	The connection between the freshwater rivers and the sea via creeks and mangroves helps the water regulation.	++	Y			
	Flood hazard regulation	Mangroves and creeks	++	Y			
	Storm hazard regulation	Mangroves and creeks	++	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Mangroves and creeks	++	Y			
	Water purification	Creeks and rivers help purify the water.	++	Y			
	Pollination	Mangroves support pollination	++	Y			
	Salinity regulation	Creeks regulate the salinity of the wetland.	++	Y			
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage		0				
	Recreation and tourism	The mangroves attract tourists.	++	Y	Y		
	Aesthetic value	The mangroves and lagoons attract people.	++	Y	Y		

Name of the village	Maravakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Spiritual and religious value		0				
	Inspirational Value		??				
	Social relation	The people of Maravakadu are dependent on the wetland and agriculture.	+	Y			
	Education and research	The subject of many research studies.	+	Y			
Supporting Service	Soil formation	The silt from the river and mangroves help soil formation.	++	Y			
	Primary production	Mangroves and scrub	++	Y			
	Nutrient cycling	The agricultural runoff and aquafarm runoff disturb the nutrient cycle.	--	Y			
	Water recycling	The rivers, creeks and mangroves help recycle water.	++	Y			
	Provision of habitat	The mangroves, scrub and creeks support the aquatic life and birds.	++	Y			



Name of the village	Manganakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Provisional Service	Fresh water	The Paatuvanachi and Nasuvani rivers are recharging the water resources. The ponds and lakes add more freshwater benefits.	++	Y	Y		
	Food	Fishes and prawns harvested from artificial creeks and backwater channels. Livestock fodder from mangroves.	++	Y			
	Fuel	<i>Prosopis</i>	+	Y			
	Fibre		0				
	Genetic resources	Mangroves, scrub and some specific species such as snakes and insects	++	Y			
	Natural medicine	Umiri and other plants	0				
	Ornamental resources		0				
	Clay, mineral, aggregate harvesting	Small-scale salt production	+	Y	Y		
	Energy harvesting from air and water	Yacht boats (Pai Mara Kapal) use winds and reduce the fuel consumption of fishing boats.	++	Y			
Regulatory Service	Air quality regulation	The mangroves help regulate the air quality	++	Y	Y		
	Local climate regulation	The mangroves help regulate the climate.	++	Y	Y		
	Global climate regulation						

Name of the village	Manganakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Regulatory Service	Water regulation	Connect between freshwater rivers and the sea via creeks and the mangroves helps in water regulation	++	Y			
	Flood hazard regulation	Mangroves and creeks	++	Y			
	Storm hazard regulation	Mangroves and creeks	++	Y			
	Pest regulation		??				
	Disease regulation- human		??				
	Disease regulation- livestock		??				
	Erosion regulation	Mangroves and creeks	++	Y			
	Water purification	Creeks and rivers help purifying water.	++	Y			
	Pollination	Mangroves support pollination	++	Y			
	Salinity regulation	Creeks regulate the salinity of the wetland.	++	Y			
	Fire regulation	No potential source of fires	0				
	Noise and visual buffering	No potential source of pollution	0				
Cultural Service	Cultural heritage		0				
	Recreation and tourism	The mangroves attract tourists.	++	Y	Y		
	Aesthetic value	The mangroves and lagoons attract people.	++	Y	Y		

Name of the village	Manganakaadu	Description of benefit	Scale of benefit				REMARKS
			How important?	Local	Regional	Global	
Cultural Service	Spiritual and religious value		0				
	Inspirational Value		??				
	Social relation	The people of Manganakaadu are dependent on the wetland and agriculture.	+	Y			
	Education and research	The subject of many research studies.	+	Y			
Supporting Service	Soil formation	The silt from the river and mangroves help soil formation.	++	Y			
	Primary production	Mangroves and scrub	++	Y			
	Nutrient cycling	The agricultural runoff and aquafarm runoff disturb the nutrient cycle.	--	Y			
	Water recycling	The rivers, creeks and mangroves help recycle water.	++	Y			
	Provision of habitat	The mangroves, scrub and creeks support the aquatic life and birds.	++	Y			

## ANNEXURE VI - Details of PHSCs and PHCs in dependent villages

S. No.	Village	CD Block	Primary Health Centre (Numbers)	Primary Health Sub-centre (Numbers)
1	Eripurakarai	Pattukkottai	0	1
2	Narasingapuram	Pattukkottai	0	0
3	Soundaranayakipuram	Pattukkottai	0	0
4	Thamarankottai South	Pattukkottai	0	1
5	Thambikottai Maravakad	Pattukkottai	0	0
6	Thambikottai Melakkadu	Pattukkottai	0	1
7	Thampikotai Kelakadu	Pattukkottai	0	1
8	Thambikottai Vadakadu	Pattukkottai	0	0
9	Alangadu	Muthupet	0	1
10	Uppur	Muthupet	0	0
11	Jambuvanodai	Muthupet	0	1
12	Thillaivilagam	Muthupet	0	3
13	Thondiyakkadu	Muthupet	0	0
14	Karppaganatherkulam	Muthupet	0	1
15	Idumbavanam	Muthupet	1	1
16	Vilangadu	Muthupet	0	0
17	Annappettai	Vedaranyam	0	3
18	Voimedu East	Vedaranyam	1	1
19	Voimedu West	Vedaranyam	0	0
20	Pachanathikulam Middle	Vedaranyam	0	1
21	Pachanathikulam West	Vedaranyam	0	1
22	Pannal	Vedaranyam	0	0
23	Kadinevayal	Vedaranyam	0	1
24	Marudur Therku Sethi	Vedaranyam	0	1
25	Thennadar	Vedaranyam	0	0
26	Ayakkarambulam IV Sethi	Vedaranyam	0	0
27	Kodiakkadu	Vedaranyam	0	1
28	Kodiakarai	Vedaranyam	1	1
29	Agasthiyanpalli	Vedaranyam		
30	Kallimedu	Thalainayar	0	1
31	Avarikadu	Thalainayar	0	1
32	Naluvedapathi	Thalainayar	1	1
33	Vandal	Thalainayar		

## ANNEXURE VII – List of activities prohibited or to be regulated within the Eco-sensitive Zone

S. No.	Activity	Description
<b>A. Prohibited Activities</b>		
1	Commercial mining, stone quarrying and crushing units	<p>(a) All new and existing mining (minor and major minerals) and stone quarrying and crushing units are prohibited with immediate effect except for meeting the domestic needs of bona fide local residents, including digging of earth for construction or repair of houses and for manufacture of country tiles or bricks for housing and for personal consumption.</p> <p>(b) The mining operations shall be carried out in accordance with the order of the Hon'ble Supreme Court dated the 4th August, 2006 in the matter of T.N. Godavarman Thirumulpad Vs. UOI in W.P.(C) No. 202 of 1995 and dated the 21st April 2014 in the matter of Goa Foundation Vs. UOI in W.P.(C) No. 435 of 2012.</p>
2	Setting up of industries causing pollution (water, air, soil, noise, etc.)	<p>New industries and expansion of existing polluting industries in the Eco-sensitive Zone shall not be permitted:</p> <p>Provided that non-polluting industries shall be allowed within the Eco-sensitive Zone as per the classification of industries in the guidelines issued by the Central Pollution Control Board in February 2016, unless otherwise specified in this notification and in addition non-polluting cottage industries shall be promoted.</p>
3	Establishment of major hydro-electric project	Prohibited (except as otherwise provided) as per the applicable laws.
4	Use or production or processing of any hazardous substances	Prohibited (except as otherwise provided) as per the applicable laws
5	Discharge of untreated effluents in natural water bodies or land area	Prohibited (except as otherwise provided) as per the applicable laws
6	Setting up of new saw mills	New saw mills or expansion of existing saw mills shall not be permitted within the Eco-sensitive Zone.
7	Setting up of brick kilns	Prohibited (except as otherwise provided) as per the applicable laws
<b>B. Regulated Activities</b>		
8	Commercial establishment of hotels and resorts	<p>No new commercial hotels and resorts shall be permitted within 1 km of the boundary of the protected area or up to the extent of the Eco-sensitive Zone, whichever is nearer, except for small temporary structures for eco-tourism activities:</p> <p>Provided that, beyond 1 km from the boundary of the protected area or up to the extent of Eco-sensitive Zone whichever is nearer, all new tourist activities or expansion of existing activities shall be in conformity with the Tourism Master Plan and guidelines as applicable.</p>

S. No.	Activity	Description
<b>B. Regulated Activities</b>		
9	Construction activities	<p>(a) New commercial construction of any kind shall not be permitted within 1 km from the boundary of the protected area or up to the extent of the Eco-sensitive Zone, whichever is nearer:</p> <p>Provided that local people shall be permitted to undertake construction in their land for their use including the activities mentioned in sub-paragraph (1) of paragraph 3 as per building bye-laws to meet the residential needs of the local residents</p> <p>Provided further that the construction activity related to small-scale industries not causing pollution shall be regulated and kept at the minimum level, with prior permission from the competent authority as per applicable rules and regulations, if any.</p> <p>(b) Beyond 1 km it shall be regulated as per the Zonal Master Plan.</p>
10	Small-scale non-polluting industries	Non-polluting industries as per classification of industries issued by the Central Pollution Control Board in February 2016 and non-hazardous, small-scale and service industries, agriculture, floriculture, horticulture or agro-based industries producing products from indigenous materials from the Eco-sensitive Zone shall be permitted by the competent authority.
11	Felling of trees	<p>(a) There shall be no felling of trees in the forest or on Government or revenue or private lands without the prior permission of the competent authority in the State Government.</p> <p>(b) The felling of trees shall be regulated in accordance with the provisions of the concerned Central or State Act and the rules made thereunder.</p>
12	Collection of forest produce or non-timber forest produce	Regulated as per the applicable laws
13	Erection of electrical and communication towers and laying of cables and other infrastructure	Regulated under applicable laws (underground cabling may be promoted)
14	Infrastructure including civic amenities	Taking measures of mitigation as per the applicable laws, rules and regulations and available guidelines.
15	Widening and strengthening of existing roads and construction of new roads	Taking measures of mitigation as per the applicable laws, rules and regulation and available guidelines.
16	Undertaking other activities related to tourism such as flying over the Eco-sensitive Zone area by hot air balloons, helicopters, drones and microlights	Regulated as per the applicable laws
17	Protection of hill slopes and river banks	Regulated as per the applicable laws
18	Vehicular traffic at night	Regulated for commercial purposes under applicable laws



S. No.	Activity	Description
<b>B. Regulated Activities</b>		
19	Ongoing agriculture and horticulture practices of local communities along with dairy farming, aquaculture and fisheries	Permitted as per the applicable laws for use of locals
20	Establishment of large-scale commercial livestock and poultry farms by firms, corporate and companies	Regulated (except otherwise provided) as per the applicable laws except for meeting local needs
21	Discharge of treated waste water or effluents in natural water bodies or land area	The discharge of treated waste water or effluents into water bodies shall be avoided, and efforts shall be made to recycle and reuse treated waste water. Otherwise the discharge of treated waste water or effluents shall be regulated as per the applicable laws.
22	Commercial extraction of surface water and groundwater	Regulated as per the applicable laws
23	Open wells, bore wells, etc. for agriculture or other use	Other use. Regulated, and the activity should be strictly monitored by the appropriate authority.
24	Solid waste management	Regulated as per the applicable laws
25	Introduction of exotic species	Regulated as per the applicable laws
26	Eco-tourism	Regulated as per the applicable laws
27	Use of polythene bags	Regulated as per the applicable laws
28	Commercial sign boards and hoardings	Regulated as per the applicable laws
<b>C. Promoted Activities</b>		
29	Rainwater harvesting	Shall be actively promoted
30	Organic farming	Shall be actively promoted
31	Adoption of green technology for all activities	Shall be actively promoted
32	Cottage industries (including village artisans)	Shall be actively promoted
33	Use of renewable energy and fuels	Bio-gas, solar light, etc. shall be actively promoted.
34	Agro-forestry	Shall be actively promoted
35	Use of eco-friendly transport	Shall be actively promoted
36	Skill development	Shall be actively promoted

S. No.	Activity	Description
<b>C. Promoted Activities</b>		
37	Restoration of degraded land/forests/habitat	Shall be actively promoted
38	Environmental awareness	Shall be actively promoted
39	Plantation of horticulture and herbals	Shall be actively promoted



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