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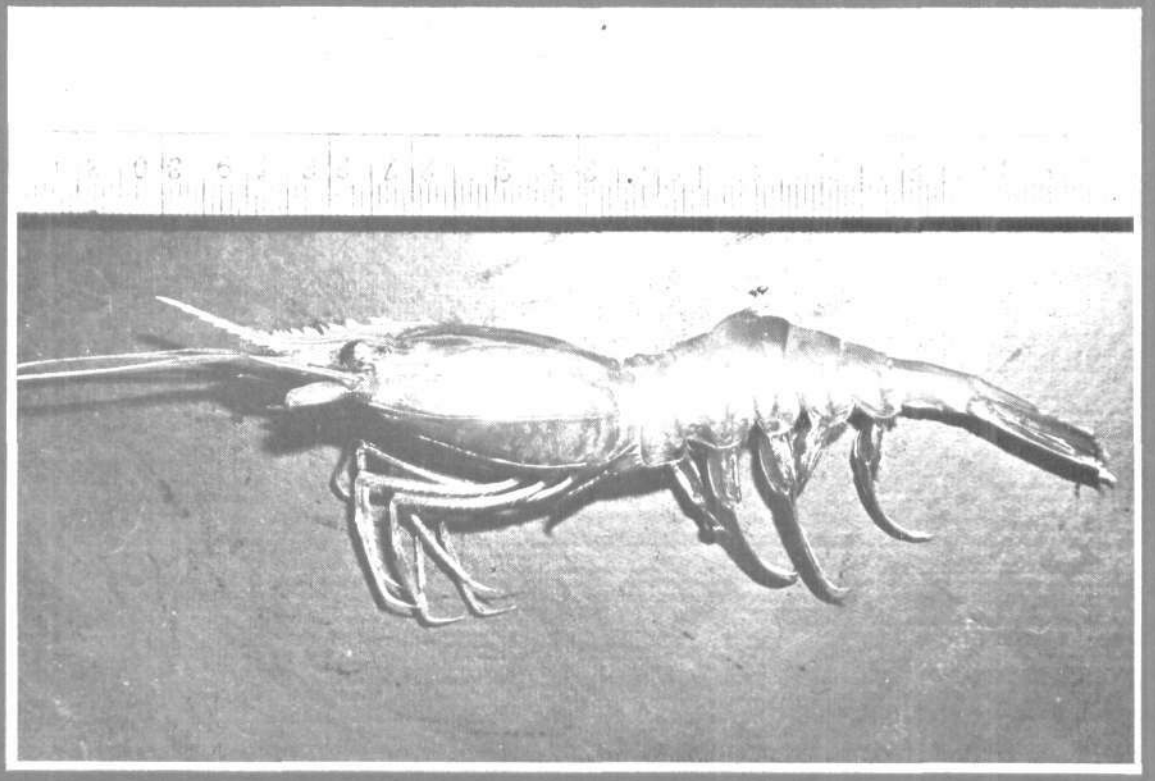

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

ENVIRONMENTAL IMPACT ASSESSMENT IN THE SHRIMP FARMING AREAS OF NAGAPATTINAM QUAID-E-MILLETH DISTRICT, TAMIL NADU

R. Paul Raj, M. Rajagopalan, M. Vijayakumaran, G.S. Daniel Selvaraj, E. Vivekanandan, R. Sathiadhas, R. Narayanakumar, P. Kaladharan, A. Nandakumar, R. Thangavelu, L. Jayasankaran, L.R. Khambadkar and A. Ahmed Kamal Basha

Central Marine Fisheries Research Institute, Cochin - 682 014, India

Introduction

In India, commercial shrimp farming made a beginning in the early 1980s and attained industrial proposition in the late 1980s. As the returns were attractive, many medium and small farmers and corporate sectors started extensive, semi-intensive and intensive culture operations. It is estimated that 74,850 tonnes of shrimps were produced through culture from 1,00,700 hectares of brackishwater area during 1994-'95. There was remarkable growth of the industry in Andhra Pradesh and Tamil Nadu. Since 1994-'95, however, the shrimp farming sector is experiencing stiff opposition from the residents of coastal villages, especially in Tamil Nadu. The coastal villagers believe that the brackishwater shrimp farming is detrimental to human habitation. Their major claims and apprehensions are: (1) most of the agricultural lands are converted to shrimp farms and there is a possibility that agriculture may not be feasible in future in the shrimp farming areas, (2) the stagnant brackishwater in the shrimp ponds would seep through the soil and convert the potable well water brackish, (3) the untreated effluent water of the shrimp farms which is allowed to stagnate around the farms and the dwellings, would be a health hazard, (4) many agricultural labourers are displaced due to depleted agricultural activity and (5) the water intake pipes of the farms which pass through the beach project into the sea, causing hindrance to the fishing activity of the coastal fishermen.

To assess the effects of shrimp farming on the environment and on the coastal population, a study was undertaken by a team of scientific and technical staff of CMFRI in Nagapattinam Quaid-e-Milleth district, Tamil Nadu in September, 1995. Several small and large farms and corporate farms in nine coastal places, viz., Thirumullaivasal, Perunthottam, Poompuhar, Manikkapangu, Tharangampadi, Karaikkal (Pondicherry, U.T.), Thirumalairayanpatnam (Pondicherry, U.T.), Nagapattinam and Velanganni, where a number of farms are located were covered in the study. With the help of the mobile laboratory of the CMFR Institute, the team collected and analysed soil, water and plankton samples in the inlet and outlet of the farm areas, shrimp ponds and from the wells of the nearby villages. Estimations on hydrological parameters, nutrients and total and differential counts of bacteria in the water and soil samples were made following standard procedures. The marine fish landings data which are available with the Fisheries Resources Assessment Division (CMFRI), for the relevant fishing villages, were analysed. The team also interviewed hundreds of fisherfolks and villagers.

During the team's visit, many of the farms were functional. After the viral attack on the shrimps during the first half of 1995, most of the ponds had been restocked and were in different stages of cultivation. This facilitated assessment of the effects of shrimp farming activity on the environment, on the fishery and on the coastal villagers. The highlights of the results, supported by the earlier investigations of the different organisations of the Government of Tamil Nadu before and after the commencement of shrimp farming are given below.

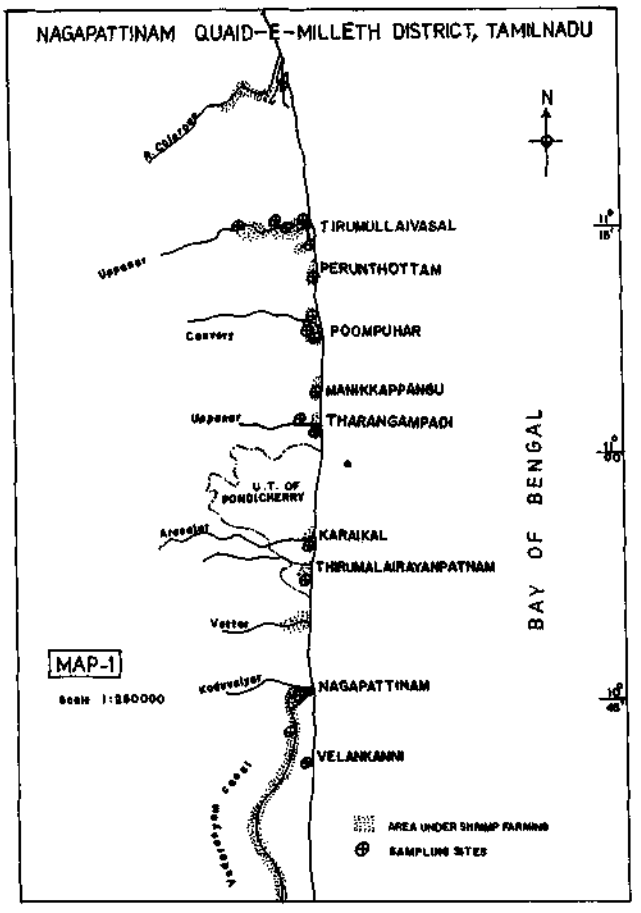
Location of shrimp farms

The total geographical area of Sirhazi, Tharangampadi and Nagapattinam taluks is about 1.07 lakh hectares (Source : Assistant Director of Statistics, NQM District). The net sown (agriculture) area in the three taluks of Sirhazi, Tharangampadi and Nagapattinam accounts for 57, 60 and 58% of the respective total geographical area. The area under prawn farming in these three taluks is about 2,000 ha, which is less than 2% of the total geographical area.

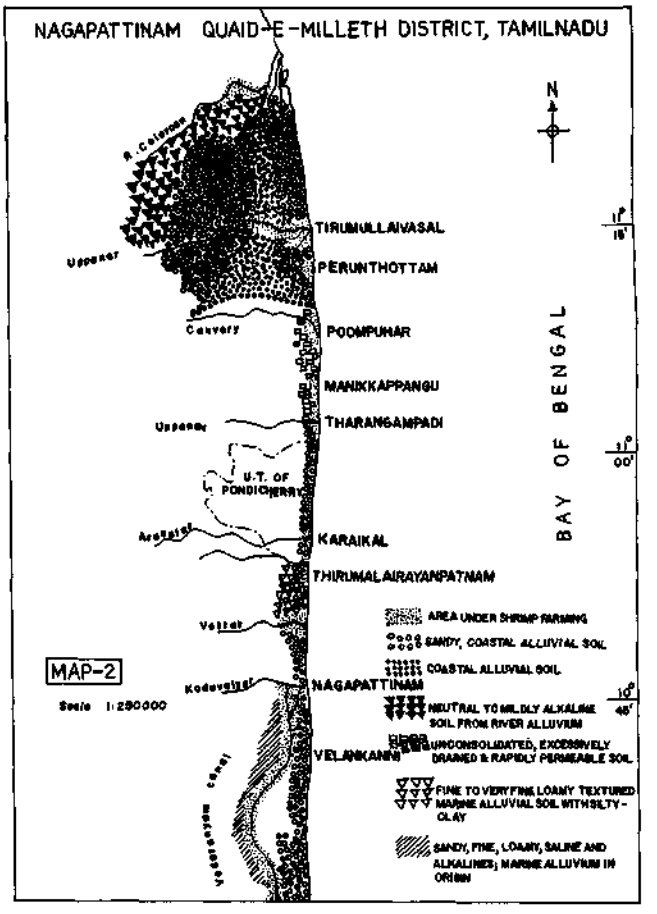
Prawn farming has paved way for utilization of the barren, uncultivable lands. Further, the

land which was under cultivation about 20 years back, has now become uncultivable/cultivable with the prospect of a maximum of 1 crop per year due to inadequate and untimely water supply as this area comes under the tail end of Cauvery irrigation system. Hence, farmers were frantically looking for an alternative use of their land for the last few years.

In the NQM District, the shrimp farms are spread over 31 villages in Sirhazi, Tharangampadi, Nagapattinam, Thiruthuraipoondi and Vedaranyam taluks. In these taluks, more than 100 farms are in operation. All the farms are located in proximity to the coast or in the vicinity of estuarine systems (Map 1).



The shrimp farming activity in the district commenced in 1991 on a small-scale and became intensive from 1993. For understanding the nature of soil and water prior to the commencement of shrimp farming activity, the soil map prepared during 1984 by the Soil Survey and Land Use Organisation, Thanjavur, Government of Tamil Nadu was referred to. The soil in the areas of shrimp farming are mostly sandy, coastal alluvial or unconsolidated, excessively drained and rapidly permeable (Map 2). According to the 1984 survey, it is also clear that the coastal area was affected by surface and sub-surface salinity and alkalinity (Maps 3 & 4). In Thiruthuraipoondi, Nagapattinam and Sirhazi taluks, where most of the shrimp farms are located, about 4,814 ha, 1,502 ha and 13,807 ha of the coastal areas were affected by surface, sub-surface and complete salinity respectively in the year 1984 itself.

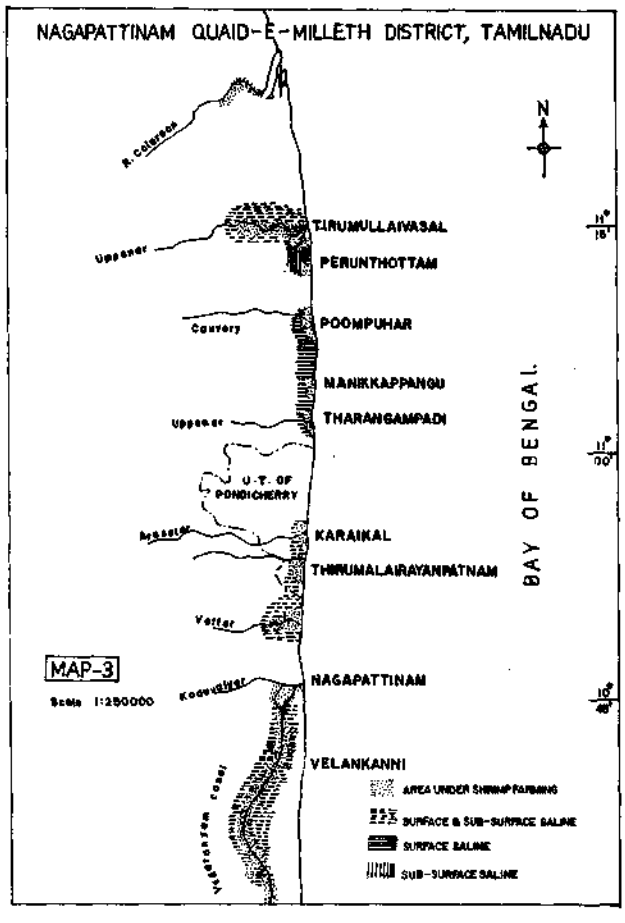


In the Special Report No. 85 (1994), the Soil Survey and Land Use Organisation (SS and LUO) and Soil Testing Laboratory, Aduthurai, Tamil Nadu Agricultural University have concluded that "all the shrimp farms are located in uncultivable waste lands where crops have not been raised for the last 20 years". Hence the question of conversion of productive, functional agricultural land for aquaculture purpose does not arise.

Soil

Prior to the commencement of shrimp farming activity in the coastal areas of Nagapattinam, the Tamil Nadu Government has

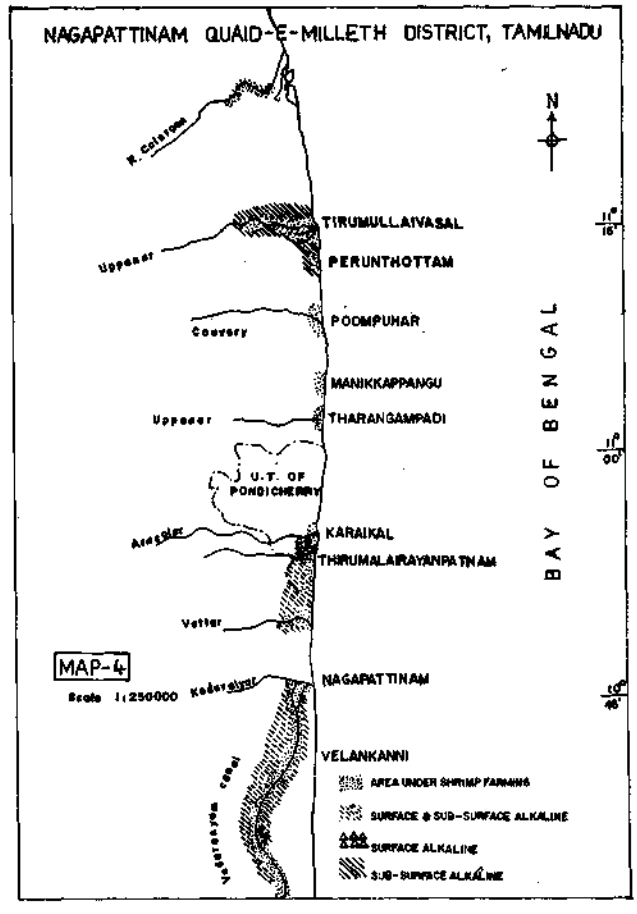
estimated that about 75% of the coastal area in the district is saline in nature either in the surface or in the sub-surface or both. The cause of saline soil is due to a combination of factors which are geographical, climatic, hydrological and monsoonic. The survey also showed that 80% of the soil is highly alkaline (pH 8.5). In 1984, the Tamil Nadu Government has recommended shrimp farming as a potential venture for improving the socio-economic condition of the Nagai Qaid-E-Milleth district.



Water

The quality of ground water in the entire coastal area is saline. Water samples collected from the bore holes of aquifers in the depth range of 30-294 m (SS and LUO, 1984) revealed that the quality of medium and deep aquifers was moderate to poor. Though the top aquifer is better in quality, the potential is very less and is not sufficient for irrigation.

As all the shrimp farms are located in the marine deposits, the quality of ground water is already brackish as established by the Public Works Department (SS and LUO, 1994). Hence the possibility of polluting the ground water (which is already brackish) by the aquaculture farms is minimum.



In general, ground water is not used by the aquaculture farms. Very few farms which were using ground water have stopped doing so due to the Tamil Nadu Government rules and awareness on land subsidence. Presently, all the shrimp farms are using saline water either by pumping from the sea or from the backwaters.

Hydrological characters

Analyses of the hydrological parameters in the water samples revealed the following features:

i. In the Uppanar estuarine system (Thirumullaivasal), the salinity increased from 0.1 ppt in the upstream to 30.9 ppt in the bar mouth and 34.2 ppt in the sea (off Thirumullaivasal). There are a number of shrimp farms on both sides of the estuary drawing water in the salinity range of 6.1 to 35.6 ppt.

ii. The possible negative effects of unregulated shrimp farming like significant increase in Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and eutrophication of creeks and estuaries due to high nutrient shedding from farm effluents were not evident in any areas surveyed during this study (Table 1). The TSS, BOD, COD and nutrient levels were within permissible limits in all places with few exceptions (Ref: Effluent standards by Tamil Nadu Pollution Control Board and Farm Effluent Standards given by Ministry of Agriculture, Government of India; Table 1).

TABLE 1. *Comparison of admissible levels of different parameters in the effluents discharged into estuaries and the actual range of estimates in the farm outlet water, (all values (except pH) are in mg/l)*

Parameters	Admissible level		Estimated range
	Pollution Control Bd (TN Govt.)	Min. of Agri. (Govt. of India)	(Present study)
pH	5.5 - 9.0	6 - 8.5	7.4 - 8.0
DO (minimum level)	3.0	3	3.1 - 8.8
BOD	50.0	20	1.4 - 22.8
COD	100.0	75	54.4 - 103.6
TSS	100.0	100	41.4 - 123.0
Ammonia	1.0	0.5	BDL - 1.0
Phosphate	5.0	0.2	0.025 - 0.25
Heavy metals			
Copper	3.0	-	0.052 - 0.317
Chromium	2.0	-	0.015 - 0.105
Zinc	1.0	-	0.2 - 0.300
Cadmium	2.0	-	BDL - 0.003
Lead	0.1	-	BDL

BDL: Below detectable level.

iii. Marginally high BOD levels were recorded in the outlet canals of two farms (Tables 2 & 3). In one of the farms, there was no culture activity since July 1995, and in the other, the farming was in initial stage with very limited exchange of water. The increase in the BOD was due to stagnation of water in the outer canal.

iv. Marginal increase in the TSS was noticed only in the outlets of small farms (2 to 5 ha area) along Kaduvaiyar, Vellayar and Vedaranyam canal. This was mainly due to high levels of TSS in the estuarine inlet itself.

v. The concentration of heavy metals was negligible in the effluents of all the farms (Tables 4 & 5).

vi. Dry culture pond sediments had slightly higher concentration of heavy metals like iron in the water in the operational ponds.

vii. Since the nutrients in the outlet is within permissible limits, it did not create plankton bloom in any of the areas except in the stagnant outlets of one non-functional farm. It is reported that low level enrichment of sea water by farm effluents increases congregation of fish upto 10 times in the discharge areas.

viii. Though zooplankton concentration was higher in a few estuary based ponds, the concentration was normal in the outlet water. Similarly, there was no marked difference in organic carbon of inlet, pond and outlet waters (Tables 6 & 7).

ix. Total and differential counts of pseudomonas, vibrios and coliforms in the culture ponds and outlets are given in Table 8. Barring one farm in Poompuhar (for which the counts are not given in the table), the bacterial population in the pond water and outlet were not very much different. Coliforms count was high in both water and soil in all the farms.

x. In a few places, agricultural activity was under initiation right across the peripheral bunds/canals of farms indicating that paddy farming can be undertaken, provided freshwater is available in the outskirts of shrimp farms.

xi. Water in the agricultural fields, in the freshwater ponds, and in the wells near the shrimp farms, was almost fresh; but alkalinity was high in some places due to alkaline soil.

xii. It is likely that the concentration of TSS, BOD, COD and nutrients in the farm effluents might increase towards the end of each crop. It is noticed that most of the larger farms are incorporating effluent treatment plants in their existing design. Effective use of effluent treatment system will reduce the concentration of these factors in the farm effluent.

TABLE 2. *Hydrological characters of water at inlet and outlet, adjacent well/borewell and in creek/estuary based shrimp farms of Nagapattinam Quaid-E-Milleth District, Tamil Nadu (Study Period : 12-28 September, 1995)*

Place	Collection site	Salinity (ppt)	pH	BOD (mg/l)	COD (mg/l)	Dissolved oxygen (ml/l)	TSS (mg/l)	Ammonia (ppm)	Nitrite (ppm)	Nitrate (ppm)	Phosphate (ppm)	Alkalinity (mg/l)	Hardness (mg/l)
Thirumullaivasal	Sea water off Thirumullaivasal	34.17	8.5	2.0	101.19	4.51	BDL	0.45	0.050	-	0.25	110.18	6423
Thirumullaivasal	Bar mouth Upparar	30.94	7.0	7.4	103.57	-	20.4	0.25	0.050	10	0.25	109.26	7089
Radhanallur (S & S Farm)	Inlet	12.10	6.8	5.8	103.57	4.84	35.6	BDL	BDL	10	0.25	120.70	2293
	Outlet	17.45	-	22.6	103.57	8.66	89.4	BDL	0.025	10	0.12	139.81	3440
	Well 300m away	0.28	7.5	-	19.09	-	BDL	BDL	0.050	10	2.50	208.51	238
	Borewell 400 m away	0.74	-	-	27.38	-	BDL	BDL	0.250	50	-	424.06	396
Thennampatnam (Sembian Aqua Farm)	Inlet	35.57	7.2	6.0	103.57	4.11	89.6	0.25	BDL	10	0.25	90.74	6464
	Pond	38.51	7.5	4.8	103.57	2.31	123.0	BDL	0.025	BDL	BDL	100.92	7923
Thirukkarugavur (May Fair & Nithya Farm)	Inlet	6.10	7.3	4.8	103.57	5.20	45.6	0.25	0.250	8.0	BDL	143.51	1251
	Pond	0.20	7.5	-	35.72	4.55	45.0	BDL	BDL	10.0	BDL	133.33	188
Seerkazi road bridge	Upparar upstream	0.10	7.0	6.0	17.86	4.33	22.4	BDL	0.025	10	0.12	123.14	166
Poompuhar (Maruthi Farm)	Inlet	24.0	7.3	1.6	78.26	4.62	BDL	0.25	BDL	10	BDL	172.22	3941
	Outlet	26.2	7.4	4.4	78.26	7.36	-	1.0	0.030	15	BDL	-	-
	Handpump	2.5	7.0	-	-	1.30	BDL	3.0	0.030	25	3.0	387.95	813
Tharangampadi	Upparar 0.5 km from bar mouth	2.0	7.8	2.6	24.99	4.76	23.8	0.10	0.200	15	0.10	135.18	559
Kazhuvinthittu (Southern Aquatic Farm)	Inlet	5.82	7.4	3.4	52.17	5.70	37.6	0.10	0.150	18	0.20	133.33	1126
	Outlet	6.86	7.4	4.0	54.35	5.85	41.4	0.10	0.200	10	0.15	140.74	1272
Karaikkal (Pondy State)	Arasalur 0.5 km from bar mouth	15.00	7.8	3.5	70.65	4.19	30.8	0.20	0.150	15	0.10	134.26	3065
Thirumalai Rayan Patnam (Pondy) Pravadanar Creek (Gnanaraj Farm)	Inlet	24.0	7.8	3.0	78.26	3.07	41.0	0.75	0.750	12	0.15	157.40	5213
	Outlet	24.0	7.6	2.8	78.26	3.15	46.0	0.50	-	18	0.10	153.70	4796
Paravai Vedaranyam Canal (Gopi Aqua Farm)	Inlet	15.98	8.2	7.4	52.17	3.68	52.8	0.20	0.150	20	0.25	137.03	1147
	Outlet	26.40	8.0	10.0	-	7.59	BDL	0.20	0.100	20	0.25	142.50	5442
Pappakoil	Kaduvaiyar 5 km away from mouth	18.28	7.8	4.7	-	-	50.4	0.40	0.150	20	0.15	125.92	3566
Velanganni (VRK Farm, Vellayar)	Inlet	20.51	7.4	2.9	78.26	4.22	97.0	0.10	0.150	20	0.10	121.29	4004
	Outlet	25.03	8.0	7.4	78.26	6.10	118.4	0.10	0.100	20	0.25	127.77	5630

BDL - Below detectable level. H_2S was below detectable level in all the samples.

xiii. To control disease, the recent trend in shrimp farming is to drastically reduce the water exchange by recycling the treated effluent. This is a welcome sign since the quantum of water used will be less.

Socio-economic impact of shrimp farms

Due to shrimp farming, the land value has considerably increased. Before the commencement of shrimp farming, the land value in coastal Nagai Q.M. district was only Rs. 18,000-20,000

TABLE 3. *Hydrological characters of inlet and outlet water in sea-water based shrimp farms and adjacent well/borewell water of Nagapattinam Quaid-E-Milleth District, Tamil Nadu (Study period : 12-28 September, 1995)*

Place	Collection site	Salinity (ppt)	pH	BOD (mg/l)	COD (mg/l)	Dissolved oxygen (mg/l)	TSS (mg/l)	Ammonia (ppm)	Nitrite (ppm)	Nitrate (ppm)	Phosphate (ppm)	Alkalinity (mg/l)	Hardness (mg/l)
Perunthottam	Inlet	30.00	7.8	4.8	102.38	3.90	BDL	0.30	0.05	20	BDL	109.26	6672
(Bismi & Bask Farm)	Outlet	34.00	8.0	22.8	103.57	16.50	94.2	0.25	0.25	15	0.25	107.40	4316
1 km away from farm	Borewell	-	7.0	-	47.24	4.37	BDL	BDL	BDL	8	BDL	250.92	334
Poompuhar	Inlet	33.71	7.3	2.6	78.26	4.22	22.2	0.25	0.05	10	0.10	105.55	7089
Amalgam Farm	Outlet	33.43	7.7	1.4	78.26	6.10	51.0	1.00	0.15	10	0.25	136.18	7506
1 km away from farm	Handpump	0.09	7.5	-	BDL	-	BDL	-	-	-	-	105.10	146
Vanagiri	Inlet	33.62	7.5	1.8	78.26	4.69	23.0	0.50	0.025	10	-	107.40	7089
(Harisson Aquaculture Farm)	Outlet	35.65	7.8	7.1	78.26	4.59	-	0.30	0.025	10	0.18	117.03	6081
Manikkapangu	Inlet	35.09	7.7	2.5	78.26	5.41	24.0	0.40	0.15	10	0.25	113.89	7296
(Coastal	Outlet	28.50	7.5	3.9	78.26	5.13	32.2	0.30	0.15	20	0.15	110.52	5004
Enterprises Farm)	Handpump	2.59	7.0	-	61.90	-	BDL	0.40	0.40	15	0.70	387.95	813

BDL - Below detectable level. H_2S was below detectable level in all the samples.

per ha which has increased to about 1.8 lakhs per hectare (10 times). More than 60% of the coastal villagers accepted that their land value has increased due to shrimp farming in their area (Table 9). Further, a major impact of shrimp farming was on the change of land ownership pattern in the coastal areas. The ownership pattern has radically changed due to various reasons. About 19% of the coastal land holdings were sold due to small size of the land (less than one ha), 39% due to high price, 33% due to inadequate profitability in crop production and about 8% due to non-availability of labour (Table 10). The traditional agriculturists in the coastal areas have profitably utilised the money realised from the sale of their lands to purchase interior fertile farm lands. Those who have purchased the lands for shrimp farming, are mostly from other regions.

Employment opportunity has increased due to the shrimp farming. The average labour requirement per ha of paddy cultivation is about 180 labour days per crop, whereas in the shrimp farming it is about 600 labour days/crop. Moreover, regarding paddy, only one unreliable crop may be raised in a year as against the possibility of two crops in shrimp farms. Most of the agricultural labourers who are displaced in the agricultural sector have been absorbed in shrimp farms and, in addition, a considerable number of the unemployed youth have been engaged in prawn farms.

It was observed that female labourers were less required in shrimp farms as compared to paddy cultivation. In paddy cultivation, about 30% of the labour required is female labour who are getting only seasonal employment. Since the women are paid comparatively lesser wage than men, they are having enormous demand in the paddy fields of adjoining regions, and hence, their employment opportunity is not seriously affected due to the growth of aquafarms. On the other hand, provision of regular employment for substantial number of agricultural labourers in the prawn farms led to the increase in the opportunity of agricultural labourers with higher wage rates both in agriculture and prawn farming sectors. The establishment of aquafarms has created subsidiary occupations like catering, transportation and handling of construction materials etc.

Agricultural labourers, on an average, earn an annual income of Rs. 7,500/- whereas the shrimp farm labourers earn Rs. 12,000. Hence, the household income of a family in this area has considerably increased except in the villages of Perunthottam and Manickkapangu where the villagers are reluctant to accept job in shrimp farms.

TABLE 4. *Heavy metal analysis in inlet and outlet water and soil in creek/estuary based shrimp farms of Nagapattinam Quaid-E-Milleth District, Tamil Nadu (Study period : 12-28 September 1995)*

Place	Collection site	Water (ppm)							Sediment/Soil (mg%)						
		Total iron	Copper	Chromium (Total Cr)	Manganese	Zinc	Cadmium	Lead	Total iron	Copper	Chromium (Total Cr)	Manganese	Zinc	Cadmium	Lead
Thirumullaivasal	Sea water off Thirumullaivasal	0.080	0.085	0.050	BDL	0.390	0.0030	BDL	-	-	-	-	-	-	-
Thirumullaivasal	Bar mouth of Upparar	0.047	0.034	0.003	BDL	0.190	0.0050	BDL	0.025	0.0037	0.0004	0.0010	0.0021	0.0004	BDL
Radhanallur (S & S Farm)	Inlet	0.044	0.081	0.003	BDL	0.190	0.005	BDL	0.220	0.0049	0.0004	0.0019	0.051	0.0005	BDL
	Outlet	0.670	0.052	0.015	BDL	0.020	0.003	BDL	0.840	0.0069	0.0008	0.0060	0.0015	0.0005	BDL
	Dry pond	-	-	-	-	-	-	-	2.500	0.0066	0.0002	0.0150	0.0010	0.0002	BDL
Thennampatnam (Sembian Aqua Farm)	Inlet	0.020	0.147	0.008	BDL	0.130	0.0023	BDL	0.620	0.0074	0.0040	0.0009	0.0054	0.0003	BDL
	Pond	0.180	0.155	0.070	BDL	0.170	0.0010	BDL	1.280	0.0077	0.0060	0.0070	0.0007	0.0003	BDL
Thirukkarugavur (May Fair & Nithya Farm)	Inlet	0.040	0.147	0.008	0.10	0.0226	0.0135	BDL	1.050	0.0068	0.0007	0.0003	0.0004	0.0006	BDL
	Pond	0.280	0.091	0.008	0.15	0.080	0.0008	BDL	-	-	-	-	-	-	-
	Dry pond	-	-	-	-	-	-	-	2.220	0.0084	0.0020	0.0042	0.0003	0.0004	BDL
	Peripheral canal	-	-	-	-	-	-	-	-	0.0074	0.0030	0.0081	0.0003	0.0012	BDL
Seerkazi road bridge	Upparar	0.360	0.199	0.003	0.47	0.010	0.003	BDL	0.560	0.0055	0.0009	0.0074	0.0018	0.0003	BDL
Poompuhar (Maruthi Farm)	Inlet	1.030	0.176	0.100	BDL	0.100	BDL	BDL	0.260	0.0280	0.0003	0.0169	0.0007	0.0004	BDL
	Outlet	0.300	0.147	0.090	BDL	0.170	BDL	BDL	0.400	0.0031	0.0004	BDL	0.0009	0.0003	BDL
Tharangampadi	Upparar	0.014	0.151	0.015	BDL	0.260	0.0004	BDL	0.320	0.0025	0.0006	0.0010	0.0050	0.0001	BDL
Kazhuvinthittu (Southern Aquatic Farm)	Inlet	0.316	0.132	0.015	BDL	0.190	BDL	BDL	0.730	0.0071	0.0008	BDL	0.0011	0.0002	BDL
	Outlet	0.048	0.141	0.020	BDL	0.150	BDL	BDL	0.720	0.0037	0.0006	BDL	0.0035	0.0003	BDL
Karaikkal (Pondy)	Arasalur	0.004	0.155	0.028	BDL	0.170	0.0015	BDL	0.210	0.0028	0.0004	BDL	0.0067	0.0002	BDL
Thirumalai Rayanpatnam (Pondy) (Gnanaraj Farm)	Inlet	0.001	0.141	0.025	BDL	0.190	BDL	BDL	0.290	0.0031	0.0006	BDL	0.0038	BDL	BDL
	Outlet	-	-	-	-	-	-	-	0.220	0.0026	0.0008	0.0022	0.0035	0.0003	BDL
Paravai	Inlet	0.104	0.302	0.030	BDL	0.280	BDL	BDL	1.000	0.0084	0.0007	BDL	BDL	0.0003	BDL
Vedaranyam Canal (Gopi Aqua Farm)	Outlet	0.050	0.300	0.043	BDL	0.300	BDL	BDL	0.110	0.0036	0.0005	0.0003	0.0003	0.0004	BDL
Pappakoil	Kaduvaiyar	0.058	0.275	0.028	BDL	0.100	BDL	BDL	0.940	0.0065	0.0004	0.0041	0.0004	0.0003	BDL
Velangarini (VRK Farm) Vellayar	Inlet	0.034	0.151	0.058	BDL	0.300	BDL	BDL	0.580	0.0057	0.0005	BDL	BDL	0.0004	BDL
	Outlet	0.058	0.143	0.058	BDL	0.065	BDL	BDL	1.780	0.0087	0.0014	0.0176	0.0020	0.0003	BDL

BDL - Below detectable level.

Realising the necessity to co-exist with the local rural population, the corporate farms have initiated welfare measures. In Radhanallur, a corporate firm is training socially backward women in tailoring and mat making and helps them to set up independent units and market the products. In Keezhaiyur (Poompuhar) and Perunthottam, free medical facility is provided to the villagers. Road condition is also improved by the farms in some of the villages.

Effect on the marine fishery

To understand whether the shrimp farming activity has affected the fishing activity of the fishermen, the data on marine landings in the Nagai Qaid-E-Milleth district, which is available with the National Marine Living Resources Data Centre (NMLRDC) of CMFRI, Kochi were analysed for a four year period from 1991 (before commencement of intense farming activity) to

TABLE 5. *Heavy metal analysis in inlet and outlet water and soil in sea water based shrimp farms of Nagapattinam Quaid-E-Milleth District, Tamil Nadu (Study period : 12-28 September, 1995)*

Place	Collection site	Water (ppm)							Sediment/Soil (mg%)						
		Total iron	Copper	Chromium (Total Cr)	Manganese	Zinc	Cadmium	Lead	Total iron	Copper	Chromium (Total Cr)	Manganese	Zinc	Cadmium	Lead
Perunthottam	Inlet	-	-	0.130	BDL	-	-	BDL	0.22	0.0045	0.002	0.0037	0.0022	0.0003	BDL
(Bismi & Bask Farm)	Outlet	0.08	0.317	0.170	BDL	0.280	0.0011	BDL	1.06	0.0049	0.002	0.0312	0.0034	0.0002	BDL
Poompuhar	Inlet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Amalgam Farm)	Outlet	0.03	0.135	0.090	BDL	0.068	BDL	BDL	1.54	0.0065	0.0009	0.0107	0.0027	0.0002	BDL
Vanagiri	Inlet	0.59	0.157	0.090	BDL	0.068	0.0004	BDL	0.18	0.0027	0.0001	BDL	0.0008	0.0003	BDL
(Harisson Farm)	Outlet	0.02	0.164	0.105	BDL	0.110	0.0004	BDL	1.59	0.0069	0.0012	BDL	0.0004	0.0003	BDL
Manikkapangu	Inlet	0.006	0.157	0.005	BDL	0.420	BDL	BDL	-	-	-	-	-	-	-
(Coastal Enterprises Farm)	Outlet	0.008	0.089	0.010	BDL	0.270	0.0019	BDL	0.42	0.0031	0.0007	BDL	0.0068	BDL	BDL

BDL - Below detectable level.

1994. There was no major change in the effort and in the annual fish landings during the period (Table 11). The shrimp farming activity has neither curtailed the fishing effort and operation of different gears nor reduced the marine fish landings. It is clear that the shrimp farming activity has not induced any change in the fishing activity of the coastal fishermen.

TABLE 6. *Organic carbon content in the soil, microbial utilization of dissolved oxygen and zooplankton concentration in creek/estuary based farms; the values are range obtained in different farms and the figures in parentheses are averages*

Site	Organic carbon in soil (%)	DO utilization (ml/l/hr)	Zooplankton (no/m^3)
Estuary	0.03 - 0.24 (0.15)	0.050 - 0.306 (0.126)	17 - 467 (224)
Farm inlet	0.06 - 0.45 (0.20)	BDL - 0.374 (0.17)	68 - 487 (252)
Pond	0.06 - 0.21 (0.13)	BDL - 0.274 (0.17)	192 - 8962 (4,330)
Farm outlet	0.06 - 0.36 (0.18)	BDL - 0.235 (0.16)	107 - 682 (312)
Agri. pond	0.30 - 0.88	-	-

Recommendations

The EIA study team did not observe any adverse impact of shrimp farming activity on the environment in the Nagapattinam Qaid-E-Milleth district. Recently, there is awareness among the small and large farmers and the corporate sector on the necessity to preserve the environment. For sustainable shrimp farming, the team recommends the following measures:

a. There is a fear among the villagers that impounding sea water may cause high salinity in the adjacent lands due to possible downward and lateral movement of saline water. Mobility of saline water towards higher elevation will be minimum and can be arrested by cutting a deep trench in the offer zone, 40 cm away from the pond. The trench may be 15 cm deep, 8 cm wide and may be lined with clay. The water collected in the trench may be drained through the outlet canal.

TABLE 7. *Organic carbon content in the soil, microbial utilization of dissolved oxygen and zooplankton concentration in seawater based farms; the values are ranges obtained from different farms and the figures in parentheses represent averages*

Site	Organic carbon in soil (%)	DO utilization (ml/l/hr)	Zooplankton@ (no/m^3)
Farm inlet	BDL - 0.12 (0.06)	0.058 - 0.321 (0.144)	37 - 2789 (1,163)
Pond	0.09 - 0.27 (0.15)	-	107 - 133 (120)
Farm outlet	0.06 - 0.09 (0.07)	0.101 - 0.409* (0.287)	417 - 1724 (1,071)
Agri. pond	0.45	-	-

* In the outlet of one farm where water remained stagnant, the value was 2.809 ml/l/hr.

@ In the creek into which water was released from more than one seawater based farm, the zooplankton concentration was 17,471/m^3.

b. A biopond for treating the waste water is a necessity for small, large and corporate farms. Presently, waste water is not treated

TABLE 8. *Total and differential counts of bacteria in ponds and outlets of shrimp farms. The values are ranges obtained in different farms; the values in parentheses refer to soil bacteria*

Site	Total	Bacterial count (CFU/ml)*			
		Pseudomonas		*Vibrio*	*Coliformis*
		Pyaocyanin	Fluorescein		
Seawater based farms					
Pond	202-212 (600-670)	102-110 (225-250)	90-119 (350-400)	30-42 (65-70)	5,000-5,800 (52,000-62,000)
Outlet	7-353 (182-632)	2-180 (80-325)	2-170 (85-310)	5-120 (18-150)	800-2400 (0-98,000)
Estuary/creek based farms					
Pond	46-350 (180-182)	6-305 (60-110)	35-40 (68-120)	15-90 (45-3,000)	450-4000 (300-28,000)
Outlet	26-370 (19-285)	8-160 (5-60)	15-210 (12-220)	10-90 (20-2,500)	20-980 (0-950)

* the values are CFU/ml x 10^3 for total count and for *Pseudomonas* in water, and CFU/ml x 10^5 for total count and for *pseudomonas* in soil.

in any of the farms. A few corporate farms are creating biopond facility. The team also recommends treatment of waste water by all the farms and the usage of sludge digesting microbes for the management of detritus and the prevention of black mud formation at the bottom of the culture ponds as well as in the biopond.

c. The treated water should not be allowed to stagnate. To maintain free flow of the treated water, desilting of the creeks and opening of bar mouth of the estuaries, as and when required, are necessary, as being done in one of the farms.

d. In order to reduce the organic matter and plankton load, secondary aquaculture of green mussel, edible oyster, pearl oyster, clam, sea cucumber, mullet and sea weed is recommended.

TABLE 9. *Opinion of villagers (in percentage) in shrimp farming areas on the impact of shrimp farming on the value of land*

Villages	Land value has increased	No change in land value	Land value has decreased	No comment
Perunthottam	0.0	2.3	8.3	0.7
Radhanallur	13.0	4.3	5.3	1.3
Pudhukuppam & Neidhavasal	14.3	0.7	2.3	0.0
Poompuhar & Keezhaiyur	4.0	0.0	0.5	10.7
Vanagiri	8.3	0.0	0.0	0.0
Manickapangu	13.3	0.0	0.0	0.0
Chinnathumbar	7.7	0.3	0.0	0.0
Total	60.6	7.6	16.4	15.4

TABLE 10. *Reasons for selling land for shrimp farming (the values are in percentage)*

Villages	Small size of land	High price	Less profit in crop	Non availability of labour
Perunthottam	0.0	2.7	10.0	0.0
Radhanallur	4.3	13.0	4.0	3.0
Pudhukuppam & Neidhavasal	7.7	5.0	4.7	0.0
Poompuhar & Keezhaiyur	6.7	5.0	2.7	1.7
Vanagiri	0.6	0.7	3.7	3.3
Manickapangu	0.0	12.6	0.7	0.0
Chinnathumbur	0.0	0.3	7.3	0.3
Total	19.3	39.3	33.1	8.3

e. The guidelines issued by the Ministry of Agriculture, Govt. of India and the Tamil Nadu Aquaculture (Regulation) Act 1995 may be strictly followed for sustainable development and management of brackishwater aquaculture.

TABLE 11. *Annual fishing effort (000 fishing hours) and catch (tonnes) from major gears in Nagai Qaid-E-Milleth District, Tamil Nadu*

Gear	1991		1992		1993		1994	
	Effort	Catch	Effort	Catch	Effort	Catch	Effort	Catch
Gill net	1,387	15,400	1,030	12,911	1,213	15,108	1,549	17,244
Bag net	20	2,785	16	5,649	12	3,346	27	3,385
Hook & line	29	196	45	262	18	157	39	264
Other gears	-	634	-	1,910	-	1,933	-	510
Total		19,015		20,732		2,544		21,403