Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

The impact of water pollution on the socio-economic status of the stakeholders of Ennore Creek, Bay of Bengal (India): Part I

V.Shanthi[1] and N. Gajendran[2]

University of Madras, [1]Dept. of Economics, Chellammal Women's College, Guindy, Chennai-600 005, India.
[2]C.A.S. in Botany, University of Madras, Chennai-25.

gajend6an@yahoo.com

The holistic nature of human ecology is the study of human social systems in relation to the total environment (UNESCO, 1979). Its aim is to understand the pattern of the interactions between different human situations to formulate prudent and effective policies for the future. At the root of human ecology lie two fundamental concerns: the concern for integrity of the ecosystems of the biosphere on which mankind's existence depends and the concern for the health and well being of the people.

Coastal area is the confluence point of the natural land based nutrients and the salt based oceans. Coastal water provides livelihood and also serves as treasure for genetic stock. Coastal zone occupies 10 % of the marine area and produces 90 % of total marine food. Coastline provides seat for atomic and thermal power generations. Optimum benefit of the coastal water can be achieved by preserving its natural integrity under unpolluted atmosphere. It is essential to bring about a joint management of enforcing agencies of environmental loss, industrial agencies causing environment pollution and users of natural resources of the coastal areas. The concept behind this approach is to evolve eco-environmental friendly strategies with a participatory approach of all concerned. Man and the Bio-sphere Project 11-considers the ecological aspects of urban systems including water (UNESCO, 1979).

The coastal zone is generally viewed as common resources available to all. The multiplicity of uses of the coast and coastal waters are for industry, transport, recreation, mariculture and fish production and also the source for non-living resources. The pollution abatement is the prime concern of everybody involved with the coastal resources. The central problem in this study of environmental economics is an understanding of the coastal resources wherein the society exerts pressure and also to evolve strategy for use of such resources economically. Humans use a wide variety of marine organisms for food, medicines, raw materials, pets and curios. Coastal resources are valuable natural endowments that need to be sustainably managed for present and future generation. Owing to the complexity of the consequences, the enforcing agencies need appropriate understandings on ecological balance, environmental constraints, social conflicts and economic efficiency.

The fishing community is the link between the sea and land and adapted to the ecological niche. Through generations of interactions with the sea and nature, fisher folks have acquired skill in protecting, preserving and using the ecosystems sustainable. They developed a variety of technologies tailored to the specific ecological niches along the coast. Dislocating or displacing them for industrial development will totally upset their livelihood, social structure and economic welfare leading to perennial conflicts and tensions. Hence, the eco-studies of the indigenous people are the need of the hour. It is not only physical environmental impact but also the social impacts of developmental interventions need to be assessed.

Of late, the coastal ecosystems are highly degraded due to high population and industrial growth (Glasby & Roonwal, 1995; UNEP, 1997). Due to various pollutions including pesticide poisoning (Sen Gupta *et al*., 1990), over exploitation of water resources by power plant industries and the municipal uses and encroachment for urban developments force the fishing community to the brink of disappearance. When those natural resources are imperilled, so too are the livelihoods of the many people who live and work there. The environmental abuse and the negligence of the governing body make the matter worse (Sreenivasan & Franklin, 1975). The severity of water pollution of Ennore Creek and its coastal areas makes the ecosystem unsustainable in which some rare fishes and plants ultimately thrive (NEERI Report, 1995). The affected fishing communities start migrating to other places for want of a suitable environment in order to improve their economic status. Together they deteriorate the skills for the optimal utilisation of coastal resources in tune with the nature. Thus, the guards of coastal ecosystem tend to disappear from the scene of sustainable marine resource utilisation only leaving the fragile resources at the mercy of profit centered industries with environmental ignorance.

India has an extensive coastline of nearly 7,527 km and vast exclusive economic zone (EEZ). It contributes about 46 per cent of total exploitable living resources of Indian Ocean. Current approaches to the management of coastal resources are not capable of sustainable development and the coastal environments and resources are being rapidly degraded and eroded in India (Ramachandran, 2001).

The State of Tamil Nadu is cherished with 950 km long coastline with Pulicat Lake in the north and Kanyakumari in the south. Chennai, which is the capital city of Tamil Nadu, is subjected to industrial development and population explosion. Environmental degradation is the major concern and the coastal pollution is expected to be most significant as the coastal area of the city (~ 75 kms) stretching between with Ennore Power Plant, and sprinkled with Manali Industrial Complex in the north and Madras Atomic Power Plants I and II in the south. The coastal belt is subjected to all kinds of anthropogenic

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

pressure. Owing to its ecological importance the narrow belt forms critical study area for environmental economist, policy makers and environmental health watch group.

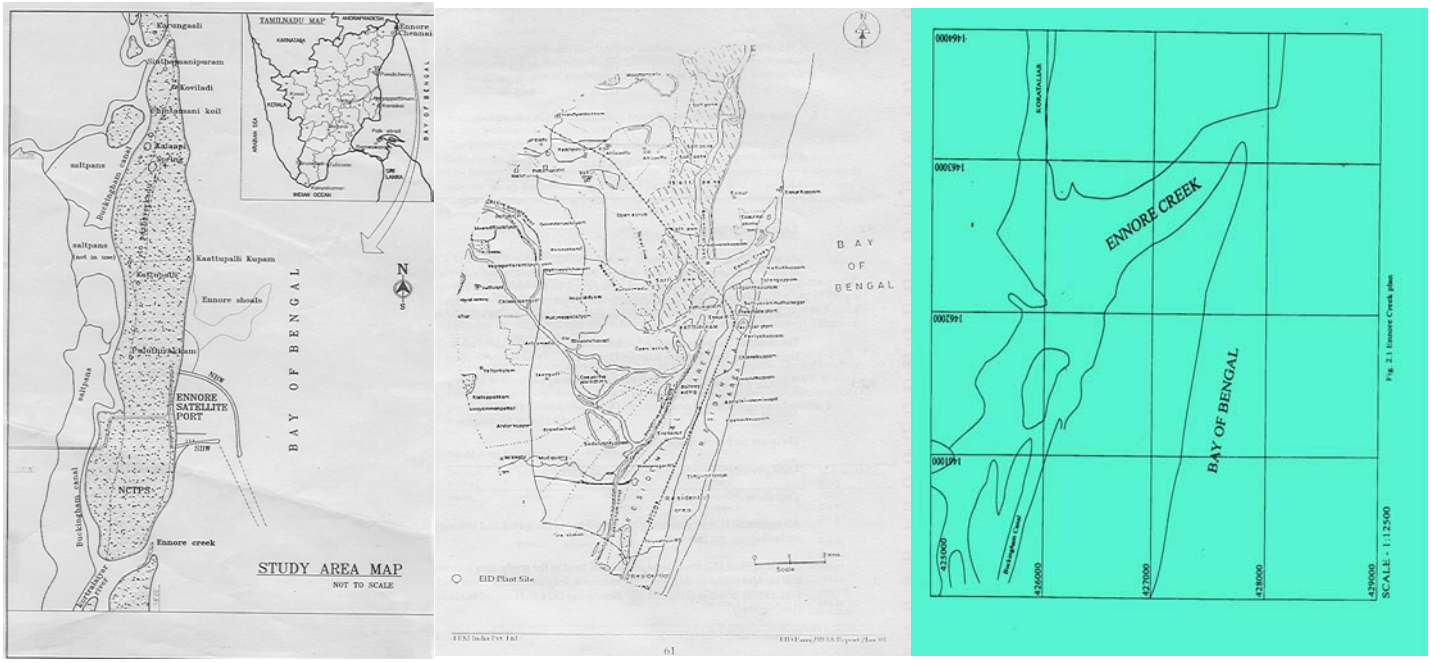
The creeks are comparatively less along Tamil Nadu coast and the analysis of LandSat and Thematic Mapper data of April 1983 and December 1983 shows that the 'creeks are dynamically changing due to the seasonal variations. The study of Ennore and Kovalam creeks are also dynamically changing during the southwest monsoon and suffer excessive sedimentation during this period. The already exiting Jetties near Kalpakkam and Madras harbour cause excessive sedimentation near the Kovalam creeks and Ennore creeks. In the Pulicat backwater, the mouth is silted much (Durariraj, 1988; Manivel *et al*., 1995).

Ennore creek was once the paradise for mangroves, reptiles, turtles and rare fishes. The study area is not only the nature's gift but also a source for sustaining the traditional fishermen community settled in this Creek (Jayaprakash, 2003, Jayaprakash *et al*., 2005). The Creek, situated in between the Kourtaliar river (fresh water source) and the Bay of Bengal is intercepted by Buckingham canal (tidal water body) and has been supporting the livelihood of many thousands of fishing families who are the original stakeholders settled in the nearby villages. Thus, the unique physical landscape and marshes of Ennore Creek are covered by fresh water and salt water which provides a rich supply of food that supports a large variety of animal and plant life (Suriyanarayana Moorthy & Mohammed Habibullah, 2001). This estuary formed a good source of fisheries, particularly of mullets and prawns. Studies on the hydrobiology and fisheries of this water area are therefore being pursued regularly at the fisheries biological station at Ennore. At present, the coastal pollution endangers Ennore Creek by all means.

Ecologically, Ennore Creek is the most strategic place where many industries started mushrooming in and around the creek in the late 1970s led to meristamatic growth affecting the fishing community (Arunagiri *et al*., 1998). The environmental degradation of the Ennore Creek is structurally different from the problem of pollution of the metropolitan city of Chennai. This narrow creek is one among the most polluted creeks along the Eastern Coast, which is not only receiving worldwide attention, but also one of the areas demanding intensive research. The ecologically sensitive Ennore is surrounded by the water body of Pulicat Lake in the northern boundary of Tamil Nadu, realizing the quantum of flow occurring in this region, the Buckingham canal was constructed to connect Northern coast line of Chennai City with its Southern coastline. The biodiversity of this study area and the people who depend on them was once inseparably embedded with the ecosystem (Sanjeeva Raj; CReNIEO p.1). However, at present they have been separated by the effluents of industries leading to the degradation of the bio-diversity and impoverishing livelihood and hygienic conditions of the fishing community.

The high pollution load in Ennore Creek has drastically changed the ecosystem (Jayapaul Azariah *et al*., 1997). The recent construction of Ennore satellite port is changing the coastal morphology in and around the Ennore area. Ennore creek is placed on the eco-pathological time bomb and the ecological jewel is running short of time for redemption. A scientific approach is needed to understand the complexity of the degradation and also to evolve a suitable strategy to

Fig.1 Location map and study area (Ennore Creek)



Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

preserve the ecological treasure, the ecological pathology of Ennore deserves for immediate attention.

Statement of the problem

Ennore Creek becomes the pollution point in Bay of Bengal which influences the marine resources and productivity of the region. This coastal belt in the neighboring areas of the city is viewed as dumping sites for industrial effluents and disposing domestic waste (Arunagiri *et al.*, 1998). The natural wealth of the creek is now being eroded to mere sewage channel (Jayaprakash, 2003).

The Ennore Thermal Power Plant uses the river waters as coolant and lets out the warm water, in the Ennore Creek. Extensive deposition of sand bar is taking place in the mouth of the creek and the northern surrounding region of the coastal sites (Kee-Chai-Chang, 2000). The discharge of the hot coolant water and flyash has created an algal bloom, which gets entangled with fishing nets and damages them. The hot cooler water from the plant discharged into the Buckingham Canal where the discharges enter the sea there is no sign of marine life (Sanjeevaraj, 2001).

The Central Pollution Control Board in collaboration with State Pollution Control Board identified Manali at the Ennore Industrial complex as one of the problem area in the country. There is an immediate danger of breaking the homeostasis due to the over loading pollutants spewing out continuously from Manali industrial complexes and Ennore Thermal Power stations (SPIC-SMO, 1990). Ennore Creek is placed on the eco-pathological time bomb and the ecological jewel is running short of time for redemption. The stakeholders of these common property resources have been facing problems in the wake of increasing anthropogenic pollution. Particularly, the fisher folks, the engineering force of transforming the aquatic productivity into sustainable protein food for malnourished people, are facing fish shortage and health hazards. The economically handicapped fisher folks are slowly poisoned maimed and are marching steadily towards the economic death trap. The once rich ecological site is the answer for various vexing questions in the realm of ecology, pollution, industrialisation, fishing community and the struggle of economic planners for sustainability.

Scope of the study

The area of the study is the Ennore Creek which is situated close to the northern boundary of Chennai City. Ennore Creek traditionally influences the livelihood of the stakeholders inhabited near the creek. A preliminary field investigations and interactions with local population indicated the quantum of environmental and health risk associated with it. The severity of the environmental degradation of Ennore creek could reflect upon the health and living conditions of the stakeholders of the area.

There have been several incidents and studies which indicate pollution induced fish killing and health hazards among the fisherfolk of Ennore. Many respondents during preliminary investigations felt that the highly polluted Ennore Creek spoils the feature of the fishing products. Some had apprehension about the migration potential of fishes throughout the belt. There have been encroachments for new constructions which would replace traditional fisher folk. There were occasional strong protests released by fisher folk over the Ennore Power Plant after witnessing thermal water killing the fish. The agitations also led to manpower loss and economic loss. In the back drop of the strong ecological pressure exerted on the coastal resources particularly on the livelihood of fishing folk, the study has been undertaken to examine the socio-economic conditions of fishermen in Ennore Creek.

Objectives

To understand the socio economic profile of fishing community and to identify various factors that affect the coastal environmental health and the livelihood of the fishing community a survey has been planned. The broad objective of the study is to examine the socio-economic conditions of the stakeholders in Ennore Creek; while the supplementary objectives centered on the analysis of the impact of water pollution & the creek environment on the health and income of stakeholders of Ennore Creek.

Hypotheses of the study

1. There is an influence of environmental factors on the prevalence of disease and the working days lost due to sickness of the stakeholders in Ennore Creek.
2. There exists a significant reduction in fish yield for over the years due to environmental degradation of Ennore Creek, thereby the fisher folks become poorer.

Methodology

The study has been undertaken using both primary and secondary data. The secondary data have been received from books, journal, news reports, working paper and the projects of various research institutions like Madras Institute of Development Studies, Madras School of Economics, Tamil Nadu Pollution Control Board, Central Marine Fisheries Research Institute, Anna University, National Institute of Ocean Technology, Department of Fisheries, Zoological Survey of India, M.S.Swaminathan Research Foundation, Tamil Nadu Water and Drainage Board, CReNIEO, NEERI, BOB Programme etc.

The primary data has been collected through field survey. A questionnaire has been designed to collect a comprehensive profile of socioeconomic conditions of households of the fisher folk and their traditional skills. Since the fishing communities are illiterate, a personal survey has been conducted and additional information have been elicited from individuals and groups. The primary data collected from the field have been meticulously entered into the computer for processing and tabulation. Special camps and programmes have been conducted to bring the hidden skills of the fisher folk to the fore.

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

It is observed that the polluted Ennore creek is the most important reason for the deteriorating living conditions of the stakeholders. In order to study the socio-economic impact of water pollution of the Ennore Creek on the socio-economic status of the stakeholders, it has been decided to draw 350 sample households from 8 villages located at the banks of Ennore Creek. Thus 350 sample households have been drawn on the basis of the proportion of total population in the selected villages.

Keeping in view of the nature of the problem, social and environmental situation and the objectives of the present study, it has been decided to use descriptive-diagnostic study. In order to ascertain the inclusiveness of each area random sampling method has been adopted. A list of households has been obtained by the Tamil Nadu Civil Supplies Corporation records. The interview schedule was considered to be the appropriate one for the purpose. Then the main instrument used in collecting the data has been the structured schedule, which has to be filled through interview schedules. Out of the 350 schedules administered for the study only 306 schedules have been complete without any errors.

Tools and Methods

The study makes uses of simple ratios, averages and Correlation Analysis. The elicited data have been subjected to analysis by using step wise multiple regression and factor analysis. In order to verify the impact of water pollution on the socio-economic status of the stakeholders, a factor analysis model has been run by taking appropriate descriptive variables.

Limitations

The poor socio-economic conditions of the sample households are not only due to the water pollution and the poor environment of the households in the study area but also there are many other personal and familial reasons influence their status. But effort has been made to isolate the socio economic status of households due to water pollution and poor living environment.

Ennore Creek (Fig.1)

Demography

Ennore Creek is located in Thiruvallur district of Tamil Nadu with the geographical coordinates of North Latitude 13°10' and East Longitude 80°20'. The zone that surrounds the Ennore comprises lagoons, with salt marshes and backwaters, which are submerged under water during high tide and form an arm of the sea with the opening to the Bay of Bengal at Ennore Creek. The total area of the creek is 2.25 sq km which lies 20 km away from Chennai in Northward direction. The creek is nearly 400 m wide and is elongated in northeast- southwest direction and merges with the backwater bodies. Its north-south trending channels connecting it to the Pulicat lake to the north and to the distributaries of Kosasthaliyar River in the south. The channel, which connects the creek to Pulicat, is marked as Kosasthaliyar in the Survey of India Topo sheets. The depth of the creek ranges from 1-2 m and is shallow near the mouth. The north-western part merges with the tidal flats. Once the flourished mangrove swamp is now noticed as degraded patches in the fringes. The area experiences rainfall mainly from South East and North West Monsoons. The annual rainfall is about 1200 mm per annum. The temperature ranges from 25^{0}C to 40^{0}C. The soil is of Loamy and Alluvial types.

Existing studies

The creek once encompassed with rich biodiversity of vegetation types and associated fauna contribute an excellent green belt that would be totally wiped out by the petrochemical complex. Industries pump their effluents into the Ennore Creek, the natural wealth is eroded to mere sewage channel and the biological productivity of the coast has come down (Jayaprakash, 2002). The recent construction of Ennore satellite port is changing the coastal morphology in and around the Ennore area (Kasinathapandian, 2002, 2008). There is a need to assess the impact of the modern technology and the market on the health and livelihood of fisher folk. They can equip themselves with the necessary education and protective measures (Kee Chai Chang & Roy, 1997). According to Masilamani *et al*. (1999), heavy economic loss has been incurred because of the mismanagement of the coastal water. The various chemicals and physical method used to control the flora and fauna in cooling channels of the power plants reduce the precious marine bio- diversity. As the Ennore thermal power plant uses the creek water as coolant and lets out the warm water the sand bar is dredged periodically to keep it open.

Industries at Ennore Creek

The Ennore Industrial Complex is located adjacent to Manali Industrial Complex. It includes pharmaceuticals, chemicals, fertilizers; automotive manufacturing unit and a coal fired thermal electricity station-ETPS. Apart from this, NCTPS came to existence at a latter stage.

Pharmaceutical and Agro Chemical Division India (ICI): It is a large pharmaceuticals and chemical complex, which releases liquid effluent with spent chemicals. The organic constituents of this waste stream are treated in an activated sludge system and discharged to the sea.

Ennore Thermal Power Station (ETPS): Ennore Thermal Plant generates 420 KLD of trade effluent from demineralising plant (DM) and 38,400 KLD of trade effluent as ash slurry. The effluent is treated and discharged into Buckingham canal. Ash slurry hitherto pumped into the sea is presently let into ash dykes constructed in the 230 acres area at 1.25 km western side of the plant. The unit is pumping seawater at the rate of 17, 60,000 kiloliters per day for condenser cooling from Ennore Creek. After condenser cooling, the hot water is discharged into the creek. In order to reduce the thermal pollution and also to overcome the difficulty in getting the cooling water due to sand dune formation at the mouth of the creek, the unit has a provision for five cooling towers to recycle the cooling water. The plant also takes sea water as coolant and discharges hot water back to the sea. About 8,000 tons of coal is burnt every day when all

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

units are in service and as this contains about 40 per cent ash, a total quantity of 3,200 tons of ash has to be disposed off every day. Fly ash is the major pollutant, which is captured by the air pollution control system in slurry form and discharged into the sea. The plant also takes sea water as coolant and discharges hot water back to the sea.

North Chennai Thermal Power Station (NCTPS): North Chennai Thermal Power Station generates 55,800 kilo litter per day (KLD) of trade effluent from DM plant regeneration, boiler blow-down and ash slurry. Ash slurry is discharged into ash dykes constructed in an area of 1000 acre. The unit was given consent to discharge cooling water into sea whereas the unit discharges the cooling water into Buckingham canal which joins with Ennore Creek. The fishermen in this area have made a complaint against the discharge. The Tamil Nadu Pollution Control Board (TNPCB) has directed the unit to stop the discharge of cooling water into Buckingham canal. In this connection, Tamil Nadu Electricity Board has engaged Central Water and Power Research Station (CWPRS), Pune for a study (CPCB, 1995). CWPRS has recommended having open pre cooling channel having width up to 130m for about 2.5 Km, after flowing through the existing hot water channel for about 2km, along the compound wall totalling a distanced of 4.5 km to Ennore Creek and thereby mixing with the creek water. The intention was to bring down the thermal pollution.

Manali

The Manali New Town and the Manali Industrial Complex are part of 'Manali', an industrial town adjoining Ennore Creek both hazardous and non-hazardous industries are located here. The Manali New Town is drained by Kosastalayar River while the Manali Industrial Complex releases the industrial effluents in the Buckingham Canal. Manali Industrial Complex comprises about 13 major industrial units of which 8 of them are classified as large scale industries. Tamil Nadu Pollution Control Board has classified these industries as Red Industries. It includes crude oil refinery, petrochemical, heavy chemical, fertilizers, pharmaceuticals and chlorine-alkali production.

Crude Oil Refining: Madras Refinery Limited (MRL) is a public limited company, which processes the imported crude containing a sulphur level of 1.8-2.5 per cent by weight. The atmospheric distillation unit fractionates the crude into overhead product, Heavy naphtha cut, Superior kerosene cut, Diesel cut and atmospheric residue.

The Chennai Petroleum Corporation: exists since 1963, processing imported crude of 2.8 Million metric tons per annum (MMTPA) in Refinery I and 1.5 MMTPA in Refinery II and indigenous crude 2.2 of MMTPA in refinery II. Thus the total processing capacity of Refinery I and II is 6.5 MMTPA. By refining the crude oil the unit produces LPG, petrol feed stock, motor spirit, light aromatic naphtha, aviation turbine fuel, superior kerosene, linear alkyl benzene, high speed diesel oil, lube oil base stock, fuel oil, low sulphur heavy stock, bitumen, sulphur, carbon block feed stock and wax. After treatment, about 60 per cent of the effluent is reused internally for green belt development, civil works and fire hydrant system and remaining (40 per cent) per unit is discharged into Buckingham canal.

The dispersion of emission from point source of fuel firing in various heater furnaces to heat the crude oil or intermediate products forming feed to various processing units. Fugitive emissions are primarily from intermittent or continuous leakage or evaporation of volatile organic carbon (VOC) from processing or storage area. The ambient air quality shows sulphur dioxide and nitric oxide were within the standards in all 8 sampling stations whereas sulphur dioxide exceeded in 3 sampling stations.

Chemical Production: The Madras Petrochemical plant produces transformer oils, petroleum jelly and other petroleum products. Liquid waste from the petroleum plant is treated in DCDA (Double Contact Double Adsorption) system, which produces acid sledge (Sreenivasan & Franklin, 1975). The sledge is presently being stored in a large lagoon on site.

Southern Petrochemicals Industries Corporation (SPIC): is a heavy chemical division a chlorine-alkali plant, which uses sodium chloride from seawater to produce caustic soda, hydrochloric acid, liquid and gaseous chlorine, hydrogen and ammonium chloride.

Organics Ltd.: The unit produces 1000 tons of Polyols and 650 tons of propylene glycol per Month. It also produces 175 Tons of by product propylene dichloride per month, dipropylene glycol 80 tons per month, Tripropylene glycol 10 Tons per month and propylene oxide 1000 tons per month. It utilizes 20 KLD of water for domestic purpose, 500 KLD for cooling and 4800 KLD for process. It generates 15 KLD of sewage and 4500 KLD of trade effluent. Sewage is treated and disposed through septic tank and dispersion trench arrangement. Trade effluent is generated from process, floor washing, boiler blow down and DM plant regeneration. The treated trade effluents are discharged into the sea along with Manali Petro Chemical Limited effluent.

Indian Organic Chemical Plant: It produces a variety of organic chemicals for commercial purposes. Dried sludge from the treatment units are currently being used as manure for on-site forestry plantation.

Tamil Nadu Petro Products (TNPP) Ltd: The unit generates 100 KLD of sewage and 310 KLD of trade effluent. Sewage is treated in the sewage treatment plant consisting of screen pit, oil removal tank, collection tank, equalization tank, aeration tank, settling tank and sludge drying bed Trade effluent is discharged into sea. The unit also generates non mercury bearing brine sludge from salt purification. It is disposed as land fill. The unit also generates mercury bearing waste. It is stored in impervious pit within the premises. Although the normal

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

route of effluent discharge is to be Buckingham canal, the effluent was being used on site for irrigation.

Manali Petro Chemicals: The unit produces propylene oxide and propylene glycol 520 Tons/Month. The unit utilizes 50 KLD of water for domestic purpose, 1800 KLD for cooling and 5150 KLD for process. It generates 15 KLD of sewage and 3400 KLD of trade effluent. Sewage is treated and disposed through septic tank and soak pit arrangement. The treated trade effluent is discharged into sea at a distance of 600 m inside from seashore.

Kothari Sugar Chemicals: The unit generates 14 KLD of sewage and 320.5 KLD of trade effluent. Sewage is treated in the septic tank and the over flow is treated with trade effluent in the effluent treatment plant. Stacks of adequate height are provided for discharge of emission from flare, boiler, oil heater and D.G. Sets. The unit generates no solid waste. This plant discharges effluent into the sea, along with the liquid effluent produced by the UB petro plant.

Cetex: It produces methyl ethyl ketone as main product and secondary butyl ether heavy fractions dimmer fraction and sulphuric acid as by product. The unit utilizes 6 KLD of water for domestic purpose 495 KLD for cooling and process. It generates 5KLD of sewage and 70 KLD of trade effluent. The unit generates ETP sludge. The sludge yielded by the treatment of wastewater, containing spent chemicals and consists largely of calcium sulphate (gypsum) is currently disposed off by landfill on the plant premises and liquid waste high in total dissolved solids (salts) is discharged via pipeline to the sea. National Aromatics reuses the treated sewage effluent with the installation of a tertiary treatment system and the final effluent is to be discharged into the sea.

Indian Organic Chemicals: Produces Polyester stable fiber 2500 tons per month and polyester filament yarn 1250 tons per month as main product and methanol 700 tons per month as by product. The unit utilizes 195 KLD of water for domestic purpose, 1205 KLD for cooling and 200 KLD for process. It generates 175 KLD of sewage and 1350 KLD of trade effluent. Trade effluent is generated from water treatment plant, cooling tower bleed off, boiler blow down and polymerization recovery plant

Fertiliser Plant:

Madras Fertilisers Limited (MFL) unit produces ammonia, urea, NPK Complex Fertilizer and Bio-fertilizer. The unit utilizes 1,350 KLD of water for domestic, 28,260 KLD for cooling and 1,350 KLD for process. It generates 360 KLD of sewage and 8,400 KLD of trade effluent. Treated effluent is discharged into Red Hills lake surplus channel, which is flowing adjoining to the unit. The unit generates calcium carbonate sludge and spent catalyst as hazardous waste. The liquid waste contains ammonia phosphate, urea, fluoride and suspended solids are discharged to sea through Buckingham canal.

The pollutants that affect the creek can be grouped based on the source of origin: They are domestic pollution, institutional and commercial pollution and other public utility services. Waste water obtained from the domestic usages such as washing, bathing, cleaning and other public utility services form the domestic pollution. Institutional and Commercial Pollution is the mass discharge of sewage from educational institutions, medical centres, public services, lodges, theatres etc. Industrial pollution is due to industrialisation, there is a large production of waste water and solid waste. This water is not disposed safely. Industries dispose the effluent, through canal and rivers, directly into the sea. Toxic pollutants discharged into the marine environment results in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing impairment or quality of sea water and reduction of amenities. Hazardous waste is termed as a type of waste which is hazardous or toxic to humans and affects the environment directly. The industries in the Manali industrial complex have been identified by the TNPCB as Red Industries.

The status of coastal environment at Ennore and its surroundings

Central Pollution Control Broad (CPCB) (1994), has identified the Ennore Creek as the major source of pollution covering Greater Chennai Coastal Zone in Bay of Bengal. GCCZ could be taken from Palar river estuary in the south to Pulicat lake mouth in the north, a distance of about 100 km. This coastal belt once boasted of the second largest beach and one of the second longest beaches and one of the finest coastal stretches in the world. Now this coast is turning out to be the one of the unsightly overburdened and polluted in the world.

A notification issued under The Environment Protection Act 1986 has listed those industries, which need environmental clearance. It includes industries like petrochemical complexes, petroleum refineries, cement, thermal Power station, fertilizer, dyes, paper etc. The Central Pollution Control Board in collaboration with the State Pollution Control Board identified Manali as one of the problem areas in the country. The Manali is spread over an area of 800 hectares with a number of industries of which ETPS, SPIC, Heavy chemicals, MRL. Madras Petroleum Limited. Kothari Industrial Corporation Limited, EID Parry and MFL are major polluting ones.

According to Akila Dinakar (2003), the major industrial belts cause health hazards in the neighbouring areas. Children and adults alike in Manali suffer from respiratory and skin ailments. The effluents are discharged into the Buckingham Canal and Ennore Creek polluted the water and killed marine life including crab and prawns.

The areas located near Ennore creek include different levels of waste generating industries:

1. Low solid waste generating industries: It is noted that the most of the centrally located industries namely: Additives Ltd., Manali Petrochemicals Ltd., Balmer Lawrie

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

Ltd., Tamil Nadu Petroproducts Ltd., Sriram Fishes Ltd., and Madras Flourine Ltd., had been identified as low solid waste generating industries because the solid waste generated from them is less than 100 Kg per year.

2. Moderate solid waste generating industries: It is evident that two areas have been delineated as moderate solid waste generating industries. These industries namely US Petroproducts Ltd., and Madras Refinery Ltd., have been identified as moderate solid waste generating industries. The solid waste generated from these industries 100 to 1000 Kg per year.

3. High solid waste generating industries: It is noted that the only centrally located industry namely MFL has been found to be maximum solid waste producing industries. More than 1000 Kg per year of solid waste are produced from this industry because it has been identified as high solid waste producing industry.

According to Vivekananandan and Rajagopalan (1999), Ennore Creek is one such marginal marine body that has been contaminated by huge amounts of untreated effluents from both point and non point resources. The depletion of fish stock has also reflected in the decline of fish catch by artisan fishes and their income. In fact, the catches from the artisan sector in India have decreased from 870000 tons in 1971 to 297000 in 1997. The catch rate has reduced from 9.5 tons /craft/year 1971 to 3.9 tons/ craft/ year in 1997. The contribution of artisan fishing sector to the total marine fish production has decreased from 78 % to a mere 11 per cent. Thus, 75 % of the fishers produce only 11 % of the total marine production. There are about 0.5 million coastal artisan fishers, which are about 75 % of the total active marine fishers. The steep declining growth of marine fishery is mainly attributed to over exploitation and general marine environmental degradation especially in the coastal areas. This has immediate effect on the income of coastal fishers.

Sanjeeva Raj (2000a,b) opined that the impact of the hot water discharge from the North Chennai Thermal Power Station extended up to Pulicat. With industrial pollution building up “the creek has turned into a septic tank”. The construction of sea walls for the Ennore satellite port has already started showing environmental results in terms of coastal erosion and accretion Swahilya (2004). According to the study conducted in the MRL revealed that total dissolved solids at Ennore Creek, point of confluence of the canal and the sea water was found to be 37,100 mg/l. Similarly high levels of sodium chlorides, sulphates, calcium and salinity were also observed in the area indicating the sea water intrusion. BOD value was high at discharge point in the canal. At Ennore Creek, BOD at 20^0C and COD were found very high. Tests indicated that total coliform, fecal coliform, *E.coli*, fecal streptococci were all present at all the above stations throughout the study period indicating the bacterial contamination (MRL, 1999).Due to pollution in the water near the city coast the catch and the income of fish worker has reduced to Rs.40 from 50 per day, ever lower than what the construction workers get in Chennai City (NEERI, 1998). The Creek carries high load of chromium contamination (Kamala Kannan *et al*., 2007)

The fly ash and hot coolant water from the NCTPS as well as the sea erosion have led to decrease in fish catch. It is feared that Tiger Prawn and crap threadfin fish and bhetki, which were found in plenty some years, have become scarce. The current fish stock is far below the carrying capacity of the lake. Even at a low rate of about 200 kg of seafood per hectare. Pulicat lagoon system ought to carry about 10000 tonnes of seafood. But according to experts the lagoon in most parts carries hardly 5 % of its capacity (Report, 2000).

The Central Pollution Control Board estimated the total waste generation in the coastal regions of Tamil Nadu and published in 1996. It reported that the solid waste generated in the coastal areas was to the tune of 7,191 tons per day. While, the effluents generated were 24, 66,114 m^3 per day. Arunagiri *et al*. (1998) concluded that Many rivers and water channels including Buckingham canal and Korataliyar river are no longer able to receive and assimilate effluents because they have fallen below minimum levels of flow.

Ennore Island and the villages on it are threatened by pollution as evidenced from GIS studies conducted by Anna University, Chennai. The land use changes, shore line changes and changes in water spread were prepared from base maps of 1974 and imageries of 1990 and 1998. Thematic maps were prepared from all identified activities and the impact of all water qualities were executed in different thematic layers in GIS. The point where the Ennore Creek connects the Pulicat lake, the water temperature in this region was 4^0C more than that of normal water temperature of the lake. This was because of the thermal discharge from NCTPS which is located southern side of the Pulicat lake. The effect was observed for a distance of 500m in the lake. Moreover, the mean annual rainfall in this region is around 120cm with the two-third of rainfall occurring during northeast monsoon period from October to December). This was because of low rainfall and the high sediment rate (15mm/yr) contributed by the Buckingham canal which confluence at the south central side of the lake (Kasinatha Pandian, 2002).

The Madras Refinery Ltd discharges it’s treated effluents through the Buckingham canal and the Madras Fertilisers Ltd., through the Red Hills surplus channel, both reaching the Ennore Backwater. It was found that the treated effluents had a nutritive effect, improving the phytoplankton population at times to bloom to the proportions of very high concentrations of phosphates up to 37 ppm. A large number of diatom species in Ennore backwater was also reported (Sreenivasan *et al*., 1975).

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

The socio-economic condition of the fisher folk of Ennore Creek became so miserable and was the focal point in the debate of the daily news magazine. Goutam Ghosh (2003), a Freelance writer for "The Hindu", visited NCTPS and observed that the livelihood of the fisher folk of the Ennore Creek was affected by the hot water released by the power plant.

According to Ramakrishnan (2002), the coastal erosion has become a perennial for the people living along the Royapuram-Ennore coast. Over the years 350 hectares of land have been lost. Apart from that hundreds of homes, even the places of worship and Panchayat roads have disappeared. A main cause cited for the sea erosion of North Chennai is due to the construction and deepening of the Chennai harbour. This forces the North-bound currents to curve in-land, eating away the coastal structures The 6 m beach erosion is well known at Thiruvottiyur displacing fisher folk, highways and temples etc. Beach erosion has started just north of it at the Kattupallikuppam but has escalated at Koraikuppam (Sundarraman, 1999).

Table 1. Sample households

Name of the Village	Fishermen Community		Total
	Yes	No	
Nettukuppam	23 (74.2) [10.5]	8 (25.8) [9.3]	31 (100.0) [10.1]
Kattukuppam	21 (67.7) [9.5]	10 (32.3) [11.6]	31 (100.0) [10.1]
Sivanpadaiveedi	26 (81.3) [11.8]	6 (18.8) [7.0]	32 (100.0) [10.5]
Ennore Kuppam	28 (100.0) [12.7]	0 (.0) [.0]	28 (100.0) [9.2]
Mugathuvarakuppam	17 (89.5) [7.7]	2 (10.5) [2.3]	19 (100.0) [6.2]
Thazangkuppam	33 (89.2) [15.0]	4 (10.8) [4.7]	37 (100.0) [12.1]
Ulaganathapuram	19 (42.2) [8.6]	26 (57.8) [30.2]	45 (100.0) [14.7]
Sathyavani Muthu Nagar	53 (63.9) [24.1]	30 (36.1) [34.9]	83 (100.0) [27.1]
Total	220 (71.9) [100.0]	86 (28.1) [100.0]	306 (100.0) [100.0]

Source: Field Survey; Nos: in the parenthesis indicate column % & in the brackets indicate row %

From the extensive review of the literature, it is clear that the Ennore Creek area has been subjected to various pollutions. In fact, it receives world-wide attention as it becomes an important point polluting source in the Bay of Bengal. In spite of this, the social and economic characteristics of the stakeholders, such as fishermen, have not been thoroughly worked out.

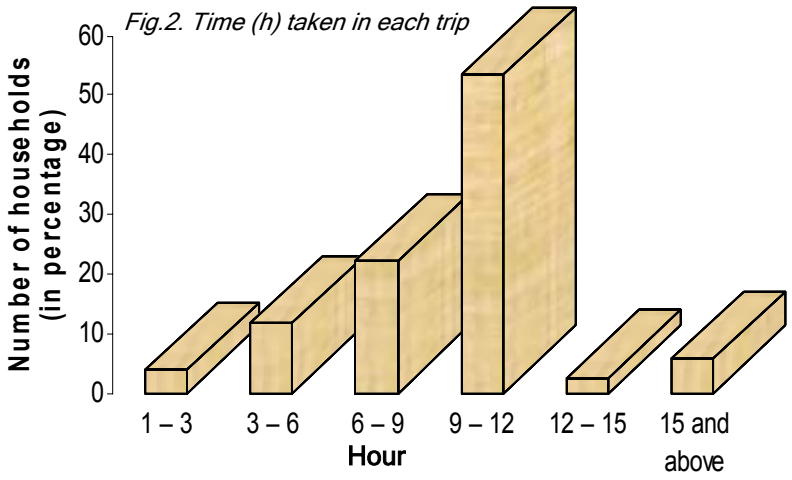
The effect of pollution on stake-holders in Ennore and the neighbourhood

They are 306 samples households, spread in eight villages in and around in Ennore Creek. The samples are drawn on the basis of the population of the respective villages. The classification of the sample households spread in eight villages according to the category of fishing and non-fishing community is shown in Table 1.

More than one-fourth (27.1 %) of the sample households are drawn from Sathiyavani Muthu Nagar. It is followed by Ulaganathapuram and Thazangankuppam in the percentage of 14.7 % and 12.1 % respectively. All other villages have a sample size ranging from 6.2 to 10.5 % respectively. All the households selected are not homogeneous and they are classified fishermen community and non-fishermen community for the sake of analytical convenience. It is found that 220 of the 306 households (71.9 per cent) are from the fishermen community and the remaining 28.1 % are non-fishermen community.

All the households selected from Ennore kuppam are fishing community and in all the villages except Ulaganathapuram are dominated by fishing communities. In Ulaganathapuram 57.8 % of the selected households belong to non-fishing community. In all other villages non-fishing community ranges from 34.9 % in Sathyavanimuthu Nagar to 2.3 % in Mugathuvarakuppam. It is observed that fishing communities are found to be heavily concentrated in areas close to the Ennore Creek and adjoining coastal areas.

Fig.2. Time (h) taken in each trip



Fishing trips

Sea and the water ways provide infinitive opportunity for the fishermen. But it involves physical exertion;

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

therefore they cannot make many trips often for fishing. The number of fishing trips made by the fishermen households vary from one to more than 7 per week. The details are given in the Table 2.

It is found from the survey that 33.3 % of the households involved in fishing make 4 trips per week. This is the mode of their frequency distribution. Only 8.5 % of the households make one trip every day and only 16.4 % of the fishing households make more than six trips per week. It is found from the survey that the urgency of earning income persuade them to have more trips.

Table 2. Number of fishing trips in a week

No:	Fishermen community
1	13 (100.0) [8.5]
2	20 (100.0) [13.1]
3	24 (100.0) [15.7]
4	51 (100.0) [33.3]
5	20 (100.0) [13.1]
6	4 (100.0) [2.6]
7	20 (100.0) [13.1]
14	1 (100.0) [.7]
Total	153 (100.0) [100.0]

Legend as per Table 1

Time taken for fishing

It is generally perceived that time taken for fishing is directly proportional to fish yield. The time taken for fishing by different fishermen households are shown in Fig.2. More than half of the households (53.6 %) take 9 to 12 h for each trip. Only 8.5 % households spend more than 12 h for fishing in each trip. It is surprising to note that 6 households spend 1 to 3 h per trip for fishing. It is reported by them that they use the traditional methods for fishing and they delimit the area closer to the coast. On an average they spend 9.78 h per trip for fishing. The time taken for fishing in each trip does not reveal the real income generating capacity of the fishing households. Therefore, they were asked about the number of days they spent for fishing in the last week of the survey. They reported frequencies are given in Table 3. It is found that only 14.4 % of those fishing households spend all the days in a week for fishing. However, 3.9 per cent of the fishing households spent only a single day for fishing. More than two fifths (43.8) of the fishing households spend four days in a week for fishing. Fishing is a laborious task that requires a lot of physical exertion. Hence, it is difficult to fish all the days in a week. Due to the urge for earning more income some households engaged in fishing all the days in a week.

The availability of fish is not uniform throughout the year. In some months they get better fish catch while in others less. The number of months they spend for fishing every year is shown in Table 4. More than half of the fishing households opined that they spend eight to ten months for fishing in every year. Only 2 per cent fishing households spend more than 10 months in a year for fishing. Such households use catamaran and do not use any fishing boats for fishing. The remaining households spend less than eight months in a year for fishing which range from the minimum of 1 to 2 months to the maximum of 6 to 8 months. The respondents were asked about the reasons for not fishing in all the months in a year. Their replies are represented in Fig.3.

It came to be known that Moratorium is the least important reason for non- fishing by the fishermen community. Therefore, it can be inferred that almost all the fishermen households are using the area closer to the coast. Moreover they are not using any mechanized boats. Fish non availability is the reason cited by 63.4 % of the fishing community. According to them in addition to fierce competition in fishing the industrial development of the area also plays a vital role for the non availability of fish.

Value of the fish caught

Three fourth (76.5 %) of the fishing community households get total value of fish catch in every trip less than Rs.400 but there are 9.8 per cent fishing households earning more than Rs.1000 in every trip. The households with lower value of fish catch are the majority when compared to the households with high value of fish catch.

Encircling net is the most popular type of net used for fishing by the fishing community. It accounts for 75.8 per cent of the total nets used by the fishing households. The other nets in the order of preferences are line fishing; bonding and direct catch by hand are in the percentages of 9.8, 7.2 and 5.2 respectively.

The respondents were asked about the trend in fish catch over the years. No one was opined that the fish catch increased over the years. Nine out of every ten respondents replied that the quantity of fish catch decreased while only 7.8 % replied that it is constant over the years. In order to assess the awareness the respondents were asked about the reason for less fish catch. The details are furnished in Table 4. Pollution was the reason for low fish catch by 58.8 % of the fishing community. It is followed by over fishing and soil erosion in the percentages of 25.5 and 2.6 respectively. Other reasons occupy only less number of respondents because the above cited two reasons are very familiar for them.

Sources of pollution

The sources of pollution of coastal areas according to the respondents are shown in Table 5. The main source of pollution is the existence of Ennore Thermal Power Station and EID Parry's. These projects discharge effluents and spread the pollutants in the atmosphere, which causes ultimately the pollution of river and coastal area. This reason is given by 25.5 % of the respondents. All other reasons cited as small scale leather industries, petrochemicals, Manali industrial effluents and hot water discharges are in the percentages of 15,13.1,5.1and 7.8 respectively. The fishermen adopt some strategies to overcome less fish catch: 86.6 % of the fishing households sought for deep fishing as a method to

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

overcome the shortage of fish catch. More than one fourth of the fishermen households suggested working overtime as the strategy.

Job satisfaction

Fishing is a traditional occupation of a particular community. This occupational change does not include the fishing occupation. In this scenario the respondents were asked about their job satisfaction with fishing. It is interesting to see that 15.3 % of the fishing households are not satisfied with fishing. Still there are 49.7 % households who still love the fish occupation. Reasons for dissatisfaction of fishing are shown in Fig.4. It can be understood that some of the reasons are close to less fish catch and some of the reasons are related to their health. Of the two reasons the reason for dissatisfaction towards the quantity of fish catch dominates. It accounts for 69.7 % of the total households. Health reasons accounts for 30.3 % of the fishing households who were not satisfied with fishing.

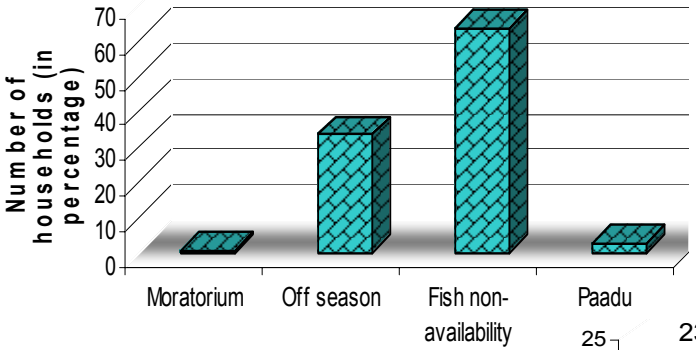
Water is an essential prerequisite for the existence of life, sanitation, human health and overall development of human beings. Fresh and marine water give food, access to potable water which are major contributors to general community health. Instead, polluted water breeds mosquitoes, flies, rodents and other disease carrying vectors.

Table 3. Days spend for fishing in the last week

Days	
1	6 (100.0) [3.9]
2	7 (100.0) [4.6]
3	23 (100.0) [15.0]
4	67 (100.0) [43.8]
5	22 (100.0) [14.4]
6	6 (100.0) [3.9]
7	22 (100.0) [14.4]
Total	153 (100.0) [100.0]

Legend as per Table 1

Fig.3. Reason for not fishing



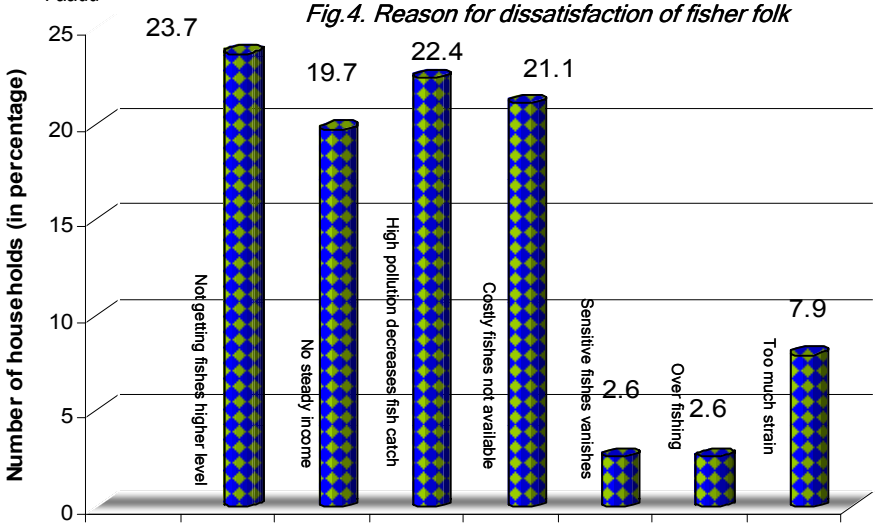
The Ennore Creek and its adjoining environment are polluted because of effluents from many polluting industries, hot water and fly ash from the Thermal Power Plants and the remains of Manali Refineries Limited etc. The quality of water in the Ennore Creek is not fit for the living organisms because of the absence of oxygen content in the water. The stakeholders of the Ennore Creek have been subjected to various diseases such as skin problems, tropical diseases, infectious diseases, diarrhoea and vaccine preventive diseases. By examining the 306 sample households it was found that 140 (41.79 %) of them have members affected by some of the diseases. The numbers of sick persons vary from household to household. It ranges from a minimum of 1 to the maximum of 3. The particulars are given in Table 6.

The illness of members in the sample households for the past one year from the date of survey is identified and they are classified under eight broad heads of diseases such as cough, TB and wheezing, skin diseases, typhoid, malaria, eye diseases, cancer and others. Cough, TB and wheezing is the most popular disease in the Ennore Creek. This category of disease was found among 40.8 % of the total sick persons. Skin diseases are the second most categories of diseases among sick person. It accounts for 29.5 % of the sick persons. The diahorreal disease like typhoid accounts for 5.5 %. From this it is clear that polluted water in the Ennore Creek is mainly responsible for the diseases like skin irritation, Typhoid, Malaria etc. There are sizable numbers of members of the sample households have been affected by air pollution from the neighbouring industries. Therefore diseases like cough, TB, wheezing and Asthma are widely prevalent among the sick members in Ennore Creek. There is 3.5 % of sick persons reported with problems of eye diseases and opined polluted water in Ennore Creek was the cause.

Reason for bad health

In order to assess the awareness of the sick persons about their reasoning of the cause of diseases, they were asked about the major reason for their sickness. Nearly

Fig.4. Reason for dissatisfaction of fisher folk



Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

three fifth of the sick persons (38.8 %) have given river water pollution as the most important reason for their bad health. It is followed by industrial pollution, which accounts for 25.1 per cent of the total sick persons. Pollution due to chemical effluents and other reasons were cited by 15.2 % and 11.9 % of the sick persons respectively. Sewage pollution and oil pollution account for only 3.5 and 5.5 % respectively of the sick person. From this it is clear that the people of Ennore Creek feel that the fly ash from the thermal power station and the polluted water of the Ennore Creek and its coastal area are mainly responsible for the diseases of a majority of the sick persons (Plate 1).

Working days lost

The number of working days lost due to the sickness of the sick members was elicited from the response. It is found that 255 of the 343 sick people seek medical help in their attempt to cure the illness. In this process they have lost some of their working days. The number of working days lost due to sickness ranged from 1 to 9 working days in the last month of the survey. It is surprising to see that 22.4 % of the sick persons sought medical assistance that has lost 8 or more than 8 working days in that month. However, nearly 60 per cent of the sick persons have lost less than five working days due to sickness. The average wage lost due to sickness is computed as Rs.467.

Household income

Though Ennore Creek area has agriculture land only 4 of the 306 households generate income from agricultural activities. In addition to that 13 households receive income from other assets. The total average monthly household income is finally arrived at and the frequency distribution of the monthly household income is given in Table 7. It is interesting to note that only 5.9 per cent of the households generate income less than Rs.2000. However, 19.3 % generate income of Rs.10000 or more per month. The middle income group is Rs.6000 to 8000. But 49 per cent of the households have income less than the modal class.

Null hypothesis (Ho)

There is no influence of environmental factors on the working days lost due to sickness of the stakeholders in Ennore Creek.

Table 4. Reason for less fish catch

Reason	
Pollution	90 (100.0) [58.8]
Soil erosion	4 (100.0) [2.6]
Shallowing of creek	19 (100.0) [12.4]
Over fishing	39 (100.0) [25.5]
Others	1 (100.0) [.7]
Total	153 (100.0) [100.0]

Legend as per Table 1

Table 5. Source of pollution

Source	
ETPS, EID	42 (100.0) [27.5]
No cleanness in river	9 (100.0) [5.9]
Oil effect	12 (100.0) [7.8]
Ash	16 (100.0) [10.5]
Domestic and sewage waste	10 (100.0) [6.5]
Manali industrial effluents	9 (100.0) [5.9]
Petrochemicals	20 (100.0) [13.1]
Small scale leather industries	23 (100.0) [15.0]
Hot water discharge	12 (100.0) [7.8]
Total	153 (100.0) [100.0]

Legend as per Table 1

Alternative hypothesis (Ha)

There is the influence of environmental factors on the working days lost due to sickness of the stakeholders in Ennore Creek.

The houses of the respondents situated in and around Ennore area are subjected to the influences of various environmental factors like water pollution, air pollution and the degraded living environment. The influence of these factors on their life and there by the productivity are analysed with the help of multivariate analysis. The determination of the working days lost of the sick persons is multidimensional in nature. In order to analyze the multidimensionality of the correlates of working days lost, as many as six predictor variables and the criterion variable (Working Days Lost) are subjected to correlation analysis by using Karl Pearson's product moment correlation.

Out of the six variables entered the predictor variable of working days lost, came out highly correlated with working days lost of the sick persons with high Beta values. The selected variables among others include skin irritation and accepted the presence of water pollution, type of fuel used for cooking, type of family, average quantity of water used for drinking and cooking and the expenditure on consumption. The correlation Matrix indicated the high degree of correlation of .622 between working lost and the type of fuel used for cooking purpose. All the other set of variables show a less degree of positive and negative correlation. The coefficient of correlation between the number of working days lost and the type of fuel used for cooking reveals that not alone the indoor pollution is responsible for these sickness but it is an index of poor socio economic set up of the household in Ennore Creek.

Summary of the findings

All the households selected from Ennore kuppam and all the villages except Ulaganathapuram were dominated by fishing community. In Ulaganathapuram 57.8 % of the households belonged to non-fishing community. In all other villages non-fishing community ranged from 34.9 % in Sathyavanimuthu Nagar to 2.3 % in Mugathuvarakuppam.

It is found that 49 % of the fishing community used Ennore estuary alone for

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

fishing while 21.6 % depended on sea alone. However, 29.4 % of the fishing households use both Ennore estuary and sea for their fishing. Hence, the degradation of Ennore estuary and sea coast had a severe impact not only on their livelihood but also on their ability to perform different functions.

One third (33.3 %) of the households involved in fishing make 4 trips per week. This was the mode of their frequency distribution. Only 8.5 % of the households made one trip every day and only 16.4 % of the fishing households made more than six trips per week. More than half of the households (53.6 %) took 9 to 12 hours for each trip. Only 8.5 % households spend more than 12 hours for fishing in each trip. Some of the fishing households used the traditional methods for fishing because of low capital and they delimited the area closer to the coast for fishing.

No one opined the trend of increase of fish catch over the years. Nine out of every ten respondents replied that the quantity of fish catch decreased while only 7.8 % replied that it was constant over the years. Pollution was the reason cited for low fish catch by 58.8 % of the fishing community. It was followed by over fishing and soil erosion in the percentages of 25.5 and 2.6 respectively.

Table 6. Diseases and the frequency of sick members

Diseases	No: sick persons	%
Cough, TB, Wheezing	140	40.8
Skin disease	101	29.4
Typhoid	19	18.4
Malaria	8	2.3
Asthma	21	6.1
Eye disease	12	3.5
Cancer	3	0.1
General fever	39	11.4
Total	343	100.0

Source: Field survey

Table 7. Total average monthly household income

Income (Rs.)	Frequency	%
Below 2000	18	5.9
2000-4000	65	21.2
4000-6000	67	21.9
6000-8000	68	22.2
8000-10000	29	9.5
10000 above	59	19.3
Total	306	100.0

Source: *Field survey*

Cough, TB and wheezing were the most common diseases in the Ennore Creek. These diseases were found among 40.8 % of the total sick persons. Skin diseases were the second most categories of diseases. It accounted for 29.5 % of the sick persons. The diahorreal disease accounted for 5.5 %. It is clear that polluted water in the Ennore Creek was mainly responsible for the diseases like skin irritation, Typhoid, Malaria etc. There were sizable numbers of members of the sample households who have been affected by air pollution from the neighbouring industries.

Nearly three fifth of the sick persons (38.8 %) had given river water pollution as the most important reason for their bad health. It is followed by industrial pollution, which accounted for 25.1 % of the total sick person. Pollution due to chemical effluents and other reasons were cited by 15.2 % and 11.9 % of the sick persons respectively. Sewage pollution and oil pollution accounted for only 3.5 and 5.5 % respectively of the sick person. From this it is clear that the people of Ennore Creek feel that the fly ash from the thermal power station and the polluted water of the Ennore Creek and its coastal area were mainly responsible for the diseases.

With regard to income generation, 45.3 % earned an income between Rs.2000 and Rs.4000. Another one third (27%) earned an income between Rs.4000 and Rs.6000. Thus more than two third of the respondents earn between Rs.2000 and Rs.6000. 59.5 per cent had earning members other than the respondents. Among them 43.4 % earned less than Rs.2000 per month. It is interesting to note that only 5.9 % of the households generated income less than Rs.2000. The modal income group is Rs.6000 to 8000. But 49 % of the households had income less than the modal class.

1. This study is centred upon a key factor i.e., identification of an ecologically important but anthropogenic vulnerable site. Ennore creek, once cherished ecological richness but is now heading towards a premature ecological death. It happens with a short span of 3 decades (after the industrialization of Ennore) in spite of the stringent law and in front of the hapless stack-holders. Ennore Creek was the sole livelihood for these thousands of fisher families.
2. The study also attempts to play back the whole scenario in the Ennore Creek and correlate the ecological plunder with the economic loss.
3. The study is able to diagnose the penury and poverty of the stockholder to its root of environment degradation.
4. The study suggests environmental restoration as a long-term strategy to find a cure for the ailing-health and income -loss of the innocent fisher folk.
5. The study also forewarns those organizations and agencies concerned with environmental up keeping acting in war-foot manner to restore this ecological jewel from its brim of destruction.
6. At this crucial juncture, the collective opinion of stake-holders drawn by this study will be helpful to those administrators and conservationists concerned with the coastal resources. The analysis gives a clear picture that in spite of the ecological wealth loss, the fisher folk still hope to make both ends on their own, if further disturbance to the environment could be stopped. They do not want to compromise the ecological conservation with any other incentive as a measure for their livelihood. The law-enforcing

Indian Journal of Science and Technology Vol.2 No 3 (Mar. 2009) ISSN: 0974- 6846

Plate 1. Skin infection of fishing folk and oil float at the mouth of Ennore creek where Buckingham canal meets

authorities should take clue from such positive situation and extend all possible help to the ailing fisher-folk so that the traditional life style is restored in an environmentally congenial atmosphere.

7. The study also highlights the environmental pathology of Ennore Creek worth to control in utmost care as it could spread to other areas and to the remaining population of the metropolitan too.
8. When crucial economic judgment needs to be passed to make choice on 'industrial economy' or 'environmental safeguard for fisher folk', the study strongly supports environmental preservation as a long term economic gain to the nation. In fact, industry is for the welfare of human need. Moreover, industries meet the short term needs but their ecological consequences are a long term loss. Certainly, the ailing fisher folk and their migration from the strategic ecological site only boomerang with the impending ecological epidemics. Fisher folks are the vanguards in protecting the coastal wealth for thousands of years from ecological destruction and from unscrupulous elements. They are the indicators of coastal wealth and its up keeping.
9. Through this study the researcher brings out the fact that how Ennore Creek need to be exploited for the long-term benefit to mankind, especially for fisher folk, which has been mishandled for the short term industrial needs.
10. The study also emphasizes the fact that the real wealth which we can pass on to future generation depends on how much pristine pure environment we leave for them. In this context, the conclusion of this study also supports the importance of environmental economy over industrial economy.
11. The study also made plans for an alternate use of coastal resources in tune with environmental hygiene in supportive of additional income to the nation/coastal folk, in particular. The recent devastation by Tsunami only emphasizes the need to protect the fisher folk and mangroves for the benefit of the entire nation.

References

1. Akila Dinakar (2003) Government should accord priority to Environmental Issues. *The Hindu*, Sunday, June.
2. Arunagiri *et al*. (1992) Modelling of pollution level in Ennore Creek. Project Report. Anna University, Madras.
3. Azariah J *et al*. (1997) Biomanagement of biogeo resources. *Bioethics In India*. pp: 16-19.
4. Central Pollution Control Board (CPCB) (1994) Industry- specific pollution control status in problem areas Manali and Digboi. Volume II. Programme Objective Series: Probes/59/94-95, pp: 1-38.
5. Durariraj S (1988) Application of remote data for costal zone mapping – A case study of the part of east coast of Tamil Nadu. M.Tech. Thesis, Anna University, Madras, p.138.
6. Glasby Y and Roonwal GS (1995) Marine Population in India: An emerging problem. *Curr. Sci*. 68, 495-497.
7. Goutham Ghosh (2003) Is it a fair deal? *The Hindu*, Jan 23 & Jan 27.
8. Jayaprakash M (2003) Geochemical Assessment of Heavy Metal Pollution in Ennore Creek. North of Chennai. Ph.D.Thesis, Madras University, Chennai.
9. Jayaprakash M, Srinivasalu S, Jonathan MP and Mohan V (2005) A baseline study of physico-chemical parameters and trace metals in water of Ennore Creek, Chennai, India. *Marine Pollution Bullettin*. 50 (5), 583-589.
10. Kamala Kannan S, Lee KJ, Krishnamoorthy R, Purusothaman A, Shanthi K and Rajeshwara Rao (2007) Aerobic chromium reducing *Bacillus cereus*

isolated ffrom the heavy metal contaminated Ennore Creek sediment, North of Chennai, Tamilnadu, South East India. *Res.J.Microbiol*. 2(2), 130-40.
11. Kasinathapandian P (2002) Coastal dynamics of north Chennai coast, southeast India. Ph.D. Thesis, Anna university, Chennai.
12. Kee Chai Chang and Rathin Roy (1997) coastal environments under threat - Demographic issues and the perceptions of fisher folk. *FAO Fact file*. pp: 5-16.
13. Kee-Chai-Chang (2000) Evolving self financing scheme for fisheries management. *Bay of Bengal Programme*, Report-76, Chennai, pp: 197-210.
14. Manivel M, Manikiam B, Kumaran Raju D and Moses Edwin J (1995) Study of ecosystem development along Coramandal coast of Tamil Nadu using remote sensing techniques. *GISdevelopment.net. AARS, Poster Session 3*.
15. Masilamani JG, Nandakumar,K, Satpathy KK, Jesudos KS, Azariah J and Nair KVK (1999) Fluctuations of marine fouling community in different parts of the cooling water systems of Madras Atomic Power Station. In: Workshop on Forestry, Forest Products and Coastal Population. Feb 10-12, p. 36.
16. MRL Report (1999) Rapid environmental assessment study of 3, MMTPA, refinary expansion project. Manali, Chennai, pp.182.
17. NEERI (1995) Coastal aquaculture, Report. p: 7.
18. NEERI (1998) Environmental Impact Assessment Studies for Proposed Development of Petrochemical estate for establishment petrochemical project at Ennore phase II. Sponsor TIDCO, Chennai. pp: 6-10.
19. Purvaraj R and Ramesh R (2000) Human impacts on methane emission from mangrove systems in India. *Regional Environ. Change*. 1 (2), 86-97.
20. Ramachandran S (2001) Coastal environment and management in India: an overview. Report. Anna University, Chennai.
21. Ramakrishnan T (2002) Government dithers as the Ennore coast faces further erosion. *The Hindu*, September 3.
22. Report (2000) Environment profile of Thiruvallur district. Director of Environment, Tamil Nadu.
23. Sanjeeva Raj PJ (2000a) Save Pulicat lake ecosystem. *Business Line*, July 03, pp: 2-3.
24. Sanjeeva Raj PJ (2000b): "Save Pulicat ecosystem", *CRENIEO*, pp. 1-5.
25. Sen Gupta *et al.* (1990) State of the marine environment in the South Asian Seas Region. *UNEP, Regional Seas Reports and Studies*. No: 123. p:19.
26. SPIC-SMO (1990) Republic of India, Government of Tamil Nadu Report. pp: 3-17.
27. Sreenivasan R and Franklin T (1975) Effects of disposal of effluents from petrochemical complex on Ennore Backwaters. *Bulletin of the Department of Marine Science*, *University of Cochin*, 7, 273-280.
28. Sundararaman TM (1999) Dirty beaches. *The Hindu*, 4th Jan.
29. Suriyanarayana Moorthy M and Mohammed Habibullah (2001) Ichyofauna of Ennore Estuary. *Convergence*. 3 (1-4), 60-64.
30. Swahilya (2004) *The Hindu,* Nov 28th.
31. UNEP (1997) Global Environment Outlook 1. Global State of the Environment Report. pp: 8-12.
32. Vivekanadan E and Rajagopalan M (1999) Management strategies for sustaining coastal fish stocks and fishing communities. In: Workshop on Forestry, Forest Products and Coastal Population. Feb. 10-12, p. 57.