INITIAL ENVIRONMENTAL EXAMINATION REPORT

Commercial Fin-fish farming Project in Trincomalee, Sri Lanka

by

Oceanpick Private Limited.

PROJECT TITLE: Commercial Fin-fish farming project in Trincomalee

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REPORT PREPARATION TEAM

- Dr. M.F.M. Fairoz, Ocean University of Sri Lanka
  Provided environmental considerations relating to ecosystem dynamics

- Dr. Garret Macfarlane of Trans Tech, Scotland, U.K.
  Quantified environmental / benthic impacts using modelling

- M.G.W.M. Kapila Gunarathne
  Contributors of the necessary data incorporated into social-economic effects.

- Kames Fish Farming Ltd
  Contributed years of reputable knowledge and experience in design and construction of sustainable, ecological farming systems. In particular: Cages, nets, bouys, moorings and nursery design.

EXECUTIVE SUMMARY

Oceanpick has been incorporated to undertake commercial scale oceanic fish farming. The project will set up its farms in the open sea off the Trincomalee coast, the first such cage system to be set up in the country, with an ambitious plan to reach nearly 1,000 tons over the next several years. Partnered by a Scottish fish farming company (Kames Fish Farming Ltd.) that pioneered oceanic farming in the North Atlantic some 35 years ago producing salmon, rainbow trout and halibut. Oceanpick plans to operate Trinco farms as per the same world class standards of their partners; adapting the technology to the local environment and species.

Whist Sri Lanka's previous attempts at aquaculture have mostly been concentrated in brackish water lagoons, fresh water bodies or inland based ponds, Oceanpick recognizes the superiority of sea-grown produce. This coupled with the greater depth and tidal current profiles offered by the oceans, the company has handpicked pristine open sea locations in Trincomalee for its activities.

The first choice species that Oceanpick will produce is to be Barramundi or Asian Sea Bass (*Lates calcarifer*),, locally referred to as Modha. Barramundi has been a preferred fish for its mild buttery taste and Omega 3 content. To ensure peak freshness of all its produce, the project intends to vertically control the entire cold chain process.

The total investment of this project would be around $ 2.5 million. This project will no doubt raise the profile of Sri Lanka's fisheries sector, providing over 100 job opportunities in the coastal zone of Trincomalee specifically and a new avenue for graduate training, whilst paving the way for import substitution and developing a value-added product. It could also trigger growth of several other related businesses both upstream and downstream including feed manufacture.

A review of the Regulatory and Institutional Framework with respect to environmental clearances as applicable to this project indicates that a requirement of getting the necessary approval from the Central Environmental Authority (CEA), the Apex body relating to such matters, along with all relevant stakeholder agencies. Based on information provided by project proponent, a decision would be made on the basis of approval of the project, either via Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) route. In the case of Oceanpick (Pvt) Ltd, after such initial review, it was decided that the project would be approved based on IEE and the project proponent has enlisted services of eminent experts, namely, Dr. MFM Fairoz, Ocean University of Sri Lanka (NIFNE) and Dr. Garret Macfarlane of Trans Tech, Scotland, U.K. to carry out IEE. The said IEE report will be presented to the Project Approving Agency (PAA), Central Environmental Authority (CEA) in order to obtain the environmental approval for the proposed project. Permits that are required for implementation of the project are granted by the following: National Aquaculture Development Authority(NAQDA), Urban Development Authority (UDA), Coast Conservation Department (CCD) and the Central Environmental Authority (CEA).

INITIAL ENVIRONMENTAL EXAMINATION REPORT

This Initial Environmental Examination (Report) (IEER) has been carried out keeping in mind existing regulatory requirements and in line with Oceanpick Pvt. Ltds. procedures and guidelines. The baseline data on various environmental components has been compiled from various recognised sources. This report is prepared based entirely on Primary and secondary data available from the present and previous studies respectively.

The project area falls within two divisional secretariats of Trincomalee district, Town and Gravets Divisional Secretariat and one Gramaniladari Division of Kuchchaveli of Trincomalee District of Eastern province of Sri Lanka. The proposed project will operate in the sea using cages entirely to farm fin-fish. The sea area is covered by two Coastal Divisional Secretaries Divisions (DSD) of areas of Trincomalee District, which are Town and Gravates and Kuchchavali DSDs. The proposed mariculture sites will be located approximately 2 km from the shoreline. A Total of four sites were selected for this project, covering approximately 70ha of sea area. Also a nursery to maintain the fry/ fingerling is under construction in the Uppuveli area. With reference to the request for ownership/ lease the proposed sea sites for the operation of fin-fish farm using cages was submitted to the commissioner general of lands, sri lanka; pending as subject to also obtaining Environmental Protection License from CEA.

The design of the cages proposed to set up the Trincomalee sites were determined to suite local environment conditions. After detailed analysis of the local environmental conditions two cage sizes were selected to be included in a cage system. Main cage circumferences are: 60 m and 40m respectively. Mooring components, navigation buoy and light are other components included in the cage system. Building of the cage structure is composed of cage collars; constructed by heavy duty circular polyethylene C-flex fish cages, manufactured entirely from high density polyethylene (PE100) This material is flexible, strong and resistant to Ultra Violet degradation.

Circular fish cage nets are used to complete construction of cages. Polypropylene ropes are used to strengthen cage nets by reinforcing the lighter netting materials both vertically and horizontally. Knotless nylon netting is used to construct circular fish cage nets.

The Kames circular cage mooring system is based on a very well established design which has been in use in fish farming for over 35 years. The design consists of flexible mooring lines fixed to the sea bed using heavy ground chain and permanent mooring anchors.

Navigation lights and markers have been supplied according to internationally recognized standards for offshore aquaculture installations and are approved by the local authorities in Sri Lanka.

The cages will be sent to the site in component form via container freight from the UK. The components are assembled using specialised fusion jointing systems and machinery which will also be sent from the UK. The cages are assembled by qualified and experienced engineers from KFFE on a beach close to the site and then launched into the water.

The project proponents plan to operate the farm using fingerlings supplied from NAQDA certified seedling centre. Feed has to be imported as there is no existing feed availability in the country. However that may be costly and impact on economic aspects of the project. Future prospects to utilise finite resources locally available from within Sri-Lanka have been considered; therefore OP plans to formulate fish feed using locally available materials. Feeding will carried out by manual and partially automated methods. Feed rations will be appropriate for the age and biology to attain the best FCRs, thus eliminating waste.

Harvesting will be done at a marketable size depending on demand. Prior to harvest, insulated fish harvest bins will be taken via workboat to the sea cages. Then fish will be harvested using brailer nets and then transferred to harvest bins with ice.

Harvested fish will be transported to post-harvest plant for processing. Processing will depend on the request of the customer. Fish will be cleaned prior to storage in cold a room (removal of gill, gut, head, tail and scaled) ready prepared to deliver to customers nationwide.

These sites will be monitored periodically to decide whether to switch the location or continue depending on the rate of flux and regeneration.

Good biosecurity is an essential part of any intensive animal production system. For this reason Oceanpick will have a strict SOP (standard operating procedure) covering this aspect of the business and which will include individual site biosecurity covering personnel, equipment and fish stock. This will restrict movement of personnel and equipment between sites, will ensure a strict disinfection regime for all personnel and equipment and will lay out a protocol for ensuring all juvenile fish stocks brought onto site at Trincomalee are disease free. Indeed the design of the new nursery currently being built includes elements specifically designed to control biosecurity.

It is expected that by using local stocks of fish while incorporating strict pre-stocking regimes, the risk of contracting such pathogens will be minimized. The predominant method of controlling the onset of disease is by screening stocks regularly. This method provides prior notice of a potential problem before a clinical outbreak occurs. By maintaining strict fish health screening, Oceanpick is able to adhere to advantageous management practices by; reducing fish stress, breaking lifecycles and pathogen transmission routes. Following this management model, Oceanpick aims to have a minimal requirement for the use of therapeutic treatments.

Generally Barramundi are regarded as very hardy fish and require little disease management. Since most of the parasites of Barramundi are salt water specific they are usually treated by lowering the salinity in the cage with fresh water for a period. Fungal disease is restricted to low salinity estuarine locations and so should not affect these offshore sites. Bacterial disease such as Vibriosis or Streptococcosis if contracted, are to be prevented by vaccination of future batches. Antibiotic use is considered a last resort.

Dead fish will be removed daily from the cage nets using either a diver or a mortality retrieval basket system. The dead fish will be placed in a watertight container and removed from the site to a nominated location for disposal. They can either be buried or treated with a neutralising product (acid or lime powder).

Cage nets will over time become affected with bio-fouling organisms such as algae or crustaceans. This can cause a problem to the fish if it restricts water flow through the nets. To resolve this issue we can change the nets and fit clean ones in situ taking the dirty ones ashore to clean and repair as required. Using a motorised power washer we can remove the fouling that has accumulated on the nets.

Some grading of fish will be required and for this purpose, an additional 40m cage will be used to segregate the fish during the grading process. The grading will be done with a mechanical grading machine powered by a generator on the main work vessel, and / or be done manually.

Juvenile fish will be transported from the nursery to the offshore cages in purpose built fish transportation tanks fitted with oxygenating systems and monitoring instruments. The fish will first be netted into the transportation tank on a lorry at the nursery and then taken to the local port estuary where they will be transferred to other tanks on the boat and then by boat to the offshore cages where they can be decanted using the special Mucon valves by gravity directly to the cage nets.

Harvesting will be carried out at the offshore cages. The fish will be either netted or pumped directly into large insulated containers filled with sea water ice slurry. The temperature shock will kill the fish immediately. The bins also have insulated lids which are then fitted tightly to ensure minimum loss of temperature. The fish will be transported to shore and transferred to a truck which will have a refrigerated closed box and so help maintain the temperature inside the bins. Ideally the fish should reach the processing or packing plant at no more than 3 or 4 °C. From here the fish will follow various different routes to the market. Either being processed locally or it may only eviscerated and sent to another location for further processing.

The fallowing of production sites is recognised as an effective way of controlling disease in fish. To this end Oceanpick intend to operate sites on a one crop basis. It is envisaged that the production cycle will be 8 to 9 months.

The sea area proposed for the fish farming was investigated for site specific information to be used in designing cages, mooring systems and models to predict the zonal effects which will occur during operation of the proposed farm. These

studies also included examinations of the sites and nearby environs. A socio economic study was also conducted to describe the existing social and economic status of the proposed project area.

The tides on the East coast of Sri Lanka are mixed, predominantly semi diurnal tides with pronounced diurnal inequality. Tides are low, ranging from 0.2 m (during the neap period) to 0.8 m (during the spring period). General tidal current velocities recorded are around 0.05 cm/s. Horizontal water current velocity data for the sub surface (13.67m above sea bed,0.17 ms^{-1}), net bottom (7.67m above sea bed, 0.13 ms^{-1}) and near bottom (3.67m above sea bed, 0.12 ms^{-1}) was measured using an Acoustic Doppler Current Profiler (ADCP) instrument.

The Trincomalee sea area contains a sea bed surrounded mainly by rocky habitats; these habitats support large amounts of fish resources. Distributions of coral reefs are patchy along the coast and they were limited to few in coverage. The main coral reefs are located at Nilaveli, (Pigeon Island and Coral Island,
10 km north from the center of proposed project sites). There are extensive rock and sandstone reef habitats, both inshore and offshore. Narrow fringing coral reefs have developed on rock substrates, extending about 200 m from the coast to a depth of about 8 m, while offshore reef habitats are found to a depth of more than 50 m. To date, over 100 species of corals and more than 300 species of reef fish have been identified in Trincomalee and surrounding areas. Fishing for edible species and ornamental fish collecting are high in Trincomalee, while extensive harvesting of sea cucumber and Chanks (*Turbinella pyrum*). There are no systematic studies performed on benthic and soft bottom communities (i.e. Sponges, Cnidariens, Polychaetes, Molluscs, Crustaceans, Echinoderms) for these areas to date.

The ecological observations performed using underwater surveys in order to obtain a clear understanding of the project area with reference to ecological resources. At the project location coral reefs were not evident, however there were few forms of *Favia, Favites, Goniopora, Porites*, domes were observed along the seaward margin and in the deeper parts of the sea bed areas around 1km distances (near shore) to selected sites. Some deeper parts contain substantially large rocks.

No significant cover or diversity of algae is present in the study area such as Green Alga or Brown Algae, however there was a notable amount of Red algae (Rhodophyta) belonging to genus *Gracilaria,* communities exist in areas with coral domes. This genus is important economically for use as a food for humans (not popular in local) and various species of shell fish.

The most commonly observed fish species belong to the families of *Acanthuridae, Balistidae, Caesionidae, Carangidae, Chaetodontidae, Haemulidae, Labridae, Lutjanidae, Lethrinidae, Mullidae, Nemipteridae, Pomacentridae, Pomacanthidae, Scaridae, Serranidae and Siganidae*. These fish were important in the ornamental fish trade. Other fish species observed are important as food fish. Some species of grouper (Family: Serranidae), snapper (Family: Lutjanidae), emperor (Family: Lethrinidae) etc.), were observed.

Jelly fish are common (Phylum: Cnidaria) in the surface of water column might feeding on plankton or any other particles suspended/ floating in the water.

The sea bed in the study area has mixed characteristics' ranging from fine compact coarse sand and in some areas, that are suitable habitat for bottom dwelling organisms belongs to *Polychaetes, Molluscs, Crustaceans, Echinoderms*.

There were no observation records for marine mammals such as whales and dolphins or sea turtle nesting within the sites limits. There is no presence of a large ecosystem present such as a coral reef or a sea grass bed in the proposed site; therefore less chance of occurrence of rare, endangered and endemic species within or near the proposed project sites.

Social and economically the proposed land area belongs to three main fish landing sites namely Samudragama, Thirukadaloor and Salli. Sinhala, Muslim and Tamils are mainly occupying these areas. According to field observation there are more than 60 fish landing sites located in this coastal stretch. Total fishing families living in the area are about 2500 - 3000 and more than half of the fishing population are engaged in marine fishing while less than 1000 families are engaged in inland fishing activities including Trinco bay area.

Operation of Madel is one fishing method used in the area, Historically there have been Madel licences issued; however practice seems to have ceased as a result of unsustainable income. Very low numbers of fishermen engage in this sector at present.

The proposed project is located in the 2 km coastal zone, in shallow costal water. Thus there are is no major navigation routes intercepting the area, though some tour boats are operating in the area.

This reports attempts to examine the social and environmental acceptability of the projects impacts during its construction and operation. The Following principal areas were identified as major impacts with possible mitigations measures.

Using the Flux and Degradation model results (using the hydrographic data) particles may affect the benthic community on the seabed. Anticipated quantity and quality of waste is determined with relation to ITI contours. This shows that within the ITI contours 30 - 0 (Flux 191.8) will be degraded and within ITI contours 60 - 30 (Flux 0.1 to 191.8) will be changed.

Predicted size and location of the benthic footprint is quantifiable from the model output. For both sites the maximum area of seabed predicted to be effected as a result of the proposed fish farm operation is 50,000 m^2.

Nutrient enrichment can result from the input of quantities of soluble organic matter and its consequences, including enhanced phytoplankton production, however this can be eliminated by present site selection with suitable hydrographic characteristics such as flushing and residence times etc.

There is no significant wild stock availability according to local fisher folk at present. Proposed fish species (Barramundi) is more abundant in brackish water and occasionally in sea near lagoon out lets.

Impacts on other benthic and pelagic organisms within the project sites are also considered. The infaunal macrofauna, i.e. the larger animals such as bristleworms, shellfish and starfish which live in the sediment on the seafloor under the cages react to the input of organic material in a variety of ways the project will impact on activities of these organisms. Pellagic organisms such as rock fish are not abundant in the water column at the time of examination and limited to coral patches and rocks. There are no records of observations of large marine mammals in the proposed sites or any breeding grounds of mammals; therefore there will be less possibility to consider impacts on marine mammals.

The project does not have major negative impact to the existing fishing activities since this is located off shore. The mariculture project will bring many advantages for the subsistence level community who totally depend on fishing but not achieving a sustainable yield. There are no harbours or anchorage facilities in the area nor proposed to be constructed in both DSs in near future, resulting in the majority of them fishing seasonally. Coastal fishing is the prime fisheries activity in the area and the fleets target a mixed fishery.

There are no major navigational routs posing a threat to the proposed sites and development activity. Fishing and tourism boats going through the area from Samudragama to Sali will able to manage without much inconvenience. Furthermore the sites will be well marked with navigation buoys fitted with radar reflectors as well as flashing beacons.

The impact of this site is typical of other fish farming operations with similar equipment, hydrographical characteristics and depth. The impact is completely reversible upon cessation of fish farming operations.

However the full recovery is essential for the site even if it operated in full efficiency or lower than that. This can be done by moving the cages to a new location and allowing a period for regeneration. This time period for regeneration could vary with the status and condition of the particular site.

The possibility of minimising the quality and quantity of wastes could be managed with modern husbandry practices which aim to minimise feed wastage. The supply of food can be managed by giving only the minimum amount required food with reference to food conversion rations (FCR). Monitoring feeding using underwater cameras could be used to monitor feeding and eliminate feed waste.

Nutrient enrichment can result mainly from the input of excessive quantities of soluble organic matter and this can be minimised by good husbandry practices and quality of the diet ration. However, negative impacts on water quality will be managed by the rotation of cages to different locations. Frequent diving and analysis of the sea substrate allows for qualitative surveys to be conducted as to when site relocation is required.

Sites selected with good hydrographic characteristics would result in a lower impact to water quality.

Impact to the benthic organisms from the farm operations can be minimised during the site selection, however there will be a zone subjected to degradation, that zone needs a defined period to regenerate to its natural condition. After a period of operation, the farm management may need to switch the cages to another location or stop the cage operation in the particular site.

Mitigation measures to the Impacts can be managed by designing a suitable mesh size for covering nets. Suitable nets with suitable mesh size for cage top nets will ensure piscivorous birds are not entangled in them and damaged.

Anchor deployments are site specific and have been designed after inspection of the sea floor to ensure no coral reefs and delicate marine structures are present.

The project will support local community development and social improvement projects constantly and some of the activities will continue throughout the project span. A more indirect business environment would open many unexposed income sources to the community. The proposed project envisions recruiting of local unskilled labour.

To assess the level of the changes, a monitoring program is proposed to record the levels of changes in the environment and to help with implementation of mitigating measures. The monitoring should include a control site in addition to sites for fish farming. This will enable comparisons in water quality, the composition and cover of the macrobenthic fauna near sea-cage fish farm sites. With relation to condition of Water quality, sediment accumulation on sea substrate and biological assemblages in the benthic substrates, need to be included as relevant parameters suggested in the monitoring program. In addition to this the recovery of benthic organisms after cessation of fish farming activities also provides an indication of the site's recovery.

Project proponents will be responsible for the implementation of the monitoring programme.

Monitoring socioeconomic aspects is essential through communication with the local community and local government bodies. The following two operational bodies in the area could be the best for such communications, namely: Divisional Environmental Committee and Divisional Coordinating Committee.

The impacts assessed in this report uses quantitative and qualitative approaches. Qualitative assessments were based on professional judgement. The report also proposes environmental monitoring & social management plan for mitigating potential adverse impacts and recommendations on good management practices.

While taking in to account the importance of aquaculture development using marine sea cages in Sri Lanka and its social and economic benefits, the anticipated impacts are of low significance. The impacts identified during the study will be mitigated adopting a profound Environmental monitoring plan and precautionary principles identified and highlighted during the course of this study.

Terms of Reference

CHAPTER 1 : INTRODUCTION

This chapter should include the following;

- Project background
- Objective of the project
- Objective of the IEE report
- Approvals needed for the proposed development from state agencies.
- Any conditions laid down by state agencies in granting preliminary clearance for the project.
- Conformity with existing/ proposed development/conservation plans in the area.

CHAPTER 2 : DESCRIPTION OF THE PROPOSED PROJECT

2.1 Location of the Project

- Provide a location map indicating the project sites. Maps should indicate the general location and specific location of the project area together with GPS coordinates.

2.2 Extent of the project sites (in ha)

2.3 Present ownership of the project sites. Please submit letters of consent for the release of sea sites from the relevant state agencies

2.4 Project components

- A description of the major components including the following
- Size, dimension, design details of nursery and grow out cages, details of nets (mesh size, material etc.) walkways and hand rails etc.
- Design details and components of mooring systems
- Details of navigational lights/ buoys used for the clear making of farm sites.
- Details of any other facilities required
- Project lay out plan (drawings to be provided) clearly indicating all project components, and reservation to be maintained (if any) in order to get a clear picture of the project.

2.5 Installation of project components

- Installation of nursery and grow out cages
- Installation of walkways and hand rails
- Installation of mooring systems

- Installation of navigational lights/ buoys

2.6 Operational Activities

- Availability of stocking materials (brood stock, fry or fingerlings etc.) if stock materials are imported give details
- Details of feed including the ingredients, water solubility, availability etc, feed regime and feeding process & frequency of feeding
- Details of veterinarian process such as disease disinfection/ vaccination process & frequency
- Chemicals/drugs to be used.
- Process of dead fish removal
- Process of cleansing/flushing of cages (if any)
- Process of grading / segregating fingerling
- Juvenile transferring process
- Harvesting and post harvesting process
- Transport & marketing of products
- Details of rotation cycle of cages, site regeneration process
- Any other operational/maintenance activities required.

2.7 Implementation plan

- Phased out development plan
- Whether future addition, expansions envisage (If so give details).

CHAPTE R 3: DESCRIPTION OF THE EXISTING ENVIRONMENT

Study area

a) Project sites
b) Area beyond the project site where there is potential for environmental impacts

Following details should be provided for the study area

3.1 Hydrographical data

- Surface current pattern of the area
- Current velocity
- Site specific water depth including bathymetric data
- Area of dispersion of waste (foot print for settlement of waste)
  (The method adopted in establishing the foot print should be detailed)

3.2 Ecological Resources

- A brief summary of existing flora and fauna (pelagic and benthic communities)

3.3 Social data

- Presence of "Madel" Operators or other fishermen within the project sites and the surrounding area.
- Presence of navigational /shipping routes within the project sites.

CHAPTER4: ASSESSMENT OF ANTICIPATED ENVIRONMENTAL IMPACTS

This chapter should evaluate the anticipated environmental impacts due to the project at all stages of site development and operation on the component of the environment. The assessment should focus on following principle areas.

4.1 Water Quality impacts

- Types and sources of waste to be generated (food residues, faecal matter, dead fish etc.)
- Anticipated quantity and quality of waste to be generated
- Method of collection/treatment and accumulation of chemicals in marine waters due to veterinarian activities
- Expanse of marine waters which will be negatively affected by the discharge and magnitude of changes to the water quality parameters

4.2 Ecological Impacts

- Impacts on other benthic and pelagic organisms within the project sites
- Impacts on piscivorous birds due to project components/activities
- Impact on marine mammals
- Disruption of natural habitats due to project activities

4.3 Sociological Impacts

- Impact on beach seine/"Madel" operators/fishing routes
- Impact on ship navigational routes
- Impacts on tourism and recreational activities in the area such as surfing and other water sports
- Availability of job opportunities for the local people.
- Socio economic benefit other than employment to be provided to the local people.

4.4 Any other impacts not listed here but may be significant in view of the project proponent.

CHAPTER 5: PROPOSED MITIGATION MEASURES

This chapter should include the proposed mitigatory measures to reduce the impacts mentioned in the chapter 4.

CHAPTER 6: MONITORING PROGRAMME

A suitable monitoring plan should be suggested to monitor the changes of environment and implementation of mitigatory measures. This section also include following;

- Parameters to be monitored
- Proposed locations of sampling points
- Frequency of monitoring
- Institutional frame work for monitoring

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

The environmental acceptability of the proposed project and key findings and recommendations of the assessment should be given.

Any programme to improve general environmental conditions can also be stated here.

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ABBREVIATIONS

CCD - Coast Conservation Department
CCA - Coast Conservation Act
CEA - Central Environmental Authority
DSD - Divisional Secretariat Division
EEZ - Exclusive Economic Zone
FA Fisheries Act
FFPO - Fauna and Flora Protection Ordinance
GN Grama Niladhari
KFFC - Kems Fish Farming Company Ltd, U.K.
KFFE - Kems Fish Farming Engineers, U.K.
MEPA - Marine Environment Prevention Authority
NAQDA- National Aquaculture Development Authority
NEA - National Environmental Act
OCP – Oceanpick Pvt. Ltd.
PC- Provincial Council
PAA - Project Aproving Agency
PP- Project Proponant
SLPA- Sri Lanka Ports Authority
UDA - Urban Development Authority

CHAPTER 3: DESCRIPTION OF THE EXISTING ENVIRONMENT

Study area

a) Project sites
b) Area beyond the project site where there is potential for environmental impacts

Following details should be provided for the study area

3.1 Hydrographical data

The tides at the west coast of Sri Lanka are mixed, predominantly semi diurnal tides with pronounced diurnal inequality. Tides are low, ranging from 0.2 m (during the neap period) to 0.8 m (during the spring period). General tidal current velocities recorded are around 0.05 cm/s.

Hydrographical data was collected after on site examinations using Acoustic Doppler Current Profilers (ADCP) to measure the horizontal water current velocity. ADCP instrument (RD Instrument, 600 kHz) was mounted in aluminium frame and deployed at a location with approximately with equal distance from two selected points. Data collection period was from 14.12.2012 to 18/12/2102. Deployment depth from the mean sea level was 18.55m. Summary of the current data for the sub surface (13.67m above sea bed), net bottom (7.67m above sea bed) and near bottom (3.67m above sea bed) is given in Table 3.1.

Table 3.1: Summary of the current data for the sub surface (13.67m above sea bed), net bottom (7.67m above sea bed) and near bottom (3.67m above sea bed).

Description of the observed current	Mean Speed of current / ms^{-1}	Residual current/ ms^{-1}	Direction	Vector average residual
Sub surface current (13.67m above sea bed)	0.17	0.07	168.1° True north	0.003 m/s at 32 degrees
Net bottom current (7.67m above sea bed)	0.13	0.016	345.6 ° True north	
Near bottom current (3.67m above sea bed)	0.12	0.064	345.8 ° True north	

The site specific bathymetric data is shown in Fig. 3.1 and 3.2 obtained from *Navionics hydographic* charts and Admiralty maps. Additions to these sites specific depths were measured using on board portable eco-sounder during the survey.

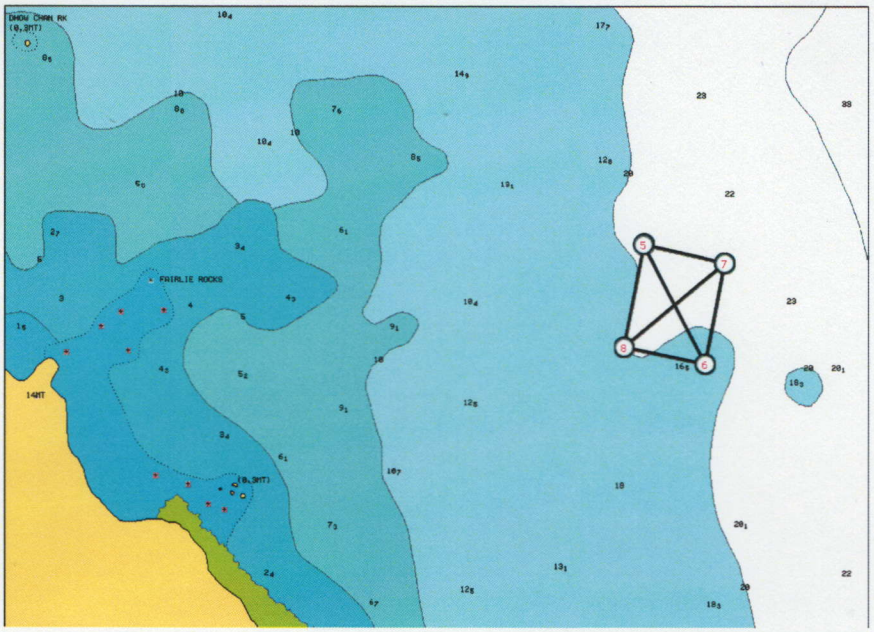


Fig. 3.1. Site specific bathymetric data for coconut point.

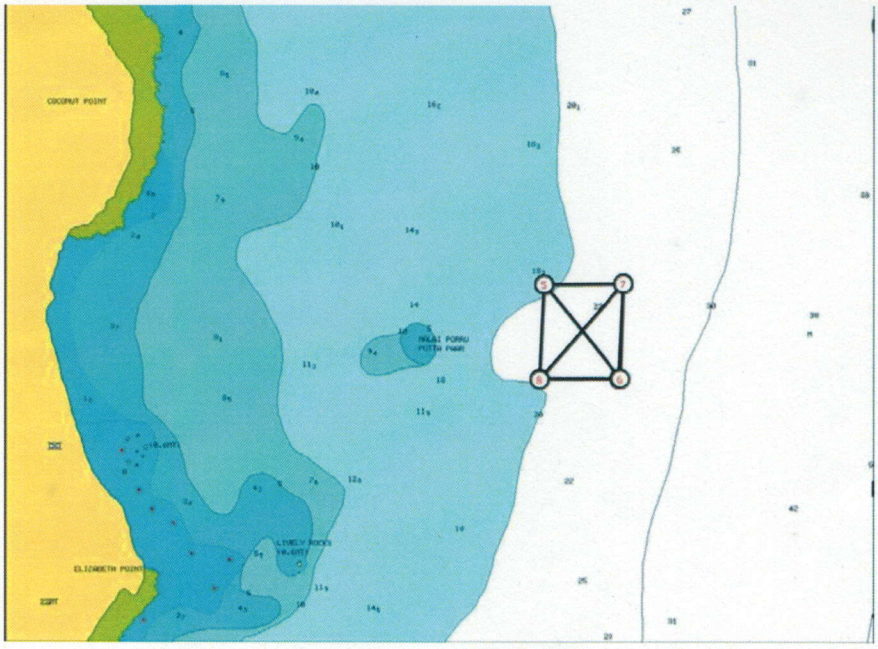


Fig. 3.2: Site specific bathymetric data for Malai porru site

The above hydrographical data was utilized to apply to a computerized model to predict the area of dispersion of waste (foot print for settlement of waste). The computerised model (MERAMOD v1.6) is used for the validation of benthic foot prints particularly for Sea Bass. This modelling was done and reported by TransTec Limited, U.K. The purpose of this model is to (a) Generate the model on benthic footprint (b) Particle Tracking (c) Flux and Degradation with reference to proposed fish farming sites in Trincomalee.

Summary of the data used for calculations by using MERAMOD v1.6 is summaries below in Figures 3.3 to 3.4.

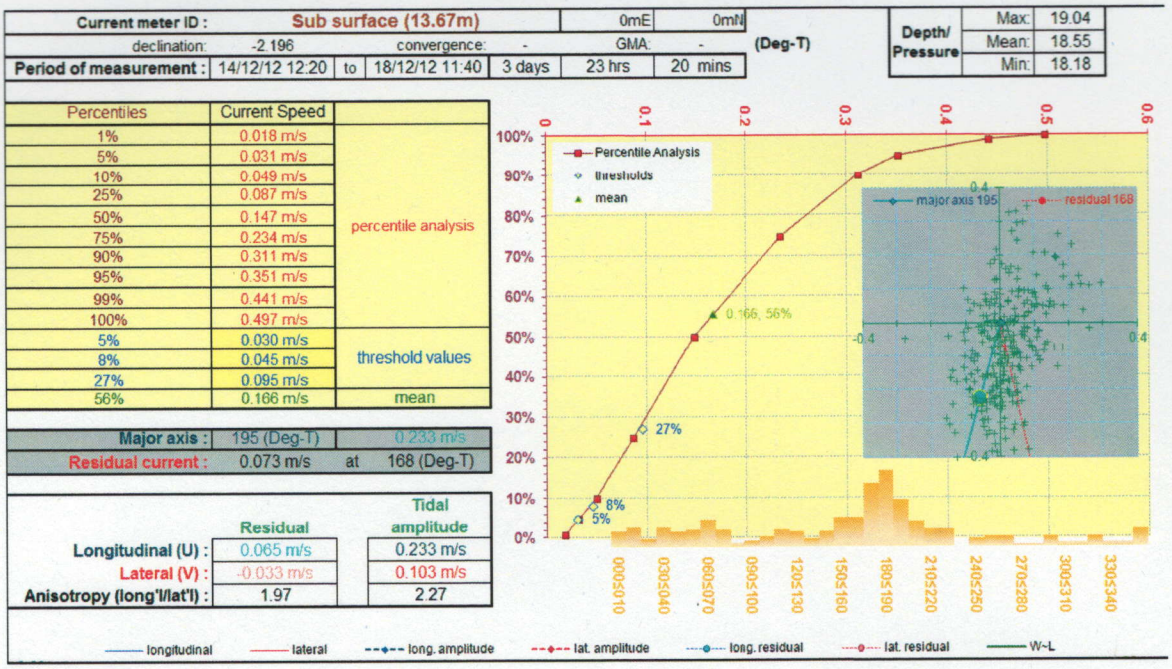


Fig. 3.3: Sub-surface current profile

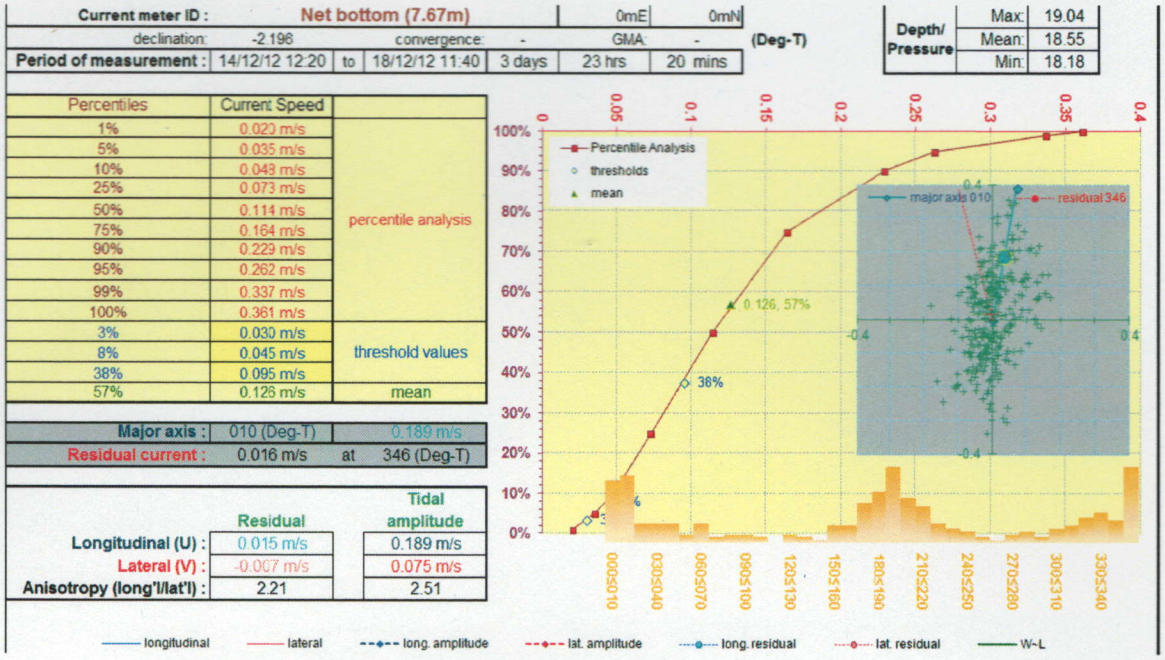


Fig.3.4: Net bottom current profile

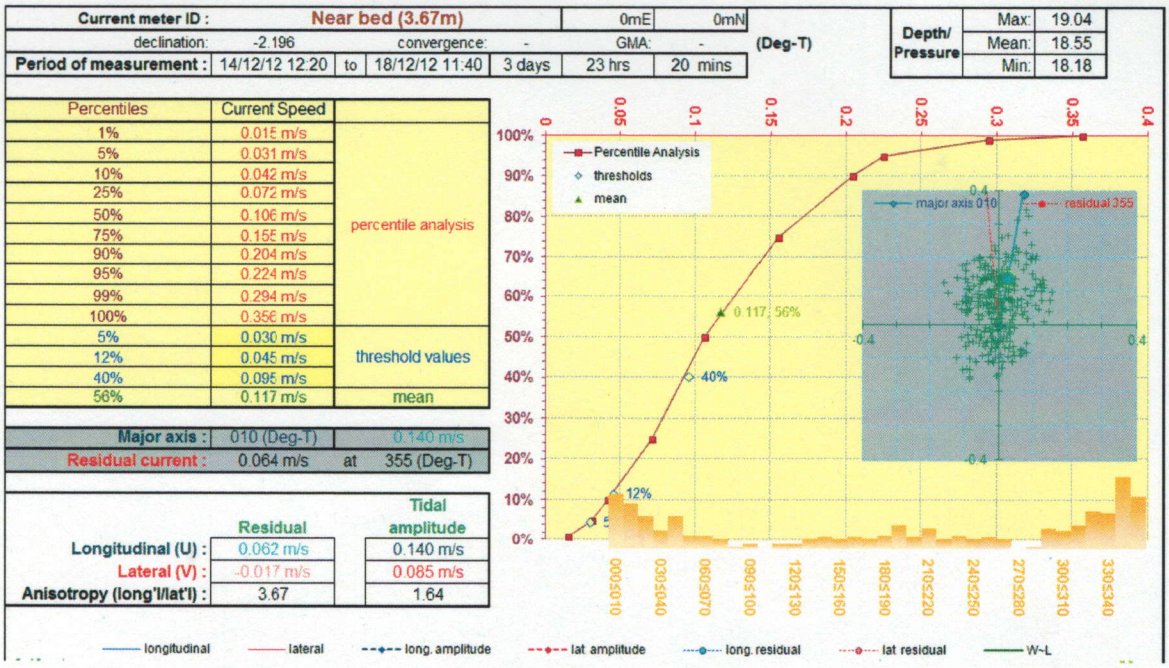


Fig. 3.5: Near bed current profile

(a) Generate the model on benthic footprint

To generate the model 1km^2 area around the approximate centre of each was generated on an Admiralty chart. The bathymetric contours within these areas were digitised using softwear Surfer v8.0.1. Grid limits were set 0 to 1000 m east /west and 0 to 1000 m south/ north. This digitalised chart was imported into AutoDEPOMOD to determine pen positions and generate the major grid file containing the bathymetry to predict benthic foot print for proposed fin-fish farm sites. The pen positions determined using this method is given below for the following sites i.e Coconut point and Malai Porru sites.

Table 3.2: Summary of modelled pen positions using AutoDEPOMOD

	COCONUT POINT			MALAI PORRU		
Pen	East (m)	North (m)	Pen Diameter (m)	East (m)	North (m)	Pen Diameter (m)
1	528	571	12.7324	529	569	12.7324
2	512	546	12.7324	513	544	12.7324
3	553	555	12.7324	554	553	12.7324
4	538	530	12.7324	539	528	12.7324
5	496	520	19.0986	497	518	19.0986
6	480	495	19.0986	481	493	19.0986
7	464	469	19.0986	465	467	19.0986
8	448	444	19.0986	449	442	19.0986
9	521	504	19.0986	522	502	19.0986
10	506	479	19.0986	507	477	19.0986
11	490	453	19.0986	491	451	19.0986
12	474	428	19.0986	475	426	19.0986

The modelled pen positions (as shown in Table 3.2) were entered after loading the computer programme MERAMOD to generate grid. This is used by the model to track the deposition of faecal material as a minor grid file.

(b) Particle Tracking

The minor grid file was loaded into Particle Tracking module of MERAMOD (Particle input data configuration file). This module defines the site's configuration in terms of the proposed feeding regime at peak biomass, equipment details and species to be farmed. The daily feed input (worst-case based on peak feed load), pen shape (circle), pen dimensions (circle diameter), net depth, and species farmed (Sea bass).

Following assumptions were considered for the application above.
(a) Continous food release
(b) Feeding automated OR supply of many feed during working days

The current data used herein (sub surface, bottom and near bed) is only limited to four days, however this is only slightly different from the results from the long term data more than four days.

Mean tidal height (MSL) was obtained from Admiralty Total tide for the nearest Tidal port, Trincomalee (8° 33' N, 81 ° 31' E). For the particle trajectory model the number of particles was set to 10 with the trajectory evaluation accuracy set at the highest value of 6 s.

To get the worst-case scenario we assumed that no waste pellet material was consumed by wild fish.

The model was run as detailed above to generate required output for the Flux and Degradation module.

(c) Flux and Degradation

The flux and degradation module determines the flux or total deposition of waste material (faeces and feed) at the sea bed discharged from mariculture operations.

The majority of mariculture waste deposition models predict the flux of waste materials from a discharge as this is quantifiable, takes account of current induced resuspending and the model can be validated during its development using sediment traps (see Chapter 7 for details)

Flux was selected as the modelled output as opposed to total deposition because it defines the benthic impact area where the seabed is degraded or changed as a result of fish farm faecal and uneaten feed deposition. The flux model uses the Intrafuanal Trophic Index, (ITI) according to Codling and Ashley (1992). This helps to determine the area for impacted sea bed. Table 3.3 show the details of ITI scores applied for 30 ITI contour, within this contour the community is degraded. Within 60 - 30 ITI contour the benthic community susceptible to change and beyond 60 ITI contour as normal.

Table 3.1: Summary of the current data for the sub surface (13.67m above sea bed), net bottom (7.67m above sea bed) and near bottom (3.67m above sea bed).

ITI Contour	Status of the benthic community	Flux / $gm^{-2}yr^{-1}$
>60	Normal	0.0
60 - 30	Changed	0.1 to 191.8
30 - 0	Degraded	0. 191.8

Final output from the model shows that the benthic footprint for the two proposed sites with reference to the amount of predicted benthic environments. (Fig. 3.6 and 3.7)

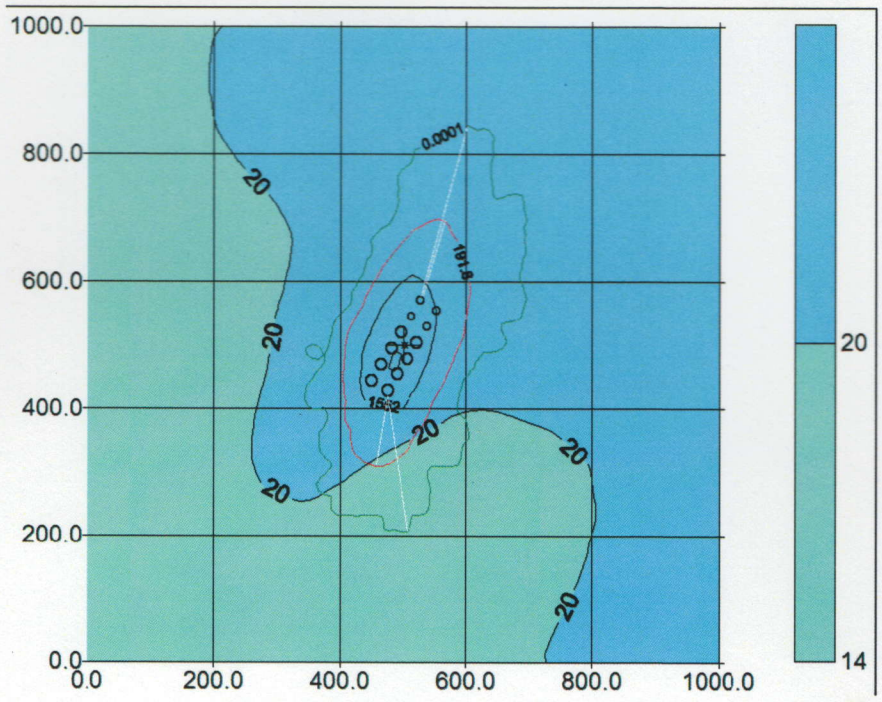


Fig. 3.6: Benthic footprint predicted by MERAMOD for the site Coconut point

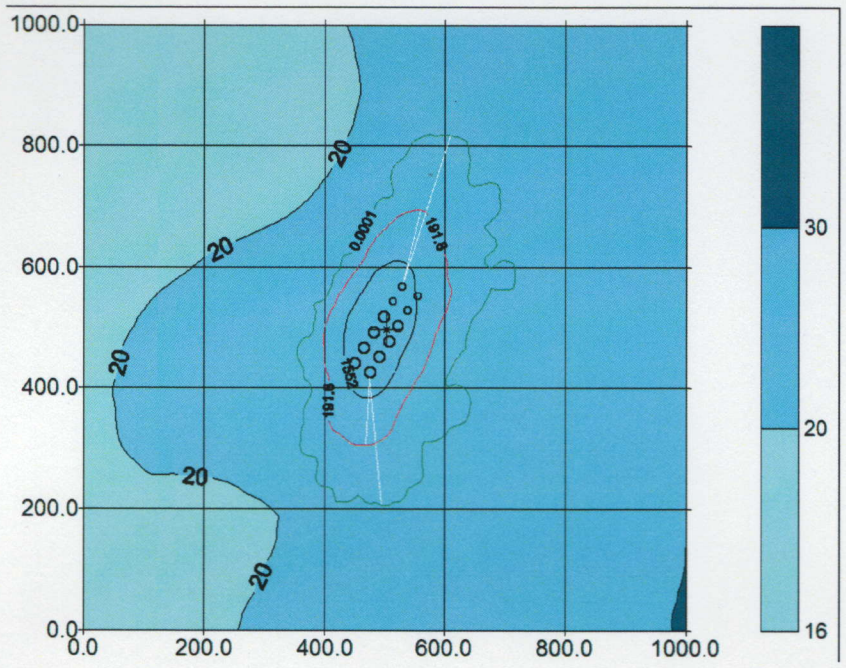


Fig. 3.7: Benthic foot print predicted by MERAFMOD for the site Malai porru

3.2 Ecological Resources

Locations of the proposed project (4 Sites) are within the deep waters of Trincomalee sea (Back bay).

According to the previous studies performed for the Trincomalee Ocean areas in general we described that these areas contain a sea bed surrounded by habitats mainly with rocks (Swan, 1983; Rajasuriya & Premaratne, 2000). Distribution of coral reefs are patchy along the coast and they were limited to few in coverage. The main coral reefs are located at Nilaveli, (Pigeon Island and Coral Island, 10 km north from centre of proposed project sites). There are extensive rock and sandstone reef habitats, both inshore and offshore. Narrow fringing coral reefs have developed on rock substrates, extending about 200 m from the coast to a depth of about 8 m, while offshore reef habitats are found to a depth of more than 50 m.

To date, over 100 species of corals and more than 300 species of reef fish have been identified in Trincomalee and surrounding areas (Rajasuriya and Karunarathne, 2000).

Fishing for edible species and ornamental fish collecting are high in Trincomalee, while extensive harvesting of sea cucumber and Chanks (*Turbinella pyrum*). There are no systematic studies performed on benthic and soft bottom communities (i.e. Sponges, Cnidariens, Polychaetes, Molluscs, Crustaceans, Echinoderms) for these areas to date.

The ecological observations were conducted during 7th July in order to obtain a clear understanding of the project area with reference to ecological resources. The sea sites 1 to 4 and surrounded underwater environment were subjected to examination.

- A brief summary of existing flora and fauna (pelagic and benthic communities)

  Project location not covered with coral reefs, however there were few forms of *Favia, Favites, Goniopora, Porites*, domes were observed along the seaward margin and in the deeper parts of the sea bed areas around 1km distance (near shore) to selected sites. Some deeper parts contain substantially large rocks. Rocks are dominant with barnacle communities. This pattern was similar for sites 3, 4, 5 and 6.

  No significant cover or diversity of algae present in the study area such as Green Alga or Brown Algae, however there were notable amount of Red algae (Rhodophyta) belonging to the genus *Gracilaria.* Communities exist in areas with coral domes. This genus is important economically used as a food for humans (not popular in local) and various species of shell fish.

  The most commonly observed fish species belong to the families of *Acanthuridae, Balistidae, Caesionidae, Carangidae, Chaetodontidae, Haemulidae, Labridae, Lutjanidae, Lethrinidae, Mullidae, Nemipteridae, Pomacentridae, Pomacanthidae, Scaridae, Serranidae and Siganidae*. These fish were important as in ornamental fish trade.

  Other fish species observed are important as food fish. Some species of grouper (Family: Serranidae), snapper (Family: Lutjanidae), emperor (Family: Lethrinidae) etc.), were observed.

  Jelly fish are common (Phylum: Cnidaria) in the surface of the water column feeding on plankton or other particles suspended in the water. These jelly fishes more abundant nearby rocks and corals.

  The sea bed in the study area has mixed characteristics' ranging from: fine compact coarse sand, some areas with sand mixed with sediment or calcareous coral gravel. There may be suitable habitat for bottom dwelling organisms including: *Polychaetes, Molluscs, Crustaceans* and *Echinoderms.* There were no visual observations of such organisms except few sea cucumbers (*Holothuroidea).*

- Existing natural habitats (marine mammal habitats of whales and dolphins, corals etc.) within the study area and their importance

  There were no observation records for marine mammals such as whales and dolphins within the site limits of the proposed project, according to local tourist guides, locations important to watch whales and other cetaceans were in deeper waters i.e. further north from proposed project sites (beyond north from Nilaveli area).

  There are records of sea turtle landings along the beaches off *Nilaveli*, however there were no recent records (*P.comm. local boat operator Mr. Sajith*) for sea turtle landings within the beeches parallel to project site location.

- Rare, endangered and endemic species of the above habitats

  There is no presence of a large ecosystem present such as a coral reef or a sea grass bed in the proposed site; therefore less chance of occurrence of rare, endangered and endemic species within or near the proposed project sites.

3.3 Social data

The project area falls within two divisional secretariats of Trincomalee district, Town

Study area subjected examination on socio economic aspects
and Gravets Divisional Secretariat and One Gramaniladari Division of Kuchchaveli of Trincomalee District of Eastern province of Sri Lanka.

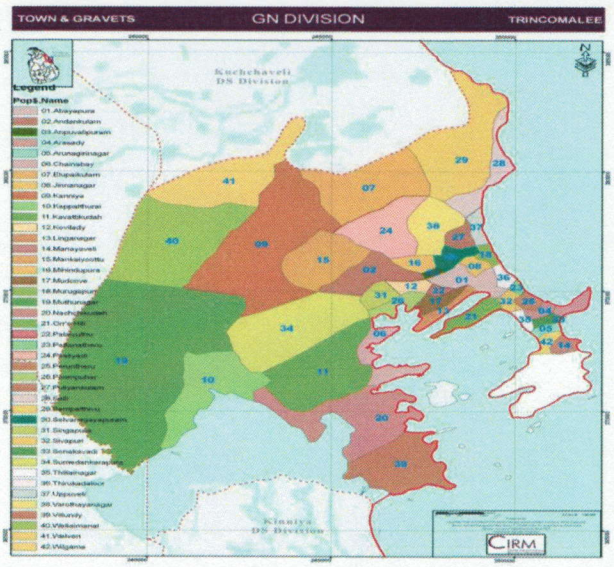


Figure 3.8: Study area shows the Town and Gravets DS Division and Kuchchaveli DSD of Trincomalee

The study area is covered by two Divisional Secretaries Divisions (DSD) of Coastal areas of Trincomalee District, which are Town and Gravates and Kuchchavali DSDs (Figure3.2). There are 11 Grama Niladari Divions (GND) and Iqba Nagar respectively from both DSD are directly affecting coastal GNDs.

Assessment survey techniques were used in gathering socio economic aspects of the study area as well as affected area. Most of the secondary data has been compiled according to the DSD levels and not discussing here in micro level.

There are 12 GNDs directly covering the entire study area are shown in the Table 3.2

Figure 3.9 (a) Study area of the Socio Econmic Survey Kuchchaveli

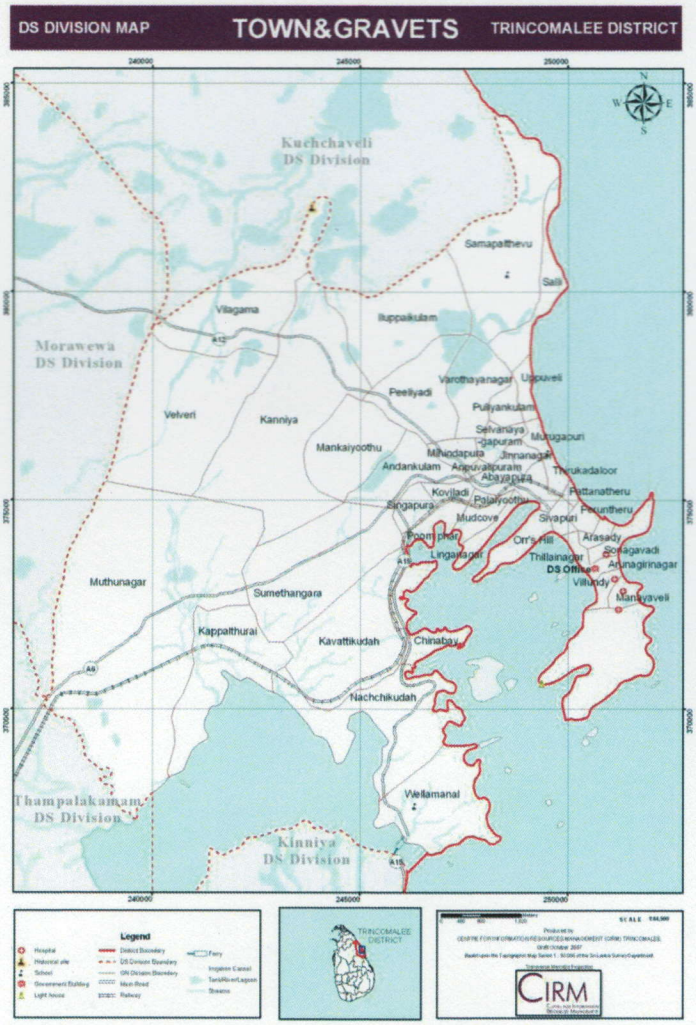


Figure 3.9 (b) Study area of the Socio Econmic Survey Town and Gravets DSDS

Table 3.1: Grama Niladari Divisions of Study area.

S.N	Gramaniladari Division Name	Grama Niladari Division No
1	Salli	242A
2	Appaveli	243
3	Maragapuri	243G
4	Thirakadoloor	243
5	Pattanathera	244K
6	Peruuthera	244L
7	Villundy	244E
8	Thilunagar	244H
9	Oris Hill	244p
10	Lingnagar	244R
11	Chnabay	229
12	Iqbal Nagar	241D

sources; Trincomaliee District profile 2010

Total population of the study area is about one hundred fifty two thousand two hundred ninety two (152,292) according to the most recent compiled secondary data available (Fiture 3.2). According to the available figures it shows Kuchchaveli has a low population while Town and Gravets shows the mostly populated DSD in Trincomalee.

The area is covered with broad beach and dead coral mixed materials. The depth of the shallow sea is gradually increasing. The coastal stretch up to Uchchavali is densely populated and fishing families are residing along the coastal stretch. It is rare to find abundant lands in the coastal stretch from Thiriconeshwaran point to Elezabath Point. However, fishing population in this coastal stretch is about 152,292, higher than any other areas.

Table 3.2: Population of two DSDS in 2010

Total population of Town and Gravets DS and Kuchchaveli 2010				
S.N	**DS Division**	**GN Divisions**	**Fa milies**	**Population**
1	Town & Gravets	42	29129	115988
2	Kuchchaveli	24	9904	36304
	Total	**66**	**39033**	**152292**

Table 3.3: Fishing Population of Town and Gravates 2011

Fishing Population of Town and Gravates 2011							
S.N.	GN Division	No. of Families	No. of Families in Marine Fisheries	No. of Families in Inland Fisheries	Active Fisher men	No. of Affected Families	
						Tsunami	War
1	Chaina Bay	113	73	30	113		
2	Linganagar	75	28	47	75	-	-
3	Murugapuri	442	306	136	442	-	-
4	Orr's Hill	6	-	6	6	6	-
5	Pattanatheru	340	316	24	340	56	45
6	Peruntheru	109	109	-	109	10	-
7	Salli	412	397	15	412	315	-
8	Thillainagar	32	12	20	32	4	4
9	Thirukadaloor	890	245	645	890	-	10
10	Uppuveli	175	103	72	175	29	-
11	Villundy	5	3	2	5	-	-
Total		**2,599**	**1,592**	**997**	**2,599**	**420**	**59**

There are mainly three fisheries inspector areas covering the entire area with the main three fish landing sites, Samudragama, Thirukadaloor and Salli. Sinhala, Muslim and Tamils are mainly occupying these areas. According to a field observation there are more than 60 fish landing sites located in this coastal stretch. Total fishing families living in the area are about 2500 - 3000 and more than half of the fishing population are engaged in marine fishing while less than 1000 families engaged in inland fishing activities including Trinco bay area.

The project study area covered the Marine area as well as bay areas, which include in total about 12 Gramaniladari Divisions.

- Presence of "Madel" Operators or other fishermen within the project sites and the surrounding area.

  The Fisheries Sector plays a lead in Sri Lanka in general, with heightened significance in Trincomalee District, as a coastal district with extensive opportunity and potential of marine, estuary and inland fishery resources. Coupled with the fact that it sustains extensive employment and revenue to the community which must be safe guarded.

The Fishery industry consists of relatively low investment and is a source of animal protein to a growing number of consumers. Therefore if managed in a targeted manner it will play an important role in protecting livelihoods as well as an important role in food security in the area, especially as agricultural land productivity is considerably low due to water scarcity.

The productivity of the water around Trincomalee was far more abundant in the past. During the recent decades unsustainable fishing practices and other exploitative activities have led to reductions in the output and remain a serious threat to the industry, especially those seeking to make a livelihood at the subsistence level.

Table 3.4 : Fish Production of Trincomalee District - 1983 to 2010

Year	1983	2007	2008	2009	2010
Fish Production metric Tons	13510	8150	17980	27690	36250

The table shows that fish production has dramatically increased to 36,250 metric tons in 2010, while it was 8,150 mt in 2007.

This considerable increase is due to the fact that on one hand the security disturbances that prevailed during the 30 years of insurgency and civil unrest had halted as well as there being no regulatory barriers set in place to restrict over fishing practices.

Further, active fisherman in the area have increased both from within the area and out during the last 3-4 years.

Table 3.5: Active Fishers in Trincomalee District

1989	1996	1999	2004	2008	2010
6502	7557	10748	16100	29970	32970

This situation does not vary in the study area, Town & Gravets and Kuchchaveli divisional Secretariat divisions. Communities have not made the transition to sustainable alternative's for livelihood activities or other sources of income. Fishing is an open pool of resources not like land base activities. The obvious increased fishing pressure in recent years, poses the questions into the sustainability and longevity of the fisheries natural stocks.

Local Fisheries are either non-motorized (whereby fishing is done not too far from shore), or motorized with out -board or in board motors fitted to larger fishing vessels.

Total fishing population in the area is 50,833 out of which, 81% is from Town and Gravets and 9564 from Kuchchaveli South (Figure 3.3.1). `Fishing population distribution among the Grama Niladari divisions are shown in the following figure.

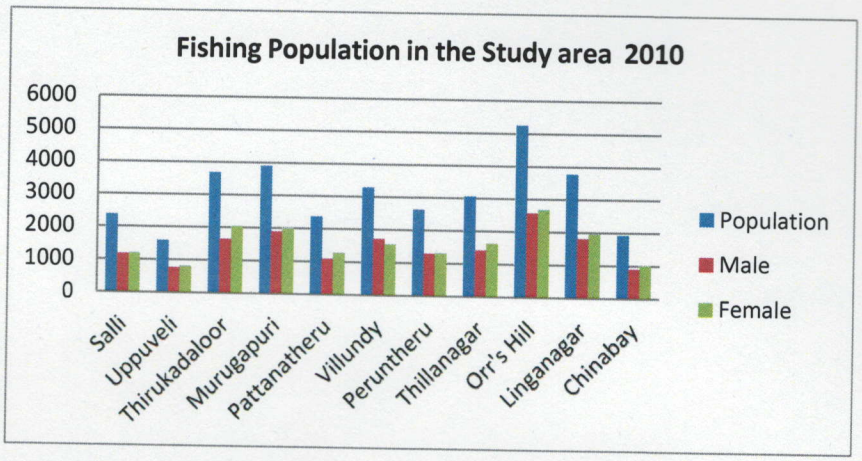


Figure 3.10: Distribution of fishing population among the Grama Niladari Divisions.

There are about 30 registered fisheries cooperatives societies in the area with the total members of 5265 in the area in 2010. According to these figures it shows that most of the fishers in the area are involved in these societies.

Table 3.6: Numbers of fishing crafts in operation in 2010

Fisheries Inspectors Divisions	Traditional Craft				
	3 1/2 Ton Boat	Fiber Glass boats	One Day Boat	Model Vallam	Kullaa/Teppama
Town & Gravets	143	1145	65	93	738
Kuchchaveli South		141		13	23
Total	**143**	**1286**	**65**	**106**	**761**

(Source Fisheries Department Trincomalee)

The fishing crafts in operation in Town and Gravets and Kuchchaveli south are shown in the table 3.3.1. According to these figures there are about 106 Madel fishing activities in the Study area, 93 from Town and Gravets and 13 from Kuchchaveli south. Even though these are registered Madel activities, these rarely can be seen in practice in the area currently. Madel fishing mainly occurs in the Murugapuri and Uppuveli areas. During the field observation period no Madel fishing operations were apparent.

- Presence of navigational /shipping routes within the project sites.

The proposed project is located in the 2 km coastal zone, in comparatively shallow waters. Thus there is no major navigation routs intercepting the location of the sites. Fishing and tour boats are operating in the area, however as previously mentioned clearly marked sites are easily avoidable by these boats.

CHAPTER 4: ASSESSMENT OF ANTICIPATED ENVIRONMENTAL IMPACTS

Firstly it should be acknowledged that all farming activities, including aquaculture, may have some environmental impacts. The farmers and the regulators must ensure that the impacts of the activity are socially and environmentally acceptable. This chapter evaluates the anticipated environmental impacts at all stages of site development and operation. The following principal areas were considered for the assessment.

4.1 Water Quality Impacts

Types and sources of waste to be generated during the proposed mariculture operations include: Organic trace elements, food residues, faecal matter etc.)

(a) All fish naturally excrete organic nutrients. The fish ingest food and excrete nutrients, nitrogen, in the form of faeces, and ammonia (via the gills). In a tropical environment one of the important factors to consider is the fate of the nutrients excreted by the fish and the assimilation rate of the organic nutrients into natural systems.

Operational areas of the fish farm are surrounded by the natural environment; mainly with an abundance of surface microalgae. These organisms have a very large assimilative capacity to break down and utilise organic nutrients.

(b) Another potential impact of fish farming is the risk of accumulating solid matter (faeces) in the environment. In the case of sea cages these may accumulate under or near the cages.

Studies of the environmental impacts of cage aquaculture on the water column have shown an increase in the levels of (a) nutrients and (b) suspended solids.

(c) Oxygen consumption by fish and microbial activity can lower oxygen concentrations in the water column. Consumption is variable and relates to fish biomass, the season and the physical characteristics of the site. Oxygen reductions can be increased by the settlement of algae, molluscs etc.

- Anticipated quantity and quality of waste to be generated

Using the Flux and Degradation model results (See Chapter 3 for details) particles may affect the benthic community in the seabed. This study used hydrographic data the Trincomalee sea (Coconut point and Malai porru sites) as a representation of the rest of the sites.

Anticipated quantity and quality of waste is determined with relation to ITI contours. This shows that within the ITI contours 30 - 0 (Flux 191.8) will be degraded and within ITI contours 60 - 30 (Flux 0.1 to 191.8) will be changed

- The method of collection/treatment and accumulation of chemicals in marine waters due to veterinarian activities

It is a common misbelief that fish farms are major sources of chemical pollutants such as antibiotics, anti-fouling, anti-parasitics etc. Whilst it is true that some fish farms do on occasions use antibiotics, so does every other form of primary production when it is appropriate to do so.

Anti-fouling will not be used as part of operation of practices .This procedure will be eliminated by regular net cleaning. Net cleaning will be happen as a maintenance procedure of cages. This activity will take place in land and removal of attached organisms to nets. The removed organism's debris will be used as fertilizer and nets will be cleaned with fresh water and dried.

- Expanse of marine waters which will be negatively affected by the discharges and magnitude of changes in water quality parameters.
Predicted size and location of the benthic footprint is quantifiable from the model output. For both sites, the maximum area of seabed where traceability of organics are evident from the fish farm site is 50,000 m^2.

Nutrient enrichment can result from the input of quantities of soluble organic matter and its consequences, including enhanced phytoplankton production (Gowen and Bradbury, 1987). Nitrogen tends to be the factor limiting phytoplankton growth in seawater. However, several other growth factors may restrict the utilisation of additional nitrogen by phytoplankton (for example, light, turbulence, hydrographic characteristics such as flushing and residence times etc.).

4.2 Ecological Impacts

There is no significant wild stock availability according to local fisher folk at present. Proposed fish species (Barramundi) is more abundant in brackish water and occasionally in sea near lagoon out lets.

There is a possibility that other wild fish in the adjacent pelagic waters are likely to interact near cages. There will be wild fish communities consuming suspended matter during its resistant time in the water column. However this will not have a severe impact, as the food particles contain no harmful substances or chemicals. Consumption of food particles in this way may reduce the contribution to benthic enrichment.

- Impacts on other (a) benthic and (b) pelagic organisms within the project sites

  (a) If enrichment rates are high, the sediment under the cages may be devoid of any larger infaunal animals such as sea cucumbers (*Holothuria*) and a variety of large worms all of which re-work the upper 5 – 10 cm of sediment, using up its organic load and helping to maintain relatively high levels of oxygen within the sediment. This activity is known as bioturbation.

  (b) Pellagic organisms such as rock fish are not abundant in the water column at the time of examination and fish were only limited to coral patches and rocks situated far away from the proposed cage deploying sites. There may be a possibility that fish may move to cage sites for food and shelter.

- Impacts on piscivorous birds due to project components/activities

  Sea-cages in coastal waters have long been known to be a focus for many species of predatory and scavenging bird species (cormorants, shags, herons, gulls and eider ducks) attracted by feeding opportunities around mariculture sites.

  Few piscivorous birds such as cormorants and gulls were observed during the site examination and found near rocky patches along the sea. These birds might be attracted to the cage sites during farm operations for feeding opportunities. This issue has been addressed by utilising top netting of the appropriate size thus preventing this occurrence.

- Impacts on marine mammals

  There are no records of observations of large marine mammals in the proposed sites or any breeding grounds of mammals; therefore there will be less possibility to consider impacts on marine mammals.

- Disruption of natural habitats due to project activities

  Project locations operate within a depth range between 18 – 25 m. These waters are not surrounded by any special ecosystem or habitat; therefore there will be no disruption to any natural habitats.

Other impacts

If wild stocks of the same species are present, accidental escapement of farm stock could interact with the wild species.

Possible effects of escaped fish include interactions with wild fish by predation and competition for resources.

There are controversial opinions on the effects of accidentally released fish on the natural genetic variance within wild stocks. Ocean pick has addressed this issue by selecting a species that is native to Sri Lankan waters, further considered by sourcing fingerlings that are progeny of Sri Lankan parentage.

4.3 Sociological Impacts

The project will not have any major negative impact to the existing fishing activities since this is located off shore.

Apart from fisheries, tourism is the other main income source for the area which also has a season. In the season most of the fishing craft engage in tourist activities as well. Since there are two tourism centres located close to the project area, Nelaveli Beach and Pigeon Island. This has been an added advantage for fishermen. Total fish production in the study area records about 8500 Metric tons in 2010, fresh fish account for 8300 while dried fish contribute by 200 metric tons according to the sources provided by the fisheries department.

Most of the fishers earned only Rs. 5000 per week as an average, and they are engaging in fishing only 4-5 days per week. Accordingly average income of one fisherman per day is about Rs. 850.00 in this area (this is based on the community consultation held in Sampaltheve, Salli, Uppaveli and Peruntheru areas). The income of a fisherman per month, if they had been working for 20 days per month, will be about Rs. 17000.00. Out of 364 days of the year they only work 240 days per year. Thus annual income of a fisher is about Rs. 204,000.00.

The proposed project has planned to provide up to 25 direct job opportunities during the initial pilot phase of the project. In forthcoming years OP aims to provide >120 sustainable employment opportunities to local fisher families upon expansion of the project. Furthermore by establishing an abundant work force and industry sector, OP will bring surrounding generation of revenue into the local area. These factors considered OP plans to generate an additional 30-50 and 100-150 indirect employment opportunities during the pilot and expansion phase respectively.

It is important to note that during the pilot scale there will be no skilled labour, but two expatriates employed to train local staff. Unskilled employees will attain a salary within the region of RS 600 per day 180,000 per annum (it should be noted that this will be part

time employment). Once trained and competent, skilled employees will earn RS1120 per day (336,000 per annum) This could be a huge benefit for a family in the area. This along with many others is one aspect of the proposed project, showing great changes.

Social work of Oceanpick will be tremendous, the company has already given many benefits to the area, providing safety fishing gears is one activity. The project also has planned to provide many community support programs in coming years. This is a model project which explores the possibility of expanding fish culture in Sri Lanka, increasing fish production and income in the area.

The proposed cage structures are located away from the beach, 2 km away from the low water line; thus no impact to the existing residence of the area. No compensation or resettlements will be required due to the proposed development. All the fisheries landing sites are located along the coastal stretch do not have any influence or impact. Discussion with the members of the fishing community revealed their expectations in joining the fish farming project as an alternative income source.

The coastal belt in Nilaveli is the main tourist attraction

- Impact on beach seine/"Madel" operators/fishing routes

  Coastal fishing is the prime fisheries activity in the area and the fleets target a mixed fishery. There are fishing routes in the area in the marine as well as Bay area. Since Multiday boats and day boat operations are taking place in the area, no navigation routes have fallen though the proposed project.

  There are no madel fishing activities in the area and no impact to them. In comparison to the extent of the open sea and bay area this project will have no significant impact on on-going fishing activities or tourism in the area.

- Impact on ship navigational routes

  Since there are no major navigational routes, these will not impact on this development activity. Fishing and tourism boats going through the area from Samudragama to Sali will able to manage without much inconvenience. Most of those boats fishing and tourism are operated within the 200 m zone.

Figure 4.1: Tourist routes are located close to the beach, less than 100m zone

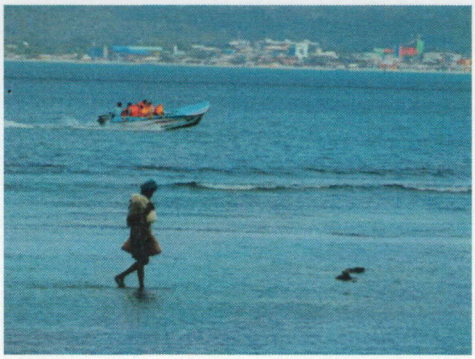
Figure 4.2: Fishing routs can easily managed once the buoys are installed

- Impacts on tourism and recreational activities in the area such as surfing and other water sports

The proposed site is not close to Nilaveli beach area, where tourist activities are taking place and away from Pigeon Island. Most of the tourism sites are located away from the fin fish cages. The main impact to the existing navigation and fishing activities of the area can be easily managed through establishment of proper coordination mechanism with local and existing stakeholders in the area.

This project will have a more positive impact to the local community in general, fishers and tourist in particular, because proposed fish farming would be another tourist attraction, where fine fish will be readily available.

Figure 4.3 witnesses that most of the tourism; recreational activities are always taking place at a closer proximity to the beach. These events will not be affected such floating cages located 2 k.m from the beach.



(a)

(b)

Figure 4.3: Most of (a) fishing and (b) tourism activities are taking place in close proximity to the beach not far distance

- Availability of job opportunities for the local people.

  Once established in full scale (not expanded fully as expected in forthcoming years), the project will generate around 90 direct employment opportunities. A large proportion of this is allocated to an unskilled workforce, which would be significant for the subsistence fishers who do not have a sustainable income.

- Socio economic benefit other than employment to be provided to the local people.

  Trincomalee in General and the project area in particular have vast resources, including fisheries and sea around the area. Mineral resources, tourism and agriculture are not sufficiently used at this stage.

  The proposed project would be an innovative approach which would indirectly create many entrepreneuring opportunities for the local community.

CHAPTER 5:
PROPOSED MITIGATION MEASURES

CHAPTER 5:

This chapter proposes mitigation measures to the anticipated environmental impacts (as Chapter 4) due to the project at all stages of site development and operation on the component of the environment. Following mitigations were suggested for consideration of project proponents.

5.1 Mitigation measures for impacts associated with cage operational activities in proposed sites.

The MERAMOD model specifically uses faecal and waste feed settling rates for sea bass (or sea bream). The parameters used by the model are well suited to Barramundi farming and as such we have a high level of confidence in the model predictions. It should be noted here that a worst-case scenario has been modelled.

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- Minimize the anticipated quantity and quality of waste to be generated

The possibility of minimising the quality and quantity of wastes could be managed with modern husbandry practices which aim to minimise feed wastage. The supply of food can be managed by giving only minimum amount required food with reference to food conversion rations (FCR). Monitoring feeding using underwater cameras could be useful to eliminate un-necessary loading of food.

- Expanse of marine waters which will be negatively affected by the discharges and magnitude of changes of water quality parameters

Nutrient enrichment can result mainly from the input of excessive quantities of soluble organic matter and this can be minimized by good husbandry practices related to quality and quantity of feed ration. However negative impacts on water quality will be managed by the rotation of cages to different locations, depending on the analytical results of substrate monitoring.

Sites selected with good hydrographic characteristics could result in a reduced impact to water quality. In addition to site selection, management of stocking density is the main mitigating measure against oxygen depletion. Hydographic characters will advantageously increase flushing of particles in water.

5.2 Mitigation measures for Ecological Impacts

- Mitigation on wild stock within the project area due to water quality changes

  Site selection of the proposed project with moderate water current will reduce the time of suspended particles in the water column. It is difficult to predict how many wild fish will be attracted to the site, minimized by utilising proper feed management.

- Mitigation of impacts on other benthic and pelagic organisms within the project sites

  Impact to the benthic organisms can be minimised by selecting a location with suitable hydrographical conditions, minimising the impact of released particles from the fish farm. After a period of operation, the farm management would need to switch the cages to another location or stop the cage operation in the particular site depending on level of degradation, allowing the particular site to regenerate.

- Mitigation measures to the Impacts on piscivorous birds due to project components/activities

  This can be managed by designing a suitable mesh size for covering nets. Suitable nets with adjustable mesh sizes will not cause any accidents to piscivorous bird activities during cage operations.

- Disruption of natural habitats due to project activities

- Divisional Coordinating Committee, which is the local body of the Trincomaliee District Coordinating Committee, chaired by Member of Parliament, Hon, Deputy Minister of Fisheries.

  This forum consists of all stakeholders' participation including political authority as well as public participation.

The Anchor deployment needs to be site specific and deployed after inspection of the sea bed. This will minimize the potential damage to sea bed structures supporting life.

5.3 Mitigation for sociological impacts

The project management will make necessary arrangements to get representation at the Divisional Coordinating Committee levels, chaired by the deputy minister with the presence of all other key stakeholders in the respective thematic areas and public representation in the division. This would be a coordinating body where all parties can share their views on development activities in the region and take necessary measures as appropriate.

The Divisional Environmental Committee (DEC) is the other local forum the project can support in order to improve close communication with relevant stakeholders, public representatives, relevant government agencies, fisher leaders and various other interested parties. This meeting is limited to officials. Under the close coordination with the relevant parties, Oceanpick will support this type of committee to coordinate and ensure environmental controls and water quality measures, are undertaken regularly through a technical organization and review accordingly.

The proposed project will layout awareness building and community mobilization programs on a regular basis to update the local community about the status of the project, to find ways and means to improve integration of the project with local needs.

The project will support local community development and social improvement projects constantly, and some of the activities will continue throughout the project span. More indirect business activities will open many unexposed income sources to the community. Through collaboration of the (DCC), assistance is to be provided in shortlisting the potential candidates appropriate for the employment opportunities available. Formal notification will be given in writing to the chairman of the DCC, initiating recruitment the process. Following this procedure allows for an equally equated, unbiased employment process, among all surrounding areas and villages. OP would like coordinate the provision of unskilled and skilled criteria. OP will be responsible for undertaking the interviews of potential short listed candidates.

CHAPTER 6:
MONITORING PROGRAMME

The aim of this monitoring program is to assess the level of changes in the environment and implement mitigation measures. The monitoring should include a control site in addition to sites for fish farming. This will enable the comparison of (a) Water quality, (b) the composition and cover of the macrobenthic organisms near the sea-cage fish farm sites (with an established control location).

The following sections suggest relevant parameters that need consideration in a monitoring program.

(1) Water quality; Dissolved Oxygen, Nitrate, Nitrite, Ammonium, hydrogen iron concentrations in Surface and bottom samples (triplicate) at all sites with relation to the control site. Sampling on site needs to be performed bi-monthly and every two months from control sites.

(2) Dynamics of sediment accumulation beneath fish farms and benthic enrichment. Installation of sediment traps (4 traps per site) in all site plus control site. The amount of sediment can be used to determine the rate of deposition. Also the concentration of organic matter can assessed.

(3) Biological assemblies

Two controls and two impact locations were established at each farm following a symmetrical sampling design. Four 50X50 cm^2 quadrates were randomly deployed within each sampled locations and along nearby habitats such as rock or coral patch. Photographs encompassing sampling quadrants were taken to assess the coverage occupied by assemblages. Temporal replication was included by sampling three times within one year. Differences in species composition and coverage between control and fish farm locations can assess. Therefore, the data can be easily interpreted visually, without the need of statistical analysis tools. Also a periodic monitoring (2 times a year) on the benthic cover (using random transect study) near shore could be a reference point if there are any changes in the natural system.

(4) The recovery of benthic organisms after cessation of fish farming activities

Benthic communities may return to close to pre-impact conditions once the source of organic enrichment has been removed. Therefore the abandoned site may also need to be monitored at least twice a year to confirm the sites recovery period and quantify the rate of return. Monitoring the organic matter content (TOC) measurement could be a good reference.

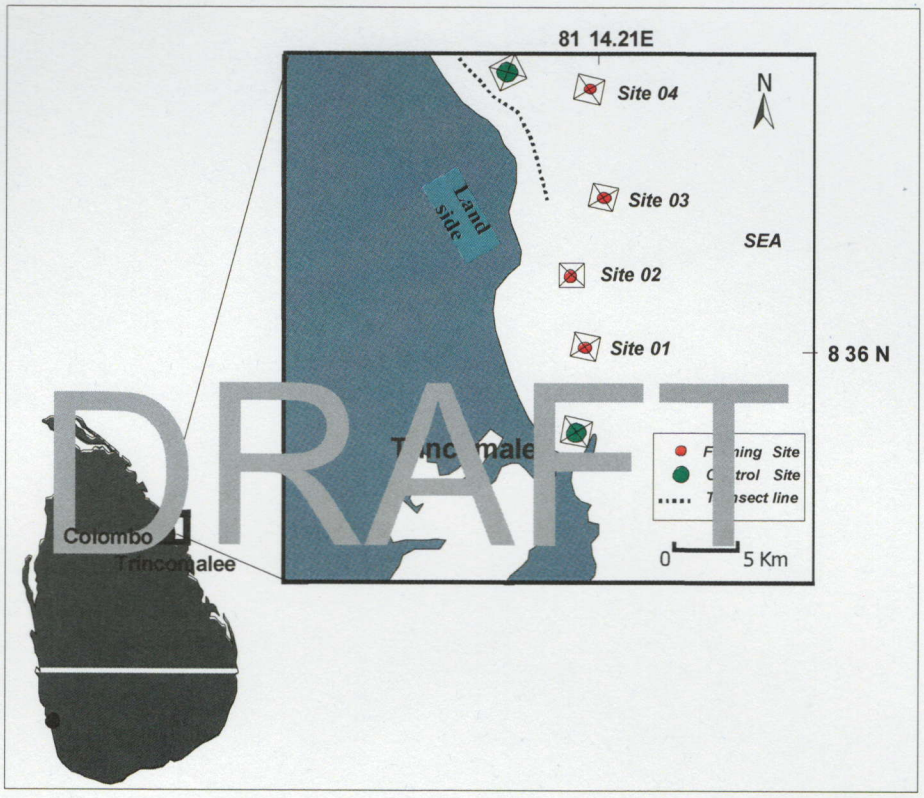

Figure 6.1: Locations including control sites and fish-cage site for monitoring and evaluation

The project proponents will be responsible for the implementation of the monitoring programme. An environmental monitoring committee has to be appointed to oversee the implementation of monitoring plan.

Socioeconomic perspective of the monitoring is essential through communication with the local community and local government bodies. Following two operational bodies in the area could be the best for such communications, namely:

01. Divisional Environmental Committee, chaired by DS Town and Gravat in representing of all the government sector agencies involved in taking decision related to the environment.

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Rajasuriya, A., & Premaratne, A., (2000) "Sri Lanka". In: Sheppard, C. R. C., (ed.) *Seas at the Millennium: An Environmental Evaluation*. Elsvier Science, pp. 875–887.

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Date of Birth: 15th June 1968
Nationality: Sri Lankan
Sex: Male

Professional Preparations
Doctor of Philosophy (Ph. D.) 2007 April – 2010 March
Environment and Energy Systems (Biogeochemical cycles in Coastal and Marine Ecosystems)
Graduate School of Science and Technology
Shizuoka University, Japan
Title of thesis *"Role of coral mucus and Dissolved Organic Matter (DOM) in Coral reef waters"*

Master of Philosophy (M. Phil.) 2000 January – 2006 May
Biological Oceanography
Faculty of Fisheries and Marine Science and Technology
University of Ruhuna, Sri Lanka
Title of thesis *"Impacts of natural processes and anthropogenic activities of two fringing coral reefs of southern Sri Lanka"*

Bachelor of Science (B.Sc.) Biological Sciences 1994 March – 1998 May
(Fisheries Biology, Botany, Chemistry, Zoology)
Faculty of Science
University of Ruhuna, Sri Lanka.

Training
Microbial Oceanography and Genomics Summer 2006
Bermuda Institute of Ocean Science (BIOS), Bermuda, U.K.

Marine Conservation Biology and Policy Summer 2005
Duke University Marine Laboratory (DUML)
Beoufort, North Carolina, NC, U.S.A.

Professional training "Assessing the Health of Pacific Corals"
(Microbial Ecology, Biogeochemistry, histopathology, Summer 2003,Coral Physiology and Molecular biology) Hawaii Institute of Marine Biology (HIMB),
University of Hawaii at Manoa, Hawaii, U.S.A.
Instructor training Coral Reef Monitoring (Reef Check) and April 2003
Marine Aquarium Trade Monitoring (MAQTRAC),
Republic of the Philippines

Certified Diver for Scientific Research from September 2000

Academic and Research experience (Marine Ecology, Marine Biology and Oceanography) and teaching in Universities

Senior Lecturer, Ocean University – Sri Lanka 2011 April to date
(National Institute of Fisheries & Nautical Engineering)

Doctoral Researcher, Global Biogeochemistry Laboratory,
Shizuoka University, Japan
2007 April – 2010 August

Collaborating Research Scientist with
Professor Forest Rohwer (P/I)/ Molecular Microbiology Laboratory,
San Diego State University (SDSU), CA, U.S.A.
2005 January – 2007 April

Research Assistant to Sida/SAREC Marine Science Program
Dept. of Fisheries Biology,
(Presently Faculty of Fisheries and Marine Sciences),
University of Ruhuna, Sri Lanka. 1999 October – 2004 December

Demonstrator: Department of Fisheries Biology,
University of Ruhuna, Sri Lanka 1998 May – 1999 October

Oceanographic research cruises
R/V Atlantic Explorer, expedition to hydro-station "H" Bermuda, U.K. / Summer 2006
R/V Weather Bird, benthic ecosystem survey Atlantic Ocean U.S.A. / Summer 2005
R/V *Suruga maru,* time series study in Suruga Bay, Shizuoka, Japan / 2007,2009

Completed consultancies on nationally important projects in 2013

Consultant Marine Biologist, Environment Impact Assessment Project (EIA), Puttalam Coal Power Plant / Ceylon Electricity Board (PCPP/CEB) Phase II Project.

M.F.M.Fairoz
Date: 04th April 2013

Dr Garret Macfarlane

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Current Status:

Managing Director
TransTech Ltd

Recent Experience:

2006 - Present

TransTech (formerly Dalriada Solutions) has been providing water related environmental impact assessment services since January 2006. One of our areas of expertise is in waste discharge impact assessment. This work involves accurately predicting the transport and fate of waste and has primarily been carried out for the following companies:

- Dawnfresh Farming Ltd
- Kames Fish Farming Ltd
- Lakeland Marine Ltd
- Loch Duart Ltd
- Marine Harvest (Scotland) Ltd
- Scottish Sea Farms Ltd
- Scottrout Ltd
- Invergordon Distillery (via C. D. Campbell Marine Contracts)
- Glenglassaugh Distillery Company Ltd
- Isle of Harris Distillers Ltd
- Balcas Ltd - Invergordon Biomass Plant
- TSL Contractors Ltd

Since January 2006 we have also undertaken a great deal of hydrological assessment work for developments throughout Scotland. These include a great many private water supplies as well as risk assessment work for housing, office, school, restaurant, supermarket, fishery, community hall and care home developments.

Qualifications:

2004	ADVANCED Hazard Analysis Critical Control Point (HACCP) Royal Environmental Health Institute for Scotland
2004	ADVANCED Food Hygiene Royal Environmental Health Institute for Scotland
2000	PhD Carbon and nitrogen stable isotope fingerprinting of feed and faecal waste from a finfish pen site and tracing this through the aquatic ecosystem. During my PhD I took a 18 month sabbatical (September 1998 - February 2000) to manage a trout farm and fishery in Wiltshire
1993	2.1 BSc Fishery Science

Employment Record:

Jan 2009 - Present	Managing Director TransTech Ltd, Barcaldine, Oban, Argyll, UK (In 2009 *Dalriada Solutions Ltd became TransTech Ltd in order to provide a more generic name given the UK wide/International work it was carrying out*)
Sep 2001 - Dec 2008	Owner/Managing Director Dalriada Solutions (from 2006 a Ltd company), Oban and latterly Barcaldine, Argyll, UK Initially Dalriada Solutions provided food safety services and from 2006 environmental impact assessment related work
Apr 2000 - Aug 2001	Production Planning Manager Dawnfresh Seafoods Ltd, Uddingston, Glasgow, UK
Oct 1995 - Mar 2000	PhD in Stable Isotope Fingerprinting Scottish Universities Research & Reactor Centre, East Kilbride with laboratory at University of Paisley, UK - Including 18 month sabbatical running trout farm and fishery
Aug 1993 - Aug 1995	Development Manager Alkioni Fish Farms Ltd, Limassol, Cyprus
Sep 1990 - Jun 1993	BSc Fishery Science University of Plymouth, Devon, UK
Jul 1988 - Aug 1990	Live Feeds Technician Aquaculture Technologies Ltd, Limassol, Cyprus
Jun 1987 - Jul 1988	Fish Husbandryman Atlantic Freshwater Plc, Furnace, Argyll, UK
Prior to Jun 1987	Fish Husbandry during school holidays and at weekends Fish Farm Development Group, Stronachullin, Argyll, UK

Key Skills:

- In depth knowledge of the aquatic environment - freshwater and marine.
- Design and coordination of field data acquisition campaigns in aquatic environments.
- Acquisition and analysis of hydrological and hydrographic data and data quality control.
- Structured and concise report writing for government and other official bodies.
- Ability to problem solve in demanding situations.
- Experience of oral dissemination to a range of audiences.
- Good analytical skills with work carried out to a very high level.
- Excellent PC skills - in addition to Microsoft Office I am highly experienced in numerous modelling packages including particle tracking and hydrodynamic models and mapping software including AutoCAD, MapInfo, Promap, Findmaps and Surfer.

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A. PROFESSIONAL PROFILE

- Environmental Resource Management Specialist
- Preparation of environmental profiles, Special Area Management Plans (SAM).
- Experienced project manager with extensive planning and project management expertise in environmental resource management and ecosystem restoration.
- Dedicated team leader with exceptional organizational, troubleshooting, and problem-solving skills.
- Computer-proficient in Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Web browsing, and Geographic Information System and Remote Sensing applications.
- Specialist in conducting community consultation meetings and preparation of reports.
- Organizing and Conducting RRAs related Socio-environmental resource planning.
- Design environmental resource management projects, programs, monitoring plans and project evaluation formats.
- Preparation, conducting and coordinating communication, education and awareness strategies.
- Organizing and conducting, workshops, seminars and in environmental resources managements and livelihood developments.
- Preparation of periodical project reports, activity completion reports, project monitoring and evaluation reports.

B. Education background

i. **Master of Science**, Ecosystem Analysis and Governance, the University of Warwick, Coventry, United Kingdom 1999.

Course works:

- Environmental management
- Coastal Zone Management
- GIS and remote sensing
- Climatology
- Environmental Economics

- Ecosystem Analysis and Governance

ii. **Bachelor of Arts**, Geography Special, University of Peradeniya, Sri Lanka (1992)

Course works;

- Tropical Environment
- Geography thought
- Climatology
- Geology
- Statistic and research techniques
- Regional Planning and development planning
- Urban planning
- Cartography and spatial mapping

iii. **Following a M.SC in GIS and Remote Sensing at University of Sri Jayawardanapura Sri Lanka, 2012- 2014.**

Course works

- GIS mapping
- Remote Sensing
- Data Base management
- Cartography
- Photogrammetry, Photoshop and image processing

C. Professional Training

i. Environmental Impact Assessment – September 1994 - Sri Lanka

- Conducting of Initial Environmental Impact Assessment &
- Conducting of Environmental Impact Assessment

ii. Community Economic Development- April 1996 – Sri Lanka

- Development of project and program to enhance livelihood of local community

iii. Community-Based Coastal Resources Management – 2005 – AIT Thailand

- Community based coastal resource management
- Community based disaster management
- Empowerment of community in resource management
- Project management

iv. Applying Project Cycle tool to Support Integrated Coastal Management –October 2008- Samarang University - Indonesia

- Project design, implementation and monitoring needs in the coastal zone
- Economic valuation of coastal ecosystems, marine and coastal protected areas management, and sustainable financing.
- Community participation in coastal resources management, and sustainable livelihood considerations.
- Climate change considerations in the coastal zone, and Disaster Risk Reduction (DRR).

v. **Designing Theory – based Impact Evaluation –April 2009 - Sri Lanka Evaluation Association in collaboration with the Ministry of Plan Implementation**
   - Evaluation and project monitoring
   - Outcome mapping of projects.

vi. **Improving Natural Resources Governance for Rural Poverty Reduction Professional development training workshop organized by IUCN SL**
   - Appling Governance Principles in decision making.

vii. **Residential Advanced short course on GIS and Application conducted by the Postgraduate Institute of Science (PGIS), University of Peradeniya September 2011**
   - Using advance tools of GIS mapping and remote sensing in project planning and implementing.

D. Professional experience

i. Since November 2007 up to date

Coordinator Livelihood and Policy – IUCN Sri Lanka
IUCN Sri Lanka –

Overall Scope of Work:

Taking leading role in administering and managing projects and programs related to livelihood and policy and supporting staff in designing, implementing and monitoring projects and programs under IUCNSL in related to coastal and livelihoods by ensuring team spirit among the team members to achieve set target of projects and programs within given time.

Specific Task:

- Provide necessary administrative and management inputs to the division to run daily functions successfully.
- Ensure financial and physical progress of the projects and programs within the project scopes.
- Support team in designing projects proposal, implementing and monitoring
- Assist in preparation progress report, financial reports and progress monitoring report to the program coordinator Coastal Resource Management Unit of IUCNSL.
- Overall coordinating of on-going projects and program under the Coastal Livelihood and Policy Unit, such as Post Tsunami Ecosystem Restoration Program in Ampara District funded by CIDA and Ecosystem and Livelihood Restoration Project (BMZ) funded by MFF.
- Coordinating field staff, internal experts and hired consultants adequately in the ongoing projects and programs.
- Preparation of concept notes for projects and support develop project proposals in consultation with relevant field staff and technical experts within IUCNSL, region and Globe.
- Prepare ToR for staff, Consultants and hired contractors to design, implement and monitoring project and programs.
- Assist superior and minor staff members in implementing programs successfully in the field.

- Project planning and implementing on coastal disaster risk reduction and coastal resource planning.

ii. December 2006 to October 2007

Position: Manager Participatory Coastal Zone Management and Department Division of USAID, Tsunami Reconstruction Project funded by USAID implemented by CH2 M Hill in collaboration with Environmental Management Limited (EML) of Sri Lanka.

Overall Scope of Work:

A lead role in designing and implementing projects and programs under the Participatory Coastal Management Component (PCM) to enhance community involvement and participation in Sri Lanka Tsunami Reconstruction Program (SLTRP). Responsibilities also include assisting the Team Leader of SLTRP in preparation of monthly reports, activity completion reports, mid-term and annual reports for PCM.

Specific Tasks:

- Assisting in the preparation of Coastal Development Plans for 4 sites, Hikkaduwa, Weligama, Puranawella and Arugam Bay to arrest coastal issues.
- Preparation of Solid Waste Management Assessments for Hikkaduwa, Weligama, Puranawella, and Arugam Bay Pradheshiya Sabhas.
- Preparation of Coastal Hazard/ Disaster Preparedness Plans with Coastal Hazard Maps for, Hikkaduwa, Weligama, Devenuwara and Pottuvil (Arugam Bay) DS divisions.
- Preparation and conducting of Coastal Disaster Risk Reduction awareness program in the field.
- Design and conduct community awareness programs on Coastal Hazard preparedness in 4 sites.
- Preparation of Quality Environmental Management Systems for Hikkaduwa, Mirissa (Weligama) and Puranawella harbors.
- Enhance stockholders coordination and established institutional coordination mechanism for respective SLTRP sites.
- Design and implementation of Coastal Resources Management Program in respective sites, mainly Hikkaduwa, Weligama and Devenuwara.
- Design and implementation of awareness and motivation programs to improve community participation in harbor management in 3 harbor sites.
- Design and implementation of awareness program on coastal habitat conservation in 4 SLTRP sites.
- Assist in preparation of Financial Management Plans

iii. FROM July 2001 TO: August 2006

Project Manager: Project Implementation Unit Lunawa Special Area Management (SAM) Site of Coastal Resources Management Project (funded by ADB) under Coast Conservation Department of Ministry of Fisheries and Aquatic Resource Development since 2001 up to 2006.

Overall Scope of Work:
Responsibility in administering and managing Special Area Management Site of Lunawa and assisting Director, Coastal Resource Management Project (CRMP) in preparation of all administrative obligations and documentations such as preparation of monthly reports, quarterly reports, mid term reports and annual reports of the site. Specific tasks included the planning, development, implementation and monitoring of action plans in the target areas.

Special Task;

- Take lead in preparation of SAM plans for Lunawa Lagoon
- Take lead in preparation of Profile for Lunawa lagoon
- Preparation of Lunawa action plan based on SAM Plan
- Implementing of Lunawa action plan in collaboration with other relevant partners and agencies.
- Preparation and implementation of Solid waste management projects,
- Preparation and implementation of Participatory coastal risk reduction program.
- Prepare and conducted disaster risk reduction awareness program
- Preparation and conducting of education and awareness program
- Preparation reports, minutes and project proposals.

iv. Since September 1993 – August 1996

Planning officer: Coast Conservation Department.

Responsibilities included the planning and implementation of Coastal Zone Management Plan and regulatory system of the department based on Coastal Zone Management Act No. 57 of 1980 and amendment of Act No. 64 of 1988.
Specific tasks included –

- Preparation of National Coastal Zone Management Plans;
- Conducting and monitoring of coral and sand mining activities along the coastal zone of Sri Lanka; and

- Designing and Implementing of Phase I of SAM plans in Hikkaduwa and Rakawa conducted under CCD funded by Integrated Coastal Resource Development Program.

v. Since January – September 1993

Research officer: Plan International Kandy, from 1993 to 1994.

E. Publication and contribution to researchs

i. Chandana. Seneviratne & Kapila Gunarathne, Colombo Sri Lanka, "Tsunami hazards and preparedness"

ii. One of author of Preparation of Governance Training Manual by DFID project
iii. Team leader of Bio-Diversity and Socio economic survey of Gulf of Mannar funded by FAO in 2009

iv. Project manager of preparation of Environmental Profile for Puttalam Lagoon published funded by FAO in 2011.
v. Preparation of SAM plan and Environmental profile for Lunawa Lagoon in 2004.

F. LANGUAGE PROFICIENCY

Efficiency of work in Sinhala and English languages.

G. PERSONAL DATA

Date of birth	: 05th of April 1965
Nationality	: Sri Lankan
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School Attended	: Mahaweli Maha Vidyalaya Katugastota, Kandy, Sri Lanka

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End of Report