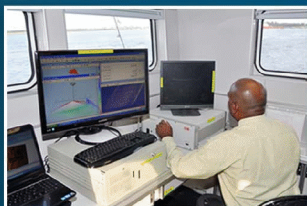




ANNUAL REPORT & ACCOUNTS



2016 NARA

National Aquatic Resources Research and Development Agency

Crow Island, Colombo 15

Telephone : 011 2521000, 011 2521006 Fax : 011 2521932

Web : [http:// www.nara.ac.lk](http://www.nara.ac.lk)

MINISTRY OF FISHERIES & AQUATIC RESOURCES DEVELOPMENT

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NATIONAL AQUATIC RESOURCES RESEARCH & DEVELOPMENT AGENCY

1. CORPORATE INFORMATION

The National Aquatic Resources Research and Development Agency (NARA) is the principal national institution charged with the responsibility of carrying out and co-coordinating research development and management activities on the subject of aquatic resources in Sri Lanka. NARA was established in the year 1981 by restructuring the Research Division of the Department of Fisheries. In the restructuring process Research Division was amalgamated with the institute of Fish Technology which existed in the present premises of NARA at Crow Island, Mattakkuliya, Colombo 15 to establish a fully fledged research agency, under an Act of Parliament, National Aquatic Resources Agency Act No. 54 of 1981 and amended subsequently by National Aquatic Resources Research and Development Agency Act No. 32 of 1996. The following Vision, Mission, Goals/Objectives as the highlights of the NARA functions as a statutory body under the Ministry of Fisheries and Aquatic Resources Development are as follows.

Our Vision

To be the premier institution for scientific research in conservation, management and development of aquatic resources in the region.

Our Mission

To provide innovative solutions for national development issues in the aquatic resources sector utilizing scientific and technological knowledge & resource base.

The main objectives and functions of the Agency:

- To ensure application and utilization of Scientific and Technological expertise for the implementation of national development programs.
- To promote and conduct research activities directed at identification, assessment, management and development of living and non-living aquatic resources.
- To co-ordinate and provide advisory and consultancy services on matters relating to exploitation, management and development of aquatic resources.
- To undertake collection, dissemination and publication of scientific research information on aquatic resources & related subjects.
- To provide training related to fisheries and aquatic resources fields.

Governing Board

The Governing Board consists of Eight (08) Appointed Members and Eight (08) Ex officio members in accordance with the Section 6 of the National Aquatic Resources Research & Development Agency Act No 54 of 1981 as amended by Act No 32 of 1996. The following members served as the members of the Governing Board during the year 2016 and eleven Board Meetings were held during the year.

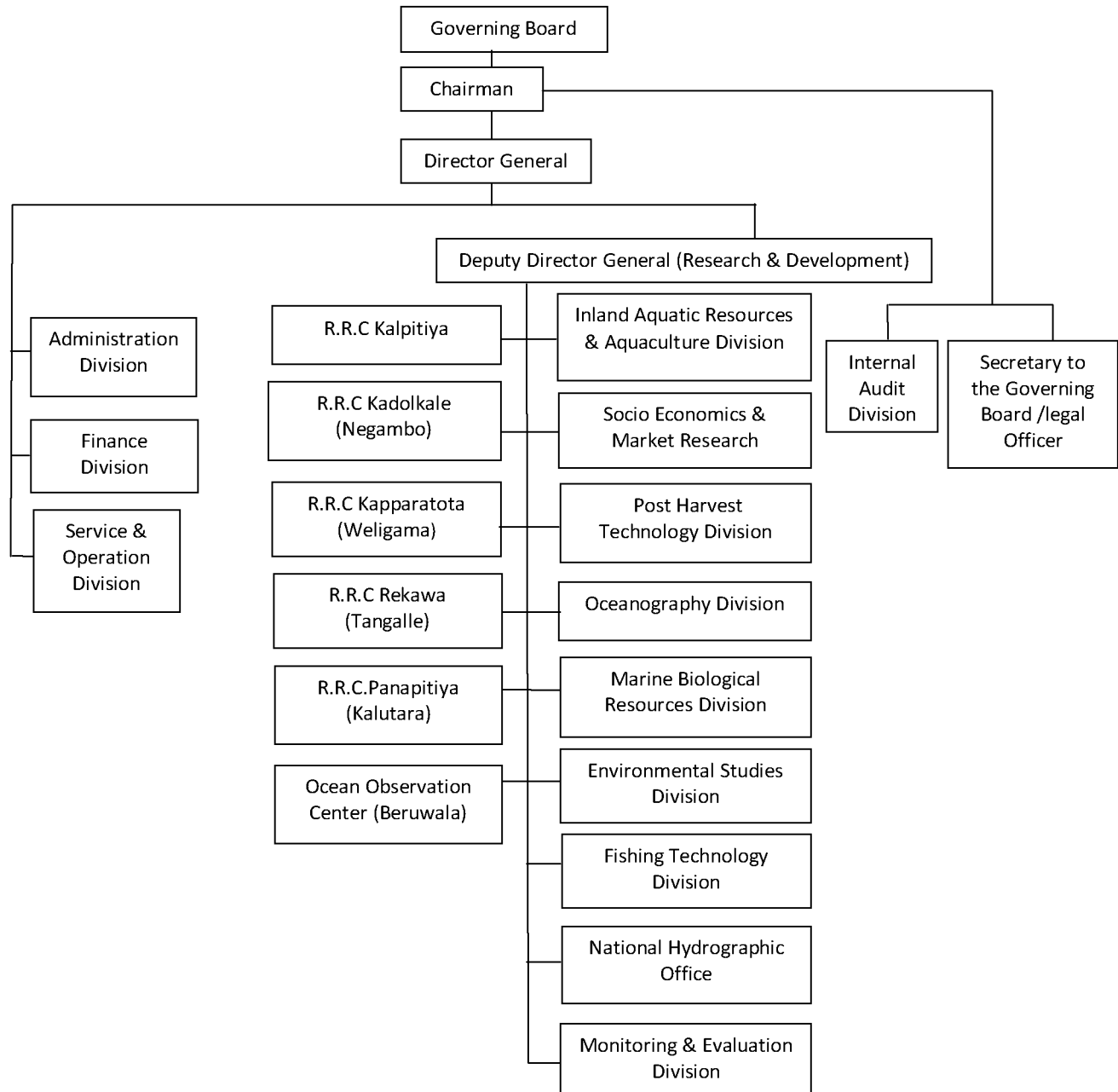
Appointed Members

1	Dr. Anil Premarathne	Chairman
2	Mr. E.A.D.B. Gamini Perera	Board Member
3	Mr. Noel Palliyaguru AAL	Board Member
4	Mr. T.M. Nihal	Board Member
5	Prof. W.M.T.B. Wanninayake	Board Member
6	Mr.Sadun Malinda Thenuwara	Board Member

Ex –officio Members

1	Mr.R. Semasinghe	Board Member
2	Ms.T.B. Fahmiya	Board Member
3	Rear Admiral S. Jayakody	Board Member
4	Mr.P.M.P. Udayakantha	Board Member
5	Mr.M.C.L. Fernando	Board Member
6	Mr.A. Abdul Majeed	Board Member
7	Mr.B.C.W. Iddamalgoda	Board Member

Organizational Structure



Organization

Dr.Anil Premarathne functioned as the Chairman and Mr.B.C.W.Iddamalgoda functioned as the Director General during the year under review. In order to perform the mandated functions of the Agency the organization had been designed to constitute nine Research and Technical/Services Divisions, Environmental Studies, Fishing Technology, Hydrographic Office, Inland Aquatic Resources & Aquaculture, Monitoring & Evaluation, Marine Biological Resources, National Institute of Oceanography & Marine Sciences, Socio-Economic and Market Research, Institute of Post Harvest Technology divisions. Supported divisions were, Administration, Services & Operations and Finance Divisions.

Following officials officiated as Heads of Divisions during the year 2015.

Research Divisions

Mr. S.A.M. Azmy	Environmental Studies Division
Mr. N.B.P. Punyadeva	Fishing Technology Division
Mr. A.N.D.Perera	Hydrographic Office Division
Dr. V. Pahalawattaarachchi	Inland Aquatic Resources & Aquaculture Division
Dr. R.R.P. Maldeniya 01.01.2016 - 25.04.2016 Dr.S.S.K. Haputhantri 26.04.2016 – 31.12.2016	Marine Biological Resources Division
Mr. S.U.P. Jinadasa(Actg.) 01.01.2016 – 31.01.2016 Dr. K. Arulanathan 01.12.2016 – 31.12.2016	National Institute of Oceanography & Marine Sciences
Dr. G.J. Ganegamaarachchi	Institute of Post Harvest Technology
Mr. K.H.M.L. Amaralal	Socio Economics & Market Research Division
Mr. A.B.A.K. Gunaratne	Monitoring & Evaluation Division

Support Services Divisions

Ms. R.A.L.T. Rupasinghe 01/01/2016 – 30/04/2016)	Administration Division
Mr. M.D. Senarathne(Actg.) (06/01/2016 – 31/12/2016)	Finance Division
Mr. A.J.G.S. Dahanayake (01.01.2016 - 2016.03.31) Mr. P.S. Ranaweera (actg.) (2016.04.06 to 2016.10.02) Mr. S.K.S. Liyanaarachchi 2016.10.03 – 31.12.2016)	Services & Operation Division
Ms. K.G.L. Iranganie(Actg.) 06.01.2016 – 31.12.2016)	Internal Audit Division

2. RESEARCH HIGHLIGHTS

Dr.H.M.P.Kithsiri, Deputy Director General Research and Development

Aquaculture and inland Fisheries

Three economically viable and nutritionally balanced feed formula were developed with 37% protein level and the price between Rs. 140.00 to 150.00 per Kg for culturing of Seabass fingerling in floating net cages and pond cages. Essential baseline data were collected to develop breeding technique/s for economically important two ornamental fish species; *Puntius denisonii* and, *Balantiocheilos melanopterus*. Technology invented to increase survival of the seahorse, *Hippocampus kuda* under aquarium condition. Stock enhancement of sand fish (sea cucumber) in Uchchamunei area was done where natural population has decreased from the sustainable level. A map was prepared indicating the suitable areas for oyster farming and natural depuration. A community based pen culture with the hatchery produced sand fish is ongoing. About 10422 depurated oysters were sold by local fisher community after setting the NARA depuration plant. It was found, the *Kappaphycus alvarezii* seaweed seed growing capacity was 1000 kg with 10 cages of 2m x 0.75 x 0.5 m for 4 cycles. Maximum yield of carrageenan can be produced in May to June period. Fish feed producing program was initiated using the newly purchased fish extruder and two types of feed are being producing and sold (Nursery feed and special grower feed.) Panapitiya RRC is now becoming a self-income generation body and succeed to earn Rs.531,610.00 income with Koi Carp and fish feed production. Shrimp health management research exposed that Mole Crabs- (*Emerita analoga*), Brine shrimp/Artemia - (*Artemia*), Marine bivalves-, Cuttle fish- (*Sepia officinalis*) were possible trans carriers of WSSV and mostly prevailed from Ambakandawila to Kalpitiya. It was found that three 3 imported probiotics used for water quality management were effective only once they used systematically and under favorable salinity conditions whereas a locally prepared probiotic was effective even under very low salinity conditions, and used systematically. Study of community based management of fish assemblages in brush parks of Negombo estuary revealed that maximum brush park yield can be obtained within 30 days optimal period since installation and with about 2 kg m⁻³ optimal twig density. A Mangrove palm, *Nypa* nursery was established to get 0.1 to .5 liters per fruit stalk daily sap yield . Culture conditions and soil quality was determined.

Marine Biological Resource

The large pelagic fishery database (PELAGOS) and small pelagic database was updated. Also, the large pelagic fish production for 2015 was estimated and submitted to the Ministry of Fisheries and Aquatic Resources Development for official submission to the Indian Ocean Tuna Commission (IOTC). The study conducted for exploring gear-vessel catch efficiency of frigate tuna in tuna fishery showed the ring-net as the most efficient fishing gear used in Sri Lanka for catching frigate tuna. For Skipjack Tuna (*Katsuwonus pelamis*) in gillnet fishery, vessel type was found to be the most significant factor for determining the catch rates. In the study of neritic tuna (Kawakawa, Frigate tuna and Bullet tuna) showed that they are non-selective feeders and their length weight relationships were highly co-related. The three species were confirmed by DNA sequencing. A case study in longline fishery for billfish showed the strongest relationship between Sea Surface Chlorophyll (SSC) and billfish catch per unit effort (CPUE) whereas the weakest relationship was present between Sea Surface Temperature (SST) and billfish CPUE. The study conducted for identification of thirteen

pelagic shark species of the Indian Ocean occurring around Sri Lanka; using morphological characters of their fins, showed that the species were identifiable by the morphological characteristics of any fin among the first dorsal, pectoral and caudal fins.

The small pelagic catch and effort data analysis showed a declining trend of the key species in the total catch and also a declining trend in CPUE series. Weligama Bay study showed that more than 50% of the harvest in the bay is coming from anchovy fishery and recorded second largest production is *Thryssa* sp. In the study of the Batoid fishery in the four fishery harbors investigated, a total of 28 species belonging to two orders and six families were recorded. The octopus study identified the potential locations for resource availability, gear technology (traps) used was successful and the species were confirmed as *Amphioctopus aegina* and *Cistopus taiwanicus* by DNA sequencing. Coral reef study in Hikkaduwa marine sanctuary showed that the diversity, abundance and live coral cover of corals has considerably reduced. The study conducted for alternative fishing method for bottom trawling in the West coast showed that 83% of total catch consists of *Portunus sanguinolentus* (three spot swimming crab) and therefore, it is recommended that the prepared trap is more effective for the catching of three spot swimming crab. The study conducted for in situ conservation of berried spiny lobster showed that the highest contribution was coming from *Panulirus homarus* which was 86% total catch in south coast lobster fishery. Annual length frequency distributions *P. homarus* showed majority of small size lobsters were reported from March to July and this period can be considered as major recruitment season. The estimated Spawning Potential Ratio (SPR) for blue swimming crab was 38% for northern waters. This implies that the crab stock in the northern waters is still healthy but the study suggests the importance of implementing some effective management measures for the long term sustainability of BSC. The MBRD research on blue whales showed that the average density of blue whales in the south coast is 0.0221 km^{-2} smaller than that of east coast (0.067 km^{-2}) but highest mortalities were recorded in the south.

Fishing Gear Technology Development

Three floating buoys, Fish Aggregating Devices (FADs) were produced and one was deployed in Kalmune area. Three submerge Fish Enhancing Devices (FEDs) were prepared and one submerge FED was deployed in Kalmune area attach with the cable of floating buoy (FAD) and other two FEDs were deployed in Sinnapaduwa area with the help of fishing community. A newly developed environmental friendly “surukku” net was introduced as an alteration for the existing harmful “Surukku net” to minimize the resource depletion and environmental impacts. Experimental Fishing done with the fisherman and the results showed that the reduction of the height and width of newly introduced Surukku net increases the operation efficiency. Due to the increase the eye size of the new net, the juvenile catch rate was found to decrease compare to the total catch. Environmental friendly bottom set fishing trap to harvest Bigfin reef Squids which has high economic value was developed at Sinnapaduwa area in Puttalam district. These traps can be used for several months instead of the traps used by fisherman which made from sand bag and branches of coastal trees (Akeshiya) branches. Experimental fishing trial showed that newly introduced trap was more effective to lay the squids eggs which can help to reduce entangling of the drift nets of the other fishermen’s. A draft copy of the catalogue of fishing gears and crafts used in Lagoons, was prepared.

Post-Harvest Technology

Fish post harvest quality losses (PHQL) and find relevant remedial measures study was conducted for fish caught by multi-day boats (MDBs). This study investigated post harvest quality losses of Skipjack tuna, Indian Scad and Yellow fin tuna. Sensory evaluation based PHQL of skipjack tuna stored in MDBs for <10, 10-19, >20 days were about 37, 43, and 45%, respectively. Post harvest quality losses (PHQL) of Indian scad were about 22, 28 and 35% in MDBs which spent <10, 10-19, and >20 days in fishing trip, respectively. When unloading from MDBs, amount of fish belong to each grade (AAA, AA, A, B, and "Reject-grade") were about 18, 18, 15, 10 and 39 % (wt/wt), respectively. Water used for fish washing at harbor and ice samples taken from MDBs were contaminated with *Escherichia coli*.

To test the microbiological quality (total coliforms, faecal coliforms, *E.coli*, *Faecal streptococci*, *Vibrio cholerae*, *Vibrio parahaemolyticus* and *Salmonella* spp), Oysters, clams, cockles and water samples were collected from harvesting areas (Gangewadiya, Kandakuliya Anaiwasala and Janasavipura) and analysed. Microbiological quality of lagoon water is suitable for natural relaying of bivalves with the exception of a very few instances.

Canned product using *Sardinella longiceps* and Ceylon Moss (*Gracilaria edulis*) Jam incorporating Palmyrah (*Borassus flabellifer*) pulp were developed and relevant technologies are available for stakeholders. In addition silage has been produced by fish offal following natural fermentative process with addition of lactic acid bacterial inoculums and molasses as the fermentable carbohydrate source.

Quality, safety and nutritional aspects of fish and fisheries product study revealed that the average provisional tolerable weekly intake (PTWI) of mercury (Hg) and cadmium (Cd) were calculated based on World Health Organization (WHO) International Program on Chemical Safety (IPCS) value (Hg; 4 µg/kg and Cd 7 µg/kg of body weight). The total diet study (TDS) approach survey in Gampaha district found that the average person weekly fresh fish consumption was 301 g and dried fish consumption was 59.5 g. The PTWI value was calculated based on average body size person (50 kg) and thus Hg-PTWI was 200 µg/kg (4x50) and the Cd-PTWI was 350 µg/kg (7x50). According the value when a person consumes fresh fish (301 g), they obtain 75.40% from swordfish (SWF), 40.49% from yellowfin tuna (YFT) and 7.60% from sardinella (SAF) while not significant contribution for spotted sardinella, anchovy and Indian Scad. All these species and average consumption amount don't exceed the recommended value except SWF. The Hg-PTWI contribution through dried shark represented 93.70%, while sailfish 7.24% in average body weight person. It means that the average consumption of fresh SWF and dried shark may affect to make the risk. The Cd contribution for Cd for PTWI is comparatively very low. The highest contribution given in the fresh fish spotted sardinella was 4.2%, dried fish anchovy 1.3%. The Cd contribution for the canned fish for PTWI represented 0.1% and canned fish was not contributed to Hg exposure.

Environmental Studies

Most of the research projects were related to the water pollution. Status of some selected reservoirs (Maduru oya), river basins, lagoons and marine environments including Chilaw lagoon, Negombo lagoon, Madu Ganga, Ramsar Wetland were studied throughout the year.

There is continuing research on Genotoxicity screening of drinking water wells located in the North Central Province (NCP) of Sri Lanka.

Maduru Oya research showed that the excess nutrients and *Mycrocystis* blooms were causing the water pollution. Water quality of the Chilaw lagoon was influenced by discharges of Deduru Oya, Lunu Oya, tidal patterns and anthropogenic activities. High pH values (> 8.5) and low DO levels (<5 mg/l) detected in several locations of the lagoon during the dry season. High aquatic weed growth and *E.coli* contamination were also detected in several locations.

The pesticide behavior in the river basins (Upper Mahaweli catchment) revealed that, more than 70% of Chlorpyrifos and Diazinon pesticides were adsorbed to the soil and when the organic carbon content is increased, adsorption becomes increased significantly. Under the laboratory conditions, there were significant differences between mortality of aquatic invertebrates (*Daphnia* and *Moina* spp), pesticide concentrations, and time after the adsorption experiments.

Bioaccumulation of heavy metal levels in muscle tissues in selected edible fish species of Negombo estuary indicated that the Hg and Pb were detected in high concentration in north region fish tissues and the recorded values were higher than the maximum permissible levels in EU standards.

Pollution Tolerance Index taken for Madu ganga lagoon was 20 -30 which indicated moderate water quality. Except common phytoplankton, toxic phytoplankton namely *Ceratium furca* and *Protoderidinum* sp were recorded in Madu ganga lagoon as a bio indicators of water pollution.

Results of the geno-toxicity screening test in the North Central Province revealed that total hardness of the water of dug wells used by CKDu affected families were above the standard limits. Arsenic was detected (2.0 µg/L) in water of one dug well used by CKDu affected families and orthophosphate concentration (0.321 mg/L) in this water sample was also higher than that of all the other water samples. The bioassay indicated potential toxicity associated with water in the dug wells used by CKDu affected families.

Ten emergency incidents were investigated and some of those incidents were fish kill incidents at Horana Export Processing Zone (HEPZ), Nedimala Canal, Kandawala Wewa in Rathmalana, Kanthiwewa in Kanthale, Mahabo Wewa in Rukmalgama. It was determined that majority of the fish kills occurred due to poor aquatic health conditions owing to water pollution. Another emergency incident was investigated at Moratu Modera Fishery Harbor regarding a sand extraction problem.

Oceanography

Forecasting of potential fishing zone was extended to southern Indian Ocean and Arabian Sea and VMS data is used to improve fishing ground forecasting. Issuance of Potential fishing zone forecast was expanded to all major fishery harbors. The bulletins are disseminated to the fishermen via fax, email and radio communication. Ocean expeditions, undertaken RV Samudrikka had identified upwelling areas off southern coast of Sri Lanka. The expeditions also established thermocline, halocline and pycnocline depths on the southern Sri Lankan waters as 50m, 40m and 40m respectively. It also found that bioluminescence planktons are distributed up to the 160 m depth, with a maximum density

at 40 to 60 m depth range. Sediment transport along the coast from Colombo to Negombo was found northward and varied from 78,488 to 213,635 m³/year. Beach sand along the Beruwala – Maggona iwas found with heavy mineral; *Illmanite*, *Zircon*, *Monozite* and *Garnet* upto 3.12 percentage.

Hydrography

Under the National Charting Programme Hydrographic Surveys were carried out Colombo to Weligama coastal chart which enclose Colombo and Galle Harbours in the scale of 1:50,000. The total coverage planned 2016 was 2300 Sq.Km. At the end of year 2016, new surveys covered 70% of the area. Surveys were ensured to maintain International Hydrographic Organization (IHO) standards. Simultaneously approaches to Oluvil Harbor nautical chart completed in 2016 which helps port administration to make necessary development to ensure safe approach to the harbor as a fulfillment of essential requirement.

In order to support marine sector development in the northern part of Sri Lanka, approaches to KKS Harbour survey were conducted during the year 2016. The compilation of the basic out lining of the chart was completed and the rest of the surveys are planned to compare the chart in 2017.

Charts and hydrography underpin every human activities in, on or under sea including coastal zone management, environmental protection and management, marine science, where bathymetric coverage is inadequate , satellite derive bathymetry is a new approach to address above requirements. The first time in Sri Lanka NHO has developed necessary methodology to extract bathymetric data from multi spectral satellite images. The images were selected to cover the 286 Sq.km in the Kankasnathurai area. Derived bathymetry data are in the accuracy of the order 1-5, ± 2.5 m. This technology can be manipulated to derive depths up to 25m. It has found that many factors such as water clarity, turbidity, clouds, sun glint...etc affect the accuracy of the derived bathymetry.

Bathymetric and profile surveys for Port City Development impact confirmation monitoring surveys, marine archeological surveys and identification of new navigation route surveys were also conducted as consultancies to support Public Sector involvement in various development activities in Sri Lanka.

Socio-economic and marketing

Kokkilai lagoon is unique ecosystem having diversity in biological social and economic spheres. Major gear types operated in lagoon were fyke net, cast net, gill net, trammel net, crab net and scoop net. Other than fyke and crab nets all gear are operated year round. Fyke nets targeted for shrimp but accidental by catch of fish and crabs are common. The average catch of the trip was about 7 kg per craft irrespective of craft category. However, craft wise catch for OFRP, MTRB, NTRB and no-craft category was 8.4, 4.9 and 2.4 kg per craft per trip respectively. In terms of gross income, NTRB was highest and the lowest was for no craft- gear only category. Due to higher variable costs OFRP craft's gross income is decreased despite the catch highest among all craft. The ROI depicts the economic viability of fishing operation. All fishing units show economically viability of which NTRB is the most profitable craft category. The estimated total production of the lagoon per year is 219kg/ha.

This indicates that the rich fish and shell fish resource availability of lagoon. The fish trade in Kokkilai was whole-seller dominant and fishers are compelled to dispose their catch due to bonded relationship with them.

The study of cost of production in marine fisheries of Sri Lanka found that the average cost per trip of IMUL (Multiday boat), OFRP (Out boat engine Fiberglas Reinforced Plastic boat), and NTRB (non-mechanized traditional boat) were Rs. 1,021,159, Rs 8,320 and Rs.1, 598 respectively. The gross profit of a trip of respective craft category was Rs.308, 059, Rs. 2,880 and Rs. 748 in sequence. The highest gross profit to operation cost ratio was found with NTRB (0.88), followed by OFRP boat category (0.53) while the least ratio was belonged to IMUL crafts due to high operational cost.

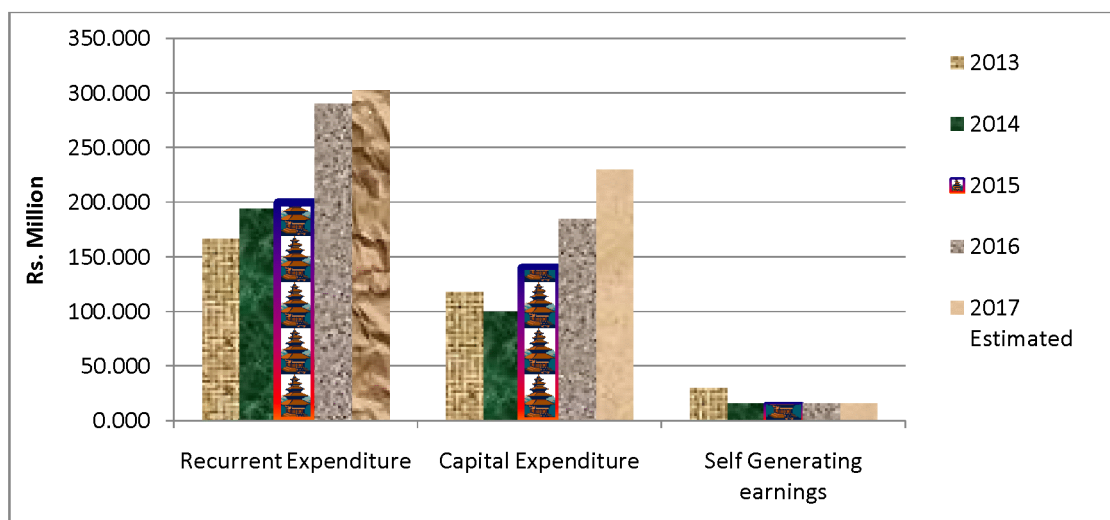
3. FINANCIAL HIGHLIGHTS

Financial Performance at a glance

Estimated Budget
Rs.(Million)

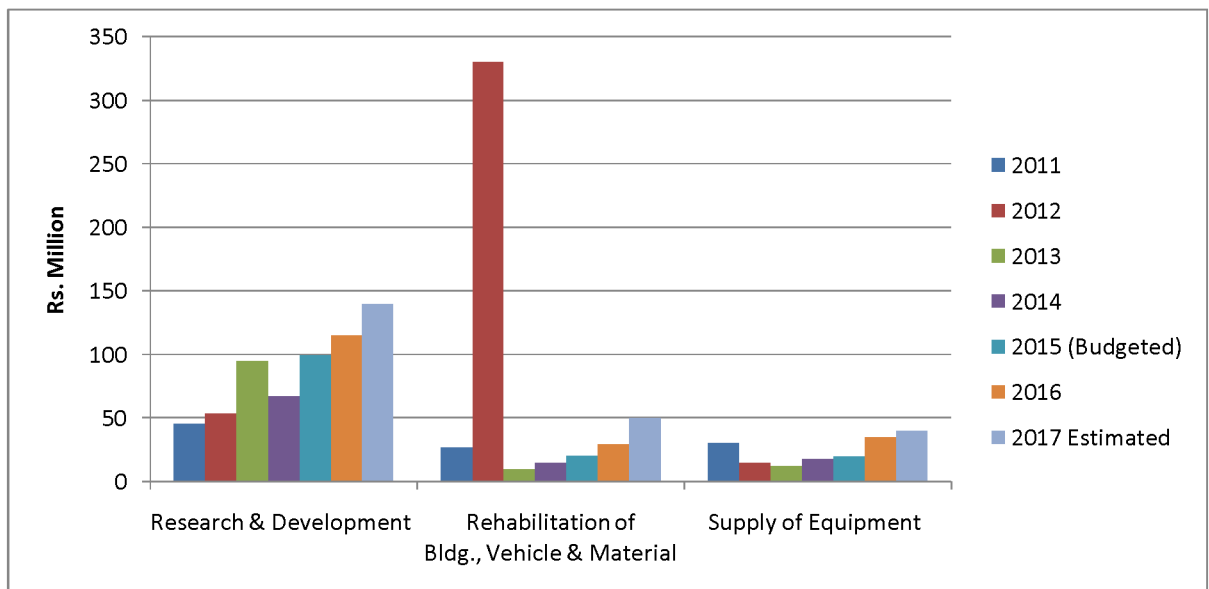
Description	2013	2014	2015	2016	2017 Estimated
Recurrent Expenditure	166.894	194.260	200.000	290.731	303.000
Capital Expenditure	118.272	100.000	141.000	185.000	230.000
Self Generating earnings	30.000	16.000	16.000	16.000	16.000
Total	315.166	310.260	357.000	491.731	549.000

Self generated income was increased due to starting of major projects & consultancy in the year 2013. However, in 2014, 2015, 2016 & 2017 it was constant since there are no such special major projects in these years. On the other hand recurrent expenditure was increased due to new recruitment based on the new SOR and salary revision in the year 2016.



Capital Expenditure
Rs.(Million)

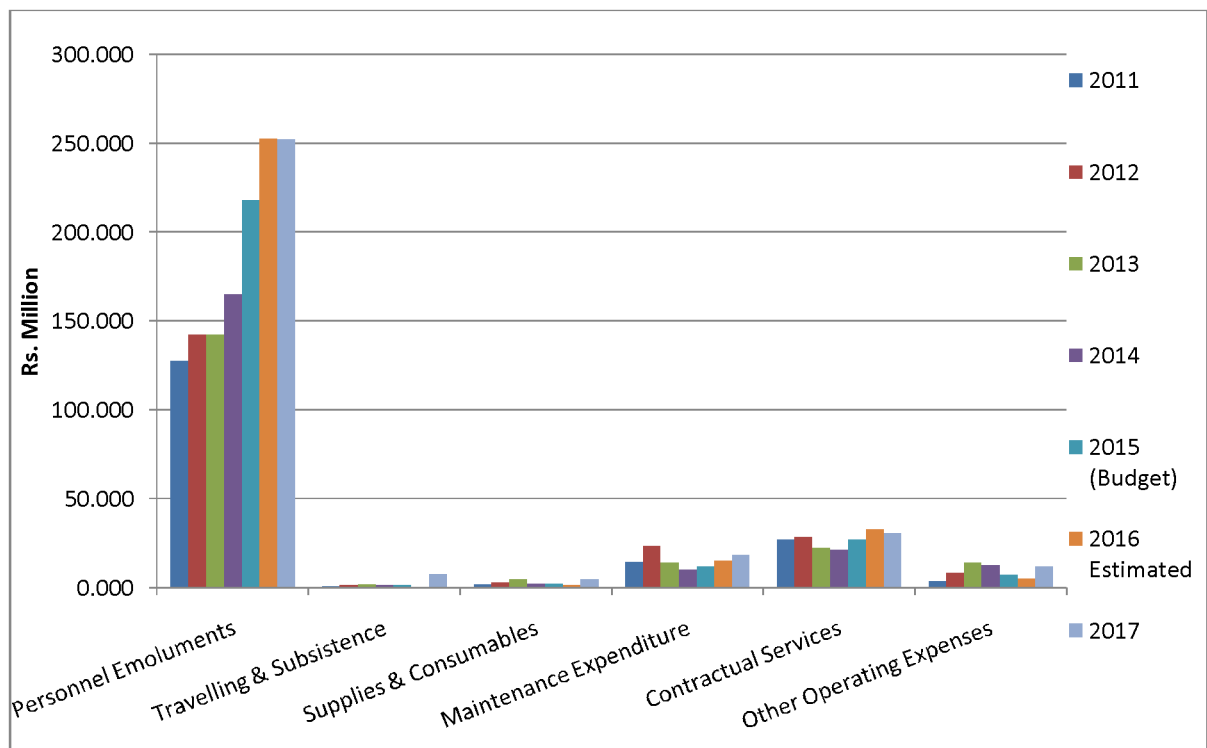
Description	2011	2012	2013	2014	2015 (Budgeted)	2016	2017 Estimated
Research & Development		54.053	95.000	67.000	100.000	160.000	140.000
Rehabilitation of Bldg., Vehicle & Material	26.762	330.060	10.000	15.000	21.000	66.000	50.000
Supply of Equipment	30.842	15.161	13.000	18.000	20.000	135.000	40.000
Total	103.27	399.274	118.000	100.000	141.000	361.000	230.000



Considerable amount in rehabilitation of bldg. vehicle & material was increased due to high price in the open market.

**Recurrent Expenditure
Rs.(Million)**

Description	2011	2012	2013	2014	2015 (Budget)	2016 Estimated	2017
Personnel Emoluments	127.402	142.392	142.376	168.164	176.100	231.524	252.281
Travelling & Subsistence	0.823	1.364	1.602	1.250	1.000	2.300	7.500
Supplies & Consumables	1.833	2.629	4.353	2.074	2.050	8.525	4.450
Maintenance Expenditure	14.272	23.38	14.064	11.879	9.850	24.850	18.220
Contractual Services	26.909	28.464	22.443	27.433	21.100	32.250	30.550
Other Operating Expenses	3.229	8.017	13.950	10.814	5.900	22.450	12.000
Total	174.468	206.246	198.788	221.613	218.000	321,899	325.001



4. HUMAN RESOURCES INFORMATION

Recruitments

No	Name	Designation	Per/con	Appoint Date
01	Ms.Diluka Sumanarathne	Legal Officer	Assignment	2016.02.01
02	Mr.V.G.Janaka Kumara	Driver	permanent	2016.09.05
03	Mr.H.D.Hemantha Ariyarthne	Driver	permanent	2016.09.05
04	Mr.S.K.S.Liyanaarachchi	Director(S & O)	permanent	2016.10.03
05	Mr.P.A.D.Sunil	Coxswain	Contract	2016.10.10
06	Mr.N.I.Amarasinghe	Driver	permanent	2016.10.31
07	Mr.K.R.W.W.M.A.P.Weerakoon	Scientist	permanent	2016.12.15
08	Mr.G.A.H.Galahitigama	Scientist	permanent	2016.12.15
09	Mr.M.T.U.Bandara	Scientist	permanent	2016.12.15
10	Ms.H.B.G.U.M.Wimalasiri	Scientist	permanent	2016.12.15
11	Mr.s.Thiruchandran	Scientist	permanent	2016.12.15
12	Ms.W.B.W.M.R.Y.C.Aluwihare	Scientist	permanent	2016.12.15
13	Ms.H.P.D.A.Lakmali	Scientist	permanent	2016.12.15
14	Ms.S.H.S.M.Siriwardane	Development Officer(Project)	permanent	2016.12.15
15	Ms.T.P.Hemachandra	Scientist	permanent	2016.12.15
16	Mr.W.H.U.Prasad	Development Officer(Project)	permanent	2016.12.15
17	Mr.R.A.N.Chamara	Development Officer(Project)	permanent	2016.12.15
18	Ms.A.S.Wijesinghe	Development Officer(Project)	permanent	2016.12.15
19	Ms.D.G.I.S.Rupamala	Development Officer(Project)	permanent	2016.12.15
20	Ms.R.M.S.Darmasiri	Scientist	permanent	2016.12.15
21	Ms.R.H.S.Alwis	Scientist	permanent	2016.12.15
22	Ms.T.C.Balawardane	Scientist	permanent	2016.12.15
23	Ms.W.K.Suwandahennadi	Scientist	permanent	2016.12.15
24	Ms.M.N.D.F.Abeykoon	Scientist	permanent	2016.12.15
25	Ms.U.K.I.Damayanthi	Development Officer(Project)	permanent	2016.12.15
26	Ms.M.B.I.Anuradha	Development Officer(Project)	permanent	2016.12.19
27	Ms.M.T.N.Thilakarathna	Scientist	permanent	2016.12.20

Departures

No	Name	Designation	Departure Date	Remarks
01	P.G.C.Galappaththi	Research Assistant	2016.01.04	Resigned
02	N.M.K.S.Ranjith	Director(finance)	2016.01.05	Resigned
03	W.K.E.Sanjeewa	Development Officer	2016.01.18	Vacation post
04	G.Premalatha	Management Assistant	2016.01.19	Pension
05	D.Senevirathne	Research Assistant	2016.01.23	Resigned
06	R.V.Narasinghe	Research Assistant	2016.01.31	Resigned
07	G.Wijerathna	Driver	2016.02.12	Pension
08	R.P.Perera	Accountant	2016.02.23	Dismissed
09	M.S.Fernando	Research Assistant	2016.03.27	Pension
10	K.A.S.Madushanka	Research Assistant	2016.03.28	Resigned
11	W.P.S.Kalani	Research Assistant	2016.03.28	Resigned
12	A.I.G.S.Dhanayake	Director(S & O)	2016.03.31	Resigned
13	R.A.L.T.Rupasinghe	Assistant Director(Admin)	2016.04.30	Resigned
14	Dr.R.R.P.Maldeniya	Principal Scientist (Marine Biology)	2016.04.25	Pension
15	A.R.Wanigasekara	Management Assistant	2013.12.06	Dismissed
16	Roshan Abeywikrama	Diver	2016.05.09	Resigned
17	R.Jayawickrama	Scientist	2016.05.27	Vacation post
18	H.D.Sunil Santha	Helper	2016.06.05	Resigned
19	R.A.N.Kumari	Development Officer	2016.06.13	Resigned
20	R.H.S.P.Ranasighe	Accountant	2014.01.29	Dismissed
21	S.W.S.Weerasinghe	Chief System Analyst	2016.07.10	Pension
22	E.A.R.De Zeyza	Management Assistant	2016.07.31	Resigned
23	M.H.S.Ariyaratna	Principal Scientist	2016.08.03	Pension
24	W.A.Sumanadasa	Research Assistant	2016.08.13	Pension
25	P.L.D.D.Nisansala	Development Officer	2016.08.08	Resigned
26	D.A.D.Champika	Development Officer	2016.08.09	Resigned
27	Chamali Madushani	Development Officer	2016.08.09	Resigned
28	H.T.R.Sureshika	Development Officer	2016.08.13	Resigned
29	T.S.Madapatha	Driver	2016.10.07	Pension
30	S.U.Amarasinghe	Development Officer	2016.10.06	Resigned
31	K.D.S.C.Rathnayake	Management Assistant	2016.10.27	Pension
32	A.P.C.T.Sandaruwana	Helper	2016.10.21	Resigned
33	P.S.A.Fernando	Skipper	2016.10.15	Completed contract
34	D.D.G.L.Dahanayake	Scientist	2016.11.28	Resigned

Unfilled vacancies

Srl No.	Designation	Salary Code	Approved Cadre	Vacant
01	Director (Finance)	HM1-3	1	1
02	Director (Admin/HR)	HM1-3	1	1
03	Senior Hydrographic surveyor	AR-2	2	2
04	Sociologist	AR-1	1	1
05	Economist	AR-1	1	1
06	Hydrographic Surveyor	AR-1	8	1
07	Senior Cartographer	MM 1-2	1	1
08	Senior System Aanalyst/Programme	MM 1-2	1	1
09	Data Analyst	MM 1-2	1	1
10	Asst.Director (Service & Operation)	MM 1-2	1	1
11	Asst.Director (HR)	MM 1-2	1	1
12	Asst.Director (Admin)	MM 1-2	1	1
13	Asst.Director (Information Technology)	MM 1-2	1	1
14	Senior Extension Officer	MM 1-2	1	1
15	Assisitant Director (Vessel Operation & Maitainance)	MM 1-2	1	1
16	Technical Officer (Mechanical)	JM1-2	1	1
17	Cartographer Data Analyst (Nautical)	JM1-2	1	1
18	Cartographer Data Analyst (GIS)	JM1-2	1	1
19	System Analyst /Programmer	JM1-2	1	1
20	Skipper	JM1-2	1	1
21	Technical Officer (Civil)	JM1-2	1	1
22	Land Surveyor	JM1-2	1	1
23	Cartographer	JM1-2	2	1
24	Landscaping Officer	JM1-2	1	1
25	Diving Officer	JM1-2	1	1
26	Translator	MA 4	3	3
27	Development Officer (Project)	MA 3	20	3
28	Assistant Network Administrator	MA 2-2	1	1
29	Field Research Assistant	MA 2-2	13	3
30	Research Assistant	MA 2-2	70	28
31	Catographic Draughtsman	MA 2-2	2	2

32	Coxwain	MA 2-2	2	1
33	Head Driver/Marine	MA 2-2	1	1
34	Malti Media Designer	MA 2-2	1	1
35	Management Assistant (Transport)	MA 2-2	1	1
36	Draughtsman	MA 2-2	2	1
37	Diver	MA 2-2	3	2
38	Diver Assistant	MA 2-2	1	1
39	Technical Assistant (Electrical)	MA 2-2	1	1
40	Mgt.Asst. (Library)	MA 2-2	2	2
41	Ocean Observation Technician	MA 2-2	1	1
42	Assistant Skipper	MA 2-2	1	1
43	Geological information System Technician	MA 2-2	1	1
44	Radio Officer	MA 2-2	1	1
45	Management Assistant	MA1-2	38	3
46	Hydrographic Assistant	MA1-2	1	1
47	Boatswain	MA1-2	1	1
48	Plumber	PL-3	1	1
49	Carpenter	PL-3	2	1
50	Mason	PL-3	2	2
51	Motor Mechanic	PL-3	2	1
52	Driver	PL-3	27	1
53	Deck Hand	PL-3	2	1
54	Marine Mechanic	PL-3.	1	1
55	Vedio Editor	PL-3	1	1
56	Lab Attendant	PL-2	12	0
57	Caretaker/Cook	PL-2	4	2
58	Helper	PL-1	87	9
59	Survey Helper	PL-1	6	1
Total				107

Promotions

No	Name	Previous Designation / Grade	Promotion Designation / Grade	Effective Date
01	Dr.W.D.N.Wickramarachchi	Scientist AR 1	Senior Scientist AR 2	2013.04.10
02	Dr.A.A.D.Amarathunga	Scientist AR 1	Senior Scientist AR 2	2013.04.08
03	Mr.S.R.C.Ranaweera	Senior Hydrographic Survey AR 2	Deputy Hydrographic Survey AR 2	2016.12.01
04	Dr.H.B.Jayasiri	Principal Scientist HM 1-3	Principal Scientist (Marine Biological) HM 1-3	2016.12.01
05	Dr.K.Arulananthan	Principal Scientist HM 1-3	Principal Scientist (Oceanography Marine Science)	
06	D.C.Udawaththa	Draughtsman MA-2-2 Grade-II	Draughtsman MA-2-2 Grade-I	2016.09.20

Local Trainings

	Name	Date	Course	Venue	Ammount (Rs.)
01	Mr.K.H.M.L. Amaralal Principal Scientist	2016	Mphil/ PhD in Economic	University of Colombo	260,000.00
02	Ms.N.D. Hettige Scientist	04/01/2016	Statistics for Biological Research	University of Kelaniya	5,000.00
03	Ms.S.R.C.N.K.Narangoda Scientist	04/01/2016	Statistics for Biological Research	University of Kelaniya	5,000.00
04	Mr.H.D.Sunil Shantha Electrician	29/01/2016	Water Machanic/ Plumbing Workshop	Jinasena (pvt) Ltd	-
05	Mr.H.A.M.Priyankara Thisera Electrician	29/01/2016	Water Machanic/ Plumbing Workshop	Jinasena (pvt) Ltd	-
06	Mr.D.A.Athukorala Principal Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
07	Dr.M.G.I.S.Parakrama Senior Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
08	Mr.P.A.D.Ajith Kumara Senior Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
09	Ms.M.A.J.C.Mallawarachchi Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00

10	Mr.Rochana Weerasinghe Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
11	Ms.G.D.N.Pavithra Assistant Director/ Finance	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
12	Ms.K.G.L.Irangani Internal Audit Officer	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
13	Ms.A.T.P.K.De Silva Purchasing And Supply Officer	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
14	Ms.Tamali Erandika Management Assistant	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
15	Mr.W.A.S.Perera Management Assistant	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
16	Ms.S.S.G.Nelumdeniya Management Assistant	29/30/01/2016	Procument Planing & Bidding Document	Skill development Fund Limited	8500.00
17	Ms.B.R.C.Mendis Scientist	28/01/2016	Degree of PhD	University of Colombo	58,000.00
18	Mr.N.B.P.Punyadewa Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
19	Mr.M.G.C.R.Wijesinghe Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
20	Ms.N.D. Hettige Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5000.00
21	Ms.M.D.S.R.Maddumage Scientist	11/12/02/2016	Statistics for Biological Research	University of Kelaniya	5,000.00
22	Ms.M.B.F.Suhadha Helper	10/11/03/2016	Microsoft Excel Advance Analysis Tools	Distance Learning Center	16,000.00
23	Ms.Nisansala Perera Management Assistant	10/11/03/2016	Microsoft Excel Advance Analysis Tools	Distance Learning Center	16,000.00
24	Ms.A.C. Madushani Development Officer	10/11/03/2016	Microsoft Excel Advance Analysis Tools	Distance Learning Center	16,000.00
25	Ms.Thushari Pradeepika Account Officer	2016	Master of Bussiness Administrative	University of Colombo	198,500.00

26	Ms.J.K.P.C. Jayawardhene Scientist	2016	MSc Post Graduate in Forestry & Environmental Managmenet	University of Sri Jayewardenepura	130,000.00
27	Mr.T.D.W.Kasthuriarachchi Research Assistant	2016	MSc Degree & Post Graduate Diploma	University of Kelaniya	160,000.00
28	Ms.M.D.S.R.Maddumage Scientist	2016	MSc Degree & Post Graduate Diploma	University of Kelaniya	160,000.00
29	Ms.K.G.L.Irangani Internal Audit Officer	2016	Dipploma in Government Management	University of Sri Jayewardenepura	49,900.00
30	Ms.P.A.M.J.Wijepala Research Assistant	2016	MSc in Fisheries & Aquatic Resources Mgt	University of Sri Jayewardenepura	50,000.00
31	MS.M.Ruwanthi Samila Management Assistant	7/04/2016	Official Bank Accounts & Cheques	Prag Institute (Pvt) Ltd.	6000.00
32	Ms.K.M.T.M.Kuruppu Helper	7/04/2016	Official Bank Accounts & Cheques	Prag Institute (Pvt) Ltd.	6000.00
33	Ms.Y.T.Wijeysekara Development Officer	11/05/2016	Disciplinary Procedures	Skills Development Fund Ltd	8500.00
34	Ms.B.G.S.Kariyawasam Chief Librarian	23/06/2016	National Conference on Library & Information Studies	Sri Lanka Library Association	3500.00
35	Ms.R.S.Liyanarachi Librarian	23/06/2016	National Conference on Library & Information Studies	Sri Lanka Library Association	3000.00
36	Ms.Menaka Karunarthne Helper	31/05 & 01,03/06/2016	Library Automation Project	Open University	-
37	Ms.Eranga De Zoysa Management Assistant	31/05 & 01,03/06/2016	Library Automation Project	Open University	-
38	Ms.B.G.S.Kariyawasam Chief Librarian	02,03/06/2016	Library Automation Project	Open University	-
39	Ms.K.G.L.Irangani Internal Audit Officer	24/06/2016	Information System Audit	Prag Institute	6,000.00
40	Ms.K.K.Thamali Erandika Management Assistant	24/06/2016	Information System Audit	Prag Institute	6,000.00

41	Ms.Y.T.Wijeysekara Development Officer	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
42	Ms.D.A.D.Champika Development Officer	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
43	Ms.A.M.Gunathilaka Accounts Clerk	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
44	Ms.W.A.K.R.Mallika Management Assistant	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
45	Ms.I.J.J.Fernando Management Assistant	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
46	Ms.H.S.I.P.Fernando Management Assistant	30/06 01/07/2016	& Salary Conversion Programme	Skill development Fund Limited	8500.00
47	Ms.G.W.N.Pavithra Assistant Director/ Finance	23,29,30/07/2016	Awareness Programme on Sri Lanka Public Sector Accounting Standards	Institute of Chartered Accounts of Sri Lanka	
48	Ms.K.G.L.Irangani Internal Audit Officer	23,29,30/07/2016	Awareness Programme on Sri Lanka Public Sector Accounting Standards	Institute of Chartered Accounts of Sri Lanka	
49	Ms.D.S.R.Maddumage Scientist	17/06/2016	Workshop on Inderdisciplinary in Research	Sri Lanka Association for the Advancement Science. (SLASS)	4000.00
50	Mr.T.D.W.Kasthuriarachchi Research Assistant	17/06/2016	Workshop on Inderdisciplinary in Research	Sri Lanka Association for the Advancement Science. (SLASS)	4000.00
51	Mr.M.D.Senarathne Internal Auditor	25/07/2016	Microsoft Excel Advance Analysis Tools	Adams Skills Development Centre	16000.00
52	Dr.H.B.Jayasiri Principal Scientist	28/07/2016	Traning programme on Uncertainty Estimation in Measurement Science	Measurement Units, Standards & Services Department	9500.00
53	Dr.V.Pahalawatthaarachchi Principal Scientist	18/08/2016	The Economic of Nature	IUCN- Standard Chartered Bank	10,000.00
54	Dr.D.D.G.L.Dahanayaka Scientist	18/08/2016	The Economic of Nature	IUCN- Standard Chartered Bank	10,000.00
55	Ms.Siriyalatha Gamage Lab Attendant	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00

56	Ms.U.K.Kusumlatha Lab Attendant	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
57	Mr.Jude Ranjith Helper	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
58	Mr.Priyantha Ruckman Helper	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
59	Mr.Chandana Senavirathna Helper	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
60	Mr.Kapila Jayasena Helper	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
61	Ms.W.Chamila Nilanthi Helper	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
62	Mr.U.L.S.C. Perera Lab Attendant	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
63	Mr.K.I. Thushara Lab Attendant	09/09/2016	Good Laboratory Practices in Testing Laboratories	Sri Lanka Association of Testing Laboratories (SLATL)	3000.00
64	Mr.T.H.Darmashena Skill labour	26/08/2016	Programme of the responsibility of the Helpers	Skill development Fund Limited	5000.00
65	Mr.M.R.S.P.Senevirathna Helper	26/08/2016	Programme of the responsibility of the Helpers	Skill development Fund Limited	5000.00
66	Ms.D.D.D.Weragodatenna Scientist	17/08/2016	Certificate on project Management	Sri Lanka Institute of Development Administraion	15,000.00
67	Ms.M.P.M.T.Karunaratna Helper	31/08/2016	Diploma In Library and Information Science- Level- I	Sri Lanka Library Association	18,500.00
68	Ms.K.G.L.Irangani Internal Audit Officer	09,08/09/2016	Course on Administration of Government Institue, Corporation and private Sector	Skill development Fund Limited	8500.00
69	Ms.W.A.K.R.Mallika Management Assistant	09,08/09/2016	Course on Administration of Government Institue, Corporation and private Sector	Skill development Fund Limited	8500.00

70	Dr.H.B.Jayasiri Principal Scientist	08/07/2016	International Forestry & Environment Symposium	University of Sri Jayewardenepura	2000.00
71	Dr.V.Pahalawatthaarachchi Principal Scientist	21/09/2016	Writing a winning Research Proposal	National Science And Technology Commission	2500.00
72	Ms.M.A.J.C.Mallawarachchi Scientist	21/09/2016	Writing a winning Research Proposal	National Science And Technology Commission	2500.00
73	Ms.D.M.S.Sugeeshwari Scientist	21/09/2016	Writing a winning Research Proposal	National Science And Technology Commission	2500.00
74	Mr.K.A.D.A.T.Harishchandra Scientist	21/09/2016	Workshop on Data Science & Big Data Analytics	Post Graduate Institute of Science	10,000.00
75	Mr.N.B.Suriyaarachchi Scientist	21/09/2016	Workshop on Data Science & Big Data Analytics	Post Graduate Institute of Science	10,000.00
76	Mr.S.S.Gunasekara Scientist	21/09/2016	Workshop on Data Science & Big Data Analytics	Post Graduate Institute of Science	10,000.00
77	Ms.N.D. Hettige Scientist	04/10/2016	Water Quality & Human Health	Institute of Chemistry Ceylon	2000.00
78	Ms.M.D.S.R. Maddumage Scientist	04/10/2016	Water Quality & Human Health	Institute of Chemistry Ceylon	2000.00
79	Ms.J.K.P.C. Jayawardhane Scientist	04/10/2016	Water Quality & Human Health	Institute of Chemistry Ceylon	2000.00
80	Ms.S.R.C.N.K. Narangoda Scientist	04/10/2016	Water Quality & Human Health	Institute of Chemistry Ceylon	2000.00
81	Ms.V.K.G. Jayasena Administrative Officer (Admin)	10/11/2016	Industrial Disputes, Social and Termination of Employment	PRAG Service (Pvt) Ltd.	6000.00
82	Mr.T.H. Dharmasena Skill Labour	15/11/2016-28/11/2016	Book Binding	Department of National Archives	3500.00
83	Mr.T.D.W.Kasthuriarachchi Research Assistant	10,11/11/2016	4th National Workshop on Scientific Data Management.	Post Graduate Institute of Science	3000.00
84	Ms.R.S. Liyanaarachi Librarian	21,22/11/2016	New Trends in Library Space Design	National Institute of Library & Information Science	5000.00
85	Ms.B.G.S. Kariyawasam Chief Librarian	21,22/11/2016	New Trends in Library Space Design	National Institute of Library & Information Science	5000.00
86	Mr.W.D.T. Padmasiri Motor Mechanic	10/11/2016	Course of Professional Development	Centre For Housing Planning & Building	3000.00

87	Mr.W.Antony Fernando Carpenter	10/11/2016	Course of Professional Development	Centre For Housing Planning & Building	3000.00
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Foreign Tranings/Workshops

Number	Name & Designation	Country	Purpose	Period
01	Mr. N.B. Suriyaarachchi Scientist	China	Training Programme of Joint Investigation on Sea Level and Early Warning System	16.01.2016 - 28.01.2016
02	Mr.R.A.M.Jayathilaka Scientist	China	Training Programme of Joint Investigation on Sea Level and Early Warning System	16.01.2016 - 28.01.2016
03	Mr.U.W.S.Adikari Research Assistant	China	Training Programme of Joint Investigation on Sea Level and Early Warning System	16.01.2016 - 28.01.2016
04	Mr. K.W. Indika Lab Attendant/ Research Assistant (Actg)	China	Training Programme of Joint Investigation on Sea Level and Early Warning System	16.01.2016 - 28.01.2016
05	Dr H.A.C.C. Perera Senior Scientist	Maldives	Indian Ocean Coastal States Workshop	02.02.2016 – 05.02.2016
06	Dr R.R.P. Maldeniya Principal Scientist (Marine Biology)	Iran	03 rd Session of the Technical Committee on Allocation Criteria (TCAC03) of Indian Ocean Tuna Commission and G16 Meeting	18.02.2016 - 25.02.2016
07	Mr.R.M.D.I. Rathnayake Hydrographic Surveyor	China	Training on Acoustics and equipment operation training for Zheng He's second season survey	18.02.2016 - 25.02.2016
08	Mr.M.M.A.S.Maheepala Senior Scientist	U.S.A. & Australia	United Nations – The Nippon Foundation of Japan Special Strategic Fellowship Award in Ocean Affairs and the Law of the Sea Building catalytic capacity to address critical needs of the most vulnerable States	19.03.2016 - 17.12.2016
09	Mr A.N.D. Perera Chief Hydrographer	Bangladesh	16 th North Indian Ocean Hydrographic Commission (NIOHC) Meeting\	12.03.2016 - 17.03.2016
10	Dr Anil Premarathne Chairman (NARA)	Korea	International Symposium on Ocean Science and Technology ODA in Seoul	04.04.2016 – 09.04.2016
11	Ms W A A P Wijesundara Hydrographic Surveyor	Canada	Training Programme on OCEAN GOVERNANCE: POLICY LAW AND MANAGEMENT	18.05.2016 - 17.07.2016

12	Dr.K.Arulananthan Principal Scientist	Malaysia	Indian Ocean Rim Association (IORA) Ocean Research Data Management Training Course	21.05.2016 27.05.2016	-
13	Mr.S.U.P.Jinadasa Principal Scientist	Monaco	Forum for Future Ocean Floor Mapping	12.06.2016 19.06.2016	-
14	Mr.S.R.C.Ranaweera Senior Hydrographer surveyor	Monaco	Forum for Future Ocean Floor Mapping	12.06.2016 19.06.2016	-
15	Mrs. Y.M.R.N.Kumari Hydrographic Surveyor	Monaco	Forum for Future Ocean Floor Mapping	12.06.2016 19.06.2016	-
16	Dr. S.S.K. Haputhantri Principal Scientist	Seychelles	6 th Working Party on Neritic Tunas (WPNT006)	20.06.2016 26.06.2016	-
17	Mrs. A.S.L.E. Corea Scientist	Thailand	Invitation Participation to the Workshop on FAO TCP/INT/3502- “Reducing and managing the risks of Acute Hepatopancreatic Necrosis Disease (AHPND) of cultured shrimp” and the FAO TCP/INT/3501- “Strengthening biosecurity governance and capacities for dealing with the shrimp disease infectious myonecrosis virus (IMNV)	22.06.2016 29.06.2016	-
18	Mr. D.A. Athukorala Principal Scientist	China	Training Course on Land – based Aquaculture for Asian Countries	25.06.2016 18.08.2016	-
19	Dr. M.G.I.S. Parakrama Senior Scientist	China	Training Course on Land – based Aquaculture for Asian Countries	25.06.2016 18.08.2016	-
20	Mr. Rochana Weerasinghe Scientist	China	Training Course on Land – based Aquaculture for Asian Countries	25.06.2016 18.08.2016	-
21	Dr. R.P.P.K. Jayasinghe Senior Scientist	New-York USA	Workshop to Discuss Implementation of Resolution 66/68 Sustainable Fisheries	31.07.2016 04.08.2016	-
22	B.C.W. Iddamalgoda Director General (NARA)	Brazil	Olympic Games 2016, Rio Brazil	15.08.2016 24.08.2016	-
23	Mr. K.H.M.L. Amaralal Principal Scientist	Japan	Value Chain Development for Sustainable Use of Fisheries Resources	18.08.2016 04.10.2016	-
24	Mr. G.S.C. Perera Scientist	China	Seminar on Sustainable Aquaculture & Climate Change for the Belt Road Countries	22.08.2016 13.09.2016	-
25	Mr. N.B.P. Punyadewa Senior Scientist	India	Training Course on Essential EAFM: Developing Capacity in Ecosystem Approach To Fisheries Management	29.08.2016 04.09.2016	-
26	Mr. M.I.G. Rathnasooriya Scientist	Seychelles	14 th Working Party on Billfish (WPB14)	05.09.2016 12.09.2016	-

27	Mr. R.A.M.Jayathilaka Scientist	Seychelles	12 th Working Party on Ecosystem & Bycatch (WPEB12)	11.09.2016 – 18.09.2016
28	Mr. E.D.M.Epasinghe Scientist	Belgium	International Training Programme – Health Management in Aquaculture	22.09.2016 – 16.12.2016
29	Dr Anil Premarathne Chairman (NARA)	China	Global Ocean Summit -2016	25.09.2016 – 29.09.2016
30	Ms. R.R.A.R.Shirantha Senior Scientist	Bangladesh	Regional Expert Consultation “Policy Framing on Fish Biodiversity Management in Transboundary Rivers”	02.10.2016 – 06.10.2016
31	Ms. G.D.T.M. Jayasinghe Scientist	Singapore	Training for Vitamin Acids Analysis by Using high Performance Liquid Chromatography	17.10.2016- 20.10.2016
32	Dr. D.D.G.L. Dahanayaka Scientist	South africa	Overseas study Tour on Control & management of Invasive Species (IAS)	22.10.2016 – 01.11.2016
33	Dr. H.B.Jayasiri Principal Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
34	Dr. A.A.D. Amarathunga Senior Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
35	Mr. U.S.P.K. Liyanage Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
36	Mr. K.W.R.R. Amaraweera Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
37	Mrs. S.N.P.H.G.D.D.D. Weragodathenna Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
38	Ms. N.D.Hettige Scientist	China	Coastal Zone Biodiversity Protection for Asia and the Pacific	24.10.2016 – 17.11.2016
39	Mrs. P.S. Jayasinghe Senior Scientist	Thailand	The 9 th Asia Pacific Conference on Algae Biotechnology	14.11.2016 – 19.11.2016
40	Ms W A A P Wijesundara Hydrographic Surveyor	Malaysia	OTGA – INOS /UMT Training Course: Metadata using GeoNetwork	19.11.2016 – 25.11.2016
41	Dr. S.S.K. Haputhantri Principal Scientist	Seychelles	Attend the CITES Workshop, IOTC 18 th Working party on Tropical Tunas (WPTT18) , 07 th Working party on Methods (WPM07	31.10.2016 – 15.11.2016
42	Dr Anil Premarathne Chairman (NARA)	Bangladesh	MOU between Sri Lanka Council for Agriculture cooperation (SL CARD) and Bangladesh Agriculture (BARD)	20.11.2016 – 27.11.2016
43	Dr.H.M.P.Kithsiri Deputy Director General (Research & Development)	China	Public marine Management Training Programme	20.11.2016 – 01.12.2016

44	Mr.S.J.W.W.M.M.P. Weerasekara Scientist	Bhutan	2016 APN Proposal Development Training Workshop	13.12.2016 – 18.12.2016
45	B.C.W. Iddamalgoda Director General (NARA)	China	Visit of NARA Delegation to First Institute of Oceanography and Second institute of oceanography , the Workshop on the impact of Extreme Climate on Southeast Asia and the Associated Disaster Prevention and mitigation	25.12.2016 – 30.12.2016
46	Dr.K.Arulananthan Principal Scientist	China	Visit of NARA Delegation to First Institute of Oceanography and Second institute of oceanography , the Workshop on the impact of Extreme Climate on Southeast Asia and the Associated Disaster Prevention and mitigation	25.12.2016 – 30.12.2016
47	Mr.S.U.P.Jinadasa Principal Scientist	China	Visit of NARA Delegation to First Institute of Oceanography and Second institute of oceanography , the Workshop on the impact of Extreme Climate on Southeast Asia and the Associated Disaster Prevention and mitigation	25.12.2016 – 30.12.2016
48	Mr. K A D A T Harischandra Scientist	China	Traini9ng on 3-D Ocean environment numerical modeling	29.12.2016 – 22.01.2017
49	Ms.K.W.A.K.M.Saman Kumari Research Assistant	China	Traini9ng on 3-D Ocean environment numerical modeling	29.12.2016 – 22.01.2017

Court Cases

01. The Cases filed against the Agency and the Cases filed by the Agency

A. The Cases filed against the Agency

a) The Outside Authority that case has been filed:-

Ms. Achala Ruwanthi Wannigasekera

b) The scope of the case

This officer is an interdicted officer who had charged with three charges of abusing the Chairman of the Agency, Discrepancies in Procurement, and for leaving the country without informing the Agency.

c) The requested Damages

Reinstatement to the Post with arrears of salaries

As a substitution to the Reinstatement to the Post a amount of Damages

d) The Court where the case has been filed
Labour Tribunal

e) Present Status

As the NARA had terminated her services NARA is presently leading evidence The Attorney General Department has not been granted this case and the Legal Officer of NARA is presently leading evidence. .

The Court may give order to pay 06 months' salary.

B. The Cases filed by the Agency

a) The Outside Authority against case has been filed:-

- i. Mr.N.H. Dassanayake and his Guarantors
- ii. Mrs. S. Thalakada and her Guarantors

b) The scope of the case

- i. Breach of the Agreement and the Bond signed with NARA and non Reporting to service after conclusion of No Pay Leave.
- ii. Breach of the Agreement and the Bond signed with NARA and non Reporting to service after conclusion of No Pay Leave.

c) The requested Damages

- i. To charge Rs.5 932 721/- & interest
To charge Rs 5 788 241/- & interest from the Guarantors
Legal fee and others
- ii. To charge Rs.5 83 125/- & interest
Legal fee and others

d) The Court where the case has been filed

- i. District Court Colombo
- ii. District Court Colombo

e) Present Status

- i. The case has been continued
- ii. The case has been continued

Welfare Activities

Annual New Year festival and chrismas day celebrated. In addition to that transport facilities provide to the staff to make easy.

5. RESEARCH DIVISIONS

5.1 ENVIRONMENTAL STUDIES DIVISION

Head of the Division: Mr. S. A. M. Azmy

Overview of the year

The Environmental Studies Division (ESD) is the division which is responsible for considering environmental aspects related to water quality and aquatic ecology. By conducting several research projects the division provides technical and theoretical advice to government and other stakeholders to enhance decision-making process and implement sustainable aquatic resource management strategies.

Scientists in ESD conduct research, develop technology, and perform analyses to understand and assess responses of environmental systems at the environment-human interface and the consequences of alternative energy and environmental strategies. Moreover, they seek to understand how natural and anthropogenic factors (e.g., regional changes, environmental stress, and energy production and use) interact to influence environmental systems and society. The divisional methods integrate field and laboratory methods with new theory, modelling, data systems, policy analysis, and evaluation to create solutions to complex environmental challenges.

Divisional staff consists of four senior scientists including head of the division, eight scientists, a development officer, two research assistants, a word processing operator, two laboratory assistants, and a helper. During 2016, the division carried out seven research projects, which mainly focused on environmental related topics and for the development of the fisheries industry including a project to cater the emergencies such as fish kills and oil spills, and also a project to improve the quality of the laboratory.

Programme		Project		Allocation (Rs.) Mn	Officer Responsible	Period	
						From	To
1	Conservation and Management	3.4.5	Assessment of water quality and algae composition in selected reservoirs in cascade system of Maduru Oya and immunological treatment for disease management.	1.3	Dr.W.D.N.Wickramaarachchi S.A.M Azmy K.A.W.S. Weerasekara Dr. A.A.D. Amaratunga N.D.Hettige M.D.S.R. Maddumage J.K.P.C. Jayawardane S.R.C.N.K. Narangoda	January 2016	December 2016
2	Conservation and Management	5.1.2	Assessment of water pollution status of lagoons and marine environments – Western and North Western coast of Sri Lanka.	0.5	S.A.M. Azmy K.A.W. S. Weerasekara Dr.W.D.N.Wickramaarachchi N.D.Hettige M.D.S.R.Maddumage J.K.P.C.Jayawardane S.R.C.N.K. Narangoda	January 2016	December 2016

3	Conservation and Management	5.1.3	Investigation of causes for emergency incidents such as oil spills, algal blooms and fish kills (emergency studies).	0.2	S.A.M. Azmy K.A.W. S. Weerasekara W.D.N.Wickramaarachchi B.R.C. Mendis N.D.Hettige M.D.S.R.Maddumage J.K.P.C.Jayawardane S.R.CN.K. Narangoda	January 2016	December 2016
4	Conservation and Management	5.1.4	Development of Methodologies and technologies to improve inland water resources including river basins.	2.2	Dr.A.A.D. Amarathunga S.A.M. Azmy K.A.W. S. Weerasekara Dr.W.D.N.Wickramaarachchi N.D.Hettige M.D.S.R.Maddumage J.K.P.C.Jayawardane S.R.CN.K. Narangoda	January 2016	December 2016
5	Conservation and Management	5.1.5	Assessment of bioaccumulation of heavy metals in water, sediments and muscle tissues of selected edible fish and crabs species from Negombo estuary, Sri Lanka.	0.4	B.R.C. Mendis S.A.M. Azmy	January 2016	December 2016
6	Conservation and Management	5.1.6	Study of different bio indicators for assessing water quality in the selected lagoon – Maduganga – Ramsar wetland in Sri Lanka.	0.4	N.D.Hettige S.A.M. Azmy K.A.W. S. Weerasekara Dr.W.D.N.Wickramaarachchi M.D.S.R.Maddumage J.K.P.C.Jayawardane S.R.C.N.K. Narangoda	January 2016	
7	Conservation and Management	5.1.7	Genotoxicity screening of drinking water wells located in the North Central Province (NCP) of Sri Lanka using plant and fish based bioassays.	1.0	K. A. W. S. Weerasekara S.A.M Azmy N.D.Hettige S.R.C.N.K. Narangoda	January 2016	December 2017 (Continuou s)
8	Conservation and Management	10.1.1	Quality improvements to ESD laboratory and test & advisory services.	1.0	S.A.M. Azmy K.A.W. S. Weerasekara Dr.W.D.N.Wickramaarachchi B.R.C. Mendis N.D.Hettige M.D.S.R.Maddumage J.K.P.C.Jayawardane S.R.CN.K. Narangoda	January 2016	December 2016

PROJECT No: 3.4.5

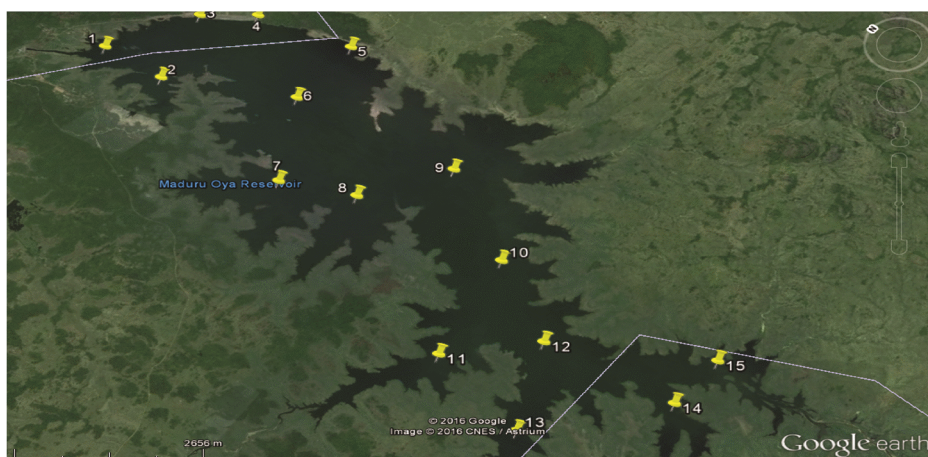
ASSESSMENT OF WATER QUALITY AND ALGAE COMPOSITION IN SELECTED RESERVOIRS IN CASCADE SYSTEM OF MADURU OYA AND IMMUNOLOGICAL TREATMENT FOR DISEASE MANAGEMENT

Maduru Oya dam and reservoir was constructed in 1983 under the Accelerated Mahaweli Program. The reservoir receives water from 453-km² catchment area of Maduruoya basin and receives substantial supplementary flows from the Mahaweli River itself via a link tunnel. Maduru Oya reservoir has gross storage of 597 mega cubic meters.

The reservoir water quality has deteriorated during last decade due to high accumulation of nutrients such as nitrate and phosphate. It could be due to intensive uses of inorganic fertilizers and other agrochemicals. Therefore, assessment of status of water quality, algal diversity, and abundances were identified as main objectives of this study. Field sampling were done monthly basis for February to October 2016. Sixteen sampling locations were monitored during the period.

According to the results, *Microcystis* species were identified as the most abundant algal species. *Microcystis aeruginosa* is a species of freshwater cyanobacteria which can form harmful algal blooms of economic and ecological importance. They are the most common toxic cyanobacterial bloom in eutrophic fresh water. Cyanobacteria produce neurotoxins and peptide hepatotoxins, such as microcystin and cyanopeptolin. The distribution of *Microcystis* occurs about 60 % to 80% of the reservoir. Especially, it was distributed both vertical and horizontal dimensions in the reservoir during the study period.

The results of the study revealed that some of the physico-chemical properties of water in Maduru Oya have strong positive correlation in determining phytoplankton diversity and abundance. Based on the water quality data, highest phosphate concentration was detected as 0.468 ppm near the dam site of the reservoir in July. The highest pH was recorded in June near the dam site of the reservoir and exceeds the WHO standards for drinking water. The maximum nitrate and nitrite concentrations were recorded in June at the middle of the reservoir and maximum ammoniacal nitrogen was also recorded in June and it was at the dam site. The highest abundance was observed in the months of May and June. Therefore, it showed the positive correlation with the *Microcystis* growth.



Sampling locations

As a conclusion, it is obvious that the excess nutrients are causing water pollution. It leads to the *Mycrocystis* blooms during May to June. This is a cyclic process in every year due to following reasons.

1. Presence of the *Mycrocystis* in the reservoir
2. Addition of excess nitrogen and phosphorus from the Maduru Oya river
3. Seasonal growth of grass land on reservoir bank and releases of nutrient boost with onset of rainy season due to death and decay.

On the other hand, around 10 000 families drink water from the water released from the reservoir and its cascade system. Unfortunately, their drinking water purification systems are limited to sand filters including stations belonging to the Water Supply and Drainage Board.

Therefore, following recommendations need to be implemented to sustain the lives of the people in Mahaweli B system.

1. Increase awareness among the farmers in the catchment of the Maduru oya on wise use of agrochemicals.
2. Stocking of planktivorous fish species in the reservoir and try to balance the nutrient balance with food web manipulation.
3. Development of drinking water treatment system in the area and ensure safe drinking water of the community.
4. Regular monitoring of algal composition & abundance and their toxicant production.
5. Proper irrigation managements in the reservoir.
6. Increase awareness among water consumers to implement safety precautions such as domestic water filters etc.

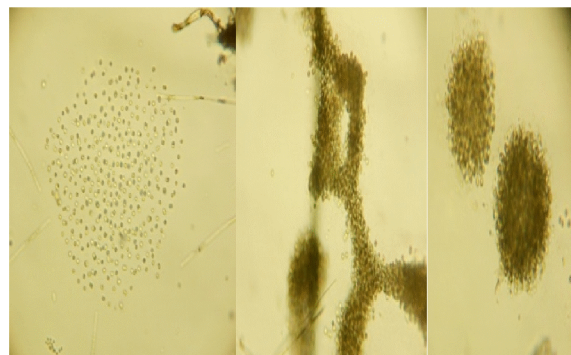
Two Master students from University of Kelaniya and University of Peradeniya completed their research dissertations under this project.

Remarks

Due to non-availability of vehicles few field visits were cancelled.



***Mycrocystis* Blooms in the reservoir**



Some recorded *Mycrocystis* Species



Water buffalos grazing in the vicinity



Birds in the reservoir habitats



Community water purification units (sumps with two sand filters)



Nutrient rich waters of Maduru Oya

Project progress

Progress (%):-

Financial: 70%

Physical: 93%

PROJECT No: 5.1.2

ASSESSMENT OF WATER POLLUTION STATUS OF LAGOONS AND MARINE ENVIRONMENTS – WESTERN AND NORTH WESTERN COAST OF SRI LANKA

Component 1:

Identification of toxin producing marine phytoplankton and dinoflagellates with special reference to physico-chemical aspects of coastal waters in Western Province, Sri Lanka

Marine algae and toxin producing dinoflagellates present in Sri Lankan coastal waters are less studied. There had been limited number of studies carried out on dinoflagellate diversity and abundance in the recent times in Sri Lanka. However, those studies did not cover the entire coastal belt along the Western province. The detrimental impact of red tides and cyanobacterial blooms on wetland, shore, and pelagic species has long been suspected but not often been substantiated because information on the effects of these

toxins in fish and wildlife species is lacking and diagnostic tools are limited. This study was initiated with the objectives to identify and quantify the species of marine algae, dianoflagellates and harmful toxin producing dinoflagellate species present in coastal waters in Western Province; to detect environmental factors and water quality parameters that affect their growth and seasonal occurrence.

Water quality and plankton in coastal water samples were studied in 15 selected sampling locations along the coastal belt of Gampaha, Colombo and Kalutara districts. According to the results, water temperature and pH recorded within 28-32 °C and 6.4-8.5. Nitrate and dissolved phosphorus concentrations which are important for growth of marine algae were within 0.002-0.1 mg/l and 0.005-0.2 mg/l. However, the proposed quality standards for different use classes of coastal water in Sri Lanka have not specified limits for nitrates and phosphates. During the study period, 21 dinoflagellate species were found in coastal waters along Western Province, Sri Lanka. Among these species, *Prorocentrum micans*, *Prorocentrum sigmoides*, *Alexandrium* spp. and *Dinophysis caudata* cause shell fish poisoning. *Karenia brevis* cause Neurotoxin Shell fish poisoning. The most abundant dinoflagellate species found were *Ceratium furca*, *Ceratium fusus*, *Protoperidinium grandae*, *Ceratium trichoceros*, *Dinophysi scaudata*, *Triceratium* sp., *Protoperidinium depressum*, *Ceratium gibberum* etc. Based on the results, any algal bloom conditions (red tides) were not recorded during the study period.



Sampling location- Uswatakeiyawa



Sampling location- Mt. Lavinia



Plankton sampling



Laboratory analysis

Project progress

Progress (%):- Financial: 100%

Physical: 98 %

Component 2

Spatial and Temporal Variation of Water Quality Parameters in Chilaw, Lagoon Sri Lanka.

Chilaw Lagoon is an intermittently closed, shallow coastal lagoon located in the North Western province of Sri Lanka. The lagoon is opened to the ocean through long confined channels at northern and southern ends of the lagoon. Shrimp aquaculture has become highly popular in Chilaw compared to traditional lagoon fisheries. Excessive shrimp farm development has resulted in pollution of the lagoon since the farms extract water from the lagoon and discharge the effluent to the same lagoon. The abundant mangrove vegetation in the southern part and peripheral areas have been cleared for the construction of shrimp farms and also been damaged by the poor water quality of the lagoon. Furthermore, significant amount of domestic waste and effluent is discharged into the lagoon by the large community living around the city, which extends on the northern shore of the lagoon.

This study investigated the seasonal and spatial variations of water quality parameters at fifteen different locations situated between 7° 29' 17"N to 7° 36' 25"N latitude and 79° 47' 19"E to 79° 49' 02"E longitude in the Chilaw lagoon for a period of twelve months (January to December, 2016). Physical and chemical parameters as pH, Electrical Conductivity (EC), Salinity, Dissolved Oxygen (DO), Turbidity, Air Temperature and Water Temperature was measured at the sampling sites with the use of hand held meters. While the parameters namely Nitrite Nitrogen, Nitrate Nitrogen, Ammoniacal Nitrogen, Dissolved Phosphate, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Chlorophyll a concentration and Alkalinity were analyzed in the laboratory according to the Standard Methods for the Examination of Water and Waste Water 22nd Edition, 2012 by American Public Health Association.

According to the results, pH values ranged from 6.68 to 9.41 and it exceeded the proposed ambient water quality standards for fish and aquatic life. There is a significant variation ($p < 0.05$) of pH values among sampling months and higher values recorded in the dry period (July to October) The lagoon DO levels varied between 1.25 to 7.52 mg/l and the lower limit did not comply with the tolerance limit for fish and aquatic life. EC values ranged from 2.8 to 55.0 mS/cm and the corresponding salinity variation was 2 to 35 ppt. The surface water temperature and the turbidity of the lagoon waters varied in the range of 27.4 to 33.9 °C and 0.96 to 50.3 NTU respectively. Nutrient pollution was detected in several locations during the study period and the observed ranges were: Ammoniacal nitrogen- 0.0010 to 0.2483 mg/l, nitrite nitrogen- 0.0001 to 0.0365 mg/l, nitrate nitrogen - 0.0004 to 0.3225 mg/l and orthophosphate- 0.0006 to 0.2942 mg/l.

Water quality of the Chilaw lagoon is influenced by discharges of Deduru Oya, Lunu Oya, tidal patterns and anthropogenic activities. Anthropogenic activities contribute largely to the pollution of the lagoon and the Wet season non-point sources of city waste runoff, Chilaw fish market, prawn farm outlets, solid waste dumping site along the shoreline, aquaculture activities such as fish cages (possible overfeeding) and huge number of settlements along the shore line are the major pollution sources in the study area. Lagoon water quality is hampered by uncontrollable discharge of shrimp farm effluents and this excess nutrient input have contributed seasonal eutrophic condition resulting heavy growth of filamentous algae (*Rhizoclonium* spp.).



Fish Market



Shrimp farm outlets



Garbage dump site



Shrimp farms along the lagoon shoreline



Fish cages for Seabass



Community living around the lagoon

Project progress

Progress (%):-

Financial: 228%

Physical: 98 %

PROJECT - 5.1.3

INVESTIGATION OF CAUSES FOR EMERGENCY INCIDENTS SUCH AS OIL SPILLS, ALGAL BLOOMS AND FISH KILLS (EMERGENCY STUDIES).

Environmental emergencies are sudden occurrence of Fish kills, pollution of rivers with toxic chemicals, oil spills, algal blooms. etc. These kinds of incidents are associated with sensational media headlines and mass public protests. Their effects can be devastating and long lasting, and it is the our responsibility to prevent them where possible and deal with them quickly when they occur. NARA receives many requests from public to investigate and provide scientific reports based on the site inspection and field/laboratory experiments

Therefore, the main objective of this project was to identify and investigate the major causes for environmental emergencies and provide recommendations to the relevant authorities to overcome those situations .Within the 2016, total of ten emergencies were informed to NARA to investigate. The summary of each incident is given in the following table.

MONTH	PLACE	INCIDENT	OBSERVATIONS	CONCLUSION/OTHER REMARKS
February	Waste water treatment plant site, Horana Export Processing Zone (HEPZ)	Fish kill	All the dead fishes were identified as the <i>Oreochromis mossambicus</i>	Eutrophication of the water body

March	Nedimala Canal, Aththidiya area	Fish kill	High fishing density	Eutropic condition and high population density
April	Kaduwela Wewa, Rathmalana	Fish kill	Too many fish exceeding the stocking density	Low Dissolved Oxygen (DO)
May	Kandawala Wewa in Kothalawala Defence University, Rathmalana	Fish kill	Few dead fish were observed	Low DO, High fish density, Turbidity
June	Kanthiwewa, Sooriyapura, Kanthale	Sudden death of tortoise	Nearly 9 tortoises had died before the time of investigation	Physical damages to the tortoise by fishing nets and other fishing gear.
June	Malimba, Akuressa	Fish kill	Nearly 100 fishes had died; They were identified as <i>Oreochromis niloticus</i> , <i>Ophiocephalus striatus</i> , <i>Heropnustes fosiils</i> .	High Electrical Conductivity (EC), low DO
June	Theldiyawaththa, Dikowita	Oil spill	Leakage of crude oil receiving pump	There were high impact on mangroves and fishing community. A report indicating environmental causes due to the above oil spill was sent to the relevant authorities.
August	Waste water treatment plant site, Horana Export Processing Zone (HEPZ)	Fish kill	Dead fishes were identified as <i>Thilapia (Oreochromis mossambicus)</i>	Low DO and High density algal blooms and Eutrophication of the water body
September	Moratu Modera Fishery Harbour in Panadura	Sand Extraction	Issues related to fishing community in relation to the sand extraction activities in the Panadura fisheries harbour	Sand mining activities were stopped temporally and a report was sent to the relevant authorities.
November	Mahabo Wewa, Rukmalgama	Fish kill	All the dead fishes were identified as the <i>Oreochromis mossambicus</i>	High population density, low DO, High turbidity



Fish kill at Horana Export Processing Zone



Fish kill at Aththidiya area



Fish kill at Kaduwela Wewa, Rathmalana



Sand extraction at Moratu-Modara fishery harbor

Project progress

Progress (%):- Financial: 111 %

Physical: 100 %

PROJECT No: 5.1.4

DEVELOPMENT OF METHODOLOGIES AND TECHNOLOGIES TO IMPROVE INLAND WATER RESOURCES INCLUDING RIVER BASINS

Presence of pesticide in environment poses adverse effects on health and the environment. Mahaweli Upper Catchment (UMC) is heart of the River basins and many areas are dominated by Tea and annual crop cultivations. Vegetable cultivation in the UMC consumes large volume of pesticide and it has direct impact to aquatic ecosystems, fauna and also ultimately to humans. Many different processes influence pollutant and pesticide fate in the environment and it is very important to understand such processes. Many studies conducted related to such processes (specially Europe and north America, Japan etc.) However, there is poor understanding on such processors in the tropical environment and specially in Sri Lanka. Hence, it is very important to study such processors behaviour in the tropical river basins and Sri Lankan waters. Therefore, this study was focused to determine the adsorption process and its behaviour in the tropical Sri Lankan environment specially in the upper river basin. Also, two pesticides (Chlorpyrifos and Diazinon) were used for the

research. Chlorpyrifos and Diazinon are organophosphate pesticide categorized under insecticide. Toxicological impact was assessed using two aquatic species; *Daphnia magna* and *Moina* species. *Chlorella* sp was cultured by inoculating in to the Bold's Basal medium, to maintain the pure cultures of *Daphnia magna* and *Moinasp* by feeding *Chlorella* sp.

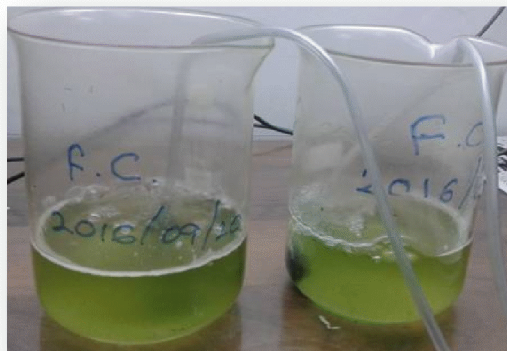
Both soil and sediment samples were collected from 4 randomly selected sampling locations in UMC. Collected samples were oven dried at 140°C and sieved through the 2 mm mesh size. Then Diazinon and Chlorpyrifos known concentration was added into the soil samples and kept in shaker for the adsorption. The non-adsorb Diazinon and Chlorpyrifos were extracted by Solid Phase Extraction and concentrations were determined by gas chromatography (Agilent 6890 GC). For the toxicity test, diluted non-adsorb Diazinon and Chlorpyrifos solutions were used. LC50 value of *Daphnia magna* and *Moina* species was determined by following OECD Guidelines for the Testing of chemicals. According to the findings of the study, Diazinon pesticide was absorbed into the selected soil and sediment samples. Highest total organic carbon content was reported in Soil 3. Negative correlation between soil total organic carbon content and pesticide adsorption by soil was reported in 0.5 ppm and 1 ppm Diazinon concentrations.

Positive correlation was reported in 2 ppm Diazinon concentration. Diazinon adsorption by soil showed significant difference with the soil total organic carbon content and pesticide concentration. Both *Daphnia magna* and *Moina* species mortality percentages were significantly different with the Diazinon concentration and expose time. *Daphnia magna* highest LC₅₀ value was 0.0490 ppm. *Moina* species highest LC₅₀ value was 0.0068 ppm. To determine the relationship between the total organic carbon content and chlorpyrifos adsorption, correlation was done. There was a positive correlation. There was a significant difference between adsorption and total organic carbon content. To determine the chlorpyrifos LC₅₀ values of *Daphnia magna* and *Moinasp*, probit analysis was done. There was a significant difference between mortality and concentration, time. Under the laboratory conditions, more than 85% of Chlorpyrifos was adsorbed to the soil. When the organic matter content is increased, adsorption becomes increased significantly. Highest LC₅₀ value of *Daphnia magna* is 0.0044313 and Highest LC₅₀ value of *Moina* sp is 0.005574.

In addition, Ratgama lagoon monitoring study reveals that, mean air and water temperature in the lagoon are 35.7± 1.7 and 32.5± 1.4 °C respectively. Mean turbidity is 11.5 ±14.6 NTU and the Dissolved Oxygen varies 1.0 mg/l to 8.6 mg/l. The nutrients are in normal range except dissolved phosphate range from 0.01 mg/L to 2.9 mg/L. This may be cause from the sediment silt runoff from agricultural land. Also, high clay and silt were observed in the sediment quality.



Soil and sediment sample



***Chlorella* cultures**



Adsorption experiment



Toxicity experiment

Project progress

Progress (%):- Financial: 73 % Physical: 98 %

PROJECT No: 5.1.5

ASSESSMENT OF BIOACCUMULATION OF HEAVY METALS IN WATER, SEDIMENTS AND MUSCLE TISSUES OF SELECTED EDIBLE FISH AND CRABS SPECIES FROM NEGOMBO ESTUARY, SRI LANKA.

The study was focused on assessment of bioaccumulation of heavy metals viz, Zn, Pb, Hg, Cd, Cu and Cr in water, sediment and muscle tissues of selected edible fish species of Negombo estuary. The Negombo estuary, covering 3,164 hectares, over 3,000 fishermen are engaged in their livelihood is heavily silted, endangering its continuity. Project was initiated with the objectives of to determine the heavy metal concentrations in water, sediments and fish tissues in the ecosystem and to evaluate the seasonal variations in the bioaccumulation patterns of heavy metals in selected edible fish species and to determine the bioaccumulation factor. For this study, water samples were collected from eight sampling locations during one year study period from January to December and heavy metals (Pb, Cd, Hg, Cr, Zn and Cu) levels were analyzed employing standard methods. Results indicated that the dissolved total heavy metals levels in water concentrations in water of estuary were

below the recommended limit for the proposed effluent water quality standards of Central Environmental Authority, in Sri Lanka. Results indicates that toxic metals Hg and Pb were detected in high concentration in muscle tissues and the recorded values were higher than the maximum permissible levels in international standards EU, 2002. Hence, the main reason for the above results was highest values indicated the discharge of sewage and dumping of solid waste from houses and other anthropogenic activities and accelerating sedimentation at the North region. The seasonality in the heavy metal levels of water was observed with a peak period from May/June and October/November, which apparently coincided with the inter monsoonal periods of the island respectively. The results of the present study will be helpful for developing future management plans for sustainable utilization of this brackish water ecosystem.



Sample collection



Negombo Estuary

Project progress

Progress (%) : Financial - 142% Physical -98 %

PROJECT NO: 5.1.6

STUDY OF DIFFERENT BIO INDICATORS FOR ASSESSING WATER QUALITY IN THE SELECTED LAGOON IN SRI LANKA – MADU GANGA, RAMSAR WETLAND IN SRI LANKA

Maduganga lagoon is a one of the lagoons with unique biodiversity including different vegetation types such as mangroves and marshlands in Sri Lanka. The Objective of this project are to investigate the relationship between physico - chemical parameters and macro-benthic invertebrates including their impact on fish production, to determine the species composition of plankton as bio indicators in relation to the existing water quality

Totally thirteen sampling locations were selected for the study covering entire lagoon. Water samples, both surface and bottom were analysed. Benthic macroinvertebrates were analysed from July to August and plankton samples were collected monthly basis as a bio indicators.

Nutrients namely dissolved phosphate, ammonical - nitrogen, nitrate - N and nitrite - N were slightly below the standards limits for fish and aquatic life. Associated fresh water discharges, bring in significant amount of nutrients to Madu Ganga Lagoon. However, oil

and grease content is higher than standards limits for fish and aquatic life ($> 10 \text{ mg/L}$). Several boats are operated in the lagoon for tourism purposes and recreational activities.

Pollution Tolerance Index in lagoon was 20 -30 which indicate moderate water quality. Except common phytoplankton, toxic phytoplankton namely *Ceratium furca* and *Protoderidinium* sp were recorded in Madu ganga lagoon as a bio indicators of water pollution. Benthic macro invertebrates were identified belonging to three phylums, five classes and fifteen families. Class Gastropods represented 83.04 % of total composition. Littorinidae was the dominant family and the benthic abundance was dominated by *Littorina* sp in each sample locations contributing 83.23 % of total species abundance. The average values of Shannon - Weiner Index and Pollution Tolerance Index were recorded 0.44 ± 0.38 and 6.05 ± 4.56 respectively. Shannon - Wiener diversity index (H') was in range of <2 , the lagoon was considered as heavy polluted with indicator species. Pollution Tolerance Index was less than 20. It indicated that the water quality was poor which pave the way to decrease health quality of lagoon. *Lamellidens lamellatus* was recorded as threatened species in IUCN Red list. *Geloina coaxans* was also found in mangrove mud as an indicator species.

One undergraduate student from University of Ruhuna was supervised for his final year project using this project.



Project progress

Progress (%):- Financial: 108 %

Physical: 100 %

PROJECT No: 5.1.7

GENOTOXICITY SCREENING OF DRINKING WATER WELLS LOCATED IN THE NORTH CENTRAL PROVINCE (NCP) OF SRI LANKA USING PLANT AND FISH BASED BIOASSAYS

Chronic Kidney Disease of unknown aetiology (CKDu), is becoming a major health problem, especially in the North Central Province, Sri Lanka showing the highest prevalence in Medawachchiya area. Aetiology of this disease seems to be multifactorial which includes chronic exposure to environmental toxicants. Previous research studies have hypothesized the link of CKDu occurrence with the drinking water quality but toxic effects of these waters are not characterized yet. Therefore, the main objective of this research was to evaluate biological significance of the contaminants in drinking water sources through toxicity (especially cytotoxicity and genotoxicity) screening of drinking water wells using plant and fish based bioassays. This is a continuous research project consisting with two main phases and during this year, the project was mainly focused on evaluating potential toxicity of drinking water wells located in the Medawachchiya area using combination of physico-chemical analysis and bioassays.

Relevant data were gathered during nine (09) field visits for total 20 Grama Niladhari (GN) divisions covering 44 villages and 430 wells, which included 351 Dug Wells, 44 Tube Wells and 35 Agro Wells. Data analysis was completed using SPSS® 21 statistical package to assess potential risks associated with the use of dug wells and tube wells as drinking water sources in developing/aggravating the disease in the study area.



Figure 1& 2: Questionnaire Survey in Medawachchiya

Altogether 16 sampling locations including eight dug wells and eight tube wells were selected for the study using judgmental sampling technique and also two (02) negative controls were used. *Allium cepa* was used as a plant model and common carp was used as a fish model for bioassays. Root cells of the *Allium cepa* and blood of the fish (from head kidney and caudal vein) were utilized for the cytogenetic preparation and analysis of these to identify cytotoxic and genotoxic effects is ongoing. Kidney tissues of the fish exposed for bioassays were obtained and preserved for histopathological studies to assess potential organ damage.

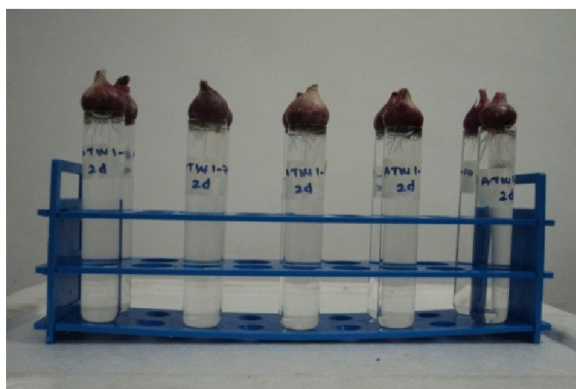


Figure 3& 4: Conducting Bioassays in the laboratory using Fish and Plant Models

Field sampling for toxicological analysis of water were carried out in (02) field visits during prolong dry season (August & September) 2016 and collected samples were analyzed for physico-chemical parameters viz. water temperature, pH, conductivity, turbidity, alkalinity, calcium hardness, total hardness, nitrate - N, nitrite -N, ammonical-N, ortho-phosphate, chloride, fluoride, selected metals/metalloids and the herbicide glyphosate using standard analytical methods. Overall results of the study revealed that, most of the water quality parameters in all the sampled dug wells were within the standard limit of portable drinking water except total hardness and alkalinity levels.

Results revealed that total hardness of the water of dug wells used by CKDu affected families were above the standard limits (250 mg/L, SLSI:2013). Alkalinity levels of water of all the dug wells used by the CKDu affected families and one reference dug well also exceed the stipulated limits for drinking water (200 mg/L, SLSI:2013). Arsenic was detected (2.0 µg/L) in water of one dug well used by CKDu affected families and orthophosphate concentration (0.321 mg/L) in this water sample was also higher than that of all the other water samples. Mercury (Hg), Lead (Pb) & Cadmium (Cd) levels in all the wells were less than detectable limits (Hg < 1.0 µg/L ; Pb < 10.0 µg/L ; Cd < 1.0 µg/L). Glyphosate was not detected in all drinking water samples (< 5 µg/L, detection limit). The bioassay indicated potential toxicity associated with water in the dug wells used by CKDu affected families based on *A. cepa* root growth retardations effect compared to negative controls and reference dug wells ($P < 0.05$).

During next year (year 2017) studies will be continued using bioassays with plant and animal models covering different climatic seasons in order to evaluate potential toxic/cytotoxic/genotoxic effects associated with the drinking waters of the dug wells and tube wells used by CKDu affected families.

Project progress

Progress (%):- Financial: 102 %

Physical: 98 %

PROJECT No: 10.1.1

QUALITY IMPROVEMENTS TO ESD LABORATORY AND TEST & ADVISORY SERVICES

Water quality is an important tool in monitoring and assessment of pollution of aquatic environment. This helps in management and conservation of ecological aspects including biological and fisheries aspects. It is very important to have a fully equipped ESD laboratory since NARA is the mandatory institution for Research and Development development of aquatic research.

Within the year of 2016, instrumentation for certain parameters such as Dissolved Oxygen, pH, Ultrasonic cleaning equipment and solar lamp, laboratory cabinet were received. Number of instruments calibrated and serviced against the plan Number of new test parameters tested Amount of earnings from test services as against previous year. Laboratory cabinets, sinks and marble tops installation were completed.



Lamina-flow cabinet for microbiology experiments



Lab equipment installation

Project progress

Progress (%):- Financial: 144%

Physical: 98 %

Test services

During the period of 2016, 50 clients have been provided with test reports by Environmental Studies Division and the total earning is 542,970.00.

During this period, officers participated in several scoping meetings related to EIA and IEE projects conducted by the Central environmental Authority, Coast Conservation and Coastal Resources Management Department, Ministry of Environment.etc to advice on management and conservation of aquatic resources.

Meetings attended by Mr. S.A.M.Azmy and other officers of the division

1. Progress meeting on oil spill at Uswetakeiyawa on 8th January 2016 at MEPA
2. Meeting on Establishment of aquaculture development center at Welikanda, Polonnaruwa district on 14th January 2016 at CEA.
3. Meeting on 158th coast conservation and coastal resources management advisory council on 22nd January 2016 at Ministry of Mahaweli Development and Environment.

4. Technical Evaluation Committee Meeting for an Environmental Impact Assessment on Proposed 136 units of Residential Development Galle Road, Randombe North Ambalangoda on 18th February 2016 at CCD, Maligawatta.
5. 8th Exporters' Forum by Sri Lanka Export Development Board on 29th February 2016 at Export Development Board, Colombo 2.
6. Meeting on Proposed Project on Integrated Waste Management on 4th March 2016 at Ministry of Mahaweli Development, Colombo 10
7. Meeting on National Coastal water Quality Monitoring Project on 20th April 2016 at MEPA, Baseline Rd, Colombo 09
8. XIII th Monsoon Forum by Department of Meteorology on 3rd of May 2016 at the Department of Meteorology, Colombo 7.
9. Meeting on fisheries sector related conditions of the permit granted to the Colombo port city development on 18th May 2016 at Ministry of Fisheries and Aquatic Resources Development.
10. Meeting on Proposed offshore sand extraction for construction industry at Kerawalapitiya, Muthurajawela on 26th May 2016 at CEA, Battaramulla
11. Joint Site Inspection on Request for the Renewal of Permit for Mining Mineral Sands Kirinda to Magama Beach Stretch on 2nd June 2016 at Kirinda
12. Meeting on Establishment of an Industrial Aquaculture Park in Batticaloa District on 7th June 2016 at Central Environmental Authority, Battaramulla.
13. Scorpings Committee Meeting on 13th June 2016 at Sri Lanka Institute of Tourism and Hotel Management, Colombo 03.
14. National Coordination Committee Meeting on Basel Rotterdam Stockholm Convention on 13th June 2016 at Sapthaparisara Mandapaya, Ministry of Mahaweli Development and Environment.
15. Meeting with IUCN on lagoon fisheries development on 15th June 2016 at Ministry of fisheries and Aquatic Resources Development.
16. Meeting on International coastal cleanup day on 16th June 2016 at CCD.
17. Meeting on oil spill events Orugodawatta oil tankers on 04th July 2016 at Ministry of Mahaweli Development and Environment.
18. Meeting on National Survey on Usage of non - Ozone depleting substances on 12th July 2016 at State Timber Corporation.
19. Meeting on proposed project on Construction of a Jet A1 Fuel Transfer pipeline from Muthurajawela to Bandaranayaka International Airport and associated development on 21st July 2016 and 14th June 2016 at Central Environmental Authority, Battaramulla.
20. Technical Evaluation Committee Meeting for an Environmental Impact Assessment on Proposed 212 Roomed Five Star Hotel Project – Thalramba, Kamburugamuwa, Matara on 2nd August 2016 at CCD, Maligawatta.

21. Technical Evaluation Committee Meeting for an Environmental Impact Assessment on Proposed 240 roomed Hotel Project at Modara, Kosgoda on 2nd August 2016 at CCD, Maligawatta.
22. Meetings on Environmental pollution control of Kaluwamodara stream-Aluthgama on 04th August 2016 at District Secretariat, Kaluthara
23. Meeting on finalization of Trincomalee, Galle and Hambanthota - Port Biological Baseline Survey (PBBS) final report on 10th of August 2016 by Marine Environmental Protection Authority (MEPA).
24. Initial Meeting on proposed extension to Marine Drive Section from Kolpetty railway station to Galle face and section Dehiwala to Panadura road Development Authority on 27th September 2016 at CCD, Maligawatta
25. Technical Evaluation Committee Meeting for the Initial Environmental Examination Procedure on Proposed 240 room city hotel project on 27th September 2016 at CCD, Maligawatta.
26. XIV monsoon forum organized of Department of Meteorology on 3rd October 2016 at Department of Meteorology, Colombo 07.
27. Seminar on “Water quality and Human Health” on 4th of October 2016 conducted by Institute of Chemistry, Ceylon.
28. Meeting on First Curriculum Revision, Aquatic Resources Technology Degree Program of Uwa Wellassa University on 17th October 2016 at Aubrona Hotel, Kiribathgoda.
29. Meeting on National Oil Spill Combat Drill on 11th October 2016 at MEPA
30. Meeting for update National Oil Spill Contingency Plan on 14th October 2016 at MEPA
31. Switch- Asia regional roundtable and networking conference on “The role of SCP in climate change mitigation and adaptation” on 18th of October 2016 conducted by switch Asia (sustainable consumption and production).
32. Technical Evaluation Committee Meeting for an Initial Environmental Examination Procedure on New Cement Plant and 8 MW Biomass Power Plant in Cod Bay, China Bay, Trincomalee on 23rd October 2016 at CCD, Maligawatta.
33. Meeting on proposed 100 roomed Eight Storied Hotel with Swimming Pool, Kammala South, Waikkala on 23rd October 2016 at CCD, Maligawatta.
34. Meeting on the first Environmental committee Meeting of Environment Programme on proposed Colombo port city development project on 24.10.2016 at the Department of coast conservation & coastal Resource management ,4th floor, New Secretariat, Maligawatta, Colombo 10.
35. Technical Evaluation Committee Meeting for an EIA on proposed 250 room 11 storied Araliya Unawatuna beach hotel project on 10th November 2016 at CCD, Maligawatta.

36. Meeting on introduction to KOICA fellowship programme on 15th November 2016 at Randora, Ground floor, Ministry of finance.
37. Technical Evaluation Committee Meeting for the Proposed Jaffna City Sewage System by CEA on 25th November and 2016 16th December 2016 at Central Environmental Authority, Battaramulla
38. Meeting on National oil Spill Combat Drill on 28th November 2016 at MEPA, Base Line Road, Colombo 09.
39. Meeting on National Expert Committee on Climate Change Adaptation and Mitigation on 29th November 2016 at Ministry of Mahaweli Development and Environment , Sampathpaya, Battaramulla.
40. Meeting on proposed development activities and infrastructure facilities within the reclaimed land area of Colombo Port City Development Project (Phase ii) on 29th of November 2016 at CCD, Colombo 10.
41. Technical Evaluation Committee Meeting for the Initial Environmental Examination Procedure on proposed middle income housing and infrastructure development project on 29th November 2016 at CCD, Colombo 10.
42. National Oil spill drill 2016 by Marine Environmental Protection Authority (MEPA) and Disaster management on 10th of December 2016 at centre of Disaster management.
43. Coastal Engineering Symposium and field visit organized by CCD on 20th December 2016 at Club Palm Bay, Marawila.
44. Meeting on Sri Jayawardhanapura Kotte waste water disposal project on 21st December 2016 at Central Environmental Authority, Battaramulla
45. National Biodiversity Clearing house mechanism website launching programme on 23rd December 2016 at Galadari Hotel, Colombo in collaboration with SACEP

Management plans- national level

1. National water quality monitoring programme-2015/2016

Dr. A.A.D. Amarathunga and Ms.N.D. Hettige

Public awareness programmes

Special walk and beach cleaning programme organized to celebrate the World Ocean Day under the theme 'Healthy Ocean, Healthy Planet' Organized by Marine Environment Protection Authority.

Dr. A.A.D. Amarathunga, Mrs. M.D.S.R. Maddumage, Mrs. K.Chandra de Silva

Lectures

1. Workshop "Preserving a valuable Natural Heritage: Mitigating threats and promoting sustainable management of coastal and marine areas" Colombo (Sri Lanka), June 2016.

Presentation on “Challenges to Preserve the Coastal Environmental Quality in relation to the Aquatic Environment”-*S.A.M.Azmy*

2. Lecture on “Detailed description on impacts of oil spill accidents to sensitive ecosystems and fisheries in coastal zone” for government officers which organized by District Office, Marine Environmental Protection Authority, Hambanthota (14th July 2016). *Ms. N.D. Hettige*
3. Lecture on ‘Ecosystems and water pollution’ for 60 school teachers and instructors at Chilaw educational zone which organized by NARA on 2016/09/02 *Dr. W.D.N.Wikramaarachchi*
4. Lecture on “Aquatic Resources Conservation and Management” for school students in Hambanthota Education Zone which organized by National Aquatic Resource Research and Development Agency (NARA), Sri Lanka to Diwara Nana Saviya programme (14th September 2016). *Ms. N.D. Hettige*
5. Lecture on “Aquatic Resources Conservation and Management” for school students in Walasmulla Education Zone which organized by National Aquatic Resource Research and Development Agency (NARA) to Diwara Nana Saviya programme (15th September 2016). *Ms. N.D. Hettige*

TV Programmes

1. ITN programme ‘Coffee Table’ – 30 min interview on ‘Coastal Pollution’ on 2016/10/09 *Dr. W.D.N.Wikramaarachchi*

Number of postgraduate research projects has been supervised as an external supervisor – industrial training

1. Plankton diversity and abundance in relation to water quality in Maduru Oya, Sri Lanka, M.Sc. student in Post Graduate Institute of Science, University of Peradeniya *Supervised by Dr. W.D.N.Wikramaarachchi*
2. Heavy metal pollution and water quality status of Hamilton Canal, M.Sc. student in Faculty of Graduate studies, University of Kelaniya *Supervised by Dr. W.D.N.Wikramaarachchi*

Number of undergraduate research projects has been supervised as an external supervisor

1. Study on toxicological impact of chlorpyrifos pesticide to the aquatic invertebrates, Final year student B.Sc. (Special) in Aquatic Resources Technology, Uwa Wellassa University of Sri Lanka *Supervised by AAD Amarathunga*
2. Study on diazinon pesticide impact to aquatic invertebrates, Final year student B.Sc. (Special) in Aquatic Resources Technology, Uwa Wellassa University of Sri Lanka *Supervised by AAD Amarathunga*

Training of research students as an external supervisor – industrial training

1. Industrial training was given to 10 students from University of Ruhuna, 02 students from Uwa Wellassa University, 03 students from University of Kalaniya, and 03 students from university of Colombo by the Environmental Studies Division.

External reports

1. Report on fish kill incident at Lake, located in the Horana Industrial Zone *A.A.D.Amaratunga and N.D.Hettige*
2. Study report on Tangalle, Kudawella and Beruwala Harbours *N.D.Hettige and M.D.S.R.Maddumage*
3. Travel Report on “Coastal Zone Biodiversity Protection for Asia Pacific” conducted by Fujian Institute of Oceanography, China *N.D.Hettige*
4. Initial Environmental Examination (IEE) report on dimensional seismic survey for oil exploration in deep sea blocks in North East Cauvery basin of Sri Lanka. *In coordination with: ESD, NBRD, NHO, IARAD*
5. Preliminary Investigation Report on Sand Extraction of Moratu Modera Fishery Harbour in Panadura
6. Report on investigation of the fish kill incident at Lake, located in the Export Processing zone Horana.

Training obtained

Local

1. Training on “Statistics for Biological Research” organized by Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR) (11th to 12th February 2016) *Ms. N.D.Hettige and Ms. M.D.S.R.Maddumage*
2. Training workshop on “Stream Ecology and Environmental Flow” at Kothmale International Training Institute (KITI) organized by Water Resource Science and Technology on (9-10 March 2016) *MS. N.D.Hettige and MS.J. K. P. C. Jayewardena*

Foreign

1. Seminar on “Coastal Zone Biodiversity Protection for Asia Pacific” conducted by Fujian Institute of Oceanography, China from 26th October to 15th November 2016 *Dr. A.A.D. Amarathunga, Ms. N.D. Hettige*

Workshops participated

1. Workshop on Preparation and Finalization of Action Plan for Adaptation sector INDCs of Sri Lanka on 12th February 2016 at Center for Banking Studies, Rajagiriya- *Dr. AAD Amarathunga*

2. Workshop on radio activity around Sri Lankan coastal line and launching baseline data about radioactivity around Sri Lankan coast on 07th April 2016 at Sri Lanka Foundation Institute.
3. Workshop on National Biodiversity Strategy and Action Plan on 7th June 2016 at Sri Lanka Institute of Development Administration, Colombo 07 - *Dr. AAD Amarathunga*
4. Workshop on Stakeholder consultation on 21st and 22nd June 2016 at Tangerine Beach Hotel, Waskaduwa, Kaluthara - *Dr. AAD Amarathunga*
5. Workshop on Data Entering for the CHM website on 28th June 2016 at Construction, Equipment and Training Center, Pellawatta, Battaramulla.- *Dr. AAD Amarathunga*
6. Workshop on Interdisciplinary in Scientific Research Commercialization and Technology Transfer on 29th June 2016 at Auditorium, Sri Lanka Association for Advancement of Science - *Ms MDSR Maddumage, Mr. TDW Kasthuriarachchi*
7. Workshop to finalize the report on 'Economic Assessment of Ballast Water Management' on 11th July 2016 at Center for Banking studies, Rajagiriya.- *Ms. MDSR Maddumage*
8. Stakeholders' workshop to update Research Priorities on Fisheries & Aquatic Resources Sector (22/07/2016) by Sri Lanka Council for Agricultural Research Policy (SLCARP) and NARA at Nara auditorium.- *S.R.Chandima*
9. Workshop on study on environmental flow determination for water sector development projects with main focus on mini hydropower projects on 01st August 2016 at CEA.
10. National Workshop on Promoting synergies among the biodiversity conventions and linking SDGs on 8th and 9th August 2016 at the Galadari Hotel.- *Dr. AAD Amarathunga*
11. Workshop on Update National Oil Spill Contingency Plan (NOSCOP) on 9th August 2016 at Center for Banking studies, Rajagiriya. - *Dr. AAD Amarathunga*
12. Workshop on Climate change Technology Development and Transfer on 11th & 12th August 2016 at Sri Lanka Development Administration (SLIDA) and Saptha Parisara Mandapaya, Ministry of Mahaweli Development and Environment, Battaramulla - *Dr. AAD Amarathunga*
13. National workshop for capacity building in first respondents of oil spill on "Implementation of National Oil Spill Contingency Plan (NOSCOP)" (31/08/2016 – 02/09/2016) conducted by Marine Environmental Protection Authority (MEPA). - *S.R.Chandima*
14. National SDG6 workshop on "Application of a framework for Integrated system thinking approach for implementation of water related SDGs and targets in Sri Lanka (14/09/2016 – 15/09/2016) conducted by the Economic and Social Commission for Asia and the Pacific (ESCAP). - *S.R.Chandima*
15. Workshop on Recommendation to avoid waste disposal to Kelani River Ecosystem on 9th September 2016 at Sri Lanka Foundation Institute.

16. Workshop on action plan on cleaner production on 30th September 2016 at CEA, Battaramulla.
17. Seminar on “Water Quality and Human Health” organized by Institute of Chemistry Ceylon on 4th October 2016 *N.D.Hettige, M.D.S.R.Maddumage, J. K. P. C. Jayewardena and S.C.N.K. Nagangoda*
18. Workshop on The Role of SCP in Climate Change mitigation and Adaptation on 18th October 2016 at the BMICH - *Dr. AAD Amarathunga, SRCNK Narangoda*
19. Workshop to implement national strategy for marine pollution prevention from fisheries sector on 28th October 2016 at Center for Banking Studies , Central Bank of Sri Lanka, Rajagiriya.
20. Workshop on Sri Lanka's third National Communication on Climate Change on 24th November 2016 at Waters Edge, Battaramulla.
21. The Biodiversity Finance Initiative (BIOFIN) launch and inception workshop on 3rd -4th November 2016 by United Nations Development Programme (UNDP) at Taj Samudra hotel, Colombo 3. - *S.R.Chandima*
22. Workshop on National Oil Spill combat drill 2016 conducted by Marine Environmental Protection Authority (MEPA) on 02nd December 2016 *N.D.Hettige and S.C.N.K. Nagangoda*

Research publications

Abstracts

1. Azmy, S.A.M. Weerasekara, K.A.W.S. Hettige, N.D. Mendis, B.R.C and Weragodatenna, D.D.D. (2016). Comparison of water quality status around the exploratory drilling locations in Gulf of Mannar: Before and after drilling. In: International Research Symposium- 2016, Ministry of Mahaweli Development, Colombo, Sri Lanka
2. Amarasinghe, A.A.D.T., Azmy, S.A.M., Weerasekara, K.A.W.S., Maddumage, M.D.S.R., Jayawardhane, J.K.P.C, Narangoda, S.R.C.N.K., Hettige, N.D., Amarathunga, A.A.D., Wickramarachchi, W.D.N., Rajapaksha, R.M.G.N., and Jayamanna, S.C. (2016). Current water pollution status of coastal waters in North Western Province, Proceedings of the twenty second Scientific Sessions of the Sri Lanka Association for Fisheries and Aquaculture Resources, Colombo, Sri Lanka, pp.17-18
3. Maddumage, M.D.S.R., Azmy, S.A.M. and Prenarathne W.A.P.J. (2016). Spatial and Temporal variation of selected physicochemical parameters in Chilaw lagoon in Sri Lanka, International postgraduate research conference – 2016 Faculty of Graduate Studies, University of Kelaniya.
4. Mendis, B.R.C. Najim, M.M.M and Kithsiri, H.M.P (2016). Effect of Heavy Metal Contamination of Water in Negombo Estuary in Sri Lanka. In: Annual Research Symposium - 2016, Faculty of Graduate Studies, University of Colombo, Sri Lanka.
5. Mendis, B.R.C. Najim, M.M.M and Kithsiri, H.M.P (2016). Heavy Metal Concentrations in Fish Muscle Tissues of Grey Mullet (*Mugil cephalus*) Obtained From Negombo Estuary in

Sri Lanka. In: Annual Research Symposium - 2016, Faculty of Graduate Studies, University of Colombo, Sri Lanka.

6. Weerasekara, K.A.W.S, Pathiratne, A. and Kithsiri, H.M.P (2016). Combination of Physico-chemical Analysis and a Plant Bioassay for Screening Potential Toxicity of Drinking Waters in Selected Dug Wells in Medawachchiya Area, Sri Lanka: A Preliminary Study. Proceedings of International Postgraduate Research conference (IPRC). Faculty of Graduate Studies, University of Kelaniya, Sri Lanka. *pp* 155.
7. Weerasooriyagedara, M. S. , Hettige, N.D., Amarathunga, A.A.D., Rajapaksha, R.M.G.N., and Jayamanna, S.C., Weerasekara, K.A.W.S., Maddumage, M.D.S.R., Azmy, S.A.M., Wickramarachchi, W.D.N., Jayawardhane, and J.K.P.C., Narangoda, S.R.C.N.K. 2016. Study of the Diversity of Benthic Macro invertebrates at Panadura estuary in Sri Lanka, 6th Research symposium, Uva wellassa University of Sri Lanka, pp.135

5.2 FISHING TECHNOLOGY DIVISION

Head of the Division: N.B.P.Punyadewa

- Deployment, monitoring and promoting the use of low cost Fish Aggregating Devices (FADs) and fish enhancing devices (FEDs) for to enhance fish production and socio economy of the small scale fishermen (Project No 1.1.1)
- Introduction and development of an environmental friendly fishing gear and method as alternative fishing gear for the “Lyla” fishing gear (Project No 1.1.3)
- Development of environmental friendly bottom set fishing trap to harvest big fin reef squids (Project No 1.1.4)
- Preparation of catalogue for lagoon and estuarine fishing gear and crafts in Northern and Eastern Province (Project No 9.1.4)

Activities

Deployment of low cost fishing Aggregating Devices is a popular fishing technique in many countries of the Asian region. Even in Sri Lanka these low cost FADs are used quite successfully in the western and southern areas and sees this as having good potential whereby the small scale fishers in the other parts of the country can earn good incomes. Therefore, under the project number 1.1.1, three floating fads and six submerged fish enhancing devices (FEDs) have built by Fishing Technology Division. At the end of September one FAD & three FEDs were successfully deployed at Kalmunei and Sinnapaduwa area with the help of fishing community. Monitoring & Data collection process was temporary stop for the end of monsoon. Monitoring and data collecting process will be carried out in year 2017.

“Both Lyla and Surukku ” nets are an encircling fishing net that hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. A line passes through all the rings, and when pulled, draws the rings close to one another, preventing the fish from "sounding", or swimming down to escape the net. Major difference between Lyla and Surukku net is Lyla net sink up-to the bottom and Surukku net sink about half of the water column. Requirement of divers are essential for operate Lyla net. Therefor to operate Lyla net divers are essential. A study was conducted about Lyla and surukku net in 2015 by FTD project number 1.1.3. The “Lyla and Surukku” nets are preferred technique for capturing fish species which school or aggregate, close to the surface, such as sardines, mackerel, anchovies, herring, certain species of tuna (schooling) including skipjack, yellow fin and big eye tuna.

In Sri Lanka, “Lyla and Surukku” fishing methods are most common in Puttalam and Kalpitiya area and most of the time it collects large quantity of fish or sometime mature and **immature (juvenile) fish** while destroying the environment (coral and bedrock reefs) and it can put too much pressure on fish stocks. Therefor it should need to develop an environment and resource friendly fishing gear instead of Lyla net and have to introduce it as an alternative gear for the fisherman. To minimize the resource harm alteration for the surukku net was given to the fisherman and fishing practices are conducted.

In Sri Lanka, various kind of fishing gear and crafts are using to harvest lagoon fish recourses. But there is no any documented catalogue with details/specification about those fishing gear and craft for future uses. Therefore to build a catalogue, information and technical specifications were collected with the help of fishing community, diagrams were sketched for different fishing gears and crafts by scientist of Fishing Technology division (FTD) under project number 9.1.4.

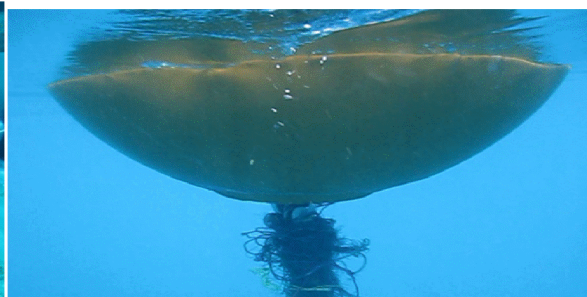
The survey was conducted during 2015-2016. Lagoon fishing gear and specification of fishing gears were collected during field survey. Kalpitiya, Puttalam, Jafna, Vellamulliwaikkal, Chalei, Kokilai, Baticoloa, Periyakalaru, Walachchenei, Kalawanchikudi, Nandikadal, Nayaru, Mulathive North and town area, Chemmalei, areas were visited for data collection. Height, Length, Number of eyes and eye size, operating hour's etc. data were collected during survey. A sketch of each fishing gears were drawn on site. Specification of Sangili net, Kadippu net, madu net (Ray nets), Morali net, Mora net (Shark net) were collected from Puttalam lagoon. Specification of Disco net, Nuul walei (Nuul net), Fish trap, Koduwa net, Ralwalei net (prawn net), fish trap made from palm leaves, Crab pot, Hook and line, cast net etc. collected from Baticolloa area. Because of 30 year of war lagoon fishery has not well developed in Jaffna lagoon area. Few kind of fishing gear operated in Jaffna lagoon area basically for shrimp and fish. Specification Ja- kotu, (Shrimp net), Fish nets, Trawling shrimp net, Kalankandi gear, Kandy (Shrimp net) net, Pari kudu, (Fish Trap), Pokkam walei, was collected in Jaffna lagoon area. Some of these gear are traditional gear.

Mulathivu district was visited for data collection. Specification of Cast net, Tramel net used in Lagoon, Fish trap (like fike net), Crab pots and Crab net, saraya net, Katta net, Puttu net, trawl net using canoes were collected in Mullathivu district.

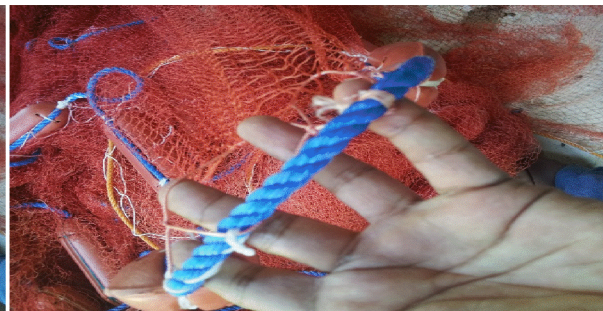
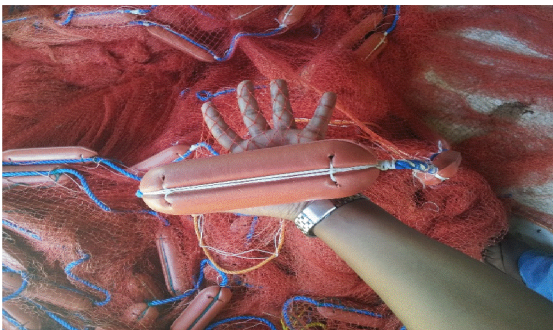
Under the project no 1.1.4, environmental friendly bottom set fishing trap to harvest big fin reef squids were developed and deployed in Sinnapaduwa area in Puttalam district. *Sepioteuthis lessoniana* (Big fin reef squid) is an underutilized resources and it has high demand in export market. Normally fisherman used parts of mangrove of associated plants as a substrate to egg laying of squid at the open sea. In this project artificial substrate provides to egg laying and it will reduce the mangrove cutting. Developed substrate deployed in depth 36 feet with the help of fisherman divers.

FAD DEPLOYMENT

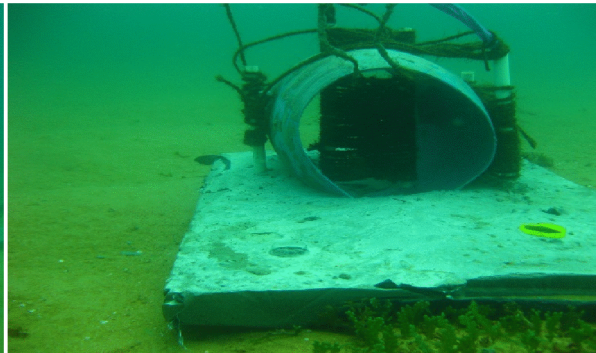
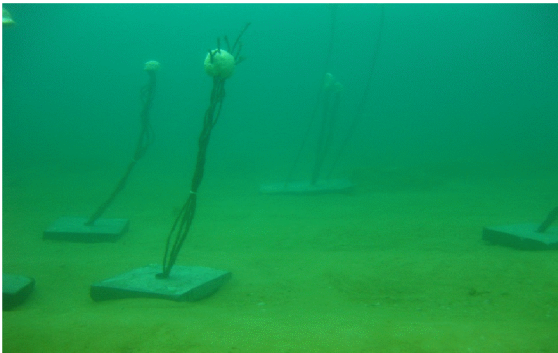
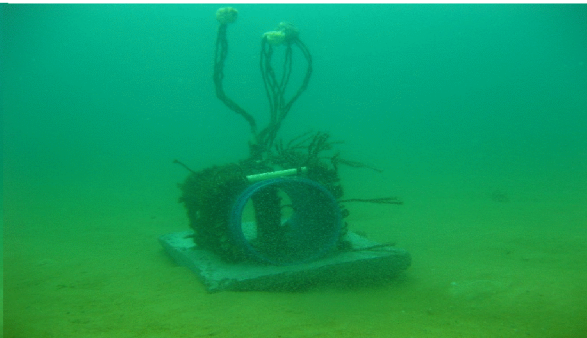
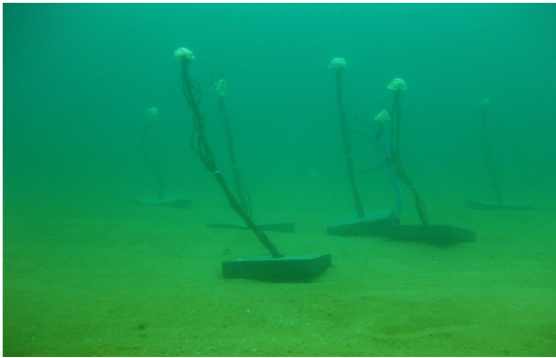
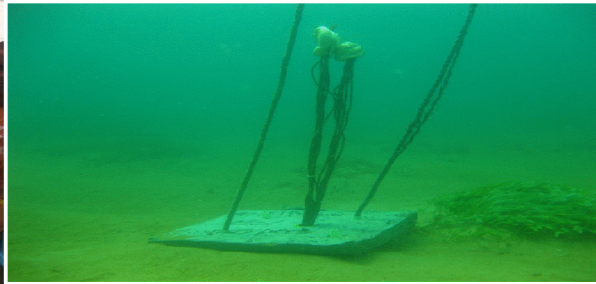




SURUKKU NET ALTERATION



SQUID TRAPS



FISHING GEAR CATALOGUE



Programme	Project	Allocation Rs (Million)	Officers responsible	Period from	Physical Progress	Financial Progress
Development of New Fishing Techniques	Preparation of a catalogue for lagoon and estuarine fishing gear and crafts		NBP Punyadeva	2016 Jan-Dec	T-100% P- 95%	T- 100 % P- 123 %
			NBP Punyadeva	2016 Jan-Dec	T-100% P- 60%	T- 100 % P- 50 %
			NBP Punyadeva	2016 Jan-Dec	T-100% P- 60%	T- 100 % P- 50

TRAINING / AWARENESS PROGRAMMES CONDUCTED

Meetings were arranged with, Fisheries Inspectors and fishermen of in the fishing area.

CONSTRAIN

Most field visits were cancelled due to lack of vehicles and due to bad sea conditions.

5.3 NATIONAL HYDROGRAPHIC OFFICE

Head of the Division : A.N.D Perera

Overview of the Year

The prime objective of National Hydrographic Office is to provide Hydrographic services to safe and efficient navigation in Sri Lankan waters. This is a mandatory requirement of full filling the obligation of the International Convention for the Safety of Life at Sea (SOLAS). Accordingly charting areas selected to ensure that hydrographic surveying is carried out, as far as possible, adequate to the requirements of safe navigation where stakeholders are requested to prioritize. The other principal services are the provision of up dated and accurate topographic and bathymetric data for coastal zone management, environmental protection and maritime delimitation. The up to date hydrographic information coverage offers significant economic and commercial benefits through facilitating maritime trade and other marine activities.

For the year 2016, the following surveys and activities were conducted.

6.2.2. National Nautical Charting Program

- 1.1 Nautical Chart of Approaches to Kankasanturai
- 1.2 Nautical Chart of Approaches to Oluvil
- 1.3 Bathymetric data acquisition to fill the gap from Colombo to Weligama Coastal chart.

2. Surveys conducted for special requests

- 10.1.2 Oceanographic Surveys, deployment of drifters and moorings to ocean observations by using RV Samuddrika.

- 6.2.1. Derivation of Shallow water bathymetry and Sea floor classification using multispectral satellite imageries.

Activities Undertaken

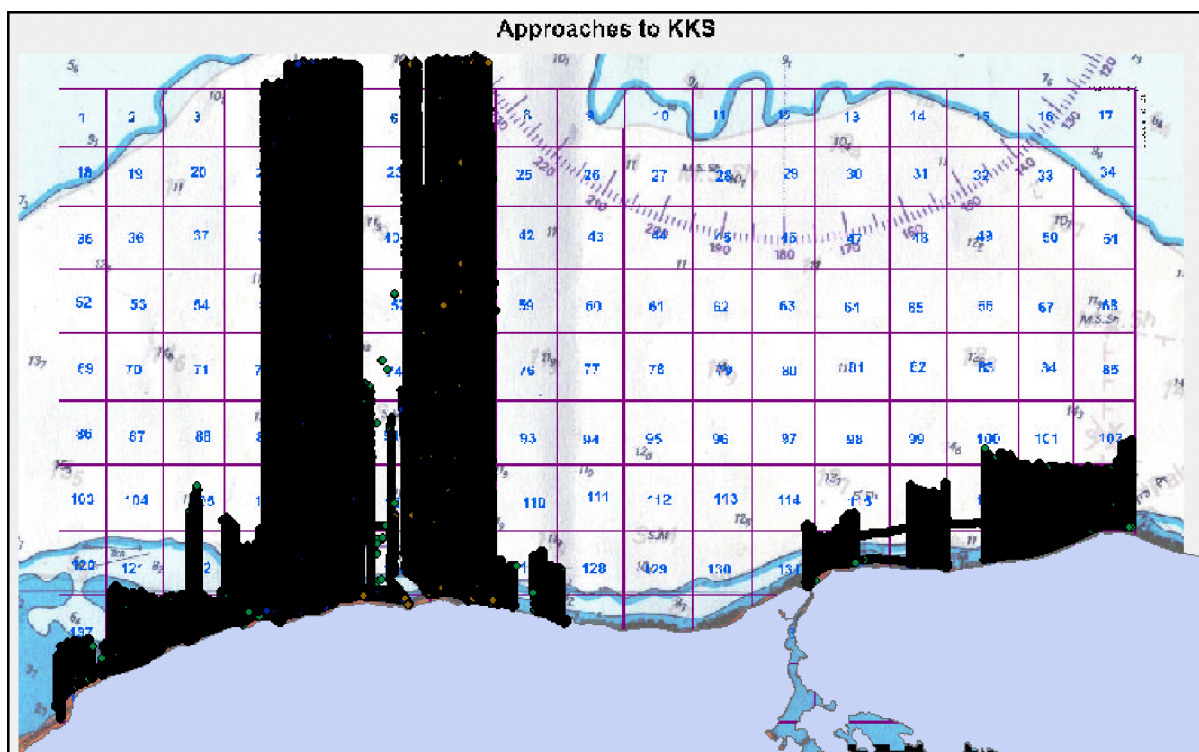
Program/Projects	No.	Activities	Officer Responsible	Period
6.2.2.National Nautical Charting	6.2.2.1	Data Acquisition of Kankasanturai approaches chart	S.R.C. Ranaweera R.K.A. Ariyaratne	Jan- Dec
	6.2.2.2	Data Acquisition of Approaches to Oluvil Chart	K.A. Ranasinghe D.L.P. Hewage L.S.C. Siriwardane	
	6.2.2.3	Data Acquisition for gap filling between Colombo to Weligama coastal chart equivalent to BA chart 3700	R.M.D.I. Rathnayake S.W.S. Weerasinghe Y.M.R.N. Kumari W.A.A.P. Wijesundara	
	6.2.2.4	Data processing and Cartography	S.R.T.B. Singhabahu B.H.B. Jayamalie KelumPrabath	

2. Consultancy Surveys Conducted for special requests	2.1	Bathymetric Survey at Mannar Island for identifying navigation route for barges – Phase I	S.R.C.Ranaweera Y.M.R.N. Kumari R.K.A Ariyaratne K.A. Ranasinghe D.L.P. Hewage L.S.C. Siriwardane R.M.D.I. Rathnayake S.W.S. Weerasinghe W.A.A.P. Wijesundara S.R.T.P. Singahabahu B.H.B. Jayamalie Kelum Prabath	Jan- Dec
	2.2	Bathymetric Survey at Mannar Island for identifying navigation route for barges – Phase II		
	2.3	Sabaragamuwa University Training Programme		
	2.4	Zheng – He project for Second Season Survey		
	2.5	Bathymetric Surveys at Kayts for trace the navigation route		
	2.6	Port City Development Project - Negombo		
	2.7	Impact confirmation Monitoring Survey – Monitoring of Coastal effects near Beira Outlet		
	2.8	Bathymetric and Profile Survey at Koggala		
10.1.2.Surveys Conducted with RV Samuddrika	10.1.2.1	Offshore and Near Shore Bathymetry for Production of Navigational charts	Research Officers and Hydrographic Surveys Co-ordinate by A.N.D Perera Head/ NHO	Jan-Dec
6.2.1 Derivation of Shallow water bathymetry and Sea floor classification using multispectral satellite imageries.	6.2.1.1	Background study and literaturereview	W.A.A.P. Wijesundara R.M.D.I. Rathnayake	Jan- Dec
	6.2.1.2	Select the study area and check the availability of high resolution images and verifying the feasibility of deriving bathymetry		
	6.2.1.3	Purchase satellite images		
	6.2.1.4	Establish ground control points for geo-referencing images		
	6.2.1.5	Image Processing		
	6.2.1.6	Processing sounding data		
	6.2.1.7	Models calibration and derivation of bathymetry for entire scene.		
	6.2.1.8	Performance Assessment		
	6.2.1.9	Report Writing		

PROJECT NO: 6.2.2.1

DATA ACQUISITION FOR APPROACHES TO KANKESANTURAI NAUTICAL CHART

The Kankesanturai harbor is to be developed as the third international harbor after Colombo and Ruhunu Magampura. Therefore, the nautical chart of this area is a prime requirement to fulfill the obligations to ensure safe access to this harbor. Kankesanturai is the main port situated in Jaffna District Northern Province of Sri Lanka and it is the nearest port for all eastern ports in India as well as for Myanmar and Bangladesh. Rapid development was started in war affected areas by government to uplift the living conditions of the civilians. Under this project provides hydrographic data to facilitate development of coastal passenger transport and fishing activities. Hence considering the necessity of having sea chart for Kankesanturai Harbor, NHO commenced to collect the bathymetric data for KKS chart since 2015 and for the year 2016 total coverage area of 415 Sq.km were planned. The data acquisition and processing for the approaches to KKS is 40% completed. As progress has been affected by bad weather, security clearance and demobilization of the survey team to carry out bathymetric for Ministry of Mega polis and Western Development

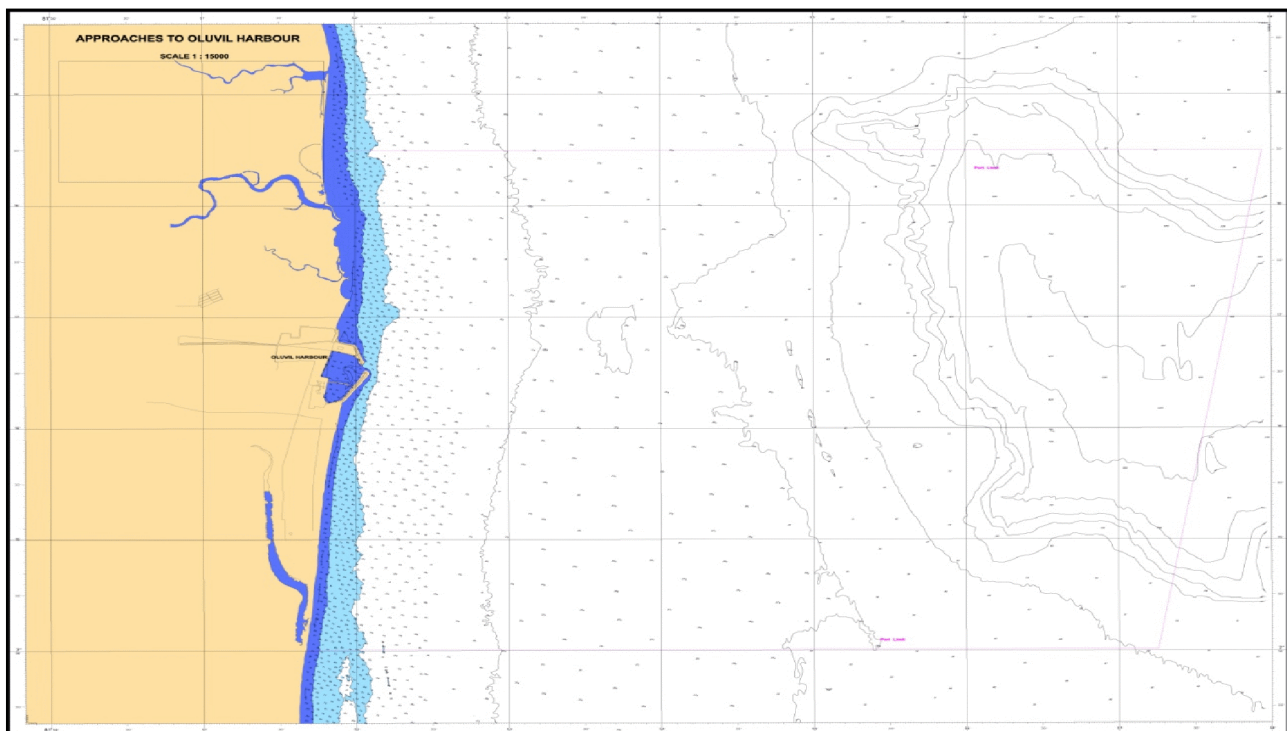


PROJECT No: 6.2.2.2

DATA ACQUISITION FOR APPROACHES TO OLUVIL NAUTICAL CHART

Government of Sri Lanka, in its plan to give impetus to economic development in the Eastern region, has decided to build a port at a site in Oluvil. Under the “Nagenahira Navodaya” Programme which was launched to expedite the development activities in the region, higher priority was given for the Oluvil Development Project which will no doubt be an economic infrastructure the catalyst for the growth of the Eastern Region of Sri Lanka. This port will form the South Eastern link in the developing chain of coastal harbours in the country and will provide more convenient and cost effective access to and from the South Eastern region for goods and cargo originating on the west coast.

Been evaluated the above economical value of the Oluvil harbor to become fully functional, NHO carried out regional bathymetric and topographic surveys to produce Approaches to Oluvil harbor nautical chart. The scale of the chart is 1: 15,000 and the total survey area was 60 sq km. The progress of the data acquisition and processing for the approaches to Oluvil harbor chart is 100% completed. It is found significant shallow depth areas at entrance to harbor. The chart is now available print on demand for port facility development.



PROJECT No : 6.2.2.3

BATHYMETRIC DATA ACQUISITION TO FILL THE GAP FROM COLOMBO TO WELIGAMA COASTAL CHART

The data acquisition for the gap filling between Colombo to Weligama was conducted under National Charting Program using RV Samuddrika. The progress of the data acquisition and processing is 70% and total covered area around 2300sq km during 2016. Existing charts is based on unsystematic surveys conducted during the period of 1940 (lead line surveys). The updated information will give the opportunity for accessible to a new generation of cargo vessels and it will assist the growth of economy. Further, this will facilitate the Sri Lankan government to capitalize on the island's strategic location to promote as a maritime hub in South Asia

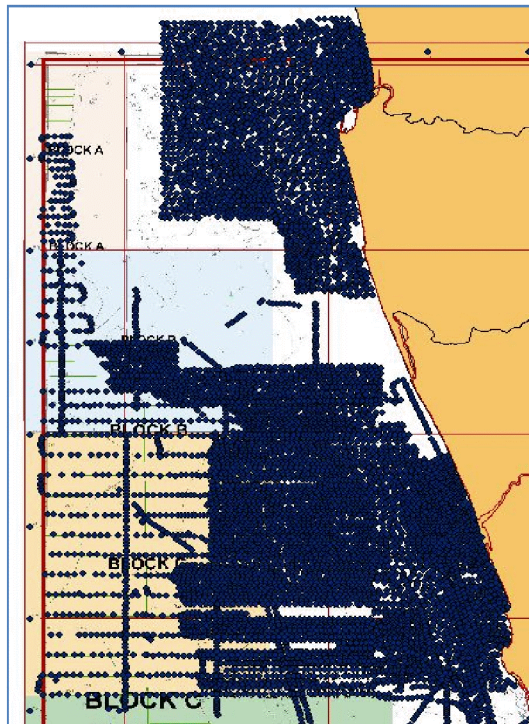


Figure 3 - Offshore Data-
Colombo to Weligama Coastal Chart

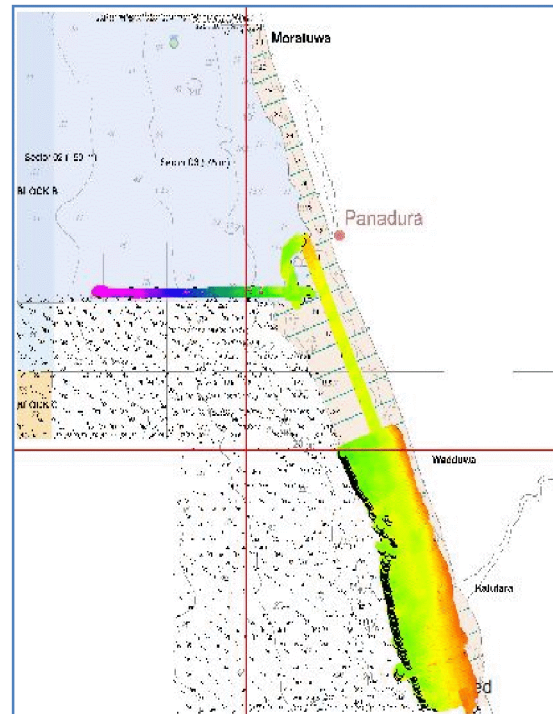


Figure 4 - Near shore Data-
Colombo to Weligama Coastal Chart

PROJECT No : 6.2.2.4

DATA PROCESSING AND CARTOGRAPHY

- Data processing for the acquired bathymetry for the Approaches to KKS chart data processing are completed.
- Completed the production of Approaches to Oluvil 1: 15,000 nautical charts.
- Data Processing for the acquired bathymetry for the gap filling between Colombo to Weligama is completed.

Project progress

Progress (%):- Financial: 76% Physical: 80 %

PROJECT No : 2.0

SURVEYS CONDUCTED FOR SPECIAL REQUESTS FROM GOVERNMENT AND OTHER INSTITUTIONS

PROJECT No : 2.1

BATHYMETRIC SURVEY AT MANNAR ISLAND FOR IDENTIFYING NAVIGATION ROUTE FOR BARGES – PHASE I

Ceylon Electricity Board had identified the potential of wind resources for generating electricity under the major renewable electrical power resources of Sri Lanka. As per the studies, The Mannar Island has been identified as the best location to locate Large Wind farms. At the initial stage, CEB has taken a decision to develop the 100 MW wind farm at Mannar Island, which would be owned and operated by the CEB. Transportation of the wind turbine Blades which are to be installed under this project is impossible by land since they are very long. CEB suggest transporting those from barges at least with 5 m draft and then there arise a requirement to construct a pier for unloading. This consultancy work was carried out to identify the navigation route for above barges at the Southern Coast of Mannar.

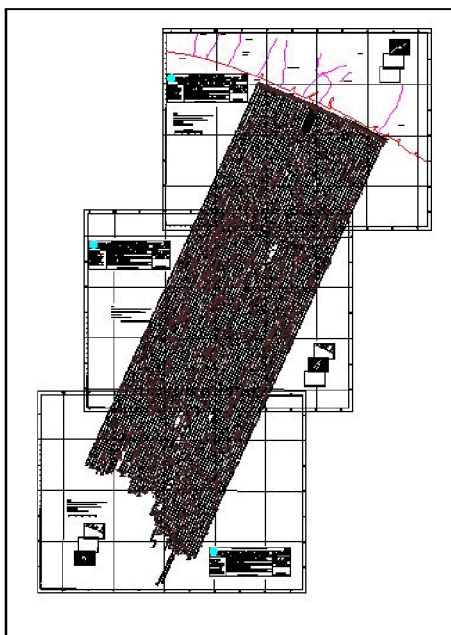


Figure 5 - Navigation Route at Mannar – Phase I

PROJECT No : 2.2

BATHYMETRIC SURVEY AT MANNAR ISLAND FOR IDENTIFYING NAVIGATION ROUTE FOR BARGES – PHASE II

Ceylon Electricity Board had identified the potential of wind resources for generating electricity under the major renewable electrical power resources of Sri Lanka. As per the studies, The Mannar Island has been identified as the best location to locate Large Wind farms. At the initial stage, CEB has taken a decision to develop the 100 MW wind farm at Mannar Island, which would be owned and operated by the CEB. Transportation of the wind turbine Blades which are to be installed under this project is impossible by land since they are very long. CEB suggest transporting those from barges at least with 5 m draft and then there arise a requirement to construct a pier for unloading. At the Phase I, survey was done reasonable large line spacing covering 5 km distance along the coast and 15 km towards the sea.

This consultancy was conducted to analyze the phase I bathymetric data within the identified suitable area 200m along the coast and 15km towards the sea. location to promote as a maritime hub in South Asia

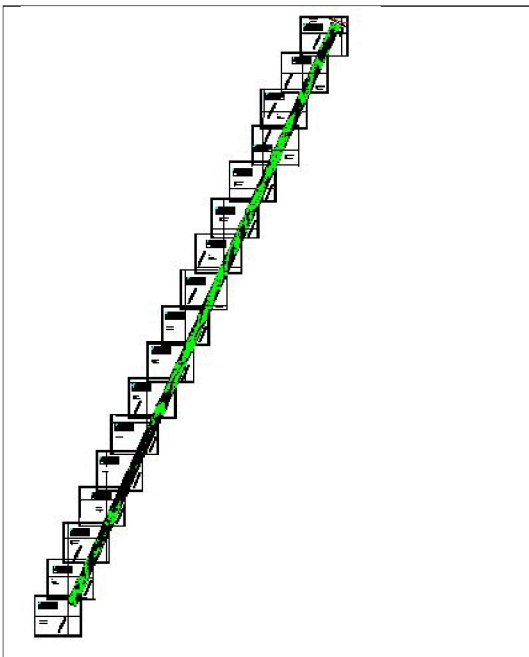


Figure 6 - Navigation Route at Mannar – Phase II

PROJECT No : 2.3

ZHENG – HE PROJECT FOR SECOND SEASON SURVEY

This survey was done according to the request of Central Cultural Fund to search for wreckages of Zheng He's fleets off the coast of Sri Lanka by using the side scan sonar's and sub bottom profilers.

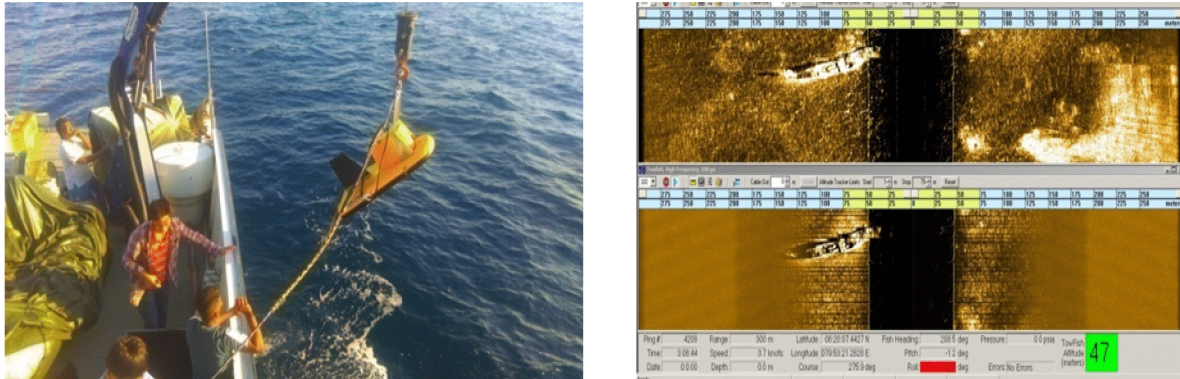


Figure 7 - Zheng – He project for Second Season Survey

PROJECT No : 2.5

BATHYMETRIC SURVEYS AT KAYTS FOR TRACE THE NAVIGATION ROUTE

The District Secretariat, Jaffna awarded this consultancy project to conduct bathymetric survey from Kayts to Analaitivu and Eluvativu to find out suitable draft for a Ferry which will be planned to construct and to identify suitable navigation route between above jetties.

At the phase 1 stage, survey was conducted with 10 m line spacing and found out shallow patches of comparatively lower depths which may obstruct to navigate the propose ferry which require 0.9 m water depth. From the second stage of the project, bathymetric survey was done with 10 m line spacing for 100 m wide alternative passage.

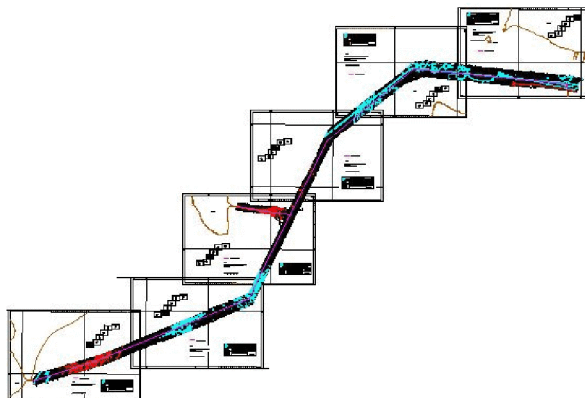


Figure 8 - Navigational Channel Kayts to Analaitivu and

PROJECT No : 2.6
PORT CITY DEVELOPMENT PROJECT - NEGOMBO

This Consultancy work was done as per the request of Ministry of Mega polis and Western Development to check whether there is a continuous reef at around the 10km distance from the shoreline in Negombo area. Bathymetric survey was conducted by obtaining the depth variation and side scan sonar in order to visualize the sea bed and the survey carried out perpendicular to the shoreline at 100m intervals within the 6km * 6km. Further, the client requested to demarcate the scattered rock out crop above the sea bed on a map with the geo co-ordinates.

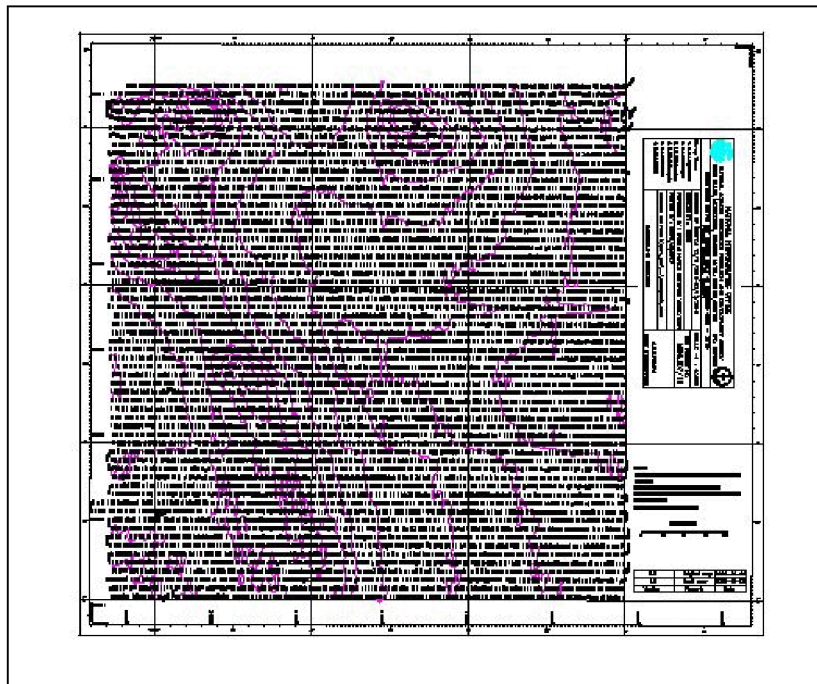


Figure 9 - Sea Bed Survey for Ministry of Mega Polis and Western Development

PROJECT No : 2.7
IMPACT CONFIRMATION MONITORING SURVEY – COLOMBO PORT CITY- CONSTRUCTION PHASE

China Harbor Engineering Company, the main contractor of Colombo Port City Development project granted this project to monitor the coastal effects near Beira outlet during its construction phase.

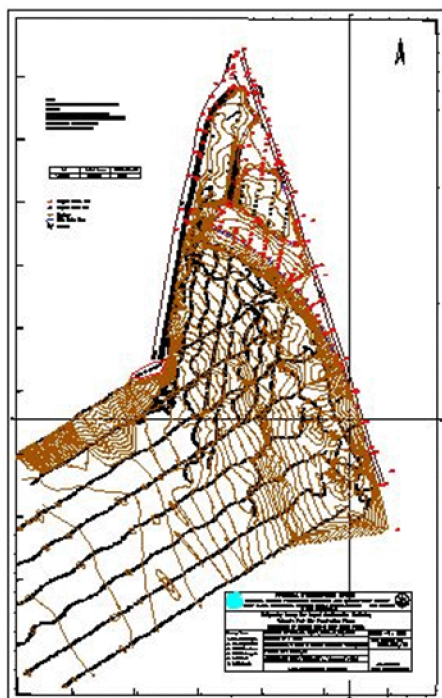


Figure 10 – Bathymetric Survey at Beira Outlet for Port City Development Project

PROJECT No : 2.7

BATHYMETRIC AND PROFILE SURVEY AT KOGGALA

Coast conservation and Coastal Resource Management Department awarded this consultancy to carry out a bathymetric and shore profile survey at Koggala coastal stretch in order to investigate the sea bottom and near-shore profiles for coast protective design purposes.

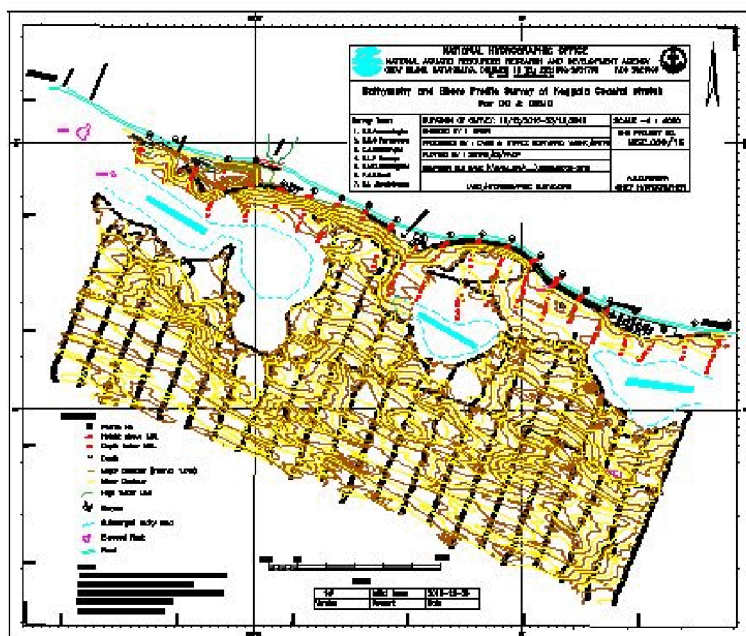


Figure 11 - Bathymetric and Shore profile Survey at Koggala for Coast Conservation Department

Bathymetric surveys for the gap filling from Colombo to Weligama and Kankasanturai were done by using RV Samuddrika.

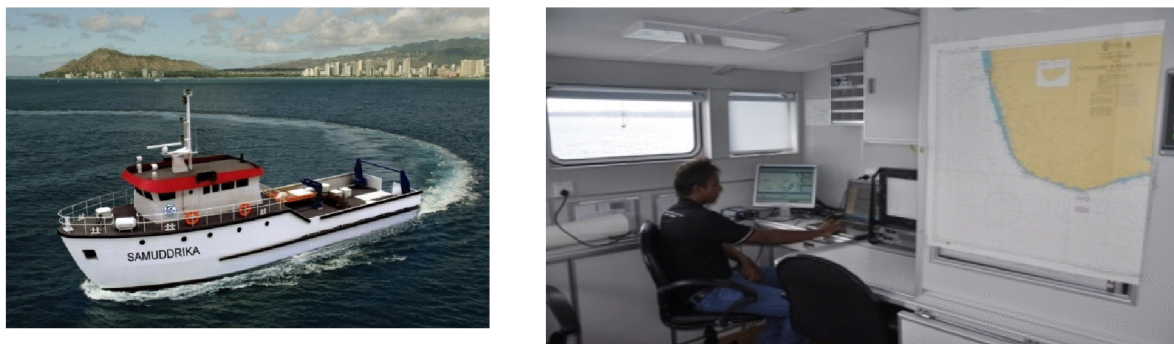


Figure 12 - Bathymetric Survey by using RV Samuddrika

Project progress

Progress (%):- Financial: 93.75% Physical: 28.2 %

PROJECT NO : 6.2.1

DERIVATION OF SHALLOW WATER BATHYMETRY USING MULTISPECTRAL SATELLITE IMAGERIES.

Bathymetric information is of fundamental importance to coastal and marine planning and management, nautical navigation, and scientific studies of marine environments. Mapping shallow water bathymetry from conventional methods of employing ships or boats with sonar is a quite an expensive task and comparatively inefficient. Many shallow water areas are not accessible by hydrographic ships due to rocks, coral reefs or simply the shallowness of the water. Active or passive remote sensing from aircraft and/or satellites could be the tools to solve the problem. In recent decades, airborne bathymetric LiDAR (Light Detection and Ranging) systems have been developed to map shallow coastal waters. While maximum penetration of LiDAR systems is heavily dependent upon water clarity, these systems commonly achieve depth measurements of up to 30 m, with 4 m spatial resolution and 20 cm vertical accuracy. While these airborne bathymetric LiDAR systems provide a rapid and precise means for mapping shallow coastal waters, their use is limited by the high cost of operations. The feasibility of deriving bathymetric estimates from remote sensing imagery was first demonstrated using aerial photographs over clear shallow water. The technique has been expanded to include the use of passive optical multi-spectral satellite imagery including Landsat, IKONOS, and Worldview and QuickBird images. The obvious advantages over conventional echo sounding methods include the wide data availability, synoptic surface coverage, and high spatial resolution. The only requirement is that remotely sensed images need to be carefully calibrated to ensure the accuracy of extracted depth information. The derivation of shallow water bathymetry is ideal because of the speed of coverage of the coastal land and sea areas although not recommended for nautical charting. Satellite derived depths can also be used for reconnaissance surveys, assessment adequacy and completeness of nautical charts, ecosystems valuation services, environmental impact

assessments and scientific studies. In this project, the high resolution satellites images (World view-2) used to derive the near shore bathymetry along the Coastal belt of Kankasanturai area.

The retrieved depths are compared with the echo-sounding data and the results demonstrate that the method is competent for extract shallow water depths a accuracy of.

These methods cannot replace highly accurate and thorough hydrographic surveys using specialist ships and equipment, but they can provide useful depth information where otherwise we have none. Implementation of this project is providing the required solution.

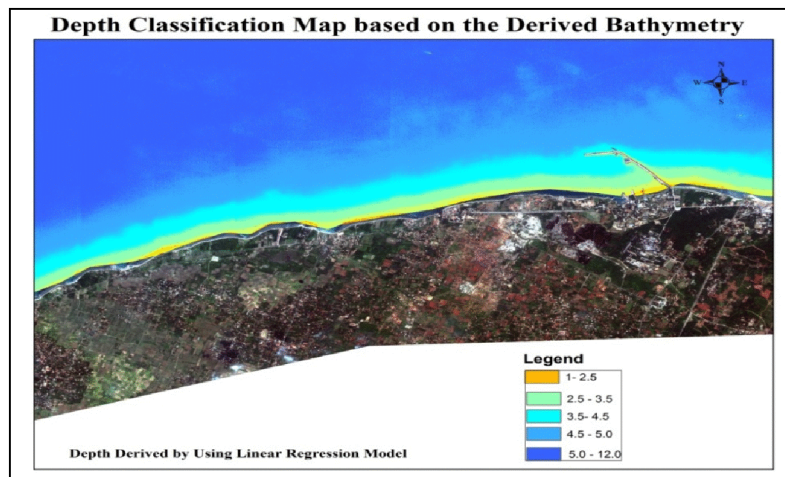


Figure 13 - Bathymetric Grid Derived using the Log-Linear Inversion Model

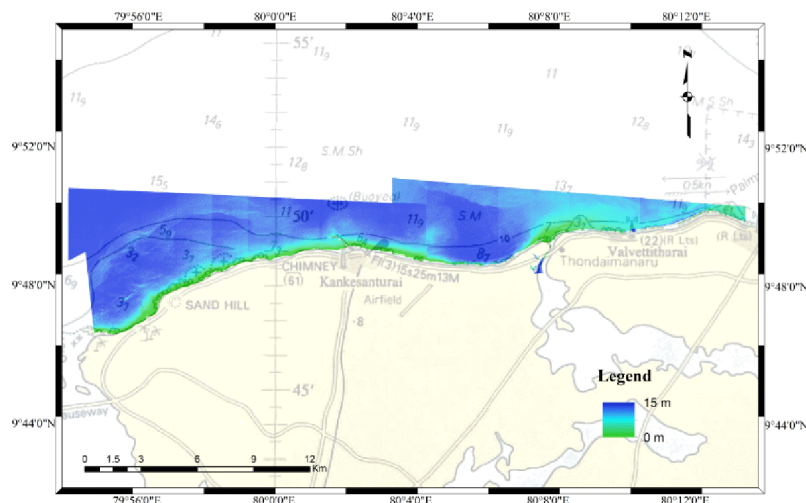


Figure 14 Derived Bathymetric Grid Overlaid with BA1584

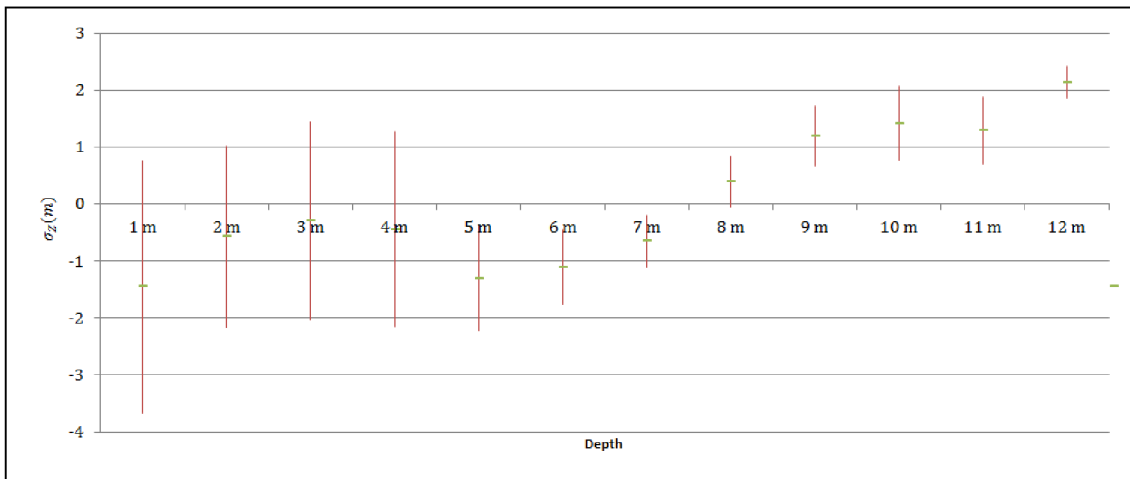


Figure 15 Estimated depth uncertainty .Minimum depth uncertainty values occur at ~5.0–12 m

Project progress

Progress (%):- Financial: 59.6% Physical: 100 %

Publications / Maps

1. Satellite Derived Map- Using Non-linear empirical model
2. Approaches to Oluvil Nautical Chart
3. Map of Navigation Route at Mannar – Phase I
4. Map of Navigation Route at Mannar – Phase II
5. Map of Navigational Channel from Kayts to Analaitivu & Eluvativu
6. Map of Sea bed survey for Ministry of Mega Polis and Western Development
7. Map of Bathymetric survey at Beira Outlet for Colombo Port City Development
8. Map of Bathymetric and Shore Profile Survey at Koggala for Coast Conservation Department

Training / Awareness Programs conducted:

1. Routine awareness programs in Hydrographic Surveying and Chart Production for Naval Officers and Seamen.
2. Four undergraduates from Faculty of Geomatics, University of Sabaragamuwa were trained for 4 months period.
3. Onboard Bathymetric Survey training was conducted to 60 undergraduates from Faculty of Geomatics, University of Sabaragamuwa at Beruwala.
4. Two undergraduates from Department of Geography, University of Colombo were trained for 01 month period.

Foreign / Local Training and International Commitments

1. No. of Officer 01: Training on Underwater Acoustic and Sonar Device Operation, Institute of Acoustic Chinese Academy of Science, China.



Figure 16 - Training on Underwater Acoustic and Sonar Device Operation, Institute of Acoustic Chinese Academy of Science, China.

2. No. of officer 01: Ocean Governance: Policy, Law and Management, International Ocean Institute, Dalhousie University, Canada



Figure 17 - Ocean Governance: Policy, Law and Management, International Ocean Institute, Dalhousie University, Canada

3. No. of Officer 01: IOC/IODE/Ocean Teacher Global Academy: Met Data Using Geo Network Training Course, University of Kuala Terengganu, Malaysia



Figure 18 - IOC/IODE/Ocean Teacher Global Academy: Met Data Using Geo Network Training Course, University of Kuala Terengganu, Malaysia

4. No. of Officer 01 : Participation of North Indian Ocean Hydrographic Commission at Chittagong, Bangladesh



Figure 19 - North Indian Ocean Hydrographic Commission at Chittagong, Bangladesh

5. No. of Officer 02: Forum for Future Sea Floor Mapping at Principality of Monaco



Figure 20 - Forum for Future Sea Floor Mapping at Principality of Monaco

6. No. of officers and Cartographers 13: Electronic Navigation Chart Production at NARA under the supporting of North Indian Ocean Hydrographic Commission (NIOHC)



Figure 21 - Training Programme on Electronic Navigation Chart

Consultancy Surveys Conducted for special requests

Project	Contract Amount
Bathymetric Survey at Mannar Island for identifying navigation route for barges – Phase I	Rs.3,094,000.00
Bathymetric Survey at Mannar Island for identifying navigation route for barges – Phase II	Rs.1,585,610.00
Zheng – He project for Second Season Survey	Rs.5,979,430.88
On board bathymetric surveys training for undergraduates at Sabaragamuwa University	Rs.356,850.00
Bathymetric Surveys at Kayts for trace the navigation route	Rs.2,026,960.00
Port City Development Project - Negombo	Rs.1,279,850.00
Impact confirmation Monitoring Survey	Rs.1,255,150.00
Bathymetric and Profile Survey at Koggala	Rs.1,514,110.00
Total	Rs.17,091,960.88



Figure 22 - On board bathymetric surveys training for undergraduates at Sabaragamuwa University



Figure 23 - Impact Confirmation Monitoring Survey



Figure 24- Bathymetric Survey at Mannar Island for identifying navigation route for barges

5.4 INLAND AQUATIC RESOURCES AND AQUACULTURE DIVISION

Head of the Division: Dr.V.Pahalawattaarachchi

Overview

The Inland Aquatic Resources and Aquaculture Division (IARAD) contributes to the fisheries sector development mainly focusing on research related to inland and brackish water aquaculture through sustainable utilization of the natural resources. During year 2016 division has carried out 14 research projects which lead to contribute policy objectives of the Ministry of Fisheries and Aquatic Resources under the strategies of improvement of feed technology for aquaculture, developing the technology for breeding and culture for selected marine and freshwater species, nontraditional aquaculture development, aquatic health management, aquaculture related enhancement technology and conservation and management of aquatic environment.

In summary, the major outputs of the projects carried out were as follows; Feed formulations were done for development of economically viable and nutritionally balanced feed for Seabass fingerling culture in lagoon floating net cages and pond cages. Fish culture in abandoned clay pits using low cost aqua feed demonstrated very well. Important baseline data on introducing developed breeding technique/s for economically important two species *Puntius denisonii* and *Balantiocheilos melanopterus* was collected while breeding and rearing of other exotic species is in continuation. Services provided to general public on providing good quality fish, live feeds algae stocks as well as technical trainings. Technology invented for increase survival of seahorse, *Hippocampus kuda* and *Nannochloropsis sp.* and *Chetoceros sp.* mother cultures were maintained. Stock enhancement of sand fish (seacucumber) conducted at Uchchamunei in where natural population has drastically decreased, in Puttalam lagoon and monitoring was initiated. Community based pen culture with the hatchery produced sand fish is ongoing at the same area. Oyster culture community based pilot scale projects were launched in 03 places at Puttalam lagoon including Kandakuliya, Anawasala and Janasavipura while continues monitoring was carried out to determine spat availability and water quality condition. A depuration plan was set up at NARA Kalpitiya regional research center to purify the oyster before marketing, so that the oyster will be safe to eat. The communities have produced 10422 oysters and marketed after depurating them at the provided facility during the year.

The seaweed, *Kappaphycus alvarezii* seed growing capacity of by handling 10 cages of 2m x 0.75m x 0.5 m size for 4 cycles was 1000 kg. Monitoring of commercial culture sites revealed that higher growth rates of seaweeds could be obtained from September to February (06 months). But the maximum yield of carrageenan produced in May to June period in which high wind recorded and high SGR or DGR not recorded due to fragment loss but healthy growth was observed in thallus. Koi Carp production including brooders, feed development for ornamental fish, disease treatments for the fish brought by farmers and fish meal production using invasive and alien Knife Fish as a special research activity were practiced based on Panapitiya Center. Then pellet feed producing program was initiated using newly bought fish extruder and it was sold two types of feeds. (Nursery feed and special grower feed.) Panapitiya RRC is progressing to be a self-income generation body and it has earned Rs.531, 610.00 of income selling Koi Carp only from 3 mud ponds and fish feed selling in the last two months in the year 2016.

Shrimp health management projects revealed that over 350 samples of WSSV possible trans carriers were screened for the WSSV disease and slight positive level to highly positive level results were found in some other crustaceans. Environment conditions in the North western province prevailed favorable for shrimp culture during 2016. The water quality in the lagoon was favorable during most parts of the year, (salinity, 35ppt, ammonia 0.002 - 0.04mg/l and DO > 3.0 mg/l). Community Based Ornamental fish culture project at Hambantota district exposed that most suitable species for culture in ponds in the area is Koi carps. To get the good survival one month old fish should be stocked. On the other hand There is an immense scope to develop fresh water prawn industry in Hambantota district with introducing of low cost feed. Study of community based management of fish assemblages in brush parks of Negombo estuary suggest the optimal period since installation was about 30 days and the optimal twig density was about 2 kg m⁻³ to achieve maximum brush park yield. Two nurseries of *Nypa fruticans* were developed close to GingOya area, UthruKammala, Waikkala. At present, over 500 *Nypa* nursery plants were produced with community under NARA technical guidance and financial support. The daily sap yield varied from 0.1 to .5 liters per fruit stalk during study period. There are 21 scientific publications (abstract, conference proceedings, review papers) produced with the authorships of the divisional members in 2016.

Research Projects

Strategy	Project No	Name of the project	Responsible officer
3.1 : Improvement of feed technology	3.1.1	Development of formulated feed for Seabass fingerling culture in lagoon floating net cages	D.A. Athukorala R. Weerasinghe
	3.1.2	Development of formulated feed for seabass culture in ponds	Dr.M. G. I. S. Parakrama
	3.1.3	Community based fish culture development in abundant clay pits using low-cost aqua-feed	M.H.S. Ariyaratne, RangaJayawickrama
3.2 : Developing the technology for breeding and culture for selected marine and freshwater species	3.2.1	Development of suitable breeding techniques for selected high value ornamental fish species.	E.D.M. Epasinghe; AmithaAdikari, Dr. PalithaKithsiri
	3.2.2	Economically Important Marine Ornamental Species and Micro algae culture for Aquaculture	M.A.J.C.MallawaArachchi
3.3: Nontraditional aquaculture development	3.3.1	Community-based Sea cucumber Farming as an Alternative Livelihood Development Method in North and Northwestern Provinces in Sri Lanka	P. A. D. AjithKumara
	3.3.2	Development of community based oyster farming through advances in cultivation, seed stock production and processing technologies	C. Medagedara, S.Corea; Dr.H.M.P.Kithsiri

	3.3.3	Seed production, extermination of generic variations, monitoring of commercially level cultivation and site selection for expansion based on remote sensing and field sampling	Dr.V.Pahalawattaarachchi; Dr.D.D.G.L.Dahanayaka UpulLiyanage
	3.3.4	Development of suitable technique for propagation of selected ornamental aquatic plants and commercially important seaweeds	D.M.S. Sugeeshwari, Dr.V.Pahalawaththaarachchi
	3.3.5	Livelihood development of ornamental fish farmers in Kalutara District through Panapitiya RRC	G.S.C.Perera , M. Epasinghe
3.4 Aquatic Health Management	3.4.1	Management of White Spot Syndrome Virus (WSSV) disease in the shrimp farming sector in Sri Lanka	M.L. RasikaThanthrige, J.S. Jayanatha
3.5: Aquaculture related enhancement technology	3.4.4	Community Based Ornamental fish culture and disease management in Hambantota District	Dr.A.D.W.R.Rajapakshe
	3.5.1	Study of water quality, feeding ecology, structural properties and community based management of fish assemblages in brush parks of Negombo estuary.	M.Gammanpila
	3.5.2	Enhancing the productivity of selected small water bodies in Hambanthota and Matara District by stocking suitable fish/prawn.	K.W.R.R.Amaraweera
8.1. Conservation and management of aquatic environment	8.1.4	Feasibility of utilizing mangrove ecosystems for improvement of the livelihood of coastal communities	Dr.D.D.G.L. Dahanayaka, Dr.V.Pahalawattaarachchi

PROJECT No : 3.1.1

DEVELOPMENT OF FORMULATED FEED FOR SEABASS FINGERLING CULTURE IN LAGOON FLOATING NET CAGES

Responsible officers: D. A. Athukorala
R. Weerasinghe

Objectives of the projet were to develop economically viable and nutritionally balance feed for Seabass fingerling culture in lagoon floating net cages, compare different formulated fish feedson growth performance of Seabass fingerlings and to compare formulated fish feeds with trash fish on growth performance of Seabass fingerlings. Asian Seabass culture has been identified as a profitable business and most popular in South Asian countries such as Thailand, Malaysia, Indonesia, Singapore, Taiwan and Hong Kong. As sufficient brackish water resources, there is a good potential to develop Seabass culture also in Sri Lanka. However, main obstacle for developing this aquaculture practice in Sri Lanka is lack of low-cost nutritious feeds in the market for Seabass. This project is aim at the use of locally available ingredients to produce cost-effective and nutritionally balanced feeds for Sea Bass fingerling culture in lagoon floating net cages. A location at Munnakarai area in Negombo

lagoon was selected for conducting feed experimental trials. Locally available feed ingredients were analyzed and based on that results 03 feed formulas were formulated for Seabass fingerling stages. Floating net cage system with 12 floating net cages was constructed in Negombo lagoon at Munnakkarai area to conduct experimental feeding trials. The water quality parameters of the study location were monitored monthly to assess the water quality condition of the lagoon throughout the year. As no Seabass fingerlings, available in the local market, it was decided to import required Seabass fingerlings from Thailand through a local agent. Necessary approval to import Seabass fingerlings was requested from NAQDA. This project is continuing to 2017 and expects to import Seabass fingerlings in February 2017 and start experimental feeding trials in March 2017.

Project progress

Progress (%):- Financial: 100% Physical: 52 %

Constraints:

- Unable to start experimental fish feed trials as planned in October 2016, as Seabass fingerlings were not available in the hatchery in Sri Lanka
- Unavailability of vehicle for field work in some months

PROJECT No :3.1.2

DEVELOPMENT OF FORMULATED FEED FOR SEABASS CULTURE IN PONDS

Responsible officers: Dr. M.G.I.S. Parakrama

Objectives were to develop an economical feasible highly nutritious feed for sea bass pond culture practice, increase the local fish meal utilization through bulk use of the product for producing sea bass fish feed and to explore the potential of replacing high cost imported feed with locally produced fish feed. As using trash fish is the traditional method of feeding sea bass fingerlings up to harvesting, this practice is becoming increasingly unsustainable due to the availability of trash fish, its seasonality, high price of off season, bulky and messy handling, storage problems and deterioration of the bulk, bad smell, labour cost etc. To overcome the problems, an experimental feed trial using a new feed formula with 45 % crude protein level was started at Pitipana, Negombo in a private fish farmer's pond. Objectives of the study were, to increase the local fish meal utilization for producing sea bass fish feed, to explore the potential of replacing high cost imported feed with locally produced low cost fish feed and to compare the growth parameters and the quality of harvested formulated feed fed fishes with trash fish fed fishes (by fatty acid analysis).

Total 400 fingerlings were stocked in a single large cage for weaning to the feed before start the experiment, with average single wt 6g and initial length $4.5 \pm 0.50 - 7.5 \pm 0.50$ cm. They were weaned from farm fed imported feed to mixed feed with trash fish mash and finally to NARA prepared feed. After another two weeks, they were totally given the formulated feed. Total price for 1kg of prepared fish feed is 190/= to the present market price. No diseases were recorded up to this stage. Trial experiment is going on and not yet finished.

Project progress

Progress (%):- Financial: 34% Physical: 68 %

Constraints:

- Delay to purchase the cage constructing material (nets) until July.
- As we had to wait for cage materials, purchasing of fish fingerlings also had to be cancelled twice and it caused long delay to start the experiment.

PROJECT No :3.1.3**COMMUNITY BASED FISH CULTURE DEVELOPMENT IN ABUNDANT CLAY PITS USING LOW-COST AQUA-FEED**

The abundant clay pits are filled water and not in use after excavating the mud in maximum quantity. As these are not use in any other task, its getting environmental problems and danger for the community living nearby. However, as these clay pits could be used in aquaculture practices, introducing culturable fish species. These are chief protein sources and particularly Seabass culture is economically attractive. Accordingly seabass culture and other fin fish species such as carps and Tilapia will introduce to the community as pilot project those who had hands on experience about cage culture in abundant clay pits through NARA Projects since 2010. The community in the area who are the victims of this water bodies could be involve in these aquaculture practices and could be obtain cheap animal protein as well as income through this self-employment. Objectives of the project were to develop sea bass and the culturable fish species culture in abandoned clay pits; enhance the income and fish consumption of small scale fish farmers and to technology transfer on low cost aqua feed preparation. Awareness and training programs on floating cage construction, repairing, deploying, fish stocking was conducted 38 people who are new at Muruthana, Kochchikade and Bolagala areas to fish farming. Fish feed preparation using available local ingredients were conducted for 23 people. By providing low cost fish feeds community involved research were conducted for tilapia fry to fingerling rearing and polyculture practices of carp, tilapia and freshwater shrimps. Approximately 1000kg of fish were harvested from a clay pit associated cage culture system in which Rs.150,000 earned by the community. These 3 feed could be used in food fish culture of Tilapia in cages that installed in abundant clay pits. A Feed (Rs.37/-)that prepared using Shrimp waste meal as protein component is highly recommended due to low cost.

Outputs:

- Fish farming model for the abandoned clay pits
- Low cost aqua Fish feed #

Outcome

- Increase fish production and local fish consumption

Project progress

Progress (%):- Financial: 38% Physical: 94%

Remarks : Project was completed by August

PROJECT No : 3.2.1

DEVELOPMENT OF SUITABLE BREEDING TECHNIQUES FOR SELECTED HIGH VALUE ORNAMENTAL FISH SPECIES.

Responsible officers: E.D.M. Epasinghe

Amitha Adikari

Ornamental fish industry is one of the very competitive businesses in the world. Singapore, Japan, Malaysia and India are our market competitors. This contest always presses us to move forward and the sustainability of the local ornamental fish industry always depends on research and development activities that we are carrying out over the years. Therefore, stakeholders in ornamental fish sector of Sri Lanka and the local fish breeders always requested NARA to develop suitable breeding techniques for selected high value ornamental fish species that have higher international demand. Currently such species are being imported to country and re exporting. Therefore price is comparatively high. Since, 2016 NARA has started a project on developing breeding and larval rearing technology for *Balantiocheilos melanopterus* and *Puntius denisonii* targeting to develop suitable induced breeding techniques, manage fry production of such high value exotic ornamental fish species while maintaining the sustainable development of the industry. Two different synthetic gonadotropin hormones were used as an inducing agent such as sGnRH α and HCG. 500 IU/kg and 2000 IU/kg concentrations of HCG and 0.5 ml/kg sGnRH α were tested for *Balantiocheilos melanopterus*. sGnRH α 0.2 ml/kg and 1.0 ml/kg concentrations were tested for *Puntius denisonii*. Intra peritoneal (IP) axis and Intra muscular (IM) axis were used to inject the hormone for *Balantiocheilos melanopterus* and *Puntius denisonii* respectively. Hormones were given as a double dose for *Balantiocheilos melanopterus* and as a single dose for *Puntius denisonii*. In both species, dry method was used to fertilize the eggs. Eggs hatching were done in 60 cm x 30 cm x 30 cm glass tanks. *Balantiocheilos melanopterus* was a serial spawner and it was positively response to sGnRH α (0.5 ml/kg) but not for HCG and eggs were semi buoyant. *Puntius denisonii* breeding was not successful for 0.2 ml/kg and 1.0 mg/kg concentrations of sGnRH α . Post spawning mortality of that species was high for 1.0 ml/kg concentration of sGnRH α . Therefore, results of that project can be concluded as *Balantiocheilos melanopterus* is a serial spawner. sGnRH α 0.5 ml/kg concentration can be used to induced the breeding of *Balantiocheilos melanopterus* and eggs are semi buoyant. Therefore, Mc Donald jars should be deployed for hatching eggs. Low concentration and high concentration of sGnRH α cannot be used for breeding of *Puntius denisonii*. High concentration of sGnRH α makes more post spawning mortality stress to *Puntius denisonii*.

Output

- Introducing developed breeding technique/s for *Puntius denisonii* and *Balantiocheilos melanopterus*

Outcomes

- Decreasing of quantity imported *Puntius denisonii* and *Balantiocheilos melanopterus*
- Enhancing income of fish breeders and fish exporters

Project progress

Progress (%):- Financial: 100%

Physical: 79%

Constraint :

- Lack of adequate amount of matured brood stock.

PROJECT No :3.2.2

MICRO ALGAE CULTURE AND TECHNOLOGY DEVELOPMENT FOR SELECTED ECONOMICALLY IMPORTANT MARINE ORNAMENTAL SPECIES

Responsible officers: M.A.J.C. MallawaArachchi

Sri Lanka received great amount of foreign exchange from marine ornamental fish. All these species are collected from the wild and the technology to captive breeding and culture is far behind than fresh water ornamental fish breeding and culture. Technology development to breed and culture marine ornamental fish is vital in present aquaculture sector in Sri Lanka. Hence, this project aimed to develop technology to breed seahorse in captive condition.

Live feed play major role in fish and shell fish culture in Sri Lanka. Although, there is a difficulty in reaching reliable culture protocols and for mother cultures. This project targeted to develop feasible culture protocols and maintain mother cultures for marine algae.

Seahorse (*Hippocampus kuda*) brood stock were transported from Kalpitiya to marine hatchery at NARA head office. Brooders were conditioned in recirculatory system in the hatchery. Brooders fed twice a day with fresh water glass shrimps. Conduct a research on growth and development of seahorse fry fed with *Artemia* enriched with different enrichments. Enrichments used in the experiment were sesame oil and sunflower oil. As growth parameters fry weight and length were measured as well fry survival also taken in account. Results revealed that there is no significant effect on growth of seahorse fry while comparing with the control. *Nannochloropsis sp.* and *Chetoceros sp.* mother cultures maintain at the laboratory and issuing mother cultures for fish breeders. Ongoing research on study of growth performance of *Nannochloropsis* and *Chetoceros sp.* with bacterial cultures.

Outputs and Outcome:

- Maintenance of algae mother cultures.
- Providing mother cultures for commercial hatcheries.

Project progress

Progress (%):- Financial: 42%

Physical: 77%

PROJECT No :3.3.1

COMMUNITY-BASED SEA CUCUMBER FARMING AS AN ALTERNATIVE LIVELY-HOOD PROGRAMME FOR FISHER-FOLKS IN NORTHWESTERN AND NORTHERN PROVINCES IN SRI LANKA

Responsible Officers: P. A. D. Ajith Kumara
C. B. Medagedara

Major constraint for the expansion of mariculture or coastal aquaculture of marine species (fin fish, shell fish and non-fin fish species) is the inconsistent supply of seeds in Sri Lanka. Presently, some sea cucumber stocks (i.e. *Holothuriascabra*) are depleted rapidly due to over exploitation of adults, therefore development of artificial seed production technology and farming is timely need. Coastal aquaculture can be introduced as a tool for women empowerment activity that brings into play communities that were not engaged in fishery-related activities previously. Objectives of the project were to development of breeding, culture and grow-out techniques of economically important sea cucumber species; Initiate alternative livelihood programmes through transferring artificial breeding technology and culture techniques of sea cucumber species to public and private sectors and natural stock enhancement. To fulfill the objectives activities carried out on establishment of hatchery facilities for *H. scabra*, collection, conditioning of broodstock, larval rearing; determination of the factors affecting breeding, larval survival and culture of sea cucumber species (effect of different induce methods for spawning ;effectiveness of two larval feeds); community-based sea cucumber farming; replenish wild stocks and awareness programmes

Hatchery facilities were further establishing to develop collection, conditioning of broodstock, study the effectiveness of different breeding methods and larval rearing with commercially available feeds for enhance the survival rate in order to develop consistent and quality seed production of *Holothuriascabra*. Algamac, a commercial feed was identified as the best feed for early larval rearing. Cold shock method also identified as the best method for induce breeding than heat shock method.

Community-based sea cucumber farming was introduced to fisher-folks as an alternative livelihood method. 10 beneficiary families have been involving in the activity presently and after 6-8 month culture period it is estimated that community will get Rs 200.0000 income from 225 m² pen enclosure. This activity is also important as a fisher-women empowerment. Introducing low cost materials to facilities develop and increasing extent of the farming site is recommended to further enhance income of the practices. As sea cucumbers totally depend on naturally available feeds inside the pen, the society need not to spend any money for supplementary feeds and this is the major advantage for them. Development of alternative livelihoods such as sea cucumber culture has a good potential to become a popular policy to uplift the socio-economic status of small-scale fishers and to reduce fishing pressure on over-exploited fisheries.

As sand fish population was > 1 individual per hectare in Northwestern province according to reason survey carried out by NARA, two groups of hatchery produced sand fishes (800 no's, medium size ~ 60-80 g and small ~2- 5g) were released to Uchchamunei in where they were harvested naturally two decades ago, in Puttalam lagoon with the idea of re-populating the lagoon.

An awareness programme was conducted with collaboration of National Research Council, University of Sri Jayewardenepura and Sri Lanka Association for Fisheries and Aquatic

Resources for Government officials from Sri Lanka Custom, Sri Lanka Police, Sri Lanka Navy, Coast Guard, Department of Fisheries, NAQDA and Universities to “Identify fresh and processed sea cucumbers”

Output:

- Built up awareness among fishing communities, university students and Governmental officials on sea cucumber breeding, farming and identification of fresh and processed sea cucumbers
- Trained fisher-folks on community-based sea cucumber farming
- Development and integration of different kind of breeding methods
- Effectiveness of commercial formulated feed on larval rearing
- Replenish wild stocks through restocking
- Dissemination of the technical *know-how* by preparing reports and scientific publications

Outcome:

Successful marine conservation thus calls for the provision of livelihood alternative and also natural stock enhancement that reduce the pressure on the marine environment. In this project it was identified that marine aquaculture (also called mariculture) is increasingly advocated as such an alternative that are readily accepted by coastal communities.

Project progress

Progress (%):- Financial: 91% Physical: 85 %

Constraints:

Climatic changes acted as the major killing factor of this year too. Heavy precipitation got to Northwestern and North central provinces throughout the December (2015) and January this year. Spilling of perennial and seasonal tanks in the two province heavy water load drained through MeeOya and Kala Oya that are the major two rivers connected with Puttalam lagoon. That has been caused to drastic salinity changes in the lagoon not only during first quarter of the year but also sudden rainfall experienced in April, salinity existed below 28 ppt until end of August. Then we were face great problem in water exchange process both indoor and outdoor tanks and also perform breeding trials. As two days consequent raining in to Kalpitiya area during November, temperature of the nursery tanks suddenly dropped down from 29.5° C to 25.5° C. That caused heavy mortality among juveniles. As they were shown fatal signs like immobility, skin lesions, curved body etc., they were released to adjacent lagoon pen (approximately 700 juveniles of 60 day old). Unidentified parasitic attack experienced during feeding experiment and that caused to decrease the larval density in *Sargassum* fed four tanks.

Juvenile marking was unable to conduct as late arrival of chemical. As we had to release juveniles to wild before on set of North east monsoon there wasn't time to carry out laboratory experiment on marking when chemical arrived.

Relatively low survival rate was observed during the community-based pen culture trial. It was identified that some hermit crab species encroached in to the and made some slight scars and lesions on the top of the sea cucumbers.

PROJECT No: 3.3.2

DEVELOPMENT OF COMMUNITY BASED OYSTER FARMING THROUGH ADVANCES IN CULTIVATION, SEED STOCK PRODUCTION AND PROCESSING TECHNOLOGIES

Responsible officers: C. Medagedara
S. Corea
Dr.H.M.P. Kithsiri

The objective of the study was to transfer the technology of Bivalve culture to selected communities and develop Bivalve culture in Sri Lanka as an extra income generation project to fisher communities and to popularize Bivalve culture as an aquaculture activity.

Based on the studies community based pilot scale projects were launched in 03 places at Puttalam lagoon including Kandakuliya, Anawasala and Janasavipurawhile continues monitoring was carried out to determine spat availability and water quality condition. Growth studies were continued at selected sample points.

A depuration plan was set up at NARA Kalpitiya regional research center to purify the oyster before marketing, so that the oyster will be safe to eat. The communities have produced 10422 oyster and marketed after depurating them at the provided facility during the year. Since water quality conditions remained favourable a good growth has been achieved this year. However some culture areas were affected by heavy rains and floods.

Output:

- Community based oyster culture projects developed in 03 villagers (30 families)
- Depuration setup developed to help to increase oyster market

Outcome:

- Development in oyster industry in Sri Lanka

Project progress

Progress (%):- Financial: 100%

Physical: 87 %

PROJECT No: 3.3.3

SEED PRODUCTION, EXTERMINATION OF GENERIC VARIATIONS, MONITORING OF COMMERCIAL LEVEL CULTIVATION AND SITE SELECTION FOR EXPANSION BASED ON REMOTE SENSING AND FIELD SAMPLING

Responsible officers: Dr.V. Pahalawattaarachchi
Dr.D.D.G.L. Dahanayaka
Upul Liyanage

Kappaphycus alvarezii (previously *Eucheumacottonii*) and the trade name cottonii is one of the most commercially important species which is being cultured by many South-East Asian countries. At the moment community-based seaweed farming has been developed from Mannar to Jaffna shallow sea areas. Main objectives of the projects are to develop a continuous seed stock of commercially cultured cottonii seaweeds irrespective of seasonal changes and enhance the quality of seed stock and to study the seasonal patterns of growth and carrageenan yields in the prevailing culture systems. To fulfil the objectives cage culture of *K.alvarezii* was conducted at Dondra, Southern Coast while growth monitoring was conducted at Walepadu in Killinochchi district. Parallel to the growth study samples were collected for the analysis of quantity and quality of carrageenan which is the main extractant of the seaweed. The seed growing capacity of 2mx0.75X0.5 m cage was 25 kg /cycle. If one person handles 10 cages, the final yield of 01 cycle (36 days) would be 250 Kg. Normally minimum 04 cycles could be conducted in the calm season so that one person can get minimum 1000 tons of seeds /year. Specific growth rates of commercial culture sites were highest in January to February while the lowest SGR reported in March to May. There is a highly significant relationship between daily growth rate and specific growth rate ($p < 0.001$).

In the commercial site, highest growth rates were observed from January to February and September to October trials. While the lowest growth rate was observed in March to April trial. Although the wind impacted to detach the propagules in May to June it was observed profusely grown healthy thallus. Weight decrease was due to breakdown of the fragments. Although there is a significant positive correlation observed between SGR and DGR, its significance was $P < 0.05$. The highest yield of carrageenan extracted from the samples harvested in May to June ($70.81 \pm 2.16\%$) is not significantly different at 0.05 level to the yield of samples got in June or August ($64.76 \pm 1.08\%$ and $66.87 \pm 2.12\%$). The lowest yield was observed in March ($50.88 \pm 1.76\%$) and it is significantly lower than all other samples ($p < 0.05$). Higher carrageenan content was observed during these months which go through a dry season (southwest monsoon season). Hayashi et al. (2007), Hurtado et al. (2001) and Reis et al. (2010) proved that the carrageenan yield can change according to environmental parameters as a mechanism of survival against stressful situations. The lowest yield occurred in sample 3 harvested in March where the region undergoes the northeast monsoon with high rainfall and plants undergo stressful situations like high water current movements, storms and salinity fluctuations. Other factors that can affect the yield of extracted

The highest gel strength was reported in the samples harvested in May ($410.70 \pm 7.44 \text{ gcm}^{-2}$) during Southwest monsoon season and the lowest gel strength recorded in August. ($271.10 \pm 18.43 \text{ gcm}^{-2}$)

Outcomes:

- Sound management practices of *Kappaphycus alvarezii* cage culture in the Southern sea in calm season.
- Best period for culture of *K. alvarezii* for getting high quality carrageenan is May to June in the Northern water.

Output:

- Input for seaweed culture development

Project progress

Progress (%):- Financial: 48% Physical: 98 %

PROJECT NO: 3.3.4

DEVELOPMENT OF SUITABLE TECHNIQUE FOR AQUATIC PLANTS *CRYPTOCORYNE WENDTII*, *C. WALKER*, *C. PAVA*, *MICROSORIUM PTEROPUS* (JAVA FERN) AND SEAWEED. THE EXTRACTION OF CARRAGEENAN AND BIOLOGICAL ACTIVE COMPOUNDS FROM SEAWEED.

Responsible officers: D.M.S. Sugeeshwari
V. Pahalawaththaarchchi

The main objectives of this research were; to develop suitable method for surface sterilization of aquatic plants and seaweed, To develop suitable media combination for aquatic plants and seaweed, To find out the best growth hormone concentrations which is going to produce highest number of shoots or callus from explants.,

Select the Explants (Rhizome/leave) from healthy mother plant from NARA plant house. Wash the explants thoroughly under running tap water. And then disinfection by using 0.1% mercuric Chloride, 70% ethanol and Clorox solutions (Commercial Bleaching). Then culture on culture media (MS medium) consists of different combinations of plant hormones. Observed for 21 days for shoot/callus initiation and then sub culture on MS medium consists of different concentrations of 6-Benzyl amino purine (BAP). Then the shoots are subculture on the medium for maximum six cycles. Then the shoots subjected to rooting on rooting medium. The rooted plants undergo acclimatization in different planting media at laboratory and then introduce to plant house for hardening.

Cut the healthy thallus of seaweed in to pieces and wash with sea water. Disinfect the explants with tween twenty solution and Betadine solution. Then culture in culture medium consists of antibiotic for overnight by providing aeration. Then wash with sterile sea water and culture on solid medium consists of different 2,4- Dichlorophenoxy acetic acid (2,4 D) for callus formation.

Developed a proper Micro- propagation method for *C.wendtii*. According to the finding of the micropopagation cycle. The maximum shoots initiation has taken by using 4mg/L BAP+0.1mg/L IBA. That was 7 shoots/rhizome segments. The maximum shoot multiplication was able to get by providing 4mg/L BAP. The average number of shoots was 12. Then comparative study was conducted to select the best media and hormone combination to obtained highest number of roots. According to the findings 0.1 IBA has produced maximum

number of shoots. Further to that ½ MS liquid media gave the highest number of roots compared to ½ MS Solidified medium. That was average of 20 roots per shoot. During the acclimatization of the tissue cultured plants at the NARA Plant house, different media were tested. According to the data, 60% of the survival was able to get by using sterile soil as the plotting media. But, 93% of survival was able to get by using sterile core particles as the plotting media.

Different types of surface sterilization methods were tested to developed the proper surface sterilization method for *Microsoriumpteris*(Java Fern). Out of those method best survivals was able to get by using the 70% ethanol 30 second, 10% Clorox solution for 5 minutes and 4% Clorox solution for 10 minutes. That was 90%.

Conduct several experiments to find the best media for seaweed survivals at the laboratory. According to the findings, the best media was ½ PES (Proxazole Enriched seawater), which was able to give 80% of the survivals at the laboratory.

Output :

- Contribute to the growth of the aquaculture sector by developing aquatic plants

Outcome :

- Introduce mass propagation technique for commercial culture of *C.wendtii*

Project progress

Progress (%):- Financial: 100%

Physical: 83 %

Constraints:

- Unable to conduct chemical extractions of seaweed as the delay of chemicals.

PROJECT No : 3.3.5

LIVELIHOOD DEVELOPMENT OF ORNAMENTAL FISH FARMERS IN KALUTARA DISTRICT THROUGH CENTER FOR LIVING AQUATIC RESOURCES RESEARCH AND DEVELOPMENT (CLARRD)- PANAPITIYA

Responsible officers:

G.S.C. Perera

E.D.M. Epasinghe

There was an established opinion that Panapitiya Regional Research Center was not suitable for aquaculture practices even among the experts of the field before NARA has been handed over the applicable center. But being given to understand the positive potential for aquaculture, NARA gradually initiated infra structure development activities and aquaculture programmes from 2014.

Koi Carp production including brooders, feed development for ornamental fish, disease treatments for the fish brought by farmers and fish meal production using invasive and alien Knife Fish as a special research activity were practiced based on Panapitiya Center in the year 2016.

Many people have initiated ornamental fish breeding practices as an income generating way because of government subsidy programs, loan schemes, awareness programs and so on. Those farmers are operating their activities in small scale and so they have not got facilities and enough spaces to maintain a proper brood stock especially larger fish like Koi Carp. So they always rely on the outer sources for the brooders and it is impossible to find suitable brooders easily. Therefore, as an alternative to the above issue, Panapitiya RRC of NARA initiated Koi Carp production program and the selected fish were developed as brooders and those fish were issued to the farmers. Rest of the stages was sold to the middlemen and fish keepers as a hobby.

Most of the ornamental fish farmers use the imported feeds and it waste foreign currency. Some farmers irrationally use the so called “higher protein diets” and some use shrimp feeds. As an alternative to the above situation we initiated to develop suitable ornamental fish feeds and those feeds were tested at Panapitiya RRC. Then pellet feed producing program was initiated using newly bought fish extruder and it was sold two types of feeds. (Nursery feed and special grower feed.)

Panapitiya RRC generated Rs : 531,610.00 income selling Koi Carp only from 3 mud ponds and fish feed selling in the last two months in the year 2016. Knife Fish is an identified invasive and alien fish which is damaging our bio diversity. It is hardly consuming and value adding is the one of the main solutions to control its population. Fish meal production using Knife Fish is identified as a value adding way and it was conducted at the center as a special research.

Knife Fish were collected from Uyanwatta reservoir and Bolgoda Lake. After removing the scales and gut contents hose fish were steamed and pressed. Then it was dried using a sun drier and finally powdered. It was succeeded to produce a fish meal with a better texture. Wet weight and dry weight of each fish were measured separately. Nutritional facts of the fish were analyzed in two ways. (1. Including head and bones. 2. Excluding head and bones.) Average recovery percentage of the fish was 22.24%. crude protein level excluding head and bones was 70.01 % and crude protein level including head and bones was 59.64%. This results prove that there is a possibility of producing a commercial fish meal using Knife Fish. More research needed to find out how to produce those fish meal economically.

New cement tank system was built and internal water supplying system was also established during the year 2016. In adding to that 3 mud ponds were cleaned.

As field activities, Freshwater prawns were stocked in 6 small mud ponds in order to find the production enhancing methods.

Output

- Introducing fish meal producing techniques using invasive and alien Knife Fish.

Outcomes

- Controlling the Knife Fish population.

Project progress

Progress (%):- Financial: 100%

Physical: 93%

Constrains

- Unavailability of lab facilities including microscope limited the diseases checking.

PROJECT No : 3.4.1

MANAGEMENT OF WHITE SPOT SYNDROME VIRUS (WSSV) DISEASE IN SHRIMP FARMING SECTOR IN SRI LANKA

Responsible officers: M.L. Rasika Thanthrige
J. Sarath Jayanatha

Viral diseases are challenging problem for the global shrimp industry. Disease caused by white spot syndrome virus (WSSV) has resulted in heavy mortalities and severity may occur up to 100% within 3 to 7 days (Zang and Wang, 1998) in all life stages of penaid shrimp. Apart from the shrimps WSSV has a wide host range that includes more than 40 species, which extends to wild crustaceans, planctonic copepods and other arthropods where it may cause no gross signs, thus act as carriers to infect cultured shrimp. Nucleotide comparisons in small regions of the whole genome among the geographical isolates have shown high sequence homology indicating that genotypic variations in the White Spot Syndrome Virus. The virus can be transmitted horizontally where it mostly happens by means of predation on diseased individuals thus one objective of this study was to investigate the possible carriers of the WSSV disease in the shrimp farming environment of North Western region. Although WSSV continuous spreading in the industry it is lack of research studies on mode of transmission and genetic variation of the disease. Comparison of the ORF94 gene region between the small (rr1) and the large (rr2) subunits of the ribonucleotide reductase genes can revealed the part of the genome consist a tandem repeat sequence (TRS) region which contain 54 base pair (bp). Therefore, the other objective of the study was identifying the genetic variations which responsible to the pathogenicity of WSSV disease in Sri Lanka. Tissue samples of *P. monodon* post larvae, juvenile stages, different species of crustaceans such as Mole Crabs (*Emerita analoga*), Mangrove crabs (*Scylla olivacea*) Mud crabs (*Scylla serrata*) and pleopods of Wild Shrimps (*Penaeus indicus*, *P. semisulcatus*), total body of Brine shrimp/Artemia (*Artemiasalina*) and muscle tissue of some mollusks were collected from hatcheries, fish collectors at the markets and sellers in vicinity of the shrimp farms, in North Western Province of Sri Lanka during 2016. DNA was extracted from 25-50 mg the above sample using DNA extraction reagents supplied in IQ 2000 TM WSSV Detection and Prevention kit (Gene Reach Biotechnology Corp. Taiwan) according to the manufactures protocol. Extracted DNA was screened by nested PCR for the disease detection using reagents and master mixtures supplied by above kit according to the manufactures guidelines and under recommended thermal cycle instructions. The samples which were positive to the WSSV disease were subjected to 2-step nested PCR amplification for the genotypic studies. Using specific primers in the TRS region at OFR 94, between the rr1 and rr2 genes. The amplified PCR products will be resolved by electrophoresis in 2% Agarose – TAE gel containing 0.5µg/ml ethidium bromide and visualized by UV- transilluminator. (Dolphin-Doc Gel Image System, Wealtec, Version 2.1). Over 250 samples of crustaceans were screened for the WSSV disease and slight positive level to highly positive level results were found in some other crustaceans. Those species have potential to act as a carrier for the disease. The PCR procedure and the thermal cycle were optimized to some extent and have to do optimize for the samples in other species. By testing the shrimp samples for WSSV disease in the farm and hatchery owners and doing researches about horizontal transmission studies could have to cater to the shrimp aquaculture sector by managing the viral diseases conditions.

Output:

- Could be Identify the possible carriers of that bearing the wssv disease in North Western Region
- To optimize the thermal cycle parameters to Identify the genotypes of the wssv disease in some extent.

Outcome:

- Increase shrimp production through better health management

Project progress

Progress (%):- Financial: 71% Physical: 81%

Constraints:

- Test kit not availability in the right time and last year it came in the month of September
- Lack of staff for the disease monitoring field schedules and the laboratory works
- In some emergency disease conditions transport requirements were not available

PROJECT No: 3.4.3**EFFECT OF WATER QUALITY MANAGEMENT AND USE OF PROBIOTICS IN SHRIMP PONDS IN DIFFERENT CULTURE ZONES WITH ENVIRONMENTAL PARAMETERS TO ENHANCE PRODUCTION**

Responsible officers: A.S.L.E. Corea,
Ranga Jayawickrama

The main objectives of the project are to study the impact of culture environment and management practices on use of probiotics and production. Although many methods are adopted by farmers to enhance production and combat disease. The results are not very successful. Therefore, the project analyzed the reasons underlying low production or low profits and disease situation.

The environment conditions in the North-western province prevailed favorable for shrimp culture during 2016. The water quality in the lagoon was favorable during most parts of the year, (salinity, 35ppt, ammonia 0.002 - 0.04mg/l and DO > 3.0 mg/l). But post larval quality was not very good during early parts of the year after the heavy rains and flooding experienced during latter part of the year. Few incidence of White spot disease were recorded during both culture seasons of the year. Most probiotics used were not successful in maintaining water quality during low saline conditions. In normal conditions, farmers who used such products methodically were successful while those who used probiotics without proper planning were not able to get good results. Pathogenic Bacteria levels in ponds varied with the pond management practice. In farms using probiotics without proper planning showed pathogenic bacteria levels above 90cfu/ml. Farms adhering to good management practices showed lower bacterial counts, the total bacteria counts remained at a similar level in all ponds. However most of the harvests received were good with an average growth of > 20g per piece. Continuous monitoring of ponds and appropriate usage of probiotics may help in increasing production.

Output

- Average harvest size with water management methods and use of BMP's in farms

Outcome

- Production increase through better pond management

Project progress

Progress (%):- Financial: 100%

Physical: 78%

Constraints

Unavailability of Chemicals affected the work throughout as sample analysis could not be carried out as planned. Requested chemicals were not received and some parameters of water quality could not be carried out at the latter part of the year due to lack of chemicals.

PROJECT No :3.4.4**COMMUNITY BASED ORNAMENTAL FISH CULTURE AND DISEASE MANAGEMENT IN HAMBANTOTA DISTRICT****Responsible officers:**

Dr. A.D.W.R. Rajapakshe

Ornamental fish farming is a high income generating industry. It is very popular every where in the country and many people are engage in this industry in Hambanthota district. But they are facing lot of problems such as Lack of good quality brood fish insufficient fry collection, frequent disease out break and limited buyers, Mitigating these problems this project was initiated by RRC Rekawa with the help pf recent development in the area a good potential for developing ornamental fish industry in Hambanthota district.

7 Mud ponds were selected for the study. 04 ponds were located in Murawesihena, Ambalanthota AGA division and other 03 ponds were located in Kanuketiya area in Angunakolapelessa AGA division. All ponds have been constructed by owners. Famers were aware the study and cleaned, All ponds were covered by netting for prevent entering predators. Drain all the ponds and applied Cl2 for eradicating the pest and other wild fish species. Filled water and left for conditioning with cow dong for the nourishment of ponds.

Measured initial water quality and stocked one week old carp fry on 28th July 2016 except B pond. However due to high mortality and severe drought condition project works have been post pone. Restocked fish on August and growth rates monitored once a month and water quality measured fortnightly. Fish were fed with commercial feed twice per day.

Ph , Dissolve oxygen ,water and air temperature and turbidity were measured as the water quality of all ponds. All these measurements were kept acceptable levels of the fish growth except turbidity. OnePond couldn't restocked due to lack of water and Another two (M3 and M4) due to lack of fish fry.Fish will be harvested at the end of this month.

Therefore, the survival not contain with this data. According to this experiment it is concluded that koi carps are more suitable for the mud pond culture in this area and surrounding by netting materials is good method for protecting from predators.

Output

- Farmers aware the fish farming.
- Tested the ponds suitability for carp fish farming.

Out come

- Extra income for the community

Project progress

Progress (%):- Financial: 100%

Physical: 75%

PROJECT No : 3.5.1

STUDY OF WATER QUALITY, FEEDING ECOLOGY, STRUCTURAL PROPERTIES AND COMMUNITY BASED MANAGEMENT OF FISH ASSEMBLAGES IN BRUSH PARKS OF NEGOMBO ESTUARY.

Responsible officers: M.Gammanpila

Negombo estuary (3,164 ha) in the western coastal belt of Sri Lanka supports many species of fish and crustaceans which are important sources of livelihoods for the people around the estuary. Brush parks are a kind of traditional form of fishing method which are installed in shallow areas of the estuary using dense masses of mangrove twigs. Data were collected from major brush park fishing areas (Munnakkaraya, Katunayake and Dungalpitiya) in Negombo estuary, Sri Lanka to investigate and classify diet composition, evaluate trophic guilds structure, determine the degree of food resource partitioning and effect of structural properties on sustainability and economics of periphyton based brush park fisheries production. Additionally questionnaire survey was carried out including semi-structured interviews and participatory observations to investigate how fishers optimize resource use in the brush park fishery through community based management.

The results of present study illustrated that the fish assemblage in brush parks show both food resource partitioning and dietary competition, the former characterizing divergence of resource use to minimize competition for limited food resources and the latter reflecting resource abundance. Consequently, knowledge on the feeding habits, trophic ecology and dietary overlap, examining the complex association between fishes that sharing similar resources in brush parks is fundamental tool for ecosystem based fisheries management.

The yield and its catch value of brush parks were related to the period since installation and twig density. Present findings suggest that to achieve maximum brush park yield, the optimal period since installation was about 30 days and the optimal twig density was about 2 kg m^{-3} . Although there was no specific authority for governing the brush park fishery, owners themselves hold rights to implement and monitor traditional community-based fishery management (CBFM) strategies. It is important to establish co-management strategies, where centralized fisheries management authorities also play a significant role in the decision-making process.

Out put

- Installation and harvesting between 30 days and the twig density using 2 kg m⁻³ recommended for maximum yield.
- Sustainability of brush-park fishery needs proper management strategies based on indigenous knowledge of fisher community.

Out come

- Recommendations and guidelines for sustainable ecosystem based fisheries management and co-management strategies based on traditional knowledge of brush park fisher communities.
- Minimized destruction of coastal ecosystems with an emphasis on mangroves caused by fisheries activity.
- Identify factors effect for brush park fishery production.

Project progress

Progress (%):- Financial: 99% Physical: 87%

PROJECT No: 3.5.2

ENHANCING THE PRODUCTIVITY OF SELECTED SMALL WATER BODIES IN HAMBANTHOTA AND MATARA DISTRICT BY STOCKING SUITABLE FISH/PRAWN.

Responsible officers: K.W.R.R. Amaraweera

The change from traditional subsistence to semi-intensive is leading to an increase in the aquaculture feeds. The culture of freshwater prawn, *Macrobracium rosenbergii* in Hambanthota District Sri Lanka as protein source and source of income for small-scale farmers is important. However, due to the unavailability and high cost of feed ingredients and formulated cost-effective channels to deliver feeds to farmers has contributed to the poor production and profitability. A nutritional study was conducted to evaluate growth performance of *M. rosenbergii* fed low cost formulated diets, using locally available ingredients in ponds for 150 days. Experimental formulated diet (diet-1) and commercial diets (imported prawn diet, Tom boy Till 300) were fed. Although there were no significant difference between the formulated Experimental diet and the commercial diet for crude protein content, this study indicated there were significant difference between the formulated Experimental diet and the commercial diet for Growth rate, Survival rate, Feed conversion ratio and the total production of *M. rosenbergii* ($P > 0.05$). The economic analysis of feed production showed that production cost of formulated experimental Diet-1 was Rs 130/= The cost of commercial feed used for the research study was Rs 180/= in the market. According to the feed conversion ratio to produce 1 kg of prawn used less amount of formulated Experimental Diet- 1 than the imported commercial feed. Therefore, formulated diet - 1 can be recommended for *Macrobracium rosenbergii* semi-intensive culture in ponds as cost effective feeds in comparison to imported commercial prawn feed.

Out put

- Establishment of mud ponds for fish/prawn farming
- Transferal of technology for semi intensive culture of prawn
- Generation of economic growth and indirect employment

Out comes

- Final Report

Project progress

Progress (%):- Financial: 99% Physical: 88%

PROJECT No : 8.1.4**FEASIBILITY OF UTILIZING MANGROVE ECOSYSTEMS FOR IMPROVEMENT OF THE LIVELIHOOD OF COASTAL COMMUNITIES**

Responsible officers: Dr.D.D.G.L. Dahanayaka
Dr.V.Pahalawattaarachchi

Mangrove ecosystems are among one of the most productive ecosystems in the world. Mangroves are rapidly diminishing wetland type in Sri Lanka, vulnerable to conversion by private investors for purposes such as shrimp farming, tourism, housing complexes and other development activities and also being used as wastelands where solid waste is dumped. *Nypafruticans* is one such palm, which has a good potential for sugar, vinegar and alcohol production. The technology is available in Thailand, Malaysia, Papua New Guinea and Philippines but yet not developed in Sri Lanka. Objectives of the project were to utilize unexploited natural resources for development, improve livelihood of coastal communities and conservation of *Nypa* ecosystems. Two nurseries of *Nypafruticans* were developed close to GingOya area, UthruKammala, Waikkala. At present, over 500 *Nypa* nursery plants were produced with community under NARA technical guidance and financial support. CCD & GA office Waikkala purchased over 200 plants under the "Divinaguma", Wanavaga Project. It was directly benefited for the community and motivate keeping nurseries for future planting activities. Five soil samples were analyzed in different locations *Nypa* culture sites along the GingOya. Soil texture was measured using mechanical. Toddy trapping of *Nypa* initiated at Nainamadama and UthruKammala, Waikkala area with support from toddy trappers, who was successfully supported to NARA during similar toddy trapping activities during 2007-2008.

The soil composition was recorded as 68% clay; 31% silt. 9% encountered organic matter. According to the analysis of sap by ITI ethyl alcohol percentage was 2.3%v/v. The daily sap yield varied from 0.1 to .5 liters per fruit stalk during study period. Presently, the coastal communities in the selected areas are not using the mangrove ecosystems to uplift their livelihoods. The palm *Nypafruticans* leaflets are made into thatched used for roofing and walls of rural houses. At the initial stage toddy trapping were delayed due to the legal provisions. For the research activities, permission were granted with the discussion from the AGA, Waikkala and sap collection were initiated. At present, major constrain is the limitation of the suitable flower buds for the trapping. According to the traditional knowledge, trapping should initiate with early stage flowers which are not opened. Those flowers were

reported rarely according to our survey. GingOya area, *Nypa* were limited to narrow stripes and isolated patches due to the anthropogenic activities. Therefore, suitable trapping plants also limited. In this contest *Nypa* should expand through the nursery maintain and plantation through the proper technical guidance.

Output:

- Proper technique and drawbacks identified in sap extraction of *Nypa* nursery management was successful

Outcomes:

- Sustainable utilization of available resources in order to develop live hood

Project progress

Progress (%):- Financial: 24% Physical: 95%

Constrains:

Disturbance of water circulation, illegal land reclamation, garbage dumping, unplanned development activities, illegal liquor distillation and tourism activities are the identified threats for the *Nypa* ecosystem

Publications

Full papers/ short communications

1. Upali S. Amarasinghe & P. A. Don Ajith Kumara & Sena S. De Silva 2016. A rationale for introducing a subsidiary fishery in tropical reservoirs and lakes to augment inland fish production: case study from Sri Lanka *Food Security* 8:769–781 (DOI 10.1007/s12571-016-0596-4).
2. Gammanpila, M., Wijeyaratne, M.J.S. & Amarasinghe, U.S. (2016). Shedding of gill epithelia by grey mullets (Family Mugilidae) in Negombo Estuary, Sri Lanka. *Sri Lanka Journal of Aquatic Sciences*. 21(2), pp.151–155. DOI: <http://doi.org/10.4038/sljas.v21i2.7509>
3. Jayasinghe PS, **Pahalawattaarachchi V**, Ranaweera KKDS, 2016, Seaweed contains all the trace elements and growth hormones required by plants. Recently there is a growing concern over the use of seaweed liquid fertilizer (SLF). Today, there is a high demand for environment friendly agriculture for production of quality and healthy food to nourish the increasing population. *Discovery* 52(244), 723-734
4. Jayasinghe PS, **Pahalawattaarachchi V** and Ranaweera KKDS 2016 Formulation of Nutritionally Superior and Low Cost Seaweed Based Soup Mix Powder J Food Process Technol, 7:4 <http://dx.doi.org/10.4172/2157-7110.100057>
5. Jayasinghe PS, **Pahalawattaarachchi V** and Ranaweera KKDS 2016 Effect of Extraction Methods on the Yield and Physiochemical Properties of Polysaccharides Extracted from Seaweed Available in Sri Lanka *Poult Fish Wildl Sci* 4:1

6. **RamaniShirantha** (2016). Current conservation issues in *Sytomusasoka* endemic to Kelani river, Sri Lanka. *Wildlanka* R.M.R.N.Rajapaksha (Ed.), pp. 7-9, Department of Wildlife Conservation, Sri Lanka.
7. **RamaniShirantha** (2016). The Asoka Barb of Sri Lanka. In: Sri Lanka's Five Most Concerned. R.M.R.N.Rajapaksha (Ed.), (pp. 19-23), Department of Wildlife Conservation, Sri Lanka.
8. Dahanayaka D.D.G.L; H.D. Wimala Sena, **V. Pahala Wattarachchi** Potential of the conservation oriented mangrove based ecotourism; a case study of Kadolkele Mangrove Reserve, Negombo, Sri Lanka, Journal National Aquatic Resources Research and Development Agency (In press)

Proceedings/Abstracts

1. **Gammanpila M.**, Amarasinghe U. S. and Wijeyaratne M. J. S. (2016). Community-based management strategies in the brush parks fishery of Negombo estuary, Sri Lanka. Proceeding of International Postgraduate Research Conference, organized by Faculty of Graduate Studies, university of Kelaniya, Sri Lanka. pp. 165.
2. **Gammanpila M.**, Amarasinghe U. S. and Wijeyaratne M. J. S. (2016). Trophic ecology and resource partitioning of fish assemblages in brush-parks of Negombo estuary, Sri Lanka. Proceeding of International Research Symposium on Pure and Applied Sciences (IRSPAS), organized by Faculty of Science, University of Kelaniya, Sri Lanka. pp 01.
3. **Gammanpila M.**, Amarasinghe U. S. and Wijeyaratne M. J. S. (2016). Ecomorphological correlates with food habits of fish assemblages in brush parks of the Negombo estuary, Sri Lanka. Proceeding of **22nd annual sessions of Sri Lanka Association for Fisheries and Aquatic Resources.**
4. **Gammanpila M.**, Amarasinghe U. S. and Wijeyaratne M. J. S. (2016). An evaluation of the effect of structural properties of construction materials on the brush parks fishery in the Negombo estuary, Sri Lanka. Proceeding of **annual scientific sessions of National Aquatic Resources, Research and Development Agency.** pp. 4.
5. Fahim, M.S.M., B.K.K.K. Jinadasa, G.D.T.M. Jayasinghe, **C.B. Medagedara and P.A.D Ajith Kumara** 2016. Proximate composition and fatty acid profile of the sea cucumber *Holothuriascabra* collected from two geographical locations in Sri Lanka. Proceedings of the National Aquatic Resources Research & Development Agency (NARA), Scientific Sessions 2016, 19-22 pp.
6. Nishanthan, G., **P.A.D A. Kumara**, M.D.T.S. Croos, D.V.C. Prasada and D.C.T. Dissanayake 2016. Processing of sea cucumbers to *beche-de-mer*: A case study from Sri Lanka. Proceedings of the Wayamba University International Conference, Sri Lanka p.06, 19-20 August 2016.
7. **M. Epasinghe, A.M.A.N. Adikari**, H.M.P. Kithsiri, **V. Pahala Wattarachchi** and T.A.D.W. Karunaratne, **(2016).** Induced breeding of Tinfoil Barb

(*Barbonymusschwanenfeldii*) using Ovaprim, Annual Scientific Session of NARA 2016, March 29, Colombo, Sri Lanka; 35 pp.

8. W.A.U. Isharini, **E.D.M. Epasinghe**, T.A.D.W. Karunaratne, **A.M.A.N. Adikari** and N.P.P. Liyanage (2016). Examine the appropriate ovulation time to determine latency period of Golden Tinfoil Barb (*Barbonymusschwanenfeldii*) using Ovaprim™, Proceedings of the 6th research symposium of UvaWellassa University 201, January 28-29, Badulla, Sri Lanka; 106 pp
9. W.M.W.S. Thilakaratn, **E.D.M. Epasinghe**, T.A.D.W. Karunaratne, **A.M.A.N. Adikari** and N.P.P. Liyanage (2016). Strategies to reduce larval cannibalism of *Pangasiussutchi*, Proceedings of the 6th research symposium of UvaWellassa University 201, January 28-29, Badulla, Sri Lanka; 107pp.
10. D.M.S. Sugeeshwari, **V. Pahalawaththarachchi** 2016. Optimization of Sterilization of the Explants of *Cryptocorynewendtii* and Selection of a suitable Hormone combination for the Initiation of Shoots from the Explants. NARA Scientific Session; Pg 29.
11. G.S.C. Perera and E.D.M. Epasinghe 2016; Optimum requirement of fish based animal protein for the growth performance of juvenile freshwater Angel Fish (*Pterophyllumscalare*) Conference – WinC– Wayamba International Conference, Wayamba University of Sri Lanka, Date – 19-20 August 2016
12. **Pahalawattaarachchi V.** 2016 Role of NARA in seaweed sector development in Sri Lanka. Unlocking the Industrial Potential of Seaweed Resources in Sri Lanka, Presented at 13th January at SLINTEC, Auditorium.
13. Jayawickrama R.D.G.R, A.S.L.E. Corea **V. Pahalawatttharachchi** (2016) Impact of disease and pond management options in shrimp farms during heavy rains and floods– 72nd Annual sessions of Sri Lanka Association for Advancement of Science (SLAAS)
14. Jayasinghe, P. S. ; **V. Pahalawatttharachchi** and K.K.D. S. Ranaweera 2016 Seaweed extract as a natural food coloring agent on chemical, microbial and sensory quality of Jelly desserts Annual Scientific Session of NARA 2016, March 29, Colombo, Sri Lanka;
15. Srikrishnan, R., Hirimuthugoda. N.Y, **Rajapakshe. W** 2016 .Effect of 3 different live feeds on growth performance of fighting fish.
16. Weerasingha R., Punyadewa N. B. P., **Pahalawaththarachchi V.** and H. M. P. Kithsiri (2017) Preparation of fishmeal as a possible method to eradicate *Pterygoplichthys species* (Amazon sail fin catfish and vermiculated sail fin catfish) from Sri Lankan Reservoirs. Proceedings of the national symposium on invasive alien species. 25
17. **Weerasingha, R.** (2017) Invasion of *Pterygoplichthys species* (Amazon sail fin catfish and vermiculated sail fin catfish) in Sri Lankan Reservoirs and a possible control measure. Proceedings of the national symposium on invasive alien species

Full papers Submitted

1. Kodithuwakku, H. **Parakrama, M.G.I.S, Heenatigala, P.P.M and Pahalawattarach, V.** “A comparative laboratory trial on the effect of *Sargassum wightii* incorporated formulated feed on growth and immunity development of Asian sea bass *Lateolabrax niloticus* (Bloch, 1790) Full research paper resubmitted to *Sri Lanka Journal of Aquatic Science*
2. Shanmugama* S. Kulendranb , E. Rajeevb, **V. Pahalawattaarachchi** , P. N. Chandraratned , J. M. Asokad , Abhiram Seth 2016 Successful establishment of commercial farming of carrageenophyte *Kappaphycus alvarezii* Doty (Doty) in Sri Lanka: Economics 2 of farming and quality of dry seaweed . To Journal of Phycology
3. Weerasingha R. and **V. Pahalawattaarachchi** (2017) Present status of coral community in the Bar reef marine sanctuary, Sri Lanka. MEPA Journal (Accepted)

Posters prepared

1. Illustrated and informative poster prepared on “Fish feed preparation” (Sinhala medium)
2. Conduct demonstrations about Sea Cucumber culture, Oyster culture and Sea weed culture for agriculture undergraduates of Rajarata University of Sri Lanka at RRC premises
3. Conduct demonstrations about Sea Cucumber and Oyster culture for Students in University College Anuradhapura at RRC premises
4. Organized the opening inauguration ceremony of “Wevaksamagamak” in Janasavipura village, the chief guest of Fisheries and Aquatic Resources Minister Hon, Mahinda Amarawaseera

Extension work:

Knowledge transfers (Individual, groups, mass media)

1. Lecturers delivered to Junior Naval Officers on “Fishery, Aquaculture and Related Regulation in Sri Lanka” at NARA auditorium.
2. Visiting lecturer in Aquatic Ecology, Wildlife Certificate Course/Giritale National Wildlife Training and Research Center (NWLTRC), March and November, 2016.
3. Key address on freshwater fish conservation on the “World Wildlife Day”, Uda Walawe National Park, 3rd of March 2016.
4. Media conference with Rupawahini and Derana television to discuss “Endemic fishes and their conservation issues”.
5. Participated in ITN “Coffee Table” live program.

6. Provided information and instructions to the ornamental fish farmers and interested people on fish feed formulation, Fresh water prawn culture, food fish culture, tank preparation etc on their request.
7. Provided necessary instructions and knowledge on aquaculture, ornamental fish culture etc...for some school children who wish to prepare assignments on the subjects.
8. Provided technical knowhow and theoretical knowledge on fish nutrition, fish feed formulation and preparation, feed enrichment, feed management and feeding for various university undergraduate students.
9. Information and instructions were provided to the ornamental fish farmers who engaged with fish induced breeding on their request.
10. Provided information on shrimp culture for school a/l project students and to farmers who came to seek information
11. Dissemination of knowledge on fish breeding and Therapeutic measures for disease conditions for ornamental farmers when requested.
12. The two our lecture was done for the Open University students about fish diseases
13. A one day awareness program on 'Invasion of *Pterygoplichthys* species (Amazon sail fin catfish and vermiculated sail fin catfish) in Kalawewa' which held in Praja shalawa, Dhathusenapura diyawara gammanaya, Wijithapura, Kalawewa on 16/10/2016 for fishermen and responsible officers in NAQDA and Department of wild life, Kalawewa.
14. A presentation was done for all officers in NAQDA about the Invasion of *Pterygoplichthys* species (Amazon sail fin catfish and vermiculated sail fin catfish) in Sri Lankan Reservoirs and the identified possible control measure on 17/12/2106.

Seminars /workshops/ exhibitions conducted /coordinated

1. One day school seminar programme conducted on "Endemic fish identification, their importance and conservation", "Water pollution and conservation of Aquatic Environment" and "Importance of Mangrove Vegetation" at SariputhraMahaVidyalaya, Ahangama on 02.02.2016
2. Practical work shop on "Fish Nutrition and feed processing" was conducted to 25 fish farmers in Hambantota District and gave the practical knowledge on the subject. Workshop was held at the auditorium of RRC/Rekawa.
3. General instruction on "fish feed preparation, feeding and management" discussion was conducted to few fish farmers in Negombo area.
4. Workshop on Mangrove resources for the 120 student of Shariputhracollege, Ahangama on 02nd February 2016
5. Workshop on Mangrove resources for the 90 students of HapugalamahaVidyalaya on 13th May 2016.

6. Conducted lecture on Importance of Mangrove for the public sector, organize by MEPA on 24th November 2016.
7. NARA stakeholder meeting committee chair on 22nd July 2016 in NARA Auditorium.
8. Organized and conducted three-day training programme on Ornamental fish culture, breeding and disease management in RRC Rekawa for the young people in Tangalle division.
9. Coordinated the awareness programmes conducted in Hambantota district for “DeewaraSawiya” from 14th-27th September 2016.
10. Organize the 03 awareness programme for fishing society for making dried fish and Moldive fish in Kahandamodara and Mawella area on the month of November 2016
11. Organized the “NATUREX 2016 exhibition stall Faculty of Agriculture, University of Ruhuna on 23rd to 25th March 2016.
12. Conducted one day practical training program on ornamental fish management for the students from Open University on 04th April 2016.
13. Organized training program on Ornamental Fish Breeding, Culture and Management 2016 (OFBC&M 2016) and delivered lectures, conducted practical classes on “Ornamental Fish Breeding Rearing and Management”. 38 participants successfully completed training program and 304,000 LKR income earned
14. **NextLanka** Exhibition, a parallel event to Asia Pacific climate Change forum, held at BMICH, 17-19 October 2016 organized by Biodiversity Secretariat, Ministry of Mahaweli and Renewable energy, Colombo

Services provided

1. Represent the panel for the presentation of Diploma students in Ocean University, Tangalle on 12th February 2016.
2. Made the visit to Dellawa, Wekada Ela for investigating the fish kill incident on 04th July and given the report to the Police station, Neluwa.
3. Provided reports when submitting the illegal lobster samples by Tangalle Magistrate.
4. Analyzed disease fish samples and recommended treatments for the disease fish submitted by fish culturists.
5. Served as a field inspection committee member for project based on “Power supply for Mohottuwarama Island” organized by the Divisional Secretariat
6. Participated as a resource person for the special guest meeting on “Marginal fisher folks empowering project” conducted by SEDEC NGO

7. Conduct demonstrations about Sea Cucumber culture and Oyster culture for (BSc) Aquaculture and Fisheries undergraduates of Wayamba University of Sri Lanka at RRC premises
8. Participated as a resource person for field inspection conducted by the Land Use Policy Planning department of Puttalam on "Finding on issues of prawn farms at Arachchikattuwa and Mundalama divisional secretariats.
9. Participated as a resource person for Reforestation programme-2016 conducted by Marine Environment Protection authority at Echchankaduwa Naval Detachment
10. Fish feed preparation for "Sojan Program" at Walallawita.
11. Represent panel for presentations Post graduate Institute of Peradeniya
12. Review two project proposals for NSF funding
13. Review two research papers for NSF and Department of Forest
14. Participated as an Aquatic biodiversity expertise for baseline survey of Nagarkovil lagoon, Jaffna; a proposed Wildlife sanctuary.
15. Served as an Aquatic biodiversity expertise - proposed micro hydropower project at MahaEliya, Horton Plains National Park, Department of Wildlife Conservation, December 2016.
16. Worked as the Fish ecology expert – Madakadaproposed mini hydro power project, Forest Department, December 2016.
17. Expert Consultant (2016) – Conservation of Sri Lanka's Most Concerned Five – *Systomusaskoa*, Special species conservation project, Department of Wildlife Conservation (DWC), Sri Lanka.
18. Participated at project evaluation board (Judge) of the Post graduate institute of Peradeniya
19. Revived papers for Forest department, MEPA conference, University of Uva Welassa symposium.
20. Review paper on heavy metal phytoremediation potential of 1mangrove plant species of pattani bay, Thailand
21. Serving in editorial board of Journal of APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH, <http://www.aloki.hu> • ISSN 1589 1623 (Print) • ISSN 1785 0037 (Online)

Report/Letters prepared:

1. On the request made by the Director General, Department of Fisheries and Aquatic Resources Development (DFARD) on 24th February 2016 under the theme of "Implementation of Development activities in Fisheries sector", I have submitted project proposal on "Study of the effectiveness of re-stocking in perennial reservoirs to enhance the inland fish production"
2. On the request made by the Ministry of Foreign Affairs on 06th June 2016 regarding "Concept Note on Blue Economy for the SAARC Region" feedback was given.
3. A comprehensive project report submitted to Asian Development Bank seeking financial assistance to promote "Mariculture development with special emphasis on fin fish and non-fin fish farming in Northern Province in Sri Lanka". 16th August 2016.
4. On the request made by the Ministry of Primary Industries to establish "Fisheries Mega Zone" in Northwestern province the detailed description of hatchery design were submitted on 31st August 2016
5. Provided suggestions and recommendations for the document sent by Sri Lanka Standard Institute for the preparation of Sri Lanka Standard Specification for *Beche-de-meras* a working group member of NARA of this committee.
6. A comprehensive project report submitted to Ministry of Environment, Department of Coastal Conservation and Tourist Development Authority seeking their approval to acquire a land for NARA to "Establishment of Multi-Species Marine Hatchery in Kalpitiya" December 2016.
7. Preparation of a document on "Environmental Education Programme (EEP) for NARA" as a member of committee which appointed to formulate NARA Outreach programme.
8. Preparation of field inspection report on "Recommendations for establishing a salt production factory for Hiru Food Products (Pvt.) Ltd at Karamba, Kalpitiya" December 2016.
9. Preparation of field inspection report on "Recommendations for establishing a salt production factory for Hiru Food Products (PVT) Ltd at Karamba, Kalpitiya" December 2016

Meetings Attended:

1. Participated to District fisheries meeting held at District Secretariat Puttalam
2. Participated to the meeting organized by North Western provincial council regarding fisheries issues resolving and Fisheries and Aquatic resources act preparation held at St. Sebastian community hall Kalpitiya.

3. Participated to the Regional Coordinating committee held at Divisional secretariat Kalpitiya
4. Participated to District fisheries meeting held at District Secretariat Puttlam
5. Participated to the Regional Coordinating committee meeting held at Divisional secretariat Kalpitiya
6. Participated for District coordinating committee meeting on “Preparation of Guidelines for International Fisheries” held at *Ceylon Fishery Harbors Corporation at Kalpitiya*
7. Participated to District fisheries meeting held at District Secretariat Puttlam
8. Participated for special meeting held regarding on “Conservation project on Dugong and sea grass in Puttalm lagoon and Mannar”
9. Participated to District fisheries meeting held at District Secretariat Puttlam
10. Participated to the Regional Coordinating committee meeting held at Divisional secretariat Kalpitiya
11. Participated for the meeting held regarding “Issues of kite surfing on Puttalam lagoon” at District Secretariat Puttalam.
12. Participated to District fisheries meeting held at District Secretariat Puttlam
13. Took part on a meeting about “National Protection Day” held at District Secretariat Puttalam
14. Participated to the “District Coordinating Committee meeting on International Fisheries” at *Ceylon Fishery Harbors Corporation at Kalpitiya*
15. Attended District coordinating committee meeting in Hambantota
16. Attended district committee meetings at Kalutara
17. Attended the meeting in Hambantota District secretariat on 12th August organized by CCD.

Training

1. Conducted one week industrial training program for undergraduate students of Uva Wellassa university, Wayamba and Peradeniya, and Jayawardanapura

2. Trainings conducted at Panapitiya center

Institute	Name of the Student	Duration	Nature of the Training
Dept. of Applied Sciences, University of Sri Jayawardanapura.	(Miss) S.A.S.R. Sirimanna	08.12.2015 to 14.01.2016	Fish feed preparation, water quality monitoring/checking, fish rearing techniques, diseases treatments
Dept of Agriculture, University of Ruhuna	(Miss) B.R. Wickramarachchi	08.04.2016 to 20.05.2016	Do

Seminars workshops training attended (Local):

1. Workshop on “Preparation of Draft Thematic Reports” for formulation of national fisheries and aquaculture policy on 17.12.2016 at NARA
2. Workshop on “statistics for Biological Research” conducted by Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR) and Department of Zoology and Environment Management University of Kelaniya.
3. Workshop on writing a winning Research Proposal” Organized by Young Scientists Forum, National science and Technology Commission.
4. Workshop on “How to write a winning proposal” held on 30th September 2016, organized by Young Scientist Forum of the NASTEC. Held in SLIDA.
5. Workshop on the presentations of action plan for year 2017 in NARA held in Paradise Beach Hotel, Negombo on 27th -28th October 2016.
6. NARA scientific sessions
7. SLARFAR scientific sessions
8. One day training programme on Invasive Alien species in Hambantota district on 27th July 2016.
9. Participated for Min Visithuru exhibition on 5-7th August
10. Stakeholder workshop on curriculum revision, Aquatic Resources Technology degree programme, Aubrone Hotel, Wattala, 18th to 19th October 2016
11. Stakeholder consultation workshop on validation of identified requirements and changes to attract local and foreign investors to develop a commercial marine aquaculture sector in Sri Lanka. At NAQDA, 09.09.2016.

Foreign trainings/ workshops/ conference attended

1. Two months training course on “Land-based aquaculture for Asian countries” held from 22nd June to 16th August, 2016 at the Freshwater Fisheries Research Centre, Wuxi, Jiangsu province, China
2. Seminar on Sustainable Aquaculture and Climate Change in the Belt and Road Countries. Country – China, Duration – 03 weeks
3. Participated as an expert – SARRAC regional consultancy program on Policy framing on fish biodiversity management in Transboundary Rivers, Bangladesh, 2-6 October 2015.

Student Supervision:

1. Fahim, M.S.M., 2016. Artificial breeding, larval rearing and grow out culture of sea cucumber *Holothuriscabra* in Sri Lanka, M.Sc. Thesis 65p., October 2016, Department of Zoology& Aquatic Science, University of Sri Jayawardanapura.
2. Thilakshi, E., 2016. The effectiveness of two commercial feeds for sea cucumber larvae, *Holothuriscabra*. Undergraduate Thesis 72p., December 2016, Department of Animal Science, University of Ruhuna.
3. Ms.BuddhikaRasanjalee, under the topic of “Assessing the possibility of using natural caretenoids to enhance skin pigmentation of Oscar fish, using Photoshop software as the analyzing tool. Faculty of Agriculture, University of Ruhuna(.2015/2016)
4. Ms.PradeepaJayasingha, under the tropic of seaweed processing and quality analysis leading to a PhD at University of Sri Jayawardanapura.

Committees served in

1. Environment committee - Sri Lanka Association for Advancement of Science (SLAAS)
2. Science popularization committee – Sri Lanka Association for Advancement of Science (SLAAS)
3. Sectional committee –(section B - Agriculture and forestry) - Sri Lanka Association for Advancement of Science (SLAAS)
4. SLAFAR Executive Committee meeting monthly from January 2016.
5. Aquaculture Technical committee – National Aquaculture Development Agency
6. “UNDP/GEF funded project ON “Capacity building for control, prevent and spreading of Invasive Alien species (IAS) in Sri Lanka, Ministry of Environment and Renewable Energy, Sri Lanka.
7. Aquaculture technical committee - National Aquaculture Development Authority (NAQDA)

8. National Expert Committee on Mangrove conservation and Sustainable use organized by Bio Diversity Secretariat of Ministry of Mahaweli Development and Environment.

Developments

1. Established depuration system at Kalpitiya
2. Established plant tissue culture facility
3. Established algal culture laboratory
4. Established feed and nutrition laboratory
5. Established two fish feed extruders and initiated the fish feed selling to the farmers at Panapitiya RRC
6. Renovation of cement tank system and establishing the internal water supplying system at Panapitiya RRC and renovation of three mud ponds
7. Expansion aquatic plant section through developing new plant net house
8. Expansion and renovation of ornamental fish section

External projects conducted

1. GEF funded project on Ensuring seagrass ecosystem values are incorporated with coastal area planning in Sri Lanka
2. Eradiction of Invasive alien fish species, Tank cleaner funded by Biodiversity secretariat
3. Surveying, Translocation, Monitoring and Relocating of *Labeo fisheri* in Mahaweli River - Moragolla Hydropower Project of CEB
4. Desktop study on Living resources in coastal region around Sri Lanka, for Petroleum Resources Development Survey'.
5. Feed development for seabass -FAO funded

Postgraduate trainings

1. Ms. P. Heenatigala- Reading for a PhD degree on at Institute of Hydrobiology, Chinese academy of Science, China.
2. Mr.M.Gammanpila, Reading for a PhD degree at University of Kelaniya
3. Mr.P.A.D.Ajith Kumara Reading for a PhD degree University of Kelaniya

5.5 MARINE BIOLOGICAL RESOURCES DIVISION

Head of the Division: Dr. Sisira Haputhantri

Overview of the year

The Marine Biological Resources Division (MBRD) is responsible for carrying out research towards management, development and conservation of salt water living resources. Nine treasury funded research projects were carried out by MBRD in 2016. Major research areas include;

Project No	Project title	Officer/s responsible	Allocation/ millions
1	Assessment and monitoring of large pelagic , small pelagic and demersal fishery resources in Sri Lanka	Dr. R. Maldeniya Dr. S.S.K. Haputhantri Dr. H.A.C. C. Perera Mr. M. Jaythilaka Ms. K.H.K Bandaranayake Mr. M.I.G Rathnasuriya Mr K.G.S Nirbada Mr. M.Weerasekara	4
2	Biological assessment of Batoids fisheries and slipper lobster fisheries around Sri Lanka	Dr. R. Maldeniya Dr.H.A.C.C. Perera Mrs. D.Herath Mr. I Rathnasuriya Mr. M. Jayathilaka	1.25
3	Molecular and biological studies on neritic tuna species	Mrs D.Herath	0.8
4	Study on the Distribution and abundance of the blue whales and Dolphins around the South west and North East coasts of Sri Lanka	Mr. U.S.P.K. Liyanage Dr. K.Arulanandan Mr. Akila Harischandra Mr. M. Jayathilaka Mr. I. Ratnasuriya	0.4
5	Experimental fishing for octopus in Northern coastal sea	Mr. M. Weerasekara	0.2
6	A ecological study on coral reefs and species diversity in Hikkaduwa marine sanctuary	Ms. A.A.S.H.Athukoorala Mr. K.G.S Nirbada Dr.S.S.K. Haputhantri Mr.M.I.G Rathnasuriya Mrs.K.H.S Bandaranayake	0.2
7	Alternative fishing method for bottom trawling/stock assessment of shrimp resources in West ,North and Northeast coast	Ms. A.A.S.H.Athukoorala Mr. K.G.S Nirbada	0.5
8	Study on seasonality, diversity and spatial distribution of small pelagic fish species and associated water quality parameters in the Weligama bay.	Mr. U.S.P.K. Liyanage Mr. J.S. Jayanatha	0.15
9	In situ conservation of berried spiny lobster	Mr. U.S.P.K. Liyanage	0.5

Apart from the treasury funded projects, MBRD carried out seven external funded/ consultancy projects:

1. A study of the population biology and fishery of the Blue Swimming Crab (*Portunus pelagicus*) fishery in Jaffna District
2. GEF sea-grass - dugong project: Monitoring and assessment of sea-grass associated fauna including commercially important fish species and assessment of impact to sea-grass bed by gear use in fishery
3. “Sri Lanka – Norway bilateral project” Technical assistance to improve the management of the fish resources of Sri Lanka
4. Environmental impact assessment and study of fish reproductive biology of Karattaya and Yaksalaya
5. Supplementary Environmental Impact assessment for “Extraction of Sea Sand for reclamation work from the site already allocated to Sri Lanka Land Reclamation and Development Corporation SLLRDC”
6. Carry out a marine environmental baseline survey within the Exclusive Economic Zone (EEZ) of Sri Lanka
7. Initial Environmental Examination (IEE) on two Dimensional Seismic Survey for Oil Exploration in Deep Sea Blocks in North East Cauvery Basin of Sri Lanka

MBRD attended to a number of activities in advisory and consultative capacities. More importantly, MBRD responded to a number of requests made by the Ministry of Fisheries and Aquatic Resources Development (MFARD) and the Department of Fisheries and Aquatic Resources (DFAR) by providing recommendations to resolve problems on the exploitation of marine fishery resources.

On court orders, a number of fish samples were analysed by MBRD to determine whether the fish samples provided were killed by using explosives or not. In addition to this, the MBRD research staff got involved in the inspection of dynamited fish samples at the Peliyagoda fish market and inspection tours were made in collaboration with Department of Fisheries and Aquatic Resources Development (DFAR) and Sri Lanka Police. The MBRD staff also appeared at several Magistrates’ Courts in order to provide experts’ evidences regarding dynamite cases handled by the Police and DFAR.

The staff of the division was quite interactive with the fishing community throughout the island and also supported the private sector by attending to requests made by them. The division provided facilities and guidance to university students in undertaking industrial training and final year research projects and to school pupils to carry out their research projects. In addition, the division conducted a number of lectures and awareness programmes especially for Sri Lanka Coast Guards, Sri Lanka Navy, and for fishing community.

The research staff of MBRD was actively engaged in updating the large pelagic and small pelagic fishery databases, analysing the statistics, providing national statistics on large pelagic fish production and preparing research papers on trends and prospects of large pelagic and small pelagic fisheries in Sri Lanka. Several reports were also prepared and submitted to the Department of Fisheries and Aquatic Resources for settling fishing disputes.

Treasury funded projects carried out:

PROJECT No: 2.1.1

ASSESSMENT AND MONITORING OF LARGE PELAGIC, SMALL PELAGIC AND DEMERSAL FISHERY RESOURCES IN SRI LANKA

Large pelagic fish landings were monitored at fishery harbours and major fish landing sites in Sri Lanka. This includes collecting information/data such as details on fishing operations, recording the quantity of the landings by species and by different fishing vessel-gear combinations, biological data collection including measuring the lengths of key species and reporting the active fishing boats operated etc. The Sri Lankan multiday fishing vessels mainly target tuna and tuna-like species. The bulk of offshore and deep sea fish production mainly comprises of tuna and tuna-like fish. In addition, some single-day vessels operating in coastal waters also target those species but, fishing operations are mostly confined to a particular fishing season. Based on above port sampling data collection programme, the large pelagic fishery database (PELAGOS) of MBRD was updated for year 2016. Also, the large pelagic fish production for 2015 was estimated as per data submission requirements of Indian Ocean Tuna Commission (IOTC). The filled data submission forms for IOTC were submitted in May 2016 to the Ministry of Fisheries and Aquatic Resources Development for official submission to IOTC. Using time series data of PELAGOS database, various analyses were carried out and publications were prepared.



Exploring gear-vessel catch efficiency of frigate tuna (*Auxis thazard*) in tuna fishery of Sri Lanka

Tuna is the most important commercial fish group in the marine fishery in Sri Lanka. Within the tuna group, the subgroup of neritic tuna, comprising *Auxis thazard* (frigate tuna), *Auxis rochei* (bullet tuna), *Euthynnus affinis* (kawakawa) and *Scomberomorus commerson* (narrow-barred Spanish mackerel), is also an important contributor in the marine fish production. Among the four key species of neritic tuna found in Sri Lankan waters, frigate tuna is the dominant species presently contributing over 40% to the total neritic tuna production. Frigate tuna is normally caught as a by-catch in the tuna fishery. Ten year port sampling data of Sri Lanka (2005-2014) was used to explore the gear-vessel catch efficiency of frigate tuna in the tuna fishery of Sri Lanka. Four single gears (gillnet, pole & line, ringnet and trolling line) and three gear combinations (gillnet-handline, gillnet-ringnet, longline-gillnet) mainly contributed for catching frigate tuna. However, only 14% of tuna vessels operated during this period with above gears brought frigate tuna. Based on port sampling data, the estimated probability of presence of frigate tuna on a given fishing boat (p) greatly varies among above gears/ gear combinations. Accordingly, the highest probability ($p=0.36$) was reported for boats operated with ringnets whereas the lowest probability ($p=0.08$) was reported for boats operated with gillnet-longline gear combination. In terms of operated vessels in the tuna fishery, a lower probability of presence of frigate tuna on a given fishing boat was reported for two types of boat categories which are operated in shallow coastal waters (UN2A ($p=0.04$) & UN1 ($p=0.01$)) and the boats operate mostly at high seas (UN3B ($p=0.05$)). A higher probability of presence of frigate tuna on the fishing boat was reported for two boat categories (UN2B ($p=0.22$) and UN3A ($p=0.15$)) which are mostly operated in the continental slope and bordering areas of offshore. The average non-zero catch rates in terms of frigate tuna catch in terms of kg per boat per day is higher for single day fishing boats operated in coastal waters than the multiday fishing boats. The study concluded that ringnet is the most efficient fishing gear used in Sri Lanka for catching frigate tuna.

Temporal and operational effects on the catch rates of Skipjack Tuna (*Katsuwonus pelamis*) in gillnet fishery of Sri Lanka

The aim of the study was to examine the relative influence of temporal and operational factors to change the catch rates of skipjack tuna (*Katsuwonus pelamis*) in the gillnet fishery of Sri Lanka. Skipjack tuna is the key target species in the gillnet fishery. Gillnets are sometimes operated as a gear combination and the most popular gear combination is gillnet–longline combination. Apart from that, gillnet-handline and gillnet-ringnet are other frequently used gear combinations in Sri Lankan tuna fishery. Skipjack tuna landed by Sri Lankan fishing vessels were monitored at the major tuna landing sites and fishery harbours in Sri Lanka. Five types of vessels which are operated targeting tuna and tuna-like fish, catch skipjack tuna. At the field, the unloaded skipjack tuna catch of the vessels was recorded. In addition, the parameters related to fishing operations were recorded: boat type, used gear/ gear combination, number of days taken for completion of the fishing trip and number of net panels used per fishing operation. Two temporal variables used for this study are “year” and “month”. A monthly series of skipjack tuna CPUE (Catch Per Boat Per Trip) was derived from the catch data. A Gamma based Generalized Linear Model (GLM) was fitted to determine the relationship between the explanatory variables and monthly average CPUE.

All zero-catch rates of skipjack tuna were excluded for the analysis. All main effects and their first order interactions were taken into the account. The fitted GLM model explains 85.8% of the deviance and the vessel type was found to be the most significant factor for determining the catch rates of skipjack tuna. Among the first order interactions, year: month was found to be the key explanatory variable.

Environmental preferences of Billfish in Bay of Bengal: A case study in longline fishery of Sri Lanka

Billfish are an important by-catch species in the tuna fishery of Sri Lanka. The gillnet and longline, which are frequently used in the Sri Lankan Tuna fishery mainly contribute for capturing the billfish too. The present study was undertaken to study the relative influence of three environmental parameters (sea surface temperature (SST), sea surface chlorophyll (SSC) and dynamic height of the sea surface (SSH)) on the billfish catch rates. The fisheries data in longline fishery of Sri Lanka was collected during the period 2006-2010 and used for this audit. The relevant values of above three environmental parameters were obtained from remote sensing data. A Generalized Additive Model (GAM) was fitted for describing the relationships between environment parameters and billfish catch rates. The results of GAM shows that the relationships between billfish catch rates and oceanographic parameters are significant. The GAM model could also be used as a predictive model to find the potential fishing grounds of billfish. The higher catch rates of billfish were observed from the areas where SST varied between 27 – 30.5 °C, SSC ranged from 0.05 - 0.2 mgm-3 and SSH ranged from 85 – 105cm. The results of the Empirical Cumulative Density Function (ECDF) show that the degree of the differences between the ECDF and catch-weighted cumulative distributions of the three variables are statistically significant ($p < 0.01$). The ECDF approach identified that high Catch Per Unit Effort (CPUE) of billfish occurred when SST ranged from 27 to 30 °C, SSC ranged from 0.05 to 0.5 mgm-3, and SSH ranged from 85 to 105 cm. Among the environmental parameters, strongest relationship was present between SSC and billfish CPUE whereas the weakest relationship was present between SST and billfish CPUE. The GAM results show that space-time factor has more influence on billfish catch rates. Also, all environmental parameters were significant at 0.05 level ($p < 0.05$).

Identification of thirteen pelagic shark species of the Indian ocean occurring around Sri Lanka; using morphological characters of their fins

Sharks are of great commercial importance in the marine fisheries sector in Sri Lanka. They are taken in large quantities for human consumption, especially to obtain shark fins, which is an export oriented product and to a lesser extent for the extraction of liver oil. Past research has reported 60 species of sharks. Among the shark landings in Sri Lanka Silky shark (*Carchahinus falciformis*) is the dominant species followed by Blue sharks (*Prionace glauca*) Oceanic whitetip shark (*Carcharhinus longimanus*) and Scalloped hammerhead (*Sphyrna lewini*) respectively. Contribution of other sharks including Shortfin mako (*Isurus oxyrinchus*), Smooth hammerhead shark (*Sphyrna zygaena*), Longfin mako (*Isurus paucus*) Great hammerhead shark (*Sphyrna mokarran*) and Blacktip reef shark (*Carcharhinus melanopterus*) sharks to the total shark landings is relatively very small. Under the Shark Fisheries Management regulations in 2015; prohibition of catching Common thresher shark (*Alopias vulpinus*), Big-eye thresher shark (*Alopias superciliosus*), Pelagic thresher shark

(*Alopias pelagicus*), Oceanic whitetip shark (*Carcharhinus longimanus*) and Whale shark (*Rhincodon typus*) in high seas were declared. Fins from these species crossing international boundaries are required to be accompanied by an export permit issued by the national CITES authority. One of the most important issues is the identification of species by using shark fins. Accordingly, it is important to investigate the morphological characteristics of shark fins in establishing a key to discriminate species. In this study, shark fins from 9 species landed mainly in large pelagic fishery and 5 species prohibited catching in high seas were used for examination. To assist in identification of fins, we have designed an easy-to-use identification key based on morphological characteristics of the fin such as fin colour, distinct markings, fin shape to be used by fisheries field officers, custom officers, wildlife inspectors, and fishers to IOTC-2016-WPEB12-23 Rev_1 2 provisionally identify detached, dried, unprocessed dorsal, pectoral and caudal fins from pelagic sharks that are commonly occurring around Sri Lanka. Results of our examination revealed that the species were identifiable by the morphological characteristics of any fin among the first dorsal, pectoral and caudal fins.

Assessment and monitoring of small pelagic fishery resources

Small pelagic fish landings were monitored at the major fish landing sites in the West, South and the East coasts of Sri Lanka. This includes collecting information such as details on fishing operations, recording the quantity of fish landings by species and by different fishing vessel-gear combinations, and length measurements of some key small pelagic species. Gillnet is the major gear used in the fishery followed by beach seine, gillnet-handline combination and handline. There is a gradual decrease in the hand line operations whereas there is an increasing trend in the gillnet operations. The major target fish group in small pelagic fishery is clupeids comprising mainly of *Amblygaster sirm* (Spotted sardinella) and *Sardinella sp* (Sardines) etc. *A. sirm* is the dominant species in the catches followed by *Sardinella sp*. However, the percentage contribution of *A. sirm* during the recent years (2011 to 2015) is only 27% of the total small pelagic catch. In the past, this species had contributed more than 40% to the total catch. Further, Catch per unit effort (catch per boat) showed a significant decrease after 2014 for major boat categories: motorized traditional crafts and Outboard engine Fiber Reinforced Plastic (OFRP) boats. In gillnet fishery, a clear increase in net panel usage was also noted after 2000. The study emphasizes the importance of introducing new management measures in order to ensure the sustainability of small pelagic fishery resources.

Assessment of demersal fishery resources

Common fishing methods used to catch demersal finfish include bottomset gillnets, handline, bottom longline, and traps. Of the observed methods the bottom set gillnet, and handline were most popular in northwest, north, and southern fishery landing sites in Sri Lanka. Handline is the most popular in all fishing areas while bottom longline was popular in northwest, west, southwest and south. Demersal catches are highly varied in terms of number and size of species depending on the gear used and area of operation. Large demersal finfish species like emperor fishes (Family-Lethrinidae), snappers (Lutjanidae) and groupers (Serranidae) were caught mainly using bottom hand-lining and bottom long line. The natural bait types used to catch demersals were Sardines (*Sardinella albella*, *S. gibbosa*), Herrings (*Amblygaster sirm*), Squids (*Loligo sp*) using OFRP boats or dugout canoes with 2-3

crew members and 15-20 fathoms. Of the observed catches; emperor fish (Lethrinidae): *Lethrinus nebulosus*, *L. elongatus*, *L. lentjan*, *L. mahsena* ; Lutjanidae: *Lutjanus argentimaculatus*, *L. rivulatus*, *L. Kasmira*, *L. Russellii*, , *Pristipomoides typus* : Serranidae: *Epinephelus longispinis*, *Epinephelus undulosus*, *E. Tauvina* and *Epinephelus malabaricus* were higher in fish catches



Project progress

Progress (%):- Financial:81 %

Physical: 100%

PROJECT No: 2.1.2

BIOLOGICAL ASSESSMENT OF BATOID FISHERIES AROUND SRI LANKA (JAFFNA, NEGOMBO, CHILAW AND BERUWALA)

Batoids have adapted to a wide array of habitats, occurring in all the oceans and they are commonly found in shallow estuarine, coastal, and shelf regions and in depths up to 3000 m. Many species are increasingly important in directed or by-catch fisheries. Present study provides information about current status of the diversity of batoid fishes in four major fishery landings namely; Jaffna (Mathagal and Munai), Negombo, Chilaw and Beruwala.

The survey consisted of two major parts, a frame survey and a comprehensive survey. The frame survey was carried out along the coast in Jaffna peninsula. The frame survey was the initial attempt made to identify the main landing sites for batoid fishery in Jaffna District. A total of 11 fisheries landing sites in Jaffna peninsula (Sendankulam, Marisunkudal, Mathagal, Saukkadi, Karainagar, Polikandy, Satkoddai, Vijaparimoolai, Munai, Gurunagar, Navanthurai) were visited to collect basic information. Moreover, randomly selected fishermen, coastal villagers were interviewed from each landing site and the data were collected over a period of one year from January to December 2016. This part of the survey was the initial attempt made to identify the occurrence of batoid species in Jaffna peninsula.

Batoids are mainly caught with bottom set gill nets and bottom set long lines. These gears are mainly used by OFRP boats. OFRP boats are usually operated within the 8-50 m depth range. Each boat carries 2-3 crews and duration of fishing time is around 20 hours per trip. Each boat contains 250 to 500 hooks with the hook size range 6 - 11 but most fishers' use hook size no. 9 with natural bait types Herrings (*Amblygaster sirm*) or Sardines (*Sardinella albella*, *S. gibbosa*) or Squids (*Loligo* sp). The gillnet mesh size varies from 2' to 22'. Member of family dasyatidae were higher in day boat catches whereas *Mobula* and *Manta* species

were higher in multiday boat catches. Of the four fishery harbours investigated, a total of 28 species of batoids were recorded. In this study, two orders of batoids (Myliobatiformes and Torpediniformes) belonging to six families were recorded namely; Dasyatidae, Myliobatidae, Gymnuridae, Mobulidae, Rhinobatidae and Narcinidae. Of the observed catch in Jaffna, 65 % of the catch consisted of *Himantura undulata* (Leopard whipray), *Aetobatus narinari* (Spotted eagle ray) and *Rhinoptera javanica* (Javanese cownose ray); in Chilaw more than 80 % of the total catch consist of *Dasyatis kuhlii* (Blue spotted stingray), *Dasyatis zugei* (Pale-edged sting ray) and *Himantura undulata* (Leopard whip ray), in Negombo and Beruwala, the total contribution of *Manta birostris* (Oceanic/ Giant Manta ray) and *Mobula japanica* (Spinetail mobula) were 70% and 75% respectively. It was observed that Female *Dasyatis kuhlii* (DL- 28cm, DW-23cm) with three pups, *Gymnura micrura* (DL- 42 cm DW-77 cm and weight 8.9 g) with three pups, *Aetobatus narinari* (DL- 53 cm, DW-85 cm) with three pups and *Dasyatis zugei* (DL- 24, DW- 21.2) with fully matured eggs were found during the study period. As a result of investigating the coastal area, a special feature noted was that the surface of the skin of batoids can be converted into fancy leather for export purposes.

Two types of lobsters are occurring around Sri Lanka; spiny lobster and slipper lobster. This study aimed to investigate the present status of the slipper lobster in northern Sri Lanka. Primary data were collected by coastal fishermen in Jaffna peninsula. The bed of the northern part (Gurunagar, Madagal and Munai) provides a good habitat for slipper lobsters. Slipper lobsters are mainly harvested by bottom set net and trawl nets. *Thenus orientalis*, *Parribacus antarcticus*, *Scyllarus batei* and *Scyllarcus martensil* are the main slipper lobster species occurring around Jaffna peninsula.



Project progress

Progress (%):- Financial: 65%

Physical: 100%

PROJECT No: 2.1.3

MOLECULAR AND BIOLOGICAL STUDIES ON THREE COMMON NERITIC TUNA SPECIES FOUND IN SRI LANKAN WATERS

Samples of the three neritic tuna species, Kawakawa (*Euthynnus affinis*), Frigate tuna (*Auxis thazard*) and Bullet tuna (*Auxis rochei*) were collected as whole fish from the fishery harbours of Chilaw, Negombo, Beruwela, Dodanduwa, Weligama, Galle and Kalpitiya. The whole fish were transported to the laboratory on ice and stored in a freezer until analyzed. 279 Kawakawa samples, 204 Frigate tuna samples and 45 Bullet tuna samples were collected and analyzed.

Each fish sample was used for biological analysis as well as molecular analysis. 23 morphometric measurements (weight, total length, fork length, standard length, fin lengths etc.) were recorded for each fish. The fish samples were dissected to separate the organs of the body cavity. The gut was dissected to identify the different food items that were present and the weight of each food type was recorded. The gonads were separated out and the weight of the gonads and the stage of maturity were recorded as F1 to F5 (F1-Immature, F2-Maturing, F3-Mature, F4-Spawning and F5-Spent) for females and M1 to M5 (M1-Immature, M2-Maturing, M3-Mature, M4-spawning and M5-Spent) for males according to the stage of maturity. Gonads with eggs were preserved in 10% buffered formalin to count the number of eggs for the calculation of fecundity.

Muscle tissue samples of all the samples analyzed for biological parameters were preserved in alcohol for molecular analysis. The DNA of these samples were extracted using the conventional phenol chloroform method. The extracted DNA was checked on an agarose gel to determine the concentration and the quality. The mitochondrial COI PCR has been carried out with the universal fish identification primers for the DNA of the 3 species and 22 samples have been sequenced and the identity confirmed.

The analysis of the length frequency data for Kawakawa revealed that the length range of the fish sampled was 21.4 to 61.5 cm. A strong correlation was obtained between the length and weight with the R^2 value being 0.99 for Kawakawa. The gonado-somatic index for the female samples collected peaked in June for Kawakawa. For frigate tuna the highest length range of sampled fish was between 30.1 to 35.0 cm, the length weight relationship showed an R^2 value of 0.98. The highest length range of the sampled fish for Bullet tuna was 26.1 to 28.0 cm and the length weight relationship showed the R^2 value to be 0.96.

Kawakawa, frigate tuna and bullet tuna showed non-selective feeding with major prey item being fish (herrings, anchovies and sardinella sp.), followed by shrimp and cephalopods. In addition, a few stomachs containing plastics items and leaves. The fecundity for Kawakawa ranged from 203,000 to 1,723,000 ova.

The DNA extraction was successfully amplified with the mitochondrial COI primers and the resultant PCR products were ~650 bp in length. 9 samples of kawakawa, 7 samples of frigate tuna, 6 samples of Bullet tuna were sequenced and their identification has been confirmed. This is a two year project and data collected in 2017 will also be used to carry out statistical analysis and to determine the stocks in the different regions for the 3 species.



Project progress

Progress (%):- Financial: %

Physical: 100%

PROJECT NO: 2.1.4.

DISTRIBUTION AND ABUNDANCE OF THE BLUE WHALES (*BALAENOPTERA MUSCULUS*) IN COASTAL WATERS OF SRI LANKA, IN RELATION TO THE SEASONAL CHANGES OF OCEANOGRAPHIC FACTORS AND MANAGEMENT OF THE WHALE WATCHING INDUSTRY

The interest in the marine mammals has increased recently among various community groups such as general public, wildlife and nature lovers, academics, scientist and the people who are involved in the maritime transportation industry. The first marine mammal sanctuary of the world, “Indian Ocean Marine Mammal Sanctuary” was established in 1979 for protecting the marine mammals from commercial whalers. This sanctuary covers entire Indian Ocean North of 55° plus adjacent waters including the Red and Arabian seas and the Gulf of Oman. The cetacean community living in the Indian Ocean is still not well studied, but their diversity is extremely high compared to the other oceans in the world. Coastal waters of Sri Lanka have been identified as a one of the Blue whale (*Balaenoptera musculus*) hot spots in the world. High abundance and distribution of the blue whales were recorded in the southern tip of Sri Lanka where they aggregate for feeding is the busiest shipping lane. Recently, marine mammals specially inhabit in South end of Sri Lanka is facing multiple threats such as ship strikes, acoustic pollution, disturbances due to commercial whale watching based in Mirissa, and fisheries etc. For implementation of a proper management and conservation programme for the Blue whales in waters of Sri Lanka, basic knowledge on the distribution, abundance, population size, seasonality, and the oceanographic parameters influencing the above factors are very important.

Two dedicated visual transect surveys and opportunistic surveys with whale watching boats were completed for the Southwest coastal region (2015-2016) covering 1600 km² and 230 km transect length. Similar transect survey were performed for the East coastal region 2015. CTD transect were done along the mid points of the transects with some water quality parameters to understand the environmental variable. The thermocline of both seasons of the south coast lies between 70-80 m (23-24 °C) and in east coastal region below 120 m. The highest chlorophyll concentration, 1-2 mg/l above thermocline in south revealed the depth of the highest primary productivity. The relationship between surface water quality parameters (No⁻³, Po⁻⁴, pH, Salinity) with the abundance of the zooplankton and phyto

planktons was not statistically proved. Highest number of Blue whale sightings 50 % (n=10) and abundance 58% (n=12) were made during both SW monsoon and inter monsoon period close to the continental shelf, in front of Mirissa area on the dens shipping lane. Average Blue whale density of the South coast is 0.0221 km⁻² smaller than that of East coast 0.067 km⁻² but highest mortalities were dominant in the south. Already 92 individual blue whales in the South coast were identified through the photo ID techniques. Frequent oceanographic surveys are needed to study the spatial and temporal changes of the ocean but high coast and rough sea conditions adversely impacts on the work.



Project progress

Progress (%):- Financial:106 %

Physical: 98%

PROJECT No :1.1.2

EXPERIMENTAL FISHING FOR OCTOPUS IN NORTHERN COASTAL SEA

There is no fishery interest or no local or export oriented market established for octopus in Sri Lanka. Currently, the octopuses are caught as a by-catch from shrimp trawling mainly in Pesalai, in Mannar district and Gurunagar area, in Jaffna district.

The project initiated due to an expression of interest of a Korean counterpart targeting an export market for Octopus in Sri Lanka. A fishing technique which is being used in Korea was introduced and supported for project initiation. A preliminary survey was carried out to find the abundance of octopus species in the Northern coastal waters of Sri Lanka and to identify their potential for developing for export market as a value added product.

The two types of fishing gears (traps) were introduced for trial fishing. One was composed of two artificial plastic shells imitating the shape of bivalves in nature and the other was a single shell imitating the shape of a gastropod shell. The project targeted several locations such as Pukulam, Chatty, Kiranchi, Gangewadiya, Gurunagar and Pesalai covering three districts; Putalam, Jaffna and Mannar. The trail fishing is carried out at Pukulam using the traps prepared in a longline fashion and wild octopuses were caught. The project is continuing towards a comprehensive study targeting the coastal waters in Pukulam, Pesalai and Gurunagar.

Project Highlights

- Traps distributed among the fishermen at Pukulam and Chatty.
- Trail fishing carried out at Pukulam.
- Trial fishing successful and octopuses captured.
- Species identified.
- Potential export market identified.

Findings

- Gear technology (traps) used was successful.
- Potential locations for resource availability identified.
- Confirmed species, *Amphioctopus aegina* and *Cistopus taiwanicus* via PCR Analysis.
- Potential for export oriented octopus fishery in Sri Lanka.

Further Studies

- Studies on seasonality.
- Biomass estimation.
- Resource area mapping.
- Nutritional analysis.
- Detailed analysis of biology viz. reproduction, food and feeding and fecundity etc.



Figure .Trial Fishing at Pukulam



Figure. *Cistopus taiwanicus*



Figure. *Amphioctopus aegina*

Project progress

Progress (%):- Financial: 145 %

Physical: 90%

PROJECT NO: 2.1.5

AN ECOLOGICAL STUDY ON CORAL REEFS AND SPECIES DIVERSITY IN HIKKADUWA MARINE SANCTUARY

Hikkaduwa National Park is one of the two marine national parks in Sri Lanka and Hikkaduwa is Sri Lanka's first Marine Protected Area (MPA). Hikkaduwa National Park covers a coastline of approximately 1.35 km between the southern breakwater of the Hikkaduwa fisheries harbour and rocky islets near the Coral Gardens Hotel. The national park contains relatively small fringing coral reef and however it contains high biodiversity. Hikkaduwa National Park has been of conservation interest since the 1960's due to its location in the

vicinity of one of the most popular tourist destinations in Sri Lanka. It was declared as a sanctuary in 1979 and later a National Park in 2002. Long-time residents of Hikkaduwa have stated that the entire reef has been highly degraded at present due to both natural and anthropogenic impacts. In recent years the large number of glass bottom boats operating without regulations, is now the main cause of coral reef destruction within the Sanctuary. The boats hit the corals, anchors are dropped, tourists, foreigners as well as locals, stand and walk on the corals. Anchoring, discharging of oil by fishing and other boats is also a major problem. In addition, polluted water from periphery restaurants and waste are dumped directly into the Sanctuary. Sedimentation of the coral reef is major cause of degradation due to natural and anthropogenic activity mainly possible reason might be a construction of breakwater for Hikkaduwa fishing harbor. Also, much of sediments is stirred up and deposited on coral due to boat movements within sanctuary.

The remaining coral reefs mainly fringing reef and it's situated between Coral garden hotel to the south and the fisheries harbor to the north (60 8' 42 N and 800 5' 33 E to 60 7' 39 N and 800 6' 0 E; 678030 N and 398574 E to 676185 N and 400415 E). A survey was conducted by the Marine Biological Resources Division (MBRD), NARA in April 2016 and December 2016. Information collected during the survey included the status of the coral reef, diversity and abundance of the corals, of the extent of live hard coral cover, dead coral, live soft coral, reef substrate, algae and sea grass, and the abundance and diversity of reef associated fauna including reef fish. Two manta tows, randomly selected three video transect (length 50 m), three line transects (length 50 m) and eight quadrates (1 m X 0.5 m) also specially decided six photo belt transects (50 m X 0.5 m) (onboard photos captured using glass bottom boats within glass bottom boats operated area) surveys were conducted during the study. It was found that most of corals degraded within the sanctuary. The diversity, abundance and live coral cover of corals comparatively reduced comparing with available published literature. Further , 17 genera of corals under 10 families, 25 fish species under 19 families, 02 sea cucumber species, one starfish and lobster species were recorded during the survey. This study is continued for 2017.

Project progress

Progress (%):- Financial: 104 %

Physical: 85%

PROJECT No: 1.2.2

ALTERNATIVE FISHING METHOD FOR BOTTOM TRAWLING IN WEST COAST

Fishermen are mostly used destructive fishing methods like “bottom trawling” to catch bottom dwelling organisms like shrimps, crabs and some fish species. Therefore, introduction of a new alternative fishing gear for catching bottom dwelling species is essential for protection of habitats and development of fishing industry in the country. Therefore, a trap was prepared and used with various types of baits to investigate the effectiveness of the trap instead of bottom trawling (Figure 1).



Figure 1: Trap testing at the coast of Negombo

The experiment was conducted at the Palagathure sea at Negombo coastal district throughout the year. Fifteen traps were used for each fishing trial. The harvest was recorded into by species against different bait types and different fishing locations. Recorded data were entered in to a MS Excel data sheet.

According to the results, 83% of total catch consists with *Portunussanguinolentus* (three spot swimming crab) and 14% consists with small shrimp varies while 3% consists with other fish species. Therefore it is recommended that the prepared trap is more effective for the catching of three spot swimming crab due to following reasons.

1. Environment friendly than bottom trawling
2. Selectivity is higher than other fishing methods- only 3% by catch
3. Economically feasible and simple technology
4. Easy to operate

Project progress

Progress (%):- Financial: 68 %

Physical: 100%

PROJECT No: 2.1.7

STUDY ON SEASONALITY, DIVERSITY AND SPATIAL DISTRIBUTION OF SMALL PELAGIC FISH SPECIES AND ASSOCIATED WATER QUALITY PARAMETERS IN THE WELIGAMA BAY

Weligama bay and surrounding ecosystem including Polatumodera River is very productive coastal ecosystem in the South part of the Island. This Bay area was divided into four main harbour areas by the regulation made under the Game Protection Ordinance in 1939. Large scale fishing operations are now practiced outside the bay from the Mirissa fisheries harbour. After the introduction of ring nets, most of the fishermen in Pelana started to use them within the bay area using motorized big canoes. Artisanal fishermen of the other landing sites around the bay are severely affected due to this fishery. The Weligama bay fisheries regulations were implemented to safeguard the rights of the small scale artisanal fishermen.

Approximately 150 fishing families are directly or indirectly depend on the bay fisheries and many of them affected due to the illegal fishing operations carried out by the fishermen of Pelana. In this bay area, small pelagic species such as *Sardinella* sp, Anchovy, Shads, *Thryssa*, Pony fish sp and Ribbon fish are abundant during the Northeast monsoon. Both recruitment and growth overfishing is common in the bay and large number of small scale fishermen and

their families are affected due to this overfishing practices. This is the first study carried out in the Weligama bay fishery for formulation of best management practices. Catch and efforts data, market values of fish and operation cost etc were collected from January to December in 2016 at every fort night. Fifty six percent of the harvest (46 MT) contributed by anchovy fishery and recorded second largest production is Thryssa sp. In addition, sardinella sp and pony fish contribute about 6% of the total catch. The fishing season in the bay is confined to non-monsoon period, from September to April.

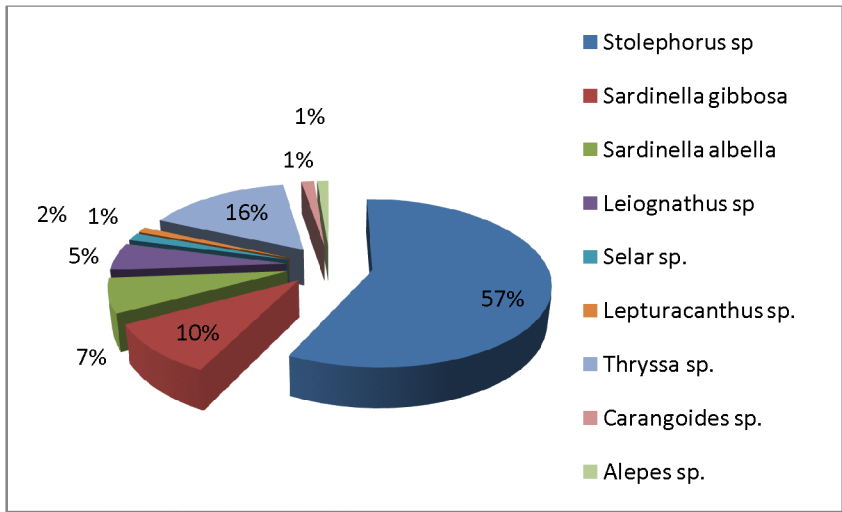


Figure 1: Total catch variation and species distribution. The highest harvest was recorded from anchovy species.

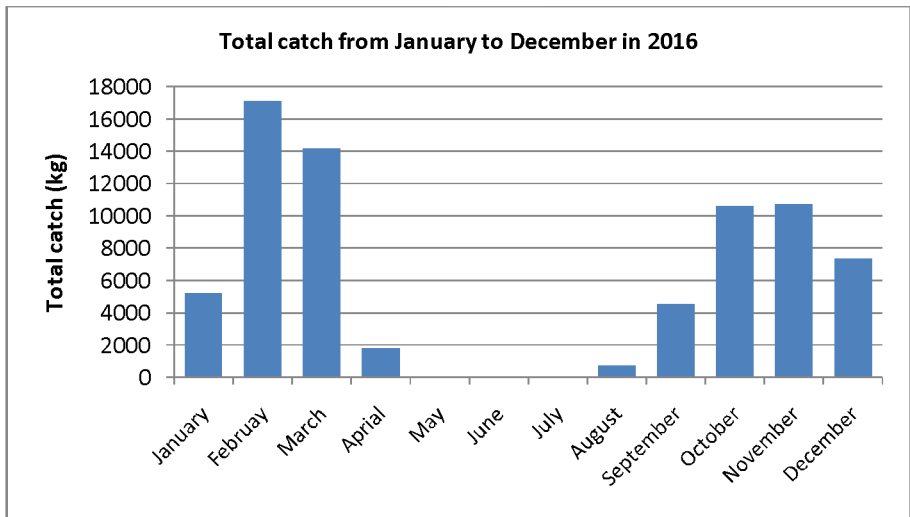


Figure 2 : The seasonal changes of total landing

Project progress

Progress (%):- Financial: 121 % Physical: 94%

PROJECT No :2.1.6
IN SITU CONSERVATION OF BERRIED SPINY LOBSTER

The Spiny lobsters are highly valuable export oriented artisanal coastal fishery resource in Sri Lanka. Catching of berried females and smaller sizes of lobsters are mostly affected for declining lobster populations. The set of regulations implemented by the DFAR have not been effective for the conservation and management of the fishery. Different stakeholder groups who are represented Fisheries Co management Committees requested to introduce an effective mechanism for protecting berried females until releasing their external eggs. Accordingly, a lobster culture site was established in Kaisawella Dondra inside the sheltered bay close to the Dondra lighthouse. A 2 m height dam was built around the culture site with rubbles brought from outside and bolders collected from the sites to provide maximum protection from the waves during the rough period. Further, larger bolders which were disturbed to establish tanks were mechanically removed from the site. Five concrete cylinder tanks (Diameter 3 ft and height 4 feet) with small holes in the outer walls were set in the deeper end of the sites. In addition to this tanks rectangular shaped concrete blocks with inside big hole facilitate for hiding for lobsters were set at the bottom of tanks. At the beginning 16 berried females with different length sized were stocked in November. Stocking was delayed due to Rough season and closed season for lobsters. During the rough season lobster fishermen in the area were not engage in fishery. At the first cycle all lobsters except one were released their eggs within 6 weeks after passing different maturity stages of the eggs and one lobster release eggs before reaching to the mature stages. During two month culture cycle lobsters were fed with low valued sarding with 10 percent of the body weight. Mortality percentage of the culture cycle was 6 percent. 93.75 percent of the females were successfully released their eggs. At the 2nd cycle one of the berried lobster died from 13 stocked.#

Further length frequency, and other fisheries data required for the fishery management were also collected. Length frequency data and other biological data collected from south coast region during the period January -December 2016. Total length frequency data were also used to estimate Von Bertalanffy growth parameters. The Grouped length frequency data were computed using FISAT data analysis software and growth parameters were estimated using Von Bertalanffy growth function (Bertalanffy, 1960). The highest contribution was coming from *Panulirus homarus* which was 86% total catch in south coast lobster fishery. Sex ratio was 1:1.4 male and female respectively and the mean carapace length was estimated at 67 mm for male and 69 mm for females. Annual length frequency distributions *P.homarus* showed majority of small size lobsters were reported from March to July and this period can be consider as major recruitment season.



Project Progress

Progress (%):-

Financial: 130%

Physical: 95%

EXTERNAL FUNDED PROJECTS/ CONSULTANCY WORK CONDUCT BY MBRD:
A STUDY OF THE POPULATION BIOLOGY AND FISHERY OF THE BLUE SWIMMING CRAB (*PORTUNUS PELAGICUS*)
FISHERY IN JAFFNA DISTRICT

The Blue Swimming Crab (BSC) *Portunus pelagicus* has a wide geographical distribution and is an important commercial species throughout the subtropical waters. The geographical extent of the BSC resource in Sri Lanka extends from Chilaw on the Northwest coast to Trincomalee on the nNortheast coast. The resource is more abundant in the shallow coastal waters of the Palk Bay which is bounded by three administrative districts: Mannar, Kilinochchi and Jaffna. MBRD agreed to undertake a study on behalf of the Seafood Exporters' Association to fulfill the research needs for the management of BSC. For this study, 3.04 million LKR rupees were provided to MBRD. The aim of the study was to carry out a comprehensive research including the reproductive biology, food & feeding, population biology and fishery of BSC. The blue swimming crab (BSC) (*Portunus pelagicus*) landings were monitored by MBRD at five major BSC landing sites in Jaffna district, Sri Lanka during November 2014 – February, 2016. The eight enumerators recruited for BSC data collection were first undergone for training in September 2014. Biological data with catch and effort data were collected over the period. The biological parameters investigated in the field included sex, carapace width (CW), body weight, maturity (mature or immature) and egg colour with egg sac weight. Normally, around seven hundred individuals were measured at a single site per month. Randomly selected samples were also brought to the laboratory and analysed for their maturity stages (six stages for female and two stages for male), length at first maturity, Gonadosomatic Index (GSI) and fecundity. Food and feeding habits of BSC were also studied. Accordingly, stomachs of adults and juveniles BSC were analyzed for the stomach fullness and diet composition. Stomach fullness was categorized into five levels: stomach empty (0% fullness), 25% fullness, 50% fullness, 75% fullness and 100% fullness. Twelve morphometric parameter measurements with body weight were also obtained for each individual of BSC. A least squared method was used to obtain the Length-Length (L-L) and Length-Weight (L-W) relationships. Of the 65 L-L linear relationships obtained for BSC by the study, 34 relationships were correlated ($r^2 > 0.5$). The estimated L-W relationships between body weight (W) and carapace width (with spine) (L) for males and females were $W = 0.0001L^{3.01}$ ($r^2 = 0.84$) and $W = 0.0001L^{2.90}$ ($r^2 = 0.86$) respectively. The average Carapace Width (CW) of a male BSC in the catch was 133.5mm (SD=17.3) whereas the average CW of a female BSC was 135.1mm (SD=14.4). The monthly variation in GSI revealed that BSC spawns though out the year in northern Sri Lankan waters (Jaffna Peninsula), with two clear spawning peaks; in February and May. Length at first maturity for male and female *P. pelagicus* indicates that males mature at smaller size than females. The estimated size at 50% maturity of male and female *P. pelagicus* was 105mm and 112.8mm respectively. The average sex ratio between male and female *P. pelagicus* in the fishermen's catch during the study period was 1.9 : 1.0. The sex ratio varied greatly with time. Total fecundity estimated in the study varied from 123,482 to 2,630,730 eggs, with an average of 884,982 eggs. The food and feeding study concluded the diet of BSC is highly variable reflecting the ability of adopting different modes of feeding. The estimated Spawning Potential Ratio (SPR) for BSC was only 38%. This suggests the importance of implementing some effective management measures for the long term sustainable utilization of BSC fishery in the Northern Waters.

GEF SEA-GRASS - DUGONG PROJECT: MONITORING AND ASSESSMENT OF SEA-GRASS ASSOCIATED FAUNA INCLUDING COMMERCIALY IMPORTANT FISH SPECIES AND ASSESSMENT OF IMPACT TO SEA-GRASS BED BY GEAR USE IN FISHERY

The relevant activity in the GEF sea-grass – dugong project is conducted by MBRD with the aim of (1) identifying faunas associated with sea-grass (2) the present status of the exploitation of sea-grass associated commercial fish species in the northern waters and (3) assessing the impact on sea-grass bed by different gear use in the fishery. To study the food fish inhabited with sea-grass, a survey is carried out based on marine fish landing sites in Mannar and Jaffna districts. At the landing sites, the boats which bring the catch by fishing at sea-grass and sea-grass associated areas are monitored. Accordingly, sea-grass species are identified correctly to the species level. Then, the information relating to the respective fishing operation (vessel horse power, total fishing time, true fishing time etc.) is recorded with the fishing gear used and gear specific information (number of net panels used and mesh sizes etc.). Also, fish species and other organisms brought by the vessel are recorded to the species/genus/family level. The species composition of the fish catch is recorded and the maturity stages (mature or immature) of the species are also attempted to record. Finally, the quantity of sea-grass bring by the vessel is qualitatively assessed (low, median, high etc) and the results will be used for the assessment of the impact. For the impact assessment, seasonal variation of the impact on sea-grass bed with respect to each gear type operation is taken into the account by monthly monitoring of landings of the catch in Jaffna and Mannar. Before starting the monthly monitoring, a preliminary survey was conducted in Mannar and Jaffna districts. One year field survey is in progress since July, 2016.

“SRI LANKA – NORWAY BILATERAL PROJECT” TECHNICAL ASSISTANCE TO IMPROVE THE MANAGEMENT OF THE FISH RESOURCES OF SRI LANKA

The project will have an initial duration of two years with the possibility of extension depending on implementation speed and possible new identified needs approved for funding. It is proposed to divide the work in two separate work packages; the first one is on improvement of port sampling programs and fisheries data management. The second work package is for conducting independent marine resource surveys and technical assistance. The detailed content of these work packages was decided during the inception workshop held in June 2016. It was proposed that a final workshop will be held to consider the work carried out, look at how NARA with available data best can conduct fisheries surveys and stock assessments for the conservation and management of marine resources. A part of the project will be a training program where scientists from NARA will work for a period within the two Norwegian institutions and take part in relevant activities to meet the goal of the project. MBRD will have to play the leading role in this project.

LONG TERM PROJECT OBJECTIVE

Providing technical assistance to conduct fisheries independence marine research surveys and upgrade existing fisheries dependent data collection to generate scientific data and information for sustainable management of the fisheries resources. Facilitating rearranging the deck of RV Samuddrika (NARA research vessel) and developing required human

resources to conduct fisheries survey thus make available a national survey vessel platform and skilled personnel to conduct multi-disciplinary (Hydrography, Oceanography and Fisheries) survey in Sri Lankan waters.

Environmental impact assessment and study of fish reproductive biology

This one year project comprises two interrelated parts that will be implemented simultaneously. Part I is intended to study marine environment and the fish reproductive biology of Karattaya and Yaksalaya to identify their breeding seasons and Part II is to evaluate the existing waste management capacity of the complex and to develop a comprehensive environmental management plan coupled with sourcing plan which will initiate temporary closure of the processing of local fish in breeding season. MBRD is responsible for the implementation of Part I whereas Environment Science Division of NARA is responsible for the implementation of Part 2 of the project.

SUPPLEMENTARY ENVIRONMENTAL IMPACT ASSESSMENT FOR “EXTRACTION OF SEA SAND FOR RECLAMATION WORK FROM THE SITE ALREADY ALLOCATED TO SRI LANKA LAND RECLAMATION AND DEVELOPMENT CORPORATION SLLRDC”

Environmental Approval (EA) under part IVC of National Environmental Act (NEA) was granted for the implementation of the proposed Colombo Port City Development Project by the Project Approving Agency; Coast Conservation and Coastal Resources Management Department (CC&CRMD), after evaluating the Supplementary Environmental Impact Assessment (SEIA) Report dated December 2015 subject to implementation of several terms and conditions.

In SEIA report, it is proposed to extract required amount of sand (65mln m³) from two (02) locations (Site-1 and Site-2 as marked in annexed map) previously assigned to Sri Lanka Ports Authority (SLPA). However the EA issued by CC&CRMD allowed the project to extract sand only from Site 2 and the additional amount of sand for reclamation; as proposed in SEIA, is allowed from the site allocated to Sri Lanka Land Reclamation and Development Corporation (SLLRDC) after obtaining a separation approval from the Central Environmental Authority (CEA). Environmental Impact Assessment (EIA) for this site was carried out in 2008 by SLLRDC for the extraction of sea sand for construction industry based on the Terms of Reference (TOR) issued by the Central Environmental Authority (CEA). As per a request of Port City Development Project, SEIA for this site for an extensive sand mining was conducted by NARA in 2016. This work involved the assessment of the bio-physical and socio-economic environment of the study area. Specially the marine ecology and biodiversity, habitat mapping of marine ecosystem including coral reefs, marine mammals, fisheries, migratory species and marine flora and fauna in the study area, and the existing socio-economic situation of the study area specially the description and assessment of fisheries and aquaculture resources in the study area including type, catch and production, value etc. Identification of fishing grounds and fishing routes were also included. A vast area in this assignment was completed by MBRD in 2016.

CARRY OUT A MARINE ENVIRONMENTAL BASELINE SURVEY WITHIN THE EXCLUSIVE ECONOMIC ZONE (EEZ) OF SRI LANKA

A consultancy was awarded to NARA by Petroleum Resources Development Secretariat (PRDS) to carry out a marine environmental baseline survey within the Exclusive Economic Zone (EEZ) of Sri Lanka with a view to prepare for mandatory Environmental Impact Assessments (EIAs) for future hydrocarbon explorations and exploitation. These data would pave the base for any future comparisons and accelerate the EIA process. Accordingly, the aim of the assignment was to collect marine environmental baseline data within EEZ of Sri Lanka which provides a vast array of data to facilitate mandatory environmental impact assessments to carryout future hydrocarbon explorations and exploitation. Accordingly, MBRD is in the process of conducting the marine environmental baseline survey with regard to sensitive habitats (coral reefs), marine resource survey and marine mammals.

INITIAL ENVIRONMENTAL EXAMINATION (IEE) ON TWO DIMENSIONAL SEISMIC SURVEY FOR OIL EXPLORATION IN DEEP SEA BLOCKS IN NORTH EAST CAUVERY BASIN OF SRI LANKA

MBRD made a significant contribution with regard to the preparation of Initial Environmental Examination (IEE) report on two -Dimensional Seismic Survey for Oil Exploration in Deep Sea Blocks in North East Cauvery Basin of Sri Lanka. MBRD work in this IEE included describing marine environment in the seismic survey area, describing sensitive marine habitats, describing marine organisms including commercial fish species, endanger, threatened and protected marine species, describing fish breeding grounds/ breeding seasons, fishing grounds and assessment of negative and positive effects, including cumulative effects on habitats, species and ecosystems etc.

Other activities undertaken

1. Examined and provided reports on fish samples sent by various high courts for blast fishing.
2. Examined and provided a report on identification of gastropod shell samples sent by the magistrate courts.
3. Identified and provided reports for court cases for dugong sample using molecular techniques – Panadura 37997/16 and a sample submitted by the Department of Wildlife in May 2016.
4. Examined and provided reports on identification of shark fin samples sent by the fish exporters.
5. Identified and provided a report for a court case for a dolphin sample using molecular techniques - 483/2016 from Angunukolapelessa.
6. Serving as a member of the National Committee on Agricultural Biotechnology under the CARP since May 2013.

7. Serving as a member of the Working Committee on Biotechnology of the National Science Foundation (NSF) since June 2016.
8. External Supervision (B.Sc) final year research project: On a request made by the Head Department of Animal Science, Uva Wellassa University, a Special degree undergraduate student was supervised for her final year research project on Marine Biotechnology
9. External Supervision of M.Sc. research project: Ms. W.D.P.D. Wijesinghe (M Sc. In Fish and wild life management); University of Peradeniya.
10. Providing expertise on preparing hatchery guide lines for turtles; collaboration with the Wild life
11. Lectures were conducted on the importance of biodiversity and coral reefs for coast guard, Sri Lanka
12. Reviewed a scientific paper on “An update of diversity of crab and species composition in Navanthurai coastal area, Jaffna Sri Lanka” submitted to the 25th Annual Congress of PGIA (Postgraduate Institute of Agriculture)-2013. University of Peradeniya, Sri Lanka.

Publications

Abstracts

1. Bandaranayake, K.H.K, Nirbadha K.G.S., Rathnasuriya, M.I.G., Athukoorala, A.S.H., Perera H.A.C.C., Weerasekera, S.J.W.W.M.M.P and Haputhantri, S.S.K., 2016. Integrating some aspects of reproductive biology into the management of Blue Swimming Crab (*Portunus pelagicus*) fishery in the Northern Coastal Waters of Sri Lanka. SLAFAR scientific session-2016. NARA, Sri Lanka.
2. Haputhantri, S.S.K., Nirbadha, K.G.S, Bandaranayake, K.H.K., Rathnasuriya, M.I.G., Athukoorala, A.S.H., Jayathilaka, R.A.M. and Weerasekera, S.J.W.W.M.M.P., 2016. A morphometric analysis of Blue Swimming Crabs (*Portunus pelagicus*) in the Northern Coastal Waters of Sri Lanka. SLAFAR scientific session-2016. NARA, Sri Lanka.
3. Nirbadha, K.G.S., Bandaranayake, K.H.K., Rathnasuriya, M.I.G., Haputhantri, S.S.K, Weerasekera, S.J.W.W.M.M.P, and Athukoorala, A.S.H., 2016. Feeding habits and food composition of adult Blue Swimming Crabs (*Portunus pelagicus*) in the Northern Coastal Waters of Sri Lanka. SLAFAR scientific session-2016. NARA, Sri Lanka.
4. R.P.P.K. Jayasinghe and S.S.K. Haputhanthi, 2016. Impact of morning and evening fishing on herring (*Amblygaster sirm*): A case study in Chilaw, Sri Lanka. NARA scientific session-2016. NARA, Sri Lanka.
5. E.G.T.P. Wijesinghe and S.S.K. Haputhantri, 2016. Length-Length and Length-Weight relationships of Blue Spotted Stingray (*Dasyatis kuhlii*) (Muller and Henle, 1841) from West Coast of Sri Lanka. NARA scientific session-2016. NARA, Sri Lanka.

6. H.A.C.C. Perera, S.S.K. Haputhantri and R.A.M. Jayathilake, 2016. Food habits of the silky shark *Carcharhinus falciformis* in Sri Lankan waters. NARA scientific session-2016. NARA, Sri Lanka.
7. Herath D.R., Perera H.A.C.C., Hettiarachchi G.H.C.M. and Ranasinghe V.K. (2016). Diet composition of Kawakawa (*Euthynnus affinis*) in three major landing sites of Sri Lanka. Proceedings of the NARA Scientific Sessions 2016.
8. Herath D.R., Perera H.A.C.C., Hettiarachchi G.H.C.M., Ranasinghe V.K. and Kumara M.D.I.C. (2016). Some biological aspects of Frigate tuna (*Auxis thazard*) found in the Southern, Western and Northwestern coasts of Sri Lanka. Proceedings of the 72nd annual sessions of the Sri Lanka Association for the Advancement of Science 2016.
9. Herath D.R., Ranmadugala D.N.A. and Amarakoon A.A.D.G.U. (2016). The occurrence of *Cistopus taiwanicus* in Sri Lankan waters. Proceedings of the NARA Scientific Sessions 2016.
10. Rathnayaka B.R.M.M.G.K.M., Herath D.R., Upeksha A.A.D.G. Upeksha and Senevirathne J.D.M. (2016). Molecular identification of selected Octopus species in Sri Lanka using DNA barcoding region. Proceedings of the International Research Symposium of the Uva Wellassa University of Sri Lanka 2017.
11. R.P.P. K. Jayasinghe, U.S. Amarasinghe and A. Newton. 2016. Evaluation of status of commercial fish stocks in European marine subareas using mean trophic levels of fish landings and spawning stock biomass. Ocean & Coastal Management. *In Press*. doi:10.1016/j.ocecoaman.2016.07.002 (Open Access)
12. R.A.M. Jayathilake, Maldeniya R. and Kumara, M.D.I.C. 2016. A study on temporal and spatial distribution of seaturtle nesting on the south west coast of Sri Lanka. NSS, 2016.

Reports

1. A study of the population biology of blue swimming crab (*Portunus pelagicus*) fishery in Jaffna District: Final Report submitted by MBRD to the Seafood Exporters' Associations of Sri Lanka's Blue Swimming Crab Fishery Improvement Project
2. Supplementary Environmental Impact assessment report for "Extraction of Sea Sand for reclamation work from the site already allocated to Sri Lanka Land Reclamation and Development Corporation SLLRDC" Biological assessment report submitted by MBRD to Colombo port City Development Project, Ministry of Megapolis and Western Development.

Trainings/workshops/meetings attended:

1. Indian Ocean Coastal States Workshop on management strategy evaluation and harvest strategies of the shared tuna stocks, Maldives on 3 – 4 February 2016.
2. Workshop on Current Status & Future Directions in Agricultural Biotechnology Research in Sri Lanka. 18th August 2016. HARTI, Colombo 7.

3. IOTC working party on Ecosystem and by catch (12th session of the), Victoria and Seychelles 12-16 September 2016.
4. Sixth session of the Indian Ocean Tuna Commission (IOTC) Working Party on Neritic Tunas (WPNT 06) held in Mahe, Seychelles from 21–24 June 2016.
5. CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) workshop, Indian Ocean Tuna Commission (IOTC) 18th Working Party on Tropical Tunas (IOTC WPTT) and IOTC 7th Working Party on Methods (IOTC WPM) held at Victoria, Seychelles from 2-4 November, 2016, 5-10 November, 2016 and 11-13, November, 2016 respectively
6. Workshop addressing the impacts of bottom fishing on vulnerable marine ecosystems and the long-term sustainability of deep sea fish stocks. 1-2 August 2016, United Nations Headquarters, New York, USA. Invited as a Panelist.
7. Training on Introduction to the International law Framework to Combat Illegal, Unreported and Unregulated fishing. Organized by the Ministry of Fisheries and Aquatic Resources Development (MFARD) and Food and Agricultural Organization of the United Nations. 29 September 2016. Held in MFARD Colombo.

Proceedings

1. Haputhanthri, S.S.K., 2016. Exploring gear-vessel catch efficiency of frigate tuna (*Auxis thazard*) in tuna fishery of Sri Lanka. IOTC-2016- WPNT 06 – 20. Sixth Session of the IOTC working party on neritic tuna.
2. Jayathilaka R.A.M., Haputhanthri S.S.K. and Perera H.A.C.C., 2016. Identification of thirteen pelagic shark species of the Indian ocean occurring around Sri Lanka; using morphological characters of their fins. IOTC-2016- WPEB 12-23. 12th IOTC working party on Ecosystems and Bycatch.
3. Rathnasuriya M.I.G., Gunasekara S.S., Haputhanthri S.S.K. and Rajapaksha J.K. 2016. Environmental preferences of Billfish in Bay of Bengal: A case study in longline fishery of Sri Lanka. IOTC-WPB14-10. 14th IOTC working party on Billfish.
4. Haputhanthri S.S.K., 2016. Temporal and operational effects on the catch rates of Skipjack Tuna (*Katsuwonus pelamis*) in gillnet fishery of Sri Lanka. IOTC–2016–WPTT18–30. 18th IOTC working party on tropical tuna.

Representing MBRD Scientists at National Committees

1. Representing NARA at the Steering Committee for Conservation of Marine Species and Ecosystems established by Department of Wildlife Conservation.
2. Representing NARA at the high level committee appointed by Ministry of Power and Renewable Energy for site selection for future nuclear energy needs in Sri Lanka.

3. Representing the three member committee appointed by Hon Minister of Fisheries and Aquatic Resources Development to study and report on illegal fishing activities within the EEZ in Sri Lanka.
4. Representing NARA at the national committee formed with the aim of combat illegal, unreported and unregulated fishing (IUU fishing) activities conducted by local fishing boats in Sri Lanka waters, waters of national jurisdictions of other coastal States, and high seas, and by foreign fishing boats in Sri Lanka waters.
5. Representing NARA at the sub-committees appointed by the Secretary/ Ministry of Fisheries and Aquatic Resources Development with the aim of formulating a national fisheries policy.
6. Representing at the parliament select committee
7. Representing NARA at National Expert Committee on Biological Diversity under the Ministry of Mahaweli Development and Environment, Sri Lanka

International Collaborations

1. A research project Proposal (Biodiversity Validation of Intact Octocorals Treasure of Gulf of Mannar& Palk Strait Ecoregion) was submitted to the Ministry of Science, Technology and Research (MSTR) under the Indian-Sri Lankan Inter-Governmental Science & Technology Cooperation Programme.
2. Collaboration between NARA and the University of Queensland, Australia for the collection and supply of Black marlin samples from the coasts of Sri Lanka for the study titled “Genetic population study of Black Marlin (*Makaira indica*) in the Indian Ocean.
3. Collaboration between NARA and The Virginia Institute of Marine Science (VIMS), USA for the collection of samples of all billfish species (Blue Marlin, Striped Marlin, Swordfish and Sailfish) for the study titled “Genetic population structure of Istiophorid billfishes in the Indian Ocean.

5.6 NATIONAL INSTITUTE OF OCEANOGRAPHY AND MARINE SCIENCES

Head of the Division: Dr. K. Arulanathan

Introduction

The *National Institute of Oceanography and Marine Sciences (NIOMS)* is responsible for planning and conducting coastal and offshore oceanographic studies around Sri Lanka. In this regard oceanographic and marine geological scientists conduct research in the fields of physical, chemical, biological oceanography. NIOIMS has been conducting research on coastal and deep ocean research having long term archival of oceanographic datasets such as tides, currents and waves.

NIOMS is equipped with modern instruments for data collection where some of the systems are connected to global ocean observation networks. The data consist of an array of characteristics allied to tides, currents and waves while other physical parameters such as salinity, temperature and chlorophyll are available in coastal water bodies and near shore areas. However, deep water physical parameters have been obtained from buoys and earth observing satellites.

The institute provides its scientific and technological services to a wider range of applications such as coastal constructions, living and non-living resource exploitation, and energy harnessing including environmental impact assessments (EIA). The *Ocean Observation Center (OOC)* of the institute is alert on 24 hours to provide early warnings on ocean based disasters such as “*Tsunamis*”. The institute consists of an information service to provide forecasts and predictions on potential fishing grounds using satellite technology to the offshore/ high seas fisheries sector.

Progress of Research Projects

NIOMS has conducted six major projects and several consultancy services during the year 2016. In addition, many publications were done by the NIOMS where international collaboration was no table.

Following are the major projects and consultancy services carried out by NIOMS during 2016.

Table 1: Projects Carried-out by NIOMS in 2016

No.	Project title	Allocation (Rs.)	Responsible Officers	Year
1.2.1	Tuna fishing ground forecasting and improvement of its methodology	600,000	J.K. Rajapaksha S. S. Gunasekara	2016
1.2.3	The monsoonal impact on upwelling and productivity around Sri Lanka	6,000,000	S.U.P. Jinadasa H.B. Jayasiri	2016
5.1.1.	Hydrodynamics and bio-chemical characteristics of Kalpitiya Lagoon	600,000	Kasun Dalpatadu Dileka Samaranayake S. S. Gunasekara	2016

6.1.1	Operation of Ocean Observation Center (OOC)	1,200,000	K. Arulananthan S.U.P. Jinadasa N.B. Suriyaarachchi	2016
6.1.2	Numerical Simulation of Coastal Sediment transport and morphological modeling to mitigate identified contemporary coastline erosion problems: A Case Study of Sri Lanka's North- North East Coast.	600,000	R.M.R.M. Jayathilaka	2016
7.1.1	Investigation of mineral sand resources in potential coastal and offshore regions	500,000	Dileka Samaranayake N. B. Suriyaarachchi	2016

PROJECT No : 1.2.1.

IMPROVEMENTS OF AN EXISTING TUNA FORECASTING SYSTEM OF NARA BASED ON OCEAN STATUS FORECAST

Responsible officers : J.K. Rajapaksha
S. S. Gunasekara

Development of fishing ground forecasting system for offshore fishery in Sri Lanka was started in 2007 and implemented in 2008 on experimental basis. Experimental forecasts were released in weekly basis to selected fishing fleets and the validation results of the forecast have shown encouraging results. Hence, the forecast dissemination was expanded to all major fishery harbors via fax, email and radio communication. However, there were several limitations have been found to be improved to enhance the fishing efficiency to ensure the high catch rates as tuna is highly migratory species. Usages of near real-time satellite information are therefore important and providing information on swimming depth of yellowfin tuna can make a considerable impact on the fishing efficiency. As the mixed layer of the Indian Ocean is heavily influenced by its monsoonal wind reversals, the tuna vertical migration due to thermocline variability is significant. As a result depth of deployment of tuna long line is uncertain and experienced low catch rates. Therefore, development of a methodology to predict the temperature vertical profile was a challenge. Therefore, a methodology was developed to predict temperature vertical profile of the ocean using satellite data and ready to incorporate into the existing fishing ground forecast system. In addition a web portal is proposed to disseminate fisheries information under this project.

The existing fishing ground forecast system has incorporated with fishing depth to ensure the fishing efficiency of longline. The developed model predicts temperature vertical profiles to determine swimming temperature of tuna enabling to maps the depths of tuna resources. Fishery data collection and oceanographic data from satellites and the in-situ ocean observations will be continued to improve the model predictions and fishing efficiency. Since 2013, NARA fishery logbooks was not distributed to avoid duplication logbook data collection by the department of fisheries. Vessel Monitoring System (VMS) has been implemented by the department of fisheries along with their logbook data collection. This data will be useful for further development of fishing ground forecast as well as fish stock assessment.

Project Objectives

1. Improvement of existing fishery forecasting system incorporating data obtained from the longline fishery, satellites and ocean observational instruments with the following activities
 - Positioned fishery data collection from tuna longline and analysis with ocean observational data from satellites and in-situ instruments
 - VMS data analyses to investigate the possibility of improvement of the existing fishing ground forecasting system.
 - Fishing ground forecast mapping based on near-real time satellite derived oceanographic conditions and information dissemination to the offshore fisheries sector and feedback data collection
2. Development of online fisheries information services to the offshore fishery sector
 - To develop web based platform for fisheries information services for registered users
 - Increase awareness of the status of fishery information in the Indian Ocean
 - To provide marketing information and current fish prices of the international market
 - To provide information on fishing gears, accessories and service providers

Methodology

Fish forecasts were generated using satellite derived oceanographic status incorporating tuna fishery data collected. Fisheries forecast were produced twice a week (Monday and Thursday) and forecast information was disseminated to major fishery harbors by FAX, by email for registered users and by telephone on requests. Further the fisheries forecast were disseminated via SSB radio from 23rd of November 2015. This service provides twice (11.00 AM and 15.00 PM on weekdays) on channel 6213.5 KHz and feedbacks information were received via the same. Weather forecast were obtained from the Department of Meteorology delivered to tuna fishing boat. Weather information dissemination is an extended service by NARA. Total of 93 tuna fishing ground advisories were issued during 2016. Few advisories (5) were not issued due to technical breakdowns during mid-November to early December 2016.

Fishing ground forecasting system is upgraded to multi criteria decision making fuzzy logic system. Fishing ground forecast area was extended to southern Indian ocean and Arabian sea. VMS data from January 2016 to April 2016 has been collected. Fisheries logbook data from 01st January 2016 to 28th April 2016 was collected from DFAR. The datasets were analyzed and the results were published in the 37th Asian Conference on Remote Sensing (ACRS2016), at Colombo, Sri Lanka.

Although the in-situ temperature depth data collection was planned, it was hampered due to weakness of battery power. Thus, this data collection will have to be postponing until new sensors purchased. Questioner survey was conducted to identify information and services requirement of fishermen and their knowledge about tuna fish forecast of NARA. Questioner surveys and awareness interviews have been conducted on Dikowita, Negambo, Beruwala, Ambalangoda, Hikkaduwa, Galle, Mirissa and Devinuwara fisheries harbors.

Presentations were delivered to tuna fishing boat owners and skippers of Kalutara and Trincomalee districts with the support of SED division. Awareness program was conducted for multiday fishing boat owners and skippers of Tangalle and Hambantota on 16 September

2016. Presentation was delivered to tuna fishing community and related officers of Galle, and this was organized by DFAR on 28th October 2016. Presentation was delivered to Director General and Assistant Directors of DFAR to present findings and present status of tuna fishing ground forecasting system on 8 November 2016. A web portal for fisheries information was started and fisheries forecasts were converted to shapefiles which supports web GIS. This web portal will be continued to year 2017 with 1.5 million rupees' budget allocation.

Outputs of the Project

- Improved fishing ground forecasting system by updating data sources and program
- Updated databases for offshore fishery and oceanographic data
- 3 scientific publications (See section 3)

Performance Indicators

- 93 fish forecasts were issued during year 2016
- A web portal for fisheries information was initiated
- 80 Radio forecasts were issued during year 2016

Outcomes of the Project

- Increased economic efficiency of offshore fishery sector and reduce the fishing pressure on coastal fishery resources.
- Improved capacity of fisheries related information generation and dissemination

Constraints

- NARA has not issued fisheries diary since 2013 and is it difficult to collect fisheries data directly from fishermen without appropriate format such as fisheries diary. As fishermen provide fisheries data to Department of fisheries and aquatic resources (DFAR), they are not willing to fill another set of records which hasn't direct beneficiaries to them.
- Instruments failures (StarODI- DST Temperature Depth Recorders) caused cease in-situ data collection.
- Limited IT resources and Unavailability of vehicles caused to cancel several field visits.

Recommendations

Awareness of Skippers and owners of multiday fishing boats about PFZF of Nara will be key factor to success of project. Therefore, awareness programs should conduct frequently.

Remarks

Unavoidable cancellation of in-situ data collection and technical failures caused for 10% difference between target and actual physical performance.

Project progress

Progress (%):- Financial: 21% Physical: 90%

PROJECT No: 1.2.3.

THE MONSOONAL IMPACT ON UPWELLING AND PRODUCTIVITY AROUND SRI LANKA

Responsible officers: S.U.P. Jinadasa
H.B. Jayasiri

Introduction

Upwelling process around Sri Lanka is much important to increase ocean productivity and which directly influence on fish production. Though, there is some evidences on upwelling around Sri Lanka scientific knowing of the seasonal cycle of upwelling would be vital for fishery industry to reduce searching time. The proposed study was designed to understand impact of monsoonal dynamics on upwelling around Sri Lanka.

Methodology

During the monsoonal impact on upwelling and productivity around Sri Lanka project three cruises were conducted in the offshore area south of South of Sri Lanka perpendicular to the coastline. The survey included conductivity temperature and density measurements and primary productivity measurements such as zoo and phytoplankton studies. Apartment this plankton samples were collected for the analysis of bioluminescence animals in the study area.

Results

Salinity temperature measurements

The results obtain from the CTD survey is given in Figure 1.

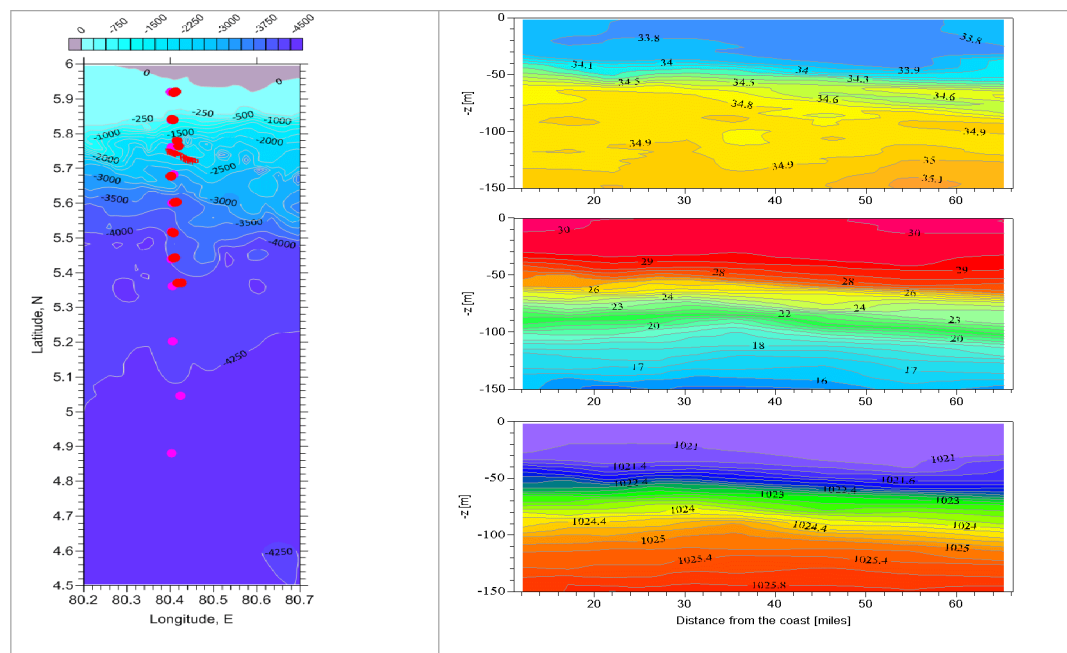


Fig. 1. Illustrates the CTD survey conducted perpendicular to the south coast of Sri Lanka during May 3-5, 2016

The Figure 1 illustrates the Salinity temperature density profiles along the transect in the offshore Weligama area. During this study 11 CTD profiles were collected with 10m station spacing. The results indicated that thermocline, halocline and pycnocline occur at the depth of 50m, 40m and 40m respectively. The observations show that thermocline depth deepening towards the offshore area. Salinity/thermal fronts could be observed at the distance of 22 and 60 miles. Salinity in the area between fronts was 33.8psu. That could be due to insertion of up welled water to due dynamical process.

Identification the most productive zone

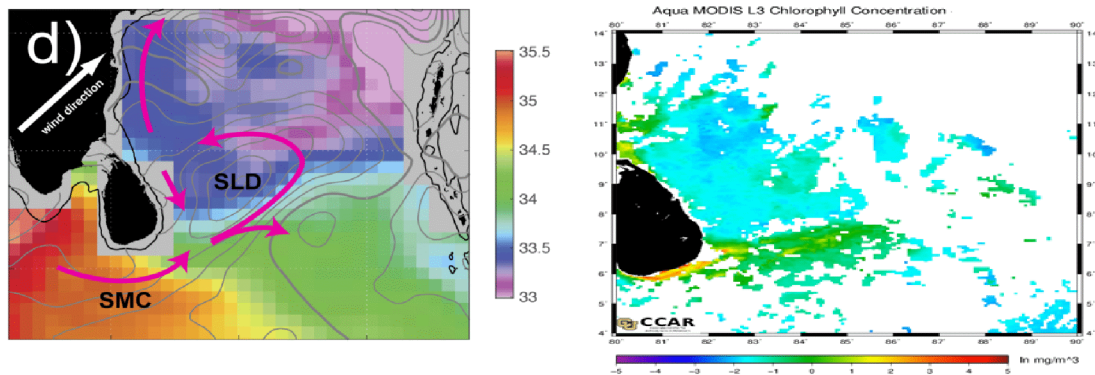


Figure 2.. Zones Identified by Satellite Imageries and Field Investigations

Most productive zones were identified using satellite imageries as well as the field investigations (Figure 2.). The salinity fronts were identified as demarcated in the left diagram is mainly due to wind driven summer monsoon currents. Similar observations on chlorophyll were observed using satellite imageries which show in right diagram (Chlorophyll concentration during the month of July). The red circle indicated the most productive zone. The study on salinity fronts and Sri Lanka Dome was observed based on the Sea glider measurements which collected during 2015. The results of remotely sensed data products will be incorporated with other in situ parameters like salinity, temperature, chlorophyll, nutrients and fish catch data.

Bioluminescence Studies

There are cruises conducted to study bioluminescence in the sea. During this study, bathy-photometer measurements for bioluminescence intensity and samples were collected in fix station. Time series bioluminescence intensity data indicate vertical migration of planktonic bioluminescence in the south coast of Sri Lanka. Day time bioluminescence intensity measurements could not be obtained due the interference of sun light.

South coast data indicate presence of bioluminescence in the ocean up to 160m. Recoverable bathy-photometer recorded bioluminescence intensity peaks up to above depth with high intensity between 40m to 60 m depth range. The intensity distribution shows relationship with thermocline. High bioluminescence intensity observed with in the mix layer. Average thermocline depth recorded as 60-80m. Minor amount of bioluminescence peaks could be observed beneath the thermocline.

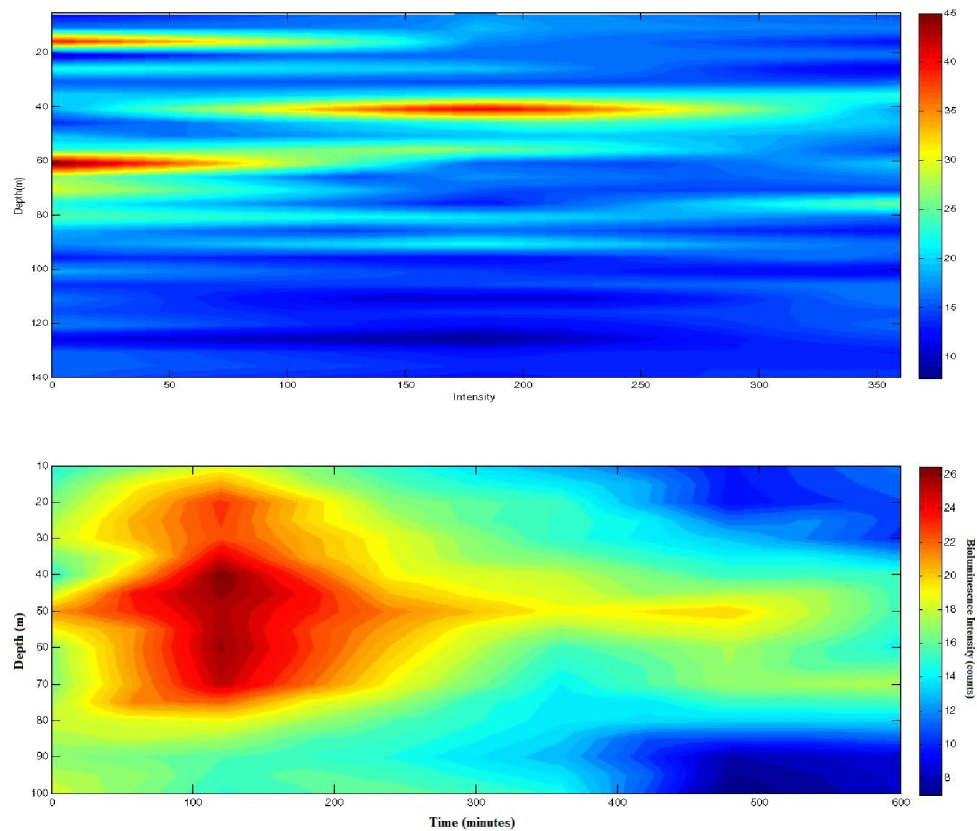


Figure 3. Bioluminescence intensity variation with depth and time in south coast of Sri Lanka. (a) Bioluminescence intensity variation from 6.00 pm to 5.00am in January 2016 (b) bioluminescence intensity variation from 7.00 pm to 5.00am in May, 2016.

Constraints

The proposed survey was planned to conduct using R/V Samuddrika vessel belongs to NARA. The research work was carried out uninterruptedly up to May 2016. However, It was unable to carry out schedule works except sea glider deployment throughout the year due to technical default of R/V Samuddrika.

Project progress

Progress (%):- Financial: 69.3% Physical: 100%

Responsible officers : Kasun R. Dalpathadu
Dileka Samaranayake,
S.S. Gunasekara
Kolitha Jinadasa

Introduction

Coastal water bodies in Sri Lanka are the most productive, having characteristics of high diversity of environmental factors, habitats, a high connectivity in the food chain and a high diversity of species. Among them Puttalam Estuary is the second largest estuary in the country with a surface area of 32,700 ha. It is a relatively shallow estuary with average depth of 1 – 2 m depth and one of the most productive coastal eco-systems in the Northwest coast of Sri Lanka. The Puttalam Estuary receives fresh water from two rivers, namely “*Kala Oya*” and “*Mee Oya*”. Wide variation in ‘salinity’ has been observed from 34psu to 55psu. Thus it has been classified as ‘Inverse Estuary’ based on the water balance. Some of the early studies state that the salinity gradient was opposite to that of positive estuaries, so the water density gradient increases landwards’. Further according to the earlier work it is exceptional amongst estuarine lagoons as the salinity rarely decreases below 15 psu even during the rainy season.

As a result of the ongoing development activities in the area, several alterations in the physiochemical and biological conditions in the lagoon has been observed such as increased the pH of the water and gradual increase of ammonia concentration. In addition a significant decline in salinity over the last 50 years has been reported mostly due to the regulation of freshwater input via “*Kala Oya*” and “*Mee Oya*”. Despite the significant importance of the Puttalam Lagoon as remarkable ecosystem in the West coast of Sri Lanka, it is well obvious that the lagoon is threatened due to mainly anthropogenic forces.

During this research work, current status of some important physical and chemical parameters such as nutrients, salinity, pH, TSS....etc. were estimated as they indicate the level of pollution as well as thropic level of the lagoon eco system. An evaluation of the spatial distribution of sedimentary organic carbon at the basin scale in relation to the sediment dynamics can contribute new knowledge both to lagoon ecology and management issues. According to the published literature, a very few studies on heavy metal contamination in coastal ecosystems had been carried out in Sri Lanka. Therefore heavy metal concentration in two commonly available fish species in the lagoon fishery (Catfish and Mullet fish) as well as in the sediments were studied in the Puttalam Lagoon in order to understand the level of heavy metal contamination. Further it was attempted to understand correlation between some physiochemical factors such as sediment particle size vs. heavy metal concentration in the lagoon sediments.

Project Objectives:

- To assess the spatial and temporal variation of some important physiochemical parameters (pH, Temperature, DO, Salinity, TSS, Nutrients – nitrate, nitrite, orthophosphate)
- To study the sediment distribution in the lagoon eco system.

- To estimate the heavy metal concentrations in sediment, two edible fish species in the lagoon ecosystems
- To identify the feasibility of the lagoon/selected areas of the lagoon for selected aquaculture practices (ex: bivalve culture, sea cucumber culture)

Materials & Methods

20 sites had been selected as to represent the entire lagoon as well as to compare the findings of previous studies in order to understand the present trends of the physio-chemical and biological parameters. Figure 1 indicates the site maps of the sampling points.



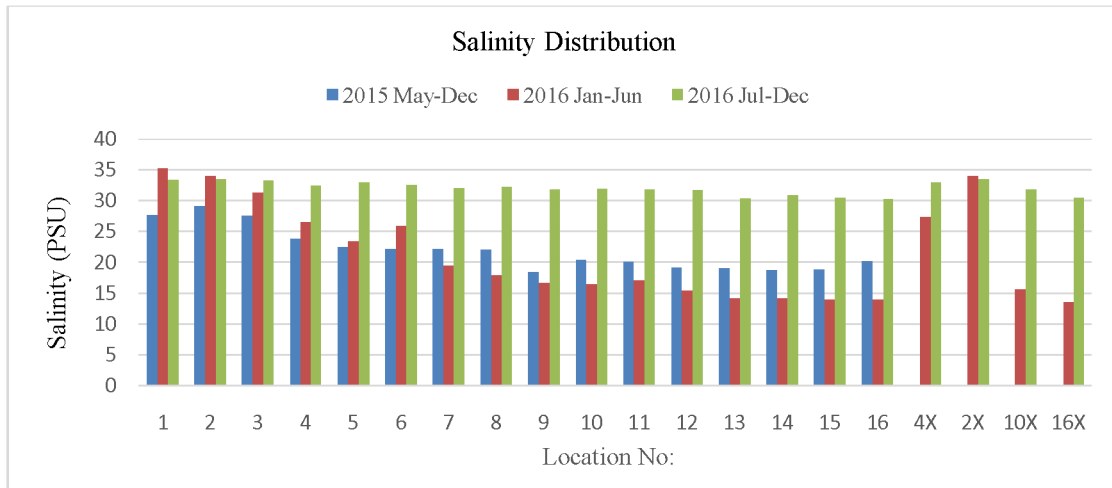
Figure 4. Sampling Points in the Puttalam Estuary

Field visits were conducted from January, 2016 to December, 2016 on monthly basis. Water samples were collected and kept in the ice (at 40 C) until transport to the division laboratory. In-situ measurements were taken for pH, salinity, DO, DO% and conductivity using the YSI 556 environmental meter. Grab samples were taken 2 times a year (in February and September) as to represent the 2 monsoon period for sediment distribution analysis as well as heavy metal analysis. Fish samples were also collected 2 times a year (in February and September) as to represent the 2 monsoon period. In the laboratory, lagoon water samples were analyzed for nitrate, nitrite, total suspended solids (TSS), and total orthophosphates according to the EPA protocols. Regarding the sediment sample analysis, the collected sediment samples were analyzed to study the sedimentological status of the Puttalam Estuary. For the heavy metal analysis it was decided to analyze the concentrations of Hg, Pb, Cd as they have been described in the Commission of the European Communities (EU, 2002). Heavy metal concentrations of cat fish species of *Plicofollis tenuispinis* (Day, 1877) and mullet fish species of *Moolgarda seheli* (Forsskal, 1775) and the sediment samples from above 20 locations were analyzed with the help of the IPHT division, NARA.

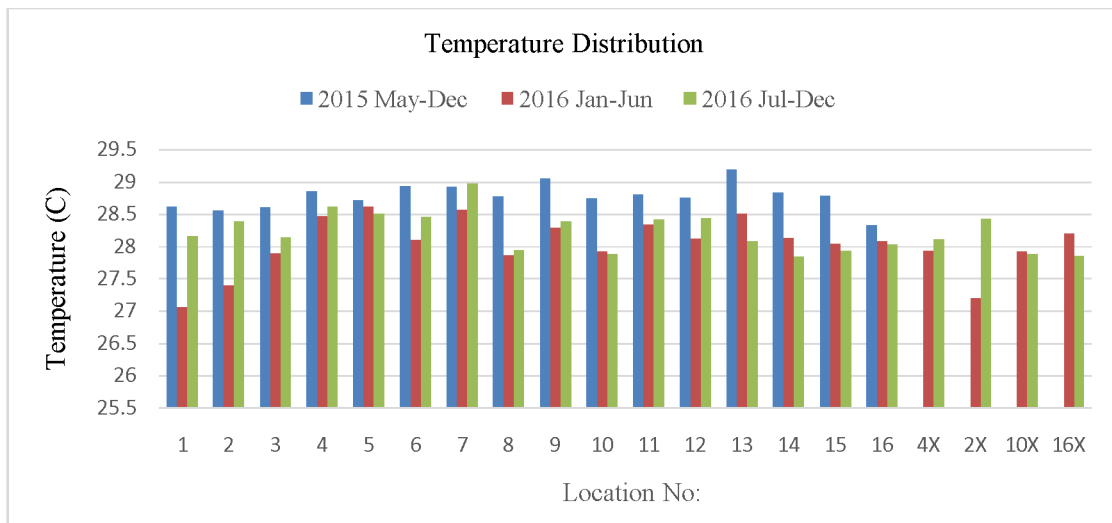
Results

At the end of one year and nine months data collection period, total number of 384 water samples, 40 sediment samples as well as four fish samples were analyzed. Some of the important findings are highlighted below.

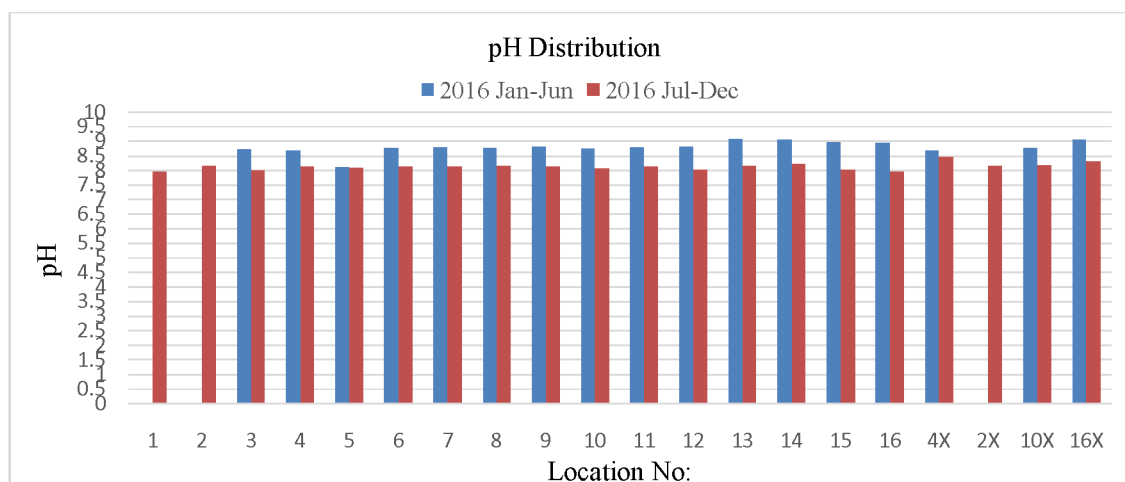
Salinity Distribution



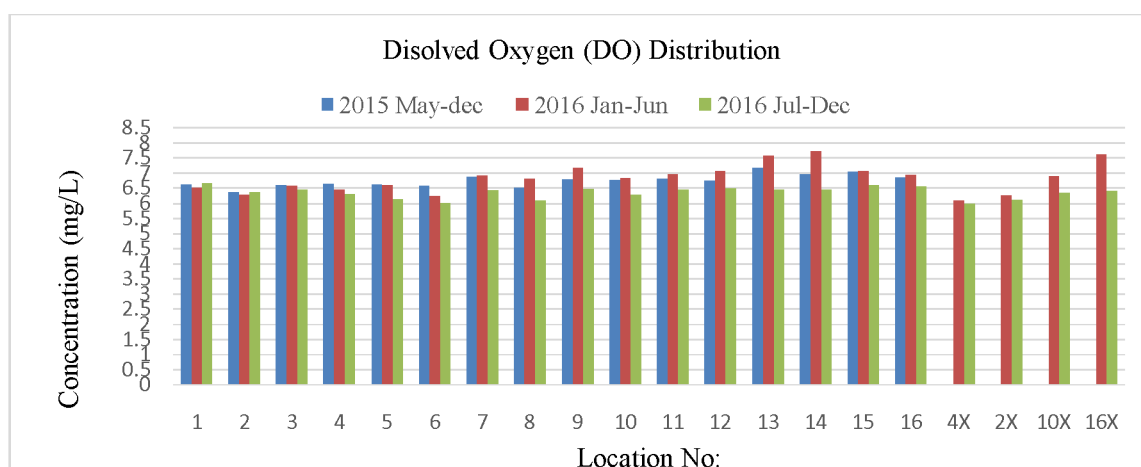
Temperature Distribution



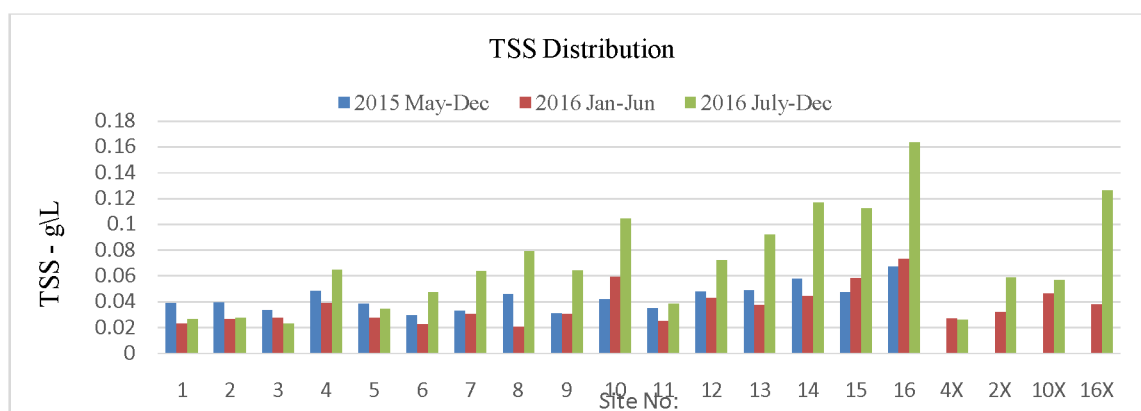
pH Distribution



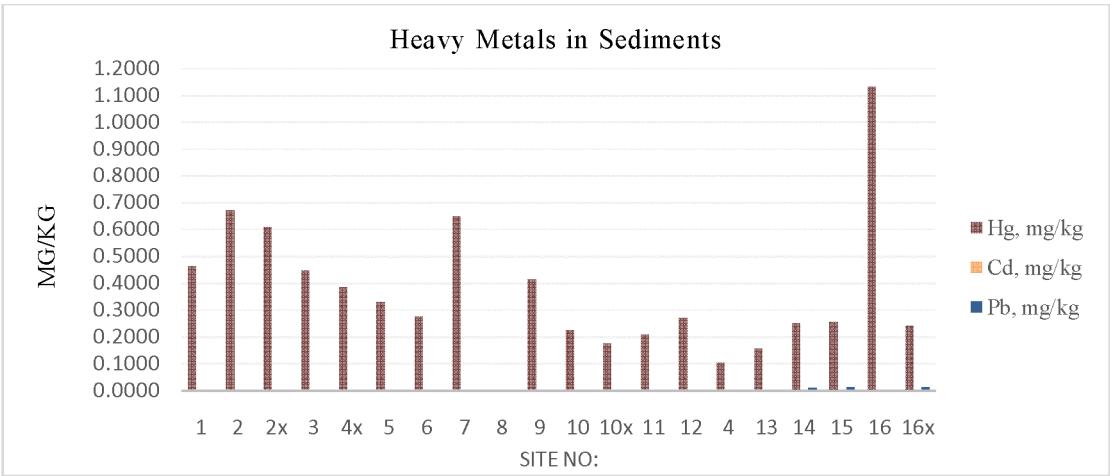
DO Distribution



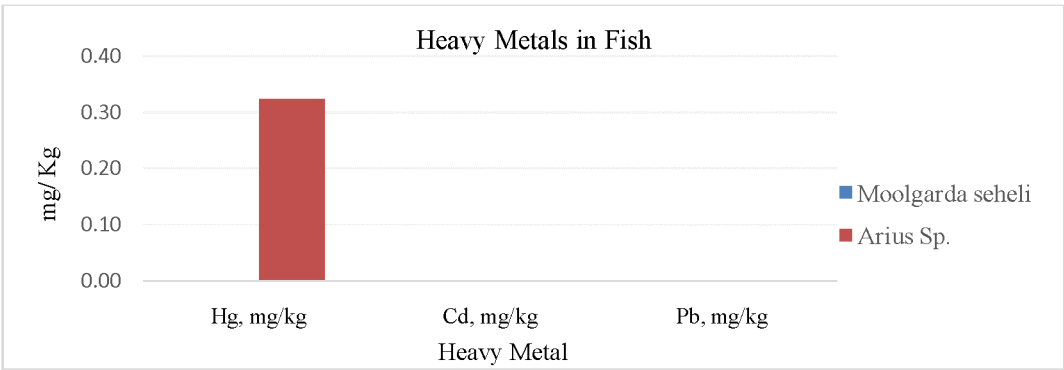
TSS Distribution



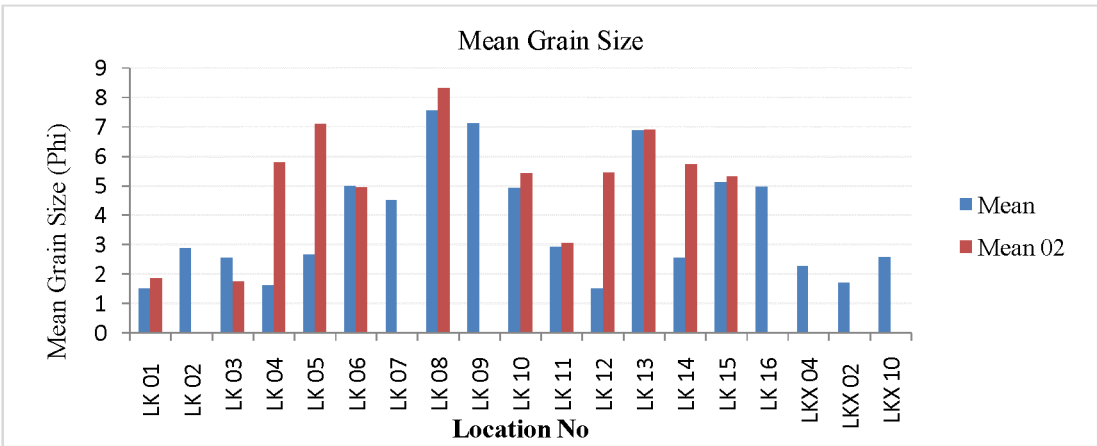
Heavy Metal Distribution in Sediments



Heavy Metal Distribution of Fish



Mean Grain Size Variation



PROJECT No : 6.1.1.

OPERATION OF OCEAN OBSERVATION CENTER

Responsible officers : K. Arulananthan
S.U.P. Jinadasa
N.B. Suriyaarachchi

The ocean observation center is functioning after the Indian Ocean Tsunami which was occurred in 2004. The center is running on 24x7 basis and monitoring and gathering real time ocean information data in the Indian Ocean especially around Sri Lanka.

The objectives of the establishment of such center are to develop and implement an observing system for monitoring the real time and near real time ocean status around Sri Lankan waters and the observations are vital during ocean based disasters to minimize impact and provide assistance for mitigating the events. Further, to implement an end-to-end system with the capability to detect, model and ultimately forecast changes in the ocean conditions around Sri Lanka waters.

The center produces updated version ocean information and provides it to coastal communities, maritime professionals and scientific communities to meet their needs. The data and information collected by the center is available in free access data base for intended users to be used. The freely available products can be utilized for scientists, researchers and university students only for scientific studies. However, in the case of commercial use can be done with written permission of Director General of NARA. The currently available products are sea level, sea surface topography, ocean wind, sea surface temperature, salinity and vertical temperature profiles, chlorophyll, wave climate, and deep ocean pressure data. The data are available as ASCII data as well as the map format.

The center collaborates with the Ministry of Fisheries and Aquatic Resources Development (MF&ARD), Disaster Management Centre (DMC), Geological Survey and Mines Bureau (GSMB) and the Department of Meteorology during the ocean based disasters to provide necessary technical support. Further provide guidance for early warning and mitigation of impacts of ocean based disasters. Additionally, center conducts awareness programs to aware the OOC activities specially ocean based disasters for three security forces, red cross, DMC and university students and school children etc. Also, facilitate the opportunities for study visits to security forces, school and University students.

Further, Ocean Observation Center of NARA responsible for maintaining of sea level station and acquisition of data from the stations at Colombo, Trincomalee and Hambatota. The objective is to gather and analyze sea level data around Sri Lanka for research and development applications such as navigational safety, climate and environmental studies and coastal development planning. The real time sea level data from sea level stations will be transferred to the sea level data base in Ocean observation center of NARA. Weekly tidal status forecasting is disseminated to relevant authorities.

Project progress

Progress (%):- Financial: 60% Physical: 100%

PROJECT No :6.1.2.

NUMERICAL SIMULATION OF COASTAL SEDIMENT TRANSPORT AND MORPHOLOGICAL MODELING: CASE STUDIES OF SRI LANKA'S WEST-NORTH-NORTH EAST COAST

Responsible Officers : R.M.R.M. Jayathilaka

Introduction

The ever-increasing economic and environmental considerations of coastal zones have provoked further studies of the variety of coastal processes such as coastal erosion, deposition and sediment transportation. Process-based numerical modelling of sediment transport and morphological change is widely recognized as a valuable approach for understanding and predicting coastal morphological developments. The study aims to trial a cost-effective modelling approach to derive a reasonably accurate sediment transport along the coastline of Negombo, Mannar and Mullathivu. In data poor environments, such as commonly found in developing countries, numerical modelling is a promising method to derive a qualitative regional sediment transport, and to identify the environmental forcing/human interventions that govern the sediment budget.

Methodology

Bathymetry and wave data are the dominant factors for determining sediment transport thus the sediment budget. Through literature review, an appropriate survey has been executed for collecting data and information. Moreover, collected data pertaining to wave (ERA Interim) was validated by ORCA (met Ocean data Transformations, Classification and Analysis) developed by Deltares. For the wave transformation, Delft3D-WAVE model was applied, forced by offshore wave/wind with spatially varying boundary conditions. The Delft3D-FLOW model was used to estimate long shore transport rates and related morphodynamics using input reduction and morphological acceleration techniques. Long-term and short-term erosion/deposition volumes were calculated by extracted coastlines from historical aerial photographs of 1956, 2005 and 2014.

Results and Discussion

Wave Transformation, Sediment Transport and Morphological Evolution

Negombo

of sediment transport modeling and wave transformation modeling therefore the results could be used as baseline data for future developments and environmental monitoring.

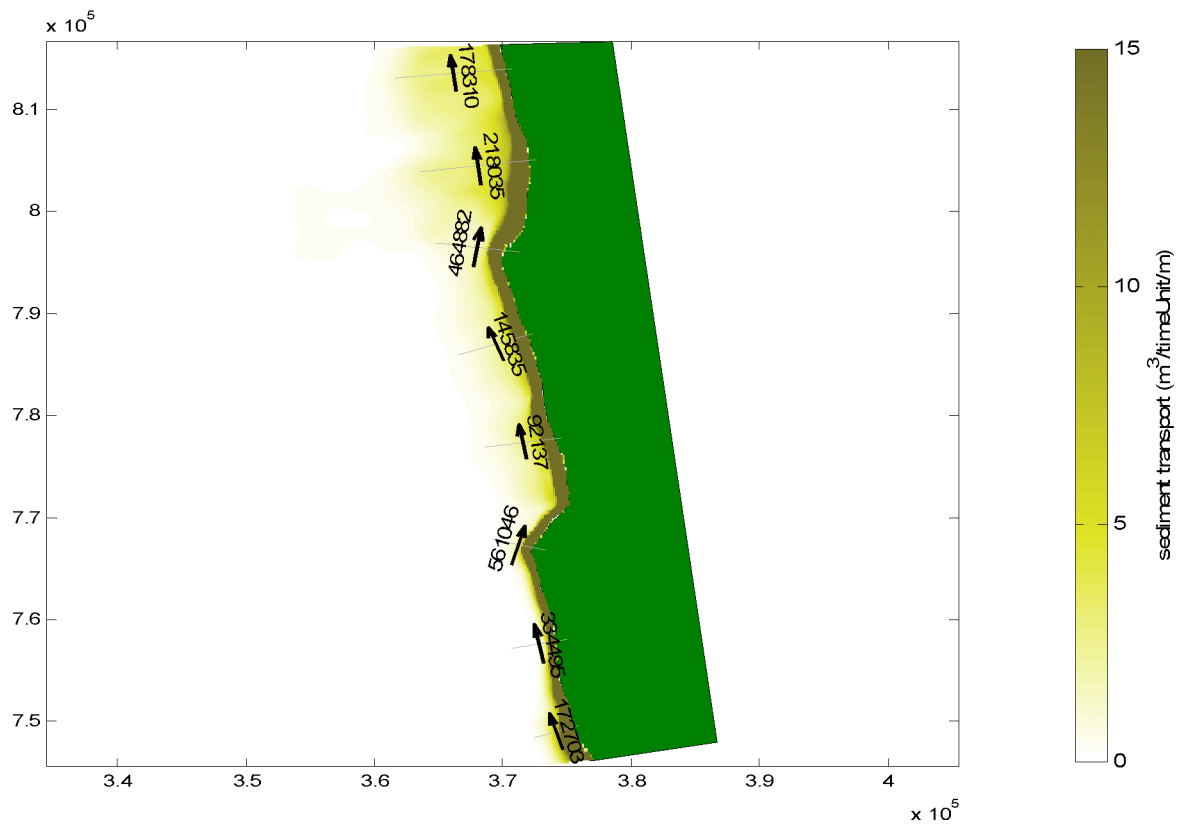


Figure 5. Annual sediment transport through transects (m^3/year)

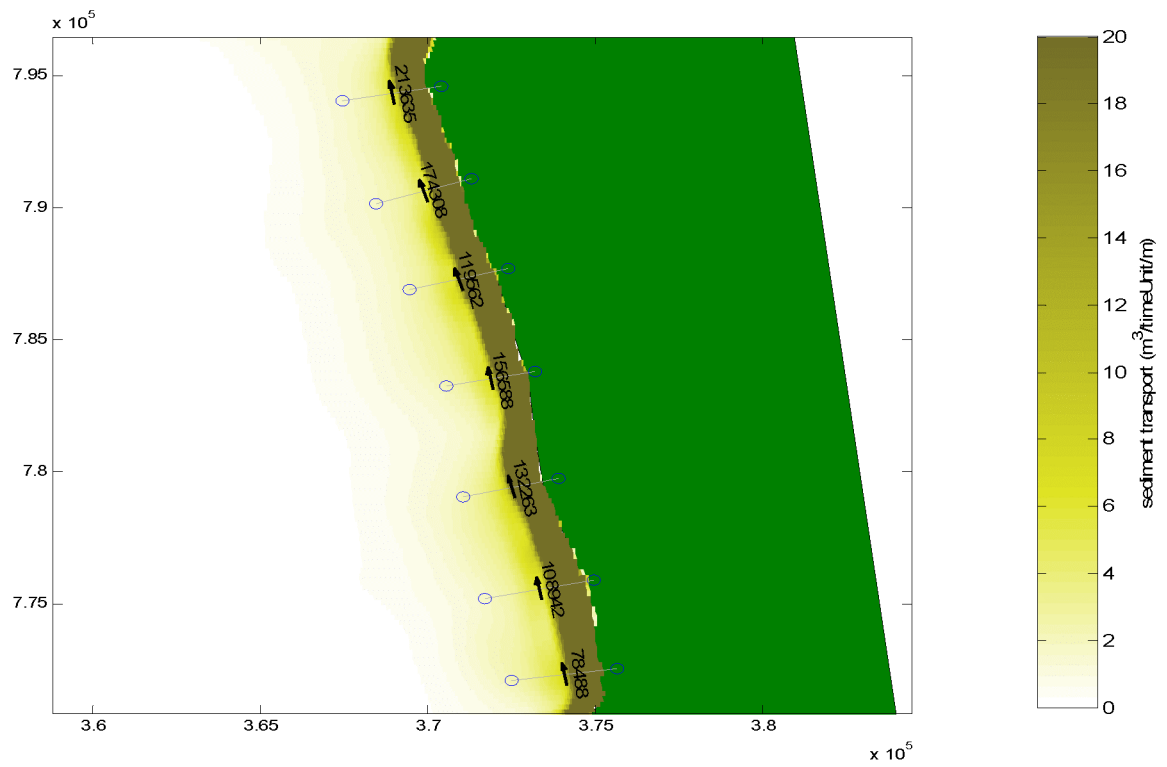


Figure 6. Annual sediment transport through transects between Colombo and Negombo (m^3/year)

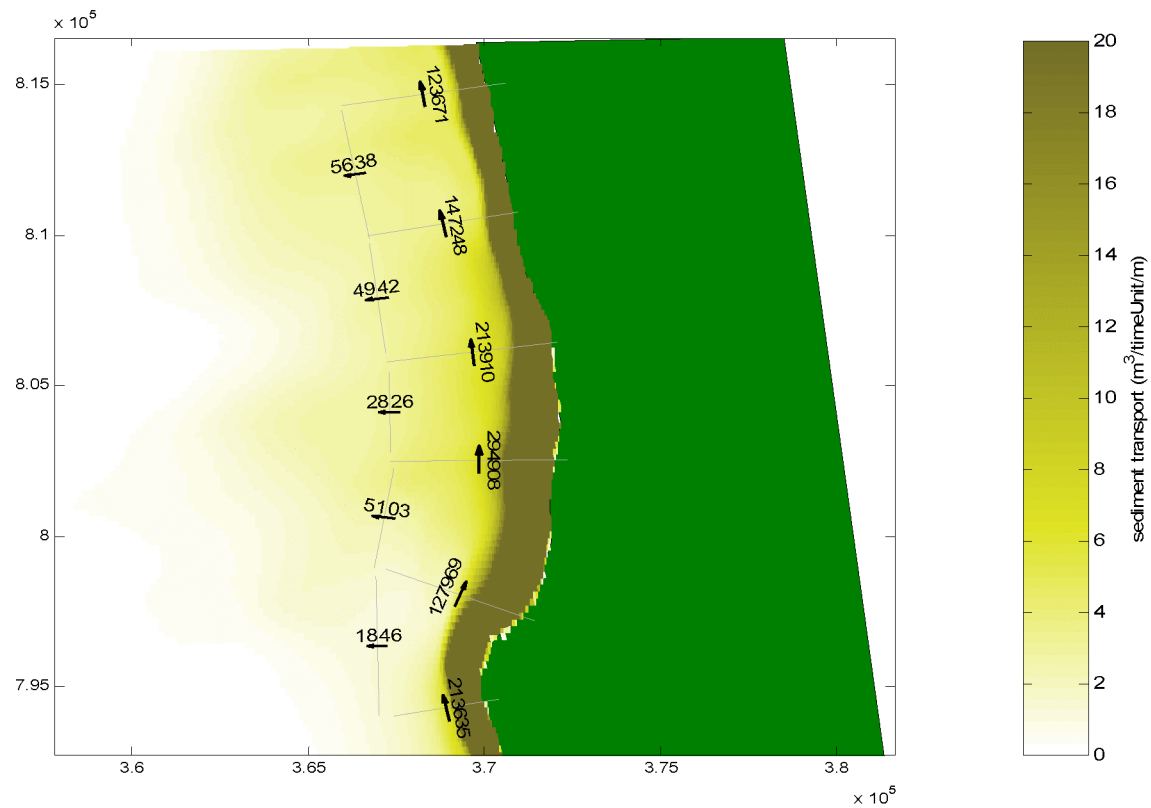


Figure 7. Annual sediment transport through transects between Negombo and Chillow (m^3/year)

Mullathivu

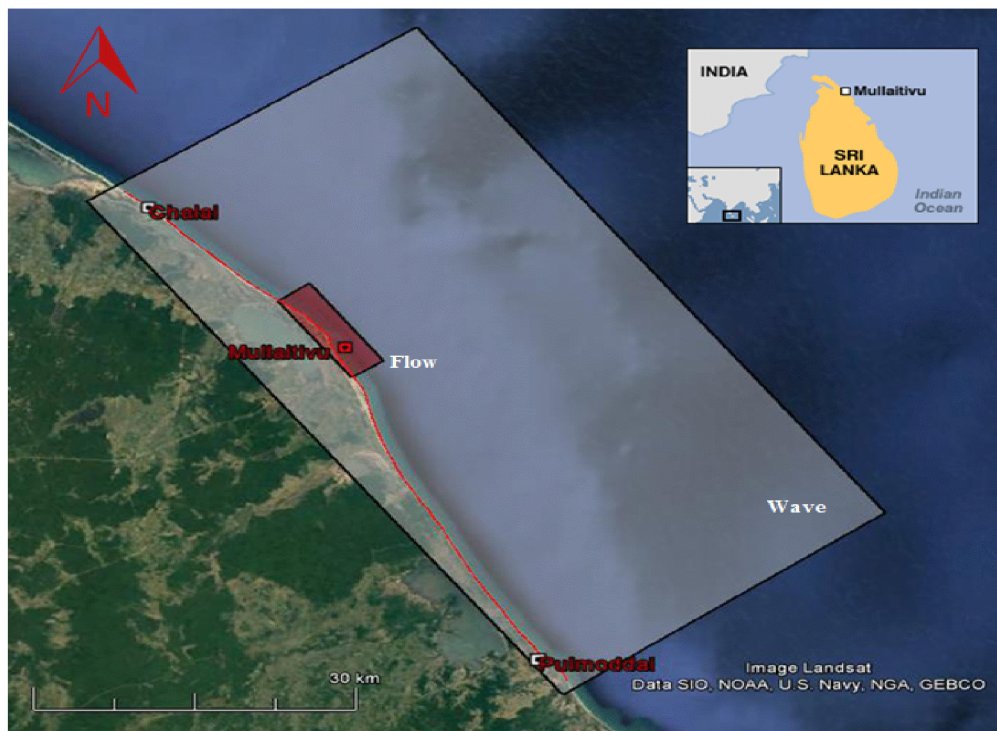


Figure 8

Figure 9

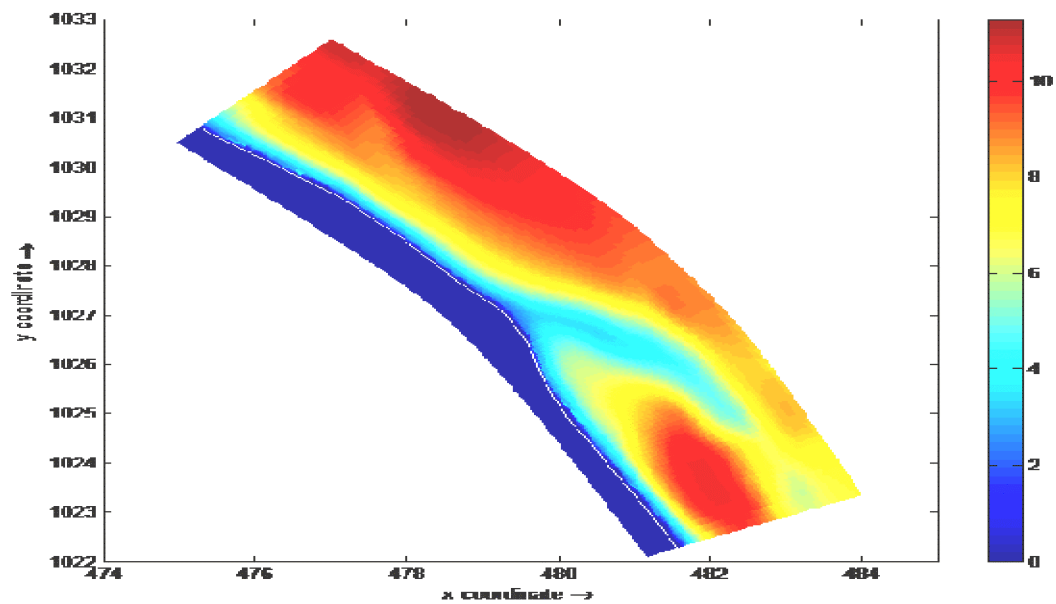
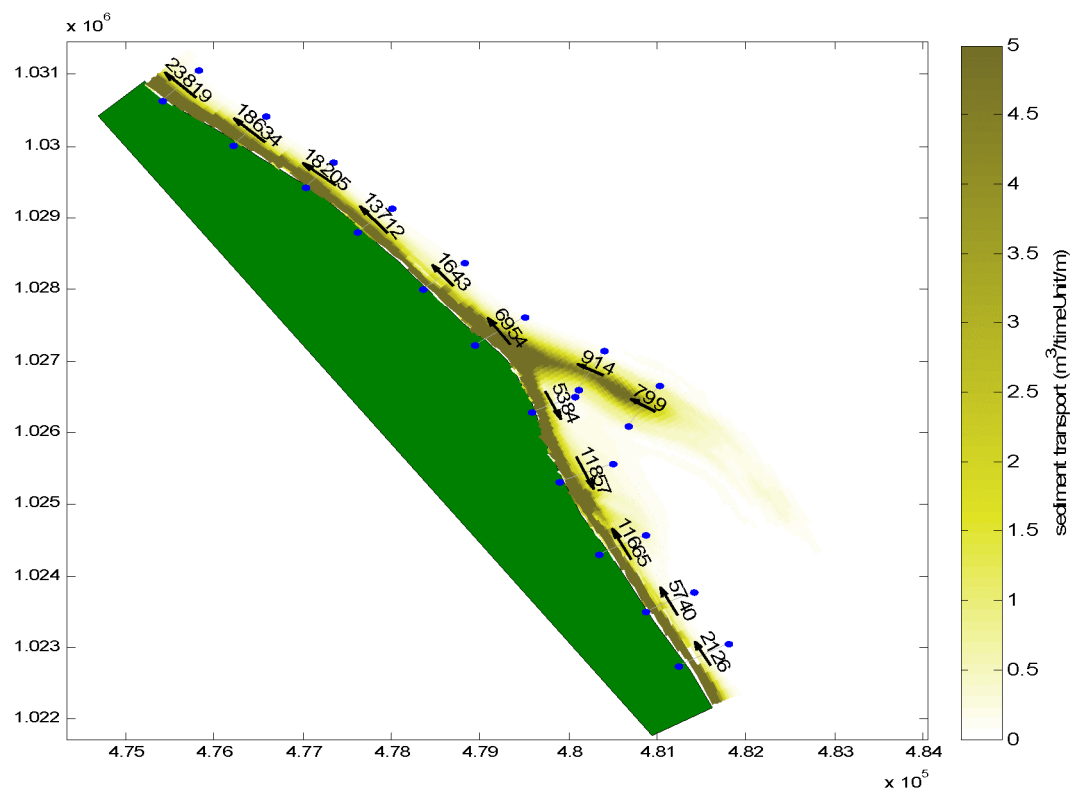


Figure 10



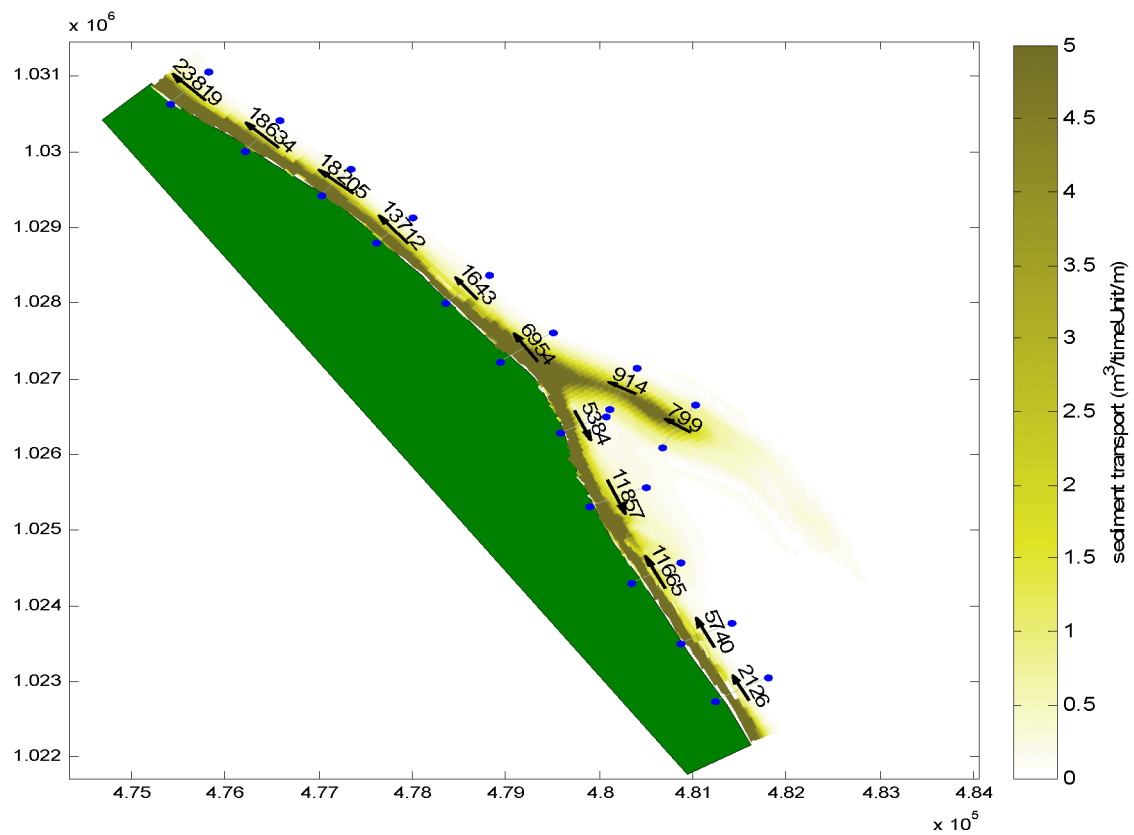
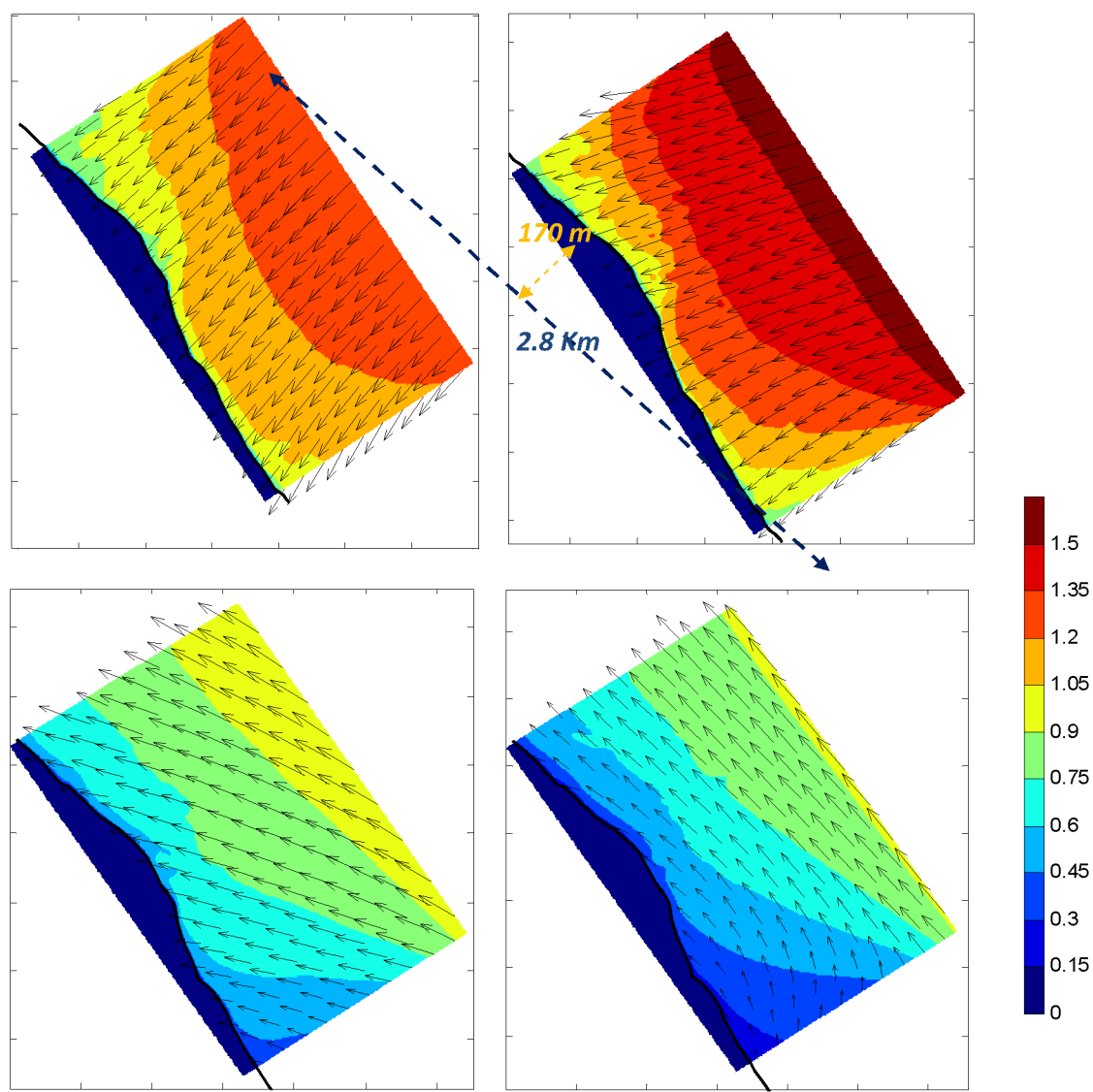


Figure 11. Annual sediment transport through transects (m^3/year)

Figure 12



Simulation no 1,289,456,529

Figure 13

Responsible Officers : Dileka Samaranayake
Nuwan Suriyaarachchi

Introduction

Sri Lanka, being an island nation possesses comparatively large continental shelf and huge ocean territory, yet considerable evaluation has not done on marine based mineral resources. Monozite is an industrial mineral which is radioactive, thus useful in many industrial applications. It is one of the more resistant minerals and becomes concentrated in the weathering debris. The southwestern coastal stretch served by two major rivers and many minor rivers with a large sediment discharge containing heavy minerals and therefore it led to the assumption that there could be considerable off shore reserves of Monozite bearing heavy minerals throughout the area.

Objectives:

- To explore potential mineral sand aggregates
- To qualitatively analyze available deposits
- To estimate mineral sand volume of the exploration area and map economically exploitable deposits
- To study its seasonal variations

Methodology

Sample collection:

- 60 samples collected from Beruwala to Maggon area including beach samples

Results

Grain Size and Distribution Characterization

a. Offshore Samples

Particle size is a fundamental property of any sediment which can provide important clues on energy and provenance. Sixty sediment samples were collected using Van-Veen grab and analyzed for grain size distribution, statistical and textural parameters. Mechanical sieve analysis was done at 1/2 phi intervals and statistical parameters were obtained using GRADISAT software following Folk and Ward (1957) method for classifications.

The majority of sediments are typically light yellow to olive green in color and contain 5-20% biogenic carbonates with exception of sixteen samples which composed of totally shell fragments and rock particles. Samples grabbed around Benthota Ganga inlet face are sub rounded to rounded in shape while the majority of other locations are of rounded to sub angular grain particles. The angularity of sediments close to rocky islands shows that they are younger sediments and perhaps derived from nearby rocks. The mean grain size of the sediments ranges between 1.55-4.36 phi with an average of 3.52 phi, indicative of very coarse silt to medium grained sand. The sediments fall under fine sand to very fine sand (50% of total samples) are localized near areas where the bottom is rough and rocky. Among the analyzed samples 45.5% are well, 22.72% moderately, 18.18% moderately well, 9.09% poorly sorted. 68.68% of samples exhibit unimodal distribution and all samples of bimodal

distribution are poorly or moderately sorted and it probably due to debris of organic origin mixed with the normal bottom sediments.

No significant variation in grain size, Kurtosis or skewness observed during two season's except some points.

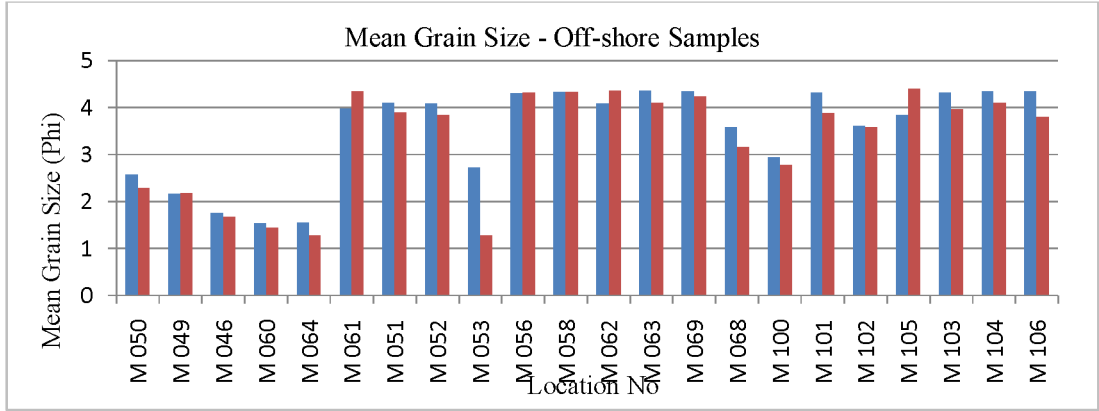


Figure 14. Mean Grain Size Variation of Off-shore Samples during Two Seasons

b. Beach Samples

Though original plan was to collect twenty samples during one season, only 10 samples could be collected due to practical problems. These were collected during Southwest monsoon and samples could not be collected during Northeast monsoon due to poor vehicle allocations. Surface samples were collected and analyzed according to the procedure described above. The majority of sediments are typically light yellow to light brown in color. The mean grain size varied from 0.949-4.36 in phi scale while the average was 2.71 indicative of fine grained sand. The sorting values varied from 0.638 to 1.165 in phi scale and most of them are moderately sorted.

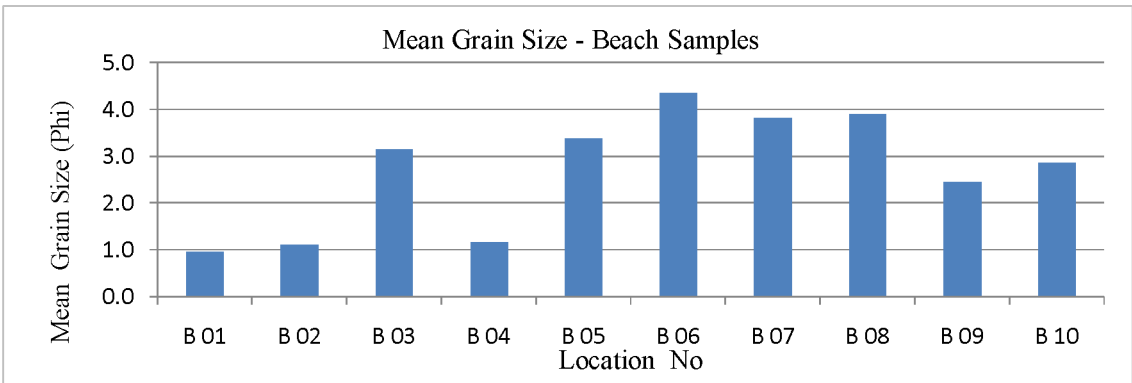


Figure 15. Mean grain size variation of beach samples

Mineralogical Analysis

The collected samples were then analyzed for heavy minerals. The fraction retained in the No 120 sieve (Mesh size 125 μm) use for the feed for magnetic separator. The Frantz's separator used for separate minerals according to their magnetic susceptibilities. The instruments was set for side slope of 5° and amperage of 1.2 Amps. The setting was to identify range of sphene ,leucoxene, apatite, andalusite, monozite and Xenotine.



Figure 16. Sampling Locations

M 50N, M 60 and M 100 points contained highest heavy mineral percentages respectively 0.89%, 1.89% and 1.25 %. Comparing with the samples taken during North-East monsoon, the samples taken during South-West monsoon showed higher heavy mineral percentage. It was 1.7%, 1.9% and 2.1% respectively for the above stated points. Considering beach samples B03, B09 and B 10 points exhibited the highest heavy mineral percentage 3.12%, 2.13% and 1.58 % respectively. The minerals identified from microscope are *Illmanite*, *Zircon*, *Monozite* and *Garnet*. Some pictures of the samples under 40X of light microscope are shown below.

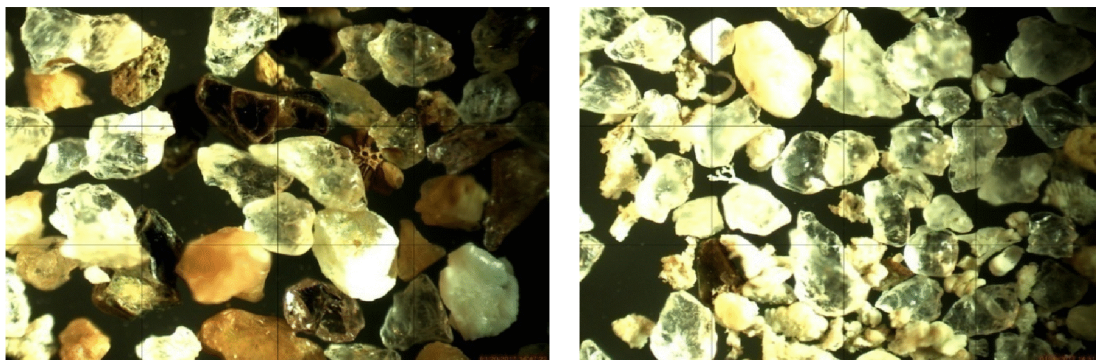


Figure 17. Microscopic view of samples (M50 Left, M 53 Right)

Conclusion

Considering the grain size parameters of sediments, majority of the sediments (54.54%) are negatively coarse skewed and are localized opposite headlands. It indicates the selective removal of fine grains by the action of high energy waves which dissipate on headlands. The Kurtosis varies from 0.56 to 2.95 phi. Kurtosis of the inlet face of Benthota Ganga shows mesokurtic to platykurtic nature indicating high energy and wide distribution of sediments. Moreover, the sediments in north-south (towards south) direction shows leptokurtic nature except near headlands, which indicates the moderate energy conditions toward south. The heavy minerals occur on beaches mainly near to mouth of rivers, bordering barrier bars and abutting headlands while the highest concentration could be observed abutting headlands. Highest heavy mineral percentage reported during South West monsoon.

The Distribution maps of heavy mineral and grain sizes of sediments are being preparing.

Research Publications

Full Papers

No	Title	Authors	Publisher
01	Coupling Logbooks and Vessel Monitoring System for Investigations of Large Pelagic Fishing Activities by Sri Lanka.	S.Gunasekara J.Rajapaksha	Proceedings of 37 th Asian Conference on Remote Sensing (ACRS) on the 17 th –21 st October 2016 at Galadari Hotel, Colombo, Sri Lanka. URL: http://a-a-r-s.org/acrs/administrator/components/com_jresearch/files/publications/Ab%200489.pdf
02	Environmental preferences of Billfish in Bay of Bengal: A case study in longline fishery of Sri Lanka	M.I.G. Rathnasuriya S.S. Gunasekara S.S.K Haputhanthri J.K. Rajapaksha	Working Party on Billfish (WPB) Indian Ocean Tuna Commission, At Victoria, Seychelles. URL: http://www.iotc.org/sites/default/files/documents/2016/09/IOTC-2016-WPB14-10_-_Rev_1_-_LKA_-_Env_Pref_Bill_NEIO.pdf
03	Temporal changes of surface chlorophyll in the sea of south of Sri Lanka based on satellite data from 2005 to 2015.	S.S. Gunasekara	NARA Scientific Sessions 2016. NARA, Colombo
04	Ocean Turbulence and Mixing around Sri Lanka and in Adjacent Waters of the Northern Bay of Bengal,	Jinadasa, S.U.P I. Lozovsky J. Planella-Morató A. Lukas J. MacKinnon J. Nash H. W. Wijesekera H.J.S. Fernando (2016)	<i>Oceanography.</i>

05	Collaborative Observations of Boundary Currents, Water Mass Variability and Monsoon	Craig M. Lee Priyantha Jinadasa Luca Centurioni H.J. S. Fernando Verena	<i>Oceanography.</i>
	Response in the Southern Bay of Bengal,	Horrmann Matthias Lankhorst, Luc Rainville, Uwe Send and Hemantha Wijesekera (2016)	
06	Observations of Currents over the Deep Southern Bay of Bengal with a Little Luck	H. W. Wijesekera W. J. Teague E. Jarosz D.W. Wang T.G. Jensen S.U.P. Jinadasa H.J.S. Fernando L.R. Centurioni Z.R. Hallock E. Shroyer J. Moun	<i>Oceanography.</i> 479.
07	ASIRI: An Ocean-Atmosphere Initiative for Bay of Bengal	Hemantha W.Wijesekera Emily Shroyer M. Ravichandran Debasis Sengupta S. U. P. Jinadasa Harindra J. S. Fernando Neeraj Agrawal K. Arulananthan G. S. Bhat Mark Baumgartner Jared Buckley Luca Centurioni Patrick Conry J. Thomas Farrar Arnold L. Gordon Verena Hormann Ewa Jarosz Tommy G. Jensen Shaun Johnston Matthias Lankhorst Craig M. Lee Laura S. Leo Iossif Lozovatsky Andrew J. Lucas Jennifer Mackinnon Amala Mahadevan Jonathan Nash Melissa M. Omand Hieu Pham Robert Pinkel Luc Rainville Sanjiv Ramachandran Daniel L. Rudnick Sutanu Sarkar Uwe Send Rashmi Sharma	<i>Bulletin of the American Meteorological Society,</i> doi: 10.1175/BAMS-D-14-00197

		Harper Simmons Kathleen M. Stafford Louis St. Laurent Karan Venayagamoorthy Ramasamy Venkatesan William J. Teague David W. Wang Amy F. Waterhouse Robert Weller Caitlin B. Whalen (2016)	
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Abstracts

01	Sedimentary characteristic of offshore sediments in Maggona to Induruwa, south-western region of Sri Lanka.	T.B.D.T Samaranayake
02	Spatial and temporal variation in water quality and current status of the sediment assemblage in the Puttalam Lagoon – Proceedings of NARA Scientific Sessions 2016 (Extended Abstract)	K. R. Dalpathadu S. Gunasekara K. Jinadasa D. Samaranayeka
03	Grain size characterization of selected locations of Kalpitiya Lagoon, Sri Lanka – Peradeniya University International Research Sessions, 2016 (Abstract)	K. R. Dalpathadu S. Gunasekara K. Jinadasa D. Samaranayeka

Work Abroad

1. The Forum for Future Ocean Floor Mapping which was held in Monaco during June 14-18, 2016
2. Joint workshop on collaborative work in the Indian Ocean with Second Institute of Oceanography (SIO) and “Impact of Extreme Climate on South East Asia and the Associated Disaster Prevention and Mitigation” which were held in China during December 24-30, 2017

Post-graduates Studies

1. W.N.C. Priyadharshani continues doctoral studies in China.

Technical Services and Consultancies

1. Port City development project-Water quality and current measurements, 2014-2016
2. Air-Sea Interaction in the Northern Indian Ocean (ASIRI) project- Oceanographic parameter studies.

Supervised Students

1. Udeshika Wimalasiri, University of Sri Jayewardenapura, M.Phil research work titled, Preliminary study on planktonic bioluminescence in the marine waters of Sri Lanka

5.7 INSTITUTE OF POST HARVEST TECHNOLOGY

Head of the Division: Dr. G. J. Ganegama Arachchi

Strategy: Development of post harvest technologies and make improvements in food safety measures

A team of 10 Scientists comprising two Principal Scientists, three Senior Scientists and five Scientists (including two scientists recruited in December , 2016 are attached to IPHT. IPHT has conducted four research projects under Thrust areas of reduction of post-harvest losses and value addition. Other additional projects were conducted using funds separately provided by MFAR. In addition, IPHT has provided Testing Services; consultancies; and tailor made training programs and awareness programs for stakeholders including fishers, fish processors, fish sellers, school children in Sri Lanka.

PROJECT No:4.1.1

SCIENTIFIC INVESTIGATIONS TO ASSESS POST HARVEST QUALITY LOSSES AND FIND RELEVANT REMEDIAL MEASURES

Responsible Officers: G. J. Ganegama Arachchi
P. Ginigaddarage

Introduction

The main purpose of this project is to find out remedial measures required to reduce high level of post-harvest losses of fish in multi-day boats (MDBs) in Sri Lanka. In 2016, this study investigated post harvest quality losses of skipjack tuna, Indian Scad and Yellow fin tuna which were landed from MDBs. Post harvest quality and losses was assessed in fish unloading boats using questionnaire in selected fishery harbours/landing sites and microbiological and chemical analyzing of fish, water and ice samples obtained from fishery harbors.

In addition, this study initiated to prepare of suitable designs of mechanical refrigeration systems to store fish in ice and chilled water in MDBs. Designing of chill storage facilities in MDBs are prepared by a six month Consultative support of University of Moratuwa and this designing activity will be continued until April in 2017. This project also assessed the quality of fish sold at Central Fish Market (CFM) at Peliyagoda as a continued monitoring task.

Study I) Assessment of quality and post-harvest losses of *Katsuwonus pelamis* (skipjack tuna) landed from multi-day boats at Negombo fish landing site

Katsuwonus pelamis (skipjack tuna) is the most abundant and fast-growing commercial tuna species. Negombo landing site, which is situated in Western province, is one of the major sites for anchoring of multi-day boats (MDBs) in Sri Lanka. In 2000 it was reported that post-harvest quality loss (PHQL) and commercial post-harvest loss (CPHL) of skipjack tuna was 40%, and 15%, respectively. In this study present levels of PHQL and CPHL of skipjack tuna landed from MDBs at Negombo landing site were assessed by using questionnaire based survey with the use of 35 MDBs from April to July of 2016. During this study, 65 skipjack tuna fish samples which belong to different quality categories were analyzed for spoilage bacterial count using iron agar media, total volatile base nitrogen (TVB-N) by steam distillation method, and histamine content by rapid colorimetric method.

Considering fish storage time during fishing trip of MDBs, PHQL were assessed in three storage time categories: as <10 days, 10-19 days, and > 20 days. PHQL of skipjack tuna stored in multi-day boats for <10, 10-19, >20 days were about 37, 43, and 45%, respectively. CPHL of skipjack tuna stored for <10, 10-19, >20 days in MDBs were 17, 21, and 21 %, respectively. In Negombo landing site total bacterial count of skipjack tuna catches from MDBs were in the range of 4.87 - 6.41 log₁₀CFU/g, spoilage bacterial counts were in the range of 4.74 - 5.64 log₁₀ CFU/g. TVB-N content was in the range of 15.6 - 20.9 mg/100g, and it increased (P<0.04) with the lower quality commercial grades. Lowest TVB-N (15.6 mg/100g) value observed in commercial grade I and it was significantly lower (P<0.002) compared to commercial grade IV (20.9 mg/100g). Histamine content was in the range of 11.55- 173.4 ppm and lowest histamine content was observed in commercial grade I (11.55 ppm), which is significantly lower (P<0.01) compared to commercial grade II (52.89) and III (173.4 ppm). PHQL and CPHL increase with the days of storing of fish during the trip duration. Tuna landed from Negombo landing site did not exceed standard level of total bacterial count (7.0 log₁₀CFU/g) and standard level of TVB-N content (35 mg/100 g).

Study II) Quality and post harvest losses of Yellowfin tuna (*Thunnus albacares*) landed at Dickowita Fishery Harbour:

At Dikkowita fishery harbor, Yellowfin tuna which are intended for export market are unloaded from multi-day boats targeting located in Western province, Sri Lanka is renowned for receiving the highest quantities of export quality yellowfin tuna by multi-day boats. Quality of fish assessed from May to September 2016. The Yellowfin tuna targeted for export market is graded over five quality categories (grade AAA, AA, A, B and reject-grade) based on the on-site sensory evaluation of core samples of flesh. Amount of fish belong to each grade (AAA, AA, A, B and reject-grade) were about 18, 18, 15, 10 and 39 % (wt/wt), respectively.

Histamine is a biogenic amine and can be produced during storage & processing of certain fish species, especially tuna & tuna like fish, usually by the action of spoilage bacteria. Histamine concentration is of great concern as a critical parameter in the seafood exportation trade. In the present study, the core flesh samples of yellowfin tuna were collected from all five quality categories randomly, as 10 from each grade, and those were analyzed for the histamine concentrations using rapid colorimetric method. Grades AAA, AA, A, B and reject-grade contained 5.18 ± 3.26 , 7.83 ± 4.35 , 9.29 ± 5.23 , 9.44 ± 3.83 and 16.16 ± 13.16 (mg/100 g) levels of mean histamine concentrations, respectively. Fish samples of AAA, AA and A categories showed low mean histamine levels compared to the reference levels (10 mg/100 g) as stipulated by the European Union. The mean histamine levels of grade B and reject-grade exceeded than the reference level in 6 and 7 out of 10 fish samples of each grade, respectively. Therefore, more than 50% of large yellowfin tuna is rejected by fish processors in export marketing in Sri Lanka. By applying good handling practices and improving the storage conditions, the post-harvest quality loss that is resulted due to increase of histamine concentration can be minimized, especially in low quality grades (B and reject-grade). This can be lead to secure more profits by the exportation of good quality yellowfin tuna fish.

Study III) Quality assessment of Indian Scad fish harvested by Multi-day boats (MDBs) in southern coast of Sri Lanka:

This study aimed to investigate quality of Indian scad fish landed in Southern coast in Sri Lanka. Indian scad unloaded from multiday boats were categorized into four grades based on sensory evaluation of raw whole fish. Sensory characteristics (odour, flavour and texture) of cooked fresh fish were checked using five panelists for each sample. According to the sensory data, Grade 4 fishes had sensory characteristics which are weaker than other three grades. Grade 1 fishes had acceptable sensory characteristics and grade 2 and 3 had intermediate sensory characteristics. Fish belong to four quality categories were sampled from Kudawella, Tangalle and Puranawella over six sampling visits. Total of 43 samples comprising 13 samples per each Grade were analyzed were analyzed for Total aerobic counts, *Escherichia coli*, *Salmonella* spp., Total Volatile Base Nitrogen (TVB-N), and salt content. Water from fishery harbor, ice manufacturing plants and ice used in multiday boats were also analyzed for microbiological parameters. Grade 1, 2, 3 and Grade 4 fish contained spoilage bacteria in the range of $1.9 \times 10^4 - 9.5 \times 10^6$, $1.9 \times 10^4 - 2.3 \times 10^7$, $2.0 \times 10^4 - 3.0 \times 10^7$ and $5.0 \times 10^5 - 8.1 \times 10^6$ cfu/g, respectively. About 46% of Grade 1 fish were contaminated with *E. coli* and ranged from ND to 9.2 MPN/g. *E. coli* was present in 54, 77 and 50 % of Grade 2, 3 and 4 fish samples, respectively. Of the 43 fish samples, tested *Salmonella* spp weren't detected in samples obtained over six field samplings. Average TVB-N of fish belong to Grade 1, 2, 3, and 4 fish were in the range of about 9-35, 6-62, 11 – 79, and 22 –67 mgN/100 g, respectively. Salt content of Grade 1, 2, 3, and 4 fish were found at range of 0.8– 1.8, 0.9– 1.6, 1.1 –1.9 and 1.2 –2.1% (w/w), respectively. All samples of harbour basin water and Bilge water in the boat in Kudawella, Tangalle and, Puranawella were heavily contaminated with *E. coli*. Ice samples (25%) from Kudawella harbor were found to be contaminated with *Salmonella* spp. Post harvest quality losses (PHQL) of Indian scad were about 22, 28 and 35% in MDB's which spent <10 , 10-19, and >20 days in fishing trip, respectively.

Study IV) Microbiological quality of fish landed in Mannar:

Presence of faecal coliform, *E. coli* and *Salmonella* in fish harvested from boats is an indication of the poor quality of fish. Samples collected near Mannar landing sites were comprised of 14 fish samples from boats, 17 fish samples from wadiya, 19 swab samples from boats and 11 swab samples from wadiya. In addition, 13 water samples and 12 ice samples were collected for the analysis. These samples were analysed for Aerobic plate count, *E. coli*, fecal coliform, and *Salmonella*. These results ultimately help to find out the sources of pathogenic contamination of fish. APC level of fish samples of boats ranged from $2.2 \times 10^3 - 3.4 \times 10^6$ cfu/g. One fish sample collected from boats was detected with *Salmonella* and *E. coli* was detected in the range of ND – 24 MPN/g. Fish samples collected after receiving to the wadiya had APC levels ranged from $7.0 \times 10^3 - 8.2 \times 10^6$ cfu/g. *Salmonella* was absent in all the samples and *E. coli* was ranged from not detectable to 460 MPN/g. Swab samples obtained from most boats had high *E. coli* numbers (>1800 MPN/g) which indicates poor sanitary quality. APC ranged from $2 - 6.4 \times 10^6$ cfu/g. *Salmonella* was absent in all the swab samples collected from boats but two swab samples collected from wadiya were positive for *Salmonella*. *E. coli* of wadiya swab samples contained high content of *E. coli* (range between 350 and >1800 MPN/g). APC ranged from $1.2 \times 10^4 - 1.3 \times 10^7$ cfu/g. Lagoon water samples were also highly contaminated with three samples (23%) detected with *Salmonella*. *E. coli* was also present and ranged between 35 and > 1800 MPN/g. About

25% of ice samples were contaminated with *Salmonella* and contaminated with *E. coli* in high numbers > 1800 MPN/g.

Conclusion

From the results obtained in above studies at fishery harbours and landing sites, indicated that there was a great chance of contamination of fish through fish contacting on uncleaned or improperly cleaned surfaces such as boat, floor of wadiya, and use of ice and water which were highly contaminated with indicator and pathogenic bacteria. High level of histamine formation in fish stored in MDBs reflect the inadequate chilling facilities in boat, improper handling practices and use of contaminated ice and water in boats.

Recommendations based on this study:

- Need to improve fish chilling facilities in Multi-day boats
- Systems to sale clean ice
- Supply of adequate amount of clean water
- Use of disinfectants to clean boats and utensils
- Adopt proper fish handling practices in boats and unloading sites

V) Quality assessment of imported fish in retail outlets:

The present study was carried out to assess the quality of imported fish by investigating the concentration of formaldehyde, total volatile basic nitrogen (TVB-N) content, and *E. coli* in selected imported fish varieties namely sailfish, mackerel, Bullet tuna, Sword fish, cuttle fish and Indian Scad sold in Sri Lanka.

Mean TVB-N content of Bullet tuna, cuttle fish, sailfish, Sword fish, mackerel and Indian scad were 36.0, 6.65, 9.00, 20.60, 10.82 and 137.4mg/100g respectively. Mean TVB-N levels of analysed Squids, sailfish, Sword fish and mackerel were below the specified limit (35 mg/100 g) and they can be considered as good in quality. 25% of the total samples exceeded the acceptable limit of TVB-N level.

75% of the samples contained *E. coli* less than 11 MPN/g which can be considered as acceptable (good in quality) based on ICMSF (1986) standards. None of the samples exceeded the *E.coli* 500 MPN/g level which is the rejection limit according to ICMSF (1986) standards. Rest of the 25% of samples were marginally acceptable.

Out of 36 samples 15 samples were analysed for formaldehyde concentration. The amount of formaldehyde present was ranged from 0.3 – 5 mg/kg.

Conclusion: In this study, none of fish sample collected from imported fish lots exceeded acceptable limit of formaldehyde (5 mg/kg). However, more number of samples could not be analysed for formaldehyde levels due to a technical failure of Steam Distillator apparatus and therefore, this study needs to continue by analyzing more number of samples.

Assessment of quality of Central fish market in Peliyagoda: Official fish samples were collected from 28 Fish Retailing stalls by Public Health Inspector at Peliyagoda and these samples were analysed for microbiological (*Escherichia coli* and *Salmonella*) and chemical (Total volatile base content and histamine content). Eighteen fish samples out of 28 samples

were unacceptable quality based on microbiological and chemical parameters. Legal actions are taken against sellers for selling of unacceptable quality fish at CFM in order to discourage distribution of low quality fish along fish supply chain.

Project progress

Progress (%):- Financial: 95%

Physical: 90%

PROJECT No :4.1.2

SANITARY SURVEY AND ASSURANCE OF SAFETY OF EDIBLE BIVALVE MOLLUSKS

Officers responsible: Sujeewa Ariyawansa
Pavithra Ginigaddarage

Oysters and clams were collected from harvesting areas (Gangewadiya, Kandakuliya Anaiwasal and Janasavipura), cleaned in situ to remove mud on shell surface was collected in to cleaned gunny bags. Water was collected into sterile polypropylene bottles transported in ice and analysed in NARA laboratories. Oysters, clams and water samples were analyzed for microbiological parameters including pathogenic bacteria namely total coliforms, faecal coliforms, *E.coli*, *Faecal streptococci*, *Vibrio cholerae*, *Vibrio parahaemolyticus* and *Salmonella* spp. The microbiological quality of the harvested oysters (n=139), clams (n=36) and the surrounding water (n=83) was tested using standard techniques. Oyster and clam samples contained Aerobic Plate Count (APC) in the range of 2.0×10^3 to 3.2×10^7 cfu/g. Faecal coliforms varied between not detected (ND) to >1100 MPN/g whereas *Escherichia coli* ranged from ND to 500 MPN/g. APC of water samples ranged from 2.0×10^2 to 7.0×10^4 cfu/ml. Faecal coliforms as well as *E. coli* varied from ND to 1600 MPN/100ml. *Vibrio cholerae* and *Vibrio parahaemolyticus* were not detected in any of oyster, clam or water samples. Of all samples tested three oyster samples and one water sample were found to be positive for *Salmonella* sp.

Water samples were collected from Puttalam lagoon and microbiological quality of water was monitored in monthly intervals (n=52). Duration: April 2016 to November 2016. Parameters. Aerobic plate counts, total coliforms, faecal coliforms, *E.coli*, *Faecal streptococci*, *Vibrio cholerae*, *Vibrio parahaemolyticus* and *Salmonella* spp. Microbiological quality of lagoon water is suitable for natural relaying of bivalves with the exception of a very few instances.

- Protocols for depuration of oysters and clams have been prepared.
- Efficacy of depuration plant installed in Kalpitiya RRC for cleaning of bivalves was monitored. The technique is effective in *reducing microbial load in oysters and clams*.
- Microbiological quality data and information of oysters, clams and water from harvesting areas were provided to the competent authority in order to facilitate bivalve exports and domestic sales.

Conclusion: Microbiological quality of lagoon water is suitable for natural relaying of bivalves with the exception of a very few instances. This study is continued in 2017.

Project progress

Progress (%):- Financial: 102%

Physical: 100%

PROJECT No: 4.1.3

INNOVATION OF VALUE ADDED PRODUCTS USING AQUATIC RESOURCES

Officer/s Responsible: P. S. Jayasinghe, Suseema Ariyaratna, G. J. Ganegama Arachchi, Sujeewa Ariyawansa Thilini Jayasinghe

A range of value added products are being developed under this project using underutilized fish species and seaweed resources and this study will be continued in 2017.

1. Development of canned product using cured *Sardinella longiceps*

In Sri Lanka, *Sardinella longiceps* (Indian Oil Sardine) is one of the most abundant coastal fishery resource. Though it has high catching rates, this nutritionally valuable, low cost small pelagic fish resource has still not been fully utilized in local industries. There is high demand for canned fish products among local community. This study plans to develop technology for low cost canned Indian Oil Sardine product with high nutritional value and longer shelf quality. Whole Indian oil sardine fish was eviscerated, headed, tail removed and scale removed. Then fish was cured to enhance the firmness of fish flesh. Curing was done by dipping fish in 12% brine and 2% *Garcinia indica* (Goraka) mixture 1:1 for 30 minutes (fish:mixture=1:3). Then, preprocessed fish was packed in 2% brine and sealed fish cans were retorted. Prototype was developed using three preliminary trials. Finally the Kruskal-wallis test sensory analysis revealed that the lemon grass containing cured *Sardinella longiceps* significantly different from other treatments. Moisture 69.74%, Ash 2.50%, Fat 8.206% and Protein 22.3335% was the proximate composition of final product. pH 5.97 and Salt percentage of fish packed in brine was 2.25%. According to the results product meet the various criteria of food safety and the standards required. This study shows potential utilization of *Sardinella longiceps* to increase production capacity of local fish canning industry.

2. Extraction of collagen from Catla catla fish waste (Skin, Bone, Scale and fin)

Catla catla fish is abundant fresh water fish variety in fresh water reservoirs in the country. Head, gut, skin and bones are discarded without further processing. Extraction of collagen from the waste material will be good opportunity to value added the waste material and increase the income of fresh water fisher folk.

In this study we have planned to extract and characterized the Acid soluble collagen (ASC) and

Pepsin soluble collagen (PSC) from the bone, skin, scale and fins of Catla catla fish. ACS was extracted successfully and extraction of PSC could not be able to complete due to the damage of

cooling centrifuge which is one of main instrument used for the extraction procedure. Amount of

ASC collagen extracted from the bone, skin, fin and scale was about 2.24%, 1.33%, 1.78% and 0.08% respectively.

3. Extraction and purification of fish oil extracted using *Sardinella longiceps* (Indian oil sardine/“Yak salaya”)

Production of Indian oil sardine is considerably higher during the season but it has low market demand and value due to the high oil content. Therefore extraction and purification

of oil using Indian oil sardine will help to increase the market value of fish and usage as resources for fish oil.

During the study, Fish oil was extracted using Indian oil sardine and Purification trials of fish oil was carryout using activated charcoal and Sodium hydroxide (NaOH). Analysis and storage trials for the purified fish oil sample will be carried out in the first three month of year 2017.

4. Trial of Fish base biscuit

We were conducted several trial for the production of Fish base biscuit with the private biscuit manufacture for the further improvements and observation of possibilities of commercialization. Trails were temporally held due to requirement of improvements of quality of fish powder.

5.Evaluation of Polycyclic Aromatic Hydrocarbons (PAHs) levels of raw and oil fried smoked fish produced by traditional methods in Sri Lanka

Modified smoking Unit that can produce safe hot smoked products are being investigated as Collaborative study with NERD Center and continued in 2017. In addition, effect of cooking method on reduction of toxigenic polycyclic aromatic hydrocarbons also studied in 2016.

Smoking is defined as the process of penetration of volatiles resulting from thermal destruction of wood into the surface of meat or fish products. Polycyclic aromatic hydrocarbons (PAHs) comprise the largest class of chemical compounds, containing two or more fused aromatic rings made up of carbon and hydrogen atoms, known to be carcinogenic agents. PAHs are formed as a result of incomplete combustion or thermal decomposition of the organic materials. In this study Concentration of PAHs in smoked fish samples and oil fried smoked fish samples processed by traditional methods in Sri Lanka were investigated with the purpose of comparing these levels to the EU standard maximum level of PAHs in food safe for consumption. For this study, three species of fish from Ampara and Randenigala area of Sri Lanka were investigated: they are namely Labeo rohita (Rohu), Oreochromis niloticus (Nile tilapia) and Catla (Catla), The methodology which involved in extraction of PAHs was compromise of Soxhlet extraction using dichloromethane, clean up on packed silica gel column and instrumental analysis using high performance liquid chromatography (HPLC) using DAD detector. The results showed that smoked fish samples which were processed by traditional fish smoking methods in Sri Lanka gave higher levels of total PAHs in the smoked fish. The sum of 16 PAHs content found in different fish species varied between 3683.94 -310.51 µg/ kg. When it's come to oil fried fish the levels were between 2703.96– 270.87 µg/ kg. An ANOVA analysis conducted at 95% CL showed statistically significant differences ($P < 0.05$) in PAH levels raw and oil fried smoked fish produced by traditional methods. The Benzo(a)pyrene content varied between level of 35.3 to 1489.63 µg/ kg. And in fried fish samples it was between 39.11 to 1060.42 µg/ kg wich are higher than the limit of 2 µg/Kg according to EU regulations. Moreover the sum of Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene and Chrysene obtained for the fried smoked fish samples are ranging between 18.49 and 2363 µg/kg which exceeds 12.0 µg/Kg EU standard level. The level of PAHs in three species of fish smoked also had a correlation with the fat content. Fish obtained from the traditional smoking methods in Sri Lanka were of good organoleptic and keeping qualities (moisture content < 65% and water activity).

Conclusion: PAH levels of hot smoked fish products available in market contained high levels of PAHs exceeding acceptable limits and frying smoked fish in oil did not reduce high levels of PAHs present smoked fish.

6. Production of Silage from Fish Waste Using Whey as The Inoculum

Fish silage, which is frequently added into animal feed is a liquid or semi-solid product made from whole fish or parts of fish that are liquefied by the action of enzymes in the fish in the presence of an added acid. This study was carried out to produce fish silage from fish waste through a biological process involving microbiological fermentation which replaces the function of fish enzymes by microorganisms. The whole experiment concentrated on developing an ensilation formula and determining a time frame to get a physically, biologically and nutritionally better quality final product, where whey is used as the lactic acid bacterial inoculum and molasses as the fermentable carbohydrate source. The combination of 6% of whey, 15% of molasses and 79% of fish viscera waste was the best formula and 5-day time period was selected as the best fermentation period.

Conclusion: The results of the analysis of proximate composition indicated $14.52 \pm 0.05\%$ of protein in the final silage product and respective N amount is appropriate to be used as a supplement for animal feed production.

7. Development of Palmyrah (*Borassus flabellifer*) Pulp Incorporated Ceylon Moss (*Gracilaria edulis*) Jam

Ceylon moss (*Gracilaria*) is rich in nutrients and contains high amount of agar-agar. This study was to formulate and to develop jam incorporating Ceylon moss. In addition, palmyrah fruit pulp was used to improve the sensory properties of jam. The palmyrah pulp is a good source of Vitamin A and C. Dried *Gracilaria edulis* was collected from Kalipitiya area. Sun dried Ceylon moss was soaked in water for 15 min, drained and steamed for 10 min, followed by blending (10 min) to obtain the pulp. Formulation was done with ingredients: Ceylon moss pulp, palmyrah pulp, citric acid and sugar. Pectin was not added because of jelling properly of the Ceylon moss pulp. Optimum Ceylon moss pulp content was determined based on four treatments (30, 40, 50 and 60 %) without using palmyrah pulp and the sensory evaluation based on flavor, colour, aroma, spreadability, sourness and overall acceptability (7 points Hedonic scale). The best Ceylon moss pulp content was 40 %. The Ceylon moss pulp content was replaced by incorporating different contents of palmyrah pulp to enhance the color, aroma and flavor. It was found that the product with 24% of Ceylon moss pulp and 16% of palmyrah pulp was the best combination. pH 3.07, titratable acidity 1.04 % and total soluble solids 65 were determined in final product. The developed *Gracilaria edulis* pulp and palmyrah pulp incorporated jam consists of moisture 13.8 %, protein 0.59%, fat 5.23%, total ash 0.42% and total dietary fiber 4.89 % (w/w).

Conclusion: The technologies developed in this research were applicable to use Ceylon moss and Palmyrah fruit pulp economically and to develop commercial products of jam. Further animal based gelatin can be replaced by plant based ingredients, *Gracilaria edulis* pulp.

Project progress

Progress (%):- Financial: 149%

Physical: 95%

PROJECT No: 4

QUALITY, SAFETY AND NUTRITIONAL ASPECTS OF FISH AND FISHERIES PRODUCTS IN SRI LANKA (TWO COMPONENT PROJECT)

PROJECT No: 4-1-4 : FISH CONTRIBUTION FOR DIETARY EXPOSURE TO MERCURY & CADMIUM OF THE GAMPAHA DISTRICT POPULATION: A TOTAL DIET APPROACH

Exposure for toxic chemicals is suspected to be associated with a wide range of human health disorders. This was the first study in Sri Lanka to evaluate the contribution of fish consumption to dietary exposure of an adult population for non essential trace metals named, mercury (Hg) and cadmium (Cd). Exposure assessment was performed by following the total diet study (TDS) approach recommended by the World Health Organization (WHO) and the targeted area was the Gampaha district. Based on the survey data (n=152), the fresh fish; yellowfin tuna, swordfish, sardinella, spotted sardinella, anchovy and Indian scad (n=66), dried fish; anchovy, queen fish, sailfish, smooth belly fish, shark & skipjack tuna (n=66) and canned fish (n=11) samples were collected in the year 2016. Several types of cooking methods, utensils and ingredients were used based on survey data in TDS survey. The exposure of Hg and Cd were estimated and calculated with consumption data received from the TDS survey. The average provisional tolerable weekly intake (PTWI) of Hg and Cd were calculated based on WHO value (Hg, 4 and Cd, 7 µg/kg body weight). The PTWI value was calculated related with average bodyweight of the average person 50 kg. Based on the study following conclusions were made. Weekly average fresh fish and dried fish consumption were 301 and 59.5 g.

The contribution of the fresh fish for Hg, PTWI for swordfish, yellowfin tuna and sardinella were 75.40, 40.49 & 7.60 %, respectively, while no contribution for spotted sardinella, anchovy and Indian scad. Consider the Hg contribution of dried fish, the shark represented 93.70 while sailfish 7.24%. However the contribution of Cd for PTWI is comparatively very low. The highest contribution given in the fresh fish group were spotted sardinella (4.2%) while in the dried fish group were anchovy (1.3%). The Cd contribution for the canned fish for PTWI represented 0.1% and canned fish was not contributed to significantly for Hg exposure.

Project progress

Progress (%):- Financial: 238%

Physical: 100 %

Testing Services of IPHT

Quality Control Laboratory (Microbiological and Chemical units) of IPHT which has obtained accreditation status for several analysis parameters as per ISO/IEC 17025: 2005 Standards. Testing Services of this laboratory have been obtained by industry, especially, for fish exporting companies; Ministries, academic institutes and other stakeholders. Total of 1329 samples were analyzed for microbiological (660), chemical (669) quality. Relevant to these samples, 445 of Test Reports were issued by IPHT and total testing payments for NARA were LKR 7,184,258.00. Forty percent (40%) of total revenue will be remitted as royalty for NARA.

Extension programs of IPHT

Training/Awareness programmes conducted during year 2016

No	Duration	Sponsored By	Area	Training area
01	25/02/2016	DFAR	Gall	Post Harvest Technology and Value added fish products
02	17/03/2016 to 18/03/2016	DFAR	Matara	Production of Maldivian fish
03	18/03/2016 to 24/03/2016	NARA	Training for CFC officers	Post Harvest Technology and Quality controlling
04	07/04/2016 to 08/04/2016	DFAR	Matara	Production of Maldivian fish
05	30/03/2016 to 02/04/2016	NAQDA	Anuradhapura (Rajanganaya wewa ,Ikiri wewa,Kala wewa)	Value added fish products from Tank cleaner fish
06	30/04/2016 to 02/05/2016	NAQDA	Batticaloa (Rugam wewa ,Kithul wewa)	Value added fish products from Tank cleaner fish
07	12/05/2016 to 14/05/2016	NAQDA	Kandy (Victoria reservoir , Polgolla reservoir)	Value added fish products from Tank cleaner fish
	26/05/2016 to 27/05/2016	DFAR	Matara	Production of Maldivian fish
08	08/06/2016 to 09/06/2016	NAQDA	Kurunagala (Daduru oya wewa)	Value added fish products from Tank cleaner fish
09	28/06/2016 to 30/06/2016	NAQDA	Ampara (Rabakan oya wewa)	Value added fish products from Tank cleaner fish
10	06/07/2016 to 09/07/2016	NAQDA	NuwaraEliya (Randenigala reservoir , Kothmale reservoir)	Value added fish products from Tank cleaner fish
11	13/07/2016 to 16/07/2016	NAQDA	Anuradhapura (Hurulu wewa)	Value added fish products from Tank cleaner fish
12	24/07/2016 to 26/07/2016	Japanese Delegation (Ehime)	Trincomalie (Kinniya)	Hygienically preparation of mince based fish product
13	27/07/2016 to 28/07/2016	Japanese Delegation (Ehime)	Negambo (Kudapaduwa)	Hygienically preparation of mince based fish product
14	28/11/2016 to 30/11/2016	NAQDA	Trincomalie (Kanthale wewa)	Value added fish products from Tank cleaner fish

15	24/09/2016	NARA(Deewara nana sawiya)	Hambantota District Awareness programs (Akunakolapalassa)	Hygienically handling of Fish and value added fish product preparation
16	14/10/2016	Ceylon chamber of commerce	Puttlum District Awareness programs (Udappuwa)	Hygienically preparation of Dry fish
17	24/10/2016	Aquinas University Collage	Undergraduate students of the Aquinas University Collage	Hygienically preparation of value added fish product
18	16/11/2016	NARA	Hambantota District Awareness programs (Gurupokuna)	Hygienically preparation of value added fish product
19	17/11/2016	NARA	Hambantota District Awareness programs (Kahada Modara)	Hygienically preparation of value added fish product
20	22/11/2016 to 23/11/2016	NARA	Hambantota District Awareness programs (Phajjawa)	Hygienically preparation of value added fish product
21	14/12/2016 to 15/12/2016	DFAR	Matara	Production of Maldivian fish
22	27/10/2016 to 28/12/2016	Ocean University	Undergraduate students of the Ocean University	Hygienically preparation of value added fish product

Exhibitions

No	Duration	Sponsored By	Area	Training area
01	06/03/2016 to 08/03/2016	DFAR	"Wasa Visa nathi ratak " at BMICH	Island wide
02			Puttlam District	Safety Issues related to bivalve farming in Sri Lanka for Medical officers for health (MOH) and public health inspectors (PHI) from the ministry of health. Government officials, growers and harvesters of bivalve mollusks in Kalpitiya area

Publications of IPHT -2016

FULL PAPERS:

1. B.K.K.K. Jinadasa, G.D.T.M. Jayasinghe & S.B.N. Ahamd (2016). Validation of High Performance Liquid Chromatography (HPLC) Method for Quantitative Analysis of Histamine in Fish and Fishery Products. *Cogent Chemistry* (Taylor & Francis). DOI:10.1080/23312009.2016.1156806
2. B.K.K.K. Jinadasa, H.K.S. De Zoysa, G.D.T.M. Jayasinghe & E.M.R.K.B. Edirisinghe (2016). Determination of the biometrical parameters, biochemical composition and essential trace metals of edible sea urchin (*Stomopneustes variolaris*) in Sri Lanka. *Cogent Food and Agriculture* (Taylor & Francis). DOI: 10.1080/23311932.2016.1143343

ABSTRACTS (INTERNATIONAL):

1. S. Ariyawansa, P. Ginigaddarage, B.K.K.K. Jinadasa, J.M. Chandrika, G. Ganegama Arachchi and S. Ariyaratne (2016). Assessment of microbiological and bio-chemical quality of fish in a supply chain in Negombo, Sri Lanka. *Procedia Food Science*, 6: 246–252

ABSTARCT AND PROCEEDINGS (Local):

1. B.K.K.K. Jinadasa , U. Piranavatharsan, C.V.L. Jayasinghe (2016). Validation of thiobarbituric acid (TBA) method and comparison of selected methods on assessing freshness quality of Indian mackerel (*Rastrelliger kanagyrta*), Research Symposium-2016, Wayamba University, Sri Lanka, 2016 Sep. 28; 43 pp.
2. A.A.A.G. Adikari, S.P.S.D. Senadheera and B.K.K.K. Jinadasa (2016). Trace metals; cadmium, arsenic and mercury in freshwater tiger prawn, *Macrobrachium rosenbergii* in Polonnaruwa district, Sri Lanka, 22nd Annual scientific sessions of the Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR), 2016 June 02, Colombo, Sri Lanka; 8 pp.
3. G.D.T.M. Jayasinghe and B.K.K.K. Jinadasa (2016). Fatty acids profile of the freshwater prawn (*Macrobrachium rosenbergii*) collected from Pollonnaruwa reservoirs. National Aquatic Resources Research & Development Agency, scientific session, 2016, March 29, Colombo, Sri Lanka; 125-128 pp.
4. A.L.S. Sewwandi, G.D.T.M. Jayasinghe and B.K.K.K. Jinadasa (2016). Determination of Total Volatile Base Nitrogen (TVB-N) in Fish and Fishery Products; Validation of the Kjeldahl Distillation Method. National Aquatic Resources Research & Development Agency, scientific session, 2016, March 29, Colombo, Sri Lanka; 129-132 pp.
5. M.S.M. Fahim, B.K.K.K. Jinadasa, G.D.T.M. Jayasinghe, C.B. Medagedara and P.A.D. A. Kumara (2016). Proximate composition and fatty acid profile of the sea cucumber *Holothuria scabra* collected from two geographical locations in Sri Lanka. National Aquatic Resources Research & Development Agency, scientific session, 2016, March 29, Colombo, Sri Lanka; 19-22 pp.

6. G.L.A. Subhashini, K.W.S.Ariyawansa, P.H.Ginigaddarage, K.S. Hettiarachchi and C.N. Walpita. 2016. Microbial Safety of Oysters (*Crassostrea madrasensis*) Harvested from Kalpitiya Lagoon in Sri Lanka. Proceedings of 3rd International Conference of Agricultural Sciences-Ag Insight 2016 (8th Dec 2016). Sabaragamuwa University of Sri Lanka. Pg. 154-155.
7. D.S. Ariyaratne^{1*}, N. Gamage², I. Wickramasinghe², and M.J. Paththuwa Arachchi² (2016). Development of a fish base biscuit using Orinoco Sailfin catfish (*Pterygoplichthys multiradiatus*). National Aquatic Resources Research & Development Agency, scientific session, 2016 March 29, Colombo, Sri Lanka; 133 pp.
8. M.J. Paththuwa Arachchi¹, G.J. Ganegama Arachchi¹ and M.A.J. Wansapala², and M.P.K. Jayarathna³ (2016). Extraction of agar from locally grown *Gracilaria verrucosa* and development of gelatin free set-yoghurt product using agar. National Aquatic Resources Research & Development Agency, scientific session, 2016 March 29, Colombo, Sri Lanka; 117 pp.
9. Dehikumbura, G. A. M. D. K., Ganegama Arachchi, G.J., Seneviratne, K. N., Prasadini, W. C., Paththuwa Arachchi, M., Perera, R., and Wickramasinghe, I. (2016). Preliminary investigation of polycyclic aromatic hydrocarbon levels in smoked fish produced by fisher community in Sri Lanka. 22nd Annual Scientific Sessions of the Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR), 2016 June 02, Colombo, Sri Lanka; 37 pp.
10. Prasangika, J. M. K., Ganegama Arachchi, G.J., Jayasinghe, T. M., Withanage, R. M., Perera, R. and Wickramasinghe, I. (2016). Investigation of formaldehyde levels of imported fresh fish in Sri Lanka. 22nd Annual Scientific Sessions of the Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR), 2016 June 02, Colombo, Sri Lanka; 41 pp.
11. P.S. Jayasinghe¹, V. Pahalawattaarachchi² and K.K.D.S. Ranaweera³ (2016), Seaweed extract as a natural food coloring agent in jelly desserts on chemical, microbial and sensory quality. National Aquatic Resources Research & Development Agency, scientific session, 2016 March 29, Colombo, Sri Lanka; 117 pp.

University Students trained at IPHT – 2016

Student Name	University	Assignment	Period
Jayarathna K.P.D.T	Wayamba	Final year research project	23 rd Feb. 2016 (15 Weeks)
Piramavatharsan	Wayamba		15 th Feb. 2016 9 (15 Weeks)
Sahini mallika	Sri Jayawardanapura		15 th May 2016
Dilrukshi P.G.M.			
Ratnayaka R.M. M.M.			
Thusi T.H.T.M.			
Sameera H.G.P	Peradeniya		10 th August 2016 (04 Months)
Weerarathna K. T. S			
Fonnseka H.M. F. H			
Jayamanne M.N			
Perera W.P.D.S			
Tharanga K.A.D.	Peradeniya		12 th August 2016
Perera W.U.M	Uva Wellassa	Internship (Microbiology)	9 th August 2016
Gunarathna A.N.G.N.S.B.	Kelaniya	Internship (Microbiology)	23 rd Nov.

5.8 SOCIO-ECONOMIC AND MARKETING RESEARCH DIVISION

Head of the Division: Mr. Amaralal

The main functions of the division include social economic and marketing studies in the fishing industry, including the welfare of the fishermen and their dependents, analysis of fish marketing system and its impact on consumers.

Research projects conducted in the year 2016

- i. Cost of production and economic efficiency of marine fishery in Sri Lanka
- ii. Socio-economic and marketing aspects of lagoon fisheries in Sri Lanka- Kokkilai, Mawella and Panama Lagoons
- iii. The fisheries information centre (FIC) of NARA

Activities

- Under the projects (i) and (ii) following activities were completed.
 - Data collection
 - Data analysis
 - Report writing/annual publications
- Under the fisheries information center, all inquiries were recorded and answered over the phone or directed to the respective institutes

Programme	Project	Allocation(Rs)	Responsible Officer	Duration
Socio-economic & Marketing	1. Study on Production Cost of Marine Fisheries in Sri Lanka (8.1.1)	1,500,000.00	KHML Amaralal MMAS Maheepala DWLU de Silva	One year
	2. Socio-economic and Marketing aspects of lagoon fisheries in Sri Lanka (8.1.2)	1,500,000.00	KHML Amaralal HD Wimalasena KPGL.Sadaruwan	One year
	3.The fisheries information Centre (FIC) of NARA (9.1.8)	1,000,000.00	K.H.M.L. Amaralal	Continues

PROJECT No: 8.1.1

STUDY ON PRODUCTION COST OF MARINE FISHERIES IN SRI LANKA.

Marine fishery contributes by 85% to the country's fish production and the cost factors involved in production acts as critical factors of profitability of the industry. Data and information on all aspects of production are vital for sustainable policy decisions that are meager especially for operational cost structure as well as its variability in fishing operations due to various reasons. Therefore, continues study on operational cost of marine fishery of Sri Lanka is vital for setting up of timely, accessible and accurate data base for relevant authorities. This study was aimed at fulfilling those gaps and will immensely helpful for policy makers for the development and planning of the industry in future.

Different types of fishing boats/crafts are operating in marine fisheries in the country. They are classified into 5 groups: Inboard Multi-day Boats (IMUL), Inboard single-day Boat (IDAY), Out-boat engine Fiberglass Reinforced Plastic Boats (OFRP), Motorized Traditional Boats (MTRB), Non-Motorized Traditional Boats (NTRB). Total number of operating fishing crafts/boats has been increasing over the years. In 2015, there were about 50,338 total registered fishing crafts/boats of which 24,028, 17,813 and 1872 comprised of OFRP, NTRB and MTRB respectively. In addition, there were about 4218 IMUL boats. The OFRP, NTRB and MTRB are mainly engaged in the costal fishery while IMUL in off shore/deep sea fishery. Among the different types of gear and gear combinations are in use, dominant gear were drift gill net and long line.

Variable costs (operational costs) comprised of fishing trip specific costs which may vary according to trip duration, fishing gear used and number of crew members. Among the components of variable costs include labour cost or crew share, cost of fuel and other costs. The other costs include cost of bait, food, ice, medicine, water and etc.

Table 1 indicates a breakdown of different cost items in the total variable cost (or operational costs) of main types of fishing craft, as amount and percentages. Labour cost accounts for the highest share of the variable cost in all the craft types (about 48%-88%). Fuel too accounts for a considerable portion of the variable cost for IMUL and OFRP (30 - 35%). The expenditure for food consumed on board and other necessities account for about 6-22% of the total variable cost.

Table 1. Operational costs and gross profits of marine fisheries

	IMUL		OFRP		NTRB	
	Amount (Rs.)	%	Amount (Rs.)	%	Amount (Rs.)	%
Fuel cost	213,930	30%	2,176	40%	0	0%
Labour cost	342,288	48%	2,880	53%	748	88%
Other cost	156,882	22%	384	7%	102	12%
Operational cost	713,100		5,440		850	
Income (Rs.)	1,021,159		8,320		1,598	
Gross Profit (Rs.)	308,059		2,880		748	
Gross Profit(Rs.) / Operation cost (Rs.)	0.43		0.53		0.88	
Gross Profit(Rs.) /Operation cost (Rs.)	0.43		0.53		0.88	



Figure 1: a IMUL boat



Figure 2: a OFRP boat



Figure 3: a NTRB boat

PROJECT No: 8.1.2

SOCIO-ECONOMIC AND MARKETING ASPECTS OF LAGOON FISHERIES IN SRI LANKA

The study was conducted in Kokkilailagoon to collect baseline data and information of socio-economic aspects and to establish the importance of lagoon environment for sustainable livelihoods of surrounding communities. Kokkilai lagoon is an ecologically rich lagoon in the country and has a significantly higher potential for ecotourism, recreation and research.

This study was based on primary data which were collected using a pre tested semi structured questioner covering two fishery inspector divisions namely Pulmoddai and Mulativu and 89 randomly selected fishers were interviewed.

OFRP, MTRB and NTRB crafts were using in the lagoon fishing and specially target for Shrimp and Crabs. Fishing were carried out throughout the year and used different types of fishing gears including crabs net, shrimp net, shrimp traps, small meshed gill nets, and medium meshed gill nets, cast nets, etc.

The principal income source of the 97% of respondents was fishing. It was observed that the majority of respondents (33.5%) was between 40-49 ages and had 17 years fishing experience on an average. Forty six percent of fishermen had exposed to the secondary education and 1% of illiterate respondents were. Vast majority of the respondents (96%) were married and the mean household size was 4 which ranged between 1- 6 person. The membership of the cooperative society was dominant and study found that 64% of respondents were members of fisheries cooperatives. The average monthly household income of the fisher family in Kokkilai lagoon was Rs. 2 5,671.00 (+/- 8 005) and 57% households were stood over the average.

Practice of the illegal fishing gears was highlighted by 61% of the respondents as the most critical livelihood constraint in Kokkilai lagoon. Use of trawling, skate (Kudu del) nets was mentioned as the harmful fishing techniques for the lagoon. Other than this issue fishermen pointed out that the population of Limpet (spinney small bivalves) is increasing and it makes much consequence such as human injuries, net damages, hampering the boat movement etc.



Figure 4 : Collecting data from a fishermen



Figure 5 : Collecting data from a fish seller



Figure 6: Group discussion with the fishermen

PROJECT NO: 9.1.2

THE FISHERIES INFORMATION CENTRE (FIC) OF NARA

Socio-economic Division maintains the Fisheries Information Center(FIC) to provide necessary information for stakeholders and other interested parties of Sri Lankan fisheries industry. Since the inception until end of the year 2016, a total number of 464 queries were received through the hot line 07 10 10 10 10 of fisheries information Centre from different respondents. All the queries are categorized in to five groups. Numbers of queries and the percentages under each information criteria are given bellow table.

Table 2.Received call for the hotline

Information criterion	Number of calls received	Percentage
Academic and Research Related Services	144	31%
Consumer and Industry related Services	118	25%
General Complains and Comments	89	19%
Fisherman Welfare and Disasters Related Services	55	12%
Trade and Investment Related Services	58	13%
Total	464	100

All queries received were successfully solved out with the assistant of NARA scientists, officials of Ministry of Fisheries and Aquatic Resources Development (MFARD), Department of Fisheries and Aquatic Resources (DFAR), National Aquaculture Development Authority (NAQDA) and other relevant officers from the governmental and non-governmental sectors. To promote the information center among stakeholders of fisheries sector more than 10 banners were displayed in the fisheries harbors and 1000 of leaflets were distributed in harbors, landing site, fisheries inspectors' offices, and other government and non-government office premises which are located all-around the costal line of Sri Lanka.



Figure 7: The workshop of Trincomalee



Figure 8: The workshop at Jaffna



Figure 9 : The workshop of Point pedro

Abstracts

1. H.D.Wimalasena, Dahanayaka D.D.G.L., Amaralal K.H.M.L., (2016). Emerging ICT applications for strengthening of fisheries information system. In: Proceedings of the International Symposium on ICT for Sustainable Development, V.P.A.Weerasinghe and W.M.D.N. Wijeyaratne (Eds.), Department of Zoology and Environmental Management, University of Kelaniya, Kelaniya.
2. De Silva D.W.L.U, Sandaruwan K.P.G.L, Wimalasena HD, Amaralal K.H.M.L and Maheepala M.M.A.S,(2016), An evaluation on fisherwomen contribution for household economy in North Western Province of Sri Lanka. Proceedings of the 6th research symposium, UvaWellassa University of Sri Lanka 28th-29th Jan. 2016. P.225
3. M.M.A.S. Maheepala, Amaralal K.H.M.L., K.P.G.L. Sandaruwan, D.W.L.U.DE Silva and Wimalasena H.D., (2016). An analysis of net income of different craft and gear combinations in the Puttalam lagoon in Sri Lanka. In Proceedings of the NARA Scientific Sessions, 29th March, 2016, Colombo, Sri Lanka.
4. K.P.G.L. Sandaruwan, DE SilvaD.W.L.U., WimalasenaH.D, MaheepalaM.M.A.S and AmaralalK.H.M.L., (2016). Daily routine activities of the fisherwomen in theNorth-Western Province of Sri Lanka. In Proceedings of the NARA Scientific Sessions, 29th March, 2016, Colombo, Sri Lanka.

Full papers

1. SandaruwanKPGL , De Silva DWLU, Amaralal KHML, 2016, A study of food consumption pattern, food culture and nutritional ntatus of the multi-day fishermen of Sri Lanka. Third International Research Symposium proceeding Part II Rajarata University of Sri Lanka.
2. De Silva DWLU, Sandaruwan KPGL ,Amaralal KHML, 2016, *An Overview of the Fish Pedicure/Spa Activity in Madu River of Sri Lank*, Third International Research Symposium proceeding Part I Rajarata University of Sri Lanka.

Trainings

1. K.H.M.L.Amaralal, Head/SED participated in a training programme in “Value chain development of sustainable utilization of fisheries resources” in Japan (JICA) from 15 September to 2 October, 2016.
2. M.M.A.S. Maheepala, Senior Scientist participated in a training programme in “ Ocean affaires and the law of the sea” under the United Nations-The Nippon Foundation of Japan Special Strategic Award from 18 March to 16 December 2016.

Other developments

Three scientists were recruited to the Division.

Industrial Training Placements – 2016

University Name	No	Student Name	Training Period
Universitiy of Kelaniya	01	A.M.G.K Alhapatththa	06 Weeks
	02	W.A.M.T Weerathunga	06 Weeks
Universitiy of Ruhuna	03	Y.G.B.D.K Dharmarathna	01 Months
	04	L.A.A.N Wickaramasingha	08 Weeks
	05	K.D.S Wijayawardena	08 Weeks
	06	H.G.S.B Prasad	08 Weeks
	07	W.N.D.S Jayarathna	08 Weeks
	08	T Paranamana	08 Weeks
	09	B.R.Wickramasinghe	08 Weeks
	10	V.Vaitheyi	05 Weeks
	11	Kamelesteena.J	05 Weeks
	12	S.A.D.M Samarakoon	05 Weeks
	13	M.D.N.D Perera	05 Weeks
University of Jaffna	14	A. Sathiharan	01 Weeks
	15	C. Shobana	01 Weeks
	16	S. Sarvga	01 Weeks
	17	R. Gobiraj	01 Weeks
	18	K.H. Manoja	04 weeks
	19	H.Gayesha Sewwandhi	04 weeks
University Of Wayamba	20	U.Prirnavatharsan	15 Weeks
	21	Y.K.D.C Weerasinghe	09 Weeks
	22	K Kalpani	09 Weeks
University of Uva Wellassa	23	I.M.C.D Bandara	07 Weeks
	24	K.C.S De Silva	07 Weeks
	25	N.L Muhamdiram	07 Weeks
	26	W.U.M .Perera	07 Weeks
	27	A.P. Werakoon	07 Weeks
University of Colombo	28	K.Gajantha	04 Months
	29	J.A.A.P Jayakododi	04 Months
	30	J.A.S.G. Jayawardana	04 Months
	31	J.K.S.G Jayawardhana	04 Months
	32	M.A.C Madushani	04 Months
	33	L.E.Udumull Aarachchi	04 Months
University of Sri Jayewardenepura	34	W.U.M Sachini Malika	03 Months

	35	K.D.K.S.Dharmasena	15 Days
	36	L.P.S.Chamindi	15 Days
	37	H.A.H.K.R.Perera	15 Days
Advanced Technological Institute (ATI)	38	K.D.O.S.Pemasiri	06 Months
University of Vocational Technology	39	B.P.M Beruwalage	02 Days
	40	S.M Degambada	02 Days
	41	Diyonisamuel	02 Days
	42	E.G.S.K Gnanasinghe	02 Days
	43	H.A.K.K Herath	02 Days
	44	M.N.D Boscoe	02 Days
	45	R.A.T.P Rathnayake	02 Days
	46	H.W.P Prabhakumari	02 Days
	47	P.A Wijewardana	02 Days
	48	H.T.D.Hettiarachchige	02 Days
	49	E.M.M.D Ekanayake	02 Days
	50	D.M.A.N Dissanayake	02 Days
	51	M.A.N.F Fasla	02 Days
	52	H.W.P Dineshika	02 Days
	53	N.M Rishard	02 Days
	54	S.P.S.M Senarath	02 Days
	55	M.N.F raihana	02 Days
	56	D.S.T.D Daniel	02 Days
	57	M.P.S.A Kumara	02 Days
	58	G.D.D.R Jayasinghe	02 Days
	59	S.H.IN Wijerathna	02 Days
	60	K.G.D Akalanka	02 Days
	61	R.M.S jayamini	02 Days
	62	H.A.A Perera	02 Days
	63	L.B.P Manjula	02 Days
	64	B.W.M Kumara	02 Days
	65	A.E Rajakaruna	02 Days
	66	N.A.S.L nissanka	02 Days
	67	G. Samarawickrama	02 Days
	68	K.L.D.S.B Rathnapriya	02 Days
	69	G.R.R.C.K Athurupana	02 Days
	70	P.A Wijewardana	02 Days

Universitiy of Kaleniya (AIESEC Committee)	71	Maree Woel	08 Days
	72	Dapeny Cheny	08 Days
	73	Enzo lim	08 Days
	74	Stacey Chen	08 Days
	75	Ada Ren Wenran	08 Days
	76	Arlene Zhang	08 Days
	77	Stephen Dai	08 Days
	78	Martim Mandarinino Alves	08 Dyas

Research Placements

University Name	No	Student Name	Training Period
University of Ruhuna	01	S.A.D.M Samarakoon	06 Month
University of Sri Jayewardenepura	02	R.M.M.M. Rathnayaka	03 Months
	03	P.G.Dilrukshi	03 Months
	04	T.H.T.M Thusi	03 Months
University of Uva Wellassa	05	K.C.S De Silva	04 Months
	06	W.Thivanka Madushan	04 Months
	07	N.L Muhamdiram	04 Months
	08	W.U.M Perera	04 Months
	09	B.R.M.M.G.K.M Rathnayaka	04 Months
	10	A.P. Werakoon	04 Months
University Of Peradeniya	11	K.A.D Tharanga	04 Months
	12	K.T.S. Weeraratna	04 Months
	13	H.F.M.H Fonseka	04 Months
	14	W.P.D.S Perera	04 Months

5.9 MONITORING AND EVALUATION DIVISION

Head of the Division: Mr. A.B.A.K. Gunaratne (Director M & E)

The Monitoring and Evaluation Division is responsible for project planning, monitoring and evaluation. It performs the duties of ensuring effective monitoring, evaluation and coordination of the research programmes. Preparation of the action plan, monthly progress monitoring of research projects, compilation of annual report are the main responsibilities of the division. Information Technology unit, Library and Information unit and Extension unit are placed under the Monitoring and Evaluation division.

INFORMATION TECHNOLOGY UNIT

The mission of the Information Technology Division is to provide the highest quality technology-based services, and support to the organization for its strategic goals and objectives as it applies to research activities and provide effective technology support for audio/visual, multimedia, desktop and web based applications and services.

Information Technology Division conducts research using Geography Information system (GIS) and Remote Sensing (RS) for resources planning and identifies suitable areas for aquaculture development and forecasting. GIS technologies applies in the diverse fields and committed to delivering high-quality spatial and attribute data to the internal researches as to allow better decisions to be made based on the best available information. Information Technology Unit acts as a store room of spatial data of marine and terrestrial areas. Division is intended to facilitate as a platform to pool all data/information available in respect to aquatic resources, environment and users and develop products for environmental friendly economic development and scientifically based management of aquatic resources/environment.

The Division is responsible to provide all aspects of IT and systems implementation for information gathering, processing, sharing and dissemination among all stakeholders for management, conservation and development of aquatic resources. It provides expertise in computing hardware and software support as well as LAN (Local Area Network) and WAN (Wide Area Network) connectivity to the staff and administrative support of computer networks. And also ITD maintains IT contracts and software licenses, and coordinates the procurement of IT related hardware and software.

Activities undertaken

Programme	Project	Allocation (Rs)	Officer Responsible	Period	
				From	To
Open access to knowledge and dissemination of information	9.1.1 Internet services and online information system	3,600,000.00	A.B.A.K. Gunaratne	2016	
	2.1.8 Demarcation of oyster beds in Northwestern coastal area using Remote Sensing	1,000,000.00	A.B.A.K. Gunaratne D.D.D.Weragodatenna	2016	

	2.1.9 Satellite Remote Sensing application for detect the coral reef distribution in Pigeon Island	400,000.00	A.B.A.K. Gunaratne D.D.D.Weragodatenna	2016
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PROJECT No: 9.1.1

INTERNET SERVICES AND ON LINE INFORMATION SYSTEM

Main objective of the project is to disseminate the information via World Wide Web and to provide other Internet services for scientific staff of NARA and its stakeholder with a view of facilitating information sharing.

Web site and Mail servers were upgraded during the period. Staff engaged with PC assembling, repairing and upgrading, 32 computers were assembled, 7 were upgraded nearly 200 repairs were undertaken. Software, network and configuration issues resolved day to day. Web page updating was carried out and new web pages were created, total number of web pages updated count was 50 pages and 65 pages were created for the new design. Inform Database that used to evaluate research cost of the institutions engaged in CARP network, was submitted to CARP.

Expected target was achieved during the period.

Progress (%) : Physical : 100 Financial: 85

PROJECT No: 2.1.8

DEMARICATION OF OYSTER BEDS IN NORTHWESTERN COASTAL AREA USING REMOTE SENSING

Oyster beds located in intertidal water serve as an important economic recourse to the coastal community while many essential functions provide to the environment, including water filtration, coastal belt stabilization and habitat for other plants and animals as well. Anthropogenic factors such as coastal development and associated waterway usage are suspected of significantly altering the extent and health of the oyster resources. Therefore Effective conservation and management of oyster reefs is essential. However it dependent on an understanding of their abundance, distribution, condition, and change over time.

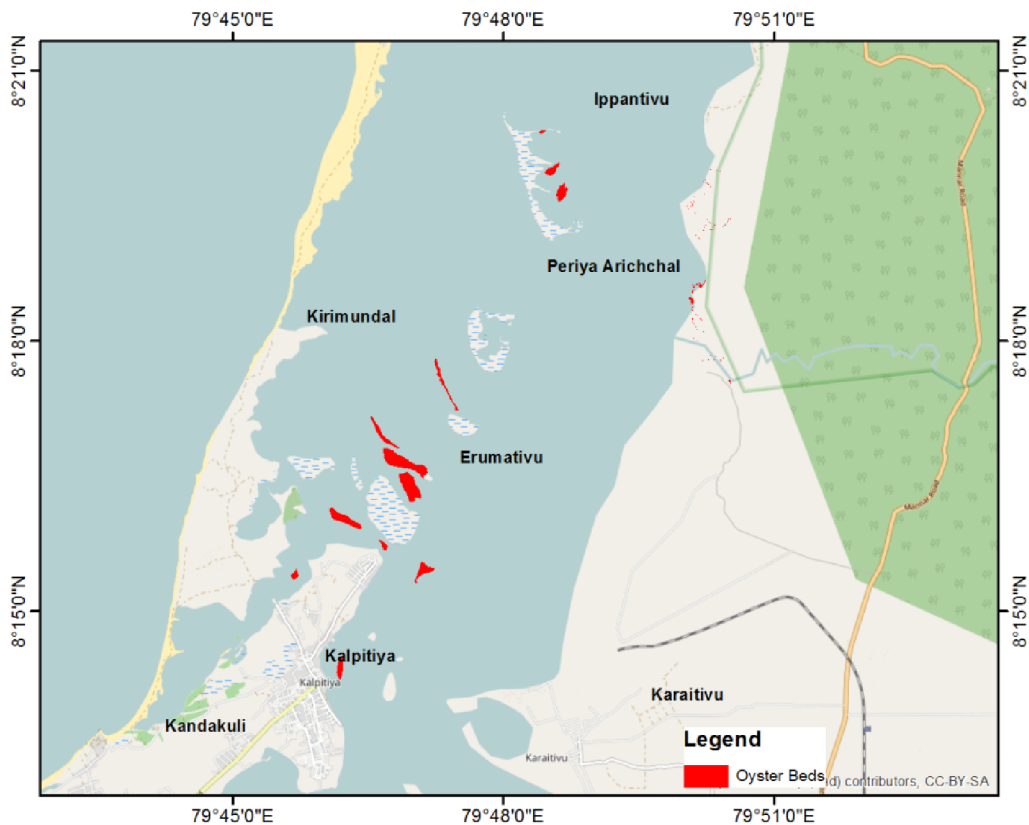
Airborne remote sensing is a viable technology for producing high-detail oyster maps over large geographies. Identification of the existing oyster beds using Remote Sensing is capable and identifiable due to the unique combination of spectral and spatial characteristics associated with oyster features. Remote sensing in combination with the field assessment data can therefore be a valuable method for mapping the oyster beds along the coastal areas. And it would be a useful tool for coastal resource managers, if a remote sensing method can be proven to secure reliable results.

Main objectives of the project included;

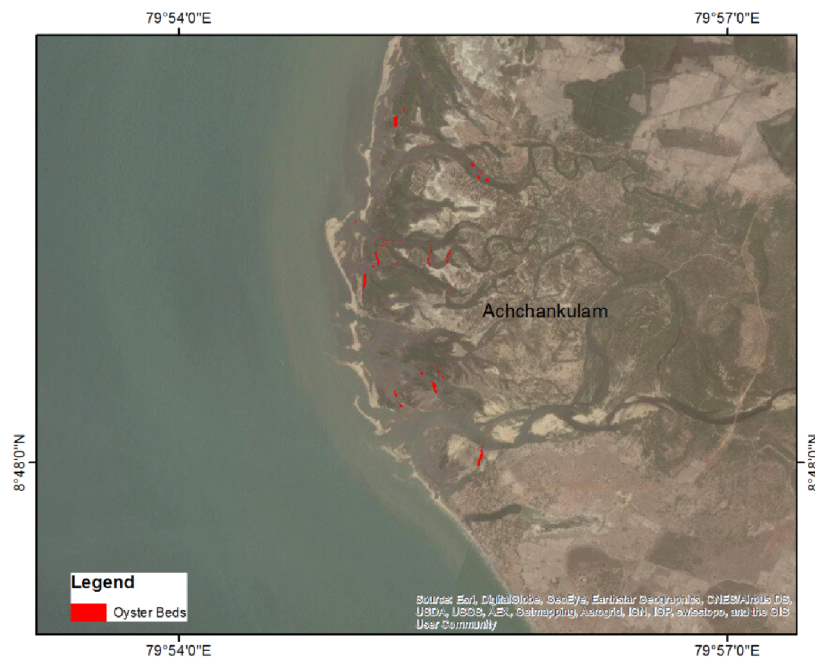
- Demarcating and mapping of the oyster beds in Northwestern coast Including Puttalam and Mannar Districts.
- Establish a baseline map layer and database for the current extent of oysters in Northwestern coast
- Sharing the data and information among the stakeholders who are working on Oyster industries.

The spatial distribution of the existing oyster beds was obtained by high resolution satellite imageries and ground truthing as shown in below. The study findings show that totally 81.5 ha of oyster beds covered in Puttalam Lagoon.

This project is extended to 2017 for further study for zonation of Puttalam Lagoon for Oyster Farming. The Lagoon will be zoned in to; brood stock growing area, natural depuration area and oyster farming area in accordance with the environmental parameters including salinity, temperature, heavy metal and micro biology as shown in below.

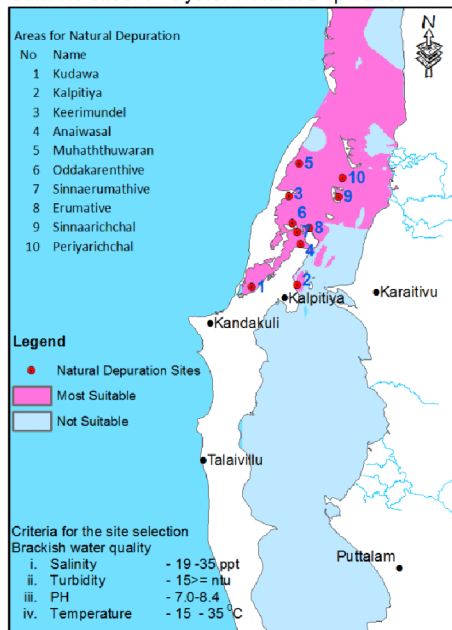


Oyster beds in Puttalam Lagoon

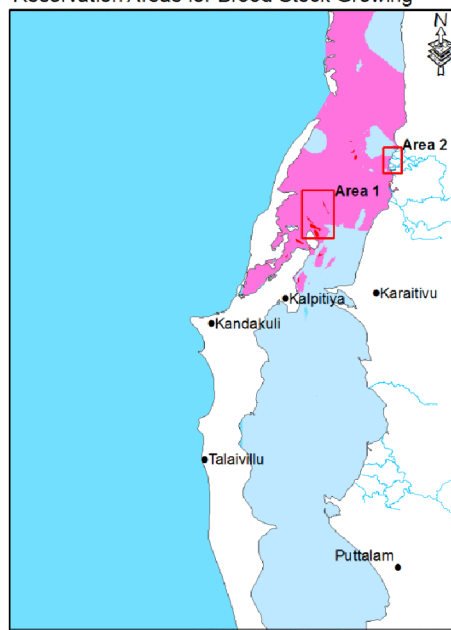


Oyster beds in Malwathuoya Estuary

Suitable sites for Oyster Natural Depuration



Reservation Areas for Brood Stock Growing



Progress (%) : Physical : 100

Financial: 100

PROJECT No : 2.1.9

SATELLITE REMOTE SENSING APPLICATION FOR DETECT THE CORAL REEF DISTRIBUTION IN PIGEON ISLAND

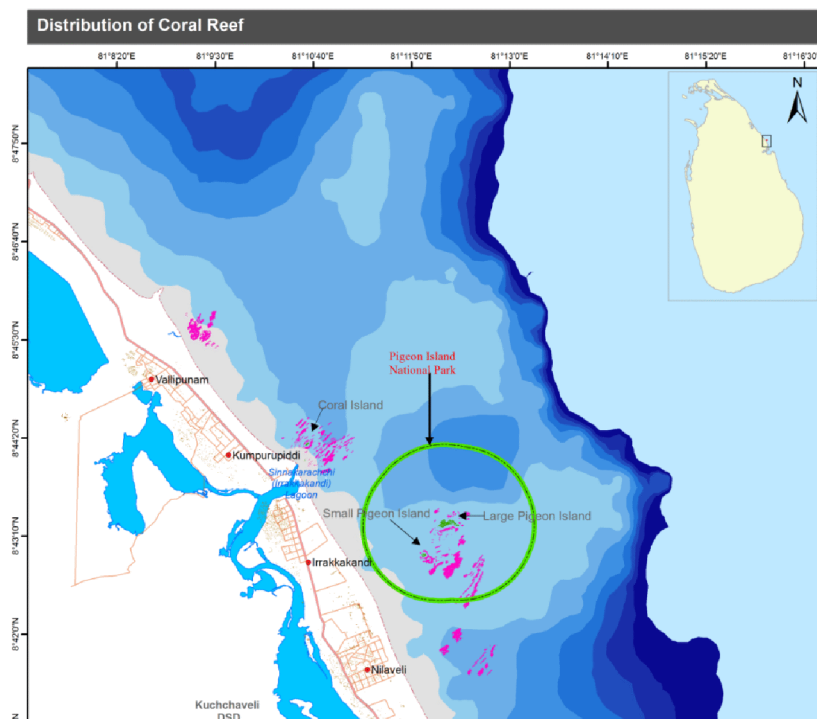
Pigeon Island is one of the four declared Marine National Parks in Sri Lanka. Compared with other coral reefs in the region, it is one of the few coral reef ecosystems that survived two natural phenomena, firstly, the El Nino related coral bleaching event in 1998 and secondly the 2004 Tsunami, which is well demonstrated by the fact that the live coral coverage has remained relatively stable at 51% in 1999 and 54% in 2005 (Christoffelsz et al., 2000; Rajasuriya, 2005).

The local and foreign tourists' influx to the Pigeon Island has drastically increased with the end of the civil war that existed in the area for last 3 decades. As a result, the coastal environment and its associated habitats are adversely affected by anthropogenic impacts associated with tourism. It includes both direct and indirect impacts such as reef walking, trampling, excess boat maneuvering, polluting due to misconduct of solid waste, chronic oil pollution, propeller cuts, excess algal growth, damages caused by novice snorkelers etc. However Trincomalee and Nilaveli, including Pigeon Island are identified as Tourism Development Areas (TDA) in the Strategic Tourism Development Plan for Eastern Coast of Sri Lanka of 2009, arrival of larger numbers of tourists to these areas in the future is inevitable. Therefore, sustainable management of the valuable resources in the Pigeon Island National Park (PINP) and its surroundings has become a top priority before the total collapse of this valuable eco system. The data and information related to the reef distribution in and around the Pigeon Island are necessary to long term management of the environment.

The identification of spatial distribution of the reef areas including live coral reef can be the first step in terms of long term management. The remotely sensed data provide updated information over large area and technology of remote sensing can gather them within a shorter time of period. Main objectives of this study include;

- Provide extent of coral coverage.
- Sharing the data and information among the key agencies involved in decision making process at local level for management of the Pigeon Island National Park.

The study findings show that most of the living coral is located shallow area of northern part while southern side of the island consist dead corals. Spatial distribution of the coral cover is given in following figure.



Progress (%) : Physical : 100% Financial: 100%

RESEARCH PROJECT MONITORING

Following Progress reports and other information were submitted during the year

1. Progress reviews of projects- by weekly, monthly, quarterly to Ministry of Fisheries and Aquatic Resources Development
2. Progress of Organizational Result Framework (ORF) to Ministry of National Policies and Economic Affairs by quarterly
3. Training requirement of the scientist in the research institute of the National Agricultural Research System (NARS) to SLCARP
4. Activity plan for the implementation of the policy statement to Prime Minister Office and Department of Project Management and Monitoring.
5. Details on Colombo districts projects to District Secretariat, Colombo
6. Ongoing and proposed projects within Western Region to the Western Region Mega Polis Planning Project (WRMPP) to Ministry of Mega Polis and Western Development

7. Progress of FAO funded projects to Ministry of Fisheries and Aquatic Resources Development
8. Details about training programs to Ministry of National Policies and Economic Affairs
9. Progress review of development projects quarterly submitted of Presidential Secretariat to submit in to the his Excellency the President
10. Details of the State Owned Enterprises to Ministry of Public Enterprise Development
11. Information requested by Sectoral Oversight Committee of the parliament on sustainable development and environment and natural resources
12. Physical and financial progress of the projects for Ministry of National Policies and Economic Affairs
13. Information on collection of research and development expenditure of the National Agricultural Research System from year 2011-2015 to SLCARP
14. Information on Regional Development programs to Department of National Planning
15. Details on Northern Province development projects to Governor, Northern Province
16. Progress of Economic development projects to be completed during 2017-2020 to Prime Minister Office
17. Progress of Foreign funded projects to Presidential Secretariat by quarterly

NARA Scientific Sessions

Main theme of the annual scientific session was “healthier aquatic environment for the economic growth”. 42 scientific abstracts were presented in 05 thematic areas. 27 reviewers engaged in reviewing extended abstracts. The session was conducted on 29th March 2016.

Technical Committees attended

The staff involves with Technical Evaluation Committees (TEC) specially in IT related procurements. There were 140 evaluations were completed during the year.

Consultancy Project

1. Project Name: Assessment of the physical, biological and socio-economic environment in the Sand exploration site 3, Supplementary Environmental Impact assessment, Colombo port city development project.

Total value of the consultancy : Rs 3,94,250.00

Duration : Sep – Dec 2016

2. Data Base Design and Web site Development for Petroleum Resource Development Secretariat
Total value of the consultancy : Rs 2,70,000.00
3. Sensitive habitat mapping for Gulf of Mannar and Palk bay for IUCN
Total value of the consultancy : Rs 430,000.00

Publications

Scientific papers

1. D.D.D. Weragodatenna and A.B.A.K.Gunaratne, (2016) Change detection of mangrove coverage in Puttalam Lagoon of Sri Lanka using satellite remote sensing techniques, Journal of National Aquatic Resources Research and Development Agency, Vol 44.

Reports

1. Assessment of the physical, biological and socio-economic environment in the sand exploration site, Supplementary Environmental Impact assessment, Colombo port city development project. Report Submitted to Ministry of Megapolis and Western province Development on November 2016

Trainings/ workshops attended

1. D.D.D. Weragodatenna, Seminar on coastal biodiversity for Asia Pacific Region , FJIO, Xiamen, China - 25 Oct. – 16 Nov. 2016

Training Conducted

1. Two undergraduates from University of Colombo were trained on GIS and Remote Sensing

Library and Information

Overview

NARA Library is a Special Library acting as an information & reference centre holding a special collection of Fisheries and Aquatic Resources related information in physical and electronic media. The division ensures the information needs of the scientists and scholars strengthening the resource and also sharing relevant and current knowledge to achieve the mission and goals of the NARA and also to the sector. The Online Public Access Catalogues (OPAC) was updated. The collection were strengthened by purchase of resources, donations, inter libraries exchanges and downloads from the web and freely available e-resources using subject gateways. NARA Library is serving effectively and competently in the world of rapid evolution of information.

Activities undertaken

Project	Activities	Allocation	Officer Responsible	Period (from-to)
1. Collection Development of Library Resources	1.1 Procurement of books, Journals (printed /electronic) and CD-Rom	2.00	BGS Kariyawasam	Jan- Dec
	1.2 Collecting Research Reports and Papers		RS Liyanarachchi	Jan-Dec
	1.3 Obtaining of library resource donation		BGS Kariyawasam -do-	
	1.4 E-downloads		BGS Kariyawasam RS Liyanarachchi	
2. Collection Management of the library	2.1 Editing and updating library catalogues		BGS Kariyawasam	Jan- Dec
	2.2. Entering data to New library Development software 'KOHA'		Menaka Karunaratne Manori Rupasinghe	
	2.3 Subject Classification & filing of library resources		-do-	
	2.4 Compilation of e-repository collection		BGS Kariyawasam RS Liyanarachchi Manori Rupasinghe	
3. Reference Services	3.1 Current Awareness Services (CAS)		BGS Kariyawasam	Monthly
	3.2 Selective Dissemination of Information Service (SDI)		RS Liyanarachchi	Jan- Dec
	3.3 Information Retrieval Services		BGS Kariyawasam	
	3.4 Indexing Services		BGS Kariyawasam	
	3.5 Literature Survey		RS Liyanarachchi	
	3.6 Inter libraries exchange services		BGS Kariyawasam	

4. Library Cooperation	4.1 Library membership British council & ITI		BGS Kariyawasam RS Liyanarachchi	Jan- Dec
5. Other services	5.1 Multi copying services (Photo copy /Scanning)		Menaka Karunaratne Manori Rupasinghe	Jan- Dec
6. Publishing Journal & Publicity Service	6.1 Sale & free distribution of NARA Publications 6.2 Re-print of NARA Publications		RS Liyanarachchi Menaka Karunaratne Manori Rupasinghe BGS Kariyawasam RS Liyanarachchi	Jan- Dec

PROJECT No : 01

ACQUISITION OF LIBRARY RESOURCES

Strengthened the Library resources by purchasing, donations, exchanges and electronic downloads according to the requests of the scientists of NARA. Also, collected information relevant to NARA.

Purchases

07 Journals were requested for the year 2016, out of them only 03 were subscribed & 02 were renewed.

Book Titles – 37 Nos. Purchased 37 Nos.

Renewed payment for purchasing AGORA database and National Geography for this year.

Donations & Exchange :

Received 08 Books, 17 Reports, 98 Newsletters, 17 Travel Reports, 06 CD-ROM).

Progress (100%)

Physical (100%)

Financial (100%)

PROJECT No: 02

RESOURCE MANAGEMENT

The resource acquired, were catalogued and classified manually and also entered to the electronic catalogue and accessible not only to the NARA but also to the public. Other indexes (electronic) were also updated regularly.

Library resource referral service was accessible to the scholars using Open Public Access Catalogue (OPAC). Journal Article Index (JAI) database was updated. Started to enter data for the new database (KOHA)

Information Retrieval

In order to retrieve from Journal articles, Postgraduate theses, Research reports, Research articles and Newspaper clippings databases were updated electronically and were compiled indexes using WINISIS & Alice software. Summary of data entered for the year as given below.

Name of the Database	Quantity of Data
Koha Database	2258
Journal Article Index (JAI)	4797
Research Reports, Papers & Theses Index	885
Newspaper Article Index	1467

3.1 Collected information for literature surveys for the following titles –

1. Aquatic Resources Technology
2. Coral Reefs
3. Ornamental Fishes
4. Endemic Fishes
5. Fishing Industry and Problems in Dikowita

Replied for the information requests made by users over the phone and also via email.

- 3.2 Under National Digitization Project, Electronic Article database was started using DSPACE software.
- 3.3 Library has provided services for the Scientists, Researchers, Postgraduates and Undergraduates who arrived from different institutions and universities. The Number of users visited was 233nos. 12 articles were supplied under SDI services.
- 3.4 Document Delivery Service - Library has joined for the British Council Membership programme and Under selective dissemination of Information service provided 12 nos research reports provided for Nara Scientists from co-operative libraries
- 3.5 Library has provided photocopy services - the total amount received through photocopying during the year was Rs. 4100.50/= and 168 Pages for free of charge for internal readers

Progress (100%)

Physical (100%)

Financial (-%)

PROJECT No : 04
NATIONAL DIGITIZATION PROJECT

4.1 Under this project, pages were tagged for scanning and Selected Nos. 682 reports, Nos.646 Journal articles.

Progress (75%) Physical (75%) Financial (-%)

PROJECT No : 05
PUBLICATION AND PUBLICITY SERVICE

Selected two NARA publication for reprint

1. විසිතුරු මත්ස්‍ය වගාවේ ලෙඩ රෝග හඳුනා ගැනීම හා පාලනය.
2. විසිතුරු මත්ස්‍ය වගාව සඳහා ටැංකි පිළියෙළ කිරීම නඩත්තු කිරීම හා ජලතත්ව කළමනාකරණය.

Sales of NARA publication were done by the library & the total amount received was Rs.89,637.50/= and distributed 20 items free of charge.

Progress (75%) Physical (75%) Financial (-%)

PROJECT No : 05
TRAINING PROGRAMMES, WORKSHOPS & COMMITTEE MEETINGS ATTENDED

LOCAL

- Workshop on Openbiblio Management System and Library Networks Organized by National Library of Sri Lanka
- Participated National Reading Month national ceremony at the National Library of Sri Lanka
- Workshop on New trends in library space design with low cost and no budget Organized by Sri Lanka Library Association

Progress (75%) Physical (75%) Financial (.50%)

Extension Unit

OBJECTIVES OF THE EXTENSION SERVICE ARE,

- Transfer the useful technology experiences and knowledge obtained by the researchers to fishermen and other stakeholder.
- Awareness – Building program
- as in a broader context are designed to educate stakeholders and to create an interest and awareness among the general public.
- To provide fishermen with the latest research result and fishery technique for their Socio-economic betterment.
- To conduct public awareness programme to enhance efficient fishing, suitable fishing method and sustainable management of ocean and aquatic resources.

PROJECT NO: 9.1.6

EXTENSION SERVICES

The unit carried out public awareness programs, providing auditorium facilities, printing services for printing Posters, Leaflet report, forms etc. 15 Requests had been received from various institutions to take part their exhibitions. However, only 04 exhibitions could be attended due to financial constraints. 13 Educational visits (schools, navy & government institution) consisting more than 1300 students & officers were noted during the year.

EDUCATION VISIT

No	Institution	No of participants	Date
01	CP/MK/Sirimawo bandaranayaka vidyalaya-Mathale	30	09 th March 2016
02	WP/Aligar muslim collage	160	17 th March 2016
03	Anuruddha kumara national school-Nawalapitiya	50	18 th March 2015
04	Sri Lanka NAVY Headquarters - Colombo	27	01 st April 2016
05	Naval & Maritime Academy Trincomale	33	02 nd May 2016
06	Gothami balika vidyalaya-Colombo 10	70	10 th May 2015
07	Sri Lanka NAVY Headquarters - Colombo	50	11 th May 2016
08	Sri Lanka NAVY Headquarters - Colombo	42	12 th May 2016
09	Naval & Maritime Academy Trincomale	59	16 th May 2016

10	Naval & Maritime Academy Trincomale	24	13 th June 2016
11	Forestry department -Girithale	38	22 th June 2016
12	Sri Lanka NAVY Headquarters - Colombo	15	06 th June 2016
13	Naval & Maritime Academy Trincomale	43	08 th July 2015
14	Narandeniya central collage	39	07 th July 2016
15	Department of zoology-University of Sri Jayawardanepura	90	27 th August 2016
16	Naval & Maritime Academy Trincomale	32	25 th September 2016
17	Sri Lanka NAVY Headquarters - Colombo	30	26-30 th September 2016
18	University of Jaffna	73	29 th September 2016
19	Ministry of health	48	07 th October 2016
20	University of Jaffna	54	19 th October 2016
21	Naval & Maritime Academy Trincomale	50	19 th October 2016
22	Sri Lanka NAVY Headquarters - Colombo	13	25 th October 2016
23	Sri Lanka NAVY Headquarters - Colombo	23	11 th November 2016
24	Naval & Maritime Academy Trincomale	30	15 th November 2016
25	Naval & Maritime Academy Trincomale	30	21 th November 2016

EXHIBITION

No	Exhibition	Place	Date
01	Kaluthara Balika National School	Kaluthara	2016/02/25- 27
02	Min visithuru-2016	Colombo	2016/08/05- 07
03	Next Lanka	Colombo	2016/10/16- 18

BOOKING OF MAIN AUDITORIUM

NO	Institution	Date
01	Ministry of fisheries and aquatic resource development	2016.01.08
02	Coastal conservation department	2016.02.20
03	SLAFAR Association	2016.05.20
04	Supply and transport director council	2016.06.29
05	University of Kelaniya	2016.11.29

MEDIA WORK

Type of Program	Broadcasted TV channel/Radio channel	Payments
'Coffee Table Program' – 2016-10-09 About Environmental study division	ITN	Gratis
'Coffee Table Program'–2016-11-03 About Fishing technology	ITN	Gratis
' Coffee Table Program '–2016-11-06 About endemic Fish species in Sri Lanka	ITN	Gratis
'Coffee Table Program'–2016-11-11 About fishing information service	ITN	Gratis
'Malapaara Program'– 2016-10-13 About identification of fish species	ITN	Gratis
' Malapaara Program ' – 2016-10-27 About endemic fishes	ITN	Gratis
' Malapaara Program ' – 2016-10-13 About how to prepare a ornamental fish tank	ITN	Gratis
'Hatha Ata Ekata' Interview with chairman in NARA bout Research fields in this institution	ITN	Gratis
'The Other Side' Program 2015-05-21 'About "Samudrika".	Derana TV/Derana TV 24 hour channel	Gratis
The Other Side' 2016-06-15 Program. About NARA head office	Derana TV/Derana TV 24 hour channel	Gratis
The Other Side' Program 2016-03-16. About Oyster farming.	Derana TV/Derana TV 24 hour channel	Gratis
LNC NEWS Program. 2016-06-08 With chairman of the NARA	TNL	Gratis
'Aruthbara Jeewithaya' Identification on new fish species as foods. 2016-07-08	ITN	Gratis
' Aruthbara Jeewithaya ' About Post harvesting technology 2016-07-15	ITN	Gratis
' Aruthbara Jeewithaya ' About Post harvesting technology 2016-07-15	ITN	Gratis
'BIZ NEWS' Program. 2015	Derana TV/Derana TV 24 hour channel	Gratis

'Aruma Puduma Rooda Hathara' Program..2016-11-06 About fish specie of Tank cleaner	The National Television	Gratis
'Widulowa' Radio Educational Program 2016-07-08 About oceanography	Sri Lanka Broadcasting Cooperation Swadesiya Seewaya	Gratis
'Widulowa' Radio Educational Program . 2016-07-08 About oceanography	Derana TV/Derana TV 24 hour channel	Gratis

- NARA Scientific News article were published in 'Divaina, Dinamina, Lankadeepa, Ade, Dally News, Tinakkural National Papers and Electronic Media .
- Published "Sayuru Netha" Magazine

Activities

- "Dhiwara Nena Saviya" School based awareness Program

No	Date	Started Time	Program	Participation	Place
01	2016.09.04	9.00a.m	Awareness Program About Post harvest technology	200	Education Office, Hambanthota Kalyana Dharma Ashramaya, Siriboopura, Hambanthota
02	2016.09.14	2.00p.m	Awareness Program About Conservation of wetlands	200	Kalyana Dharma Ashramaya, Siriboopura, Hambanthota
03	2016.09.15	9.00a.m	Awareness Program About Post harvest technology		Main Auditorium, Walasmulla
04	2016.09.15	2.00p.m	Awareness Program About Conservation of wetlands	200	Main Auditorium, Walasmulla
05	2016.09.16	9.00a.m	Awareness Program About identification of usable new fishing areas, Prohibitory fishing gears and new fishing gears	350	Auditorium, Suchi National School, Hambanthota
06	2016.09.16	2.00p.m	Awareness Program About identification of usable new fishing areas, Prohibitory fishing gears and new fishing gears	350	Divisional Secretarial Office, Tangalle
07	2016.09.24	9.00a.m-5.00p.m	Cookery program with Dr.Pabilis silwa	1000	Town hall, Angunakolapelessa

08	2016.09.27	9.00a.m	Awareness Program About Post harvest technology	175	Youth Center, Yayawathta Tangalle
09	2016.09.27	2.00p.m	Awareness Program About Conservation of wetlands	175	Youth Center, Yayawathta Tangalle
10	2016.09.28	9.00a.m	Awareness Program About Conservation of wetlands	200	Auditorium, Negambo

OTHER ACTIVITIES

- Supported to Auditorium Facilities & Printing leaflets for the NARA Scientific session 2016.
- Auditorium facilities for Conducting NARA Workshops ,Other institute and Education Tours.

Progress (%) Financial : 100 Physical : 79

6. ANCILLARY SERVICES

6.1 PURCHASING & SUPPLY UNIT

Head of the Division (Actg.) – Mr.M.D.Senarathne

Introduction

The premier function of the division is to provide all necessary services and supplies in a formal and systematic manner in accordance with procurement guide lines in order to carry out research & development activities of divisions of National Aquatic Resources Research & Development Agency and Regional Research Centers.

Overview of the Division

Purchasing & Supply Division was established with effect from 23/05/2007. The functions and responsibilities of the unit are as follows.

- Supply goods and services relevant to the all divisions
- Handle all tender works
- Procurement works relevant to all divisions
- All insurance matters
- Prepared by payment voucher
- Air freight and clearance of goods
- Auction work relevant to disposal items
- Provide details to all divisions on their requirement

Performance

1. According proper tender procedures Mainly purchase of ongoing projects,
 - Purchase of Lab Equipment & Chemical Items
 - Purchase of all vehicle Parts
 - Purchase of all technical equipment & Accessories
 - Purchase of Stationery ,Furniture & other goods

The selection of supplies is use of supplier registration 2016 & rainbow –pages. Calling of tenders, Bid from local and foreign supplies for goods /equipments /Chemicals following tender procedures as per the given specifications. Purchase of goods for day to day use by utilizing a petty cash Imprest and maintain records. For the year 2016, the division has maintained about 98 Tenders following the tender procedures.

2. Clearance of goods received as donations, purchase of goods from foreign sources or airfreight of goods for repairs. Take actions where necessary to obtain tax relief when clearance of goods received from foreign sources are done & sending equipments for repair Etc: Abroad subject to normal mail & airfreight charges.
3. Insure all vehicles /motor- cycles/equipment of NARA through proper tender procures. Obtain insurance coverage for the personal perform duty at sea and land.
4. To provide a smooth service to the NARA, the staff of the unit has been responsibility.

6.2 SERVICE AND OPERATION DIVISION

Head of the Division: Mr. A.J.G.S. Dahanayake (To 2016.03.31)

Mr. P.S. Ranaweera (act. From 2016.04.06 to 2016.10.02)

Mr. S.K.S. Liyanaarachchi (from 2016.10.03)

Overview of the Year

Service & Operation Division (S & O) is a supportive division of the institution. S & O division provides and maintains all the services and develops the infra-structure facilities in line with work programs of the institution.

Activities

Service & Operation Division have several activities. They are categorized as follows.

1. Rehabilitation of NARA main building & other regional centres.
2. Installation and maintenance of air conditioners & electric/electronic appliances
3. Installation and maintenance of electrical distribution system.
4. Repair & maintenance of vehicles.

For the year 2016, in addition to the day to day maintenance, below mentioned work has been completed.

- 1) Rehabilitation of NARA main building & other regional centers.
 1. Renovation work of IPHT corridor.
 2. Aluminium partitioning work of Library.
 3. Floor tilling & Partitioning work of FTD.
 4. Aluminium partitioning work to minor Supervisor's room.
 5. Repair work at Purchasing Division.
 6. Renovation of Toilets ESD
 7. Renovation of Toilets near Library & NIOMS
 8. Roof repair - ESD.
 9. Floor Tilling at RA's room – IARAD.
 10. Partition of IA's Room.
 11. Cleaning mud ponds at Panapitiya Regional Center.
 12. Partition of Chairman's office.
 13. Construction of New Tank system for Panapitiya Regional Center.
 14. Excavation PVC Pipe line for Panapitiya Regional Center.
 15. Pond renovation work at Panapitiya.
 16. Repair of NHO Driver's room.
 17. Construction of Tide House.
 18. Construction of Shade net of IARAD.
 19. Repair of Drivers Room.
 20. Repair of Roof – MBRD.
 21. Repair of DG's office
 22. Construction of Information Hut.
 23. Repair of Main Building Windows.

24. Repair of 1st floor area (old Ocean Univercity)
25. Tilling of Driver's Room
26. Repair of Ground Floor Roof & 2nd Floor Roof.
27. Repair of Driver's Quarters.
28. Construction of Toilet for Administration.
29. Repair of OOC Beruwala.
30. Repair of Kalpitiya circuit Bungalow.
31. Repair of Building RRC Rekawa.
32. Partition & Tiling work of S&O Division.

2) Installation and maintenance of air conditioners & electric/electronic appliances

1. IARAD Main Building - air conditioner Installation 3phase wiring Job completed.
2. IARAD opposite to DDG's room front air conditioners Installation wiring Job completed.
3. IARAD Fish processing unit wiring job completed.
4. Administration - New wiring Job completed.
5. Kalpitiya RRC - 2 air condition Installation room No 3 & 4 and New wiring system install
6. Library - air conditioners Installation 3phase wiring Job completed.
7. Panapitiya RRC - Electrical Equipment install (fish processing unit)
8. NARA Main Generator Service & Repair (AVR)
9. Algi Lab (IARAD) - New wiring system install.
10. Tissueculture Lab - air conditioner Installation new wiring Job completed.
11. Tissueculture Lab culture racks lighting Job wired & completed.
12. Kalpitiya RRC - Electrical Job & water pump & street Lamp Repair Job completed.
13. DG's office air conditioner Installation new wiring Job completed.
14. Main Building Control panel Replacing Job completed.
15. MBRD Gene Bank - air conditioner Installation new wiring Job completed.
16. S&O - 04 Nos air conditioner Installation new wiring Job completed.

3) Rehabilitation of Vehicles (10 nos.)

There are 26 vehicles & 17 Motor cycles in NARA fleet and 10 of them fleet taken for rehabilitation during the year. The vehicles under rehabilitation were.

Reg No. - 32-7028
 32-2951
 32-3417
 PA-4035
 PA-5262
 PB-8107
 PB-7365
 NA-7487
 NB-1486

Addition to above Rs.8,184,454.00 spent for services, running repairs, license and insurance of the fleet during the year. 26 vehicles & 17 Motor cycles effectively utilized for the running of 718,744 km during the year.

Cost for the Year Rs For NARA Fleet	
a) Rehabilitation of vehicles (From Capital Budget)	Rs. 3,876,436.90
b) Running repairs, Services cost Insurance & License fee (From recurrent Budget)	Rs. 5,833,292.38
c) Vehicle Monitoring System (with Installation charges)	Rs. 616,026.39
d) Vehicle Hiring charges	Rs. 0.00
e) Fuel Cost	Rs. 6,789,303.32
f) Total operated	718,744.00 km

* exclude Drivers salary, Overtime and Bata and maintenance staff cost

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

STATEMENT OF FINANCIAL POSITION AS AT 31ST DECEMBER 2016

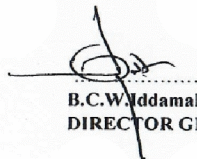
		31.12.2016	31.12.2015
ASSETS			
CURRENT ASSETS	Notes	Rs.	Rs. Restated
CASH AND CASH EQUIVALENTS	1	57,627,248	29,775,785
TRADE AND OTHER RECEIVABLES	2	15,324,810	12,847,028
INVENTORIES	3	4,142,080	2,001,440
PREPAYMENTS	4	3,158,887	3,238,153
		<u>80,253,025</u>	<u>47,862,406</u>
NON-CURRENT ASSETS			
RECEIVABLES-DISTRESS LOAN	5	12,009,093	9,096,725
INFRASTRUCTURE, PLANT AND EQUIPME	6	427,961,699	430,623,494
LAND AND BUILDINGS	6	3,698,405,808	3,719,737,138
CAPITAL WORK IN PROGRESS	7	5,250,764	2,902,938
		<u>4,143,627,365</u>	<u>4,162,360,295</u>
TOTAL ASSETS		<u>4,223,880,390</u>	<u>4,210,222,701</u>
LIABILITIES			
CURRENT LIABILITIES			
ACCOUNTS PAYABLES	8	47,918,938	25,543,213
ACCRUED EXPENSES	9	28,911,943	42,243,552
		<u>76,830,881</u>	<u>67,786,765</u>
NON-CURRENT LIABILITIES			
PROVISION FOR GRATUITY	10	91,089,383	89,726,767
		<u>91,089,383</u>	<u>89,726,767</u>
TOTAL LIABILITIES		<u>167,920,264</u>	<u>157,513,532</u>
NET ASSET		<u>4,055,960,126</u>	<u>4,052,709,169</u>
ACCUMULATED FUNDS	11	597,657,322	597,630,534
RESERVES	12	3,458,302,804	3,455,078,635
TOTAL EQUITY AND LIABILITIES		<u>4,055,960,126</u>	<u>4,052,709,169</u>

THE SIGNIFICANT ACCOUNTING POLICIES AND NOTES ANNEXED FORM AN INTEGRAL PART OF THESE FINANCIAL STATEMENTS.


M.D. Senarathne
HEAD/FINANCE

APPROVED AND SIGNED ON BEHALF OF THE BOARD.


Dr. Anil Premaratne
CHAIRMAN


B.C.W. Uddamalagoda
DIRECTOR GENERAL

COLOMBO, 17TH April, 2017

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

PERFORMANCE STATEMENT FOR THE YEAR ENDED 31ST DECEMBER 2016

		2016	2015
			Restated
REVENUE	NOTE	Rs.	Rs.
GOVERNMENT GRANT	13	377,584,429	336,904,529
OTHER INCOME	14	20,280,469	11,198,538
AMORTIZATION OF LOCL & FOREIGN GRNT	15	113,552,414	100,407,854
TOTAL REVENUE		511,417,313	448,510,921
EXPENSES			
PERSONNEL EMOLUMENTS	16	252,454,602	255,188,986
TRAVELLING & SUBSISTENCE	17	326,069	286,282
SUPPLIES & CONSUMABLES USED	18	1,864,133	1,526,352
MAINTENANCE EXPENDITURE	19	15,049,621	13,527,213
CONTRACTUAL SERVICES	20	32,686,104	27,664,831
RESEARCH & DEVELOPMENT EXPENDITURE	21	86,853,429	63,321,729
DEPRECIATION & AMORTIZATION EXPENSES	22	113,552,414	100,407,854
OTHER OPERATING EXPENSES	23	5,406,773	3,918,153
TOTAL EXPENSES		508,193,145	465,841,400
SURPLUS (DEFICIT) FOR THE YEAR		3,224,167	(17,330,479)

THE SIGNIFICANT ACCOUNTING POLICIES AND NOTES ANNEXED FORM AN INTEGRAL PART OF THESE FINANCIAL STATEMENTS.

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY
CONSOLIDATED CASH FLOW STATEMENT FOR THE YEAR ENDED 31 ST DECEMBER 2016

	31.12.2016 Rs.	31.12.2015 Rs. Restated
CASH FLOWS FROM OPERATING ACTIVITIES		
SURPLUS (DEFICIT) FROM ORDINARY ACTIVITIES	3,224,167	(17,330,479)
ADJUSTMENT FOR:		
DEPRECIATION ON PROPERTY, PLANT AND EQUIPMENT	113,552,414	100,407,854
AMORTIZATION OF DEFERRED EXPENDITURE	(113,552,414)	(98,330,247)
PROVISION FOR RETIRING GRATUITY	7,459,984	20,244,318
INTEREST ON STAFF LOANS	(641,889)	(556,487)
PROFIT ON DISPOSAL OF VEHICLES	-	(1,226,780)
OPERATING PROFIT/ (LOSS) BEFORE WORKING CAPITAL CHANGES	10,042,262	3,208,179
WORKING CAPITAL CHANGES		
(INCREASE)/DECREASE IN INVENTORIES	(2,140,640)	748,746
(INCREASE)/DECREASE IN TRADE & OTHER RECEIVABLE	(2,477,782)	(194,785)
(INCREASE)/DECREASE IN PREPAYMENTS	79,266	(782,912)
INCREASE/(DECREASE) IN ACCOUNTS PAYABLES	22,375,725	12,026,931
INCREASE/(DECREASE) IN ACCRUED EXPENSES	(13,331,609)	(18,819,511)
CASH GENERATED FROM/(USED IN) OPERATIONS	14,547,222	(3,813,352)
RETIRING GRATUITY PAID	(6,097,368)	(3,789,078)
NET CASH GENERATED FROM / (USED IN) OPERATING ACTIVITIES	8,449,854	(7,602,430)
CASH FLOWS FROM INVESTING ACTIVITIES		
PURCHASE OF PROPERTY PLANT AND EQUIPMENT	(76,474,483)	(42,467,828)
INVESTMENT IN DISTRESS LOAN	(2,912,368)	(4,907,729)
INTEREST ON STAFF LOANS	641,889	556,487
PROCEED FROM SALE OF VEHICLES	-	3,729,680
NET CASH GENERATED FROM/ (USED IN) INVESTING ACTIVITIES	(78,744,962)	(43,089,390)
CASH FLOWS FROM FINANCING ACTIVITIES		
CAPITAL GRANTS RECEIVED	98,146,571	76,678,273
NET CASH GENERATED FROM/ (USED IN) FINANCING ACTIVITIES	98,146,571	76,678,273
NET INCREASE / (DECREASE) IN CASH AND CASH EQUIVALENTS DURING THE YEAR	27,851,463	25,986,453
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	29,775,785	5,814,897
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	57,627,248	31,801,350
ANALYSIS OF CASH & CASH EQUIVALENTS AT THE END OF THE YEAR		
CASH AT BANK	57,627,248	29,775,785
	57,627,248	29,775,785

THE SIGNIFICANT ACCOUNTING POLICIES AND NOTES ANNEXED FORM AN INTEGRAL PART OF THESE FINANCIAL STATEMENTS.

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

STATEMENT OF CHANGES IN EQUITY FOR THE YEAR ENDED 31ST DECEMBER 2016

	ACCUMULATED FUND			ACCUMULATED EXPENDITURE OVER INCOME	REVALUATION RESERVES	TOTAL
	GOVERNMENT CONTRIBUTION	FOREIGN GRANT	LOCAL GRANT			
BALANCE AS AT 1 ST JANUARY 2015	392,027,020	45,698,373	17,354,252	(497,519,738)	3,915,457,593	3,873,017,500
ADJUSTMENT FOR AMORTATION OF CAPITAL GRANT FROM 01-01-2004 TO 31-12-2013	146,752,732	-	-	(146,752,732)	-	-
ADJUSTMENT FOR RE-VALUATION OF LEASE HOLD LAND AS AT 01-01-2014	-	-	-	-	183,779,765	183,779,765
OVER PROVISION FOR GRATUITY	-	-	-	17,496,923	-	17,496,923
ADJUSTMENT FOR DEPRECIATION	(2,700,654)	-	-	-	-	(2,700,654)
ADJUSTMENT FOR OVER DEPRECIATION - Computer Software	-	-	-	(336,532)	-	(336,532)
UNDR DEPRECIATION- Buildings	-	-	-	-	-	-
RESTAED BALANCE AS AT 01-01-2015	536,079,098	45,698,373	17,354,252	(627,112,079)	4,099,237,358	4,071,257,002
FUNDS RECEIVED DURING THE YEAR	140,000,000	-	22,228,395	-	-	162,228,395
FUNDS UTILISED DURING THE YEAR	(81,320,236)	(15,857,536)	(3,230,083)	-	-	(100,407,855)
ADJUSTMENT FOR DEPRECIATION	-	-	-	-	-	-
UNDR DEPRECIATION- Buildings	-	-	-	-	-	-
FUNDS TRANSFERS DUE TO REALLOCATION	(63,321,729)	-	-	-	-	(63,321,729)
ADJUSTMENT FOR OVER DEPRECIATION	-	-	-	283,835	-	283,835
OVER PROVISION FOR GRATUITY	-	-	-	-	-	-
ADJUSTMENT FOR DISPOSAL OF ASSETS	-	-	-	4,006,015	(4,006,015)	-
NET SURPLUS/ (DEFICIT) FOR THE YEAR	-	-	-	(17,330,479)	-	(17,330,479)
RESTAED BALANCE AS AT 01-01-2016	531,437,133	29,840,837	36,352,564	(640,152,708)	4,095,231,343	4,052,709,169
FUNDS RECEIVED DURING THE YEAR	185,000,000	138,630	15,294,000	-	-	200,432,630
FUNDS UTILISED DURING THE YEAR	(87,430,286)	(15,870,879)	(10,251,249)	-	-	(113,552,414)
FUNDS TRANSFERS DUE TO REALLOCATION	(86,853,429)	-	-	-	-	(86,853,429)
ADJUSTMENT FOR DISPOSAL OF ASSETS	-	-	-	-	-	-
ADJUSTMENT FOR OVER DEPRECIATION	-	-	-	-	-	-
NET SURPLUS/ (DEFICIT) FOR THE YEAR	-	-	-	3,224,167	-	3,224,167
BALANCE AS AT 31 ST DECEMBER 2016	542,153,418	14,108,588	41,395,315	(636,928,541)	4,095,231,343	4,055,960,123



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கணக்காய்வாளர் தலைமை அபிப்பதி திணைக்களம்
AUDITOR GENERAL'S DEPARTMENT



මගේ අංකය
எனது இல.
My No.

එස්.එල්.එස්/සී/1716/12

ඔබේ අංකය
உமது இல.
Your No.

දිනය
திகதி
Date

2018 පෙබරවාරි 15 දින

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ජාතික ජලජ සම්පත් පර්යේෂණ හා සංවර්ධන නියෝජිතායතනය.

ජාතික ජලජ සම්පත් පර්යේෂණ හා සංවර්ධන නියෝජිතායතනයේ 2016 දෙසැම්බර් 31 දිනෙන් අවසන් වර්ෂය සඳහා වූ මූල්‍ය ප්‍රකාශන පිළිබඳව 1971 අංක 38 දරන මුදල් පනතේ 14(2)(සී) වගන්තිය ප්‍රකාර විගණකාධිපති වාර්තාව

මාගේ සමාංක හා 2017 නොවැම්බර් 12 දිනැති ලිපියට යොමුවේ.

02. ඉහත සඳහන් ලිපිය සමඟ එවන ලද මාගේ වාර්තාවේ ඉංග්‍රීසි හා දෙමළ අනුවාද මේ සමඟ එවා ඇත.

රී.ජී.ඩී. ආනන්ද

නියෝජ්‍ය විගණකාධිපති

විගණකාධිපති වෙනුවට.

- පිටපත් :
1. ලේකම් - ධීවර හා ජලජ සම්පත් සංවර්ධන අමාත්‍යාංශය
 2. ලේකම් - මුදල් හා ජනමාධ්‍ය අමාත්‍යාංශය



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கணக்காய்வாளர் தலைமை அபிபதி திணைக்களம்
AUDITOR GENERAL'S DEPARTMENT



මගේ අංකය
எனது இல.
My No. }

FLS/A/NARA/1/16/12

ඔබේ අංකය
உமது இல.
Your No. }

දිනය
திகதி
Date }

12 November 2017

The Chairman,

National Aquatic Resources Research and Development Agency.

Report of the Auditor General on the Financial Statements of the National Aquatic Resources Research and Development Agency for the year ended 31 December 2016 in terms of section 14 (2) (c) of the Finance Act, No.38 of 1971

The audit of financial statements of the National Aquatic Resources Research and Development Agency for the year ended 31 December 2016 comprising the statement of financial position as at 31 December 2016 and the statement of financial performance, statement of changes in equity and cash flow statement for the year then ended and a summary of significant accounting policies and other explanatory information, was carried out under my direction in pursuance of provisions in Article 154(1) of the Constitution of the Democratic Socialist Republic of Sri Lanka read in conjunction with Section 13(1) of the Finance Act, No.38 of 1971 and Section 32 (3) of the National Aquatic Resources Research and Development Agency Act, No.54 of 1981 amended by the National Aquatic Resources Research and Development Agency (Amendment) Act, No.32 of 1996. My comments and observations which I consider should be published with the Annual Report of the Agency in terms of Section 14(2) (c) of the Finance Act appear in this report.

1.2 Management's Responsibility for the Financial Statements

The Management is responsible for the preparation and fair presentation of these financial statements in accordance with Sri Lanka Public Sector Accounting Standards and for such internal control as the management determines is necessary to enable the preparation of financial statements that are free from material misstatements, whether due to fraud or error.



1.3 Auditor's Responsibility

My responsibility is to express an opinion on these financial statements based on my audit. I conducted my audit in accordance with Sri Lanka Auditing Standards consistent with International Auditing Standards of Supreme Audit Institutions (ISSAI 1000 – 1810). Those Standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatements.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Agency's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Agency's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of financial statements. Sub – sections (3) and (4) of Section 13 of the Finance Act, No.38 of 1971, give discretionary powers to the Auditor General to determine the scope and extent of the audit.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

1.4 Basis for Qualified Opinion

My opinion is qualified based on the matters described in paragraph 2.2 of this report.



2. Financial Statements

2.1 Qualified Opinion

In my opinion, except for the effects of the matters described in paragraph 2.2 of this report the financial statements give a true and fair view of the financial position of the National Aquatic Resources Research and Development Agency as at 31 December 2016 and its financial performance and cash flows for the year then ended in accordance with Sri Lanka Public Sector Accounting Standards.

2.2 Comments of financial Statements

2.2.1 Sri Lanka Public Sector Accounting Standards

(a) Sri Lanka Public Sector Accounting Standard No.01

Contrary to the section 48 of the standard, total sum of Rs.891,691 creditors balance had been deducted from debtors in three instance. Hence debtors had been understated by that amount in the year under the review.

(b) Sri Lanka Public Sector Accounting Standard No.08

As per section 22 and 100 of the standard, neither provision nor disclosure had been made for arrears of Rs.5,333,724 and Rs.44,368,612 and surcharge of Rs. 2,626,544 and Rs.22,184,306 in the accounts year under the review due to failure in remitting the contribution respectively to the Employee Trust Fund and the Employee Provident Fund for the period from 2006 to October 2015.

2.3 Accounts receivable and payable

Actions had not been taken to recover advance of Rs.404,010 paid for an external institution for purchasing of computer software before 06 year and sum of Rs.1,612,898 receivables from an external institution for preparing a feasibility study report on the development of 06 fishery harbours.



2.4 Non – compliance with Laws, Rules, Regulations and Management Decisions

Instances of non- compliance with the following laws, rules, regulations etc. were observed.

Reference to Laws ,Rules , Regulations and Management Decisions	Non – compliance
(a) Section 17 of National Aquatic Resources Research and Development Agency Act No.54 of 1981	Scientific and Management Committees had not been appointed as per provisions contained in the Act.
(b) Financial Regulation of the Democratic Socialist Republic of Sri Lanka	
(i) Financial Regulation 757 (2)	Board of Survey Report relating to the year under the review had not been presented to the Audit.
(ii) Financial Regulation 104	Action had not been taken in term of financial regulations regarding misplacement of computer in the year 2012 valued at Rs.52,000 which a computer software purchased for Rs.411,000 in the year 2009.
(c) Public finance circular No.03/2015 of 14 July 2015	Although the maximum limit of Ad-Hoc - Sub Imprest that can be given to a staff officer is Rs.100,000 in an instance , a sum of Rs.150,000 Ad-Hoc Sub - Imprest had been given by the Agency on 20 th April 2016.



3. Financial Review

3.1 Financial Results

According to the financial statements presented, the financial result of the Agency for the year under review had been a surplus of Rs.3,224,167 as against the deficit of Rs.17,330,479 for the preceding year, thus indicating a increase in the financial result by Rs.20,554,646 in the year under review as compared with the preceding year. Even though the contractual services and Research and Development expenditures had increased by Rs.5,021,273 and Rs.23,531,700 respectively in the year under review, increase in government grant by Rs.40,679,900 had mainly attributed to above increase.

In the analysis of financial results for the year under review and 04 preceding years, a deficit had been occurred from the year 2012 to the year 2015. However a surplus had occurred in the year 2016. When readjusting of the employees remuneration and the depreciation on non - current assets to the financial result, the contribution of Rs.123,494,212 in the year 2012 had improved continuously up to Rs.369,231,183 in the year 2016.

4. Operating Review

4.1 Performance

The objectives and functions of the Agency in terms of the National Aquatic Resources Research Development Agency Act, No.54 of 1981 are ;

- Ensure the application and utilization of scientific and technological expertise for the implementation of the national development programme on the subject of aquatic resources.
- Promote and conduct research activities directed towards the identification, assessment, management, conservation and development of aquatic resources ; Provide advisory and consultancy services on technological and legal matters relating to aquatic resources ; Co - ordinate the affairs of institutions engaged in those activities ; Collection, dissemination, publication and taking over of data



useful; Provide the training required and exercise , discharge and perform all the powers , functions and duties conferred or imposed on the Agency.

Following observations are made regarding fulfillment of those objectives.

- (a) Even though the provision of consultancy services and expertise knowledge for activities relating to the Identification, Assessment , Management and Development of Aquatic resources , Promotion of Research activities and coordinating activities of the institutions engaged in those activities was an objective of the Agency , advisory had not been issued by conducting surveys and researches regarding fish harvest promotion and post harvest promotion in Inland water Reservoir. It was observed that the consideration which the Agency focused to fulfill relevant objectives was in a minimum level.
- (b) In the Examination of the Action Plan and the progress report relating to the year under review , provision of Rs.95.74 millions had been allocated for 54 research projects and a sum of Rs.91.61 millions had been spent. The physical progress of the implementation of 25 Projects / Researches ranged from 52 per cent to 98 per cent and following weaknesses were observed in the examined projects.
 - (i) A sum of Rs.3,585,496 was under the United Nations Food and Agriculture Organization and Treasury Grant of Rs.1,600,000 had been received for production of fish feed for sea bass culture with low cost , highly nutritious . Even though out of Rs.2,262,926 had been spent up to the year under review. Fish feed with lower cost had not been introduced to the farmers by producing. Hence the objectives such as upgrading the annual income condition of small scale farmers engaged in sea bass farming industry and eradication of poverty of fishermen through introducing nutritious fish feed had not been fulfilled through this project.



- (ii) A sum of Rs.1,440,000 had been allocated in the year under review for the project of development of effective fishing gear to harvest deep sea skip jack Tuna with the help of fish aggregating devices and radio buoys and a sum of Rs.1,412,535 had been spent out of it. 03 Fish aggregating devices had been constructed and one device had been established on 29 September year under review in the area of Kalmunai. The remaining 02 devices was remained idle even by July 2017 and the established Fish aggregating device had been removed by fisherman in the year 2017.
- (iii) Even though Research had been conducted by spending sum of Rs.1.02 millions out of the allocation of Rs.1.07 millions for the project of development of technology for breeding two ornamental fish species which have high value in the market, the fulfillment of the expected objectives such as improving export fish quantity by reducing imported fish quantity, promoting inland farmers and increasing their income had not been assessed by doing follow up activities.
- (iv) Even though it has been spent sum of Rs.399,000, Rs.591,094 and Rs.341,100 as total of Rs.1,331,194 respectively in the year 2014,2015 and 2016 with the objective of improving the quality of shrimp harvest and reducing the post harvest loss by introducing efficient fishing method for shrimp species, A suitable fishing method had not been introduced for shrimps.
- (v) Provision of Rs.1,130,000 had been allocated in the year under review for ornamental fish culture and disease management through community participation in Hambanthota District and a sum of Rs.1,223,300 had been spent thereon. Although deposit of the brood stock in Mud ponds should be done in the month of March of the year under review, it had been commenced on 28 July and the project had been unsuccessful due to the death of brood stock. Further an adequate consideration had not been focused on diseases management.



- (vi) A sum of Rs.750,000 had been spent out of the provision of Rs.740,000 making for promoting fish and prawns culture in small water bodies in Hambanthota and Matara Districts. The prawn culture had been tested only in Hamabanthota District and this project had been also conducted in those area in last two preceding years . Accordingly the objective such as promoting fish and prawn culture had not been fulfilled through this project.
- (vii) Provisions of Rs.2,320,000 had been received in the year under review for the project of livelihood development of ornamental fish farmers in Kalutara District and a sum of Rs.1,973,700 had been spent. Even though the actions such as production of fish feed using Knife fish and distribution of technical knowledge to community, identification of fish diseases and making aware fishing community regarding basic treatment methods, improving the fish quality of two fish species had been planned under this project. The consideration had been focused only on quality improvement of one ornamental fish species. No other plans whatsoever had been fulfilled.
- (viii) Even though research had been conducted by spending a sum of Rs.679,000 out of the provision of Rs.770,000 for usage of pro - bio tics that is relating to improvement of production of shrimp in different culture zone and testing water quality management. According to the results of that research actions had not been taken to give knowledge that is relating to correct usage techniques to the relevant parties.
- (ix) Even though sum of Rs.400,000 had been spent by making provision of Rs.380,000 for the project such study of water quality , feeding ecology and community participated management on production of brush parks in Negombo estuary which was conducted on usage of mangrove twigs used as a traditional fishing method in Negombo Lagoon and those of results , The actions had not been taken to give benefits of that Research out comes to the fishing community.



- (x) Provision of Rs.1,420,000 had been allocated in the year under review for management of White Spot Diseases and a sum of Rs.1,411,800 had been incurred thereon. Even though this study had been conducted based on 07 objectives only out of 02 objectives had been fulfilled it. The objectives such as reducing virus diseases for shrimp farmers and methodology to hold disease free brooders and introducing safety test kits with low cost and the way of expanding white – spot virus diseases in shrimp industry and identification of strain variation had not been fulfilled.
- (xi) A sum of Rs.1,020,000 had been allocated for the project such introducing tissue culture for aquatic plants and seaweeds quantity with the objective of conducting researches to extract seaweeds in a good tissue composition and giving those benefits to farmers. Even though to the research had been conducted spending Rs.943,000, the outcomes of that had not been given to the farmers.
- (xii) Provision of Rs.370,000 had been made for the project such Micro Algae Culture and Breeding and Culturing of high economically valuable marine ornamental fish species and sum of Rs.296,000 had been spent. The objective of this project was such as study of growth and culturing methods of seahorse fry and conducting researches for Algae species which are most suitable and most helpful to environmental conditions of Sri Lanka and issuing culture sample of Essential Algae species to farmers. The reason to select this project was that exportation of marine ornamental fish currently take place through collection of fish which are in natural environment. Hence this is a damage to the environment as well as there is a threat to vanish those species from Natural Environment. Hence this project had been commenced and those benefits had not been given to the farmers in the year under review.



- (xiii) Out of the provision of Rs.4,360,000 had been made for the project such scientific study about remedial measures that could be taken to prevent quality losses in fish harvest, a sum of Rs.3,568,600 had been spent. A study had been conducted at the end of year 2016 on quality assessment of fish that are collected from Multi day boats in Foreshore area Such as Negambo, Kudawella, Puranawella, Mannar, Dikkowita and Imported Fish. Even though it has been identified that quality of fish which are taken to eat in tested 05 Foreshore areas was in a lower level and required facilities for protecting fish quality were not in Multi Day boats, A methodology whatsoever had not been prepared to minimize those weaknesses.
- (xiv) A sum of Rs.2,470,000 had been allocated for the project of introducing value added products using Aquatic Resources for introducing Nutritious Food and sum of Rs.2,234,800 had been spent. conducting researches to produce canned food using fish, Extraction of collagen using waste of Catla fish species, Extraction and purification of oil using Sardinella Longiceps, Manufacturing fish biscuits had been planned. Even though the relevant project had been finished, outcomes of research findings had not been given to the parties who are interested in that regard.
- (xv) The project that was commenced to study on fish and fish production quality, Nutritional and safety and a sum of Rs.3,568,600 had been spent in the year under review thereon under the provision of Rs.4,360,000. Toxic trace that enter into consumers body through consumption of fish meals had been analyzed through this project in the year under review and it had been concluded that trace metals are highly in specific fish. However actions had not been taken to aware consumers in this regard.



- (xvi) Even though a sum of Rs.9,679,000 had been spent out of provision Rs.8,340,000 in the year under review for the project of Designing National Nautical charts, The activities which had been planned such as Nautical chart to approach Kankasanthurei Harbour, Nautical chart from Colombo to Weligama, Nautical chart to approach Norochcholai Coal power plant, Nautical chart to approach Oluvil harbour and updating Bathymetric Survey Data had not been fulfilled.
- (xvii) Even though a sum of Rs.877,500 had been spent out of the provision of Rs.920,000 made for the project of collecting shallow water Bathymetric data using satellite technology, the expected outcome of this project such floor classification map had not been designed.
- (xviii) A provision of Rs.230,000 had been made of project of ecological study about coral reefs and species diversity in Hikkaduwa marine sanctuary and a sum of Rs.207,800 had been spent. The planned activities such as maintaining a data base about Coral species and eco diversity and identification of bad impact, Identification of diversity in coral species and Identification of changes in eco system, Determination of water quality had not been fulfilled in the year under review.
- (xix) A Provision of Rs.200,000 had been allocated for the project such studying on seasonality, diversity and spatial distribution of small pelagic fish and water quality parameters in the Weligama Bay and sum of Rs. 181,300 had been spent. However considerable changes in water had been found, the definite reasons thereon had not been found.
- (c) According to the progress report for preceding year, out of Rs.1,000,000 allocated for the project of identification of Bio logical Matters and valuation in respect of persistence fish on the area of Mannar and Nilaweli. A sum of Rs.884,292 had been spent thereon. However, designing a map in respect of the eco system and presentation of proposals on the bio diversity which are the main activities of that project had not been fulfilled. Further a sum of Rs.600,000 had been



allocated for the project of Identification of special instances on Breeding of sea Turtle and their dispersal in the Kalpitiya area only timely collection of data had been done by spending a sum of Rs.250,131. No activities whatsoever such as the Management of dispersal of turtles scientifically, establishment of breeding centers for turtles and giving publicity so as to attract tourists in an environmental friendly manner, had been fulfilled and the project had been discontinued halfway. The management attention had not been focused in this regard.

4.2 Management Activities

The following observations are made.

- (a) Actions had not been taken to vest the agency land located at Kalpitiya research center, Kapparahotta NARA regional center and Rekawa regional center of the Agency which are valued respectively at Rs.31,885,000, Rs.3,597,700 and Rs.17,918,200 as total of Rs.53,400,900.
- (b) Action had not been taken by the management to reply 15 Audit reports issued in the year under review and apply recommendations contained in those reports.
- (c) Even though in term of section 34 of National Aquatic Resource Research and Development Agency Act a registry which is contained data, reports and descriptions obtained relating to the study research, testing and other investigation and exploration conducted by the Agency should be maintained by the Director General, such a registry had not been maintained. Hence, the ability to use data collected annually for similar research has been deprived. The management's attention had not been focused in this regard.

4.3 Transactions on Contentious Nature

A fish stall constructed by spending Rs.15,245,000 contrary to the objectives of the Agency had remained idle without using for any purpose since 21 March 2014. Further actions had not been taken to properly vest the land relevant to these construction in the Agency.



4.4 Uneconomic Transaction

Even though a sum of Rs.4,493,052 had been spent in the year 2011 for the purchase of two powerful engines for production of 02 boats and sum of Rs.2,902,938 for production activities of 02 boats, those production activities had been ceased halfway.

4.5 Idle and underutilized Assets

The following observations are made.

- (a) The Thandoori Burner valued at Rs.120,000 and the plate washing machine valued at Rs.352,800 purchased for canteen and the Aluminum Ladder purchased valued at Rs.100,000 had remained idle without using from the year 2011 up to 31 July 2017, the date of Audit.
- (b) A computer software purchased for Rs.76,800 in April 2014 had not been made use of up to July 2017 the date of audit.

4.6 Commencement of projects on lands not properly vested

The Agency had carried out construction by spending Rs.552,906 in the preceding year without vesting the ownership of land located at Panapitiya area belonging to the National Aquaculture Development Authority, even the ownership of the land had not been vested at the end of the year under review.

4.7 Resource of the Agency given to other public institutions

The Agency had released 04 officers to the Line Ministry and other government institutions and paid a sum of Rs.1,736,502 to those officers as allowances in the year under review.

4.8 Staff Administration

The following observations are made.

- (a) It was observed that existence of vacancies in the post of Director Admin, Assistant Director Human Resources and Assistant Director (Admin) and 88 vacancies in 27 posts directly connected to the research activities was badly affected to carryout



activities of the Agency Further 03 excess of scientists had been recruited without approving the posts.

- (b) Duties of the post of Director (Human Resources) had been covered by an acting officer since November 2014 and action had not been taken to appoint a permanent officer for that post.

5. Accountability and Good governance

5.1 Presentation of financial statements

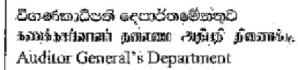
Even though the financial statements should be presented to audit within 60 days after closure of the financial year in terms of section 6.5.1 of the Public Enterprises Circular, No.PED/12 dated 02 June 2003, the Agency had presented financial statements for the year under review to audit after a delay of 98 days that is on 06 June 2017. Further the Draft Annual Report which should be presented along with the financial statements had not been presented to the Auditor General.

5.2 Internal Audit

An Internal Audit Test had not been carried out as per Internal Audit Programme regarding 10 areas including, monthly accounts, Inventory controls, Granting Advances, Implementation of projects and procurement procedures.

5.3 Unresolved Audit paragraphs

The “Tharancee” vessel constructed by spending Rs.15,685,632 in the year 2012 for the research activities of coastal Zone had not been used for the relevant purpose up to end of the year under review. Even though directives had been given at the Committee on Public Enterprises held on 12 November 2014 that action should be taken to sell the relevant ship, It had not been sold even by 04 August 2017. However, a cost of Rs.8,068,524 had been spent from the date in which this vessel had been constructed up to the end of the year under review for salaries overtime and security purposes of the officers who were engaged in the activities of the vessel.



6. Systems and Controls

Deficiencies in systems and controls observed during the course of audit were brought to the attention of the Chairman of the Agency from time to time .Special attention is needed in respect of the following areas of control.

Areas of systems and controls	Observations
(a) Presentation of Financial Statements	Failure in presenting financial statements on the relevant dates in terms of circulars.
(b) Internal Audit	Failure in conducting a Internal Audit as per Audit Programme.
(c) Staff Administration	Actions had not been taken to fill vacancies.
(d) Board of Survey	Delay in conducting annual board of survey.
(e) Operational Control	(i) Failure in planning for required surveys , research and giving instructions by identifying issues of the institution which are connected to Fishery Industry and established to development of Fishing community and promotion. (ii) Not having an adequate programme for promotion of the conducted researches among fishing community, development of those researches, properly giving instruction thereon. (iii) Failure in conducting required researches regarding testing timely water in Inland water reservoirs and promotion of Inland water fish farming.



- (iv) Failure in conducting surveys in regarding Inland water fish harvest.
- (v) Failure in collecting data relating to the researches and acting as an information center.
- (vi) Failure to furnishing research reports to the interested parties.

Sgd./ H.M. GAMINI WIJESINGHE
Auditor General

H.M.Gamini Wijesinghe.
Auditor General

Corrective action taken on the shortcomings pointed out by the Auditor General's report of Annual Financial Statement for the year ended 31st December 2016 of National Aquatic Resources Research & Development Agency according to the Finance Act No. 38 of 1971 in terms of Section No. 14(2)C

2.2 Commenting on Financial Statements

2.2.1 Sri Lanka Public Sector Accounting Standards

(a) Action has been taken to rectify the shortcomings.

(b) Such situations will be disclosed in the future.

2.4 Non-compliance with the Rules & Regulations

(b) (1) Financial Regulation Section No.757(2)

Action has been taken to avoid such situations in the future. Annual Physical Verification activities for the year 2017 is being carried on systematically. Measures is being taken to rectify the shortcomings in the previous report.

(b) Financial Regulation Section No.104

Action has been taken to avoid such situations in the future. Measures is being taken to rectify this activities from 2018 in proper manner .

(c) Finance Circular No. 03/2015 on 14th July, 2015

Action has been taken the Special Advance which is being given to an Executive officer does not exceed Rs.100,000/=.

4.5 Inactive & Unutilized Assets

(b) This software has been removed from the use, because of incompetence with our new accounting system. But the steps will be taken to use this software on the necessity of another division.

5. Accountability & Good Governance

5.1 Annual Financial Statement

Action is being to submit the Annual Financial Statement on due date.

6. Systems & Controls

(a) Annual Financial Statement

Action is being taken to submit the Annual Financial Statement on due date.

Annual Board of Survey

- (b)** Steps will be taken to rectify the shortcomings in the correct manner during the relevant period and report will be submitted in the future.

Dr. N.S. Hewagama

N.S. Hewagama
Director/Finance



Dr. Anil Premaratne
Chairman

15 February 2018.