

2020

ANNUAL REPORT & ACCOUNTS



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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

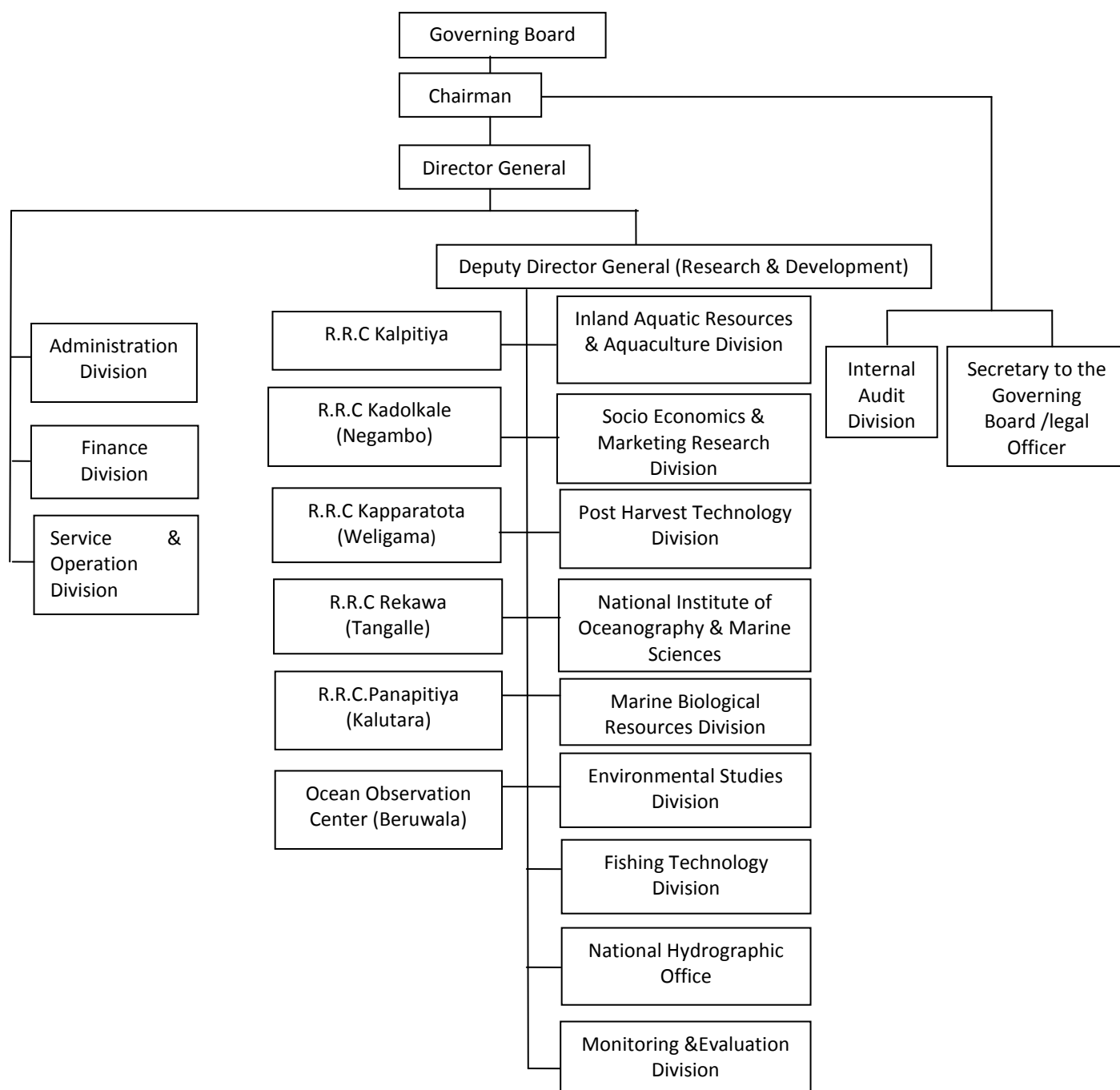
The Governing Board consists of Eight (08) Appointed Members and Eight (08) Ex officio members in accordance with the Section 6 of the National Aquatic Resources Research & Development Agency Act No 54 of 1981 as amended by Act No 32 of 1996. The following members served as the members of the Governing Board during the year 2020 and four (04) Board Meetings were held during the year.

The Governing Board Members of the Governing Board of NARA 2020		
Members who appointed by the Minister		
The Name and Address	Designation	Period of the service
Mr.S.N.B.K S.Senarathne, National Aquatic Resources Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	The Acting Chairman	From 01 st January 2020 to 23 rd January 2020
Prof. A. Navaratnarajah, Chairman, National Aquatic Resources Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	The Chairman The Governing Board Member	From 24 th January 2020 to 04 th August 2020. Reappoint- 17 th August 2020 to 31 st December 2020
Mr. SelvendranSalivan de Marian No. 17/2, Uyarappulam, Anaikoddai, Jaffna.	The Governing Board Member	24 th January 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Mr. GizalChinthana de Silva No. 273, Stanley Road, Jaffna No 3/9,Railway station Road,Colombo 04.	The Governing Board Member	24 th January 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Ms.GawriIndrarathne No. 06, Gauder place, Sri Saranankara Road, Dehiwala	The Governing Board Member	28 th February 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Dr. Asha De Vos No.14,Malalasekare Place, Colombo 07.	The Governing Board Member	28 th February 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Prof. K.H.M Ashoka Deepananda (JP) Head & Professor in Fisheries and Aquaculture, Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences &Technology,University of Ruhuna,Matara No.07, Jayamahavihara Road, Nupe, Matara.	The Governing Board Member	28 th February 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Dr. W.A.D.V. Weerathilake No.139,05 th Lane New Town, Giriulla.	The Governing Board Member	28 th February 2020 and the Secretary to the Ministry of Fisheries has informed that The appointment will be effective until further notice as per the instruction given by Secretary to the President, on 17 th August 2020
Mr. Jayantha Chandrasoma, No 15, Horana Road, Panadura	The Governing Board Member	24 th January 2020 to 04 th August 2020.

Ex-Officio Members		
The Name and Address	Designation	Period of the service
Eng. W.N.M Zoysa National Aquatic Resources Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Director General, The Governing Board Member	From 18 th February 2019 to 27 th January 2020
Mr. L.T.C. Lokukumara, National Aquatic Resources Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Director General, The Governing Board Member	From 27 th January 2020 to 03 rd November 2020
Dr. H.M.P. Kithsiri National Aquatic Resources Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Director General, The Governing Board Member	From 04 th November 2020 until further notice.
Mr.S.N.B.K S.Senarathne Additional Secretary, Ministry of Fisheries & Aquatic Resources , New Secretariat,Maligawatta,Colombo 10	The Governing Board Member	From 12 th February 2020 until further notice.
Ms. K.D.A. Munasinghe, Additional Director General, Department of Project Management & Monitoring, Ministry of Finance, Economy and Policy Development,TheSecretariat,Colombo – 01	The Governing Board Member,	From 12 th February 2020 until further notice.
Mr. S.D.P.J. Dampegama, Surveyor General, Survey Department of Sri Lanka 150, Kirula Road, Narahenpita, Colombo, 05.	The Governing Board Member,	From 12 th February 2020 to 25 th June 2020
Ms. A.L ShyamaliChithralekhaPerera, Surveyor General, Survey Department of Sri Lanka 150, Kirula Road, Narahenpita, Colombo, 05.	The Governing Board Member,	From 26 th June 2020 until further notice.
Ms. K.N. Kumari Somaratne Additional Secretary (Development), Ministry of Ports & Shipping, No. 19, Chaithya Road,Colombo 01.	The Governing Board Member,	From 12 th February 2020 until further notice.
Rear Admiral. S. Jayakody Chief Hydrographer, Sri Lanka Navy Hydrographic Service, Crow Island, Mattakkuliya, Colombo 15 Sri Lanka	The Governing Board Member,	From 12 th February 2020 to 27 th August 2020.
Rear Admiral Y.N.Jayarathne Director General Operations Naval Headquarters,Colombo 15.	The Governing Board Member	From September 2020 (It has not indicated appointment date of the appointment letter)

Mr. S.J. Kahawatta Director General Department of Fisheries & Aquatic Resources Development, Maligawatta Sec,Colombo 10	The Governing Board Member,	From 12 th February 2020 to until further notice.
Mr. Anura Disanayake Secretary, Ministry of Higher Education, Technology & Innovation No. 18, Ward Place, Colombo 7.	The Governing Board Member,	From 24 th July 2020 to 04 th August 2020.
M.M.G.K. Meegahakotuwa Director General State Ministry of Development Vocational Educational Research and innovation 3rd Floor, Sethsiripaya Stage I,Battaramulla,	The Governing Board Member,	From September 2020 to until further notice. (It has not indicated appointment date of the appointment letter)

ORGANIZATIONAL STRUCTURE



ORGANIZATION

Mr. S.N.B.K.S. Senarathne (Additional Secretary/Admin & HR) to the Fisheries Ministry) covered up the duties as the Chairman from January 01st to 23rd and Prof.Nawarathnarajh functioned as the chairman from 24th January to December2020. Mr.NipunaZoyza (from 01.01.2020 to 30.01.2020), Mr.L.K.T.C.Lokukumara (from 30.01.2020 to 04.11.2020) and Dr H.M.P.Kithsiri(from 01.11.2020 to date) 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

	Name	Division
1	Ms.K.A.W.S.Weerasekara	Environmental Studies Division
2	Mr. N. B. P. Punyadeva	Fishing Technology Division
3	Mr.S.R.C.ranaweera	Hydrographic Division
4	Dr. V. Pahalawattaarachchi 01'01'2020 - 28/10/20 Dr.PrajaniHennatigala(Actg.) 20.10.2020 – 31.12.2020	Inland Aquatic Resources & Aquaculture Division
5	Dr.S.S.K.Haputhantri	Marine Biological Resources Division
6	Dr.K.Arulananthan	National Institute of Oceanography & Marine Sciences
7	Dr.K.W.S.Ariyawansa	Institute of Post Harvest Technology
8	Mr. K. H. M. L.Amaralal	Socio Economics &Market Research Division
9	Mr. A. B. A .K. Gunaratne	Monitoring & Evaluation Division
10	Dr.G.J.GanegamaArachchi	Technology Transfer Division

SUPPORT SERVICES DIVISIONS

Mr.R.D.P.P.Ranasinghe	Administration Division
Mr.N.S.Hewagama	Finance Division
Mr.S.K.S.Liyanaarachchi	Services & Operation Division
M.D.Senarathne 01.01.2020 - 01/10/2020 Ms. K.G.KL.Iranganie(Actg.) 01.10.2020- 31.12.2020	Internal Audit Division

2. RESEARCH HIGHLIGHTS-2020

MARINE BIOLOGICAL RESOURCES DIVISION

The large pelagic and small pelagic databases were updated according to the research work done on the relevant species. Sri Lanka achieved an overall compliance rate of 90 % as a result of complying with the resolutions relating to data submission. The research staff published papers related to the subject and attended 5 virtual conferences of the Indian Ocean Tuna Commission (IOTC) in 2020. In the small pelagic fishery, an increasing trend in the average number of gillnet pieces in a fishing operation had been observed in the West coast fishery. Under this study, the formulation of a Fishery Management Plan for small pelagics in the West coast of Sri Lanka is in progress under the Norwegian technical guidance and a stock assessment for key small pelagic species in the West coast is in progress with the technical support of the World Bank. According to the spiny lobster study the highest percentage of the catch had been represented by *Panulirus homarus*. The female to male ratio of 2.3 revealed that the fishing pressure was high for these species and the spawning potential has been shown to be too low. The study on blue sharks revealed that the sex ratio was 1:1 for the blue shark landings. The demersal finfish study showed that in the Kalmunai fisheries district 14 species of finfish were recorded and the highest percentage (by weight) was represented by *Lethrinus* spp. In addition, in the Tangalle fisheries district 19 species had been identified and the highest percentage was represented by *Lutjanus quinquelineatus*. Genetic analysis carried out with regard to this study identified samples collected as *Lutjanus quinquelineatus* as belonging to the species *Lutjanus rufolineatus* and samples of *Lutjanus fulviflamma* collected as being *Lutjanus johnii*. In the study done on marine mammal interactions and population estimates of blue whale (*B. musculus*), it was shown that 89 blue whale sightings had been recorded in the Mirissa area from January to Mid March 2020 and two areas in the South and East coasts around Mirissa and Trincomalee have been proposed to be declared as protected areas.

Under the Work Package I of the Norway Sri Lanka bilateral project, a sampling strategy with a sampling plan was developed to obtain reliable statistics for the marine fisheries, including coastal fisheries. The tablet application interface for the collection of data was developed based on developed paper sheets and database designs so that data can be entered electronically to the tablets at the landing site itself. The data collection in the marine fishery under the novel sampling programme has been in progress since October, 2020.

The second acoustic survey with RV Samuddrika was conducted on the Northeastern coast in August 2020. The main objective of the acoustic surveys was to establish time series abundance estimates on pelagic resources while producing indices on the status and development of the pelagic fish resources after the continuation of surveying for many years.

INLAND AQUATIC RESOURCES AND AQUACULTURE DIVISION

The IARAD division conducted 13 research & development / inland aquatic resource monitoring projects in 2020. Aquaculture development project of Assessment of fisheries & aquaculture potential in floodplain ecosystem of Nilwala river has identified 20 suitable sites for fish culture development. Experimental reef restoration study conducted with new oyster reefs to enhance the spat availability showed good growth and survival rate during the study period. Survey on natural pearl oyster resource in North West & East coasts revealed that community based pearl oyster farming programme can be easily launch with sea cucumber farmers in the area. Study on seaweed *Kappaphycus alvarezii* (Doty) strains in relation to different environmental conditions disclosed that the direct sea is most suitable to culture this sea weed species and KOH extraction technique was the most suitable method to extract semi refine carrageenan (SRC) from *K. alvarezii*. Application of biofloc technology to enhance production of Guppy (*Poecilia reticulata*) confirmed that this technique can successfully apply to improve the growth performance of male guppy juveniles as well as water quality in culture systems. Further coconut husk media has been identified as the most suitable, low cost, locally available substrate for the hydroponic cultivation of aquatic plant *Anubias barteri* var. *nana* (pertite). As a Biotechnological approach for seaweed

tissue culture, thallus re-generation and growth medium has been developed for the seaweed species *Kappaphycus alvarezii*. By a study conducted on parasitic diseases in ornamental fish culture systems has identified the five common parasites in gold fish and Koi carp culture practices. Study conducted on shrimp luminous disease reported, three vibrio bacteria species as causative agents and low temperature and high salinity as the underline environmental factors for this disease outbreak. Study on traditional fishing activities in Negombo Estuary, Bolgoda Lake, Madu Ganga and Jaffna lagoon revealed the importance of regulating of Ja-kotu fishery through mapping, identification of suitable locations and scientifically determination of appropriate number of Ja-kotu for identified locations. Study conducted on culture based fisheries in Hakwatunawa and Daduruoya reservoirs disclosed that, during the study period Phosphorous values in these water bodies has been exceeded the recommended limits. Ornamental fish feed development project conducted in Panapitiya has developed 03 formulated ornamental fish feed types (Nursery, Grower/02 mm and Grower/5mm). The division generated 12 research publications and conference proceedings for 2020.

FISHING TECHNOLOGY DIVISION

Study of flotsam associated fishery in offshore to introduce management strategies for sustainable fishery

Catch data were collected from Beruwala, Galle, and Tangalle and Kudawella fishery harbors. Length frequencies of Skipjack tuna, Yellowfin tuna, Indian scad, Rainbow runner, rough triggerfish or spotted oceanic triggerfish were taken. When consider about the total catch of ring net fishery, they collect about 71% of target species around and 29% of non-target species. Therefore for the management of ring net fishery recommendations were taken with the participation of offices of Department of Fisheries and Aquatic Resource of Sri Lanka.

Study the fishing efficiency of Monofilament nets comparison with Nylon nets used in inland reservoirs in Sri Lanka.

The research was conducted in selected reservoirs of Southern province, as Muruthawela, Ridiyagama and Kattakaduwa reservoir. According to the convention of the bilateral talks, the mesh sizes was decided, for the research, under three sizes as, 3 ½ inch (3 ½"), 4 ½ inch (4 ½") and 5 inch (5"). The experimental trial fishing conducted and 15 number of fish species, could be identified. Out of total catch, 54.43% by using monofilament nets, while 45.56% of fish had been caught by using nylon nets. According to the total harvest collected from monofilament nets, 83.09% of fish harvest has been collected from 5 inch mesh size monofilament nets. According to the research, for the efficiency & ecofriendly fishing and avoid catching of immature, juvenile fish, monofilament nets, mesh size with 5 inch, can be recommended for the use for fishery in inland reservoirs, especially in water deficient period. It will help to sustainable utilization of reservoir fishery.

INSTITUTE OF POST HARVEST TECHNOLOGY

It was found that under refrigeration condition within 7 hrs core temperature of Skipjack tuna reached to 0°C. Modifications are being carried out by engineers attached to NERDC and 2 boats are being modified. Digital App has been developed for identification of good quality and bad quality (2 grades) of Skipjack tuna fish. Validation of app is in progress. Antibiotic resistance of *E. coli* isolated from shrimp farming system was studied. A total of 67 *E. coli* were isolated and 48 isolates (71.64%) were resistant to at least one drug out of the total number. A high index of resistance to Erythromycin (15µg) 70.15% was reported. In contrast, none of the *E. coli* isolates was resistant to Chloramphenicol (30µg). Multidrug resistance to two or more antibiotics was observed in 24 isolates. Multiple antibiotic resistance index varied within the range of 0 to 0.8 for the antibiotics used. According to microbiological results of oyster growing areas in Negombo areas can be classified as class "B". Microbiological qualities of water in potential sites are not up to required standards and showing the need of depuration before consumption by using very effective system. From the isolated bacterial cultures from Negombo fishery harbor majority (88.8%) were *Pseudomonas* spp. which formed low amounts (less than 30 ppm) of histamine in the broth. *Morganellamorganii* and *E. coli* were isolated from an ice sample collected from fish hold and ice sample

collected from chilled transport vehicle, respectively. This is a good indication that measures should be taken to reduce the bacterial load from direct fish contacting surfaces since they are considered as spoilage bacteria as well. Yellow fin tuna waste (skin and guts) was used as raw materials for protein extraction trials. Raw materials were collected from Jay Sea foods (Pvt) Ltd Negambo. Trials were carried out using commercially available pepsin enzyme and Yellow fin Tuna gut extract. Results of the project indicated that the possibility of extraction of 12 % protein using commercially available pepsin enzyme and 7 % of protein using Yellow fin Tuna gut extract. When the production of vegetarian sausages 50% mushroom and 30% seaweed mixed sausages was found highest organoleptic and nutrition properties than other sausages. When the production of semi refined carrageenan under different drying method was found highest gel strength, viscosity and yield in method used for drying in solar dryer. Phytochemical profiles of seaweeds and zoochemical profile of marine sponge of *Xestospongia testudinaria* (Barrel sponge) were carried out and bio active compound were identified. Phytochemical analysis shows the presence of alkaloids, tannins, steroids, flavonoids, and carbohydrates, whereas proteins, free amino acids and saponins were found to be absent.

ENVIRONMENTAL STUDIES DIVISION

Throughout 2020, ESD has carried out five major research projects which fall under the category of environmental management, development, and conservation of the fisheries and aquatic resources. During the COVID-19 lockdown period also, rapid assessment surveys were done to identify the prevailing pollution condition of some coastal and inland habitats of Sri Lanka. In addition to that, the division has contributed to the lagoon profiling project that was initiated in July 2019 to prepare the environmental profiles of Jaffna, Chilaw, Arugambay and other major lagoons in Sri Lanka.

Investigation of causes for emergency incidents such as Oil spills, algal blooms and fish kills (Emergency Studies) is one of the major continuous research project coordinated by environmental studies division together with other technical divisions. Main objectives of this project were to identify and investigate the major causes for environmental emergencies and provide recommendation in the form of report, media release, and executive summaries to the relevant authorities. Total of seventeen emergency studies were carried out throughout the year, 2020. Out of these incidents, changes of water quality in different coastal and inland habitats during COVID-19 outbreak, large amount of garbage piled up at Mount Lavinia Beach, color change of sea water in Dehiwala and Agulana area and emergency situation of oil spill happened due to MT New diamond ship burning incident were caused with sensational media headlines. ESD has successfully engaged to resolve those emergencies and provided very informative recommendations to avoid such future incidents.

The study on impact of urban pollution on the water-sediment system of the Hamilton Canal was another important project carried out in order to investigate the pollution effects on water sediment system of the Hamilton canal. The canal has been investigated several times for the water quality and the impact of the anthropogenic activities but not for the planktons and the benthos which can be used to predict the water quality and the sediment composition of the canal. The results revealed that the canal had high BOD and very low DO values, indicating high organic pollution. Ammonia concentration was also higher than the standard limit (0.94 mg/l; CEA 2001) in some sampling events. High EC values (14.5 to 42.6 mS/cm) were observed in March, while relatively low EC levels were observed from June to September (0.056 to 24.1 mS/cm). There were nearly 45 genus of both phytoplankton and zooplankton recorded throughout the study period.

Within the continuous studies, **study of marine litter in coastal areas of Sri Lanka** was initiated with the objectives to identify and classify dumping of plastic and polythene waste inputs and to give recommendations to implement conservation measures to waste management. Therefore, identification of waste input status helps in management and conservation biological and fisheries aspects. For this study, marine debris was surveyed on river discharge outlet, estuary mouths and tourist destination sites as North -Western (Negombo and Chilaw) coastlines and Southern (Bentota and Horawela) river basin during study period from January to December 2020. Marine debris was dumped waste from mainly anthropogenic activities as domestic and boats which mostly comprise of plastic and polythene waste were observed at Negombo sea mouth area. According to the results obtained for the composition of debris by material types showed that the classified by use, packaging material (53%) dominated the debris, followed by

consumer products (17%) and fishing items (24%) plastic bottles (6%), while food wrappers/containers contributed only 5% respectively. Thus, it is recommended to make remedial measure to reduce the debris accumulation on sediment to conserve these valuable coastal habitats.

Identification of most appropriate fresh water fish species as bio-indicators in lower and upper catchments of the Kelani river basin for environmental pollution assessment is another continuous study starting from 2019. The year 2019 mainly covered the studies on upper catchment and 2020 focused on the lower catchment. The main objectives covered were included to identify the collected fish specimens up to the lowest possible taxonomic level, to find out the fish species diversity, relative abundance and species richness for collected species to see their suitability to serve as a biological indicator. Fish identification for the lower and upper catchment of Kelani river basin was completed along with the pollution assessment in the same locations selected. According to the results obtained Mattakkuliya, Thotalaga, Kolonnawa, Ambathale and Kaduwela locations of the lower catchment deviated from the recommended values for nutrients, pH, DO and COD and can be considered as the locations of pollution. Fish species belonged to family cyprinidae were the most abundant and dominant in both catchments. Within the upper catchment having good quality waters in most locations *Rasbora daniconius* showed high frequencies in most of the locations. These species are more frequent in undisturbed areas and could be the positive indicators of ecological integrity. Within the polluted locations *Dawnkinsiasinghala* (Sri Lankan filamented barb) was the most abundant which presence all the polluted locations. Also, *Garraceylonensis* present mostly in clean fast flowing cold waters.

The project of assessment of water pollution status of selected fishery harbours in the southern province of Sri Lanka were started to determination of the current status of water quality in three selected fishery harbours namely Puranawella, Mirissa, and Kudawella. The study was carried out in seven sampling points located within each harbour from February to December 2020 using random sampling techniques and reflected that the organic pollution is pronounced within three harbours and it is indicating the presence of load of organic matter. Disposal of solid wastes including fish offal, food waste and inadequate waste receiving facilities may be the most possible reason to record these high BOD values. The study revealed that, the water quality has been degraded and all three harbours are subjected to severe oil pollution and organic pollution. Hence, this study recommends as to; develop waste receiving facility for all multiday boats in each harbour; implement tight regulations in disposal of solid wastes, waste oil and biological waste including fish offal; introduce proper monitoring programmes to identify harbour pollution and aware the fisheries community on the negative impacts of harbour pollution and contaminated fish consumption.

OCEANOGRAPHY

Dissemination of potential fishing zone forecasting bulletin expanded to wider area, the number of recipients is increased from 250 to 500.

Coastal erosion studies on the west coast from Kalutura to Marawila completed to identify possible measures to ensure coastal stability

Potential sites of offshore sand availability is assessed off the Galle coast to meet the sand requirement for construction industry in the southern Sri Lanka

Procedures are being developed to predict and forecast coral bleaching

Permanent monitoring stations for ocean acidity and sea level are established, a new station is constructed at Point Pedro

Micro plastic contamination in the coastal water was assessed. This indicates that the concentration is high compared to the regional average, and the concentration is been increased over the time.

HYDROGRAPHY

Under the National Charting Programme Hydrographic Surveys were carried out to ensure safe and efficient navigation in Sri Lankan waters. This is a mandatory requirement of fulfilling the obligation of the International Convention for the Safety of Life at Sea (SOLAS).

- ✓ **Coastal Chart “Trincomalee to Kudremalai Point”**
NHO has planned to produce a coastal chart from Trincomalee to Kudremalai Point (Scale-1:300,000) covering about 550 km coastal stretch from East to West of Sri Lanka. Necessary surveys were planned in two phases as Mannar Island and Trincomalee to Point Pedro.
- ✓ **Coastal Chart “Little Basses Reef to Pulmoddai Road”**
Nautical Chart “Little Basses Reef to Pulmoddai Roads” covers 250 km long coastal stretch from South to East of the island. Due to unavailability of RV “Samuddirka”, and COVID-19 pandemic situation of the country is affected for continuing the surveys as planned within this year.
- ✓ **Bathymetric data acquisition for Coastal Chart Weligama to Colombo**
60% of the chart was completed of the planned chart.
- ✓ **An assessment of Tidal asymmetry around the Sri Lankan coastline**
The aim of the study identifies the amphidromic points and their influence to the tidal phenomenon around the coast line of Sri Lanka. A comprehensive regional tidal modelling is expected to carry out encompassing Sri Lanka using existing tidal data. Several new tidal stations will be set-up to validate the model results. The final results will be useful for the tidal datum establishment for hydrographic applications.
- ✓ **Establishment of Database and online data processing unit for crowd sourced bathymetry parallel with the “Sea Bed 2030” global mapping project of General Bathymetric Chart of the Oceans (GEBCO)/ Nippon foundation**
The objective of this project is to map the Indian Ocean using crowd sources bathymetry and maintain and updating the data base and disseminate data for marine management, spatial planning and research in marine geology, ecology and oceanography. This will be a continuation project until 2030. The spatial database interface was generated using ArcGIS platform and model of the surface was created.
- ✓ **Investigating Vulnerability of Coastal Erosion in Kalutara**
This study will be focused on Kalutara and sand dune was an important geographical feature in the area because it protected Kalutara town from sea waves. Seasonal variations of the sandbar were observed for the period of 2005-2017 using Google earth images. Also both the erosion and accretion have to be measured in GIS environment in order to get the relationship with monsoonal periods for decision making relevant to coastal environmental protection and policy planning.
- ✓ **Other Activities**
Surveys also conducted to support public and private Sector involvement in various development activities in Sri Lanka.

SOCIO - ECONOMIC & MARKETING

The Socio-economic and Marketing Research Division conducted 4 research projects in 2020. The project on value chain analysis and performance of Herring and Sardinella fisheries in Sri Lanka was conducted aiming to analyse value chain of Herring and Sardinella fisheries and identify ways to develop the value chain. The study area covered Negombo, Chilaw and Puttalam fisheries districts of West coast of the country. Results verified that both Herring and Sardinella fishery was profitable and the most efficient marketing channel for both Herring and Sardinella fisheries was fishermen to end consumer through the

assembler. Through this channel, price spread (LKR/1Kg), fishermen's share in consumer's rupee (%) and marketing efficiency index were 80, 76 and 3 respectively for Herring and that of for Sardinella were 60, 76 and 2.7 respectively.

The project on analysis on gender role in small scale coastal fisheries (SSF) in Sri Lanka was covered Negombo and Chilaw fisheries districts aiming finding out gender roles and constraints in gender empowerment. Results found that the majority of fisherwomen in Chilaw (40%) involved in dry fish processing activities. Though seagoing was male dominated about 27 and 40% fisherwomen in Chilaw and Negombo supported them as unpaid workers respectively. Results further revealed that over 80% of fisherwomen contributed in household decision making. Continuous reduction in fish harvest, damage caused in fishing nets and higher cost of fishing gear were major constraints faced by fishermen while lack of recognition in women's work, lack of opportunities in participating in resource management, differences in wages, lack of time for economic activities due to household chores as well as social and cultural pressures were for fisherwomen.

The project on identification of socio-economic benefits of Marine Protected Areas (MPAs) in Sri Lanka was conducted in Kayankerni reef which was declared as a natural sanctuary in 2019. Results found that fishing was the major activity in the sanctuary but tourism was emerging as an economic activity around the area. The daily income of fishing was often fluctuated and ranged 1000 to 5000 rupees. Bottom set net and dynamite- fishing, lack of knowledge of local tourists on importance of the reef were threatening factors the reef in the sanctuary and lack of monitoring and coordination activities among stockholders was also found negatively influenced for the health of the reef.

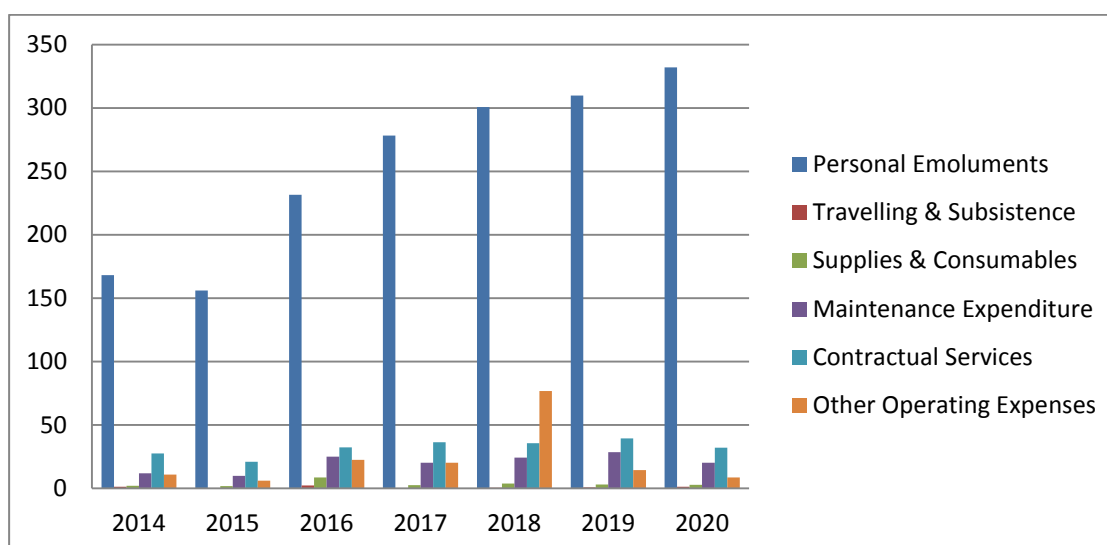
The project on dissemination of information through the fisheries information centre (FIC) of NARA had received a total number of 144 queries through the hot line of 07 10 10 10 10 of the fisheries information Centre from different stakeholder and general public and all queries were successfully resolved. Due to pandemic the total number of queries were relatively lower compared to previous years.

3. FINANCIAL HIGHLIGHTS

RECURRENT EXPENDITURE

Rs. Million

Description	2014	2015	2016	2017	2018	2019	2020
Personal Emoluments	168.164	156.053	231.524	278.110	300.533	309.714	331.910
Travelling & Subsistence	1.250	0.248	2.300	0.298	0.406	0.747	1.179
Supplies & Consumables	2.074	1.576	8.525	2.366	3.760	3.025	2.665
Maintenance Expenditure	11.879	9.871	24.850	20.133	24.059	28.535	20.114
Contractual Services	27.433	20.874	32.250	36.211	35.635	39.310	32.047
Other Operating Expenses	10.814	6.016	22.450	20.091	76.583	14.222	8.396
Total Rs. Million	221.614	194.638	321.899	357.209	440.976	395.55	396.311

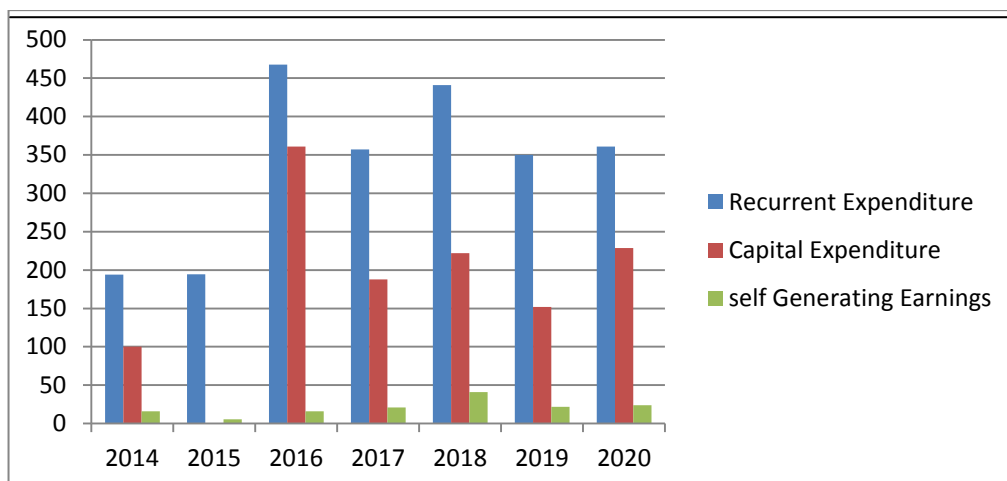


Due to restriction of treasury funds, considerable amount has been decreased for other recurrent expenditure except personal emoluments.

ESTIMATE BUDGET

Rs. Million

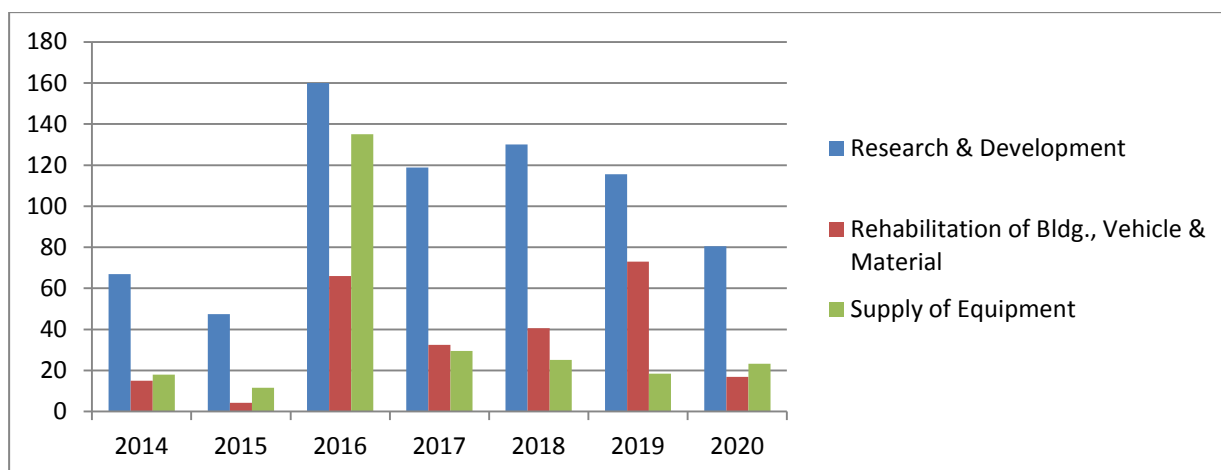
Description	2014	2015	2016	2017	2018	2019	2020
Recurrent Expenditure	194.260	194.638	467.598	357.209	440.970	350.000	360.905
Capital Expenditure	100.100	0.248	361.000	188.000	222.000	152.000	228.600
self Generating Earnings	16.060	5.370	16.000	20.810	40.814	21.678	23.900
Total Rs. Million	310.420	200.256	844.598	566.019	703.784	523.67	613.405



CAPITAL EXPENDITURE

Rs. Million

Description	2014	2015	2016	2017	2018	2019	2020
Research & Development	67.000	47.464	160.000	118.829	130.047	115.538	80.482
Rehabilitation of Bldg., Vehicle & Material	15.000	4.358	66.000	32.456	40.590	72.94	16.923
Supply of Equipment	18.000	11.602	135.000	29.530	25.173	18.477	23.346
Total Rs. Million	100.000	63.424	361.000	180.815	195.810	206.95	120.751



Expenditure for Research & Development has been decreased than previous year. Expenditure for Rehabilitation of building and rehabilitation of vehicle has been decreased and supply of equipment has been increased than 2019.

4. HUMAN RESOURCES INFORMATION

RECRUITMENTS

No	Name	Designation	Permanent/ Contract/ Casual	Date of Appointment
01	Prof. A. Nawarathnaraja	Chairman	Contract	28/01/20
02	Mr. L.K.T.C. Loku Kumara	Director General	Contract	30/01/20
03	Mr. P.V.A.J. Wijenath	DG's Driver(Temporary Basis)	Contract	10/02/20
04	Mr. J.G.K.A. Jayasinghe	Helper	Contract	02/03/20
05	Ms. K.M.B.P. Prabha Kalaotuwawe	Scientist	Permanent	20/08/20
06	Mr. N.K.R. NirangaJayawardhena	Scientist	Permanent	20/08/20
07	Ms. ShynugaThirukeswaram	Scientist	Permanent	20/08/20
08	Ms. P. A. M.JayahansiWijepala	Scientist	Permanent	20/08/20
09	Ms. K.H.K.LakmaliPiyasiri	Scientist	Permanent	20/08/20
10	Ms. M. .MihiraniSubasinghe	Scientist	Permanent	20/08/20
11	Mr. A. M.C.Pradeep Kumara	Scientist	Permanent	20/08/20
12	Ms. MythilyPanchalingam	Scientist	Permanent	20/08/20
13	Ms. N. P. H. Deepa Kumari	Scientist	Permanent	20/08/20
14	Ms. B.M.L.Perera Jayasekara	Scientist	Permanent	20/08/20
15	Ms. G.K.A. Wathsala Fernando	Scientist	Permanent	20/08/20
16	Ms. H.M. UdariAyeshya	Scientist	Permanent	20/08/20
17	Ms. L. Dilukshani Gayathri	Scientist	Permanent	20/08/20
18	Mr. M. PramodyaHendawitharana	Scientist	Permanent	20/08/20
19	Mr. K. WeligamagelIndika	Scientist	Permanent	20/08/20
20	Ms. A. K. I. UmejyaKapuge	Scientist	Permanent	20/08/20
21	Mr. H. S. DamithPerera	Scientist	Permanent	20/08/20
22	Ms. N.G. L. NadeeUthpala	Scientist	Permanent	20/08/20
23	Mr. W. N. D. SandaruwanJayarathne	Scientist	Permanent	20/08/20
24	Ms. W.A.A. Menaka Bandara	Scientist	Permanent	20/08/20
25	Ms. S.H. UdeshikaChathurani	Scientist	Permanent	20/08/20
26	Ms. H. C. Chalanika De Silva	Scientist	Permanent	20/08/20
27	Ms. J. M.N. MadushaniJayasundara	Scientist	Permanent	20/08/20
28	Mr. RatnavelSrikrishnan	Scientist	Permanent	20/08/20
29	Mr. SanthalingamThanusanth	Scientist	Permanent	20/08/20
30	Ms. W. K.A.M.T. SachiyhrangiAththanayaka	Scientist	Permanent	18/09/20
31	Mr. S.K. Sameera Premarathna	Scientist	Permanent	21/09/20
32	Ms. R. A. S.Sewwandi Ranasinghe	Scientist	Permanent	21/09/20

DEPARTURES

No	Name	Designation	Permanent/ Contract/ Casual	Departure Date	Reason
01	Ms. DilukshiniLawrance	Helper	Permanent	16/01/20	Resigned
02	Ms. G.L.A. Subhashini	Research Assistant	Permanent	21/01/20	Resigned
03	Mr. S.G. Prashantha	Helper	Permanent	24/01/20	Resigned
04	Mr. Sarath Ekanayake	Driver	Daily Basis	30/01/20	Contract Ended
05	Mr. D.G.N.M.W. De Soysa	DG	Contract	30/01/20	Contract Ended
06	Mr. H.A.P. Madushanka	Helper	Permanent	04/03/20	Resigned
07	Mr. U.K.I. Damayanthi	DO	Permanent	06/03/20	Resigned
08	Mr. P.S. Ranaweera	Technical Officer- (Electronic)	Permanent	07/03/20	Retired
09	Mr. G.R Samaraweera	Management Assistant (Non -technical)	Permanent	09/03/20	Retired

10	Mr. S.S.P. Samaranayake	Management Assistant (Non -technical)	Permanent	10/03/20	Resigned
11	Mr. H.D.C. Prasanna	Research Assistant	Permanent	20/08/20	Resigned
12	Ms. M.D. Senarathne	Internal Auditor	Permanent	01/10/20	Resigned
13	Mr. J.B. Alahapperuma	Development Officer	Permanent	01/10/20	Resigned
14	Mr. A.P. Somasiri	Driver	Permanent	05/10/20	Retired
15	Mrs.V. Pahalawaththarachchi	Principle Scientist (Inland Aquatic Resource)	Permanent	28/10/20	Retired
16	Mr. R.A.M. Jayatilake	Scientist	Permanent	30/10/20	Resigned
17	Mr. L.K.T.C. Lokukumara	Director General	Permanent	04/11/20	Resigned
17	Mr. W.W.A. Botheju	Helper	Permanent	02/11/20	Retired
18	Mr. P.D.G. Thilakarathne	Driver	Permanent	11/11/20	Retired
19	Mr. T.H. Dharmasena	Skilled Labour	Permanent	12/11/20	Retired
20	Mrs. S.L. Lakmali Fernando	Management Assistant (Non -technical)	Permanent	31/12/20	Resignation

LOCAL TRAININGS

	Name	Date	Course	Venue	Amount
01.	Dr.A.A.D. Amarathunga/ Senior Scientist	21.01.2020	1 st International Conference on Resource Efficiency and Circular Economy	National Cleaner Production Centre	7500.00
02	Ms.M.D.S.R. Maddumage/ Scientist	21.01.2020	1 st International Conference on Resource Efficiency and Circular Economy	National Cleaner Production Centre	7500.00
03.	Ms.M.R.C.N.K. Narangoda/Scientist	21.01.2020	1 st International Conference on Resource Efficiency and Circular Economy	National Cleaner Production Centre	7500.00
04.	Mr.M.G.C.R. Wijesinghe/Scientist	21.01.2020	Training on ISO/ IEC 17025:2017 Internal Auditing of laboratory Management System	Sri Lanka Accreditation Board	18000.00
05.	Mr.M.P.Hendawitha rana/ Scientist	28.09.2020 & 05.10.2020	Short Course Introduction to R	Institute of Applied Statistics Sri Lanka	10000.00
06.	Ms.H.M.U.Ayeyshya / Scientist	28.09.2020 & 05.10.2020	Short Course Introduction to R	Institute of Applied Statistics Sri Lanka	10000.00
07.	Ms.M.G.A.K. Fernando/Scientist	28.09.2020 & 05.10.2020	Short Course Introduction to R	Institute of Applied Statistics Sri Lanka	10000.00
08.	Ms.L.D.Gayathry/ Scientist	28.09.2020 & 05.10.2020	Short Course Introduction to R	Institute of Applied Statistics Sri Lanka	10000.00
09.	Mr.K.G.S.Nirbadha/ Scientist	16-18.09.2020	Training on ISO/ IEC 17025:2017 Internal Auditing of laboratory Management System	Sri Lanka Accreditation Board	18000.00
10.	Ms.K.H.K.LakmaliPiy asiri/ Scientist	16-18.09.2020	Training on ISO/ IEC 17025:2017 Internal Auditing of laboratory Management System	Sri Lanka Accreditation Board	18000.00
11.	Ms.M.MihiraniSubas inghe/ Scientist	16-18.09.2020	Training on ISO/ IEC 17025:2017 Internal Auditing of laboratory Management System	Sri Lanka Accreditation Board	18000.00

FOREIGN TRAININGS

No	NAME & DESIGNATION	COUNTRY	PURPOSE	PERIOD
01	Mrs. K.H.K. Bandaranayake Senior Scientist	Malta	International Winter Course	06.01.2020 16.01.2020
02	Mr. K.G.S. Nirbadha Scientist	Netherlands	Training on Sponge Taxonomy and Phylogenetics	04.02.2020 04.03.2020
03	Mr. K.P.G.L. Sandaruwan Scientist	Australia	IORA Blue Carbon Hubin Perth Australia under the Management of the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO)	08.03.2020 13.05.2020
04	Mrs. H.P.D.A.Lakmali Scientist	Norway	Msc - International Fisheries Management (IFM)	18.10.2020 30.06.2022
05	Mr. P.A.D.A. Kumara Senior Scientist	India	AARDO CMFRI Online Workshop – Cum Training Programme on Fisheries and Aquaculture	28.10.2020 06.11.2020
06	Mr. P.A.D.A. Kumara Senior Scientist Mr. C.B. Medagedara Scientist	China	ONLINE TRAINING ON MARICULTURE TECHNOLOGIES FOR THE ASIA – PACIFIC REGION	21.09.2020 25.09.2020
07	Mrs. P.A.M.J. Wijepala Scientist	Malaysia	CHALLENGES AND OPPORTUNITIES IN TECHNOLOGY TRANSFER & COMMERCIALISATION FOR DEVELOPING COUNTRIES (ONLINE)	24.11.2020 25.11.2020
08	Mr. S.R.C. Ranaweera Chief Hydrographer	Monaco	02 ND SESSION OF THE IHO ASSEMBLY (DIGITAL EVENT)	16.11.2020 18.11.2020

PROMOTIONS 2020

No	Name	Previous Designation	Current Designation	Permanent/ Contract/ Casual	Date of Promotion
01	Ms. Kalani Priyanwada	Research Assistant III	Research Assistant II	Permanent	08/02/20
02	Ms. L.V.D. Wayanthi De Mel	Management Assistant III	Management Assistant II	Permanent	08/02/20
03	Ms. S.S.G. Nelumdeniya	Management Assistant III	Management Assistant II	Permanent	08/02/20
04	Mr. M.A.N. De Silva	Management Assistant III	Management Assistant I	Permanent	08/02/20
05	Ms. P.A.M. JayasaniWijepala	Research Assistant	Scientist	Permanent	20/08/20
06	Ms. S.H.U. Chathurani	Research Assistant	Scientist	Permanent	20/08/20
07	Mr. K.W. Indika	Lab Attendant	Scientist	Permanent	20/08/20

UNFILLED VACANCIES

1.	Deputy Director General (R&D)	1
2.	Principal Scientist (Inland Aquatic Resource)	1
3.	Senior Scientist	4
4.	Senior Hydro Graphic Surveyor	1
5.	Deputy Hydrographer	1
6.	Scientist	17
7.	Sociologist	1
8.	Economist	1

9.	Senior Cartographer	1
10.	Data Analyst	1
11.	Asst. Director (Service & Operation)	1
12.	Asst. Director (Admin)	1
13.	Asst. Director (Information Technology)	1
14.	Senior Extension Officer	1
15.	Internal Auditor	1
16.	Assistant Director (Vessel Operation & maintenance)	1
17.	Cartographer Data Analyst (Nautical)	1
18.	System Analyst /Programmer	1
19.	Skipper	1
20.	Diving Officer	1
21.	Translator	3
22.	Development Officer (Project)	11
23.	Assistant Network Administrator	1
24.	Field Research Assistant	5
25.	Research Assistant	40
26.	Cartographic Draughtsman	2
27.	Coxswain	1
28.	Head Driver/Marine	1
29.	Engineering Artificer	1
30.	Multi Media Designer	1
31.	Management Assistant (Transport)	1
32.	Diver	3
33.	Diver Assistant	1
34.	Technical Assistant (Civil)	1
35.	Technical Assistant (Electrical)	1
36.	Management assistant(Library)	1
37.	Ocean Observation Technician	1
38.	Assistant Skipper	1
39.	Geological information System Technician	1
40.	Radio Officer	1
41.	Management Assistant	11
42.	Hydrographic Assistant	1
43.	Boatswain	1
44.	Book-Binder	1
45.	Plumber	1
46.	Mason	2
47.	Motor Mechanic	2
48.	Driver	7
49.	Boat Operator	1
50.	Deck Hand	1
51.	Marine Mechanic	1
52.	Video Editor	1
53.	Lab Attendant	2
54.	Caretaker/Cook	2
55.	Helper	9
56.	Survey Helper	1

COURT CASES

I. Cases Filed Against the Agency in the Labour Tribunal Colombo

No	The Case Number	The Applicant	The Respondent	Labour Tribunal	The Last Date Was Called the Case	Present Status
01	Case No. LT/M/26/48/2019	WarnakulasuriyaG ordiyage Jayaratne	National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Matara Labour Tribunal	26.11.2020	The case has being hearing. The next date is 19.01.2021.

II. Cases Filed Against the Agency in the Sri Lanka - Human Rights Commission

No	The Case Number	The Complainant	The Respondent	The Last Date Was Called the Case	Present Status
01	HRC/MT/127/17/5	Mr.J.B.Alahahapperuma No-08, MudalindhaPiriwena Road, Heennatiya, Matara.	Chairman, National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	18/04/2017	The inquiry has completed. Recommendations have not yet been received from Sri Lanka Human Rights Commieion.
02	HRC/3222/16	01. Mr.A.A.Suresh 02. Mr.R.C.C.Perera	Director General, National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	27/04/2017	The recommendation of the Sri Lanka Human Rights Commission has not been received
03	HRC/3573/17	Mr.D.D.P.L.Dahanaya ke No- 120, Palliya Road, Brandiyamulla, Gampaha	Chairman, National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15 Director General, National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	02/10/2020	The cases has postponed due to the COVID- 19 pandemic until further notice.
06	HRC/4443/16	Mr. R.D.P.P Ranasinghe No.248 D, Meegodamulla, Kotugoda	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Restated the service of applicant therefore, the case file was closed.	Case was over.

07	HRC/3432/19	Ms. P.S Jayasinghe 26/2 B, Henawatta, Meegoda	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	21.09.2019	The Cases has postponed due to the COVID- 19 pandemicuntil further Notice.
08	HRC/3562/19	Mr. P.A.D. Ajith Kumara 104B, Hapugahagama Road, Barawavila, Diulapitiya.	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	03.02.2020	The Cases has postponed due to the COVID- 19 pandemicuntil further Notice.
09	HRC/3561/19	Mr. N.B.P Punyadewa 447/1 B, Walgama, Kottawa Road, Aturugiriya	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	28.02.2019	The Cases has postponed due to the COVID- 19 pandemicuntil further Notice.
10	HRC/3713/19	Ms. A.A.S.H Athukorala, No.410/F, Jayamawatha, PolpitiMookalana, Kadana.	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	28.02.2019	The Cases has postponed due to the COVID- 19 pandemicuntil further Notice.
11	HRC/3948/20 19	Ms. V.K.G. Jayasena, No.58/18, IsuruUyana, Sooriyapaluwa, Kadawatha	Chairman National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	The notice has not been received for the inquiry by the Sri Lanka Human Right Commissio n.	.

III. Cases filed by the National Aquatic Resources Research and Development Agency (NARA) in the District Court Colombo

No	The Case Number	The Plaintiff	The Dependent	District Court	The Last Date Was Called the Case	Present Status	Remarks
01	Case No- DMR/3930/2 010	National Aquatic Resource Research & Development Agency, Crow Island, Mattakkuliya, Colombo 15	Dr. N.H Dasanayeka	Colombo District Court	15.03.2019	The first defendant of the case has entered into a settlement with NARA to pay bond value of Rs. 5.932.721/= within five years. The Governing board has approved the	Entered into a settlement with the first defendant.

						proposed settlement of the first defendant. Accordingly the case has laid down until the first defendant settle the Bond value of Rs. 5,932,721 / =. If the first defendant defaults on the settlement, NARA will have to take steps for reopen the case.	
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WELFARE ACTIVITIES

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

5. RESEARCH DIVISIONS

5.1 ENVIRONMENTAL STUDIES DIVISION

Head of the Division: Mrs. K.A.W. S. Weerasekara

Overview of the year

The Environmental Studies Division (ESD) has involved in research since the beginning of NARA in 1986. As a small unit, ESD started with only three officers. The division holds major responsibility to contribute to the conservation and management of fisheries and aquatic resources. Thus, it focuses in researches related multiple aspects of environments such as water quality, aquatic ecology, eco-toxicology, water pollution and environmental assessments. Further, scientists in ESD not only undertake research but also develop novel technology, perform analysis to understand the different ecosystems at the environment-human interface and the consequences of pollution in Aquatic resources. Over the past years, ESD has expanded its potential in wide range of environmental expertise and has become one of the major divisions of NARA that conducts valuable environmental studies in Sri Lanka.

Today the division provides a comprehensive range of environmental monitoring and consultancy services to help industries, developers, businesses, and government authorities to fulfill their legal obligations in terms of Environmental Impact Assessments (EIA), Initial Environmental Examination (IEE), and feasibility studies and to comply with environmental regulations. The expert research team of ESD provides island-wide research coverage and services including site investigation, sampling and analysis, stakeholder discussions, monitoring and evaluation, and consultancy.

Currently, our divisional staff body consists of one principle scientist (Head of the division), one senior scientist, and ten scientists that involve in research activities and take part in other major tasks. In addition, one scientist is on study leave for her Ph.D. Further, two laboratory assistants and an office helper have involved in supporting the team of scientists in sampling, field visits, and laboratory analysis.

Throughout 2020, ESD has carried out five major research projects which fall under the category of environmental management, development, and conservation of the fisheries and aquatic resources. During the COVID-19 Lockdown period also, rapid assessment surveys were done to identify the prevailing pollution condition of some coastal and inland habitats of Sri Lanka. In addition to that, the division has contributed to the lagoon profiling project that was initiated in July 2019 to prepare the environmental profiles of Jaffna, Chilaw, Arugambay and other major lagoons in Sri Lanka. This was mainly coordinated by the Marine Biological Resources Division (MBRD) of NARA to contribute to the development of fisheries industry in Sri Lanka. Overall, the ESD attributed to the success of NARA in many ways as a major research institution of Sri Lanka.

Programme		Project		Budget	Responsible officers	Period	
No	Category	No	Title	Rs.Mn		From	To
1	Management, Development and Conservation of the fisheries and Aquatic resources	5.1	Investigation of causes for emergency incidents such as Oil spills, algal blooms and fish kills	1.2	Mrs K.A.W.S Weerasekara Dr. A.A.D Amaratunga Mrs B.R.C Mendis Mrs M.D.S.R Maddumage Mrs J.K.P.C Jayawardane Mrs S.R.C.N.K Narangoda MsK.M.B.P.PKalaotuwawe Mr N.K.R.N Jayawardane Ms S.Thirukeswaran Mr. S.K.S.Pemarathne	Jan 2020	Dec 2020
2	Management, Development and Conservation of the fisheries and Aquatic resources	5.2	The study on impact of urban pollution on the water-sediment system of the Hamilton Canal	0.5	Mrs M.D.S.R Maddumage Mrs. J.K.P.C Jayawardane Mrs. S.R.C.N.K Narangoda Mrs. K.A.W.S Weerasekara Dr. A.A.D. Amaratunga	Jan 2020	Dec 2020
3	Management, Development and Conservation of the fisheries and Aquatic resources	5.3	The study of Marine litter in coastal areas of Sri Lanka (Continuous Project)	0.43	Mrs. B.R.C Mendis Dr. A. A. D. Amaratunga	Jan 2020	Dec 2020
4	Management, Development and Conservation of the fisheries and Aquatic resources	5.4	Identify the most appropriate fresh water fish species as bio-indicators in Kelani river basin for Environmental Pollution Assessment (Continuous Project)	0.47	Mrs.S.R.C.N.K. Narangoda Dr.A.A.D.Amaratunga Mrs.K.A.W.S. Weerasekara Mrs.M.D.S.R. Maddumage Mrs. J.K.P.C. Jayawardane	Jan 2020	Dec 2020
5	Management, Development and Conservation of the fisheries and Aquatic resources	5.5	Assessment of Water Pollution Status of Selected Fishery Harbours in the Southern Province of Sri Lanka (Hambanthota, Tangalle, Mirissa, Kudawalla, Dewundara)	0.57	Mrs.K.A.W.S. Weerasekara Dr.A.A.D.Amaratunga Mrs.W.K.Suwandhahannadi Mrs.M.D.S.R.Maddumage Mrs.S.R.C.N.K.Narangoda	Jan 2020	Dec 2020

PROJECT No : 5.1

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

Environmental emergency incidents including sudden occurrence of fish kills, oil spills, pollution of water bodies with toxic substances, and algal blooms are very prevalent in the aquatic environments of Sri Lanka. These kinds of incidents were reported mostly with sensational media headlines and mass public protests. Their impacts can be inevitable and long lasting, and it is our utmost responsibility to prevent them from reoccurring and deal with them effectively when they occur.

NARA receives information regarding emergency incidents through different source of information such as public, media, and relevant authorities. And NARA receives many requests from the public, different parties including government institutions to investigate and provide scientific reports based on the site inspection, field investigation, and laboratory analysis to reduce the negative impacts. Officers belong to other divisions of NARA such as IARAD, IPHT, MBRD and FTD also collaborate with ESD during the field investigations and reporting depending on relevancy.

Main objectives of this project was to identify and investigate the major causes for environmental emergencies and provide recommendation in the form of report, media release, and executive summaries to the relevant authorities. Total of seventeen emergency studies were carried out throughout the year, 2020. The summary of each incident is provided in the below mentioned table.

No	Date of Investigation	Incident	Causes of the emergency situation	Output
1	11 th Feb 2020	Fish kill at Beira Lake (Cinnamon Lake Hotel)	Cause of the situation was found to be reduction in DO due to increased sediment load and eutrophic condition.	Report including recommendations was provided to the relevant authority
2	March and July, 2020	Study of the distribution and impacts of the stake net (ja-kotu) fishery in Trincomalee district	To identify the present trend in stake net fishery, density and distribution of stake nets and their impacts on environment and fisheries aspects in Trincomalee district, Sri Lanka.	It is recommended to continue the study during the peak season for different species in order to identify the density and distribution thus the impacts of stake net fishery in Trincomalee district.
3	29 th Apr 2020	Changes of water quality in Kelani river during COVID-19 outbreak	Quality of water in Kelani river had improved due to the reduction of human activities and disposal of industrial effluents during national lockdown.	A report was submitted to relevant authorities

4	13 th May 2020	Coastal water monitoring study in the western and southern coastal stretch	Quality of water in western and southern coastal stretch had improved due to the reduction of human activities and disposal of industrial effluents during national lockdown	According to the Physico-chemical analysis of coastal waters, it can be concluded that coastal water is good for fish and aquatic life
5	13 th May 2020	Water quality analysis of some selected locations of Western and southern coast	Quality of water in western and southern coast had improved due to the reduction of human activities and disposal of industrial effluents during national lockdown	Coastal water is good for fish and aquatic life. However, since the present study is a one-time analysis, a better conclusion about the west and south coastal waters may be determined by long-term research
6	8 th Jun 2020	Large amount of garbage piled up at Mount Lavinia Beach	Cause of the situation was found to be either changes in wind direction and sea water movements or man imposed factors.	Field investigation was done and the report was submitted to relevant authority
7	7 th /9 th Jul 2020	Fish mortality in Seeduwa	Cause of the situation was found to be oxygen depletion due to high concentration of organic pollutants and sediment load caused by heavy rainfall.	Investigation report with recommendations were provided to the relevant authorities.
8	23 rd Jul 2020	Fish kill in Bolgoda lake	Cause of the situation was found to be sudden adverse changes in the water due to heavy rainfall	Field investigation was done and the report with recommendations was submitted to relevant authority
9	12 th Aug 2020	Fish kill in Main pond of Waters Edge, Battaramulla	Fish mortality was suspected to be occurred due to the poor quality or toxic condition due to inclusion of chlorine-based disinfectants in the water	Investigation report with recommendations were provided to the relevant authorities (Management of Waters Edge).
10	31 st Aug 2020	Colour change of sea water – Dehiwala and Agulana	Cause of the situation was found to be the presence of single cell diatom called <i>Navicula sp.</i> , in high population	Field investigation and laboratory analysis were done and a report was submitted to the ministry of fisheries

			density, according to the microscopic examinations.	with English and Tamil translations. An Article for the “Oruwalla” newspaper was submitted, several voice records were given for the different television and radio. Recommendation was provided to implement relevant mechanisms to remove algal blooms.
11	Sep 2020	Emergency situation of oil spill happened due to MT New diamond ship burning incident	Emergency oil spill situation	Information and reports were submitted to the Marine Environment Protection Authority (MEPA) for assessing the economic cost due to environmental damage for necessary legal actions.
12	22 nd Sep 2020	Fish kill at MinneriyaWewa	Cause of the situation was not identified since the investigation was done 3 weeks after the incident happened.	Report was submitted to the National Aquaculture Development Authority (NAQDA) with recommended to send the fish samples to ITI for further analysis.
13	Sep 2020	Dead turtles washed ashore in Mt Lavinia Beach		Report with possible causes for the turtle mortality was submitted to general Manager/MEPA
14	1 st /2 nd Oct 2020	Current fisheries and socioeconomic status of stake-net (Ja-Kotu) fishery in Mannar	Gillnet fishers in the Vankalai area of Mannar claimed that their fishing activities are affected by stake-net fishing	This study was done by MBRD and recommended to remove stake nets placed in the area while introducing plausible alternative livelihood for stake-net fishers who are willing to exit from the fishery

15	22-24 Oct 2020	Research on Fyke Net and other fishing methods commonly used in Kokilai Lagoon was conducted with the participation of NARA officials and members of the Sinhapura Lagoon Management Committee.	To identify the fishing methods and fish caught in the nets.	recommend, not using trap fishing in the Kokilai lagoon ecosystem, removal of fishing nets from the Kokilai Lagoon ecosystem, especially the so-called cross nets, the use of eco-friendly methods such as caramel nets and crab traps that can be used in lagoon ecosystems, the assistance of the Navy as necessary to prevent the use of prohibited methods in the lagoon, conducting a detailed study in this regard.
16	Nov 2020	Mass whales stranding at Panadura and Wadduwa Beaches	The actual causes of the situation were not identified.	Field investigation and submission of summary reports with collaborations with MBRD to related institutions.
17	16 th Dec 2020	Post-impact of the New diamond Oil spill on gills and liver of two common fish species	To identify the impact on gills and liver tissues of those fish species, a histological study should be done.	The study was done by MBRD and the collected samples were handed over to the faculty of fisheries and Marine Sciences & Technology, University of Ruhuna for histological testing. Analysis will be done after receiving the histological study results.

Photographs of garbage piled up incident in Mount Lavinia beach (8th June 2020)

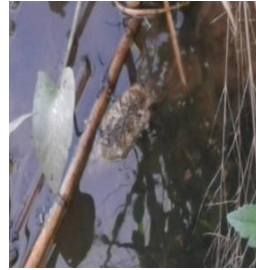


Collected waste



sorted out the collected garbage

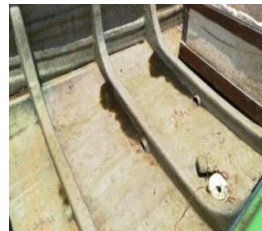
Photographs of dead fish observed during site visit of Seeduwa (9th July 2020)



Photographs taken during the site investigation of fish kill study in Minneriyawewa (22nd September 2020)



Photographs taken during the field investigation from the study of color change of sea water at Dehiwala and Agulana (31st August 2020)



Photographs taken during the field visit of fish kill study at Bolgoda lake (23rd July 2020)



Discussion with local people

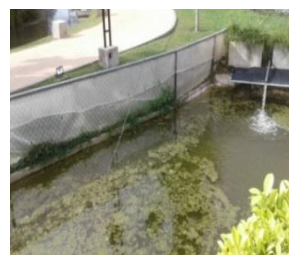


Dead Prawn collected from the canal

Photographs taken during the field visit of fish kill investigation at Waters edge (12th August 2020)

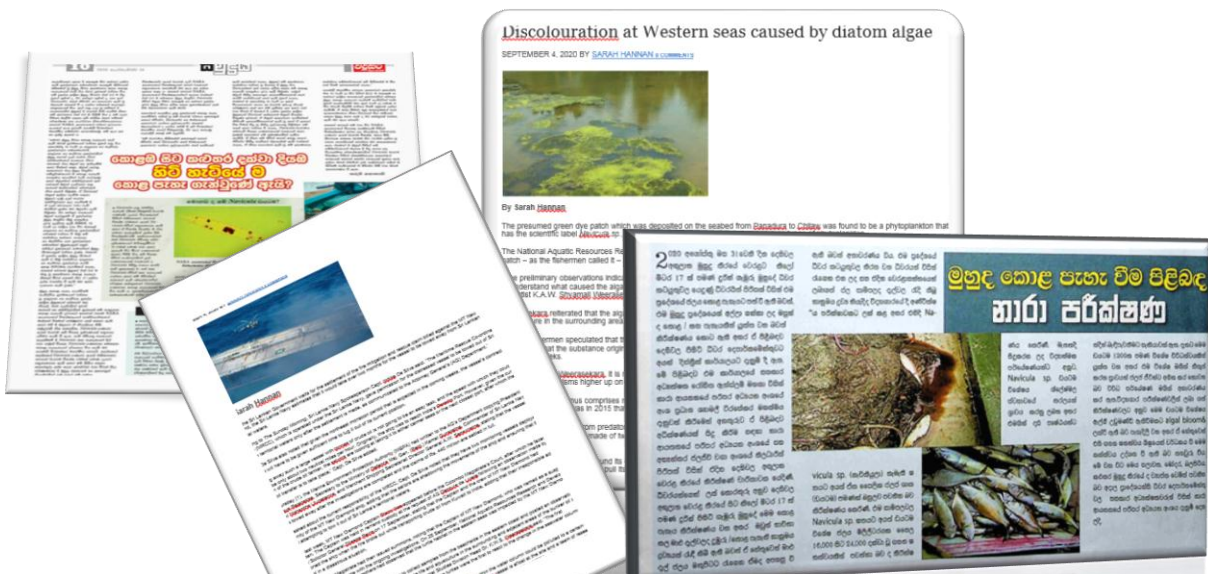


Dead fish found in the pond



algal bloom was found in the pond

Photographs taken during the field visit of whale stranding incident in Panadura Beach News coverage of emergency studies done by ESD



References of News articles

- Oruwalla Newspaper, September 2020, Published by the Ministry of Fisheries and Aquatic Resources
- The Sunday Times News Paper, 13th September 2020, Published by the Wijeya newspapers limited
- The Sunday Times News Paper, 27th September 2020, Published by the Wijeya newspapers limited
- http://www.themorning.lk/pdf/TheMorning_September4th.pdf
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PROJECT No :5.2

THE STUDY ON IMPACT OF URBAN POLLUTION ON THE WATER-SEDIMENT SYSTEM OF THE HAMILTON CANAL

This study investigated the pollution effects on water sediment system of the Hamilton canal. It is a manmade canal, located parallel to the western coast line of Sri Lanka which connects Kelani River mouth and Negombo Estuary. Another section of the canal is lengthening from the sea mouth of Negombo estuary to Maha Oya river mouth. Water quality and biological resources in the canal is highly influenced by the anthropogenic activities as well as the hydrological processes of the Kelani-Maha Oya estuaries and Negombo lagoon estuary. The bank of the canal is populated mostly by fishing community, and many fishing boats are anchored. There are sub-surface drains as well as several sub canals coming from land side connecting to the canal. Several industrial factories and organizations also located bordering the area including Kerawalapitiya Industrial Zone, and Ceylon Petroleum Storage Terminal Limited - Muthurajawela. The canal has been investigated several times for the water quality and the impact of the anthropogenic activities but not for the planktons and the benthos which can be used to predict the water quality and the sediment composition of the canal. Therefore, the present study focused on measuring selected physicochemical parameters as well as the diversity and density of plankton and benthos. The 20 sampling sites were selected in January to cover both sections of the canal. Field sampling was carried out in March and June to September. Although a monthly sample was proposed, sampling could not be carried out for several months due to the Covid-19 pandemic.

According to the results, pH of the samples varied from 5.78 to 8.19 and, the mean value was 7.08. DO concentration in the canal was significantly low in most of the sampling locations and varied between 0.43 - 6.34 mg/l and, the mean was 2.69 mg/l. Therefore, DO concentration in the canal is below the standard limits (3 mg/l, min) for fish and aquatic life given in CEA, 2001 ambient water quality standards. BOD is also significantly higher, ranging from 0.9 to 22.0 mg/l and, the median is 7.7 mg / l. The standard limit of BOD for fish and aquatic life is a maximum of 4 mg / l thus average BOD concentration in the Canal was very high, indicating high organic pollution. Further, Ammonia concentration ranged between 0.01 to 3.09 mg/l with an average 0.77 mg/l and dissolved phosphate concentration varied between 0.01 - 0.45 mg/l with an average of 0.14 mg/l. Ammonia concentration also higher than the standard limit (0.94 mg/l; CEA 2001) in some sampling events. High EC values (14.5 to 42.6 mS/cm) were observed in March, while relatively low EC levels were observed from June to September (0.056 to 24.1 mS/cm). Therefore, in the Southwest monsoon, freshwater discharge from Kelani Ganga and Maha Oya influences the EC and salinity in the Canal. Further, the turbidity of the canal was varied from 13.3 to 49.4 NTU during the study period. Ammonia and phosphate concentrations in the canal showed quite high concentrations.

Plankton and benthic macro-invertebrate were observed at several selected locations along the canal. There were nearly 45 genus of both phytoplankton and zooplankton recorded throughout the study period. Species that are found in both freshwater and marine environment were present. Most abundant phytoplankton genus was *Peridinium* sp. (Dinoflagellate) followed by *Closterium* sp., *Cyclotella* sp., *Chaetoceros* sp. and *Staurestrum* sp. while most abundant zooplanktons were Copepods. Also, considerable amount of cyanobacteria species were also present i.e. *Microsystis* sp., *Anabaena* sp., *Euglena* sp.,

Lyngbyasp., *Nostoc sp.* *Ocellularia sp.* etc. Thus, toxin producing cyanobacteria species were present. There were 16 different benthic macro invertebrate species recorded within the study area. Some identified families were Aricidae, Nephtyidae, Cirratulidae, Nereididae, Capitella, Sphaerodoridae, Heterospionidae together with 3 species of Arthropodes, 3 species of Gastropodes and 1 species of Bivalves.



Waste water outlets and Debris in the canal



Sampling in the Canal

PROJECT No : 5.3

STUDY OF MARINE LITTER IN COASTAL AREAS OF SRI LANKA. (CONTINUOUS PROJECT)

This study focused on marine debris (plastic and polythene) that is recognized as a worldwide threat to marine organisms, ecological processes and economies. Marine habitats are contaminated with man-made debris and represent the major categories of marine debris by material type on a global basis. The sea around the Western, Southern and North Western province of Sri Lanka are composed of a large coastal community and are highly affected by the increasing urbanization and industrialization activities. Therefore, dump plastic and polythene waste into marine environment harming the aquatic biota.

This project was initiated with the objectives to identify and classify dumping of plastic and polythene waste inputs and to give recommendations to implement conservation measures to waste management. Therefore, identification of waste input status helps in management and conservation biological and fisheries aspects. For this study, marine debris was surveyed on selected sites mainly focus on river discharge outlet, estuary mouths and tourist destination sites as North -Western (Negombo and Chilaw) coastlines and Southern (Bentota and Horawela) river basin during study period from January to December 2020. Debris cover was estimated in 100 x 10 m net using the sample collected in each site on monthly basis for macro debris (> 2.5 cm). The collected debris particles were categorized by material type.

Throughout the whole study period, marine debris was dumped waste from mainly anthropogenic activities as domestic and boats which mostly comprise of plastic and polythene waste were observed at Negombo sea mouth area. Significantly higher debris cover was found in Negombo sea mouth. According to the results obtained for the composition of debris by material types showed that the classified by use, packaging material (53%) dominated the debris, followed by consumer products (17%) and fishing items (24%) plastic bottles (6%), while food wrappers/containers contributed only 5% respectively. The study

revealed that the urbanization in Negombo area was highly polluted with marine debris and their impacts on water pollution. Thus, it is recommended to make remedial measure to reduce the debris accumulation on sediment to conserve these valuable coastal habitats. It is important that the awareness of the society is re-checked and an ecology-concerned society is built via timely dissemination of knowledge and apposite policy reforms.



PROJECT No : 5.4

IDENTIFICATION OF MOST APPROPRIATE FRESH WATER FISH SPECIES AS BIO-INDICATORS IN LOWER AND UPPER CATCHMENTS OF THE KELANI RIVER BASIN FOR ENVIRONMENTAL POLLUTION ASSESSMENT

The Kelani River is the most polluted river in Sri Lanka and therefore has been subjected to many pollution assessment studies over the past few years. Currently, biological indicators have been increasingly used for aquatic pollution assessment studies as they provide more precise conclusions while considering both abiotic and biotic factors. Pollution in a water body can be judged in two ways as using abiotic tests that one of most widely used techniques and biotic tests in the water, Investigation of physiochemical properties are necessary for understanding the changes of water quality and these data provide an early warning on indication of pollution. Particular cost-effective widely used tools of quick performance for either predicting or measuring water pollution if to use of chemical testing procedures through it has no indication of the underlying damages done to the ecosystem (Lopez and Diaz, 2015). Giving conclusions depending on abiotic results only give no indication to the underlying damages happened to the ecosystem (Parmer, et al 2016). Therefore, most acceptable and recognized method is to consider both abiotic (chemical and geographical) and biotic data before any conclusions regarding water quality are drawn.

According to the existing literature fresh water fish have not been extensively used as a bio- indicator to evaluate a level of contamination in the fresh water ecosystems in Sri Lanka (Sucman, Vavrova, Gargosoava and Mahrova, 2010). Furthermore, the gravity of water pollution status of Kelani river basin is apparent due to land-based sources, agricultural runoff, domestic effluents and municipal effluents (Nandasena et al, 2019). In addition to that, heavy metal, organic waste and microbial pollution also present in some places of Kelani river basin. Furthermore, some other problem arises due to saline water intrusion from the sea making the water non-usable mostly due to sand mining of lower catchments of river basin making severe salt wedges on several occasions (Wijesinghe, 2015). According to the Mahagamage and Manage (2014), among the major wastewater generating industries along the Kelani river basin, textile industries, rubber

factories, milk food industries, beverage factories, chemical industries and fertilizer manufactories industries are contributing much more pollutants to the river (Mahagamage, et al.2014). Therefore, selection of Kelani river basin is much more important with the main task due to the presence of both polluted and non-polluted sites.

This is a three-year research project consisted with two main phases and phase one consists of discovering the fish diversity, abundance and biology and some other bio indicator characteristics of the fish species found along the lower and upper catchments of Kelani river basin. And, pollution assessment also was carried out in the same locations which were used to identify the fish species to compare with their diversity. The year 2019 mainly covered the studies on upper catchment and 2020 focused on the lower catchment. The main objectives covered were included the;

- To identify the collected fish specimens up to the lowest possible taxonomic level.
- To find out the fish species diversity, Relative Abundance and Species Richness for collected species to see their suitability to serve as a biological indicator.

The main objective of the phase two is to investigate the suitability of selected fish species (discovered within the year 2019 and 2020), as biological indicators by laboratory experiments to see their relationships either at the behavioral and individual level, on selected pollution pressure. Fish identification for the lower and upper catchment of Kelani river basin was completed along with the pollution assessment in the same locations selected.

According to the results obtained L1, L2, L4, L5, and L7 locations (Mattakkuliya, Thotalaga, Kolonnawa, Ambathale and Kaduwela) of the lower catchment deviated from the recommended values for nutrients, pH, DO and COD and can be considered as the locations of pollution. Fish species belonged to family cyprinidae were the most abundant and dominant in both catchments. Within the upper catchment having good quality waters in most locations *Rasbora daniconius* showed high frequencies in most of the locations. These species are more frequent in undisturbed areas and could be the positive indicators of ecological integrity. Within the polluted locations *Dawnkinsiasinghala* (Sri Lankan filamented barb) was the most abundant which presence all the polluted locations. Also, *Garraceylonensis* present mostly in clean fast flowing cold waters. The highest Shanon wiener index recorded in L5 which was 2.47 and highest species richness with 14 species. The lowest value recorded in L3 which was 1.22 and comparatively low species richness as well.





PROJECT NO : 5.5

ASSESSMENT OF WATER POLLUTION STATUS OF SELECTED FISHERY HARBOURS IN THE SOUTHERN PROVINCE OF SRI LANKA

A fishery harbour is a complex center of activities which are potential waste generators and thus considered as coastal pollution hotspots. Discharge of burned oil and bilge water from fishing vessels to harbor waters, production of load of organic wastes which derived from fish degutting, market floor runoff, cleaning and garbage dumping are main causes for the water pollution in fishery harbours (Holmgren, 1994). In addition, other pollution sources in a fishery harbour includes improper dumping of fish offal and other garbage into harbour waters, dumping of untreated sewage from toilets and defecation inside the harbour premises. The use of contaminated water for fish may cause for the post-harvest loss due to spoilage from bacteria and chemical reactions. To improve the water safety and quality of a fishery harbour, its pollution level should be thoroughly assessed. Therefore, the determination of the current status of water quality in three selected fishery harbours namely Puranawella, Mirissa, and Kudawella was identified as main objective of this study.

The study was carried out in seven sampling points located within each harbour from February to December 2020 using random sampling techniques. In-situ parameters such as water temperature, pH, salinity, electrical conductivity, DO, turbidity were measured. Ammonia, Ortho-phosphorus, Nitrate and Nitrite concentrations, TSS, BOD, COD, oil & grease and chlorophyll-a, were the tests carried out in the laboratory. Results revealed that the pH and DO were within the standards limits of the water quality for harbour waters.



Sampling locations
Kudawella fishery harbour



Sampling locations
Mirissa fishery harbour



Sampling locations
Puranawella fishery harbour

The results of the study revealed that the average BOD (6.25 ± 2.1), (8 ± 4.5), (5.37 ± 1.10) mg/L and oil & grease (210.46 ± 79.12), (244.4 ± 84.691), (225.5 ± 86.46) mg/L, in Kudawella, Mirissa and Puranawella showing high level of water pollution of the harbours. Therefore it was revealed that, average concentrations of BOD in all the fishery harbours were above the recommended value (<4 mg/L) of environmental quality standards by CEA of Sri Lanka and primary water quality criteria for class SW-IV harbour (3mg/L) (Niroshana *et al.*, 2013). Thus, it reflects that the organic pollution is pronounced within three harbours and it is indicating the presence of load of organic matter. Disposal of solid wastes including

fish offal, food waste and inadequate waste receiving facilities may be the most possible reason to record these high BOD values.

Oil and grease content of all harbours exceeded 10 mg/l, which is the value recommended for the harbour according to the primary water quality criteria for class SW-IV harbour waters. Emission of engine oil from fishing vessels and accidental oil spillage during the refueling activities may be the possible reasons for observing high oil & grease content in the study sites. The study revealed that, the water quality has been degraded and all three harbours are subjected to severe oil pollution and organic pollution. Hence, this study recommends as to; develop waste receiving facility for all multiday boats in each harbour; implement tight regulations in disposal of solid wastes, waste oil and biological waste including fish offal; introduce proper monitoring programmes to identify harbour pollution and aware the fisheries community on the negative impacts of harbour pollution and contaminated fish consumption. Due to COVID-19 pandemic yearlong study could not be completed and the sampling was done only in February, June and September. So, study have to be continued for several months to complete all the samplings with microbial analysis.

Lagoon Development Project (Environmental Studies Division)

This is a continuous research project started in August 2019 and followed up until December 2020 as requested by the ministry of Fisheries and Aquatic Resources. In the beginning total of three lagoons namely Chilaw Lagoon, Arugambay Lagoon and Jaffna Lagoon were selected for the study in 2019. Later, in 2020, it included Nanthikadal Lagoon and the lagoons of Matala District.

Progress of Arugambay Lagoon

Preliminary field survey was conducted in September and December 2019 to select the sampling sites of Arugambay Lagoon. Collectively, eight (8) sampling locations were selected based on the importance to fisheries, pollutants discharged points, etc; and *In Situ* water quality parameters of the lagoon waters were measured in selected sampling locations. All water quality tests were performed according to Standard Methods for the Examination of Water and Waste Water (22nd Edition, 2012) which is a joint publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF).



Sampling at Arugambay lagoon

The mean water quality results for the selected locations of Arugambay lagoon indicated that, most of the in-situ and laboratory parameters tested were within the proposed standard limits published by CEA. The minimum DO value recorded as 0.41 mg/l and highest BOD value recorded as 8.09 mg/l in certain locations. The main reason for variation of DO and BOD levels in different locations of lagoon may due to presence of excessive growth of submerges plants. Considering the nutrient variation in the lagoon, all the results received for the dissolved phosphate, nitrite nitrogen, nitrate nitrogen and ammoniacal nitrogen were within the recommended acceptable range published by CEA. Considering the present study, the values (30 mg/l - 66 mg/l) received for COD is very much lower to the acceptable values (250 mg/l) published by CEA.

Zooplankton recorded during August in Arugambay lagoon constituted the protozoans, molluscs (gastropods and bivalve larvae), arthropods (copepods, crustacean larval stages, malacostraca) and chordates. High abundance of crustaceans contributed 52.87% of the total zooplankton population

followed by protozoans and molluscans which are represented 27.35% and 18.2% of the total zooplankton respectively. According to the most of water quality data received indicated that the water quality of Arugambay lagoon for most locations were within the acceptable levels for fish and aquatic life for the tested parameters when compared with the proposed tolerance limits published by CEA. As the present study was subjected to reveal the current status of the water quality variation in Arugambay lagoon, the sampling was performed for only two months period. Sampling in monthly basis or coverage of monsoon period is recommended to evaluate the seasonal variation of lagoon.

Progress of Chilaw Lagoon

A preliminary field survey was conducted in August 2019 to test the physicochemical properties and plankton in the Chilaw lagoon. Ten (10) sampling locations were selected based on the importance to fisheries, pollutants discharged points, aquaculture farming areas etc. *In Situ* water quality parameters of the lagoon waters were measured at each sampling location and water samples were brought to laboratory for chemical analysis and plankton analysis. In-situ analysis was carried out in order to determine water temperature, pH, salinity, electrical conductivity, TDS, DO, turbidity, Secchi depth and depth of the lagoon. Collected water samples were subjected to the following tests; Ammonical-nitrogen, Nitrate-nitrogen, Nitrite-nitrogen, Dissolved Phosphate, BOD, COD, TSS, Chlorophyll-a, and Oil & Grease content. According to the experimental results, pH values of water in the lagoon fluctuated from 7.7 to 8.7 and the DO levels varied from 4.63 to 6.89 mg/L. Both of these parameters are within the standard limits (CEA, 2001). Further, all tested nutrients did not exceed the tolerance limits for fish and aquatic life. However, highest ammoniacal nitrogen and dissolved phosphate concentrations were observed in a location which is near the Chilaw fish market. COD was high in CL 1 and 2 locations and it was 144 mg/l and 134 mg/l respectively. This can be due to the mixing of sea water and waste water from the fish market. However, nutrients, BOD and COD were within the standard limits (CEA, 2001).

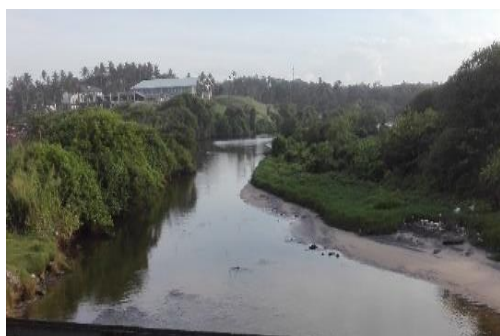
Three main parts of the lagoon can be identified as northern and southern channel and main body. Salinity, EC and TDS of the northern channel is higher compared to other two parts due to the sea water intrusion via sea mouth at the northern channel. The lowest of these parameters were observed in southern channel and it is due to the sand bar formation at the southern sea mouth and the fresh water flow from Karambalanoya. Zooplankton population in Chilaw lagoon represented nearly 92% (115 number/l) of crustaceans followed by molluscans (5.22%) and protozoa (2.86%). Out of the crustacean, majority were represented by crustacean larvae (57.93% and 66 number/l), followed by calanoids copepods (20.29% and 23 number/l), and cyclopoids (15.75% and 18 number/l). According to the water quality analysis, all tested water quality parameters of Chilaw lagoon were within the acceptable levels for fish and aquatic life. However, these results are based on one month data. Therefore, a year-round study covering all the monsoons seasons is necessary for a better conclusion about the water quality and plankton variation in the lagoon.

Progress of Lagoons of Matara

Thondile lagoon- Polgahamulla

Analysis of important water quality parameters of the lagoon were done. Observations are made on a one-time sampling and water samples were collected during the rainy days, there for the values may not reflect the typical water quality of the lagoon. The pH values of the selected sampling locations were ranging from 6.60 to 7.25 and with the mean pH value is 6.97. The pH levels are in accordance with the value given for ambient water quality standards for fish and aquatic life (6.0-8.5), as stated by the CEA (2019). Surface salinity of the lagoon is generally low, almost near to 0 ppt but expected to be high during dry season. The mean DO concentration in the lagoon is 3.38 mg/l which was lower than the minimum value (5 mg/l, minimum) for aquatic life published by CEA. The TDS in the lagoon varied between 132 mg/l to 150 mg/l and the mean value is 141 mg/l. The results revealed that, the light penetration in the lagoon is limited due to high concentration of TDS associated with freshwater runoff. When considering the nutrient concentration of the lagoon, all values are within the acceptable range with the ambient water quality

standards published by CEA, 2019. In addition to the agricultural runoff, no any point sources of pollution observed around the lagoon or nearby catchment. This rapid water sampling was done after the heavy rain, therefore it doesn't reflect the normal condition of the pollutant in the water. Long term monitoring at least 6 months is needed to predict the pollution level of the lagoon.



Thalalla Lagoon

Analysis of important surface water quality parameters of the lagoon were done on three locations. The pH values of the sampling locations were ranging from 6.72 to 6.81 and with the mean pH value being is 6.77 in accordance with the standard pH given for fish and aquatic life, as stated by the CEA. The mean surface salinity value of this lagoon during the sampling time(September 2020) is 0.36 meansthat the lagoon completely filled with fresh water.Results revealed that, the mean turbidity value was 28.89 NTU and the recorded turbidity value varied between 28.74 NTU to 29.03 NTU. The TDS in the lagoon varied between 315 mg/l to 878 mg/l and the mean value was 596.50 mg/l. The results revealed that, the light penetration in the lagoon is poor.

The Thalalla lagoon has a recorded mean phosphate concentration of 0.11 mg/l. Where the absolute values ranged from 0.0746 mg/l to 0.1547 mg/l. Average ammonia nitrogen concentration was recorded as 0.15 mg/l and maximum ammoniacal nitrogen concentration was recorded as 0.1829 mg/l. The average nitrite concentrations were determined as 0.005 mg/l. The nitrite concentrations were low compared to the ASEAN Marine Water Quality Management Guidelines and Monitoring Manual's recommended levels. In addition, nutrient concentrations recorded indicated that nutrient in the Thalalla lagoon is generally within the acceptable limits for fish and aquatic resources published by CEA, 2019.

No any point sources of pollution observed within the survey area or revealed by the interviewed personnel. When considering the ambient water quality standards for aquatic life published by CEA, which is best to describe the current freshwater condition of the lagoon and the ASEAN Marine Water Quality Management Guidelines with other Monitoring Manual's recommended levels, the nutrient concentrations are low and other water quality parameters of the lagoon are within the acceptable limits for fish and aquatic life. But exact pollution level of the lagoon doesn't reflect from a single sampling within rainy days. Therefore, at least six month of water sampling is recommended to get an idea about the pollution level.



Dondra Lagoon– Dewinuwara

Analysis of important surface water quality parameters of the lagoon were done. The pH values of the selected sampling locations in the lagoon were ranging from 6.50 to 7.39 and with the mean pH value is 6.74. All the pH values obtained are in accordance with the standard limits for pH given for fish and aquatic life, as stated by the CEA. The mean DO concentration in the lagoon is 6.77 mg/l. When compared with the standard limit published by the CEA, DO concentrations recorded in the sub catchment are within the acceptable limits (5 mg/l, min) for fish and aquatic life. Results revealed that, the mean turbidity value was 13.68 NTU and the recorded turbidity value varied between 6.94 NTU to 18.30 NTU. TDS in the lagoon varied between 630 mg/l to 1189 mg/l and the mean value was 829.33 mg/l. The results revealed that, the light penetration in the lagoon is very poor. Therefore, the decomposition rate in the bottom is low.

The Devinuwara lagoon has a recorded mean phosphate concentration of 0.03 mg/l. Where the absolute values ranged from 0.0185 mg/l to 0.0676 mg/l. Average ammoniacal nitrogen concentration was recorded as 0.3 mg/l. The average nitrite concentrations were determined as 0.01 mg/l. The nitrite concentrations were low compared to the ASEAN Marine Water Quality Management Guidelines and Monitoring Manual's recommended levels. In addition, nutrient concentrations recorded indicated that nutrient in the Devinuwara lagoon is generally within the acceptable limits for fish and aquatic resources published by CEA, 2019. And also, it should be noted that, the sampling was carried out during the rainy period after heavy rain. Lagoon filled with new muddy water and mouth also open to the sea. This lagoon is widely prone to the point sources of pollution including municipal garbage dumping, discharge of the effluents from the dry fish processing plants, discharge of the fish market and more effluent coming from the house schemes in the nearby catchment area. As a result of long-term sedimentation of the boundary and canal system, it was blocked the free flowing of the water canals specially flowing from the Dondra town. Interviewed personnel revealed that fish effluent generated from the fish market also used to feed animals in the lagoon. Plastic, polythene, bottles and many more non degradable particles are deposited in the intertidal zone and also observed that during the rainy time those particles are flowing into the lagoon mouth area from the road.

Midimodera canal – Midigama estuary

In addition to the runoff through the paddy land no any pollution source observed. Meanwhile, all the water quality parameters are within the acceptable range for the fish and aquatic life. The pH values of the selected sampling locations in the lagoon were ranging from 7.09 to 7.45 and with the mean pH value being is 7.21. The pH levels are in accordance with the standard pH given for fish and aquatic life, as stated by the CEA. The mean salinity value of this lagoon is 0.57 indicated the freshwater condition of the water. The mean DO concentration in the lagoon is 6.44 mg/l. When compared with the standards published by the Sri Lanka Standard Institute, DO concentrations recorded in the sub catchment are within the acceptable limits for fish and aquatic life.

Results revealed that, the mean turbidity value was 31 NTU and the recorded turbidity value varied between 24.41 NTU to 34.94 NTU. The TDS in the lagoon varied between 294 mg/l to 726 mg/l and the mean value was 559 mg/l. The results revealed that, the light penetration in the lagoon is very poor. Therefore, the decomposition rate in the bottom is low. The Midigama lagoon has a recorded mean phosphate concentration of 0.12 mg/l. Where the absolute values ranged from 0.0483 mg/l to 0.1777 mg/l. Average ammoniacal nitrogen concentration was recorded as 0.17 mg/l and maximum ammoniacal nitrogen concentration was recorded as 0.2605 mg/l. The average nitrite concentrations were determined as 0.01 mg/l. The nitrite concentrations were low compared to the ASEAN Marine Water Quality Management Guidelines and Monitoring Manual's recommended levels. In addition, nutrient concentrations recorded indicated that nutrient in the Midigama lagoon is generally within the acceptable limits for fish and aquatic resources.

Polathumodera estuary

Typical characteristics of the salinity and the subsurface mixing was highly altered by the rainy conditions. As a result of that, surface of the lagoon water was significantly reduced and totally replaced by the freshwater. The salinity of the lagoon was less than 1ppt with the mean of 0.39 ppt. The highest values were observed near to the river mouth and had gradual decrease extending from the mouth to upper stream. Relative to the dry period, spatial difference in both temperature and salinity were also very small, indicating strong freshwater inflow due to the heavy rain. Salinity slightly increases, and temperature dropped near to the mouth, possibly owing to the salt water intrusion from the sea. All the other significant parameters which describes the pollution nature of a water body are in accordance with the standard limits for fish and aquatic life published by the CEA in 2019.

The pH values of the selected sampling locations in the lagoon were ranging from 7.02 to 7.50 and with the mean pH value being is 7.25. The pH levels are in accordance with the standard pH limit given for fish and aquatic life, as stated by the CEA. The mean salinity value of this lagoon is 0.39 and it means that there is almost no dissolved salt in the water. The mean DO concentration in the lagoon is 6.86 mg/l. When compared with the ambient standards published by the CEA, DO concentrations recorded in the sub catchment are within the acceptable limits for fish and aquatic life. Results revealed that, the mean turbidity value was 55.44 NTU and the recorded turbidity value varied between 48.66 NTU to 65 NTU. The TDS in the lagoon varied between 120 mg/l to 692 mg/l and the mean value was 351.83 mg/l. The results revealed that, the light penetration in the lower part of the lagoon is poor. The Polwathumodara lagoon has a recorded mean phosphate concentration of 0.04 mg/l. Where the absolute values ranged from 0.0303 mg/l to 0.0399 mg/l. Average ammoniacal nitrogen concentration was as 0.16 mg/l and maximum concentration was 0.2082 mg/l. The average nitrite concentrations was 0.01 mg/l. In addition, nutrient concentrations recorded indicated that nutrient in the Polwathumodara lagoon is generally within the acceptable limits

Progress of Nanthikadal Lagoon

Nanthikadal lagoon is one of the large lagoons located in Mullaithivu District which is connected to the sea with around 2km long narrow sea mouth. Due to the number of anthropogenic activities taking place within the lagoon area nearby, such as road development activities caused several impacts to the lagoon ecosystem. Disturbing to the natural flow of the canal leads to inundates and flooding the riparian area and sediment transport along the canal caused several secondary problems as well. The sampling sites were selected considering the Northern, Southern, Eastern and Western part of the lagoon. Sampling locations are demarcated using GPS. Seven sampling sites were selected covering the entire lagoon based on the judgmental sample techniques although the upper part of the lagoon could not able to sample due to the inability to reach the required locations. In-situ parameters were taken during the field and some other water samples were taken into laboratory for further analysis. Among the measured water quality parameters, water temperature, pH, DO, Salinity, EC, Turbidity values were measured in-situ and TSS, Nutrients, BOD, COD, Oil & Grease and zooplankton were obtained after the laboratory experiments.



Taking of in-situ parameters and water sample collection

The months of June to September considered as the extremely dry season and normally consists of 30°C - 35°C water temperature variations and concluding that the present study period the mean water temperature was recorded as 31.0 °C(0.5 STD). Mean pH value was recorded as the 8.45 which is very close to the maximum recommended value published by proposed standards of CEA. However, according to some water quality parameters measured by Priyadarshana and Manathunga, on 2012, the mean pH value was recorded as 7.24 which was lower to the current measured value. The pH values recorded for all locations were exceeded the 8.0 indicated that there was an increasing trend of pH over the time in whole lagoon.

When considering the DO concentration in the present study, the mean DO value was recorded as 6.92 mg/l with the range of 4.97 mg/l – 8.37 mg/l. It was noted that, all the recorded values for DO were exceeded the minimum standard range (3 mg/l) published by CEA. There was a contrast relationship observed in the BOD of the lagoon with the DO, which is most of the sampled locations BOD values were exceeded the maximum standard range. Therefore, it is important to note that the low BOD content is an indicator of good quality water and high BOD value present in polluted water. The higher the BOD value, the greater the amount of organic matter for oxygen consuming bacteria. If the rate of DO consumption by bacteria exceeds the supply of DO from aquatic plants, algae photosynthesis or diffusing from air, unfavorable conditions occur.

The EC and salinity variation in lagoon is closer to the freshwater behavior as the samples were taken during the dry season and positively correlated. Location 1-4 and 5 recorded as the 4 ppt and 6 ppt respectively while location 6 and 7 received the 10 ppt. According to the previous research by Priyadarshana and Manathunga, 2013, the salinity variation was recorded as 1.34 ppt. Furthermore, High conductivity during dry season might be attributed to low mixing of fresh water and low value during monsoon season was due to rain and mixing of more fresh water from river. EC is an approximate indicator of TDS and hence, the variations observed in EC can be explained to a greater extent through the variation in TDS concentrations. Considering the nutrient variation in the lagoon, all the results received for the dissolved phosphate, nitrite nitrogen, nitrate nitrogen and ammoniacal nitrogen were within the recommended acceptable range published by CEA, though location 4 and 5 observed high density of submerge plants species.

COD is an indicator of organics in the water, usually used in conjunction with BOD. The COD to BOD ratio suggest that the major portion of the organic matter is biodegradable and hence lesser in toxicity. Considering the present study, the value range (8 mg/l – 40 mg/l) received for COD is much lower to the acceptable values (250 mg/l) published by CEA. Same as the values received for oil and grease (1.3 mg/l – 3 mg/l) were lower to the acceptable range (10 mg/l). Average gross primary productivity of the lagoon is within the range of 0.4–2.84 mgCm⁻³ h⁻¹. Average chlorophyll- a content of Negombo lagoon is 6.72 µg/L, thus the lagoon is in the mesotrophic state, according to the trophic status classification. Chlorophyll-a concentration shall vary from 5 to 15 mgm⁻³ in a mesotrophic water body.

Zooplankton recorded during the sampling day in lagoon mainly constituted of molluscan larvae, arthropods (calanoids copepods, nauplius stages and shrimp) and chordates. Total zooplankton density varied from 42.14 organism/l to 203.73 organism/l and comparatively highest density of total zooplankton was recorded in location 6, where deepest location of the lagoon. Significant amount (119 organism/l) of marine rotifers (*Brachionus* sp.) were also recorded in the same location. High abundance of crustaceans varied 81.6% (130 organism/l) to 97.43% (79.1 organism/l) of the total zooplankton population followed by molluscs which are varied from 2.56% (2.08 organism/l) to 17.92% (28.66 organism/l) of the total zooplankton population in the lagoon.

Consultancies / External funded projects

1. STUDY ON THE ENVIRONMENTAL IMPACTS TO MARINE RESOURCES DUE TO LAKVIJAYA POWER PLANT (CONTINUOUS STUDY; 2019-2020)

Project Proponent : Lakvijaya Power Plant, Ceylon Electricity Board (CEB).
Budget : Rs. 19,359,080.00
Duration : January 2019 to February 2021
Components : Water Quality and Toxicological Analysis- ESD
Marine Biological Survey- MBRD
Sediment Transport Analysis- NIOMS
Temperature Data Measurements & Numerical Modeling of Thermal Effluent- NIOMS
Bathymetric Survey- NHO

Project Progress : Inception report, Interim report and the draft of the final report were submitted.
Project Coordinator : Ms. K.A.W.S. Weerasekara
Project Leader : Ms. M. D.S.R. Maddumage

"Study on the Environmental Impacts to Marine Resources due to Lakvijaya Power Plant" is a consultancy project awarded to Environmental Studies Division in 2019 by the Lakvijaya power plant, Ceylon Electricity Board. This study focused on the environmental impacts due to the thermal pollution by cooling water system of the Lakvijaya power plant. The coastal ecosystem in the vicinity of the coal power plant was closely monitored to study water quality, fish resources, coral habitats, temperature dispersal, sediment transport and bathymetry. Furthermore, water quality and toxicological parameters are monitored at two reference points. The inception report, interim report and the draft of the final report were submitted by the end of 2020. Several meetings were held with the power plant manager and the environmental unit of the Lakvijaya power plant to disseminate results and findings. Discussions were held with EML consultants and the CEB to disseminate the scientific information obtained from the above study to be used as baseline data for the environmental impact assessment of a new 300 MW power plant unit as an extension to the existing power plant. The project will be concluded with the submission of the final report in February 2021.



Sampling and In-situ Measurements



Cooling Inlet & Outlet



Meetings to disseminate results

2: DEVELOPMENT OF A LOW COST TREATMENT SYSTEM FOR FISH EFFLUENT IN THE SMALL SCALE FISH STALL

Funding Agency : Arthacharya Foundation.
 Budget : Rs. 436,800.00
 Duration : February to December 2019 – Research study
 January to August 2020- Pilot Project
 Project Coordinator :Dr. A.A.D. Amarathunga

This project was carried out in collaboration with the Arthacharya Foundation as an external funding research. The study focused on developing a low cost treatment system for small scale fish stalls to treat their effluent before discharging into a natural water body or adjacent environment. Experimental treatment system (constructed wetland) was established at NARA and carried out research to analyze the reduction of the nutrient level and other chemical parameters of wastewater flowing through the constructed wetland. Based on the experimental results, large size treatment structure was refurbished and setup in Magal Kanda, Beruwala, Sri Lanka. The pilot project was conducted to examine the field level success and also to demonstrate to the relevant stakeholders.



Field installation of the treatment system

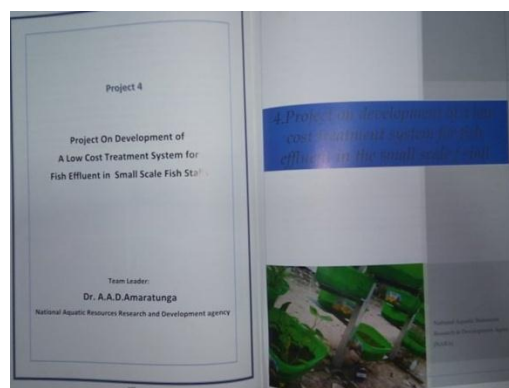
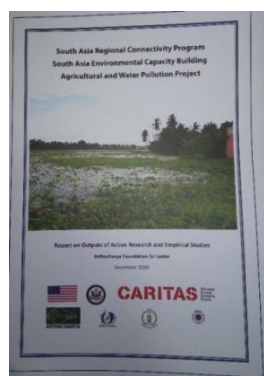
A workshop was conducted to disseminate the knowledge, inviting relevant stake holders. The workshop was held on 14.08.2020 at the Divisional Secretariat Auditorium, Beruwala. Fifty-nine personnel from different stakeholder agencies were participated to the workshop.



Workshop held at Beruwala



Demonstrating the treatment system to the stakeholder



Publication of this consultancy project

Test services

The environmental Studies division has issued test reports to 14 clients during this period, with total earnings of Rs. 230,750.00.

Others (meetings/ Field inspections/ Seminars/ Workshops etc.)

During the year of 2020 (excluding the period of Nation-wide lockdown), officers of ESD took part in handful of meetings, seminars, and workshop. It includes the meetings related to Environmental Impact Assessments, IEE and other external projects facilitated by the relevant agencies such as Ministry of Urban development and Housing, Ministry of Fisheries and Aquatic resources, Department of Wild life

conservation (DWLC), coast conservation department, and Ministry of Environment. In general, these meetings were arranged to provide suggestions and recommendations on management and conservation of fisheries and Aquatic resources.

Meetings Attended

1. Meeting on 185th Coast Conservation and Coastal Resource Management Advisory Council held on, 25.09.2020 for organized by Ministry of Urban Development and Housing "Suhurupaya Battaramulla.
2. Meeting on 172nd Coast Conservation and Coastal Resource management Advisory Council on at CCD, Maligawatta.
3. Meeting on Technical Evaluation Committee meeting for an Environmental Impact Assessment (EIA) on Proposed 364 units of Residential Apartment Complex in Unawatuna Arariya Hotel at CCD, Maligawatta.
4. Technical evaluation committee meeting for the Initial Environmental Examination (IEE) on Development of Fishery Harbour at Mirissa held at Ministry of Fisheries and Aquatic Resources, Colombo 10.
5. Preliminary meeting on proposed Golf Course and Mel Waththa development project held on 07.07.2020 at the Department of Wildlife Conservation.
6. Preliminary meeting on proposed Boutique Villa Hotel project at Balapitiya held on 07.07.2020 at the Department of Wildlife Conservation.
7. Joint inspection visit for proposed project on upgrading of Beruwala, Galle, Puranawella and Kudawella fishery harbours held on 29.07.2020 as per the request by Coast Conservation and Coastal Resource Management Department.
8. Meeting on the preparation of Coastal Zone Development Guidelines held on 10.08.2020 at the Ministry of Urban Development, Water Supply and Housing Facilities.
9. Initial meeting on Asian Development Bank assisted Sustainable Urban Development Project implement by the Ministry of Urban Development, Water Supply and Housing Facilities in the Coastal Zone in Trincomalee held on 30.07.2020 at the Department of Coast Conservation and Coastal Resources Management.
10. Initial meeting on proposed Fiber Optic Communication Cable Laying project on the sea bed of Sri Lanka territorial waters in and around Mount Lavinia to land a new cable linking Sri Lanka and Maldives held on 30.07.2020 at the Department of Coast Conservation and Coastal Resources Management.
11. Stakeholder consultation workshop on reviewing and updating nationally determined contributions of coastal and marine sector and fisheries sector held on 06.10.2020 organized by the Ministry of Environment.
12. Meeting on Batticaloa Wastewater Collection, treatment and disposal project held on 16.09.2019 at the CEA.
13. Meeting on proposed Yatimahana reservoir project held on 20th December 2019 at the CEA.
14. Initial meeting on construction of flyovers along Uttarananda Mawatha, Justice Akbar Mawatha in Slave Island and linking Baladaksha Mawatha & Colombo-Rathnapura-wellawaya-Batticaloa (A004) road held on 30.09.2020 at the Department of Coast Conservation & Coastal Resources Management, Maligawatta, and Colombo10.
15. Meeting on construction o Yatimahana reservoir in Maha Oya basin held on 16th January 2020 at the Kegalle District Office of National Water Supply and Drainage Board.
16. Inception meeting for the preparation of National Policy and management of invasive species through ships' Hull fouling- Establishment of National Taskforce on Bio fouling Management held on 12th February 2020 at the MEPA.
17. 1st International Conference on resource efficiency and circular economy held on 21st January at Waters Edge, Battaramulla.
18. Scoping meeting on Proposed Enhancing Education and Research Capacity of Ocean University of Sri Lanka through Green Concept held on 09.07.2020 at the Department of Coast Conservation, Colombo 10.

19. Meeting for the launching of National Policy for conservation and sustainable development of Mangrove Ecosystems in Sri Lanka held on 08th September 2020 at the Ministry of Environment.
20. Meeting on stakeholder consultation on operation manual of the NDA to Green Climate Fund held on 28th August 2020 at the Ministry of Environment.
21. Meeting with Hon. Kanchana Wijesekera (State Minister of Ornamental Fish, Inland Fish and Prawn Farming, Fishery Harbour Development, Multiday Fishing Activities and Fish Exports) and Executive committee of Scientific Association of NARA on 05.10.2020 at Ministry of Fisheries and Aquaculture.
22. 1st International Conference on Resource Efficiency and Circular Economy in Sri Lanka, 21 January 2020 from 8.30 am - 4.00 pm at Waters Edge Baththaramulla.
23. Environmental Monitoring Program under the EIA/IEE procedure: Monitoring of 151 units of Apartment Project, and Proposed construction of Sea out fall at Elysian Mirissa Pvt. Ltd., Project site, Mirissa
24. Progress review meeting of the project; "Study on Environmental Impacts to Marine Resources due to Lakvijaya Power Plant" with CEB and EML consultants
25. IMT Meeting MEPA – Discussion on initial action plan of pollution prevention of MT New Diamond crude carrier incident. Held at MEPA, Narahenpita.
26. Scoping Committee meeting on the proposed gated sea outfall at Muthurajawela by Land Development Cooperation. Held at Coast Conservation and coastal
27. Google Meeting- Discussion on augmentation of proposed sea outfall line at Koggala Export Processing Zone.
28. Public Consultation Meeting for Phase 03 of Lakvijaya Power Plant, Held at Lakvijaya Power Plant, Norochcholai
29. Technical evaluation committee meeting for the EIA procedure on proposed 106 units of apartment projects Weligama, Matara on 18th December 2020 at the ministry of urban development and Housing.
30. Technical evaluation committee meeting for the EIA procedure on proposed hotel construction project, Bonavista road, Unawatuna on 18th December 2020 at the ministry of urban development and Housing.

Seminars and Workshops

1. Commonwealth Blue Charter Training on Mapping Mangroves – Managers organized by the commonwealth secretariat Australia.
2. Commonwealth Blue Charter Training on Mapping Mangroves – Technicians organized by the commonwealth secretariat Australia.
3. Participated for the workshop on low- cost treatment system for fish waste effluent discharge by small scale fish stalls
4. One day workshop on low-cost treatment system for fish waste effluent discharge by small scale fish stalls. Organized by ESD, NARA under project 5113. At Auditorium, Pradeshiya Sabah- Beruwala.
5. Workshop for Syllabus revision of B.A. (Hons.) degree in Environmental Management-2020, Rajarata University of Sri Lanka. Held at National Institute of Plantation Management (NIPM), Athurugiriya

Supervision of undergraduate students for industrial training

1. Undergraduate students from University of Uva Wellassa research project "Assessment of water pollution levels in dry fish processing factories in Negombo estuary". (B.R.C. Mendis)
2. One undergraduate student from Department of Zoology and Environmental Management, University of Kelaniya has been placed for training for a period of two weeks from 01st of March 2020 to 15th March 2020. – S. R. C. N. K. Narangoda
3. Four undergraduate students from Department of Forestry and Environmental Science, University of Sri Jayawardenapura has been placed for training for a period of 60 working days. – S. R. C. N. K. Narangoda

4. Six undergraduate students from Ocean University of Sri Lanka has been placed for training for a period of 06 months commencing from 12.02.2020. – M. D. S. R. Maddumage and S. R. C. N. K. Narangoda
5. Undergraduate students from , Uva Wellassa University completed the research project “Assessing Ground Water Quality for Drinking Purposes in Norochcholai Area in Puttalam District of Sri Lanka” - Supervise by M.D.S.R. Maddumage
6. Undergraduate students from University of Sri Jayawardenepura is conducting the research project “Species diversity and abundance of plankton and benthos along the Hamilton canal” - Supervise by M.D.S.R. Maddumage

Presentations/Public Awareness

1. A team from NARA participates in the beach cleaning program of the National Coastal and marine Resources Protection Week conducted by Marine Environment Protection Authority (MEPA) on 21st September 2020.
2. Presentation on “Water Pollution” – Workshop for Aqua club Members of the Ananda Vidyalaya, Modara. Held at NARA Auditorium

Reports

1. Report on Investigation of Mortality of Fish Kill at Bolgoda Lake 2020. Preparation by B. R.C. Mendis and K. A. W. S. Weerasekara.
2. Report on Investigation of Mortality of Fish Kill at Gopal park Seeduwa 2020.Preparation by B. R.C. Mendis, K. A. W. S. Weerasekara, M.D.S.R Maddumage
3. Report on Investigation of Mortality of Fish Kill at Waters Edge Battaramulla, 2020. Preparation by B. R.C. Mendis, K. A. W. S. Weerasekara, P. Prajani Heenatigala
4. Report on Investigation of Mortality of Fish Kill at Minneriya Wawa, 2020. Preparation by B. R.C. Mendis, K. A. W. S. Weerasekara, P. Prajani Heenatigala
5. Report on preliminary study on five selected water bodies of Matara District; ESD report preparation by S. R. C. N. K. Narangoda and S. K. S. Pamarathne.
6. Report on lagoon development project of Arugambay lagoon; ESD section preparation by S. R. C. N. K. Narangoda.
7. Report on aquatic Eco-system Conservation and Development Plan for lagoons in Sri Lanka: Nanthikadal Lagoon;ESD section preparation by S. R. C. N. K. Narangoda and B. R. C. Mendis.
8. Summary report on the study on color change of sea water Dehiwala& Angulana area by S. R. C. N. K. Narangoda, N. K. R. N. Jayawardena, A. D. W. R. Rajapakshe, K. M. B. P. Kalaotuwawe.
9. Report on water Quality Analysis of some selected locations of Kelani river basin during the COVID–19 Outbreak by S. R. C. N. K. Narangoda and A. A. D. Amarathunga.
10. Report on large Amount of Garbage piles washed up on Mount Lavinia Beach The preliminary investigation report by S. R. C. N. K. Narangoda.
11. Summary Report of Fish Kill Investigation at Beira Lake by S. R. C. N. K. Narangoda and A. A. D. Amarathunga.

Local trainings

1. Participated for the Sri Lanka-Australia webinar series on Mangroves from January to November. – S. R. C. N. K. Narangoda
2. Participated for the “Understanding ARC GIS pro” free training session on 23.12.2020 organized by GIS solutions Pvt (Ltd). – S. R. C. N. K. Narangoda

Publications

Abstracts

1. Mendis, B.R.C. and A.A.D.Amaratunga (2020). Analysis of plastic and polythene waste inputs from selected Coastal areas of Sri Lanka. NARA Scientific Sessions (accepted paper-2020).

2. Narangoda, S. R. C. N. K., Dangalle, C. D. and Amarathunga, A. A. D. (2020). Comparison of Fish Biodiversity Indices with Water Quality Parameters as a Measure of Ecological Degradation in Lower Catchment of Kelani River Basin. *National Aquatic Resources Research and Development Agency Scientific Session*, 2020.
3. Narangoda, S. R. C. N. K., Dangalle, C. D. and Amarathunga, A. A. D. (2020). Variation of Physico Chemical Characteristics of Upper Catchment of Kelani River Basin Using Multivariate Analysis. *International Conference on Science and Technology* (2020) (Accepted)
4. Gunarathna, H. Y. N. A., Amarathunga, A. A. D., Bambarawana, S. M., Weerasekara, K. A. W. S., Narangoda, S. R. C. N. K. and Maddumage, M. D. S. R. (2020) Preliminary study on diversity and abundance of phytoplankton in Mawella Lagoon with reference to water quality parameters. *National Aquatic Resources Research and Development Agency Scientific Session*.
5. Dammala, J. R. O. A., Maddumage, M. D. S. R., Abegunawardana, D. W. A. S., Narangoda, S. R. C. N. K., Amarathunga, A. A. D. and Weerasekara, K. A. W. S. (2020). Assessing ground water quality for drinking purposes in Norochcholai area in Puttalam. District. *National Aquatic Resources Research and Development Agency Scientific Session*.
6. Amarathunga, A. A. D., Narangoda, S. R. C. N. K., Maddumage, M. D. S. R., Jayawardana, J.K.P.C., and Mendis. Assessment of Physico-chemical characteristics and abundance of aquatic invertebrates in Benthota river basin, Sri Lanka. *National Aquatic Resources Research and Development Agency Scientific Session*.
7. Hettige, N.D., Wickramaarachchi W.D.N. 2020. Benthic macroinvertebrates diversity in the Kokkilai Lagoon: A preliminary survey, 2nd International conference of center for Environmental Studies on Environmental Monitoring and Management, Postgraduate Institute of Science, University of Peradeniya, Sri Lanka.
8. Hettige, N.D., Jayawardane, J.K.P.C, Alwis, R.H.N.S., Weerasekara, K.A.W.S. 2020. Assessment of the impact of semi-intensive shrimp farming on water quality of Mundal lagoon, Sri Lanka, 2nd International conference of center for Environmental Studies on Environmental Monitoring and Management, Postgraduate Institute of Science, University of Peradeniya, Sri Lanka.

Journal Publications (Full Papers)

1. Mendis, B.R.C. Najim, M.M.M and Kithsiri, H.M.P (2020). The Spatial Variation of *Mugil cephalus* in the Negombo Estuary in Relation to Physico-chemical parameters. *Journal of Faculty of Graduate Studies, University of Colombo Sri Lanka*, pp
2. Weerasekara, K., Pathiratne, A. and Kithsiri, H., 2020. Cadmium and arsenic levels in edible fishes, *Oreochromis niloticus* (Nile tilapia) and *Ompok bimaculatus* (butter catfish) from Padaviya Reservoir, Sri Lanka and human health risk assessment associated with their dietary exposure. *Journal of the National Science Foundation of Sri Lanka*, 48(4).
3. Narangoda, S. R. C. N. K., Dangalle, C. D. and Amarathunga, A. A. D. (2020). Evaluation of Fish Species Diversity and abundance in order to identify the possible fish bio-indicators with respect to the Pollution of Lower and Upper catchment of Kelani River Basin. *International Journal of River basin management*. (2020) (Submitted).

5.2 FISHING TECHNOLOGY DIVISION

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

During year 2020 two research project were conducted from FTD

- Study of flotsam associated fishery in offshore to Introduce management strategies for sustainable fishery
- Study the fishing efficiency of Monofilament nets comparison with Nylon nets used in inland reservoirs in Sri Lanka.

PROJECT NO : 1.1

STUDY OF FLOTSAM ASSOCIATED FISHERY IN OFFSHORE TO INTRODUCE MANAGEMENT STRATEGIES FOR SUSTAINABLE FISHERY

Flotsam associate fishery is one of main fishing operation conducting in Sri Lanka using Ring net; a kind of small scale encircling net. This fishing techniques mainly associated with floating objects in the sea. Main target species of this fishing method is Main target species of this fishing method are *Decapterusrusselli*(Indian scad), *Elagatisbipinulata* (Rainbow runner), *Canthidermismaculata*(rough triggerfish or spotted oceanic triggerfish). Accidentally collect tuna species (non- target species) as Skipjack tuna, Big eye tuna and yellowfin tuna, which have high economical value. This fishing method is highly efficient method and fisherman are very attractive for this method day by day, they collect all fish who caught in the net. Therefore objectives of the project were, Inquire the current situation of flotsam associated Ring net fishery and provide management strategies for future plans, disseminating the findings to the stakeholders, disseminating the findings to the Ministry of fisheries for policy making. This project was conducted based on catch data and boat log sheet data. Catch data were collected from Beruwala, Galle, and Tangalle and Kudawella fishery harbors. Length frequencies of Skipjack tuna, Yellowfin tuna, Indian scad, Rainbow runner, rough triggerfish or spotted oceanic triggerfish were taken. Length data were grouped in to 8 length classes as 20-22, 22-24, 24-26, 26-28, 28-30, 30-32, and 32-34. The unit was centimeters (cm). Length class was selected according to the maximum and minimum length of recorded. 24-26cm length class was the highest dominant length class observed of Skip jack Tuna and Big eye tuna. In the case of Yellowfin tuna, 26-28 length class was most abundance length class observed. According to the data, all most all tuna family fish which are collected using ring net are immature and under size fish. Therefore, continuing of ring net fishing activities in present conditions, it will be a severe issue in Sri Lanka fisheries in near future. When consider about the total catch of ring net fishery, they collect about 71% of target species around and 29% of non-target species. Therefore for the management of ring net fishery following recommendations were taken with the participation of offices of Department of Fisheries and Aquatic Resource of Sri Lanka.

Fishing vessels with inboard engines up to the length of 18.3 meters (60 ft.) shall engage in ring net fishing operations within Sri Lankan waters, outside hundred nautical miles (100) or one hundred and fifteen miles (115) i.e. one hundred and eighty-five decimals two kilometers (185.2) from the shore.

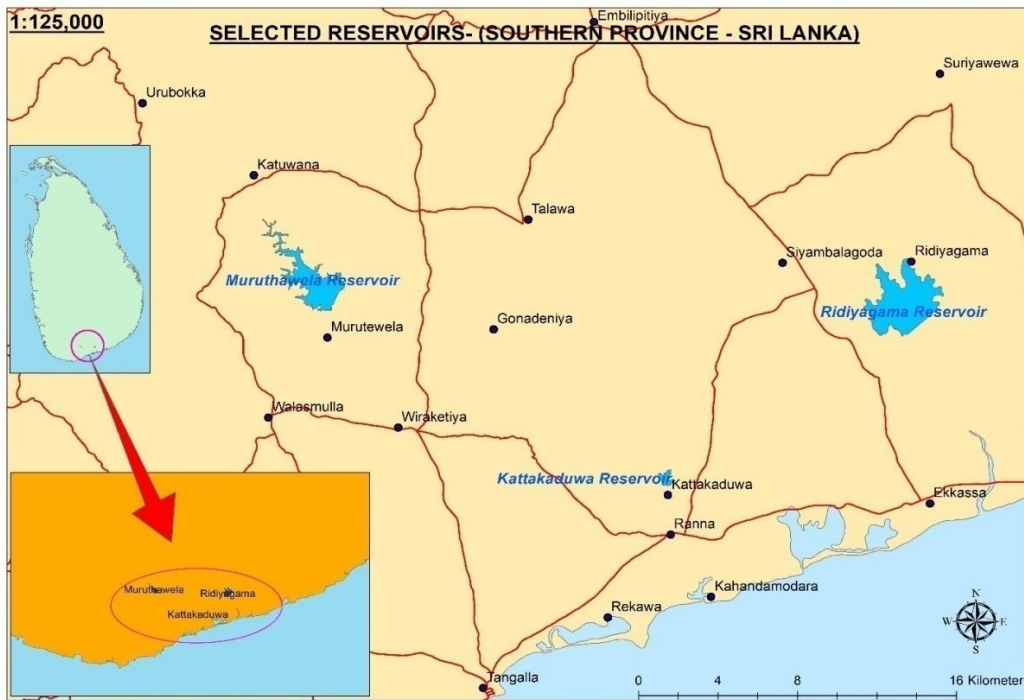
Fishing vessels with inboard engines exceeding 18.3 meters (60 ft.) and up to 24 meters (78.7 ft.) in length shall engage in ring net fishing operations within Sri Lankan waters, outside one Hundred and fifty nautical miles (150) or one hundred and seventy two decimal six miles (172.6) i.e. two hundred and seventy seven decimal eight kilometers (277.8) from the shore.

PROJECT NO : 1.2

STUDY THE FISHING EFFICIENCY OF MONOFILAMENT NETS COMPARISON WITH NYLON NETS USED IN INLAND RESERVOIRS IN SRI LANKA.

Sri Lanka is endowed with more than 12,000 perennial and seasonal, reservoirs, covering the extent of about 260,000 ha of the country. These tanks are classified into major, medium, minor and micro tanks depending on their water spread (water surface area of a tank) and command area. Reservoir fishery helps significantly to increase the availability of fresh fish to the rural communities, enhanced livelihood opportunities and income for fishers and strengthening the rural economy. In Sri Lanka, the reservoir fishery is almost exclusively a gill-net fishery, while the pole and line fishery is very few. The permissible mesh size is over 3½ inches or over (knot to knot). Mostly, the gill-net fishing is carried out through the night. The nets are hauled during the dawn and fishermen return to one or more landing sites in a reservoir. Use of motorized boats for fishing, is strictly prohibited in Sri Lankan reservoirs. Similarly, seining and use of undersized meshed gill-nets are also banned. The bottom terrain as well as numerous obstacles, such as submerged vegetation, prevent the use of any dragging gear. In order to the act no 02 in 1996, use of monofilament nets are prohibited in inland reservoirs due to its high catching efficiency. However, any scientific study has not been conducted, regarding the banned of monofilament net in inland reservoirs. There is a request, which come from the fishermen in inland reservoirs in Sri Lanka, to re-consider the ordinance, against to the Monofilament nets. Therefore, with the request of National Aquaculture Development Agency, a research was conducted to determine the fishing efficiency of monofilament nets comparatively to the nylon nets, in the inland reservoirs of Sri Lanka. Followings were the objectives of the projected which conducted as check the fishing efficiency of mono filament net and nylon net; determine the optimum mesh size of monofilament net, for fishing in inland reservoirs in Sri Lanka. In the initial stage, it was decided to select two pilot areas from north central and southern province of Sri Lanka, to carry out the project activities.

According to that, three perennial reservoirs from Anuradhapura district and, three perennial reservoirs from Hambantota district were selected, considering the scale of the reservoirs, i.e. large, intermediate and small scale. Huruluwewa, Aluthdiwulwewa and Manankattiyawewa reservoirs from the Anuradhapura district, and Ridiyagamawewa, Muruthawelawewa and Kattakaduwwawewa, reservoirs from the Hambantota district were selected according to the desired scales respectively. NAQDA was agreed to provide all required fishing nets, however, required amount of net materials not received on time. It may be due to, monofilament nets are not available in the local market of Sri Lanka. Due to the lack of raw materials, NARA decided to conduct the research works, only in southern province. The research was conducted in selected reservoirs of Southern province, as Muruthawela, Ridiyagama and Kattakaduwa reservoir (Map 01). According to the convention of the bilateral talks, the mesh sizes was decided, for the research, under three sizes as, 3 ½ inch (3 ½"), 4 ½ inch (4 ½") and 5 inch (5"). The net mending work was assigned to the Community based fisheries organizations (CBFOs) of the selected reservoirs. The CBFOs was given the net mending materials from the NARA. The experimental trial fishing activities were conducted among the three reservoirs, since February in year 2020. Minimum two times (two days) or maximum three times (three days) per a month, the experimental trial fishing was conducted on a one reservoir. The experimental trial fishing activity was started on 14th February in 2020, and ended on 19th December in 2020, completing 33 fishing efforts during seven months, within all three reservoirs. As the result of it, 15 number of fish species, could be identified among the three reservoirs. The total catch by using both nylon and monofilament nets, among all three reservoirs was 410.6 Kg. Out of total catch, 54.43% by using monofilament nets, while 45.56% of fish had been caught by using nylon nets. According to the total harvest collected from monofilament nets, 83.09% of fish harvest has been collected from 5 inch mesh size monofilament nets. According to the research, for the efficiency & ecofriendly fishing and avoid catching of immature, juvenile fish, monofilament nets, mesh size with 5 inch, can be recommended for the use for fishery in inland reservoirs, especially in water deficient period. It will help to sustainable utilization of reservoir fishery.



5.3 NATIONAL HYDROGRAPHIC OFFICE

Head of the Division :Mr. S.R.C. Ranaweera

Overview of the Year

The prime objective of National Hydrographic Office (NHO) is to provide Hydrographic services to ensure 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 are selected to ensure that hydrographic surveys are being carried out, as far as possible, adequate to the requirements of safe navigation where stakeholders and also being to prioritized. The other principal services are the provision of up dated and accurate bathymetric and topographic 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.

It has been realized that hydrographic data is underpinning the blue economy activities, accordingly NHO has carried out new surveys for Nandikadal lagoon to develop a master plan. Here the hydrographic information perform a vital and valuable part of calculating carrying capacity to quantify the optimal economic and commercial benefit of each lagoon.

Following surveys and activities were conducted for the year 2020,

3.1 National Charting Program

3.1.1. Bathymetric data acquisition for Coastal Chart from Trincomalee to Kudremalai Point – Mannar Island

3.1.2. Bathymetric data acquisition for Coastal Chart from Trincomalee to Kudremalai Point-Trincomalee to Point Pedro

3.1.3. Bathymetric data acquisition for Coastal Chart Little Besses reef to Pulmoddai Roads

3.1.4. Bathymetric data acquisition for Coastal Chart Weligama to Colombo.

3.1.5. Upgrading existing charts

3.2 An assessment of Tidal asymmetry around the Sri Lankan coastline

3.3 Establishment of Database and online data processing unit for crowd sourced bathymetry parallel with the “Sea Bed 2030” global mapping project of General Bathymetric Chart of the Oceans (GEBCO)/ Nippon foundation

3.4 Investigating Vulnerability of Coastal Erosion in Kalutara

3.5 Surveys conducted for special requests

3.6 Contribution to other projects

Activities Undertaken

Table 1:1 Activities undertaken by NHO for year 2020

Program/Projects	No.	Activities	OfficerResponsible	Period
1.0 National Charting Programme	1.1	Data Acquisition for Coastal Chart “Trincomalee to Kudremalai Point” – Mannar Island and Trincomalee to Point Pedro	S.R.C. Ranaweera C.K. Amarasinghe Y.M.R.N. Kumari W.A.A.P. Wijesundara R.K.A. Ariyaratne	Jan- Dec
	1.2	Data Acquisition for Coastal Chart “Little Besses Reef to Pulmoddai Road”	K.A. Ranasinghe D.L.P. Hewage L.S.C. Siriwardane	
	1.3	Data Acquisition for Coastal Chart “ Weligama to Colombo”	R.M.D.I. Rathnayake B.Y.T. Dhanushka	
	1.4	Upgrading Existing Nautical Charts	S.R.T.P. Singhabahu	
	1.5	Data processing and Cartographic works	B.H.B. Jayamalie	

2.0 An assessment of Tidal asymmetry around the Sri Lankan coastline	2.1	Literature review	R.M.D.I. Rathnayake S.R.C. Ranaweera Y.M.R.N. Kumari B.Y.T. Dhanushka	Jan-Dec
	2.2	Set up the tidal station		
	2.3	Tidal data collection and maintenance of tide gauges		
	2.4	Tidal modelling		
	2.5	Report writing and documentation		
3.0 Establishment of Database and online data processing unit for crowd sourced bathymetry parallel with the “Sea Bed 2030” global mapping project of General Bathymetric Chart of the Oceans (GEBCO)/ Nippon foundation	3.1	Purchasing of instruments, establishing unit and networking	Y.M.R.Nilupa Kumari S.R.C.Ranaweera, R.K.A.Ariyaratna R.M.D.I.Rathnayake, B.Y.T.Dhanushka, Darshana Wickramasinghe	Jan-Dec
	3.2	Installing fish finders to the boats		
	3.3	Create database		
	3.4	Data deriving and processing		
	3.5	Mapping		
4.0 Investigating Vulnerability of Coastal Erosion in Kalutara	4.1	Purchasing Satellite Imageries	M.Malarathne P.V.D. Tharanga	Jan-Dec
	4.2	Image processing		
	4.3	GPS survey		
	4.4	GIS analysis		
	4.5	Data acquisition from CCD and CHEC		
	4.6	GIS modelling		
5.0 Surveys Conducted for Special Requests from Government and other Institutions	4.1	Beach Profile Survey Colombo Port City Development Project	S.R.C. Ranaweera C.K. Amarasinghe 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 W.A.A.P. Wijesundara B.Y.T. Dhanushka S.R.T.P. Singahabahu B.H.B. Jayamalie	Jan- Dec
	4.2	Lagoon Survey		
	4.3	Demarcation of areas in the sea for sea cucumber export village in Kilinochchi District		

PROJECT NO : 1.1

DATA ACQUISITION FOR COASTAL CHART “TRINCOMALEE TO KUDREMALAI POINT”

NHO has planned to produce a coastal chart from Trincomalee to Kudremalai Point (Scale-1:300,000) covering about 550 km coastal stretch from East to West of Sri Lanka. Total sea area covering from this chart is about 30,000 km². Necessary surveys were planned in two phases. 40% of the total area was already covered and could not continue Offshore surveys (beyond 200m contour) due to unavailability of RV “Samuddrika”. Anyhow northern island area was surveyed using small boat and fair sheet of the Northern Islands was completed.

Due to the COVID-19 pandemic situation, the surveys couldn't carry out as planned within the year. Further, the surveys could not conduct due to permission delay from the Ministry of Defence (MoD) and unavailability of RV "Samuddrika" at the beginning of the year. The total distance of the surveyed lines are 2136 km in 2020.

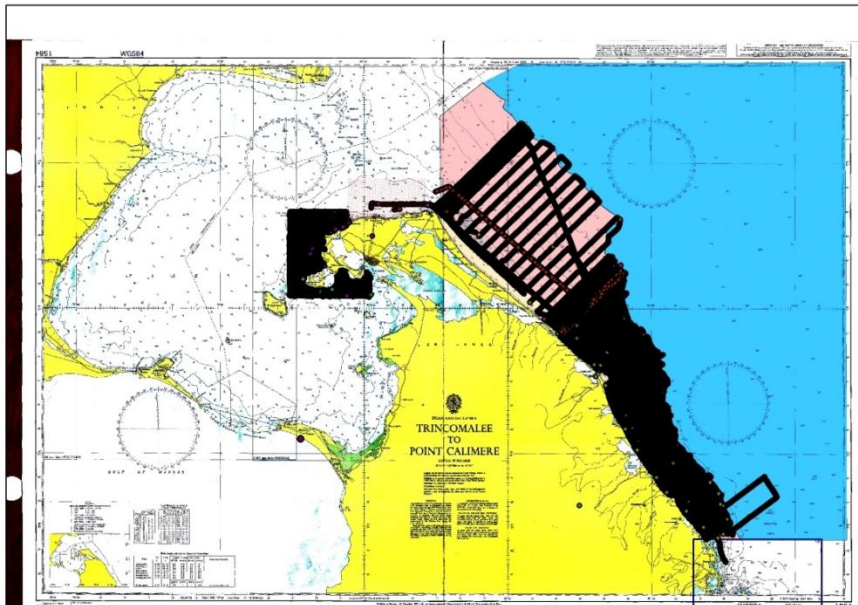


Figure 1:1 Bathymetry coverage for the Coastal Chart "Trincomalee to Kudremalai Point"



Figure 1:2 Field works for Coastal chart Trincomalee to Kudremalai Point

During the year 2020 NHO has planned to complete the 98% of the Nautical Chart for Mannar Island as a separate chart. Surveys for Nautical Chart “Mannar Island” could not start due to permission issue from the Sri Lanka Navy in 2020. Due to the COVID-19 pandemic situation, the surveys couldn’t carry out as planned within this year. During this year, the total distance of surveyed lines of the planned area is 509 km and it’s 5% of the total area of the nautical chart of Mannar Island.

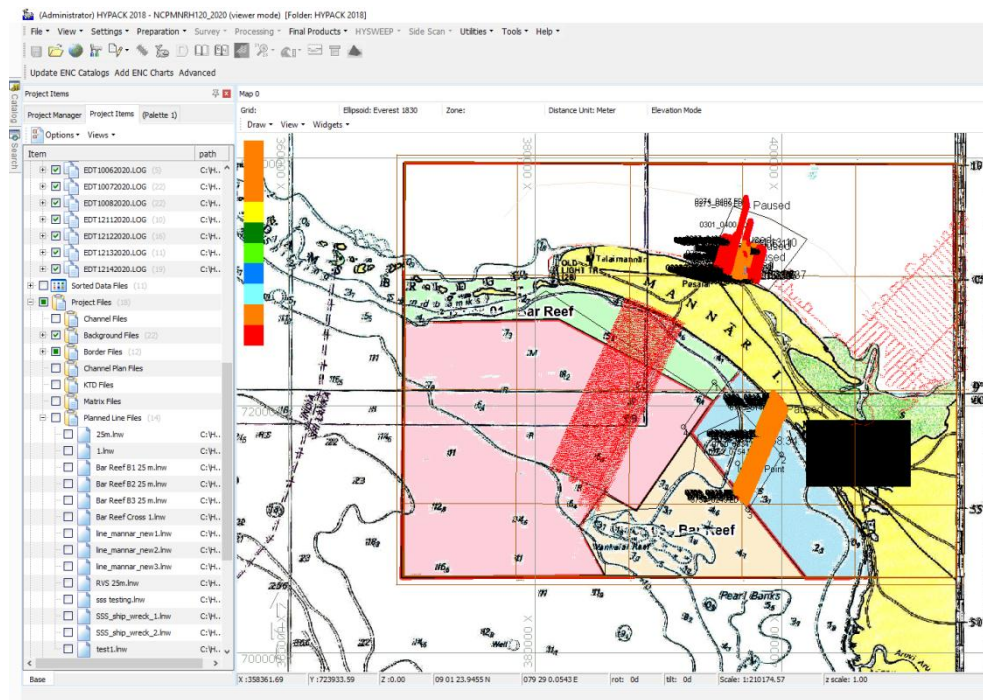


Figure 1:3 Bathymetry coverage for the Nautical Chart of Mannar Island

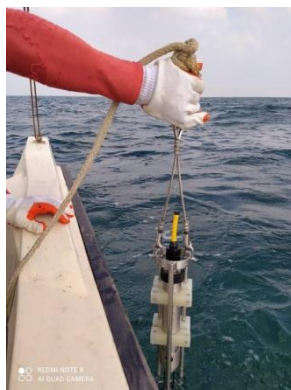


Figure 1:4 Field works for Nautical chart of Mannar Island

PROJECT NO : 1.2

DATA ACQUISITION FOR COASTAL CHART “LITTLE BASSES REEF TO PULMODDAI ROADS”.

According to the National Nautical Chart Index, the total coastal belt of Sri Lanka intended to cover with five small scale charts. Nautical Chart “Little Basses Reef to Pulmoddai Roads” is one of those. This covers 250 km long coastal stretch from South to East of the island. The total area intended to survey in two phases. During the phase one NHO has planned to complete surveys up to 200m isobath using RV “Samuddrika”. Due to unavailability of RV “Samuddirka”, the data collection couldn't completed as planned. And also the COVID-19 pandemic situation of the country is also affected for continuing the surveys as planned within this year.

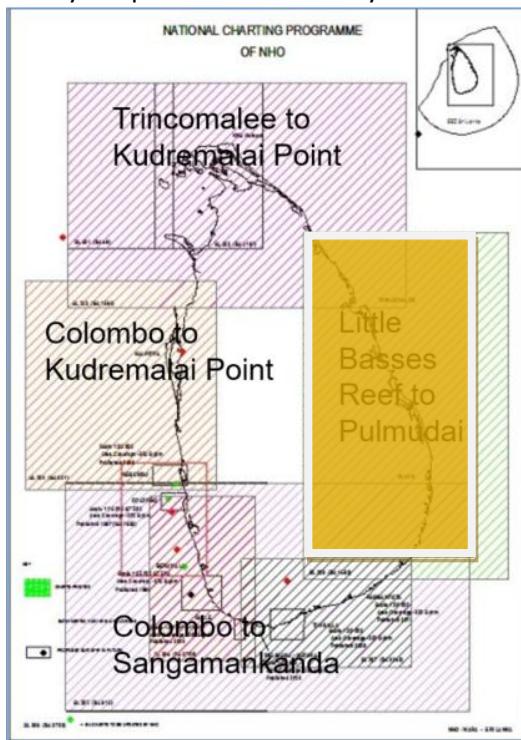


Figure 1:5 Nautical Charts covering the entire coastal belt

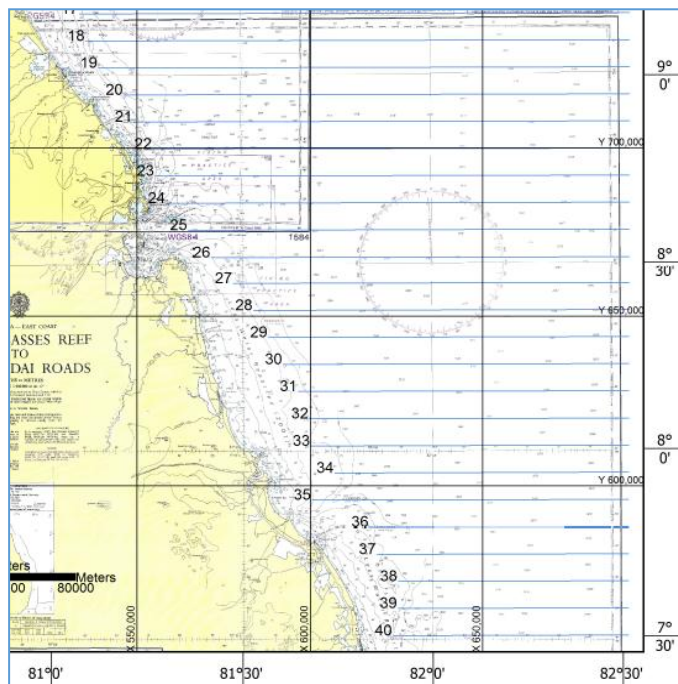


Figure 1:6 Coastal Chart “Little Basses Reef to Pulmuddai Roads”

PROJECT NO : 1.3

BATHYMETRIC DATA ACQUISITION FOR COASTAL CHART “WELIGAMA TO COLOMBO”

60% of the chart was completed at the end of year 2018 and NHO /NARA has intended to complete surveys up to 200m contour .Only 10% of the planned area could completed during the year 2019 since unavailability of RV“Samuddrika” for a considerable time period. Sri Lanka Navy hydrographic unit assure to provide bathymetric data beyond the 200m contour up to the chart limit. Due to the COVID-19 pandemic situation, the gap surveys couldn’t carry out as planned within this year.

PROJECT NO : 1.4

UPGRADING THE PUBLISHED NAUTICAL CHARTS

The published charts should be maintained to ensure the validity of existing data as the sea bed is subjected to change due to natural phenomena such as Tsunamis, storms or any other extreme weather condition or by other manmade hazard. Any changes of bathymetry are needed to be applied timely. Necessary communication links has been maintained with the relevant authorities, Harbor Master of Sri Lanka Port Authority and Director General of Merchant Shipping Secretariat.

PROJECT NO : 1.5

DATA PROCESSING AND CARTOGRAPHIC WORKS

Data processing for the acquired bathymetry (phase I and phase II) of the Nautical chart Trincomalee to Kudremalai Point was completed.

PROJECT NO : 2.0

AN ASSESSMENT OF TIDAL ASYMMETRY AROUND THE SRI LANKAN COASTLINE

Sri Lanka is an island situated in the northern part of the Indian Ocean and is separated by a shallow and narrow Palk Strait. Higher salinity Arabian Sea is located on its western side and the low salinity Bay of Bengal on its eastern side. The continental shelf in Sri Lanka is narrow and is shallower than the average depth of the shelves around the world. It is narrowest around the southern part of Sri Lanka, but it broadens to merge with the Indian continental shelf towards north and northeast. The tide around Sri Lanka is mixed semidiurnal with a spring tidal range of between 0.40 and 0.60 m. The range is less in the northern part of the island. The east coast features different phases from west coast with a rapid change in southeast. The waters around the Island are subjected to seasonal reversals of currents forced by the monsoons.

One of the significant aspect in the tide around the Island is, there exhibits a complete opposite tidal phase difference between Western to South region and East to North region. For an example, when Colombo experiencing high tides, Trincomalee experiencing low tides and vice versa.

This indicates, the tide around Sri Lanka is generated from two different amphidroms in the Indian Ocean. Therefore, the aim of the study identifies these amphidromic points and their influence to the tidal phenomenon around the coast line. A comprehensive regional tidal modelling is expected to carry out encompassing Sri Lanka using existing tidal data. The interaction boundaries of these two amphidroms at the coast line are also expected to be carried out. Several new tidal stations will be set-up to validate the model results. Finally, with these results, it is possible to make a comprehensive study on tidal behaviour around Sri Lanka.

Further, this information is very useful in tidal datum establishment for hydrographic applications such as national charting as well as further densification of the tidal network around Sri Lanka. Further investigations can be carried out regarding the MSL variation and the geoid undulation determination.

Objectives

- To identify the influence to the tidal phenomenon around the coast line caused by the two amphidromic points located in the Indian Ocean.
- To identify the interaction boundaries of these two amphidroms at the coast line along the coast.
- To develop a comprehensive regional tidal model for Sri Lankan coastline.

Data Collection & Analysis

Southeast Amphidrome

Tidal data from Trincomalee, Hambantota and Kirinda tide gauges were analyzed for identifying approximate location of the amphidromic point of Southeast coastline. Additionally 25h tidal observations were carried out at Amaduwa, Patanangala, Kirigalbay, Okanda and Panama which are located along the southeastern coastline. According to the regional tidal model BBay (Bay of Bengal) of Oregon State University (OSU) that has spatial resolution of $1/30^\circ$, the amphidromic point for M2 constituent is located between Panama and Kirigalbay (Figure 2:1). Interpolation of observed 25h and archived tidal data reveals that the amphidromic point of M2 constituent is located near Potthana bay where phase of M2 tidal constituent becomes zero. This location is also confirmed by the interpolation of tidal constituent M2 which was derived from Sea Level Anomalies (SLA) data observed by Satellite altimeters (Figure 2:2 & 2:3).

The amphidrome may also be considered as a time-dependent position of zero tidal range for a complete tidal band. Therefore daily and seasonal movements of amphidromic points needs to be tracked.

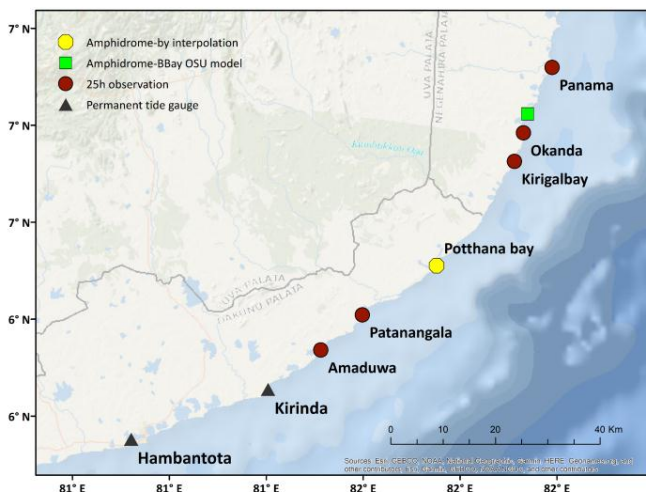


Figure 2:1 M2 constituent is located between Panama and Kirigalbay

Location	Phase (Degree)
Trincomalee (1 year data)	65.50
Panama	34.89
Okanda	31.50
Kirigalbay	31.20
Patanangala	293
Amaduwa	320
Kirinda (1 year data)	280
Hambantota(1 month data)	264

Table 2:1 Phase values of M2 along southeastern coastline

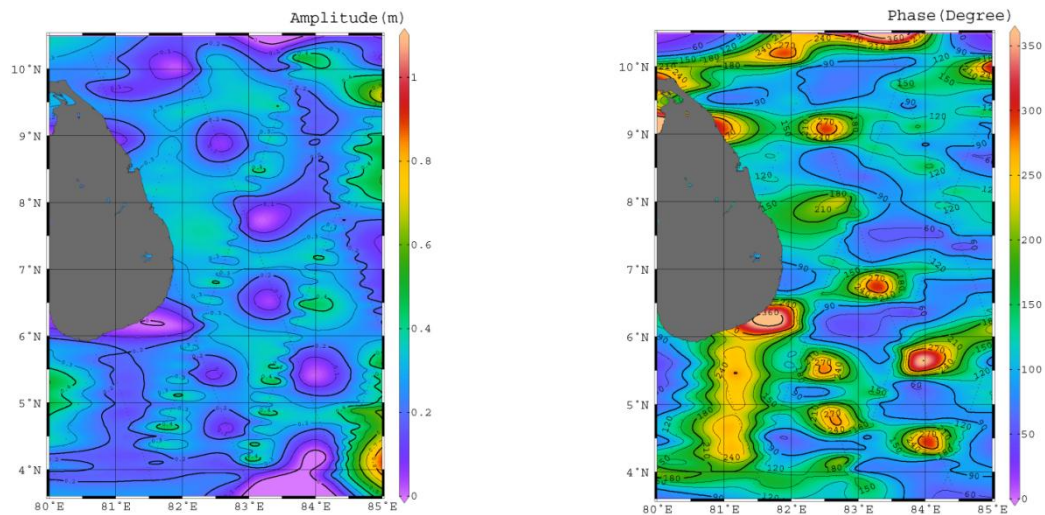


Figure 2:2 a) Interpolation of SLA derived tidal constituent M2-amplitude b) Interpolation of SLA derived tidal constituent M2-phase

Northwest Amphidrome

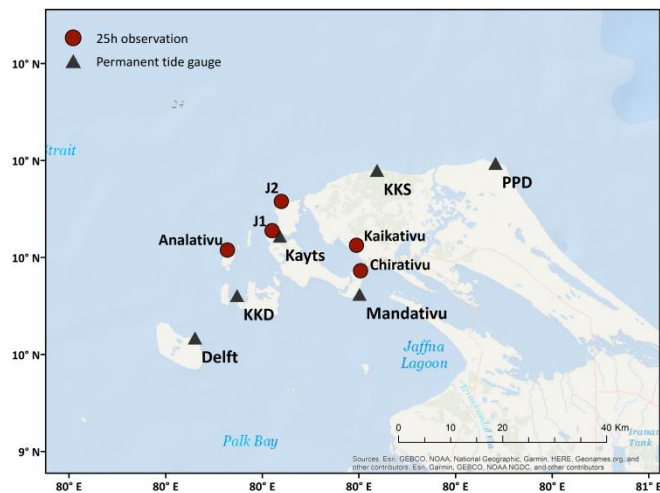


Figure 2:3: Tide gauge locations at Jaffna Archipelago

Location	Phase (Degree)
Point Pedro (1 year data)	78.00
J2	104.00
J1	112.00
Kayts	110
Analativu	239.00
Kurikadduwan	251
Delft	245
Mandativu (1 year data)	254.00
Chirativu	280.00
Kaikativu	346.00

Table 2:2 Phase values of M2 of Jaffna archipelago



Figure 2:4 Installation of tide gauges in Jaffna

A tidal model of 8 major tidal constituents was developed assimilating tide gauge observations for Jaffna archipelago.

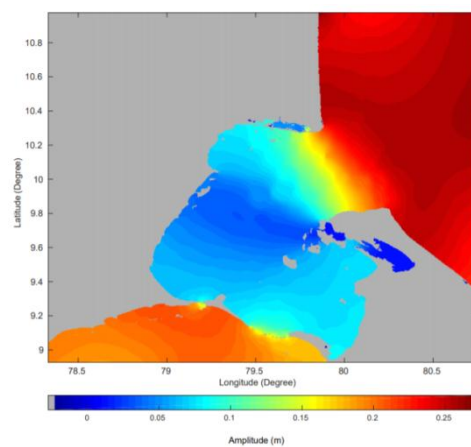
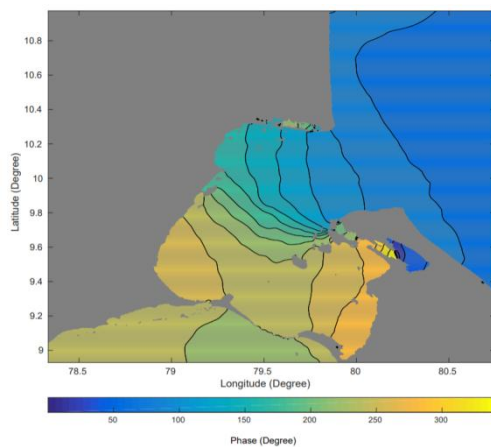


Figure 2:5 a) Phase distribution of M2 constituent b) Amplitude variations of M2 constituents

The model simulates the amphidromic point of M2 constituent around Ariyalai Bay (Figure 5a). Other semi-diurnal constituents S2, N2, K2, show the amphidromic system clearly. From diurnal constituents, except Q1, other constituents show the amphidromic system but with a northwest ward shift relative to the semidiurnal constituents.

Further tidal observations needs to be carried out within Ariyalai Bay and Kalundai Bay in order to observe the movements of amphidromic point and validate the tidal model results.

PROJECT No : 3.0

ESTABLISHMENT OF DATABASE AND ONLINE DATA PROCESSING UNIT FOR CROWD SOURCED BATHYMETRY PARALLEL WITH THE “SEA BED 2030” GLOBAL MAPPING PROJECT OF GENERAL BATHYMETRIC CHART OF THE OCEANS (GEBCO)/ NIPPON FOUNDATION

Bathymetric coverage of the sea around our country is very little and need to be done vast area and it needs years and years to fulfil this with the systematic bathymetric surveys. The world contest is very similar and hence the GEBCO Nippon Foundation has started a project called Seabed 2030 and member states of International Hydrographic Organization been invited to collaborate this project covering their own seas from the bathymetry.

The objective of this project is to map the Indian Ocean using crowd sources bathymetry and maintain and updating the data base and disseminate data for marine management, spatial planning and research in marine geology, ecology and oceanography. This will be a continuation project until 2030.

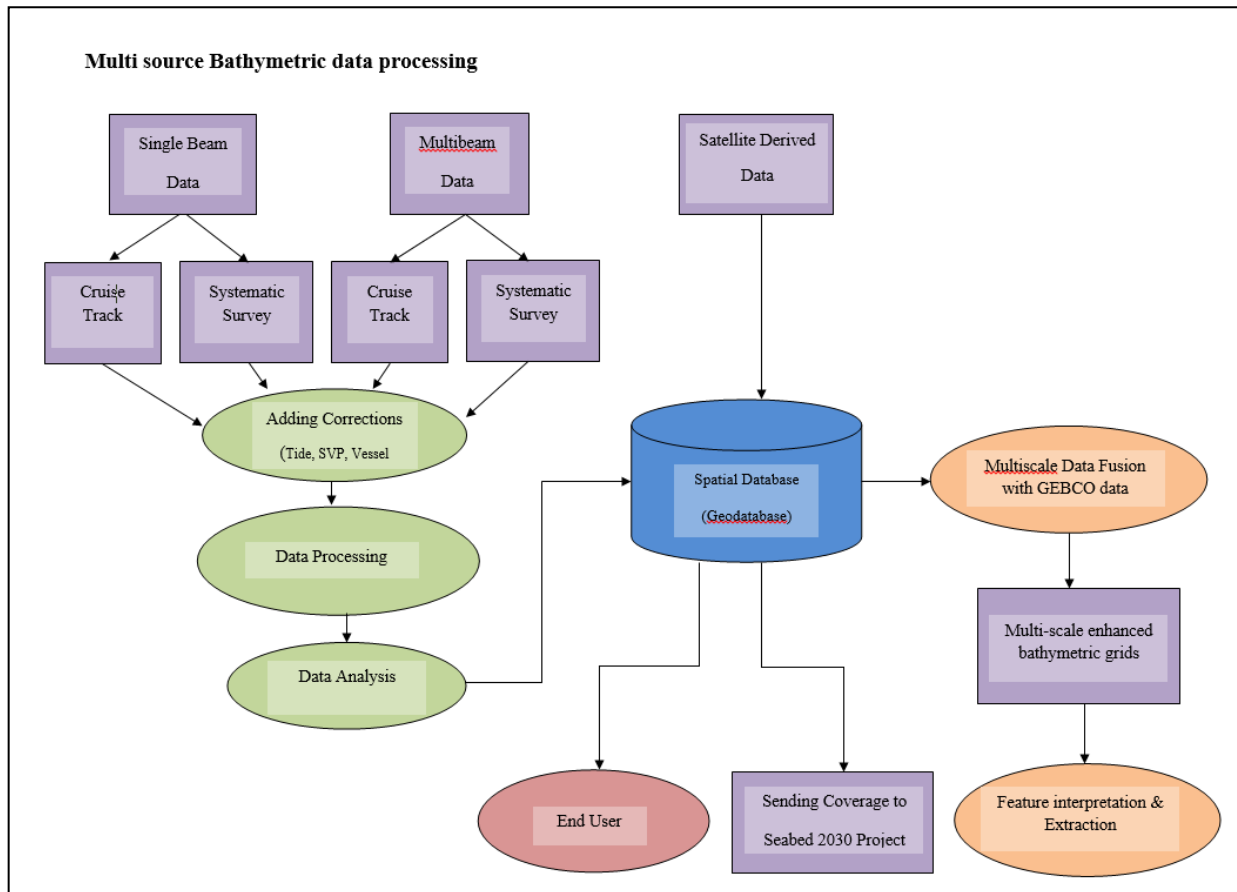


Figure 3:1 Working procedure

Because of the COVID 19 pandemic situation purchasing was delayed of necessary items of infrastructure facilities to establish the structure and networking system as planned for this year. The spatial database interface was generated using ArcGIS platform and model of the surface was created. Further, the requisition has been done from the divisions of NARA to obtain the ship cruises data collected from various sources. The overall progress of the project is 20% for the year 2020.

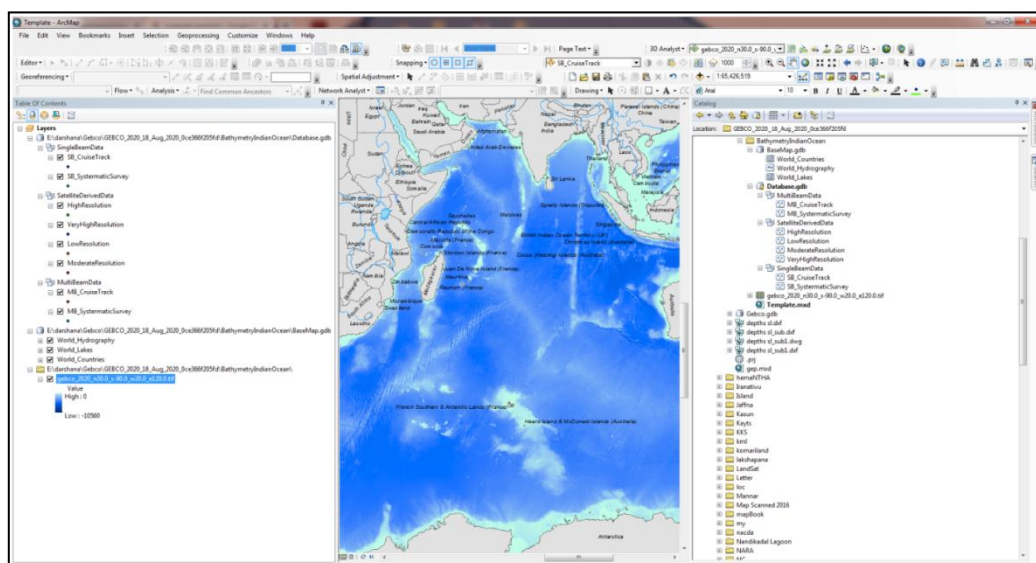
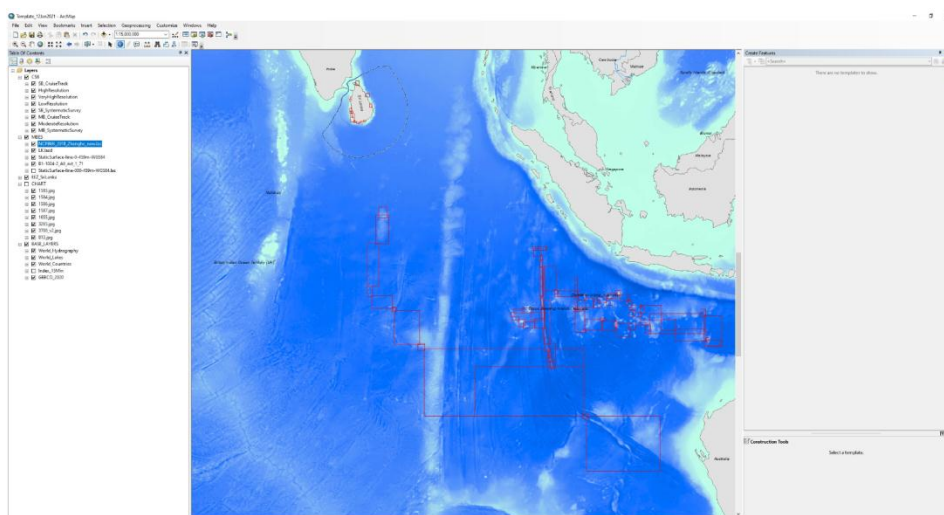


Figure 3:2 Spatial Database Interface



PROJECT No : 4.0

INVESTIGATING VULNERABILITY OF COASTAL EROSION IN KALUTARA

Coastal erosion is becoming a serious environmental issue worldwide due to sea level rise along with climate changes caused by global warming. This study will be focused on Kalutara which is a significant coastal area as the river mouth of Kalu Ganga is located. The sand dune was an important geographical feature in the area because it protected Kalutara town from sea waves. The final output of the project will contribute to fulfil the existing gap by contributing for decision making relevant to coastal environmental protection and policy planning. The literature review part is completed and due to the COVID 19 pandemic of the country, the process of the purchasing of satellite images and field work were hindered on time and couldn't continue the project within the year 2020. Further, purchasing of satellite images is in progress.

Therefore, the freely downloaded satellite images and Google earth images were used for extraction of coastlines from 2005 to 2017. The digitized outlines were opened in ArcGIS to identify the spatial variation. Seasonal variations of the sandbar were observed for the period of 2005-2017. This is mainly happening during the southwest monsoon period prevailing from May to September. Also both the erosion and accretion have to be measured in GIS environment in order to get the relationship with monsoonal periods.

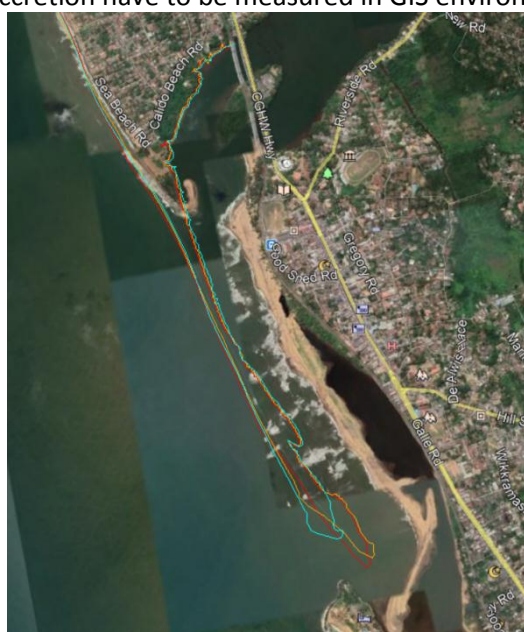


Figure 4:1 Sandbar in 2005 (blue), 2010 (orange) and 2015 (red)

PROJECT No : 5.0

SURVEYS CONDUCTED FOR SPECIAL REQUESTS FROM GOVERNMENT AND OTHER INSTITUTIONS

PROJECT No : 5.1

LAGOON SURVEY

Ministry of fisheries initiated a project in development of a master plan for pre identified lagoons and accordingly made a request from NHO/NARA to conduct bathymetric survey in urgent basis in Nandikadal lagoon. The line spacing was suggested as 100 m since it need to identify dredging areas and the real bottom topography. Final report and the bathymetric chart were submitted accordingly.

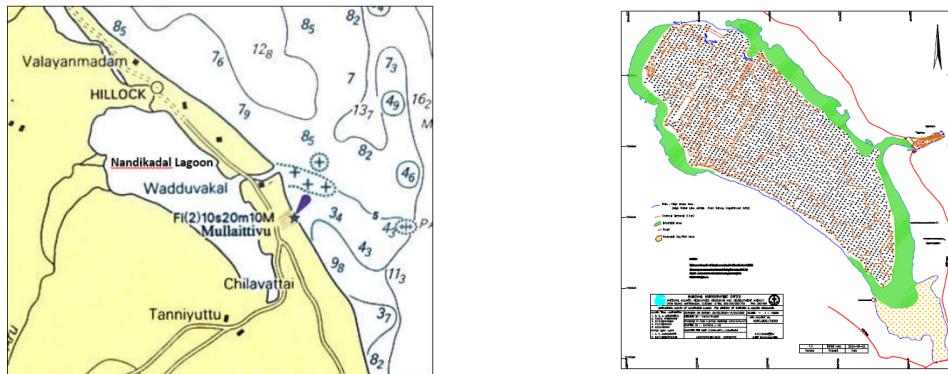
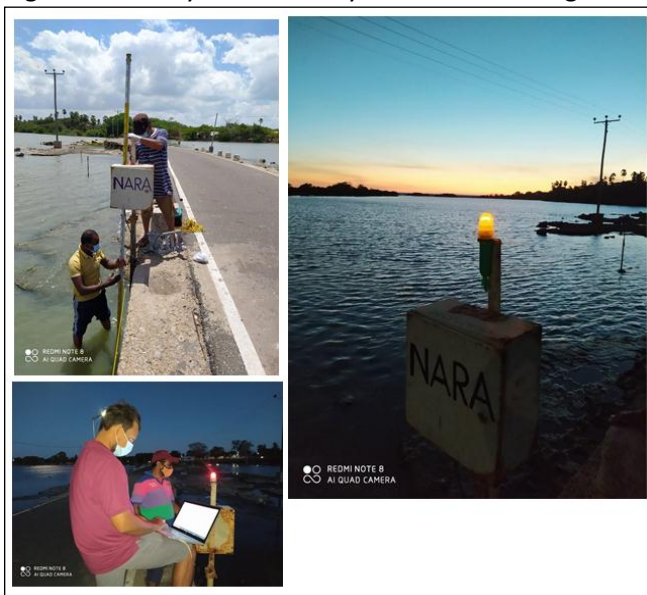


Figure 5:1 Bathymetric Map for the Nandikadal Lagoon



Figure 5:2 Bathymetric survey at Nandikadal Lagoon



PROJECTNo : 5.2

BEACH PROFILE SURVEY FOR ENVIRONMENTAL MONITORING STUDIES OF COLOMBO PORT CITY DEVELOPMENT PROJECT

The government of Sri Lanka has designed to implement a reclamation project covering approximately 500 acres of sufficient land area between the Colombo South harbor and the Galle Face Green to create “port city”. According to the agreement signed between China Harbour Engineering Company Limited (CHEC), who is the contractor of the project, with the NARA, National Hydrographic Office (NHO) has conducted the beach profile surveys to monitor the physical characteristics of the sea bed and provide data to assess the potential impactsto seabed morphology/topography, 10 km North and 10 km South of the above proposed site.

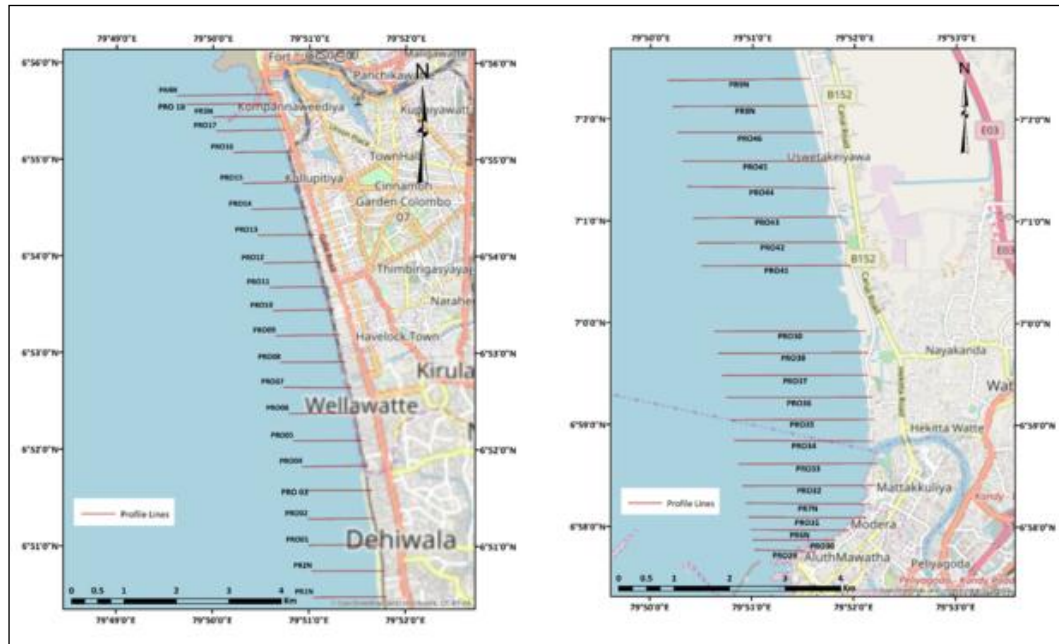


Figure 5:5
Profile
Layout



Figure 5:6 Land and bathymetric survey field work at Port City Development Project

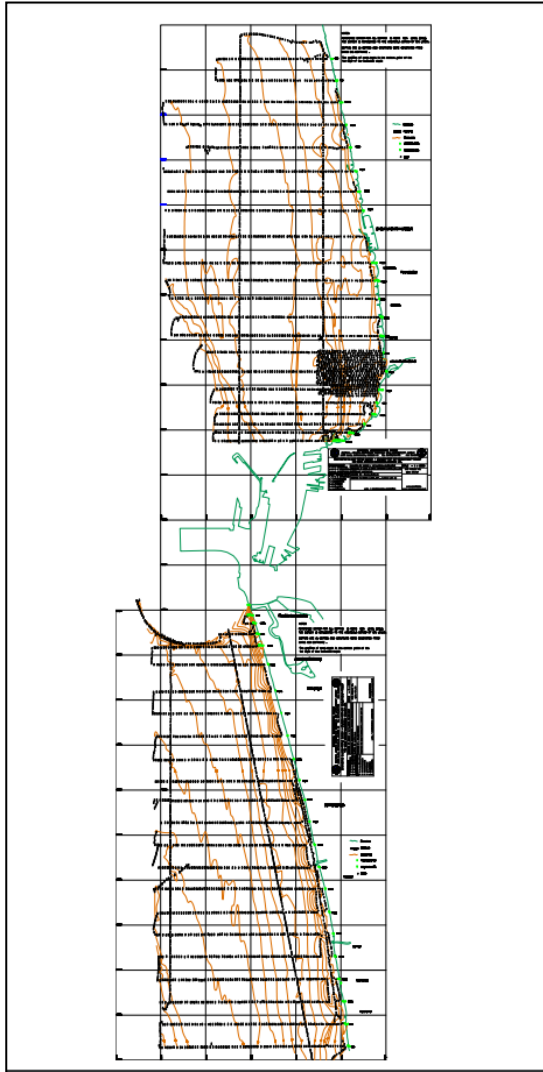


Figure 5:7 Bathymetric survey chart

PROJECT NO : 5.3

DEMARICATION OF AREAS IN THE SEA FOR SEA CUCUMBER EXPORT VILLAGE IN KILINNOCHCHI DISTRICT

To encourage the sustainable agriculture and fishery ventures, the Jaffna district is selected for establishing the dedicated buffer zone for sea cucumber farming for overseas market. The National Aquaculture Development Authority (NAQDA) is awarded this project to demarcate the sea plots for sea cucumber farms. Surveys were carried out to demarcate of plots for sea cucumber export village in Killinnochi district. Already 200 plots were demarcated and the documents were submitted for the purpose of developments.



Figure 5:8 Bathymetric survey for demarcation of areas for sea cucumber export village

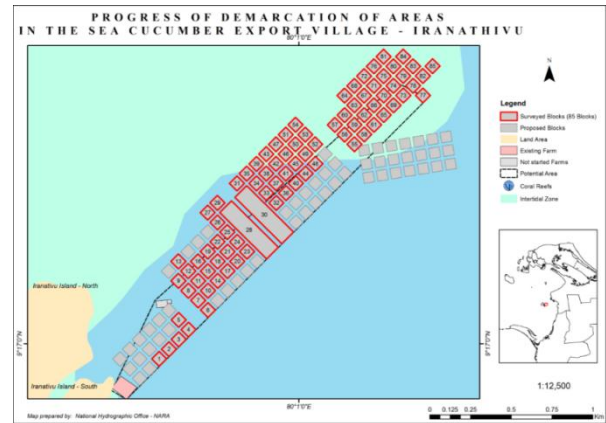
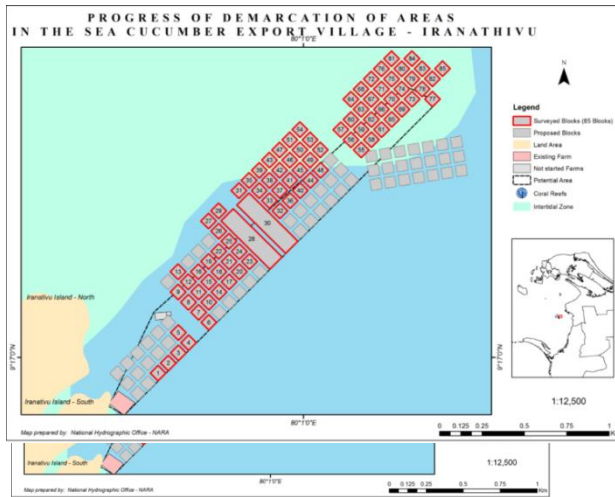


Figure 5.9: Sea plots for demarcation

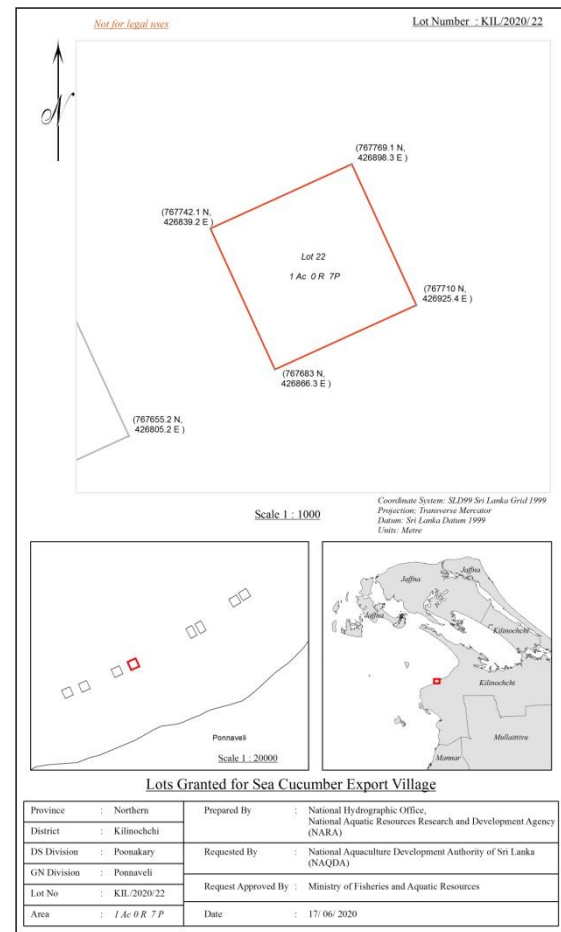
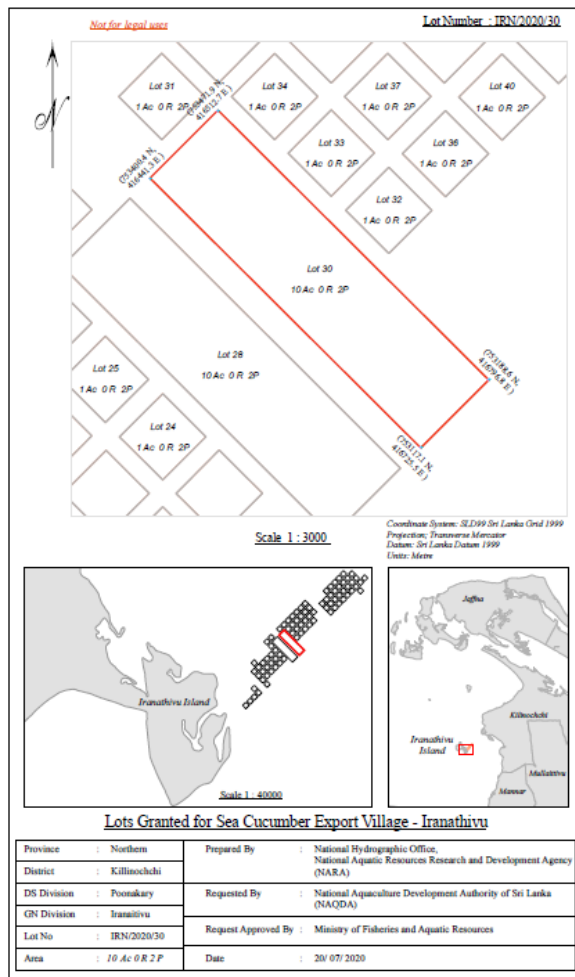


Figure 5.10: Survey plans for demarcation of sea plots

PROJECT NO : 5.4

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SEA BED RECLAMATION FOR THE RECREATIONAL BEACH/ SEA WATERFRONT DEVELOPMENT PROJECT

Coast conservation and Coastal Resource Management requested for conducting Environmental Impact Assessment for the proposed sea bed reclamation for the Recreational Beach/ Sea waterfront development project from Colpetty to Dehiwala canal outlet to consider granting their permit. The bathymetric surveys were conducted to monitor the changes in the sea bed and coastline in the project area including 10 km southward and 10 km northward.

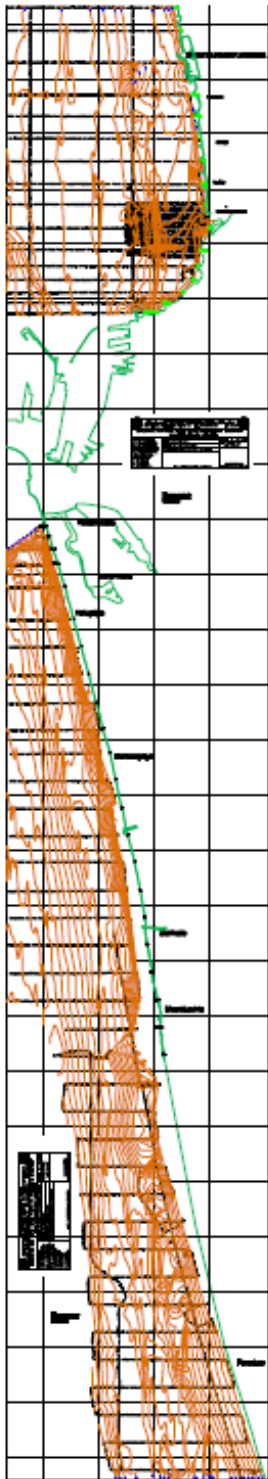


Figure 5:11 Bathymetric survey chart

Publications / Maps

Publications

1. Gunathilaka, MDEK, & Ratnayake, RMDI. (2020). An Analysis of Tidal Asymmetry around Sri Lankan Coastline. *KL GeoHydro 2020 : New Norm and Challenges in the Marine Industry* (p. 42). Universiti Teknologi Malaysia (UTM).

Training / Awareness Programs conducted

1. Four undergraduate trainees from Faculty of Geomatics, University of Sabaragamuwa for three months industrial training program under supervision of National Apprentice and Industrial Training Authority (NAITA).
2. Due to COVID 19 pandemic situation, official visits from different institutions to NHO was cancelled.

Foreign / Local Training and International Commitments

1. Second session of the IHO Assembly, Heads of Delegation (Virtual) meeting, 16-18 November, 2020



Consultancy Surveys Conducted for Special Requests

Project	ContractAmount (Rs)
Demarcation of areas in the sea for sea cucumber export village in Kilinochchi District	6,517,800.00
Beach Profile and Bathymetric Survey of Colombo Port City Development Project	2,176,330.00
Environmental Impact Assessment for proposed sea bed Reclamation for the Recreational Beach/ Sea waterfront development project	1,083,680.00

5.4 INLAND AQUATIC RESOURCES AND AQUACULTURE DIVISION

Head of the Division : Dr.V. Pahalawattaarachchi

Project No	Project/Activities	Responsible by	Allocation (Rs.Mn)
3.2	Assessment of fisheries and aquaculture potential in floodplain ecosystems of Nilwala river basin.	Mr.K.W.R.R. Amaraweera	1.105
3.3	Reef restoration for enhancing the spat availability for commercial scale oyster farming	Mrs.A.S.I.E. Corea , Mr.C.B. Medagedara Dr. V.Pahalawattaarachchi	1.354
3.4	Survey on natural pearl oyster resource in North West and East coasts regard to regain the pearl industry in Sri Lanka	Mr. C.B Medagedara, Mr. KasunDalpadudu Dr V. Pahalawaththaarachchi	0.800
3.5	Establishment of gene pool of <i>Kappaphycusalavarziidotystrains</i> in relation to cope with different environmental conditions.	Mr.J.SJayanatha, Mr.U. S. P. K. Liyanage Dr. V. Pahalavaththaarachchi	0.400
3.6	Enhancing mangrove crab (<i>Scylla serrata</i>) aquaculture in Sri Lanka through better feed and health management with special reference to popularize the crab farming industry	Dr. M. G. I. S. Parakrama, Dr. A.D.W.R Rajapakshe Dr.P.P.M. Heenatigala	0.550
3.7	Biofloc Technology as an Integral Approach to Enhance Production Performance of ornamental fish Guppy (<i>Poeciliareticulata</i>) farming	Mr. E.D.M Epasinghe, Dr. A. A. D Amaratunga, Mrs. S. R. C. N. K Narangoda Mrs. A. M. A. NAdikari	0.992
3.8	Maintenance of Endemic fish captivity breeding and display section (removed research project title and continue maintenance of endemic fish section)	Ms. R.R.A RamaniShirantha	0.300
3.9	Proceeding on biotechnological application of Aquatic plants and seaweeds and growth studies in aquaponic recirculation system	Dr. K. K. T. Nuwansi, Mrs. D. M. S. Sugeeshwari Dr. V. Pahalawattaarachchi	1.000
3.10	Study on Disease prevalence in ornamental fish and cultured Tilapia	Dr. A. D. W. R Rajapakshe	0.510
3.11	Monitoring disease conditions of shrimp aquaculture industry in Sri Lanka	Dr. P.P.M Heenatigala	0.630
3.12	An Evaluation of Traditional Fishing Activities in Negombo Estuary, Bolgoda Lake, Madu Ganga and Jaffna lagoon and Strategies for Proper Management.	Mr. J. S. Jayanatha Dr. M. Gammanpila	0.316
3.13	Culture based fisheries in Perennial reservoirs; related to Limnological studies in selected reservoirs leading to optimum stocking of fish	Mrs. Amitha Adikari	0.742
3.14	Development of ornamental fish feed and ornamental fish culture at Panapitiya Regional Research Center- NARA	Dr. M.W.C.D. Palliyaguru, Mr. D.A.Athukorala Mr. E.D.M Epasinghe	2.000

PROJECT NO : 3.2

ASSESSMENT OF FISHERIES & AQUACULTURE POTENTIAL IN FLOODPLAIN ECOSYSTEM OF NILWALA RIVER BASIN IN SRI LANKA.

Responsible Officer : K.W.R.R.Amaraweera
Budget (Rs) : 1.105 M

Introduction:

According to the Department of irrigation Inundation area map Nilwala river basin in May 2017, 12.6% of the total land area of Matara District was inundated by floods. Flood water and lands are considerably underutilized and can be used for aquatic productivity. Thihagoda, Malimbada, Athuraliya, Matara and kamburupitiya are the most inundated DS divisions of Nilwala river basin for example at least 30% of total lands in each DS division was inundated by floods in May 2017 (Inundation area map, Nilwala river basin in May 2017, Department of irrigation).

Objectives:

- To assess aquaculture potential in Nilwala river basin
- To get the maximum utilization from flood plain for aquaculture production
- To assess land use patterns, ecosystem services, fish biodiversity in Nilwala river basin
- To engage the community people towards a sustainable production system from which they can improve their socio-economic condition.

Methodology

- A preliminary survey will be carried out to demarcate flood plain areas of Nilwala river basin.
- Suitable sampling locations will be selected for collecting environment data according to the flood, water availability and rainfall data (Department of Irrigation)
Data collection in suitable sampling location
 - Water quality parameters - T, pH, DO, salinity, Turbidity, Nitrate, Phosphate, chlorophyll a
 - Heavy metals - Cd, Pb, As, Hg
 - soil quality - soil type, pH
- Conducting socio-economic & land used patterns survey vulnerable families in 20 DS divisions in Matara District.
- Monitoring riverine fishery in floodplain
- Preparing seating maps on aquaculture potential areas using GIS
- Carry out awareness workshop for transferring knowledge between relevant groups

Results

- The highest rainfall was recorded in May and October months and the lowest rainfall is recorded January to March.
- The bimodal rainfall pattern can be seen due to monsoons and cyclonic depressions. One high value is highlighted in May representing South East Monsoon (SEM) and the other high value occurs in October representing cyclonic depressions.
- Fish catch per boat fluctuates according to the fluctuation of rainfall & water height.
- Out of the three hydrological parameters, rainfall, water height and river discharge, rainfall showed the strongest negative correlation with fish catch per boat ($r = -0.976$, $p = 0.000$).
- When water depth increases, distribution of fish per unit volume decreases, unless they are migratory species which swim upstream for spawning in shoals.
- Strong correlation between percentage of active fishers engaging in fishing and the fish catch per boat ($r = 0.910$, $p = 0.000$)

- Suggested that the fish Catch per boat has increased during dry seasons because the water depth is low and the probability of fish getting tangled in nets or captured by other fishing gear is high when the water level is low.
- Most flood events can be occurred during May, October, November and December in lower lands of Nilwala river
- The corresponding water level of floods alert, minor floods and major floods are 5m, 6m and 6.5m respectively.
- Rainfall and floods impact on fishing activities such as reduction in number of fishers engaging fishing, and fish catch per boat.

Recommendations & conclusions

Thihagoda, Malimbada, Athuraliya, Matara and Kamburupitiya are the most flood inundated DS divisions of Nilwala river basin for example 30% of total lands in each DS division was inundated by floods. Water quality parameters and soil qualities in selected sites (20 Sites) in Nilwala floodplains suitable for fish culture development. According to the prepared GIS map the highest potential aquaculture area is recorded in Matara DS Division. The calculated potential aquaculture area in Matara DS Division is 9 km² & it is 50% of total flood inundation area in Matara DS division.

According to the socio-economic survey vulnerable families in 20 GS divisions more than 60% paddy lands were abandoned due to the floods and failures of Nilwala scheme. It was recorded that vulnerable families have knowledge or experience in fish keeping (< 5%). Most farmers in Matara DS Division use abandoned paddy field for alternative cultivation of green leaves. In riverine fishery, Tilapia, Giant gouramy, Loolla, are the preferred fish species & the most Valuable species is freshwater prawn.

Heavy rainfall and floods effect on fishing activities such as reduction in number of fishers engaging fishing, and fish catch per boat. Fish farmers of flood prone area should have to improve adaptable measures to cope challenges at the farm level. Small scale fish farmers can adapt to small changes but they can't adapt for rapid changes in flood prone areas. Fish farmer needs to be assisted by scientific research and technology to find solutions that will allow them to adapt to future challenges.

It is recommended that the government and other stakeholders should help enhance resilience of fishing communities by supporting existing adaptive livelihood. Strategies and management institutions support adaptation to high rainfall and floods.

Out put

- GIS maps for Thihagoda, Malimbada, Athuraliya, Matara and Kamburupitiya DS divisions on aquaculture potential areas
- Crop calendar for flood plain Nilwala River for Gift Tilapia.

Outcomes

- Development of fish culture in flood plain of Nilwala river
- Alternative live hood for rural communities

Conclusion

The values of water & soil quality parameters in Selected 20 sampling sites within the recommended ranges for fish culture development. Since abandoned flood lands can be used for Aqua culture development. According to the prepared GIS map calculated potential aquaculture area is 9 km² in Matara DS Division & it is 50% of total flood inundation area of Matara DS division.

Progress : Financial :- % Physical : 80%

Constraints

Field visits and project works were stopped or delayed for 4 months due to the Covid-19 situations in year 2021.

PROJECT NO : 3.3

EXPERIMENTAL REEF RESTORATION FOR ENHANCING THE SPAT AVAILABILITY AND IMPROVING SPAT COLLECTION METHODS FOR COMMERCIAL SCALE OYSTER FARMING

Responsible Officer : A.S.I..E. Corea, C. B Medagedara & V. Pahalawattaarachchi
Budget(Rs.) : 1.354 M
Project period : 3 years - 2018 – 2020

Edible oyster culture is expanded as a community based projects among fisher communities in the Puttalam district. Collecting sufficient spat for commercial culture has been a drawback for further expansion. Although spat collectors have been introduced for collecting spat, collection can be done only at Gangewadiya as there are no other oyster beds with sufficient breeding oysters close to culture locations. Therefore this project was designed to build new oysterbeds(Oyster reefs) so that breeding populations will be increased and spat availability will be increased.

Reefs were built and spat attachment to new reefs were monitored during first year(2018) using different structures. The reefs were shifted to new locations and the growth and survival of the oysters on the reef was monitored (2019) during second year. The spat production from the new reefs were to be monitored during this year(2020)

The reef monitoring commenced by placing collectors near new reefs in February and Reef growth was observed. But after that all field was cancelled due to COVID 19. NARA RRC at kalpitiya was taken as a COVID quarantine center and therefore field work recommenced only in July. The new reefs had been destroyed during the COVID period. A new one was constructed and shifted again in August but Second COVID wave in October stopped all field activities and therefore could not be monitored. These need to be monitored for their performance

From the spat collectors deployed about 10450 spat were collected during the year in February and August September period. Culture activities were not carried out as usual by farmers as they could not sell the products because no tourists were coming to the country. Therefore depuration plant was not operated and no workshops were held for knowledge dissemination as farmers were not actively involved in oyster culture during the year due to COVID. Some of the water quality parameters could not be tested as chemicals requested were not received during the year

Progress: Financial : Physical : 45%

PROJECT NO : 3.4

SURVEY ON NATURAL PEARL OYSTER RESOURCE IN NORTH WEST & EAST COASTS REGARD TO REGAIN THE PEARL INDUSTRY IN SRI LANKA

Responsible Officer : C.B Medagedara, Pradeep Chathuranga
Budget (Rs.) : 0.8 M

Introduction

The Black-lip pearl oyster (*Pinctadamargaritifera*) has long been an important species in the Indo-Pacific region mainly because of its beautiful shell, which is lined with a shiny and iridescent coating called nacre. The natural pearl of this species is highly valuable as a gemstone in jewellery industry. In addition, it is also

believed to increase fertility and is hence recommended for women suffering from hormonal, fertility and menstrual problems. It is also believed to prevent heart diseases, eye diseases, and digestive ailments and to alleviate allergies and their effects.

Specific Objectives

- Survey on natural pearl oyster stocks in Silwathura
- Identification of culture site in East coast and continue culture trail in North West coast
- Identification on suitable culture methods for pearl oyster culture

Activities carried out and results:

Activities carried out to take pearl oyster from natural bed and restocked at Kiranchi

Mature Pearl oyster sample of 800 no's bivalves drawn from Silawathura (E 79.43.49.29 / N 8.44.49.29) sea area. Samples were stocked in plastic box until transported safely to coast, samples were covered using wet gunny bags to increase moisture content and maintained liveness. Then samples were transported to Kiranchi area by vehicle and it took only two hours. Oyster rafts already prepared by wooden reaps and floating materials also attached increasing floating ability. Pearl oyster samples were stocked in special culture bags and plastic structures with the amount of 35-40 individuals per bag. Prepared oyster rafts were launched in selected deep trenched sea cucumber farm and oyster bags tied up. Sample sizes were recorded, shell height shell length and shell thickness parameters respectively. Level of salinity was recorded as 33ppt. Oyster rafts were anchored using 25 Kg cement blocks and 10mm nylon ropes. Oyster culture bags were suspended in water. Oyster associated sea grasses also sampled. Sample sizes were recorded shell height, shell length, shell width and weight parameters ($39.55 \pm 4.30\text{mm}$, $46.97 \pm 4.69\text{mm}$, $18.15 \pm 2.00\text{mm}$, $14.62 \pm 3.28\text{g}$)

Sites in Walleippadu Kiranchi deep trenched sea cucumber farms

- Wallippadu area along the sea cucumber farms located on deep trenches in coral garden. Depth was recorded as 12-17 feet and salinity was 33ppt.
- The most important factor as wave action, there were very small wave action and easy to launch raft.
- Poaching of Pearl oysters may be the possible effect during the long culture period, this can solve easily because every farm secured by watcher's day and nights.
- Water samples were drawn by marked trenches and assessed for other chemical parameters.
- Community based pearl oyster farming programme can be easily start with sea cucumber farmers. Pearl oyster spats can be easily transport from Silawathura area during 2-3 hours' period.
- Pearl oyster samples were cultured in perforated plastic bucket structure and net structure to facilitate growth rate. Culture structures were tied to floating rafts
- 510 Nos of pearl oysters remaining live, according to observations after five months 63.75% of pearl oyster's growth well compare with initial stock.
- Sample sizes were recorded shell height, shell length, shell width and weight parameters at the end of November ($51.01 \pm 2.31\text{mm}$, $40.92 \pm 2.20\text{mm}$, $20.65 \pm 1.64\text{mm}$, $21.56 \pm 2.24\text{g}$)
- The most important fact that we observed spats in culture structures though we stocked mature oysters in February.
- 106 Nos of pearl oyster spats were separated and stocked in separate plastic culture box for further culture, 20.78% compare with retained mature oysters. Sample sizes were recorded as shell height, shell length, shell width and weight parameters at the end of November ($26.01 \pm 1.67\text{mm}$, $24.87 \pm 1.32\text{mm}$, $7.03 \pm 2.11\text{mm}$, $6.74 \pm 2.51\text{g}$)

Formation of pearl oyster research group

- With the experts in the field of pearl oyster culture in New Zealand and Australia formed an international knowledge sharing group to uplift the pearl culture in Sri Lanka
- As the first step there were conducted some zoom meetings to collect background information about
- History of pearl industry in Sri Lanka
- Existing pearl beds in North Western sea
- Proper identification of captured pearl oyster species
- Identification of suitable locations to initiate community based pearl oyster culture
- Further development of pearl oyster culture as commercially

Constraints

Covid -2019 Pandemic acted as the major killing factor of this year because due to prolong curfew from mid of March to June and October Sampling and underwater survey of pearl oyster bed at Silawathura stopped. The monthly data recording and morphological sampling of stocked pearl oyster samples at suspended floating rafts at Kiranchi. Security issue raised by community based farmers because the poaching of rafts and oysters happened therefore responsibility of security of raft handed over to sea cucumber farmer. Nearly 20% mortality was observed after one month in deposited culture structures, transportation stress may be happened and during the next year project transportation process should be developed.

Output

- Built up awareness among fishing communities, and NARA on community based pearl oyster culture and potential of culturing pearl oysters in Kiranchi.
- Identified of Natural pearl oyster stocks, live samples were taken for species identification by JCU, Australia
- Preparation of modified floating rafts and stocked of pearl oyster spat for growth

Outcome

Proper stock analysis will be carried out to identify existing stock. Location maps already prepared and samples drawn out for identification process. Expert group of pearl research provided guidance for novel initiatives ex, newly developed spat attachment material. Survival of extracted mature pearl oysters in culture premises is acceptable percentage. Oyster spat identification after this project was important because it kept first step on pearl oyster mariculture in Sri Lanka.

Recommendation

More samples should draw and stocked for better culture practice. Local fisher folks should aware about importance of pearl oyster mariculture in future. Local culture should successful to start commercial culture of pearl oysters.

PROJECT NO : 3.5

ESTABLISHMENT OF GENE POOL OF *KAPPAPHYCUSALAVARZII* (DOTY) STRAINS IN RELATION TO COPE WITH DIFFERENT ENVIRONMENTAL CONDITIONS.

Responsible Officers : J.S. Jayanatha, VasanthaPahalawathaarchchi
Budget (Rs.) : 0.4 M

Introduction

Kappaphycus alvarezii (previously *Eucheuma cottonii*) and the trade name cottonii is one of the most commercially important species which is being culture by many South- East Asian countries. Hence under the study purpose it is suggested to use spores/ sporeling cultivation in order to increase the quality of seed

stock. Increasing the quality of extract through superior post-harvest handling and strain improvement should be achieved.

Hence it is also suggested to study the seasonal patterns of growth and carrageenan yields in the prevailing culture systems. Following varieties are mainly cultured in tropical countries, *K. alvarezii* strain Tambalang - green and brown, *K. alvarezii* strain Moumère- green and brown. However, to be sustained our culture and production, identification of exact varieties using genetic sequencing is main target.

Method

following sites were selected and seed inserted 100g per nodes, each node distance between node 20cm, 650 kg introduced to culture site (1 acre) Keerikuda-S1-S3, Walaipadu-3 sites, Kiranchi and Kokkupadayan.

Parameters	
Morphology	Colour variations
	Size
	Branches type
	Carrageenan content
	Molecular variations
	Nitrate concentrations, phosphate concentration

- General morphology were observed
- Dried to determine carrageenan
- Molecular isolations- sent sample to laboratory-MBRD
- Culture methods

Mono-lines

- Rafts
- Multiple lines
- Attached to the wooden or bamboo frame
- 20-30cm intervals line can be attached

Determination of ecotypes

- Variation color
- Size
- Branches type
- Carrageenan determinations
- Molecular verification
- Environmental parameters- system

Locations	Species	Remarks
Keerikuda-1	Green brown	Sharp ended, slightly dark
Keerikuda2	Green Brawn	
Keerikuda 3	Green brown	Light color,
Walaipadu	Green brown	Light color rather than previous
Kokkupadayan	Green brown	Thallus color whitish brawn, hard

PROJECT NO : 3.6

ENHANCING MANGROVE CRAB (*SCYLLA SERRATA*) AQUACULTURE IN SRI LANKA THROUGH BETTER FEED AND HEALTH MANAGEMENT WITH SPECIAL REFERENCE TO POPULARIZE THE CRAB FARMING INDUSTRY

Responsible Officers : M. G. I. S. Parakrama, A. D.W. R. Rajapakshe, P.P. M. Heenatigala
Budget(Rs.) : 0.550 M

Introduction

Natural stock of the crabs *Scylla serrata*, in the country is decreasing drastically as the fishing increasing due to the high demand in the export/ local market. Also, people use wild collected water crabs (moulted crabs) for fattening purposes and getting quick income instead of culturing farm produced crablets.

Farming of hatchery produced crabs can be a good solution for the proper management of natural stocks in Sri Lanka. As the use of trash fish is the traditional method for feeding crabs up to harvesting stage and the availability of trash fish being a limiting factor due to its seasonal changes, and the imported manufactured feed cost is the highest operating cost an economically profitable nutritious feed is a timely need for the enhancement/ development of the new field.

Objectives

- To introduce a quality feed for crab farming
- To identify the disease problems in crab culture systems

Activities carried out:

- Preparation and renovation of the vertical farming boxes of private crab farmer at Veyangoda area.
- Procurement of water crabs
- Feed formulation and preparation
- Proximate analysis of feed samples
- Individual water crabs are stocked in 60 vertical crab boxes/ rooms using 02 experimental feeds compared to trash fish as control feed
- Sampling and data collection for water quality parameters, growth performances, survival rate.
- Subjected to restrict carrying out the research as the site was at Veyangoda area and the area was declared as high risk and strictly prohibited to outside people and locked down due to Covid -19. Later on my home area also subjected to lock down and later on the office area too. Long term locking down affected to the survival of experimental animals and crab research totally collapsed.

Progress: Financial : Physical 58%

Constraints

Affected and collapsed the research due to lock down period of Covid – 19 during the 3rd and 4th quarters of the research.

PROJECT NO : 3.7

BIOFLOC TECHNOLOGY AS AN INTEGRAL APPROACH TO ENHANCE PRODUCTION PERFORMANCE OF ORNAMENTAL FISH GUPPY (*POECILIARETICULATA*) FARMING

Responsible Officer : E.D.M. Epasinghe
Budget (Rs.) : 0.992 M

Objectives

- Investigating water quality parameters of the BFT system
- Investigating larvae performance of guppies (*Poeciliareticulata*) in BFT

- Investigating stress resistance through the salinity stress and starvation tolerance of male guppies and fry stages in BFT
- Investigating stress resistance of male guppies for packing stress in a export packing system (Lim, *et al.*, 2003) and effect on dead on arrival during 7 days (DA7) in BFT

Activities carried out:

- Studied growth performance of guppy larval stages and qualitative parameters of water in the biofloc system with different locally available carbon sources.
- Studied growth performance of GIFT tilapia under the different stocking densities and qualitative parameters of water in the biofloc system with locally available carbon sources.

Major findings and output:

Activity 1

Carbon sources supplemented in the biofloc system have the ability to improve the growth performance of male guppy juveniles and reduce the inorganic nitrogen accumulation hence improving water quality. Molasses (MOL) and wheat flour-molasses (WF-MOL) exhibited higher fish growth and survivals as compared to the other sources of carbon. Improved water quality was recorded in MOL and WF-MOL added treatments as compared to the other treatment. This is an indicator that MOL and WF-MOL carbon sources improve growth parameters while maintaining better water quality with a higher survival rate in the male guppy juveniles

Activity 2

In the biofloc systems supplemented with carbon sources can enhance the growth of GIFT tilapia fingerlings. Based on the results, the addition of MOL with 40 m⁻³ and 50 m⁻³ fish densities, positively affect the growth parameters while maintaining better water quality and higher survival rates in the GIFT tilapia.

The biofloc technology is ready to introduce to the local aquaculture sector and it will be initiated with NAQDA as a pilot scale project for guppies and tilapia at Ornamental Fish Breeding and Training Centre, Rambadagalla and Aquaculture Development Center, Dambulla respectively.

Recommendations

Biofloc technology is a locally and internationally tested and proven aquaculture system. It would be easily adopted to grow guppy fry and tilapia fingerlings with C:N ratio 20. Molasses and 50:50 mix of Wheat Flour-Molasses could be recommended for growing guppies to use as the most performed carbohydrate sources. Further, Molasses could be used as the most performed carbohydrate source for growing tilapia fingerlings and the normal stoking density (40 fingerlings/ m³) could be increased 50 percent (60 fingerlings/ m³).

Progress: Financial: Physical: 64 %

Constraints

In the first quarter of the year this study was initiated however with the Covid 19 pandemic situation in the country we had to terminate the studies. Therefore, expected outputs were achieved partly, especially we did not receive ordered chemicals and some of the necessary equipment on the right time. Further, the latter part of the study could not continue because no one in the indoor research facility and responsible officer could not enter to the NARA premises due to above said matters.

PROJECT NO : 3.8

MAINTENANCE OF ENDEMIC FISH CAPTIVITY BREEDING AND DISPLAY SECTION

Note: Originally it was proposed to continue 2019 research project to study “Climate change impacts assessment on seven threatened endemic fish species, identification of their vulnerable ecosystems and develop conservation strategies”. Due to COVID condition the project was identified as an unfeasible project as there are difficulties to carry out relevant field based work. Then it was changed as follow;

Responsible Officer : .RamaniShirantha
Budget (Rs.) : 0.8 M

Objectives

- Continuous rearing and of rare and economically import endemic fishes
- Maintaining and upgrading of the indoor aquarium.
- However, project activity was focused to collect brooders form the wild targeting supply quality fish for fish exporter in 2021 as proposed by the line ministry.

Activities carried out

Due to COVID pandemic scenario the present research project had to be limited only to brooder collection from Kitulgala -Yatiantota, Bambarawana, Morawaka- Akuressa, Ruwanwella, Gileemale and Galapitamada and rearing them at NARA. In addition to that continuous breeding trails on Pethiabandula and *P. melanomaculata* were done through environment manipulation procedure as usual. Monitoring of the wild population of *Systemusasoka* in Kitulgala area was carried out whenever possible.

The following fish species were collected and now rear at NARA.

Fish species	No of pairs rare at NARA
<i>Pethianigrofaciata</i>	25
<i>Pethiareval</i>	25
<i>Pethiabandula</i>	10
<i>Pethiacumingii</i>	15
<i>Puntiustitteya</i>	20

Progress : Financial : Physical :80%

Constraints

COVID pandemic scenario led to die off the NARA endemic fish collection, and delayed renovation of the damaged tank system.

PROJECT NO : 3.9

STUDY THE GROWTH PERFORMANCES OF SELECTED AQUATIC MACROPHYTES IN AQUAPONIC RECIRCULATING SYSTEM AND BIOTECHNOLOGICAL APPLICATION OF AQUATIC PLANTS AND SEaweeds.

Responsible Officers : Dr. K.K.T.Nuwansi, D.M.S.Sugeeshwari, Dr. V.Pahalawattaarachchi
Budget(Rs.) : 1.00 M

Objectives

- To develop techniques to increase the production of aquaponically produce aquatic microphytes .
- To develop the technique to get high production of tissue cultured aquatic plants and marine macrophytes.

Activities carried out

Activity 1- Study the growth performances of selected aquatic macrophytes in aquaponic recirculating system

Prior to the main study of aquaponics, two preliminary studies were carried out to find out the nutrient concentration of fertilizer and suitable substrate media.

a. Study the effect of nutrient concentration for the growth performances of *Anubias barteri* var. *nana* (pertite)

Sixty-day experiment was conducted to evaluate the growth performances of *A. barteri* var. *nana* 'pertite' in a hydroponic system using different nutrient concentrations of Albert's solution such as 0.005 (T1), 0.01 (T2), 0.02 (T3), 0.05 (T4) and each treatment had three replicates. Two months old, hardened healthy tissue cultured plants were employed in the study. Albert's solution of 0.005 mg/L was used as the fertilizer. As the growth parameters plant wet weight was taken to assess the plant growth at the significance level of $P < 0.05$. Sampling and fertilization were done fortnightly.

b. Study the effect of substrate media for the growth performances of *Anubias barteri* var. *nana* (pertite)

Sixty-day experiment was conducted to evaluate the growth performances of *A. barteri* var. *nana* 'pertite' in a hydroponic system using different types of locally available growing media: crushed stones (T1), pieces of coconut husks (T2), clay stones (T3) and wood scrapings (T4) and each treatment had three replicates. Two months old, hardened healthy tissue cultured plants were employed in the study. Albert's solution of 0.005 mg/L was used as the fertilizer. The growth parameters viz. plant weight, numbers of leaves, leaf length, leaf width, length of the rhizome, root length were taken to assess the plant growth at the significance level of $P < 0.05$. Sampling and fertilization were done fortnightly.

Activity 2-Biotechnological application of aquatic plants and seaweeds

a. Development of sterilization protocol for *Aponogeton crispus* and *A. natans*

The selected explant was seed and it was thoroughly washed with soap. Then all explants were washed with 70% ethanol for 1 minute and then with 4%, 5% and 7% Clorox (Liquid bleach) for 5 minutes. Each treatment consists of 12 replicates. Then the seeds were thoroughly washed with sterilized distilled water three times and each wash was done for 3 minutes. Then the seeds were cultured in liquid Murshige and Skoog medium for 21 days.

b. Selection of best medium composition for shoot growth of the Seaweed (*Kappaphycus alvarezii*)

After ex plant sterilization, ex plants were culture in sterilized seawater with 4mg/L Benzyl Adenine Purine and 0.5 mg/L Naphthalene Acetic Acid which contain 0.5mg/L albert solution and 1g/L seaweed extract. Aeration and 12-hour photoperiod were provided. Media changed in every 2 days. Each treatment had 3 replicates and culture period was existed for 21 days.

Major Findings:

Activity 1-

Study the effect of nutrient concentration for the growth performances of *Anubias barteri* var. *nana* (pertite)

According to the selected concentrations 0.005mg/L is the suitable concentration and *Anubias* has very low nutrient requirement.

Study the effect of substrate media for the growth performances of *Anubias barteri* var. *nana* (pertite)

The results of the experiment concluded that the coconut husk media is the most suitable substrate which is a low cost, locally available media for the hydroponic cultivation of *Anubias* spp. and also wood scrapings found to be an effective media when it is available in the environment.

Activity 2-Biotechnological application of aquatic plants and seaweeds

Best medium composition for thallus regeneration and thallus growth was sterilized seawater with 4mg/L Benzyl Adenine Purine and 0.5 mg/L Naphthalene Acetic Acid. which contain 0.5mg/L albert solution.

Outputs

Development of the culture techniques for better and sustainable aquaculture practices in Sri Lanka.

Progress: Financial : Physical : 60%

Constraints

- Due to the lockdown in March 17th most of the aquatic plants were died and continuous research work also affects. Thus some of the research parts couldn't be completed and those parts will be shifted in to year 2021.
- Laboratory contamination occurred in month of June. Hence the tissue culture laboratory must be condition to start for the research performance.
- Effect for continuous research performance form the situation with Covoind19 .

PROJECT NO : 3.10

STUDY ON DISEASE PREVALENCE IN ORNAMENTAL FISH AND CULTURED TILAPIA.

Responsible Officer : A.D.W.R.Rajapakshe
Budget (Rs.) : 0.510 M

Objectives

- Reduce the risk of TiLV introduction.
- Understanding the commonly encountered disease conditions in ornamental industry.

Activities carried out (Methodology)

- Conducted Literature survey on prevailing disease condition in Industry.
- Selected aquaria from Colombo and Gampaha districts.
- Collected Samples and information from each aquaria at monthly intervals (5 fish per each species of Ornamental fish) and Tilapia when informed by NAQDA(TiLV).
- Analyzed the samples in the laboratory and identified the parasite microscopically.
- Conduct experiment in the laboratory for developing the therapeutic measures.
- For Tilapia Lake virus, clinical and histopathological observation were carried out.
- Prevelence % was calculated according to the following formula.

Prevalence = $\frac{\text{No. of Infected fish}}{\text{Total no. of fish examined}} \times 100$

Findings

Total 102 gold fish and 87 koi carps have been collected throughout the experimental period Main parasites which were encountered in gold fish and Koicarp were *Centrocestus sp.*, *Trichodina*, *Dactylogyrus*, *Gyrodactylus* and *Ichthyophtherious*. High prevelance% was recorded by *Dactylogyrus* and *Gyrodactylus* in Negombo Aquarium. Comparing two fish species, infected parasites are higher in Gold fish than Koi carp. Higher no of parasites were recorded in gold fish in Colombo and Negombo aquaria .Less prevalence % of each parasites were recorded in koi carp in Colombo Aquarium . *Dactylogyrus*, *Centrocestus* and *Gyrodactylus* were recorded in each aquaria.

Three Tilapia mortality were investigated in Wilachchiyawewa in Anuradapura ,Minneriyawewa and Ellewewa in polonnaruwa district. Tilapia fingerlings were collected from Dambulla and Sewanapitiya hatcheries for investigation of TiLV. All the samples are negative for TiLV according to clinically and histopathology.

According to the therapeutic experiments 2g/ l salt is effective for totally eradicating *Trichodina* and *Gyrodactylus* (Skin Flukes). 2g/L salt can be use for Controlling *Dactylogyrus* (Gill Flukes) in mild infection. For higher infections 10g/l salt dip is recommended.

Conclusions

- Main parasites which were encountered in gold fish and Koi carps were *Centrocestus* sp., *Trichodina*, *Dactylogyrus*, *Gyrodactylus* and *Ichthyophtherious*.
- Infected parasites are higher in Gold fish than Koi carp.
- 2g/ l salt can be used effectively for eradicating *Trichodina* and *Gyrodactylus* (Skin Flukes).
- 10g/l Salt dip is recommended for eradicating Gill flukes.
- Observed samples are negative for TiLV.

Outputs

- Therapeutic measures for eradicating the *Trichodina* and skin flukes.
- Most common external parasites in aquarium fish

Progress: Financial : 60% Physical : 60%

Constraints

Unable to continue the project work due to COVID 19 impact.

PROJECT No : 3.11

MONITORING DISEASE CONDITIONS OF SHRIMP AQUACULTURE INDUSTRY IN SRI LANKA

Responsible Officer : P.P.M. Heenatigala
Budget (Rs.) : 0.630 M

Introduction

The study will provide underline causes for White spot Syndrom – WSSV and Vibriosis disease outbreaks in shrimp aquaculture and control measures which are required for better disease management practices in shrimp culture.

Objectives

- To identify the WSSV resistant shrimps.
- To identify *Vibrio* species responsible for the luminous disease in cultured shrimp and underline courses for the disease spread.
- To monitor disease outbreaks in shrimp culture industry in Sri Lanka.

Activities carried out:

Activities carried out (Methodology)

Activity 1: Identification of WSSV resistant shrimps

Activity 2: Identification of bacterial species responsible for vibriosis and underline courses for luminescent vibriosis outbreak

Results

Activity 1: Identification of WSSV resistant shrimps

All samples collected (n = 59) were confirmed as WSSV negative by PCR.

All 59 samples were negative for the resistant gene marker.

Activity 2: Identification of bacterial species responsible for vibriosis and underline courses for luminescent vibriosis outbreak

- Luminous disease was mainly reported in
 - December – February (With low temperature)
 - June – August (With high salinity)
- 62 bacteria cultures were isolated from shrimp hatcheries and farms and 37 were shown luminescence.
- 33 of them were belongs to 3 luminous disease causing bacteria (*V. campbelli* , *V. harveyi* and *V. Rotiferianus*). *V. campbellii* (52%) was the most dominant species responsible for the luminous disease in shrimp culture practises in Sri Lanka.

Conclusions and rcommondations

- Environmental management will be the best method can be use to prevent disease in shrimp culture. More concern should be given on rigorous water management and sanitation to prevent the entry of luminous vibrios through the culture water.
- Further research should be address to identify the gaps on rigorous water management practices and sanitation activities carried out to prevent the entry of luminous vibrios in to the hatchery and farms systems.

Progress: Financial :% Physical :90%

Constraints

- Lack of staff to conduct laboratory analysis
- Delay in purchasing work

PROJECT NO : 3.12

AN EVALUATION OF TRADITIONAL FISHING ACTIVITIES IN NEGOMBO ESTUARY, BOLGODA LAKE, MADU GANGA AND JAFFNA LAGOON AND STRATEGIES FOR PROPER MANAGEMENT.

Responsible Officer : M. Gammanpila&J. S. Jayanatha
Budget (Rs.) : 0.316 M

Objectives

- To evaluate and empirically verify traditional ecological knowledge
- To provide possible recommendation for sustainable management of stake net (Kattu-del) and kraal (Ja-kotu) fisheries in the Sri Lanka.

Activities carried out

The study was conducted to assess community based management practices adopted by Kraal fishery (Ja-kotu) in Bolgodalake, Madu Ganga and Jaffna lagoon in Sri Lanka.

A semi-structured questionnaire was used in interviewing Ja-kotu fishers and all the other people related to the respective fishery of Bolgoda Lake, Madu Ganga and Jaffna lagoon with a view to assess the existing fisheries management system. Nearly 90% and 88% of fishers from Madu Ganga and Bolgoda lake areas were interviewed to collect fisheries information related to traditional fishery management practices and socio demographic information of traditional fishers. The questionnaire was focused on preliminary demographic information of their fishers including age, educational level, number of year experience, indigenous knowledge in fishing operation, factors affect to shrimp harvest including salinity, depth and distance from the sea, phases of the lunar cycle and appreciation of fishing rights for equity sharing of the resource. In addition to the questionnaire survey, group discussions and visual observations were made

during fishing practices. The questionnaire also contained statements to gather information relevant to institutional robustness for averting common pool resources (CPR) dilemma in the fishery.

Data analysis

Based on the assigned values in Likert scale, the mean and median values for each component of Ostrom's modified design principles were used to compare the institutional robustness for averting CPR dilemma.

Major Findings and outputs

Socio-demographic profile of Ja-kotu fishers in Madu ganga & Bolgoda Lake indicated that majority of fishers (85%) were in more than 40 years age group and 35% fishers in Madu ganga having over 30 years of experience in fishing. Many of them (57%) in Bolgoda lake have sufficient formal education (up to G.C.E O/L). Almost all fishers interviewed, 94% and 71% of fishers in Maduganga & Bolgoda Lake stated that the ownership of brush park fishery was passed down from generation to generation. All Ja-kotu fishers in Bolgoda lake were engaged in other various livelihood activities.

Though there is no proper legislation to define user boundaries in Ja-kotu fishers in all lagoons, multi-layer institutional structure of Ja-kotu fishers in Jaffna lagoon was comparatively strong enough to own decision making process. The Ja-kotu fishery in Maduganga estuary faces many challenges such as lack of legalization, increase in the number of unauthorized ja-kotu, unplanned development activities, development of tourism activities, environmental pollution and rapid urbanization. Such direct and indirect issues are negatively effect on traditional user rights and livelihood of fishers.

Recommendations

- Mapping of existing Ja-kotu installed in Maduganga and Jaffna lagoon and scientifically define maximum number of Ja-kotu could be operated and suitable locations, that helps to regulate Ja-kotu fishery in both lagoons.
- Establish a coordinating body that involves of relevant stakeholders, Department of Fisheries, members from local fisheries societies, local administrators, Coast Conservation Department, Forest and Wild Life Department and the Sri Lanka Tourist Board to manage the Maduganga wetland with special attention on tourism and fishing activities.
- The community rights and institutional structure of Ja-kotu fishers in Maduganga & Bolgoda lake are not strong enough to make responsible fisheries management. As such, co-management regimes through intervention of centralized management authorities that empower local communities for using scientific and traditional ecological knowledge to make management decisions are essentially needed to be implemented for sustainability of the fishery.
- Immediate action need to regulate the operation of motorized boat and engine capacity, introduces speed limits, time restriction, use of petrol engines for boat operators in Madu ganga.
- Regulate mesh size of Ja-kotu (wing and cod end) as the 1 ¼ inches for the cod-end and 5/8 inch mesh size recommended to use for the fence net (guide net) according to the present gazette in Jaffna lagoon.
- Removing of stake nets (Ja-kotu) fixed set as Z shaped at the lagoon mouth and canal areas allow better circulation of water and avoid disturbing migration pattern of fish and shrimps.
- Distance between two stake nets are not less than 300m
- Limitation of number of Ja-kotu and introducing of alternative livelihood activities including mariculture activities (Sea bass, Sea cucumber, etc).

Progress:

Financial :50%

Physical :70%

Constraints

Covid-19 epidemic situation sampling wasn't carried out during four months of the year.

PROJECT No : 3.13

CULTURE BASED FISHERIES IN PERENNIAL RESERVOIRS; RELATED TO LIMNOLOGICAL STUDIES IN SELECTED RESERVOIRS LEADING TO OPTIMUM STOCKING OF FISH

Responsible Officer : Amitha Adikari
Budget (Rs.) : 0.742 M

Objectives:

- To find out the general limnology (Physical and chemical properties) in selected reservoirs in North western province.
- To find out the plankton diversity, abundance and yearly variation in selected reservoirs in North western province.
- To find out the suitable fish species, combination and stocking densities

Activities carried out

- This study was carried out in Daduruoya reservoir and Hakwatunawa reservoir in Kurunegala district from January 2020 to December 2020.
- Morphometric characteristics, reservoir volume and the annual outflows of the reservoirs were collected from database of the Department of Irrigation.
- Five sampling locations were selected as the sampling stations. Three sampling points were selected from each sampling location to obtain the maximum representation of the reservoirs.
- Physicochemical and biological samples were collected once a month at three sampling site of each sampling location of each reservoirs.
- 75 samples were analyzed to determine the dissolved oxygen concentration, total alkalinity, dissolved phosphorus, nitrate and nitrite, in suite measurements were taken for water temperature, pH, electrical conductivity, Secchi disc depth and turbidity.
- Once a month 45 samples were analyzed for chlorophyll a, relative abundance of the plankton and density of the plankton

Major Findings and outputs

- The average water temperature of the reservoirs was ranging between 28.20 °C to 30.07°C during the study period. There was no significant change in average values of two reservoirs. -- The pH of reservoirs was found to be alkaline during the study period, ranging from 6.6-8 pH and it was within the acceptance range (6.5-8.5).
- Average DO value of the reservoirs was not significant change, ranging from 6.5 mg/l to 8.4 mg/l and it was within the acceptance range (4mg/l).
- The average value of turbidity and electrical conductivity of the reservoirs were ranging from 3.6 NTU to 7.62 NTU and 219.0µs to 338.0µs respectively. Highest turbidity value was recorded in Daduruoya reservoir as 7.62 NTU compared with Hakwatunawa reservoir.
- Alkalinity of the reservoirs was ranging from 96.96 mg/l to 167.06 mg/l which was within the acceptable limits for better growth of fish and planktons (20 mg/l to 200 mg/l).
- The nitrite and nitrate values observed during the study period were between the ranges of 0.005 mg/l to 0.041 mg/l and 0.1 mg/l to 3.29 mg/l respectively. The values also within the acceptable range, acceptable range for nitrate is 10 to 40 mg/l and for nitrite 1 mg/l.
- Phosphorus values were range from 0.3 mg/l to 2.7 mg/l. Maximum values observed was 2.7 mg/l from Hakwatunawa reservoir during the month of February to August (except April, May) (dry season).
- Maximum values for Phosphorus was observed in Daduruoya reservoir during the same period was recorded as 2.4 mg/l. But these values were recorded in the month of September as 0.58 mg/l and 0.4 mg/l Hakwatunawa reservoir and Daduruoya reservoir respectively.

- Phosphorous values of reservoirs were not range from the acceptable level (0.005 mg/l to 0.05 mg/l) during the study period. Drought condition and low water level may be reason for phosphorus levels increase.
- Chlorophyll a concentration of reservoirs varies from 4.1 mg/m³ to 9.1 mg/m³ during the study period.
- A total of 79 plankton species and 24 zooplankton species were encountered from Daruruoya reservoir. Out of 79 identified phytoplankton species, only 10 species were recorded with a relative abundance (RA) of more than 1%.
- A total of 34 plankton species and 39 zooplankton species were encountered from Hakwatunawa reservoir. Out of 34 identified phytoplankton species, only 13 species were recorded with a relative abundance (RA) of more than 1%. Out of 39 identified zooplankton species, only 8 species were recorded with a RA of more than 1%.
- Average fish yield of the reservoirs ranges from 500 kg/month to 3000 kg/ month.
- *Tilapia nilotica*, *Catlacatla*, *Macrobrachium rosenbergii*, *Lebeorohita* and *Crichinus mirigala* were the prominent species of the catch. Recorded minor fish species are *Puntius sbimaculatus*, *Mystus vittatus*, *Glossogobius giuris*, and *Heteropneustes fossilis*.

Recommendations

- Further research should be address to identify seasonal variation of limnological parameters, plankton density and plankton abundance.
- Further research should be address to identify the relationship between limnological parameters and seasonal variation of plankton.

Progress: Financial: Physical: 62%

Constraints

- Monthly sample collection could not complete due to the Corona pandemic situation of country. Thus, Seasonal variation of limnological parameters, plankton density and plankton abundance could not completely examine throughout the year.
- -Suitable fish species, combination and stocking densities could not decide under the limited available data.

Publications and other activities/ IARAD - 2020

Research papers /Conference Proceedings

1. Impact of Rainfall on Riverine fishery in Nilwala basin, Sri Lanka. K.W.R.R. Amaraweera, K.H.M.A. Deepananda, and U.A.D. Jayasinghe (2020) Twenty Sixth Annual Scientific Sessions of the Sri Lanka Association for Fisheries and aquatic Resources (SLAFAR).
2. Development of crop calendar for GIFT strain (*Oreochromis niloticus*) in flood prone-Nilwala river, Matara District of Sri Lanka. K.W.R.R. Amaraweera, K. H. M. A. Deepananda, and U. A. D. Jayasinghe (2020) International scientific Sessions-2020, National Aquatic Resources Research and Development Agency (NARA), Colombo 15, Sri Lanka.
3. P.W.A.Perera S. Ratnavel , N.Y.Hirimuthugoda. and W.Rajapakshe., Effect of salinity on Growth Performance of Mangrove Associated *Penaeus monodon* in Sri Lanka (2020) 19th Accademic Sessions, University of Ruhuna, Matara ,Sri Lanka.
4. U.N.S.Sharma, N.Y.Hirimuthugoda. P.W.A.Perera and W. Rajapakshe,. Socio Economic Impact of COVID -19 on Ornamental Fish Farmers in Sri Lanka (2020). Paper accepted for the Conference on COVID -19 Impact, Mitigation, Opportunities and Building Resilience by National Science Foundation , Sri Lanka.
5. Chathurani, S.H.U. and A.D.W.R .Rajapakshe, (2020). Investigation of Minimum Protein Percentage Required for Optimum Growth of Siamese Fighter Fish, *Betta Splendens* (Regan, 1950) in Juvenile

Stage International Journal of New Technology and Research (IJNTR) , Volume-6, Issue-2, February 2020 Pages 20-27

6. Heenatigala, P. P. M., Sun, Z., Yang, J. Zhao, X and Hou, H. (2020). Expression of LamB Vaccine Antigen in *Wolffia globosa* (Duck Weed) Against Fish Vibriosis. *Frontiers in Immunology*. 11:1857. doi: 10.3389/fimmu.2020.01857
7. Study the growth performances of hydroponically cultured *Anubias barteri* var. *nana* 'pertite' (Anubias) in different substrate media- Accepted for the poster presentation of NARA Scientific Sessions 2020
8. A.S.L.E. Corea, (2020) Length weight relationship in *Penaeus monodon* shrimp at early culture stages and its impact on final production in Sri lankan shrimp farms - 76th Annual sessions of the Sri Lanka Association for advancement of science (SLAAS) Colombo Sri Lanka (Online conference)
9. A.S.L.E. Corea, C.B. Medagedara, and V. Pahalawattearachchi (2020) Selection of suitable structures for oyster reef restoration and enhancing oyster brood stock to support oyster culture in the Puttalam lagoon area.: 26th Annual sessions Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR) Kelaniya. Sri Lanka (Online conference)
10. Parakrama, M. G. I. S. "An experimental cage culture trial to investigate the growth performance of Nile Tilapia, *Oreochromis niloticus* fed with low cost formulated ration" proceedings of NARA annual scientific sessions 2020
11. D.I.D.Niasansala, E.D.M.Epasignha ,and W.A.D.Nayananjalie (2020),The effect of different carbon sources on water quality and growth performances of male Guppy (*poecilia reticulata*) juvenile- 12th annual research symposium proceedings, Faculty of Agriculture Rajarata university of Sri Lanka.
12. W.L.D.Madushani, E.D.M.Epasignha ,and W.A.D.Nayananjalie (2020),Effect of different stocking densities and carbon sources on water quality and production performances of Tilapia - 12th annual research symposium proceedings, Faculty of Agriculture Rajarata university of Sri Lanka

Paper article/leaflets/books

1. The book on fishes in freshwaters of Sri Lanka, updated, now in the print.
2. Hand book on "Tilapia mathsyagaawa" Sinhala medium booklet
3. Hand book on "Kalapu kakuluwan wagaawa sandahaa athpothak saralawa" Sinhala medium booklet
4. Hand book on "Bahuropana mathsyagaawa sandahaa athpotha" Sinhala medium booklet
5. Hand book on "Mathsyagaawa sandahaa pokunak nirmaanaya kireema, nadaththu kireema haa pokunu kalamanaakaranaya" Sinhala medium booklet

Foreign training experience

2020 Online Training on Mariculture Technologies for the Asia-Pacific Region

Sponsor - Department of International Cooperation, Ministry of Agriculture and Rural Affairs People's Republic of China

Organizer - Yellow Sea Fisheries Research Institute (YSFRI), Qingdao

From 21stSeptember 2020 to 25thSeptember 2020

Consultancy projects involved

1. Study on seaweed habitat associated macro faunal study for the Feasibility Study of Beach/Seawater Front Development project
2. Environment Impact Assessment of the Beach/Seawater Front Development project
3. Provided technical support for different government/non-government organizations

Workshops/meeting attended

1. Attended to final workshop on finalizing Redlist of freshwater fishes of Sri Lanka prepared by IUCN.
2. 20 meetings with CEA, DWC, ADB, CEB and BDS
3. Attended the Meeting regarding the anti microbial Resistant Fleming fund programme , Oak Ray hotel, Kandy on 02.01.2020..

4. Attended the workshop in Kalawewa NAQDA center on 27 -29 August 2020.
5. Attended the NARA, NAQDA project discussion meeting on 25.09.2020
6. Attended the meeting for shrimp farm industry with SLADA on 07.10.2020
7. Annual sessions of Sri Lanka association for fisheries and Aquatic resources held in Kelaniya university
8. Annual sessions of Sri Lanka Association for advancement of science Held at BMICH Colombo.
9. Bellanwila Attidiya reserve rehabilitation meeting – District secretariat Colombo

Reports submitted

1. Interim and final draft reports on EIA- Beach/Seawater Front Development project.
2. Report on seaweed habitat associated macro faunal study for the Feasibility Study of Beach/Seawater Front Development project
3. Report submission for the Ministry of Fisheries regarding the progress of Ornamental Aquatic plant project.
4. One presentation was made for the technical evaluation committee/BF project
5. Reviewed the COP 12 Biodiversity of Sri Lanka report prepared by Bio Diversity Secretariat.

Trainings /Awareness programme

1. Training program for the staff members of Ocean University
2. Training program for university students
3. Training program for advanced level school students
4. Provide aquatic plant materials for the school science exhibitions
5. Provide aquatic plant materials for the researches in other divisions in NARA
6. Community base seaweed farming- according to field observation 52 family were selected to continue production of *K.alvarezii* in Mannar region. Initial step they were trained for cultivation and other processing activities. All members are equipped with following materials to continuation of the process; as first step, they were responsible for 1 acres extent to their own area. The approximate production for each cycle (45days) about 10000kg-15000 kg in fresh weight. The monitoring program was conducted year around and water quality data also recorded and aware them.

Materials

- Seeds materials-50Kg per person
 - Net material for a acres covering (12-15kg nets)
 - Ropes and others (12mm, 8mm, 5mm, 7mm and 3mm)
7. NAQDA and one selected private owned guppy farm will be used to implement the field trials of biofloc with guppies.
 8. In addition to the biofloc study with the guppies, a second study was carried out parallelly with the above study based on the NAQDA request.

Others (event organized/held position, responsibilities etc.)

1. Represented national steering committee –IAS, Wetland committee, research committee of DWC.
2. Resource person for Ornamental training Conducted in RRC, Rekawa.
3. Committee Member of Scientific session, NARA.
4. committee member for CCD project approval
5. Treasurer – Sri Lanka Association for fisheries and aquatic Resources. (SLAFAR)
6. Investigation done for the crab mortality in Pitipana provincial council farm in 25.06.2020.
7. Conducted field visit for testing site suitability for Oyster farming in Mulathiv district On 20.21 July 2020.
8. Field visit for Crab city in Rekawa for submitting the audit report on 25 26 Sep.2020.
9. Conducted field visit and submitted the report on the fish coloration incident in Dehiwala.

10. Investigation done for the fish kill in Global park, Seeduwa and submitted the report on 07.09.2020
11. Attended the fish kill investigation in Water's Edge on 02.12.2020
12. . Conducted field investigation on Crab mortality in Eden Farm in Mannar.
13. Disease diagnosis and recommend treatments for the fish culturists (n =6)
14. Fish kill investigation in "Minneriya weva"
15. Fish kill investigation in "waters edge"
16. Site selection visit for Oyster culture in Mannar and Mullativu
17. Site joint inspection of *Litopenaeus vannamei* shrimp farm in Mannar organized by CCD as IEE Site inspection of *Litopenaeus vannamei* shrimp farm in Mannar by NARA on the request of NAQDA
18. Farm joint inspection for stocking of shrimp illegally (out of the crop calendar) organized by NAQDA for legal action by NAQDA as resource person
19. Shared data on freshwater fishes of Sri Lanka with IUCN expert members.
20. *Labeo fisheri* distribution and population data with IUCN, regional expert Dr. Rajeeve and ADB

External Supervision

1. Supervision of community based project of Ornamental Aquatic plants conduction in Colombo, Gampaha and Kaluthara Districts.
2. Intern training for a students of Ocean university (Higher Diploma students)
3. Intern training for a student of TECH in Niwala for six month.

5.5 MARINE BIOLOGICAL RESOURCES DIVISION

Head of the Division : Dr. Sisira Haputhantri

Research Staff: The Marine Biological Resources Division (MBRD) consists of 14 Scientists, 2 Development Officers, 6 Research Assistants, 8 Field Research Assistants, 2 Management Assistants, 1 Lab Attendant and 2 Helpers.

Overview of the year

The MBRD is responsible for carrying out research towards the management, development and conservation of marine living resources. The research programme carried out by MBRD includes,

- Management-oriented research projects assessing the fish, crustacean and gastropod resources.
- Development-oriented research projects assessing the viability of under exploited and unexploited fisheries resources.
- Research projects towards coastal zone management.
- Conservation of coral reefs and threatened marine fauna.
- Species identification and population studies using molecular methods for the conservation and management of marine species.

Five treasury funded research projects with project components were carried out by MBRD in 2020. Apart from treasury funded projects, MBRD carried out several external funded/ consultancy projects. 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 (MoF) 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 large number of fish samples were analysed by MBRD to determine whether the fish samples provided had been killed by using explosives or not. The MBRD staff also appeared at several Magistrates' Courts in order to provide expert evidence regarding dynamite cases handled by the Police and DFAR.

In 2020, a large number of marine samples including fish and other aquatic organisms were received from various stakeholders notably Magistrates' Courts, DFAR, Department of Wild Life Conservation (DWLC), Department of National Zoological Gardens and the fishing industry for identification. In addition, 88 shark fin/ skin samples were identified and issued identification reports by MBRD in 2020. The identification of marine organisms was mostly based on morphological characters. When morphological identification failed, organisms were identified using molecular methods.

The staff of the division was very 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/postgraduate 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, Sri Lanka Army and for the 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 DFAR for settling fishing disputes, advising on resource utilization and fisheries management. However, some work that was planned to be carried out in 2020 was adversely affected due to the COVID-19 outbreak.

Treasury funded projects carried out by MBRD in 2020:

No	Project	Amount in million LKR
2.1	Monitoring and Assessment of Pelagic (small pelagic and large pelagic) and non-fin fish fishery resources (sea cucumber and lobsters) using port sampling	4.28
2.2	Study of some biological and fisheries aspects of selected edible finfish species in the demersal fishery in the South-eastern coast of Sri Lanka	1.64
2.3	NARA's contribution for Norway-Sri Lanka bilateral project Improved management of the marine resources in Sri Lanka	2.98
2.4	Studying the fisheries and marine mammal interactions and population estimate of blue whale (<i>B. musculus</i>)	1.80
2.5	Marine museum upgrade and skeleton preparation	1.24

PROJECT NO : 2.1**MONITORING AND ASSESSMENT OF PELAGIC (SMALL PELAGIC AND LARGE PELAGIC) AND NON-FIN FISH FISHERY RESOURCES (SEA CUCUMBER AND LOBSTERS) USING PORT SAMPLING****Large Pelagic Fishery**

Port sampling and fisheries statistics

Large Pelagic Port Sampling is a collaborative fisheries data collection program implemented by the Marine Biological Resources Division (MBRD) of NARA, Department of Fisheries and Aquatic Resources (DFAR), and Statistics Unit of Ministry of Fisheries (MoF) for obtaining large pelagic fish landing data. Large pelagic resources mainly comprise of tuna and tuna-like species. The large pelagic port sampling survey in Sri Lanka was started in the 1990s by NARA. The survey's main objective was to obtain catch and effort data on large pelagic fish, particularly tuna and tuna-like fish. Further, the port sampling data collection program is being developed under working package II of the Norway-Sri Lanka bi-lateral project. Consequently, manual data collection forms will gradually be substituted with electronic data collection procedures.

IOTC data submission and attending working parties organized by IOTC

It is mandatory to submit large pelagic fisheries data to the Indian Ocean Tuna Commission (IOTC). The data collected annually via the port sampling program must be analyzed and submitted to the IOTC before 30th June. The data submitting to IOTC needs to comply with the relevant resolutions implemented by IOTC. In the submission, catch data, effort data, length-frequency data, information on discards, and vessel information are provided in detail as per those resolutions' requirements. As a result of complying with the resolutions relating to data submission, Sri Lanka achieved a 90 % overall compliance rate in 2019. It is a 7 % increase as compared to the previous year, 2018. This is a substantial achievement compared to our past compliance rates and compliance records of other coastal states in the Indian Ocean.

IOTC organizes and conducts working party meetings annually. The working parties generally consist of scientists attending in their individual capacity. The working party meetings are open to scientists interested in the relevant issues under the working party's consideration. The working party's most common objective is to provide the IOTC Scientific Committee with the analyses of the current status of the relevant fish stocks and an evaluation of possible management actions. Some Working Parties are established to analyze and produce recommendations on a specific technical problem. Due to the unexpected conditions that occurred in 2020 due to COVID-19, the following working party meetings were virtually conducted. An information paper titled, *Neritic tuna fishery in Sri Lankan waters: An update*, was submitted to the Working Party on Neritic Tuna.

- 10th Working Party on Neritic Tuna (WPNT 10) - (06/07/2020 - 08/07/2020)
- 18th Working Party on Billfish (WPB 18) - (02/09/2020 to 04/09/2020).
- 16th Working Party on Ecosystems and Bycatch (WPEB16) - (07/09/2020 - 10/09/2020)
- 22nd Working Party on Tropical Tuna (WPTT22): Stock Assessment Meeting - (19/10/2020 - 23/10/2020)
- 15th Working Party on Data Collection and Statistics (WPDCS15) - (30/11/2020-03/12/2020)

Small Pelagic Fishery

The small pelagic group represents over seventy-five marine species found in Sri Lankan waters. The key target species in the fishery includes sardines, herrings, anchovies and mackerels. The fishery is conducted by Outboard Engine Fiber Reinforced Plastic (OFRP) boats, motorized and non-motorized traditional crafts. The main gear used in the fishery is small mesh gillnets. Surrounding nets are also used in some districts. In addition, the beach seine, a traditional fishing gear operating seasonally in Sri Lanka, also catches a considerable quantity of small pelagic.

MBRD continued to conduct the port sampling data collection programme in 2020 despite the COVID-19 pandemic situation at major small pelagic fish landing sites with the key objective of studying the trends in the fishery analyzing the data for various assessments. Data collected from the port sampling programme was stored in the small pelagic database maintained by the division. The preparation of estimates with regard to 2020 is currently in progress.

The small mesh gillnet fishery data collected from 2000 – 2019 in the west coast fishery by this MBRD port sampling programme was analyzed with the aim of obtaining a better picture about the trends in the fishery. During this period, fishing operations were mostly conducted by OFRP boats using small meshed gillnets of mesh sizes ranging from 12 – 38 mm. The gillnets having mesh sizes of 22-38 mm were widely operated for catching herrings (*Amblygaster* spp.) and sardines (*Sardinella* spp.). An increasing trend in the average number of gillnet pieces in a fishing operation was observed in the west coast fishery (Figure 1).

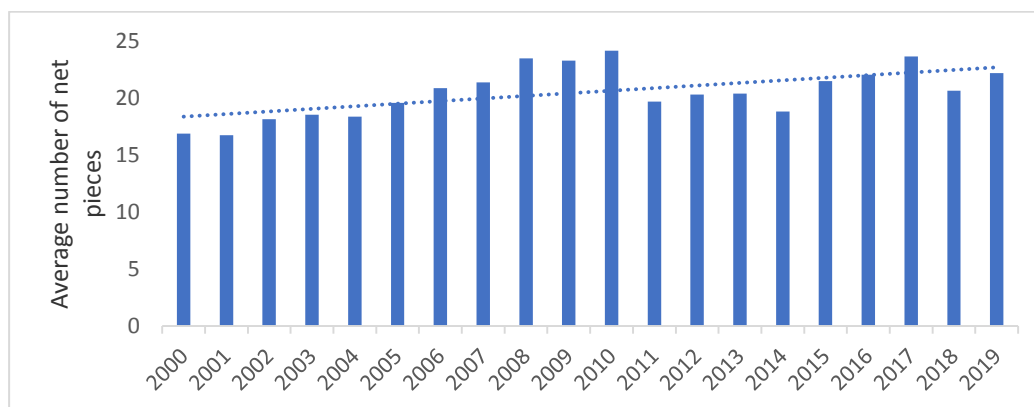


Figure 1: Gillnet usage in the small mesh gillnet fishery in the west, Sri Lanka operated targeting small pelagics.

Though the gillnet fishery was mostly operated targeting herrings, around 55% of the boats operated during this period had reported zero catch rates of herrings. Moreover, a strong seasonal fluctuation in the nominal CPUE of spotted sardinella (*Amblygaster sirm*) in terms of catch in kg/OFRP boat/hour was observed during this period (Figure 2). The highest annual average catch rate (56.38 ± 1.67) was reported in 2017 (Figure 3).

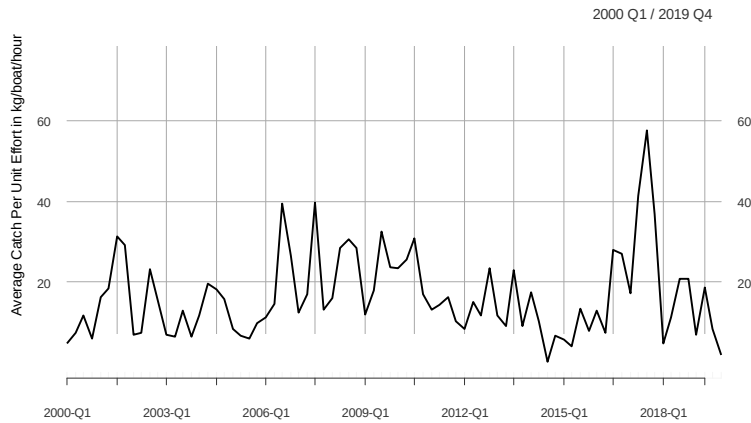


Figure 2: Quarter-wise variation in average Catch Per Unit Effort (CPUE) of spotted sardinella in the west coast small mesh gillnet fishery, Sri Lanka: 2000 -2019.

Unsustainable fishing practices exist in the small pelagic fishery such as effort increase, night fishing during spawning seasons and use of smaller mesh size gillnets targeting immature fish. At present, formulation of a Fishery Management Plan with regard to small pelagics in the west coast of Sri Lanka is in progress under the Norwegian technical guidance. Conducting a stock assessment for key small pelagic species in the west coast is also in progress with the technical support of the World Bank.

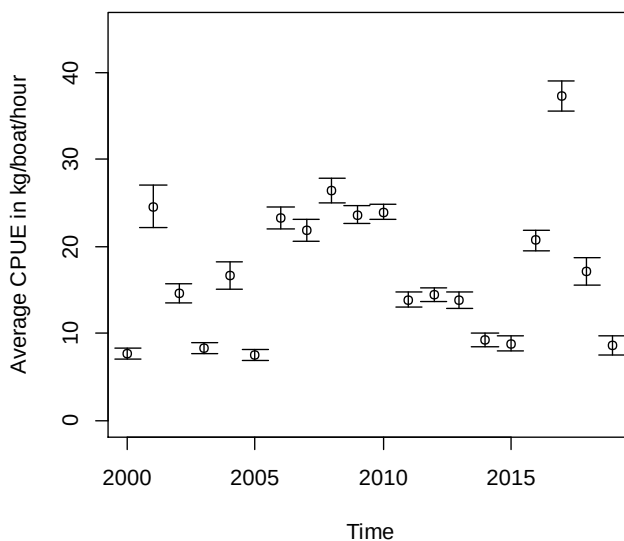


Figure 3: Annual variation in Catch Per Unit Effort (CPUE) of spotted sardinella in small mesh gillnet fishery in west coast, Sri Lanka: 2000- 2019

Spiny lobster fisheries management and in-situ conservation of berried spiny lobsters

Spiny lobster fishery in Hambanthota district has been identified as a major income source among the artisanal fishers contributing 60% to the total production of the country. Accelerated exploiting rate due to increasing foreign demand, catching berried females, environmental degradation, increasing fishing efforts and violation of the available regulations are the major causes for the decline of the stock size. A set of

regulations has been implemented for the conservation and management of the stock. Hence this study was done to understand the current status of the fishery to adjust the management regulations.

Major lobster landing sites and collecting centers in the south (Weligama, Tangalle, Hambanthota, Kirinda and Amaduwa) were visited once a month for fisheries and biological sampling. Carapace length, total length, sex, species composition presence or absence of external eggs or spermatogonia, craft type, gear and catch volume were recorded. In addition to the field sampling, berried lobsters were kept in the cage constructed at the Matara Polhena sea until they released their external eggs. This programme is continuing in collaboration with the Polhena fisheries co-management committee.

Among the five species of lobsters represented in the catch, scalloped spiny lobster (*P. homarus*) contributed 73%, *P. versicolor* 18%, *P. longipes* 1%, *P. penicillatus* 8% and *P. ornatus* less than 1% (only two lobsters within the year) to the catch. Mean carapace lengths of *P. homarus*, *P. versicolor*, *P. longipes*, *P. penicillatus*, and *P. ornatus* were respectively 7.47, 7.79, 7.72, 8.53 and 8.04 cm. Almost all the lobsters represented in the catch were above the minimum legal size and *P. homarus* mean CL was 1.47 cm above the minimum legal size. CPUE per three craft types non-motorized craft, motorized traditional craft and FRP boats were respectively 1.069 ± 0.789 , 2.458 ± 0.527 and 1.622 ± 1.431 . Length based spawning potential ratio was calculated only for the major species *P. homarus* because there was not enough data to calculate this for the other four species. F/M ratio for the healthy stock should be around 1 but the current value 2.3 (1.74 - 2.86, 95% confidence intervals) reflects the overexploitation level. Further, spawning potential ratio for *P. homarus* 0.26 (0.22 - 0.29) is very small and for healthy stock minimum SPR value should be at least 0.4. The collected data is planned to be used for the World Bank funded stock assessment programme. Already a presentation has been done for the World Bank team regarding the output of the current project.

Biology and fisheries aspects of Blue sharks (*Prionace glauca*) in offshore waters of Sri Lanka.

Study on biology and fisheries aspects of Blue sharks (*Prionace glauca*) was carried out in the major shark landing fisheries harbours in Sri Lanka. The objectives of the study were to review the research findings on blue sharks in the Indian Ocean and to study the biological and fisheries aspects of blue shark's landings by the offshore fishing vessels. Fishery dependent data collection was carried out on a monthly basis in Negombo, Beruwala, Mirissa, Valachchenei and Trincomalee fisheries harbours. However, field data collection was not carried out from March-June 2020 and from October to December 2020 due to the COVID-19 pandemic situation. According to the findings a total of 1004 individuals of Blue sharks were recorded during the field surveys and average total length recorded was 298 ± 18 cm for all landing sites. The size at maturity for the blue sharks was recorded as 201 cm. Catch Per Unit Effort (CPUE) for blue sharks was recorded as 8, 6, 5, 1 and 1 individuals/boat for Negombo, Beruwala, Mirissa, Valachchenei and Trincomalee fisheries harbours respectively. Sex ratio for the Blue sharks was recorded as 1:1 for all the blue shark landings. This study is an ongoing project which will be carried out in 2021 also. At the end of 2021 management recommendations will be made based on the data collected during the three years. In addition, a genetic study will be carried out to estimate the stock structure of the blue sharks.



PROJECT No : 2.2

STUDY OF SOME BIOLOGICAL AND FISHERIES ASPECTS OF SELECTED EDIBLE FINFISH SPECIES IN THE DEMERSAL FISHERY IN THE SOUTH-EASTERN COAST OF SRI LANKA

The present study was conducted to identify some important reproductive biological aspects of two edible reef fish species; *Epinephelus undulosus* and *Lutjanus fulviflemma*; and to understand the present status of the demersal fishery in South-eastern coast of Sri Lanka. The main objective of the study was to provide management recommendations for the proposed management plan for the demersal fishery in South-eastern coast of Sri Lanka, which will be formulated in collaboration with the Government of Norway under the Norway-Sri Lanka bilateral project. To fulfill the study objectives, a fishery-dependent survey was conducted. Monthly field visits had been planned to be conducted to the selected landing sites for the demersal fishery in Kalmunai and Tangalle fisheries district. The genetic study was conducted on the collected two edible reef fish species to identify the species and the nucleotide level variation and to study the phylogenetic relationship among species. However, due to the COVID-19 situation in the country, monthly field visits could not be conducted from March to June and from October to December in 2020. According to the findings of the study done during the rest of the year, 14 species were recorded in the demersal fishery catch in Kalmunai fisheries district among which *Lethrinus* spp. recorded the highest contribution by weight to the total catch at 51.11%. In the Tangalle fisheries district, 19 species were recorded in the demersal fish catch among which *Lutjanus quinquelineatus* recorded the highest contribution with 17.14% to the total catch. Considering the two dominant species in the catch; *Lethrinus olivaceus* and *Lethrinus lentjan* in the Kalmunai fisheries district, the recorded average sizes (TL) were 57.82 ± 16.82 cm and 35.17 ± 8.12 cm respectively. The size at maturity for these two species was 34 cm (TL) and 18 cm (TL) respectively. Accordingly, all the specimens of these two species in the commercial catch were mature ones and there was no apparent threat of capturing immature individuals of these two species in the Kalmunai fisheries district. However, due to the inconsistency of samples, a conclusion cannot be made on the reproductive biological aspects and genetic aspects of the selected fish species in the demersal fishery. It is suggested to conduct the study in 2021 to achieve the objectives of the study.

From the genetic analysis, morphology-only misidentifications of reef fishes at their species level were detected. DNA analysis identified samples collected as *Lutjanus quinquelineatus* as *Lutjanus rufolineatus*. Further, samples of *Lutjanus fulviflamma* analysed for genetic identification confirmed the species as *Lutjanus johnii*. These results emphasize that it is very important to carry out a comprehensive genetic study for a range of reef fish species in Sri Lankan coastal waters. Further, the current study highlighted the fact that there are inaccurate data recordings in the field due to the similar morphological appearances among reef fishes. Further, it is very important to update field guide, which will include a range of reef fishes with their prominent morphological features to reduce mis-identification of fishes. These will improve the precision of the data collections and final results. Further, these findings confirm the usefulness of DNA barcoding of reef fishes in Sri Lankan waters to improve the scientific knowledge as well as to improve the accuracy of the final result of reef fish data collections.

PROJECT No : 2.3

SRI LANKA – NORWAY BILATERAL PROJECT TO IMPROVE THE MANAGEMENT OF FISH RESOURCES OF SRI LANKA (PHASE II)

An increase in the number of fishing vessels and in the fishing effort in Sri Lanka, together with lack of data from the fisheries, have raised concerns that the stocks that Sri Lankan fishermen depend upon are over-exploited, and hence that the fisheries are not sustainable in the long run. The government strategy for enhancing the marine fisheries sector in Sri Lanka aims at developing the sector in a successful way using modern technology and scientific knowledge. Capacity building of Sri Lankan scientists is essential in this regard. Since knowledge about available fisheries resources and the level of harvest are the compulsory inputs for fisheries management, independent resource surveys and landing statistics need to be given high priority.

In order to accomplish above objectives, the bilateral project between Sri Lanka and Norway commenced in late 2016. In the beginning of October 2018, an addendum to the contract with the Norwegian Embassy in Colombo was signed for extending the project period till 31.12.2019. Before completion of the project in 2019, a need arose to move forward the project as a new phase (phase II) from 2020 – 2022. Accordingly, all parties agreed for the second phase of the project.

WP 1: Fisheries dependent data

The Work Package 1 (WP1) of the project was initiated with the aim of improving the fisheries data collection system for marine fisheries in Sri Lanka to provide reliable statistical landing data covering the entire country for sustainable management of the marine fisheries. Three local partners are responsible for the implementation of this work package: MBRD of NARA, Department of Fisheries and Aquatic Resources (DFAR) and the Statistics Unit (SU) of the Ministry of Fisheries (MoF).

In work package 1, a baseline survey was conducted in 2017 and the survey data were evaluated and improved after that. The report from the baseline survey conducted by DFAR and NARA in 2017 was completed in 2018 and a sampling strategy was developed in 2019/2020 to ensure representative and reliable statistics for all marine fisheries, including coastal fisheries. An immense effort had gone into improving the quality of the baseline data, as errors occurred partly due to missing automatic validation when registering data. Enhancing data quality has been considered important, since development of sound sampling design depends heavily upon baseline data analysis and the quality of these data.

Landing data was planned to be part of an integrated fisheries data system, which incorporates other data sources as well, for example vessel registry, licenses, and fishermen's registry. Integration of different related data sources into one system is considered a major strength, since it will enable coherent validation of data and more flexibility for analyzing and reporting outputs.

The formats of the data collection sheets developed in 2017 were agreed on by all parties. With the development of a new database, these data collection sheets were transferred into software applications for tablets, in order to register data electronically at the landing sites using tablets. The tablet application interface was developed in 2019/2020 based on developed paper sheets and database designs.

A series of video meetings between the Norway team and Sri Lanka project partner agencies (NARA, DFAR and MFARD/SU) was held to discuss the WP 1 activities and the progress. A series of regular internal meetings was also held between NARA, DFAR and MFARD/SU to discuss about various subjects relating to WP1.

Twenty-eight and fourteen enumerators of DFAR and NARA respectively were trained in September, 2020 on the large pelagic port sampling data collection under the new system in fishery harbours using the tablet software. The objective of the training programme was to provide basic knowledge to them about new port sampling data collection. They were mainly trained on new tablet software applications and collection of data under the new system. Moreover, they were taken to the Negombo fishery harbour and were provided a practical training on the tasks that were assigned to them to be carried out at the field. The large pelagic data collection based on fishery harbours was started in October, 2020. Though the training programme with regard to coastal fisheries data collection was planned to be conducted in mid October, 2020, it could not be conducted due to the second wave of COVID-19.

A separate data unit consisting of the officials of the MoF, DFAR and NARA has been proposed to be established at DFAR. In this regard, a draft TOR was prepared in 2020. A platform-independent programme has also been developed to measure fish using a hand-held camera (e.g. smartphone). This will be made use in future in collecting length frequency data under the phase II of the project.

WP2: Fisheries Independent Surveys (Acoustic Surveys)

Acoustic surveys are used to estimate distribution and biomass (total weight of fish in a given area) of species living in open water (pelagic) and often aggregating in large schools. Even though it is a reasonably precise tool used in fish abundance estimates, it is largely underutilized for fisheries research in Sri Lanka. Notably, that was the very first survey for establishing a time series on pelagic resources on the North East Coast of Sri Lanka during the Southwest monsoon. The pelagic fish resource is one of the main sources of seafood in Sri Lanka, and these resources are being overfished at present. Therefore, the main objective of these acoustic surveys is to establish a time series on pelagic resources while producing indices on the status and development of the pelagic fish resources after the continuation of surveying for many years. This was the second acoustic survey with RV Samuddrika conducted on the NE coast in August 2020.

A survey plan was made prior to the survey. The plan originally indicated one stratum along the coast north of Trincomalee. A random, systematic zigzag transect design was chosen. The StoX application was used to define the strata boundary definitions based on available previous depth strata from the RV Dr. Fridtjof Nansen survey of 2018 to cover the depth range of 10 – 100 meters. This was assumed to cover the main range of distribution of coastal small pelagic fish. Acoustic data were collected using the EK 15 echosounder of the RV Samudrika. Plankton samples were collected in the middle of each transect along the survey track.



Figure 4. Map of survey strata, Central East (CE) and North East (NE) with zigzag transects. Each stratum covers the depth range between 10 m and 100 m

Name	Priority	Species / Groups
PEL 1	1	Herring- like (e.g., <i>Amblygaster sirm</i>)
PEL 2	1	Mackerel-like (e.g., <i>Selar crumenophthalmus</i>)
PELAG	1	Squids (e.g., <i>Loligo</i> spp.)
PLANK	2	Plankton
BOTTOM	2	Bottom Fish
HERR	3	Possible- Herrings
MACKE	3	Possible- Mackerels
OTHER	3	Other Species

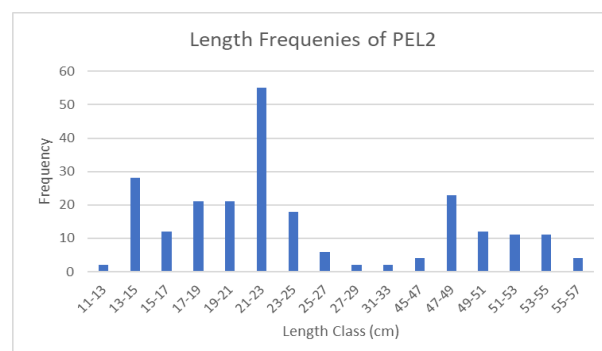
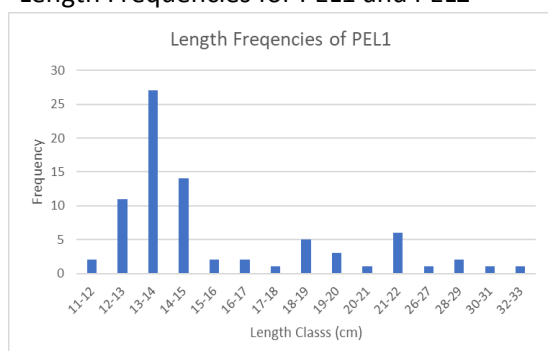
Table 1. Acoustic groups used for the processing of raw data
(1 – High, 2- Low, 3- useable)

The raw acoustics data from the EK15 echosounder was used for the post-processing in LSSS 2.6 application. Data were analyzed according to the predefined eight acoustic categories as listed in table 1.

Biological sampling of commercial catches was conducted parallel to the survey area, focusing on the landing sites, *Trincomalee*, *Salliya*, *Poduwakattu*, and *Pulmudai*. In this regard, two field research assistants were appointed to collect the fisheries and biological data, emphasizing catch composition. Here, they were instructed to pay more attention to the most abundant pelagic fish species, such as herrings (*Amblygaster sirm*) and sardines (*Sardinella* sp.), which are landed at the above landing sites. In addition, the catch data for the demersal fish and other species, which are contributing in considerable proportions to the total catch, were also collected. Further, length and weight data for individual fish were collected, which are leading to density and biomass estimation via acoustic methodologies.

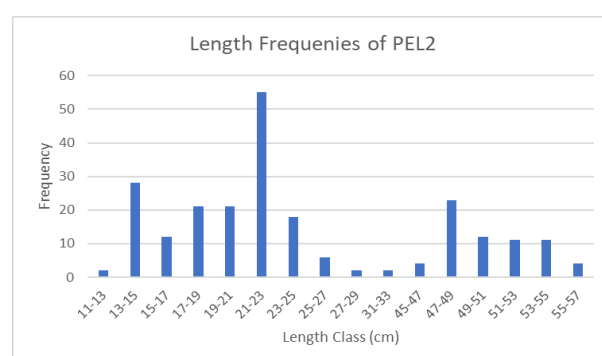
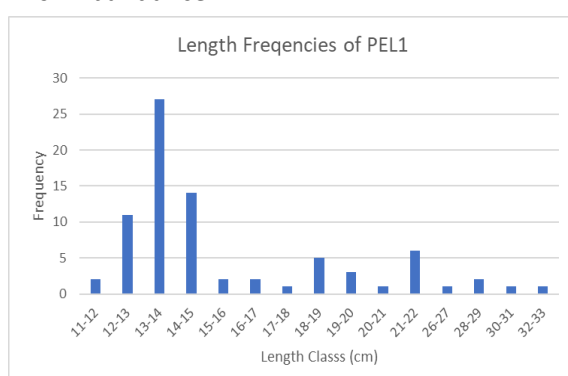
Abundance estimates for acoustic categories PEL1 and PEL2 were calculated using StoX version 2.7 considering only one PEL1 and one PEL2 fish per stratum. These fish were given the average individual length and weight calculated from the biological samples from the nearby landing site.

1. Length Frequencies for PEL1 and PEL2



The estimated biomasses for PEL 1 and PEL 2 were 2,240.2 tons and 2,271.3 tons, respectively, for the survey area.

2. Fish Abundance



The estimated biomasses for PEL 1 and PEL 2 were 2,240.2 tons and 2,271.3 tons, respectively, for the survey area.

PROJECT NO : 2.4

STUDYING THE FISHERIES AND MARINE MAMMAL INTERACTIONS AND POPULATION ESTIMATE OF BLUE WHALE (*B. MUSCULUS*)

Demersal and pelagic longline fisheries involve frequent and geographically widespread interactions with many individuals, populations, and species of marine mammals. Animals sometimes suffer mortality and serious injury following these interactions, attracted mainly to longlines as a source of food. This depredating behaviour can have serious consequences for fishermen, especially when they lose valuable catch and face other associated operational and regulatory challenges.

To study the fisheries and marine mammal interactions, a questionnaire survey was carried out based on the major fisheries harbours in Sri Lanka (Dikovita, Negombo, Beruwala, Dondra, Mirissa, Tangalle and Kirinda). The blue whale population size of Sri Lanka is estimated using the mark and recapture method through photos which are collected on a daily basis in collaboration with the commercial whale watching operators. Individuals (including re-sightings) were identified from South coast area.

According to the results, Depredation Index (DPI) for the Tuna longline fishery is 14.4. Through the questionnaire survey of IMUL boats, four marine mammal species damaged to the hooked yellow-fin tuna, skipjack tuna, marlin and sailfish were identified. These species are

- False killer whale - *Pseudorca crassidens*
- Pigmy killer whale - *Feresa attenuate*
- Melon-headed whale - *Peponocephala electra*
- Short finned pilot whale - *Globicephala macrorhynchus*

The results revealed that black fish species (marine mammals) are very common along the equator but less around Sri Lanka. Therefore, depredation is frequently reported in deep sea areas within the EEZ and international seas along the equator.

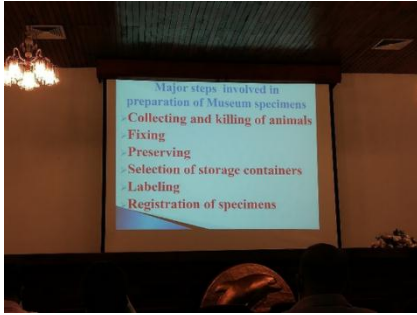
Through the Photo identification programme conducted in collaboration with commercial whale watching operators from January to mid-March 2020, 89 blue whale individuals were identified from Mirissa area including resighting.

Based on the past and present studies two areas in south and east coasts around Mirissa and Trincomalee were proposed to declare as protected areas.

PROJECT NO : 2.5

MARINE MUSEUM UPGRADE AND SKELETON PREPARATION

Major objectives of this project were establishment of whale skeletons and specimens of ETP species to exhibit to the public and to upgrade the marine museum opened to the public. During the February an attempt was made to recover a skeleton of a buried stranded whale which had been identified as belonging to a Bryde's whale (*Balanoptera* spp) buried in 2018 at Uswetakeyyawa, near Pegasus Reef Hotel. But after the preliminary investigations it was found that some part of the skeletons had washed into the sea due to the rough sea conditions during the monsoon period. A one-day training workshop was held to train Scientists and Research Assistants of MBRD regarding preservation techniques of the marine museum specimens by the curator of the museum of Department of Zoology of University of Sri Jayawardhanapura. Up until now, fish samples have been preserved in formalin for museum preservation purpose. But due to its carcinogenic effect, it was we decided to use ethanol as the preservation media instead of formalin. Preservation of rare samples collected during the Dr. Fridtjof Nansen survey was started with this knowledge. Required glass tanks were prepared for the preservation and formalin preservation was used to preserve the samples until the ethanol for the preservation is purchased. Ethanol purchasing process was also started. But these activities were interrupted due to the COVID-19 pandemic situation.



Workshop on specimen preservation techniques

External funded projects carried out in 2020

1. CONDUCT RESEARCH IN RELATION TO FISHING IMPACTS AND BIOLOGICAL IMPACTS DUE TO SAND EXTRACTION FOR COLOMBO PORT CITY DEVELOPMENT

With reference to the development permit issued for the Port City development by the Department of Coast Conservation and Coastal Resource Management in March 2016, confirmation of effective implementation of mitigation measures on the marine environment in the sand dredging areas during and after sand dredging was a necessity. NARA was assigned to monitor relevant parameters in the Environmental Management Plan (EMP) during the period of dredging in order to fulfill the requirements pertaining to the development permit. The condition 2.1.12 in the development permit indicates that proper extraction methods and technology are maintained to prevent or minimize any potential damage during the extraction period and extensive support is given to carry out collaborative research with NARA. Accordingly, MBRD has been conducting a research study since June, 2018 with following objectives:

- Evaluate the time needed for the recovery of affected seabed and marine communities in the sand dredging areas and associated habitats
- Evaluate long term impacts of sand dredging on different functional groups in the ecosystem and habitats
- Assess the present status of biological resources and habitats surrounding areas of the dredging site.

The final underwater reef survey was planned to be conducted on the reefs near the dredged sites (Thambugala, Diyambala, Onagala and Kalapugala) in 2020, but it has not yet been possible to accomplish this due to the prevailing bad weather and the COVID-19 pandemic. The results of this survey are important to assess the recovery time and long-term impacts on the ecosystem.

2. STUDY ON THE ENVIRONMENTAL IMPACTS ON MARINE RESOURCES DUE TO NOROCHCHOLI POWER PLANT

Norochcholi power plant is situated close to the Gulf of Mannar, one of the most important biologically and ecologically sensitive areas in the northern waters of Sri Lanka. Since Gulf of Mannar comprises of a variety of sensitive marine habitats like coral reefs, mangroves and sea grasses, it could be considered as one of the most productive ecosystems in Sri Lanka. Especially the water released from the power plant could affect both biological diversity and social life of the fishing community. As per a request made by Norochcholi Power Plant functioning under the Ceylon Electricity Board, NARA undertook a study in 2019/2020 on environmental impacts on marine resources due to the Norochcholi Power Plant.

A baseline survey was conducted by MBRD in 2019 in order to collect baseline information about fishing activities conducted close to the Norochcholi coal power plant. Based on baseline survey results, a fishery dependent survey was conducted in 2019/2020. Accordingly, all fish landing sites located from Thalawila to Daluwa were selected for the fishery dependent data collection. Data on fish species, weight of each fish species/group, total catch, fishing gear used, fishing time and fishing location were collected by visiting the

respective landing sites monthly. A fishery independent survey was also conducted in the sea adjacent to the coal power plant in order to obtain fishery independent data on existing resources. Furthermore, an Ichthyoplankton (fish egg and larvae) survey was conducted in order to find out whether fish breeding grounds exist in surrounding areas. In addition, an underwater visual survey was conducted in 2020 in order to find out the status of Thalawila reef situated near the power plant.

3. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED RECREATIONAL BEACH/ SEA WATERFRONT PROJECT FROM COLPETTY TO DEHIWALA CANAL OUTLET

The Government of Sri Lanka has decided to develop a recreational beach/sea waterfront from Colpetty to Dehiwala canal outlet to fulfill the needs of the public for recreational activities and reserve space for future Railway Transport Development Plan. NARA was awarded the consultancy of EIA by the Coast Conservation & Coastal Resources Management Department (CC&CRMD). Under this consultancy project, MBRD undertook work in relation to describing the existing aquatic environment and biological resources, assessment of possible environmental impacts on habitats and biological resources due to the implementation of the project and for recommending mitigation measures to minimize such impacts. All assigned tasks to MBRD has been successfully completed and NARA has already submitted the EIA study report to CC&CRMD.

4. COLOMBO SOUTH SAND NOURISHMENT PROJECT: OFFSHORE SAND MINING AND BEACH NOURISHMENT AT MT. LAVINIA TO ANGULANA COASTAL STRETCH AND RE-CREATION OF NATURAL SAND BAR AT KALUTARA – INVESTIGATION ON SAND BORROW AREA – OFF RATMALANA

Under this project, biological environment of the project site and vicinity was assessed for compiling the current environment profile of the area of interest. An underwater survey was conducted for assessing the sensitive habitats of the area of interest and fish landing site survey was conducted for assessing the fauna of the area. Information from the literature and information gathered via interviews with relevant parties were also used for preparation of the final report. The survey was completed and the final report was submitted by NARA on 24/12/2020.

Other activities undertaken by MBRD

1. On behalf of Sri Lanka, MBRD answered a questionnaire provided by Food and Agriculture Organization (FAO) of United Nations. This questionnaire was dedicated to the national reporting and monitoring of the Sustainable Development Goals (SDG) indicator 14.4.1, of which FAO is the custodian agency. The results will provide policy makers with comprehensive information on the state of fish stocks at regional and global levels towards reaching the SDG 14.4. The collected data are also expected to identify countries' capacities in producing assessments, so that FAO can provide necessary capacity development.
2. On behalf of Sri Lanka, MBRD filled the Questionnaire on "Existing capacity and needs for stock assessment training in the IORA region" in regard to "Initiate a Capacity Building programme in fish stock assessment"
3. On behalf of Sri Lanka, MBRD answered several queries made by IORA at different occasions including about recently developed IORA action plan for 2020 – 2025.
4. With regard to the import of several coral species from Vietnam for propagating under the aquarium conditions, a request had been made to MBRD by DFAR asking the observations and recommendations. Accordingly, MBRD studied and provided recommendations.
5. With regard to the request made by DFAR regarding NARA recommendations on importation of long fin eel (*Anguilla mossambica*) for re-export purposes, MBRD studied and provided recommendations.
6. MBRD contributed to training 42 enumerators (DFAR – 28 and NARA – 14) who were assigned for fishery harbours for offshore and high seas fisheries data collection.
7. MBRD assisted DFAR to draft two regulations in 2020: Ring Net Fishing Management Regulation and Crab Fishery Management Regulation.

8. MBRD actively engaged in assessing the impacts of the oil spill of MT New Diamond on marine environment and biological resources.



9. General cargo ship Sri Lanka Glory (IMO 9023081) was pushed by storm, at Rumassala coast, Galle, Sri Lanka, in the morning on 18th July 2019. It was located at position of 6°1'3.17" N and 80°14'10.57"E. As per a request made by Coast Conservation & Coastal Resources Management Department regarding cutting and removing of the ship from Galle, a research team of MBRD conducted a site visit and provided a report with observations, suggestions and recommendations.
10. Examined and provided reports on fish samples sent by various high courts for blast fishing. Accordingly, in 2020, 8 number of samples were analyzed and reports were provided.
11. Examined and provided 7 reports in 2020 on identification of gastropod shells and other samples sent by the Magistrates' Courts.
12. Examined and provided 98 reports on identification of shark fin/ skin samples sent by fish exporters.
13. Lectures were conducted on the importance of conservation of biodiversity and coral reefs for coast guard and the Sri Lanka NAVY and Sri Lanka Coastguard.
14. External supervision of an MSc degree (Mr. U.P.W. Hettiarachchi) registered at the University of Sri Jayawardenapura.
15. External Supervision of BSc final year research projects of a student from the Eastern University (Ms. U.P.V.O. Urapola), a student from the University of Ruhuna (Ms. W.A.H. Sithara), a student from the Ocean University (Ms. L.H.B.S.B. Fernando) and a student from the Uva Wellassa University (Ms. N.H.D. Surangi).
16. Provided Industrial Training for 27 Sri Lankan university students (12 students from the University of Kelaniya, 8 students from University of Sri Jayawardenapura and 10 students from the Ocean University)
17. MBRD Scientists served as members of the Technical Evaluation Committees for 2020 for purchasing of chemicals and consumables for NARA.
18. As per a request made by the Ministry of Fisheries to find out the feasibility of using marine and brackish water fish species for fish canning, MBRD provided required information with the availability of such species.
19. Collection and provision of data and samples for the investigation of impacts of the oil spill of the Blue Diamond ship
20. Report provided to Inland Aquatic Resources and Aquaculture Division of NARA on the molecular identification of the *Artemia* species currently being cultured by them.
21. Investigation and provision of the report for the dolphin stranding at Mt. Lavinia beach and Panadura beach (including molecular identification).
22. Study on the biological aspects of the Environmental Impact Assessment Survey at 4 landing sites in Kilinochchi District.
23. Study of the distribution and impacts of the 'ja-kotu' fishery in Trincomalee district
24. Environmental Assessment Study for the cleaning and fishing activities within the Nandikadal nature reserve.

25. Preparation of shark species identification reports to shark fin exporters by using fresh shark specimens, dried shark fins, sharks and ray skins and rays gill plates for the export purposes.
26. Investigation and provision of reports for the molecular identification of strandings of marine mammals.
27. Preparation of court case reports for the analysis of samples to prove the fish up to species level.

Representation of MBRD Scientists at National Committees/ National Services

1. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD has been acting as a member of the Steering Committee for Conservation of Marine Species and Ecosystems established by Department of Wildlife Conservation since 2016.
2. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD has been acting as a member in the Steering Committee for Fishery Improvement Project (FIP) for Sri Lanka longline tuna and billfish fishery since 2017.
3. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD acts as a member in the Steering Committee for Fishery Improvement Project (FIP) for Sri Lanka Blue Swimming Crab fishery.
4. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD acts as a member in the implementation committee for National Plan of Action (NPOA) for conservation and management of sharks in Sri Lanka.
5. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD acts as a member in the implementation committee for National Plan of Action (NPOA) to prevent, deter and eliminate Illegal, Unreported and Unregulated (IUU) Fishing.
6. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD acts as the Focal Point of Work Package 1 (Assistance to upgrade existing NARA's port sampling programs on coastal fisheries data collection and improve fisheries statistics) of "Sri Lanka – Norway Bilateral project" to improve the management of fish resources of Sri Lanka.
7. Dr. S.S.K. Haputhantri, Principal Scientist of MBRD acts as the NARA Focal Point of French Development Agency (AFD) funding Fisheries Harbours Project.
8. Dr. D.R. Herath, Senior Scientist of MBRD acts as the member representing NARA in the National Committee on Agricultural Biotechnology of the Sri Lanka Council for Agricultural Research Policy (SLCARP).
9. Dr. R.P.P.K. Jayasinghe, Principal Scientist of MBRD acts as a member of the National Expert Committee on Biological Diversity (NECBD) coordinated through the Biodiversity Secretariat, Ministry of Mahaweli Development and Environment.
10. Dr. R.P.P.K. Jayasinghe, Principal Scientist of MBRD acts as the Focal Point of Work Package 2 (Assistance to upgrade existing NARA's port sampling programs on coastal fisheries data collection and improve fisheries statistics) of "Sri Lanka – Norway Bilateral project" to improve the management of fish resources of Sri Lanka.
11. Mr. K.R. Dalpadathu, Scientist of MBRD is serving as the Member of the Steering Committee for the Sustainable utilization for Sea Cucumbers.

Workshops/meetings attended:

1. Meeting held to discuss Environmental Impact Assessment of proposed 300MW coal power plant unit of Lakvijaya Coal Power Plant conducted by Divisional Secretariat of Puttalam. 25 January 2020.
2. Winter School on Ocean Governance for Sustainable Marine Ecosystems, Bremen, Germany. 16-22 February 2020.
3. IUCN Grouper Fishery Monitoring & Assessment Workshop, Online, 10-11 May 2020.
4. The Indian Ocean Tuna Commission (IOTC) 10th Working Party on Neritic Tunas, Online. 6-8 July 2020.
5. Training on museum sample preservation techniques conducted by Mr. Ravindra Pethiyagoda, Museum Curator, University of Sri Jayawardhanapura. 17 July 2020.

6. SEAFDEC Teleseminar on way forward for combating Illegal, Unreported and Unregulated (IUU) fishing in Southeast Asia. 24-26 August 2020.
7. Norway – Sri Lanka Data collection workshop. Colombo, 7-8 October 2020.
8. IOTC 11th Working Party on Methods (WPM11) held from 14-15 October 2020 as a virtual meeting
9. IOTC 22nd Working Party on Tropical Tuna (WPTT22) held from 19-23 October 2020 as a virtual meeting
10. 24th Session of IOTC commission meeting held from 2-6 November, 2020 as a virtual meeting
11. Regional Capacity Building Programme on Biotechnological Tools in Aquatic Genetic Resource Management and Ex-Situ Conservation (virtual), 7-18 November 2020.
12. Marine Biotechnology conference, Marine materials and antifouling, 25 November 2020.
13. 15th Working Party on Data Collection and Statistics (WPDCS15) – Virtual Meeting conducted by Indian Ocean Tuna Commission (IOTC). 30 November - 3 December 2020.
14. 23rd IOTC Scientific Committee held from 7-11 December, 2020 as a virtual meeting.
15. One Scientist of MBRD is reading for a PhD at AIT in Bangkok, Thailand.

Publications

Full papers

1. Dalpathadu, K. R. and Haputhantri, S. Present status of fishery resources utilisation in the Panama Lagoon, Sri Lanka. *Asian Fisheries Science* **33**: 341–347. <https://doi.org/10.33997/j.afs.2020.33.4.005>
2. Haputhantri, S.S.K., Weerasekera, S.J.W.W.M.M.P. and Bandaranayake, K.H.K. Morphometric relationships in the Blue Swimming Crabs, (*Portunus pelagicus*) (LINNAEUS, 1758) from the Palk Bay, Sri Lanka. *Asian Journal of Fisheries and Aquatic Research*. Accepted for publication.

Abstracts

1. Jayasinghe, R.P.P.K., Gunasekara, S.S., Weerasekera, S.J.W.W.M.M.P., Jayathilake, R.A.M., Wijesinghe, M.G.C.R., Adhikari, A.A.U.W.S., Atle Totland (2020). Estimation of small pelagic fish stock abundances on the Northeast shelf of Sri Lanka using acoustic methods. Proceedings of the NARA Scientific Sessions 2020.
2. Gunasekara S.S. and Haputhanthri S.S.K. Effect of bait type on catch efficiency in the Sri Lankan longline fishery operated targeting yellowfin tuna (*Thunnus albacares*). Proceedings of the NARA Scientific Sessions 2020.
3. Herath D.R., Ranasinghe V.K., Kumara M.D.I.C., Seneviratne U., Prasad J.A.C., Perera H.A.C.C. and Hettiarachchi G.H.C.M. (2020). Feeding predation in some commercially important scombrid fish: a molecular perspective. Proceedings of the NARA Scientific Sessions 2020.
4. Pahalawaththaarachchi, V., Medagedara, C. B., Dalpathadu K.R., Karunarathne, C., Fahim, M. S. M., Bandara, W. and Chathuranga, C., (2020). Re-reporting of *Pinctada* sp. (Bivalve Species, Family: Pteriidae) in Gulf of Mannar, Northern Province, Sri Lanka. Proceedings of the NARA Scientific Sessions 2020.
5. Aluwihare, Y.C., Wickramasinghe, K.T.M., Jayasinghe, R.P.P.K. and Haputhantri, S.S.K. A new *Decapterus* species record: *Decapterus maruadsi* from Sri Lankan waters. Proceedings of the NARA Scientific Sessions 2020.
6. Somasundaram, T., Wimalasiri, H.B.U.G.M. and Karunarathne, M.M.C. A preliminary total fat and fatty acid screening in the gonad of four sea urchin species found in Sri Lanka. Proceedings of the NARA Scientific Sessions 2020.
7. Hettiarachchi, U.P.W., Haputhantri, S.S.K., Gunathilake, V.K. and Perera, H.A.C.C. Exploitation of *Amblygaster sirm* (Walbaum, 1972) in the Eastern Coastal waters of Sri Lanka. Proceedings of the NARA Scientific Sessions 2020.
8. Sithara W.A.H., Herath D.R., Rathnasuriya M.I.G. and Herath S.S. (2020). Spatial variation and species diversity of leaping blenny fish (family: Blenniidae) in Southern coastal region of Sri Lanka. Proceedings of the NARA Scientific Sessions 2020.

9. Fernando, L.H.B.S.B. and Aluwihare, Y.C. Identification of morphologically similar reef fishes (Perciformes, Lutjanidae) using a molecular approach. Proceedings of the NARA Scientific Sessions 2020.

Conference Proceedings

1. Presentation on the workshop of IUCN Grouper Fishery Monitoring & Assessment Workshop. Online, 10 – 11 May 2020.
2. Dalpathadu K.R. and Haputhantri S.S.K., (2020). Neritic tuna fishery in Sri Lankan waters: An update. In: IOTC–2020– WPNT10-INF02. Tenth Session of the Indian Ocean Tuna Commission (IOTC) Neritic Tunas Working Party. Online, 6-8 July 2020.

Reports

1. Current Status of Stake-net ('Ja-Kotu') Fishery in Mannar District: A report submitted to the Department of Fisheries and Aquatic Resources, Ministry of Fisheries, Sri Lanka, October 2020.
2. Survey Report - Acoustics survey on pelagic fish off Trincomalee (in Progress)
3. Cutting and removing the ship of Grounded MBC Sri Lanka Glory (IMO 9023081) at Galle. The report was submitted to the Coast Conservation & Coastal Resources Management Department.
4. Mahendra Jayathilaka and Sisira Haputhantri. 2020. Report of the study on the beach seine fishery in Sri Lanka. The report was submitted to Hon. Minister of Fisheries, Secretary/ Ministry of Fisheries and Director General/ Department of Fisheries and Aquatic Resources.

Posters

1. Poster titled, *Current Research at a glance*. Presented at the Winter School 2020: Ocean Governance for Sustainable Marine Ecosystems, 15-22 Feb 2020, Bremen, Germany.

5.6 NATIONAL INSTITUTE OF OCEANOGRAPHY AND MARINE SCIENCES

Head of the Division : Dr. K. Arulanathan

Oceanography Division is responsible for coordinating and conducting coastal and offshore oceanographic studies around Sri Lanka. Thus, Oceanographers and Marine Geologist at the Division conduct research in the fields of physical, chemical, biological oceanography. The Division has been conducting research on coastal and deep ocean research having long term archival of oceanographic datasets on tides, currents and waves. The division 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).

Progress of Research Projects

Oceanography Division has conducted eight major projects and several consultancy services during the year 2020. Following are the major projects conducted by the division during 2020.

	Projects	Allocation	Responsible Officer/s
6.1	Tuna Fishing Ground Advisory and Fisheries Information Service	0.25 M	Udeshika Wimalasiri
6.2	Numerical Model in Assessing the Impact of Offshore Dredging on the Coastal environment Along Wadduwa-Negombo	0.5 M	R.M.R.M. Jayathilake
6.3	Prospecting sand resources in offshore, Galle	0.3M	Dileka Samaranayake
6.4	Monitoring the Aggregation of Micro-plastics in Coastal Waters around Sri Lanka	0.2 M	W.R.W.M.A.P. Weerakoon
6.5	Assessment of Climate Change Impacts on the Ocean Environment: Impacts of Temperature, Salinity and Water Level on Coral Reefs in the East and the West Coasts of Sri Lanka	0.9 M	H.B.U.G.M. Wimalasiri W.R.W.M.A.P. Weerakoon
6.6	Ocean Acidification and the Changes of the Marine Carbon System in Sri Lankan Waters.	0.727M	W.R.W.M.A.P. Weerakoon Dr.W.N.C. Priyadarshani H.B.U.G.M. Wimalasiri
6.7	Sea Level Observation and Formulation of Oceanographic Data Base	2.28 M	Dr. K. Arulanathan
6.8	Seasonal and interannual variation of Coccolithophore sinking fluxes and their contribution to total carbon fluxes in upwelling regions of Sri Lankan waters	0.724M	Dr. W.N.C. Priyadarshani

PROJECT NO : 6.1

TUNA FISHING GROUND ADVISORY AND FISHERIES INFORMATION SERVICE

Officer	:UdeshikaWimalasiri
Division	: National Institute of Oceanography and Marine Sciences, NARA
Duration	: 2020 (January to December)
Budget(FY 2020)	: LKR 0.25Mn
Source of funds	: NARA

The fishery has a long tradition in Sri Lanka and contributed 1.1 % of GDP in 2019 (CBSL., 2019). The marine fishery is the dominant sector of the fisheries in Sri Lanka, which has contributed 82.1% to the country's total fish production (Ministry of Fisheries., 2020). The coastal fisheries sector contributes 58.4% of total marine fish production, and offshore fishery sector contributes remaining 41.6%. About 90% of fishing vessels (44,091 vessels) are operated within coastal waters while the rest (4,885 vessels) are operated in EEZ and high seas. Offshore tuna fishery has a significant contribution to the economy as tuna contributes 49.5% of total fish exports of 299 million US\$ in 2019 (Ministry of Fisheries., 2020).

Offshore fishery of Sri Lanka operated with long-line, gillnet and ring net or combination of them. Long-line fishery mainly target large pelagic species such as Yellowfin and Big eye tuna. Fishing ground forecasting system for Sri Lanka was developed in 2007 and implemented in 2008. Experimental level forecast was released once a week and disseminated to selected fishing vessels and validated the forecast with fish catch received by forecasted fishing grounds. After successful validation effort, with encouraging results, forecast dissemination expanded to all major fishing harbors. Since 2015 the fishing ground forecast was disseminated two times a week. During 2016, fuzzy logic base forecasting model was developed and accuracy assessment show 67% accuracy of improved forecast.

Progress

- In total, 96 potential fishing ground forecast maps were produced and disseminated via email, telephone and other web based sources during 2020.
- Fisheries awareness programs had been conducted on Dikowita, Negombo, Mirissa, Dikwella, Nilwella and Gandara Fisheries Harbors.
- E-mail user community is raised from 200 to 350 uses in the year 2020. This user community include fishing boat owners, skippers and fisheries officers.
- The fisheries information was disseminated via NARA web portal, NARA official social media page and skipper's social media page



Limitations

Only 66% of forecast production and dissemination target was achieved during 2020. During March, April and May forecast maps were not issued as per schedule due to COVIDlockdown in the country.

Satellite data for operational fishing ground forecasting drawn from open source, thus solely depend on the service providers mercy. Establishing a satellite receiving station and increasing human resources and building capacity for satellite data processing and numerical modelling of ocean would ensure continuity and quality of the project.

PROJECT No : 6.2

NUMERICAL MODEL IN ASSESSING THE IMPACT OF OFFSHORE DREDGING ON THE COASTAL ENVIRONMENT ALONG WADDUWA-NEGOMBO

Officers	: R.M.R.M.Jayathilake
Division	: National Institute of Oceanography and Marine Sciences, NARA
Duration	: 2020 (January to December)
Budget(FY 2020)	: LKR 0.5 Mn
Location	: The South-west Coast of Sri Lanka
Source of funds	: NARA

Offshore sand is evolving as a major source of sand for reclamations, construction and coastline stabilization. Offshore mining have economic and social benefits, while have a potential to cause environmental problems. Environmental problems occur when the rate of extraction of sand, gravel and other materials exceeds the rate at which natural processes generate these materials. The effects of intense mega sand extraction on coastal environment are only poorly known. The extraction is anticipated to significantly change the shape, volume and height of the sandbank. The altered morphology could also affect the current and wave patterns in the coastal waters, with possible implications on erosion of the coasts. For coastal defense re-alignment, modification, planning and implementation of current and future coastal defenses require the information include choices about mining locations and quantities which reduces the environmental impacts. Such a strategy requires knowledge on the impact of very large-scale offshore sand mining along the Sri Lankan coast.

Progress

Forty years (from 1979 to 2019) of ERA-Interim data is analysed to schematize the wind/wave climate for boundary conditions. According to the wind climate study, wind is coming from NE direction from November to March with the angle 40° - 60° while it changes to SW direction with the angle 220° - 240° from May to September. During SW monsoon, the wind speed varies between 7-11 m/s while it varies between 1-5 m/s during NE monsoon. The number of extreme events is about 65 events, when wind speeds of greater than 12 m/s recorded. More than 95% of such events occurred during SW monsoon period. The significant wave height varies between 0.5 m to 3 m having most probable wave heights around 1.5 m. The distribution of wave direction is mostly from 210° - 250° (SW) and from 30° - 80° (NE). Total number of wave events greater than 3 m recorded at offshore point is 149. The SW monsoon experiences the highest probability of occurrence of higher wave events than in NE monsoon.

Table 6.2.1 Long term (1979-2019) and short term (2010-2019) wave climate variability

Parameter	1979-2019			2010-2019		
	Yearly maximum	Yearly minimum	Yearly average	Yearly maximum	Yearly minimum	Yearly average
Significant wave height (m)	3.8101	0.4788	1.3850	3.2712	0.4788	1.3925
Wave period (s)	15.1885	5.0131	8.8386	15.1885	5.3645	8.8581
Wave direction (SW monsoon) ($^{\circ}$)	NA	NA	233.5	NA	NA	233.3
Wind speed (m/s)	10.90	NA	4.44	11.25	NA	4.50
Wind direction (SW monsoon) ($^{\circ}$)	NA	NA	248.2	NA	NA	248.3
Wave Energy (Kw/m)	NA	NA	2.2778e+05	NA	NA	2.2992e+05

Limitations

National sand mining strategy shall be developed, which shall include parameters of offshore mining (distance from coast and water depth) and quantities (sand volume/sub surface layers). Such a strategy requires knowledge on the depth of closure in an area where the wave climate is likely to have little effect on bottom sediments. The sand movement due to long-shore sand transport occurs at depths less than the closure depth, which depends on the wave climate and cross-shore profile steepness.

PROJECT NO : 6.3

PROSPECTING SAND RESOURCES IN OFFSHORE, GALLE

Officers : Dileka Samaranayake
 Division : National Institute of Oceanography and Marine Sciences, NARA
 Duration : 2020 (January to December)
 Budget(FY 2020) : LKR 0.3 Mn
 Source of funds : NARA

Project

Due to rapid development in construction industry since 2009 the demand for the construction materials including sand has grown up enormously resulting shortage of the supply. The crisis led to illicit sand mining in major river banks which creates many environmental issues. Thus, there is an urgent need for an alternative for river sand. Offshore sand is a promising alternative for river sand. Currently Sri Lanka Land Reclamation and development cooperation use offshore sands for constructions after purification. As the demand for the sand arises day by day they seek for other locations to extract sand which is suitable for construction purpose. Since the extraction process in deep ocean is not economically feasible, this study intended to study the construction sand resources in the continental shelf in Galle area.

Progress

Based on the sediment sample analysis and visual observations, surface geology map was prepared for the study area. The area covered was 35-40 km². All the parameters were calculated based on Falk and Ward(1957) classifications. A distinct sand bed was identified with the width of 105 km and ~6.5km length. It is located beyond a shell and coral patch. The deposit located approximately 3-5km from the coastal line. The mean grain size varied from 0.073-1.25 mm, is within the recommended range of 0.5 to 2 mm. D50 varied between 0.07 – 1.8 mm. The recommended range for construction is 0.6 mm. The sand deposit is moderately to well sorted. The shell and coral percentage for the size (mm)>10 was less than 5% and the size 5mm to 12mm is around 12% which is compatible with the standards. The chloride percentage was

2.8% by the weight of the sand while the recommended range is 0.075%(Dias et al., 2008). However, appropriate remedies such as piling up and artificial washing could reduce the chloride content. Heavy mineral content varied from 0.12 to 12% by weight.

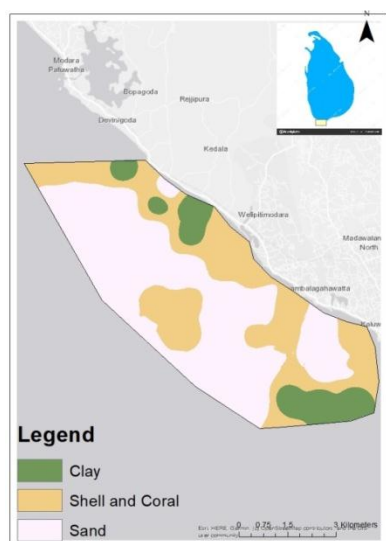


Figure 6.3.1 Study Area
Grain size distribution.

The minerals identified were Ilmanite, Zircon, Rutile and Garnet. The results of the sub bottom profiling in Chundikulum area indicate the sand layer in the surveyed area was varied from 0.5m to 4 m. However, further studies should be done to analyze the sand quality of the deposit. Bathymetry of the study area varies from 0m to 9m within the 500m from the coastline and within 2.5 km from the coast line 0-38 m depths recorded (Based on bathymetry map generated by NARA). However, the depth of the continental shelf around the Gin River shows much shallower, showing the influence of the sediment carried by the river.

A distinct sand bed was identified which extends length of ~6.5km with 1.5km width. All the other parameters except the chloride content were compatible with the standards. Further, the deposit is located beyond 15m depth and 2.5km from the shore indicating the deposit can be mined according to the regulations practice in Sri Lanka. However, a sub bottom survey should be done in the area to confirm the quantity of the sand deposit which could not complete during 2020 because of the Corona pandemic.

PROJECT NO : 6.4

MONITORING THE AGGREGATION OF MICRO-PLASTICS IN COASTAL WATERS AROUND SRI LANKA

Officers	: W.R.W.M.A.P. Weerakoon
Division	: National Institute of Oceanography and Marine Sciences, NARA
Duration	: 2020 (January to December)
Budget(FY 2020)	: LKR 0.2Mn
Source of funds	: NARA

Project

Marine pollution, in particular, micro-plastic pollution is an emerging threat in Sri Lanka, which demands continuous assessments and monitoring, especially in the sensitive eco-systems such as coral reefs, since micro-plastics could carry toxic chemicals, result in bio-accumulation, and abolish coral reefs, that may bring lethal impacts to marine biodiversity. Thus, this project (an extension of 6.4, 2019) further examined the degree of micro-plastic pollution, in particular floating micro-plastics (in the range: 0.3–5 mm) in surface waters around two major coral reefs in Sri Lanka; The Bar-Reef marine sanctuary(North-western coast), and the Pigeon Island national park (Eastern coast),

Progress

Abundance of micro-plastics: The average abundance of floating micro-plastics (0.3–5 mm) at the Bar-Reef marine sanctuary, ranged from 0.54 to 30.43 particles per square meter (PSM) in 2018, 0.60 to 30.81 PSM in 2019, and 0.65 to 32.43 PSM in 2020, whereas the average abundance of floating micro-plastics at the Pigeon Island national park varied from 0.24 to 16.83 PSM in 2018, 0.26 to 17.09 PSM in 2019, and 0.27 to 18.23 PSM in 2020 (Tables 1, 2 and 3). At all monitoring circumstances, the abundance of floating micro-plastics at the Bar-Reef marine sanctuary was notably higher, compared to the concentrations recorded from the Pigeon Island national park.

Aggregation of micro-plastics: The results indicate a rise in the abundance of floating micro-plastics in both coral reefs, where in 2019, the abundance of floating micro-plastics at Bar-Reef marine sanctuary has been increased at least by 9.47% compared to 2018, whereas that in Pigeon Island national park has been ascended at least by 5.94%. In 2020, the average abundance of floating micro-plastics in Bar-Reef marine sanctuary have been increased at least by 7% whereas that in Pigeon Island national park has been risen at least by 4% compared to 2019.

Categories of Micro-plastics: The majority of floating micro-plastics found in Bar-Reef marine sanctuary and Pigeon Island national park were fragments, and were secondary micro-plastics, where most of the floating micro-plastics were weathered particles of hard plastics. The second major category of floating micro-plastics found were foams, threads and thin fibers.

Bar-Reef marine sanctuary in very close proximity to the reef could be a major reason for the generation of abandoned, lost or discarded fishing gear (ALDFG) directly on the reef, which could impose severe issues such as ghost fishing, depletion of fish resources and loss of biodiversity. The relatively higher concentrations of thin fibers and thread-likes in the Bar-Reef marine sanctuary indicates the pollution of waters around the coral reef with the debris of fishing gear and textiles. This study provides the first evidence on the aggregation of floating micro-plastics in waters around coral-based eco-systems in Sri Lanka.

Recommendation

Since the pollution levels are increasing in both Bar reef and Pigeon Island, attention must be paid to minimize the generation of waste from single-use plastics and polythene, fishing gear and textiles. Both waste water treatment and solid waste management must be further improved to minimize contamination of waterbodies. A proper management plan is suggested for the management of ALDFG, while fishing around coral reefs must be controlled.

PROJECT No : 6.5

ASSESSMENT OF CLIMATE CHANGE IMPACTS ON THE OCEAN ENVIRONMENT: IMPACTS OF TEMPERATURE, SALINITY AND WATER LEVEL ON CORAL REEFS IN THE EAST AND THE WEST COASTS OF SRI LANKA

Officers	: Mr.H.B.U.G.M. Wimalasiri and Mr. W.R.W.M.A.P. Weerakoon
Division	: National Institute of Oceanography and Marine Sciences, NARA
Duration	: 2020 (January to December)
Budget(FY 2020)	: LKR 0.9 Mn
Location	: Pigeon Island National Park (Trincomalee) and Bar Reef Marine Sanctuary (Kalpitiya)
Location Source of funds	: NARA

Project

Ocean warming has an impounding impact on the coastal sensitive ecosystems, especially on the coral reefs. Heating and cooling of the ocean is mainly driven by the position of the earth in respect to the sun. Persistent raise in temperature for a longer period causes stress on the coral reefs than diurnal or shorter

fluctuation. The warming of ocean, also cause thermal stress to corals and cause bleaching and infectious diseases. As sea surface temperatures have already increased on average by 0.6 °C since preindustrial times and are projected to increase by at least another 2 °C under a business as usual scenario by the year 2100, coral bleaching events are expected to increase in frequency and intensity over the coming decades (Soareset *al.*, 2019).

Progress

The results indicated two peaks in May and October for both years. The maximum temperature in 2018 and 2019 were 31.1°C and 32.31°C, recorded in May just prior to the onset of southwest monsoon. During the study period the lowest temperature was observed in end of the January prior to the northeast monsoon. The temperature fluctuations during the study period at Bar reef and Pigeon Island are identical except during the 1st inter monsoon when slightly higher at the Bar reef. During sampling periods temperature did not exceed critical temperature tolerance range (36°C) for tropical coral reefs (Schoepf et al, 2015).

The observation shows that the temperature variation between the 5 and 10 m vary by ~ 0.1°C, except for two shorter periods, extending about week, once at the mid May and the other at the beginning of October, that is just prior to the onset of southwest and northeast monsoon respectively. During May the lower layer (10 m) is warmer by almost 1°C, while in October lower layer (10 m) is ~ 1.5 °C cooler. The shorter events of stratification are critical period for sensitive coral habitats, since during this events temperature of the upper layer could easily heated up.

To date 15 types of coral species were identified in the pigeon island study area. They were identified for long term monitoring for their health and growth rate study. Some of the identified species were shown in figure. Among hard corals *Acropora* sp. show highest percentage abundance.

Percentage abundance of coral species in the pigeon island study area during 2020 March

Species	Percentage	Species	Percentage
<i>Acropora</i> sp. 1	15.58	<i>Pocilloporasp</i>	3.89
<i>Acropora</i> sp. 2	7.79	<i>Porites</i> sp	1.29
<i>Acropora</i> sp. 3	6.49	<i>Millioporasp</i>	1.29
Table coral	2.59	<i>Fungiasp</i>	1.29
Soft coral species 1	31.16	Brain coral	1.29
soft coral species 2	15.58	Brain coral	2.59
soft coral species 3	6.49	Unknown 2	1.29
Unknown 1	1.29		

PROJECT NO : 6.6

OCEAN ACIDIFICATION AND THE CHANGES OF THE MARINE CARBON SYSTEM IN SRI LANKAN WATERS.

Officers : W.R.W.M.A.P. Weerakoon, W.N.C. Priyadarshani, and H.B.U.G.M. Wimalasiri
 Division : National Institute of Oceanography and Marine Sciences, NARA
 Duration : 2020 (January to December)
 Budget(FY 2020) : LKR 0.727Mn
 Source of funds : NARA

Ocean acidification (OA), the reduction in oceanic pH caused by the oceans' uptake of anthropogenic CO₂ emissions, is a climate issue worldwide and it is predicted to impact entire marine ecosystems, by influencing the structure and productivity of ecosystems and the proliferation or disappearance of organisms over geologic time-scales.

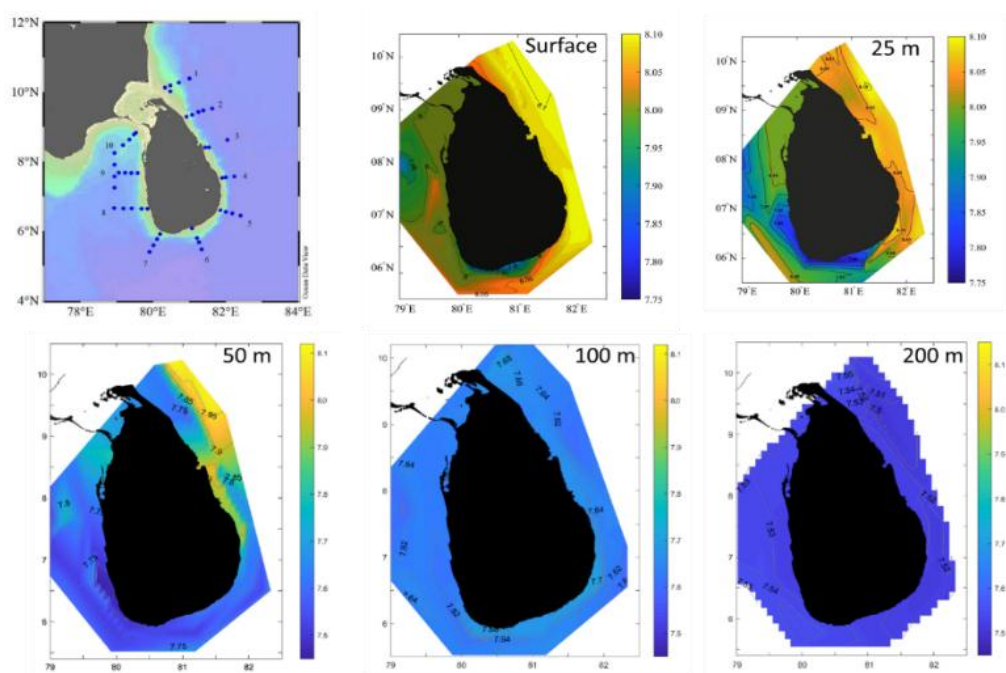
Under the current project, two main activities were focused: to analyze available data around Sri Lanka, and to collect pH and other physical parameters to get seasonal variation in particular ecosystems which

can be influenced by pH fluctuations around Sri Lanka. Here, two sensitive eco-systems; partially damaged and healthy coral reef systems at Bar Reef, Kalpitiya and Pigeon Island, and open water systems; Trincomalee adjacent waters and one cruise from Trincomalee to Galle were selected for measuring acidity, salinity, temperature, primary productivity, nutrients and plankton analysis while remote sensing data was retrieved simultaneously. initial sampling was scheduled to carry out monthly, but later altered the sampling intervals so that it could cover four monsoon seasons due to Covid-19 pandemic restrictions.

Progress

Targeted physical activities- 100% Achieved - 90%

Spatial (horizontal and vertical) pH of waters around Sri Lanka was mapped using R/V Dr Fridtjof Nansen Cruise in June-July, 2018 data.



pH data from Bar Reef, Pigeon Island and Trincomalee Canyon varied from 8.119 to 8.401 while the lowest values were found middle of Bar reef and near Pigeon Island. The highest value was recorded near coastal waters of Pigeon Island while pH in Trincomalee canyon area remains between 8.166 to 8.182. Starting and ending area of the canyon showed low pH waters compared to other ten locations. The Kalpitiya and Trincomalee data were collected during two different seasons, a clear spatial comparison cannot be done between those values. Similarly, there was no clear correlation between pH and temperature variation to confirm whether it is a driving factor or not. Continuous monitoring of pH variation together with carbonate system including total alkalinity and DIC in future work in time-series study is required to obtain solid conclusion.

The spatial variation of pH based on cruise from Trincomalee to Galle during second-inter monsoon (October, 2020) shows that the acidity is quite high in eastern coastal waters ($\text{pH} < 7.412$) while south west coastal pH varied from 7.790 to 8.052. Only Galle area had considerably high pH (8.052 to 8.110) compared to other areas. The low pH waters in eastern areas could be resulted from deep-water mixing during South-West monsoon upwelling in southern coastal waters and eastern Sri Lanka Dome waters which could bring acidic waters in surface layers and transported to eastern side.

PROJECT NO: 6.7

SEA LEVEL OBSERVATION AND FORMULATION OF OCEANOGRAPHIC DATA BASE

Officers : Dr. K. Arulanathan
Division : National Institute of Oceanography and Marine Sciences, NARA
Duration : 2020 (January to December)
Budget(FY 2020) : LKR 2.28 Mn
Location : Jaffna, Trincomalee, Colombo and Mirissa
Source of funds : NARA

Project

Sea-level is intent to increase due to the global warming. Its effect is more significant in the Indian Ocean. The observations by satellite altimeter show that the sea-level rises accelerate in the Indian Ocean since 1992, which it is much faster than the global average rising level. There were some evidences and researches indicate that Sri Lanka is one of the areas where the sea-level rise is fastest in the world.

Economic growth of the coastal areas is faster than the inland due to of the population growth and faster urbanization. The majority of coastal community is increasingly prone to ocean based hazardous such as storm surges, coastal flood, salt water intrusion and coastal erosion. To protect the social and economic development, reliable monitoring, better understanding of the process of the sea-level change, prediction of impending disasters based on science, suitable planning and adaptation are essential to device effective strategies to reduce the potential damages induced by sea-level changes.

Oceanographic data, including sea-level data is vital for the management of coastal regions. The data give insights into the dynamics of the ocean and coastal regions. Properly managed and preserved data can be used and re-used by future researchers, exploited commercially or used by educators and the general public. Such further uses will make an additional contribution to scientific advance and knowledge

Progress

Completed construction of sea level station at Point Pedro fisheries harbor getting permission from the CFHC and MFARD. Now ready to install instruments.

Sea level stations at Trincomalee: Ashrof jetty, Colombo: Port authority and Mirissa: Fisheries harbor are smoothly functioning.

Long term Sea level variation quantified as approximately 2.9 mm per year according to the available data in the west coast of Sri Lanka

The historical oceanographic data was organized typical hierarchical folders structure preparing the way to help access to the user. Data was arranged cruise, mooring, meteorology, sea level, sea glider, publications and reports issued in deferent folders based on the year of the research conducted.

Created Sea Level database using structured Quarry Language Management Studio 18.3.1 and entered last three years of quality controlled data collected from Trincomalee and Colombo 2020: 2018. Other historical sea level data are entering in progress to the database. Historical data are available Colombo : 2006 - 2020, Trincomalee 2007-2020, Kirinda 2007-2011, Hambanthota: 2009-2010, Mirissa 2018-2019.

Monthly sea level data products available on the "Sea Level Data" link (http://www.nara.ac.lk/?page_id=4018) of Interconnected NARA main website. Users who access NARA web page from outside they can visualized monthly sea level graphs Trincomalee 2020 to 2017 from, Colombo 2020 to 2016 and Hambanthota 2009, 2010 stations based on data availability. Further user can sent a mail through the Contact form mentioning there queries and requirement. Already answered and directed approximately 70 questions. Received by contact form.

PROJECT NO: 6.8

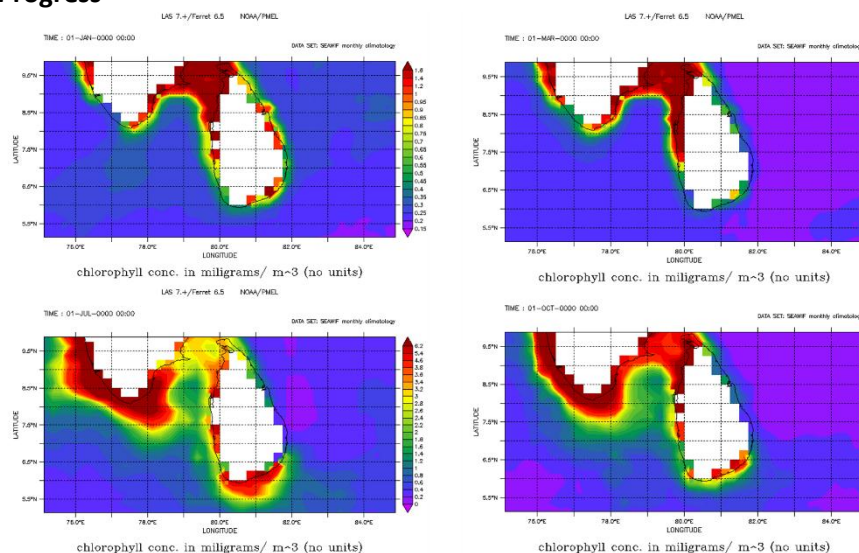
SEASONAL AND INTERANNUAL VARIATION OF COCCOLITHOPHORE SINKING FLUXES AND THEIR CONTRIBUTION TO TOTAL CARBON FLUXES IN UPWELLING REGIONS OF SRI LANKAN WATERS

Officers : Dr. W.N.C. Priyadarshani
Division : National Institute of Oceanography and Marine Sciences, NARA
Duration : 2020 (January to December)
Budget(FY 2020) : LKR 1.02 Mn
Source of funds : NARA

Primary production in the ocean is contributed by plants and microscopic phytoplankton while 50% of ocean productivity is coming from marine phytoplankton. Coccolithophore with CaCO_3 scales, is one of the key players in carbon biochemical cycles and their aggregation accelerates the fast-sinking of materials while any changes in its community structure could affect CO_2 cycling and storage ultimately.

Current study aimed to obtain the time series information on changes of Coccolithophore in different water masses by establishing sediment trap mooring system and to collect sinking particles together with other physical, chemical and biological parameters dynamics so as to address global climate change issues.

Progress



Targeted physical activities- 100% Achieved - 50%

Only few samples were able to collect from pigeon Island area and sediment trap mooring installation was not carried out due to Covid 19 pandemic restrictions while slide preparation was unable to complete since no optical glue was purchased. However, remote sensing data on Chl-a, MLD, Sea Surface Temperature (SST) sea surface height anomaly (SSHA), sea surface wind vector (SSWV) was retrieved for 6 months.

Publications (Full papers/abstracts/proceedings)

1. Masahito Shigemitsu, Hiroshi Uchida, Taichi Yokokawa, Arulananthan, K and Akihiko Murata
2. Determining the distribution of fluorescent organic matter in the Indian Ocean using in situ fluorometry. *Frontiers in Microbiology.*, December 2020, Volume 11, Article 589262
3. Dileka Samaranayake., *Proceedings, NARA annual Scientific sessions 2020* ,Prospecting sand resources in offshore ,Galle,
4. Warnasuriya, T. W. S., Jayathilaka, R. M. R. M., Gunasekara, S. S., Gunaalan, K., &. Kumara, M. P (2020). An Improved Method to Detect Shoreline Changes in Small-Scale Beaches Using Google Earth Pro. *Journal of Marine Geodesy* Volume 43, 2020 - Issue 6

5. Indika K.W and Arulanathan K., 2020. Identification of ENSO Signals on Sea Level Observations around Sri Lankan Waters. Annual Scientific Session of NARA, 22 January 2021, NARA, Colombo 15.
6. Jayathilaka, R.M.R.M. and Fernando, M.C.S., 2020. Numerical modelling of the spatial variation of sediment transport using wave climate schematization method - a case study of west coast of Sri Lanka. *Journal of the National Science Foundation of Sri Lanka*, 47(4), pp.421–433. DOI: <http://doi.org/10.4038/jnsfsr.v47i4.9679>
7. Jayathilaka, R.M.R.M. Modelling of Coastal Sediment Dynamics on the Northeastern
8. Coast of Sri Lanka, proceeding of Journal of National Aquatic Resources Research and Development Agency Scientific Sessions, 2020, pp. 43, Sri Lanka.
9. Ranatunga, R.S.G and Jayathilaka, R.M.R.M Gunasinghe, G.P Dinusha, K.A 2020, An Assessment of Wave Climate Variability Using Energy Flux Method: A Case Study in the Coastal Area of Negombo to Wadduwa, 13th International Research Conference, Holistic approach to national growth and security, General Sir John Kotelawala Defence University
10. Jayarathna W.N.D.S, Du Y, Zhang Y, and Sun Q, (2020), Observed inter-annual variability of the sea surface salinity in the Northern Arabian Sea. Proceedings of the National Aquatic Resources Research and Development Agency (NARA), Scientific Sessions 2020.
11. Rajapaksha, A.D.W.R. Ajith Kumara, Mr. P.A.D. Jayarathna, W.N.D.S.
12. Observed inter-annual variability of the sea surface salinity in the Northern Arabian Sea. Proceeding of the NARA
13. Weerakoon, W.R.W.M.A.P., Kithsiri, H.M.P. and Edirisinghe., E.P.A.(2020). Current status of microplastic pollution in the ocean around Sri Lanka. Conference of Asia Pacific Academic Consortium for Public Health (APACPH) - 2020, Sri Lankan Medical Council.
14. Weerakoon, W.R.W.M.A.P. and Wimalasiri, H.B.U.G.M. (2020). Aggregation of floating microplastics in coral-dominated eco-systems in Sri Lanka. Scientific Sessions of National Aquatic Resources Research and Development Agency (NARA), 2020.
15. Senanayake, S.M.A.B., Samaraweera, J.P.U., Thilakarathne, D.P.R., Weerakoon, W.R.W.M.A.P. and Mihirani, P.M.N. (2020). Assessment of fishers' experiences on abandoned, lost or otherwise discarded fishing gear (ALDFG) in the Northwestern Coast: Findings from the first comprehensive scientific assessment in Sri Lanka. Scientific Sessions of National Aquatic Resources Research and Development Agency (NARA), 2020.
16. Wimalasiri H.B.U.G.M, Arulanathan K., Weerakoon W.R.W.M.A.P, (2020), Seasonal water temperature at coral reef on the East and West Coast, Sri Lanka. Proceedings of the National Aquatic Resources Research and Development Agency (NARA), Scientific Sessions 2020.

REPORTS

1. Edited :Arulanathan, K., Nissanka Perera, Weragodatenna, D.D.D., Bandaranayake K.H.K., and Gunaratne, A.B.A.K. Feasibility Study for the Proposed Recreational Beach Area/Seawater Front Development Project from Colpetty to Dehiwala Canal Outlet
2. Edited :Arulanathan, K. and Gunaratne, A.B.A.K. Ecosystem Based Management of Nanthikadal Lagoon
3. Edited :Arulanathan, K. and Gunaratne, A.B.A.K and Jayasinghe, P. Environmental Profile for Arugambay Lagoon
4. Edited :Arulanathan, K. and Gunaratne, A.B.A.K., Environmental status of coastal water bodies and associated waterways Matara district
5. Jayathilaka, R.M.R.M., Preliminary Investigation Report on Issues related to Opening of Gin Ganga river mouth, Gintota, on request of the Ministry of Fisheries and Aquatic Resources, March 2020.
6. Edited :Priyadharsani, W.N.C. et al.,
 - MT New Diamond
 - Marine environmental survey to assess the impacts of oil spill
 - Met-Ocean conditions: Marine environmental survey to assess the impacts of oil spill.
 - Oceanography component in the report " Marine environmental survey to assess the impacts of oil spill

7. Edited :Priyadharsani, W.N.C. et al.,
 - Port City Development Project (Water quality Monitoring for Infrastructure and Landscape work Phase I- V 5122)
 - Port City Development Project (Environmental Monitoring works- Water Quality for Bio diversity -V5123)
 - Investigation Report on the status of debris/ garbage accumulation in the South Marina of Colombo Port City, Sri Lanka
8. DilekaSmaranayke and Wimalasiri H.B.U.G.M.,Investigation on the issues related to occasional removal of sand deposit at Gin River Mouth

Trainings

1. Wimalasiri H.B.U.G.M.,R/V Xiang Yang Hong06, China – Sri Lanka International Cooperative Cruise for the Joint Advanced Marine and Ecological Studies (JAMES).5th January to 17th January 2020
2. Wimalasiri H.B.U.G.M., Participated in, Online training on Fishery Oceanography for future Professionals, 16 –20 November, 2020 conducted by International Training Centre for Operational Oceanography, (ITCOcean), Hyderabad, India.
3. Wimalasiri H.B.U.G.M., Participated in, Online Training Course on "Discovery and Use of Operational Ocean Data Products and Services" during Aug 31 - 04 Sep, 2020 Organized by International Training Centre for Operational Oceanography (ITCOcean) ESSO-INCOIS, Hyderabad, India

5.7 INSTITUTE OF POST HARVEST TECHNOLOGY

Head of the Division: Dr. S. Ariyawansa

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

A team of ten Scientists comprising one Principal Scientist, three Senior Scientists and six Scientists are attached to IPHT. IPHT has conducted six research projects under thrust areas of reduction of post-harvest losses and value addition of aquatic resources including fisheries and seaweeds. In addition, IPHT has provided testing services; consultancies; and training programs and awareness programs on fish quality and safety, processing and value addition technologies for women in Northern province. Signing of an agreement among the National Aquatic Resources Research and Development Agency (NARA), the National Engineering Research and Development Centre (NERDC) and the Department of Fisheries and Aquatic Resources (DFAR) for the designing and development of refrigeration system with storage facility for existing multiday fishing boats took place on the 15th of July 2020 at the Ministry of Fisheries and Aquatic Resources. Preliminary arrangements were made to upgrade Maldivian fish industry and dry fish industry in Southern province.

Project	Officers	Allocation for 2020(Mn)
Enhancement of quality of fish handled in multiday boats, monitoring safety of shellfish and antimicrobial resistance in aquatic environment	K.W.S. Ariyawansa, PavithraGinigaddarage, K.G.S Nirbadha, M.G.C.R Wijesinghe	4.5
Investigation of incidences of histamine forming bacteria in chilled Yellow fin tuna (<i>Thunnusalbacares</i>) in export fishery industry	K.W.S. Ariyawansa, PavithraGinigaddarage	1.34
Extraction and characterization of bioactive peptides from Tuna fish waste	SuseemaAriyaratne	0.88
Development and commercialization of fish / seaweedproducts and extraction of bioactive compounds from seaweeds.	P.S. Jayasinghe K.G.S Nirbadha, M.G.C.R Wijesinghe	2.0
Development of capacities of Laboratories	K.W.S. Ariyawansa, PavithraGinigaddarage, K.G.S Nirbadha, M.G.C.R Wijesinghe	1.45
LKR (Mn)		10.17

PROJECT NO: 4.1

ENHANCEMENT OF QUALITY OF FISH HANDLED IN MULTIDAY BOATS, MONITORING SAFETY OF SHELLFISH AND ANTIMICROBIAL RESISTANCE IN AQUATIC ENVIRONMENT

Budget : LKR4.5 million

Officer responsible : K.W.S. Ariyawansa, PavithraGinigaddarage, K.G.S Nirbadha, M.G.C.R Wijesinghe

Activity 1

Modifications in multiday boats

Introduction

The quality of fish landings is generally poor and fish spoilage is high particularly in the landings of multi-day boats. This is due to lack of proper fish landing and quality maintenance facilities on board the vessels and the lack of knowledge of fish handling and post-harvest practices. Most multi-day boats still aim at higher volumes and only a small portion of the landings meet the required quality standards. This has serious implications on the export trade, local supplies of fresh fish and producer prices. And also it is a need to supply wholesome fish and fishery products to local consumers as well. This quality loss accounts for a significant economic loss. From previous studies done at NARA it has been found that 30% - 40% of fish are in unacceptable quality at the most fishery harbours around Sri Lanka and the prevention of these losses is a major problem that needs to be addressed without delay.

Methodology

Preliminary steps have been taken to modify fish holds and storage in multiday fishing boats in order to ensure the quality of the fish harvested in multiday fisheries across Sri Lanka. Hence, ceremonial signing of an agreement among the National Aquatic Resources Research and Development Agency (NARA), the National Engineering Research and Development Centre (NERDC) and the Department of Fisheries and Aquatic Resources (DFAR) for the designing and development of refrigeration system with storage facility for existing multiday fishing boats took place on the 15th of July 2020 at the Ministry of Fisheries and Aquatic Resources. Regular meetings were conducted, field visits to Negombo, Dickowita, Mirrissa and Kudawella fishery harbours and ice plants in Mirissawere carried out in order to gather required information and research activities related to chilled water storage, refrigeration storage and ice storage were carried out.

Results

Under refrigeration condition within 7 hrs core temperature of Skipjack tuna reached to 0°C. Modifications are being carried out by engineers attached to NERDC. 2 boats are being modified and estimated cost for modifications are 8.5 M and 9.5M.



Picture 1: Signing of an agreement among NARA, NERDC DFAR



Picture 2: Field visit to boat yards

Activity 2

Multispectral Imaging for Automated Fish Quality Grading

Introduction

Fish quality grading plays a major role in the fisheries industry. Since fishermen tend to spend five to six days or even months in the sea, the quality of the harvest depends on the duration it takes to reach inland after harvesting. The present method of grading fish is by physical inspection. Hence, the results are human dependent and vary with experience and knowledge of the investigator. Since the reliability of the traditional method of quality assurance is questionable, the need for an accurate and reliable method is on demand. Since a multispectral imaging system allows to extract more micro-level information over traditional imaging systems, so it can be utilized in fish quality grading more effectively. Steps have been taken to assess the fish quality using multispectral imaging.

Methodology

NARA has collaboration with Sensibility (Pvt) Ltd. which is AI Technology Company based in Hatch Works (Pvt) Ltd. No. 14 Baron Jayatilleka Mawatha, Colombo 01, Sri Lanka. Multispectral images from two grades of “Skipjack Tuna” have already been taken.

Results

Digital App has been developed for identification of good quality and bad quality (2 grades) of Skipjack tuna fish. Validation of app is in progress.

Activity 3

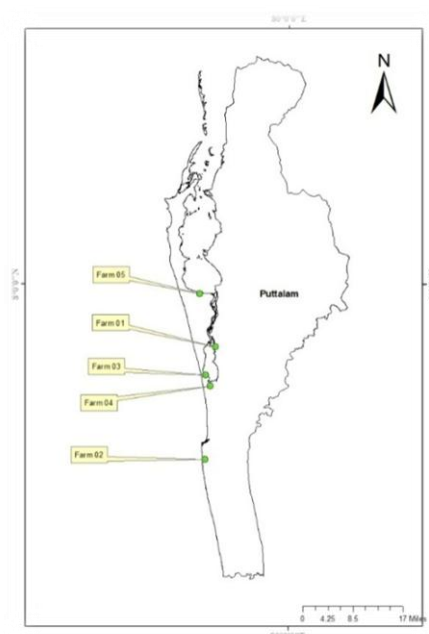
Studying antimicrobial resistant in shrimp culture environment

Introduction

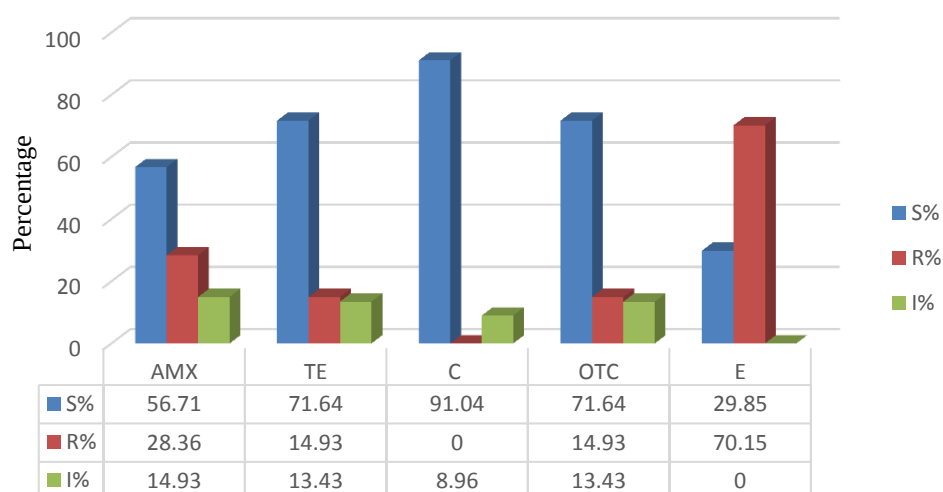
Bacterial, viral, fungal and parasitic diseases are the major causes of shrimp /ornamental farm mortality and production losses in hatcheries and culture systems. Antibiotics are commonly used to control the bacterial populations in hatcheries and farms. However these antibiotics are applied in *ad hoc* manner with consequences leading to alteration of microbial communities and the generation of drug-resistance strains of bacteria. Antibiotics could leave residues in shrimps, culture environment of shrimps which could have implications in human health. Hence it is important to be aware about the gravity of the situation in Sri Lanka and to take prompt action.

Methodology

To study the antimicrobial sensitivity in shrimp culture environment shrimps, water and sediment samples were collected from five farms (Mangalaeliya farm, Maikkulama farm, Udappuwa farm, Palanchikulama farm and Shwethapura farm) located in Puttalam district. *E.coli* was isolated from samples and sensitivity was tested against different families, β -Lactams: Amoxicillin (AMX;30 μ g); Tetracycline: Tetracycline (TE;30 μ g) and Oxytetracycline (OTC;30 μ g); Macrolides: Erythromycin (E;15 μ g), Chloramphenicol (C;30 μ g). Disk-diffusion method was performed to analyze antibiotic susceptibility.



Picture: Sampling locations



S- Sensitive, R- Resistant, I- Intermediate resistance

Picture: Antibiotic Resistance of *E.coli*

Results

In shrimp tissues, mean values of TCC, TFCC, and *E. coli* count ranged from 0.4 to 41.9 most probable number (MPN)/g, 0.2 to 27.9 (MPN)/g, and 0 to 27.9 (MPN)/g, respectively. In pond water samples, TCC, TFCC, and *E. coli* count ranged 15-98.8 (MPN)/100ml, 5.3-73.7 (MPN)/100ml and 0-22(MPN)/100ml, respectively and in bottom sediments ranged 0.5-1.6 (MPN)/g, 0.3-0.8 (MPN)/g, and 0-0.4 (MPN)/g, respectively. A total of 67 *E. coli* were isolated and 48 isolates (71.64%) were resistant to at least one drug out of the total number. A high index of resistance to E (15 μ g) 70.15% was reported. In contrast, none of

the *E. coli* isolates was resistant to C (30µg). Multidrug resistance to two or more antibiotics was observed in 24 isolates. Multiple antibiotic resistance index varied within the range of 0 to 0.8 for the antibiotics used.

Conclusions

The high range of coliform count proved that unclean water of lagoons and high indices of resistance and multidrug-resistant *E. coli* strains may be a consequence of inappropriate use of antibiotics.

Activity 4

Microbiological quality of water in oyster growing areas- Negombo

Introduction

Bivalves are filter feeders able to ingest particles in suspension that may carry pathogenic microorganisms. Microorganisms like Coliforms, including *Escherichia coli*, and *Faecal streptococci* are indicators of faecal pollution. The microbiological quality of bivalves becomes one of great public health significance. Negombo lagoon in Sri Lanka has identified as a potential site for bivalve cultivation and farming could be promoted as additional income for communities. If these farms are to produce bivalves for local or export market, they should be in compliance with the microbial standards. Therefore, the safety of bivalves is monitored and necessary information will be shared with stakeholders in order to uplift the industry.

Methodology

Water samples (two samples from each location) were collected from 3 locations in Negombo lagoon (Munnakarei, Talahena and Aluthkuruwa) to evaluate the microbiological quality of Negombo lagoon water for potential oyster growing. Water samples were analyzed for total bacterial counts (TBC) by the pour plate technique on plate count agar using SLS 516-1-Sec, 1:2013/ISO 4833-1:2013(E) method. Indicator organisms such as total coliforms, Faecal coliforms and *Escherichia coli* (*E. coli*) were tested using methods given in SLS Standard 1461 Part 1/ Section 3:2013 which are adopted by the laboratory with accreditation status as per ISO/IEC 17025 standard. MacConkey broth, Brilliant Green Bile Broth and Peptone water were employed to determine the most probable number (MPN) per 100 mL of total coliforms, faecal coliforms, as well as *E. coli* respectively, using a five-tube multiple-dilution technique.

Results

Density of all three types of faecal origin indicators present in water samples analysed were expressed as Most Probable Number (MPN) per 100 millilitres (100 mL) as shown in Table 1.

Table 1: Microbiological quality of water samples

Sample Number	Level of indicator organisms (MPN/100mL)			Total Bacterial Count (cfu/ml)
	Total coliforms	Faecal coliforms	<i>E. coli</i>	
01	900	130	130	7.0×10^2
02	1800+	1600	55	3.9×10^3
03	80	50	17	1.9×10^2
04	35	13	13	3.6×10^2
05	900	45	35	3.4×10^2
06	1800+	175	80	3.0×10^2

1, 2 from Munnakarei 3,4 from Talahene, 5,6 from Aluthkuruwa

According to the obtained results of water samples, it can be seen that all samples are contaminated with total coliforms, faecal coliforms and *E.coli*. Water sample 1 and 2 were collected from Munakkarei area and sample number 5 and 6 from Aluthkuruwa area of Negombo lagoon and results show water is highly contaminated with total coliforms, faecal coliforms and *E.coli*. Samples from Thalahena were moderately contaminated compared to other two sites.

Conclusions

According to microbiological results these areas can be classified as class “B” based on European shell fish harvesting area classification criteria. Present study revealed that microbiological quality of water in potential sites are not up to required standards and showing the need of depuration before consumption by using very effective system comprise of UV filters, sand filters, charcoal filters, cotton filters, etc. These results also indicate the need for monitoring the quality of raw oysters, including the programs for good mollusk manipulation and management practices.

PROJECT NO: 4.2

INVESTIGATION OF INCIDENCES OF HISTAMINE FORMING BACTERIA IN CHILLED YELLOW FIN TUNA (THUNNUS ALBACARES) IN EXPORT FISHERY INDUSTRY OF SRI LANKA

Budget : LKR 1.34 million

Officer responsible : Pavithra Ginigaddarage, G.J. Ganegama Arachchi, K.W.S. Ariyawansa

Introduction

Bacterial contaminations along fish supply chain play a key role since it is very important to supply good quality safe fishery products to the consumer. Measures should be taken to reduce bacterial contaminations along the fish supply chain as fish, contaminated with certain bacteria when consumed may lead to serious illnesses such as gastrointestinal diseases and histamine intoxication. Therefore, this study aimed at investigating bacterial contaminations and isolation of histamine forming bacteria at identified control points in multiday boats landed at Negombo and Trincomalee fishery harbours.

Methodology

Sample collection points from multi-day boats (MDB) included ice (n= 30) from fish holds and chilled transport vehicles (n=30); swabs from fish holds (n=30), decks (n=30); and the skin of yellowfin tuna (n=30). Presumptive histamine forming bacteria were isolated by inoculating the samples on Nivens medium and Violet Red Bile Glucose (VRBG) agar. Plates were incubated at different temperatures (37 and 25 °C) in order to isolate bacteria that have the ability to form histamine at different temperatures. Histamine forming ability of bacteria isolates were confirmed by measuring histamine levels in broth cultures grown in trypticase soy broth (TSB) supplemented with 1.0% L-histidine at different temperatures. Histamine content was measured by using AOAC 977.13 method. PCR was done for those isolates to amplify histidine decarboxylase gene (709 bp) as described in Takashi *et al.*, 2003. API 20E test kit was used to identify the isolates biochemically and further confirmation of the identities were done by amplifying and sequencing approximately 1400 bp of the 16S ribosomal DNA (rDNA) for bacteria. PCR product samples were sent to Macrogen Korea for DNA sequencing.



Results

Average Enterobacteriaceae counts of fish skin, boat deck and fish hold were found to be 2.6×10^5 (range 7.5×10^2 - 3.5×10^5), 9.6×10^5 and 7.6×10^5 CFU/cm², respectively. Ice samples drawn from chilled transport vehicles had an average Enterobacteriaceae count of 6.6×10^2 CFU/mL and ice samples collected from fish holds had 8.6×10^7 CFU/mL. From the isolated bacterial cultures from Negombo fishery harbor majority (88.8%) were *Pseudomonas* spp. which formed low amounts (less than 30 ppm) of histamine in the broth. *Morganellamorganii* and *E.coli* were isolated from an ice sample collected from fish hold and ice sample collected from chilled transport vehicle, respectively.

Bacterial species identification of samples collected from Trincomalee fishery harbor is in progress.

Shelf life study of Yellowfin tuna to assess the histamine formation and isolate histamine forming bacteria

Apart from the sample collection from fishery harbours a shelf life study was carried out to analyse the histamine formation and isolate histamine forming bacteria in chill storage.

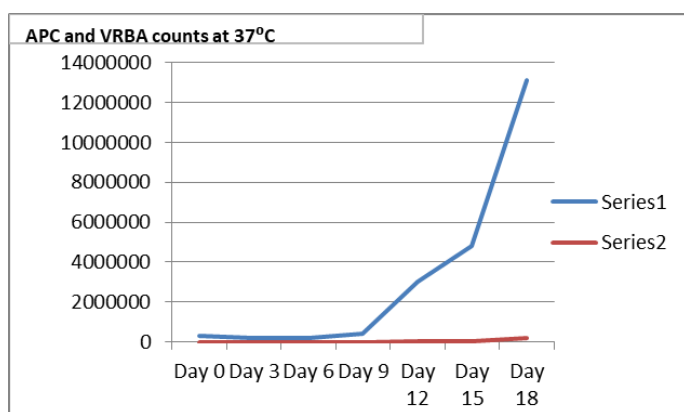
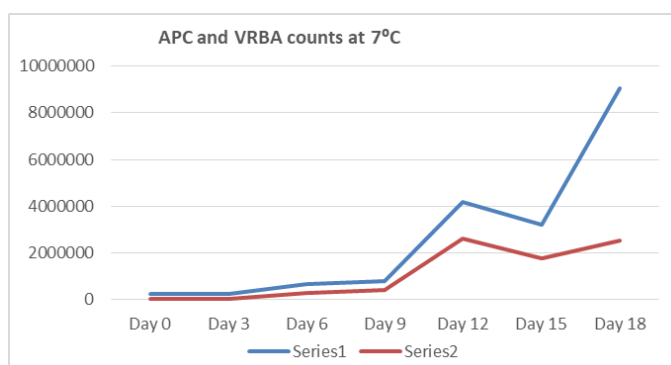
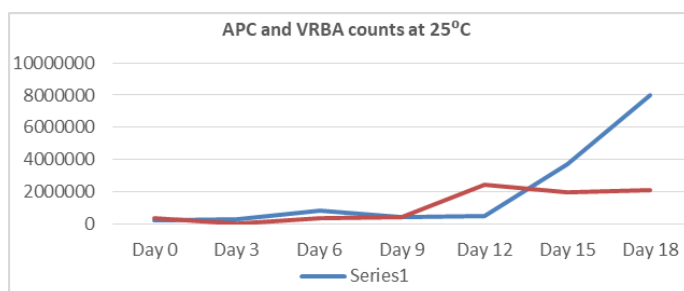
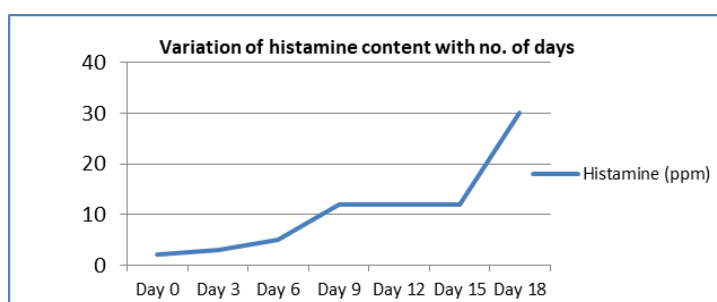
Methodology

Fresh yellowfin tuna samples (n=21) were obtained from a fish processing establishment in January, 2020 and samples were stored at chilled conditions (0-4 °C) the same way that the cold chain is maintained. Samples were analysed at three-day intervals for histamine content, aerobic plate count, Enterobacteriaceae count (VRBA medium) and histamine forming bacteria on Nivens medium. Plates were incubated at different temperatures (37, 25 and 7 °C).

Results

The average histamine content of the samples was 2 ppm at the initial stage and it reached 30 ppm on the 18th day. Average Aerobic Plate count (APC) at 37 °C, 25 °C and 7 °C varied from 2.9×10^5 to 1.3×10^7 CFU/g, 2.0×10^5 to 8.0×10^6 CFU/g and 2.5×10^5 to 9.0×10^6 CFU/g, respectively. Average Enterobacteriaceae count at 37 °C, 25 °C and 7 °C varied from 5.0×10^1 to 2.0×10^5 CFU/g, 3.2×10^5 to 2.1×10^6 CFU/g and 3.0×10^4 to 2.5×10^6 CFU/g, respectively. Fourteen histamine forming bacterial isolates were identified which produced histamine less than 100 ppm in the 1.0 % L-histidine supplemented tripticase soy broth. Isolated bacterial species were recorded as *Aeromonas* sp. (4/14), *Pseudomonas* sp. (7/14), *Psychrobacter* sp. (1/14) and *Vibrio* sp. (2/14). Though the histamine content of the tested fish samples increased with the number of days, it did not reach toxic levels and isolated histamine forming bacteria did not produce toxic amounts of histamine in the histidine broth.

Variation of histamine content, bacterial count (APC and VRBA) with increasing number of days



Conclusions

Although majority of isolated bacteria were *Pseudomonas* spp. and showed a weak histamine formation in the histidine broth it is a good indication that measures should be taken to reduce the bacterial load from direct fish contacting surfaces since they are considered as spoilage bacteria as well.

PROJECT NO: 4.3

EXTRACTION AND CHARACTERIZATION OF PROTEIN AND BIOACTIVE PEPTIDES USING YELLOW FIN TUNA (THUNNUS ALBACARES) FISH WASTE

Budget : LKR 0.88 million
Officer responsible : Suseema Ariyaratna

Introduction:

Fish protein is a very valuable and expensive food component which has high demand, due to its nutritional values and health benefits therefore developing techniques to utilize low cost, underutilized and abundant fish protein sources to full fill this gap is a timely requirement. Yellow fin tuna is one of the main fish varieties exported from Sri Lanka and it generates significant amount of fish wastes (fish skin, bone, head, viscera, dark meat) during processing for the export market. Fish skin, bones and viscera are discarded without proper usage creating environmental pollutions while other type of waste selling for low price. These valuable resources are considered as waste due to lack of knowledge of product development new innovation and technology. Therefore, this project was designed to find value addition technology for the fish waste especially target on the Yellow fin tuna fish wastes generated in the export related industry.

Objectives:

- Development of an efficient protocol to extract protein and peptide using Yellow fin tuna fish waste
- Characterization of proteins / peptides extracted.

Methodology

- Yellow fin tuna skin and gut were collected as raw materials (from J-Sea food- Negambo) for protein extraction trials.

Trials were conducted using two methods

Method -1 Commercially available pepsin enzyme was used to extract protein/peptide from Yellow fin Tuna fish skin.

Method -2 Yellow fin Tuna gut extract was used to extract protein instead of commercially available pepsin enzyme

Step-1: Preparation of gut extract and activation of pepsin enzyme.

Step-2 : Extraction of protein and peptide by using tuna gut extract .

Characterization was carried out for

- Determination of molecular weight of proteins/peptides
Method- SDS PAGE analysis (Laemmli 1970).
- Determination of antioxidant properties of proteins/peptides
DPPH scavenging method—(AOAC 2012.04.)

Results

Table 3: Proximate composition of yellow fin tuna skin

Moisture (%)	Protein (%)	Dry matter (%)
61.6	20.6	16.8

Table 4: Protein yield obtained from developed protocol

	Method -1	Method -2
Yield(%)	12	7

Characterization

Characterization part of the project was started and analyzed for SDS page and antioxidant properties. Several trials were conducted, and it was not successful enough to make strong recommendation.

Conclusions

- Yellowfin Tuna skin can be used to extraction of protein/peptides without discarding as a waste.
- Yellowfin Tuna gut extract can be used for extraction of protein/peptides from the yellowfin Tuna fish skin instead of commercially available pepsin enzyme.

Recommendations

Characterization part of the project could not complete as scheduled due to the Covid-19 pandemic therefore it should be continued further to make strong recommendations.

Outputs & outcomes

There is a possibility to produce around 60,000 kg of fish protein powder annually using Yellow fin Tuna fish skin discarded by the processing factories and estimated market value of the product will be about 300 M LKR.

Other activity

Served as a Technical Committee Chairman for purchasing of equipment in IPHT /IARAD

PROJECT NO: 4.4

DEVELOPMENT AND COMMERCIALIZATION OF FISH / SEAWEED PRODUCTS AND EXTRACTION OF BIOACTIVE COMPOUNDS FROM SEAWEEDS

Budget : LKR2.0 million

Activity 1: Development of seaweed based vegetarian sausages and Evaluation of quality parameters

Officer responsible : P.S. Jayasinghe

Vegetarianism is the practice of abstaining from meat based foods. However, sausage which is a minced meat food item is preferred by all types of consumers due to its unique sensory properties. Thereby, this study was planned to develop a vegetarian sausage from locally available seaweed (*Gracilaria edulis*) and oyster mushroom (*Pleurotus ostreatus*). The experiment was laid out in Completely Randomized Design in triplicates which consisted with six treatments incorporating different ratios of mushroom (MR) and seaweed (SW) (w/w); 60% MR + 20% SW, 50% MR + 30% SW, 40% MR + 40% SW, 30% MR + 50% SW, 0% MR + 80% SW and 80% MR + 0% SW. Samples were vacuum packaged and stored at -24°C. Proximate composition, energy value and iodine content were evaluated. Microbiological quality and pH were analyzed in 2-weeks intervals for 150 days. Sensory evaluation was conducted with 15 trained panelists adopting Friedman test. Parametric data were analyzed using Analysis of Variance. The sensory results revealed that 50% MR + 30% SW treatment had the highest scores for all sensory attributes. It consisted of 3.93± 0.16% crude fat, 8.59± 0.87% crude fibre, 6.61 ± 0.03% crude protein, 8.21 ± 1.17% carbohydrate, 88.68± 2.02 kcal/100 g energy and 1.53± 0.12 mgL⁻¹ iodine content. The yeast and mould were not detected and total plate count was 777 CFUg⁻¹ initially and further decreased in accordance with the Sri Lanka standards (<1×10⁴ CFUg⁻¹) for a period of 150 days at -24°C storage. pH was significantly reduced ($p<0.05$) in the storage period however, it was within the acceptable limit. In conclusion, vegetarian sausage incorporated 50% MR with 30% SW (w/w) has better organoleptic and nutritional properties and can be stored at -24°C in vacuum packed conditions for 150 days without any quality deterioration.

Consultancy services provided to the company Premadasas Agri Pvt (Ltd)

Compare the effect of different drying methods on the textural, physical, chemical and proximate composition of raw (*Kappaphycusalvarezii*) seaweed, semi refined carrageenan and refined carrageenan.

Semi-Refined Carrageenan was obtained by the treatment of the culture strains of seaweed *Kappaphycusalvarezii* of the class Rhodophyceae (red seaweeds) by removing impurities and fresh water washing and drying. According to the findings Semi refined carrageenan extracted from raw dried *Kappaphycusalvarezii* moisture, ash, gel strength and pH values compatible with the FAO (1992) market standards and also Asian standards (attached-1). The required specification for appearance was tiny yellowish color for semi refined and refined carrageenan. The most similar appearance whitish yellow was observed in sun dried and solar dried semi refined carrageenan in the present experiment. The highest protein content was observed in raw seaweed dried in solar dryer than other methods. The solar dried and sun dried semi refined carrageenan showed higher gel strength and other textural properties than oven drying method. It can be concluded that most profitable and suitable drying methods for processing semi refined carrageenan is sun drying and dry in using a solar dryer.

other developed seaweed based products:

Seaweed based biscuits, seaweed based Aloe vera drinks, and seaweed based pizza. Seaweed based murruku etc.

Activity 2

Application of Bio-Nanotechnology in Value Addition to Aquatic Resources :Preliminary study on analysis of bioactive compounds from selective marine sponges (Marine fauna) and seaweeds (Marine flora)

Officer/s responsible : K.G.S Nirbadha, M.G.C.R Wijesinghe

The Ocean, which is called the 'mother of origin of life', is also the source of structurally unique natural products that are mainly accumulated in living organisms. Several of these compounds show pharmacological activities and are helpful for the invention and discovery of bioactive compounds, primarily for deadly diseases like cancer, acquired immuno-deficiency syndrome (AIDS), arthritis, etc., while other compounds have been developed as analgesics or to treat inflammation, etc. The lifesaving drugs are mainly found abundantly in microorganisms, algae and invertebrates, while they are scarce in vertebrates. Modern technologies have opened vast areas of research for the extraction of bioactive, biomedical compounds from oceans and seas. Many bioactive compounds have been extracted from various marine animals like tunicates, sponges, soft corals, echinoderms, sea hares, nudibranchs, bryozoans, sea slugs and a few others (Harvey, 2000). Among these, the sessile invertebrates like sponges, bryozoans and tunicates are better candidate species for extraction of marine-derived secondary metabolites with drug leads (Falukner, 2002). Seaweeds are abundant in the intertidal zones and in clear tropical waters. Marine algae have received comparatively less bioassay attention. In addition, there are a number of seaweeds with economic potential. It will be of great significance if these species could be the major role players in drug development. The marine pharmacy currently holds more than 35000 marine-derived biological samples, with approximately 150 compounds to be cytotoxic against the tumour cells. Some of the prominent anticancer compounds in clinical trials include yonnelis, bryostatin-1, squalamine, aplidin, dolastatin-10 (Joseph and Sujatha, 2011). In general, Natural Products have long been used as food, fragrances, pigments, insecticides, medicines, etc. Marine organisms comprising approximately half of the total biodiversity on the earth and the marine ecosystem are considered as the greatest source to discover useful therapeutics (Blunt et al., 2005). Marine biotechnology is the science in which marine organisms are used in full or partially to make or modify products, to improve plants or animals or to develop microorganisms for specific uses.

The project of preliminary study on analysis of bioactive compounds from selective marine sponges (Marine fauna) and seaweeds (Marine flora) was carried out to identify specific bioactive compounds in seaweeds

and marine sponges around Sri Lanka. During the study 10 species of seaweeds (*Kappaphycusalvarezii*, *Glacilariaverrucosa*, *Caulerpa racemosa*, *Padina boergesenii*, *Actinotrichia fragilis*, *Sargassum turbinatiform*, *Anphiroa anceps*, *Avrainvilleaamadelpa*, *Halimeda opuntia*, *Turbinariaornata*) and nearly one hundred of specimens/samples of marine sponges were collected from several locations in Sri Lankan waters. Seaweed samples were identified locally using specific keys and the marine sponges samples were identified with assistance of Naturalis bio diversity centre, Leiden, Netherlands. Phytochemical profiles of seaweeds and zoochemical profile of marine sponge of *Xestospongia testudinaria* (Barrel sponge) were carried out in analytical chemistry laboratory, IPHT, NARA.



Figure 01: *Xestospongia testudinaria* (Barrel sponge) in Negombo location.



Figure 02: Seaweeds collection from Jaffna sea area

The basic chemical groups of bio active compound (Terpenoids, Flavonoids, Steroids, Glycosides, Phlobatannins, Proteins) were identified using appropriate testing methods (Salkowski test, Alkaline Regent test, Libermann test, Precipitate test, Xanthoprotein test). Ethanol was used as a solvent system for the preparation of the extract of seaweeds. The ethanolic extracts of seaweeds were undergone to the qualitatively phytochemical test by means of typical measures. Phytochemical analysis shows the presence of alkaloids, tannins, steroids, flavonoids, and carbohydrates, whereas proteins, free amino acids and saponins were found to be absent. The results of the study may lead a foundation for the further studies on those seaweeds and sponges. The Gas Chromatography Mass Spectroscopy (GC-MS) analysis will be done for the next year due to continuity of project. Bioactive compounds interpretation of the spectrum obtaining using GC-MS analysis will be perform by comparing with data base and using phytochemical standards. The project will be continued for the year of 2021.

PROJECT No: 4.5

DEVELOPMENT OF CAPACITIES OF LABORATORIES

Budget : LKR1.45 million

Officer responsible : K.W.S. Ariyawansa, PavithraGinigaddarage, K.G.S Nirbadha, M.G.C.R Wijesinghe

Arrangements were made to calibrate equipment in laboratories such as incubators, water bath, ovens, autoclaves, balances, refrigerators and freezers by the Sri Lanka Standards Institute. HPLC machine uses for Histamine analysis was repaired and it is in order and fish samples from industry are being accepted for analysis. Proficiency Test samples for Histamine method validation was purchased from FAPAS UK and PT samples were analyzed in analytical chemistry laboratory. PT results were in satisfactory range. Chemicals, Standards and reference materials necessary for amino acid profile analysis and fatty acid profile analysis have been requested and is still under purchasing procedure. Arrangements have been made to service equipment (Crude fiber analyzer, dietary fiber analyzer, bomb calorimeter and oil extraction system) in analytical chemistry laboratory and renew service agreements for the preventive maintenance of equipment.

Journal publications

1. P. S. Jayasinghe, A. Senarathna, and R. Perera . “Enhancing Nutritional and Functional Properties of wheat based noodles by incorporating seaweeds, *Gracilariaverrucosa* and *Ulva lactuca*”. On line publication in Journal of Food science and Nutrition.

Abstracts and Extended Abstracts

1. P.H. Ginigaddarage, G.J. GanegamaArachchi, K.W.S. Ariyawansa, G.P. Roshan, S. Gallage and C.M. Nanayakkara. Identifying sources of bacterial contamination of fish in multiday boats landed at Negombo fishery harbour, Sri Lanka. 7th International Virtual Conference on Fisheries and Aquaculture 2020 (ICFA 2020), 26th - 27th November 2020.
2. P.H. Ginigaddarage, G.J. GanegamaArachchi, K.W.S. Ariyawansa, and C.M. Nanayakkara. Screening of histamine forming bacteria along some stages of supply chain of *Thunnusalbaces* in Sri Lanka. 76th Annual scientific sessions, SLAAS, 16th December, 2020.
3. P.H. Ginigaddarage, G.J. GanegamaArachchi, K.W.S. Ariyawansa, G.P. Roshan and C.M. Nanayakkara. Isolation of histamine forming bacteria from yellowfin tuna (*Thunnusalbaces*) in chilled storage. Accepted for publication at NARA Scientific sessions, 2020.
4. R.H. Ukwatta, P.S. Jayasingh, W.A.G.E. Wijelath, W.A.D. Nayananjali and M.R. Perera. Development of seaweed (*Gracilaria edulis*) and oyster mushroom (*Pleurotusostreatus*) incorporated vegetarian sausage substitute. Accepted for publication at NARA Scientific sessions, 2020.
5. S.K.M.R.J. Athurupana, K.W.S. Ariyawansa and D.W.M.M.M. Kumari. Antimicrobial susceptibility of *Escherichia coli* isolated from Shrimp (*Penaeus monodon*) farming system in Puttalam, Sri Lanka. 12th Annual research symposium proceedings, University of Rajarata of Sri Lanka, 2020. Pg 83.

Other publications/reports

1. Published an Article in Oruwella magazine on Quality Development in Dried fish and Maldivian fish Industry.
2. Report on recommendations for Establishment of Smooth and Hygienic Maldivian Fish Production Operation and Marketing Plan for Gandara and Kottegoda area of Southern Province, Sri Lanka
3. Technical Report: Comparison of the effect of different drying methods on the textural, physical, chemical and proximate composition of raw (*Kappaphycusalvarezii*) seaweed, semi refined carrageenan and refined carrageenan

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 and in the process of revising to new standard as per ISO/IEC 17025: 2018. Testing Services of this laboratory have been obtained by industry, especially, fish exporting companies; ministries, academic institutes and other stakeholders. Total of 357 samples were analyzed for microbiological (275) and chemical (82) quality. Relevant to these samples, 145 Test Reports were issued by IPHT and total earnings were LKR 1,569,800.00. Forty percent (40%) of total revenue will be remitted to NARA as royalty payment.

Sensory evaluation of 15 No. of canned fish samples under IPHT mini projects (V5115) and paid Rs. 156,000.00 as analyzing charges by SLSI to NARA. IPHT has issued 03 nos. of test reports to SLSI for above evaluation.

Training/Awareness programmes conducted during year 2020

Date	Name of the programme	Aim	Participants	Place	Sponsor
23/01/2020 to 25/01/2020	Awareness on production of Value added seaweed based products	To upgrade the livelihood of the community	Women in Jaffna	Kodikaman - Jaffna	PRI (Palmyra Research Institute)
30/01/2020 to 01/02/2020	Awareness on production of Value added Fish based products	To upgrade the livelihood of the community	Fisher community	Mulathiv - Jaffna	Department of Fisheries
17/02/2020 to 21/02/2020	Awareness on production of Value added Fish and Seaweed based products	To upgrade the livelihood of the community	Fisher community	Gurunagar - Jaffna	NARA
30/07/2020 to 03/08/2020	Awareness on production of Value added Bivalves , Fish and Seaweed based products	To upgrade the livelihood of the community	Fisher community	Arippu-Mannar, Thevanpiddy - Jaffna, Jaffna & Kilinochchi	NARA
03/12/2020	Awareness on production of Maldiv Fish	To upgrade the quality of the product	Maldiv Fish manufactures from Dikwalla	AG Office - Dikwella	NARA
04/12/2020	Awareness on production of Maldiv Fish	To upgrade the quality of the product	Maldiv Fish manufactures from Devinuwara	AG Office - Devinuwara	NARA

Supervision of undergraduates

1. M.A.M. Rupasinghe, BSc (Zoology), University of Ruhuna
2. S.H.D.Y. Hewage, BSc (Food Technology), Rajarata University
3. R.H. Tharuka, BSc (Food Technology), Rajarata University
4. H.M.T.D. Kumara, BSc (Microbiology), University of Kelaniya
5. M.S.A. Perera, BSc (Agriculture), Rajarata University
6. H.P.K.E. Gunarathna, BSc (Agriculture), Rajarata University
7. S.K.M.R.J. Athurupana, BSc (Agriculture), Rajarata University

Foreign and Local trainings attended

No	Training (Local / Foreign)	Duration	Venue	Participants
	Foreign			
01	Taxonomy & phylogenetic studies of sponges workshop	05 th February to 04 th March, 2020	Naturalist Biodiversity center, Leiden, The Netherlands	K.G.S.Nirbadha
	Local			
01	ISO/ IES 17025 – 2017	18 th to 20 th February, 2020	Sri Lanka Accreditation Board	M.G.C.R.Wijesinghe
02	ISO/ IES 17025 – 2017	16 th to 18 th September, 2020	Sri Lanka Accreditation Board	K.G.S.Nirbadha K.H.K.L. Piyasiri M.M.Subasinghe

5.8 SOCIO-ECONOMIC AND MARKETING RESEARCH DIVISION

Head of the Division: Mr. K.H.M.L. 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 2020

- An analysis of Gender Role in Small Scale coastal Fisheries (SSF) in Sri Lanka (SL)
- Bio-Economic analysis of declared Marine Protected Areas (MPAs) in Sri Lanka
- Value Chain Analysis and its Performance of Herring and Sardinella Fisheries in Sri Lanka
- Fisheries Information Centre (FIC) of NARA

Activities

- Under the projects (1), (2) and (3) following activities were completed.
 - Data collection
 - Data analysis
 - Report writing/annual publications
- Under the Fisheries Information Centre, all inquiries were recorded and answered over the phone or directed to the respective institutes

Division	Projects	Responsible Officer/s	Duration
Socio-economic and Marketing Research Division	Fisheries Information Centre (FIC) of NARA (8.1)	Ms.H.P.D.A.Lakmali	Continuous
	An analysis of Gender Role in Small Scale coastal Fisheries (SSF) in Sri Lanka (SL) (8.2)	Ms.M.T.N.Thilakarathna Ms.H.P.D.A. Lakmali	One year
	Bio-Economic analysis of declared Marine Protected Areas (MPAs) in Sri Lanka (8.3)	Mr.M. M. A. S. Maheepala Mr.K.P.G.L.Sandaruwan Dr.Prabath Jayasinghe	One year
	Value Chain Analysis and its Performance of Herring and Sardinella Fisheries in Sri Lanka (8.4)	Ms. D.W.L.U. De Silva Ms.M.N.D.F.Abeykoon	One year

PROJECT NO: 8.2

AN ANALYSIS OF GENDER ROLE IN SMALL SCALE COASTAL FISHERIES (SSF) IN SRI LANKA (SL)

The contribution of Small Scale Fisheries sector (SSF) in Sri Lanka is recognized as major factor for sustaining livelihoods in fisheries industry and it is diverse with gender divisions of labour that men and women are engaged in distinct and complementary activities. Considering the significance of promoting gender division of labour to enhance the socio-economic condition of fishermen and fisherwomen, this study focused on the gender roles of three aspects of SSF: active fishing, dry fish processing and marketing. This study was conducted in Negombo fisheries district of Western Province and Chilaw fisheries district of North Western Province of Sri Lanka. A socio-economic survey was conducted using semi- structured questionnaire from 60 fishing households based on the non-probability, convenience sampling method. Data was obtained from both men and women in the selected families. The sample was comprised of 40 active fishing

households (66.7%), 12 dry fish processing households (20%) and 8 from the fishing households who engaged in fish marketing activities (13.3%) in SSF. Interviews and observation methods were used to collect further information. Field data was analyzed using SPSS statistical package and Harvard Analytical Framework was used for gender role analysis.

According to the results of the study, a majority of the fishermen in Negombo (40%) and Chilaw (43.3%) was in the range of 41-50 years. The majority of the fisherwomen in Negombo (43.3%) were in the range of 31-40 while the majority of fisherwomen in Chilaw (30%) were in the 41-50 age categories. The mean value of monthly income of fishermen was varied among the three aspects of active fishing, dry fish processing and fish marketing and it was in the range of Rs. 40000-60000. Out of the sample, 26.7% of fishermen in Negombo were engaged in secondary occupations such as driving, hiring works, lagoon fishery, agriculture and net mending while 10% of fishermen in Chilaw were engaged in secondary occupations. The majority of fisherwomen in Chilaw (40%) involve with the dry fish processing activities and the average monthly income was Rs. 18500. Sewing clothes and preparing food items were key secondary occupations of fisherwomen (13.4%) and they earned a sum of Rs. 5000 average monthly income and contributed to their families. Though seagoing fishing can be seen as a male dominated activity, 26.7% and 40% fisherwomen from Chilaw and Negombo respectively supported for their fishing activities as unpaid family workers. Except seagoing fishing and aquaculture, fisherwomen engage in pre-harvest and post-harvest activities include net clearing, net loading, net mending, repairing nets, sorting fish, dry fish making and fish selling. Study results revealed that fisherwomen played a vital role in productive activities, household and community activities. More than 80% of contribution was provided by the fisherwomen in household management.

The fishermen and fisherwomen in SSF in Sri Lanka face social, economic, institutional and environmental barriers. Reduce the fish harvest, damage to fishing nets, high cost of fuel and high cost of fishing gears are major issues faced by fishermen while fisherwomen face many constraints in gender empowerment such as lack of recognition for women's work and contribution, lack of participation for governance and sustainable resource management, gender discrimination in wage labour, fewer opportunity for economic participation due to household chores and social and cultural pressures. Both fishermen and fisherwomen face common issues in gender empowerment such as price fluctuations and marketing problems, poor coordination of fishing societies, lack of infrastructure facilities and lack of technology. It is recommended to concern gender roles and issues in to policies/planning projects in the fisheries sector to empower both gender for the well-being and economic prosperity of SSF in Sri Lanka.

PROJECT NO: 8.3

BIO-ECONOMIC ANALYSIS OF DECLARED MARINE PROTECTED AREAS (MPAs) IN SRI LANKA

The project area was Kayankerni reef that was declared as a natural sanctuary in 2019 and the major objective of the study is to identify the Socio-economic benefits of MPAs. It was found that the fishing is major economic activity around the sanctuary and tourism is emerging economic activity around the Kayankerni sanctuary. The sanctuary belongs to the Vakarai South Fisheries Inspector division and major fish landing sites are Kayankerni and Mankerni. In addition to that fishers who live closed to Wakarai, Senkadamunai are also fishing in the area around the sanctuary.

As a result of the reef is located close to the beach (around 3 Km), fishers who use non mechanized boats (NTRB) fishing closed to the sanctuary. While the fisher who use OFRP boats are fishing away from the reef (around 15km-20km). The day income is highly fluctuated and the average profit of the one day fishing is range from Rs: 1000.00 to Rs: 5000.00. Fishers who use OFRO boats, do not clearly identify extra benefits getting from reef for their harvest. However, fishers who are fishing from NTRB have clearly identify the benefit of reef for their fishery, especially during the off season. Beach de-mer fishers collect the beach de-mer, beyond the reef. Around 10 fishers in Kayankerni engage in beach de mer collation and average income of the day per fishers is 5000.00.

Boat hiring for the tourists arrange by the local fishers who are located at the fish landing site (Kankerni) and the average cost of the boat hire for visiting reef e is about Rs 3500.00. However, the fee of the boat hire varies according the time spent at the reef. For n instant, if tourists stay at coral reef around half a day, the boat hire can be around Rs 7500.00. As fishers are engaging for boat hiring for the tourist, they have increased their income.

It was identified some threaten to the reef from the fishing activities as well as tourism. According to the fishers, bottom set net and the fishing from dynamite are the major threaten for the reef, while unawareness of the local tourists for the importance of the reef has badly influence for damaging reef. Weak monitoring and coordination among stockholders of the reef users is also badly influence for the protection of the reef.

PROJECT NO: 8.4

VALUE CHAIN ANALYSIS AND ITS PERFORMANCE OF HERRING AND SARDINELLA FISHERIES IN SRI LANKA

In the coastal fisheries in Sri Lanka, *Amblygaster sirm* (Herring/ Hurulla) is the dominant species followed by *Sardinella gibbosa*(Salaya) and *Sardinella albella* (Sudaya) with the relative contribution of 21.96%, 11.65% and 9.76%, respectively (BOBLEM, 2015). The objectives of the study were to analyse and map the present value chains of Herring and Sardinella fisheries and to identify gaps and ways to develop existing value chains on the concept of value chain development. The study area was Negombo, Chilaw and Puttalam fisheries districts of West coast, selected based on the high availability of Herring and Sardinella fish. Sample of 65 value chain participants (50 fishermen and 15 intermediaries) were selected using convenience sampling method and interviewed using pre tested semi structured questionnaire. The data were analyzed using SPSS ver. 22 and Ms Excel as relevant. Analysis was done by a few steps. First, the key economic agents, their roles and main functions were identified. Basic configuration of marketing channels was mapped and flow of fish from one node to other along the value chain was simply calculated in percentage. Three marketing performance indices were calculated namely; marketing efficiency index ((Acharya and Agarwal, 2007), price spread (Narayanakumar and Sathiadhas, 2006) and fishermen's share in consumer's rupee (Aswathy, 2014) and the efficiencies of identified marketing channels were compared using calculated performance indices.

The results revealed that both Herring and Sardinella fisheries have the same structure of value chains which were aligned across five main stages; production, assembling, wholesaling, retailing and consumption. Five major value chains were observed (Table 01) and further analyses were done for channel 01, 02 and 03 because a vast quantity of Herring moved through those channels.

Table 01 Different marketing channels of Herring and Sardinella fisheries in West-coast of Sri Lanka

Channel	Player 1	Player 2	Player 3	Player 4	
1	Fishermen	Assembler	Retailer	Consumer	
2	Fishermen	Assembler	Consumer		
3	Fishermen	Retailers	Consumer		
4	Fishermen	Consumer			
5	Fishermen	Assembler	Wholesaler	Retailers	Consumer

The average annual net profit of a Herring fishing unit was found as LKR 406 416 while it was LKR 283 500 for Sardinella fishing unit. The results verified that both Herring and Sardinella fishery in the West coast is still a profitable commercial fishing activity. A market can be regarded as efficient, when the price spread is lower and share to the fishermen and marketing efficiency index are higher (Narayanakumar and

Sathiadhas, 2005, Shepherd Geoffrey, 1972). Summary of price spread, fishermen's share in consumer's rupee and marketing efficiencies of marketing channel 01, 02 and 03 were showed in Table 01. Results confirmed that the most efficient marketing channel for both Herring and Sardinella fisheries in the West coast of Sri Lanka is channel 02 in which fish flows to the end consumer through the assembler.

Table 02: Summary of price spread, fishermen's share in consumer's rupee and marketing efficiencies of marketing channel 01, 02 and 03.

Fishery	Particulars	Marketing channel 01			Marketing channel 02	Marketing channel 03		
		Motor bicycle vendor sub chain	Bicycle vendor sub chain	Roadside vendor sub chain	Assembler as the intermediate	Motor bicycle vendor sub chain	Bicycle vendor sub chain	Roadside vendor sub chain
Herring	Price spread (LKR/Kg)	205	205	205	80	180	180	165
	Fishermen's share in consumer's rupee (%)	54.44	54.44	56.32	75.53	60	60	62.06
	Marketing efficiency index	1.19	1.19	1.28	3.06	1.5	1.5	1.63
Sardinella	Price spread (LKR/Kg)	190	190	160	60	180	180	105
	Fishermen's share in consumer's rupee (%)	45.71	45.71	50	75.53	48.57	48.57	52.12
	Marketing efficiency index	0.84	0.84	1	2.66	0.94	0.94	1.13

The following recommendations can be given based on the finding of the study; to establish a proper market information network and provide access to all value chain actors, to augment the government intervention in development of infrastructure facilities for storage and processing of Herring and Sardinella fish and to ease the procedure of institutional finance to protect the fishermen from the clutches of money lenders and other intermediaries, particularly the assembler.

PROJECT NO: 8.1

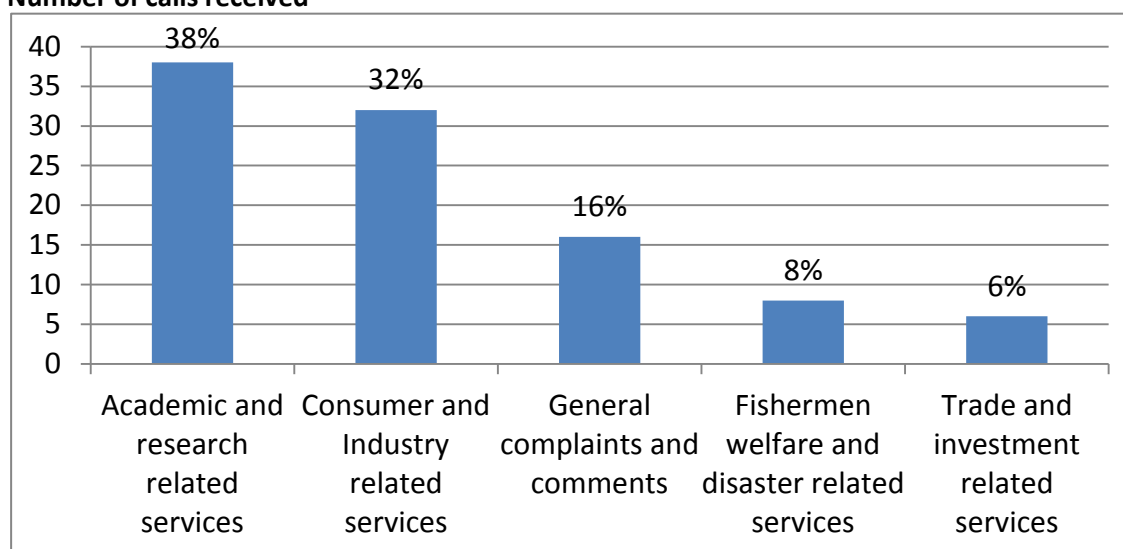
THE FISHERIES INFORMATION CENTRE (FIC) OF NARA

Socio-economic Division maintains the Fisheries Information Center (FIC) to provide necessary information for stakeholders and other interested parties of Sri Lankan fisheries industry. The end of the year 2020, a total number of 144 queries were received through the hot line 07 10 10 10 10 of fisheries information Centre from different respondents. This is relatively low number of inquiries when compared to last year, and it is mainly because of Covid-19 pandemic restricting fishing operation all around the country during 2020. All the queries are categorized in to five groups. Numbers of queries and the percentages under each information criteria are given bellow table.

Numbers of queries and the percentages under each information criteria

Information criterion	Number of calls received	Percentage
Academic and Research Related Services	55	38
Consumer and Industry related Services	46	32
General Complains and Comments	23	16
Fisherman Welfare and Disasters Related Services	12	8
Trade and Investment Related Services	9	6
Total	145	100%

Number of calls received



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 500 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.

5.9 MONITORING AND EVALUATION DIVISION

Head of the Division : Mr. A.B.A.K. Gunaratne

The Monitoring and Evaluation division is comprised with Information Technology unit, Library and Information unit. 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, facilitation to knowledge sharing and dissemination are main responsibilities of the 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 identify 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 Division 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 IT unit maintains IT contracts and software licenses, and coordinates the procurement of IT related hardware and software.

Library and Information Unit

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.

Activities undertaken

Programme	Project	Allocation (RsMillion)	Officer Responsible	Period	
				From	To
Open access to knowledge and dissemination of information	9.1. Internet services and online information systems	3.5	A.B.A.K. Gunaratne	2020	
	9.2 Assessment and monitoring of research projects	0.75	A.B.A.K. Gunaratne	2020	
	9.3 Annual Scientific session - 2020	2.7	A.B.A.K. Gunaratne	2020	
	9.4 Stakeholder consultation meeting	0.6	A.B.A.K. Gunaratne	2020	

Performance

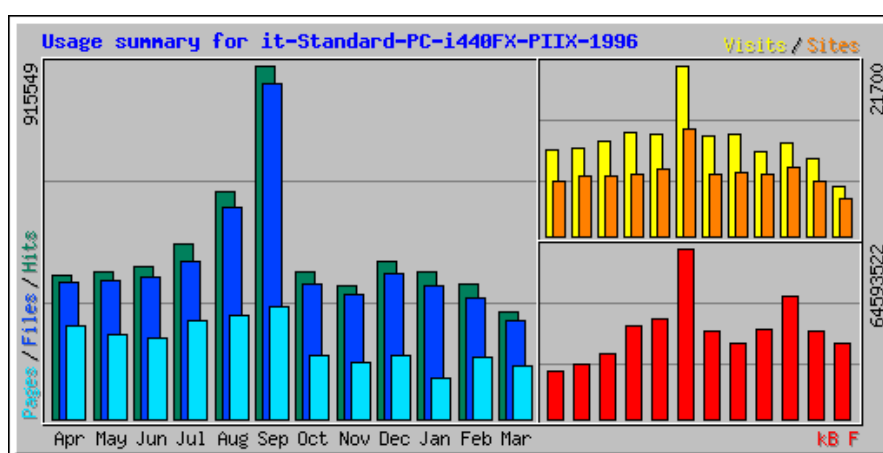
Project No: 9.1

Internet services and online information system

Responsible Officer : A.B.A.K. Gunaratne
Budget : 3.5 million

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.

Modifications were carried out to the website 98 web pages were added to the site. Average visit per day to the web site was nearly 435 and observed the highest visit counts, 19433 on June 2019.



Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	kB F	Visits	Pages	Files	Hits
Mar 2021	12011	11063	6067	274	4839	28401905	6314	139551	254467	276258
Feb 2021	12504	11257	5717	350	6924	33362979	9822	160087	315210	350113
Jan 2021	12343	11190	3388	385	8725	46787745	11955	105051	346912	382649
Dec 2020	13136	12148	5315	345	7941	34235815	10716	164786	376617	407220
Nov 2020	11447	10770	4953	430	8028	28602231	12928	148593	323111	343420
Oct 2020	12276	11316	5368	411	7963	33316988	12767	166423	350819	380584
Sep 2020	30518	28904	9672	723	13509	64593522	21700	290169	867126	915549
Aug 2020	18960	17651	8612	417	8508	38130063	12927	266991	547190	587765
Jul 2020	14576	13237	8243	423	7950	35450905	13138	255543	410369	451864
Jun 2020	13206	12245	7024	400	7721	24747421	12004	210745	367369	396186
May 2020	12323	11570	6992	362	7646	21020248	11250	216774	358685	382029
Apr 2020	12381	11841	8078	366	6885	18411645	11008	242357	355241	371443
Totals						407061467	146529	2367070	4873116	5245080

Staff engaged with PC assembling and day to day computer troubleshooting and repairs, network repairs with Network expansion work including network cabling and installing network accessories

Inform Database that used to evaluate research projects of the institutions engaged in CARP network, was submitted to CARP. Expected target was achieved during the period. Information on human resource and financial statement was submitted to the National Science Foundation and NASTEC for the Research and Experimental Survey 2019.

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

PROJECT NO: 9.2

ASSESSMENTS AND MONITORING RESEARCH PROJECTS

Responsible Officer : **A.B.A.K. Gunaratne**

Budget : 0.75 million

Project performance report and annual report for the year 2019 were produced. Monthly and quarterly progress report to Presidential Secretariat, Treasury and Ministry were submitted

Quarterly progress review meetings were conducted within the institute and required adjustments and advices were delivered by the Deputy Director General in order to solve the issues aroused.

PROJECT NO 9.3

ANNUAL SCIENTIFIC SESSIONS

Responsible Officer : **A.B.A.K. Gunaratne/Mr. M Maheepala**

Budget : 2.7 million

Annual Scientific Session 2020 was held on 22nd January 2021 as a webinar due Covid outbreak. The session theme was “Technologies innovations for fisheries and aquaculture development” and sessions were accommodated on a wide range of themes, including Fisheries and Aquaculture, Aquatic Biotechnology and Animal Health, Coastal and Marine Habitat Enhancement, Oceanography and Hydrography, Socio-Economics and Marketing, Aquatic Post Harvest Technology, Coastal and Marine Pollution, Conservation and Management of Aquatic Environment, Climate Change and its Impacts. As the leading research organization on the living and non-living aquatic resource sector, NARA contributes in knowledge sharing by conducting high quality research of national and international standards.

The Inauguration ceremony was graced by Prof. N. Nawarthenarajh, Chairman, NARA. The key note address was made by Prof. Alen Deidu, Director of the International Ocean Institute University of Malta,

PROJECT NO 9.4

STAKEHOLDER CONSULTATION MEETING

Responsible Officer : **A.B.A.K. Gunaratne**

Budget : 0.6 million

The consultation meeting was conducted at NAQDA resource center, Kalawewa parallel with induction training for newly recruited Scientists.

Progress : **Physical : 100%** **Finance : 28 %**

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) & Digital e-repository database were updated. The collection were strengthened by purchase of resources, donations, Inter Libraries Loan (ILL) 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.

Researchers, Fisheries officials, Scholars and development planners and university students are now able to view rare documents published by NARA through digital repository and web catalogue.

ACTIVITIES UNDERTAKEN

Project	Activities	Allocation	Officer Responsible	Period (from-to)
1. Collection Development	1.1 Procurement of books, Journals (printed /electronic) and CD-Rom	2.00	BGS Kariyawasam RS Liyanarachchi	Jan- Dec
	1.2 Collecting Research Reports and Papers		BGS Kariyawasam	Jan-Dec
	1.3 Obtaining of library resource by donation		BGS Kariyawasam RS Liyanarachchi	
	1.4 Obtaining of library resource by exchange			
	1.5 E-downloads			
2. Library Management	2.1 Editing and updating library catalogues		BGS Kariyawasam	Jan– Dec
	2.2. Entering data to Web Catalogue		Menaka Karunaratne BGS Kariyawasam RS Liyanarachchi	
	2.3 Subject Classification & filing of library resources			
	2.4 Compilation of e-repository collection		Menaka Karunaratne	
3. Reference Services	3.1 Current Awareness Services (CAS)		BGS Kariyawasam	Monthly
	3.2 Selective Dissemination of Information Service (SDI)		BGS Kariyawasam	Jan- Dec
	3.3 Information Retrieval Services		BGS Kariyawasam RS Liyanarachchi	
	3.4 Indexing Services			
	3.5 Literature Survey			
	3.6 Inter libraries exchange services		BGS Kariyawasam	
4. Library Cooperation	4.1 Library membership British council		BGS Kariyawasam RS Liyanarachchi	Jan- Dec
5. Other Services	5.1 Multi copying services (Photo copy /Scanning)		Menaka Karunaratne DHT Ajithwansa	Jan- Dec

6. Publishing Journal & Publicity Service	6.1 Sale& free distribution of NARA Publications		RS Liyanarachchi Menaka Karunaratne	Jan- Dec
	6.2 Re-print of NARA Publications		BGS Kariyawasam	

Project No: 01 Collection Development

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:

06 Journals were requested for the year 2020, out of them only 01 was subscribed & 01 was renewed.

16 book titles were requested, out of them only 12 were selected and 01 was not supply.

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

Purchase, Donation & Exchange :

Received 14Books, 28 journals,14 Travel Reports, 54 Research articles, 01 thesis, 15 NARA reports & 188 Newspaper article.

Progress :

Physical : 100%

Financial : 75%

PROJECT NO: 02 RESOURCE MANAGEMENT

The resource acquired, were catalogued and classified manually and also entered to the Open Public Access Catalogue (OPAC)and accessible not only to the NARA but also to the public. Digital collection was also updated regularly.

Library resource referral service was accessible to the scholars using OPAC. Edited 1,100 data with contents for the Library Management System (LMS) and 11 for the repository collection.

PROJECT NO: 03 REFERENCE SERVICES

Information Retrieval

In order to retrieve from e-Journal articles, Postgraduate theses, Research reports, Research articles and Newspaper clippings databases were updated electronically and were compiled databases using KOHA LMS and Digitization project. Summary of data entered to the digitization project as given below.

Digital Data Collection

Name of the Collection	Quantity of Data
NARA Publications	1018
Postgraduate Theses	77
Research Reports	116
Research Papers	151
Newspaper Clippings	170
Administrative Reports	45
Acts	03
Proceedings	54

3.1 Collected information for literature surveys for the following titles –

- Marine mammals
- Climate change
- Corals
- Fish disease
- Shrimp disease

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 updated by entering research paper data.

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 298 nos. 187 books were lend under library circular system.

3.4 Document Delivery Service - Library has joined for the British Council Membership programme and Under selective dissemination of Information service provided 298 nos. research reports for Nara Scientists from co-operative libraries.

3.5 Library has provided photocopy and document scanned services - the total amount received through photo-copying during the year was Rs. 3821.00 and 400 Pages photocopied and 68 documents scanned for free of charge for internal readers.

Progress : Physical : 100% Financial : -%

PROJECT NO: 04

LIBRARY WEB CATALOGUE

Updated library web site (http://www.nara.ac.lk/?page_id=3373) along with a web catalogue (www.lib.nara.ac.lk) and e repository (www.erepository.nara.ac.lk)

Progress : Physical : 75% Financial : -%

PROJECT NO: 05

PUBLICATION AND PUBLICITY SERVICE

Sales of NARA publication were done by the library & the total amount received was Rs. 42,617.50/=.

Progress : Physical : 75% Financial : 75%

5.10 TECHNOLOGY TRANSFER DIVISION

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

Extension Unit is staffed with Principal Scientist, Extension Officer, Management Assistant, Photographer and two Office Attendants. Extension Unit makes a platform for dissemination and communication of scientific and technical information generated and reviewed by NARA, to stakeholders. The relevant extension programs are conducted through effective mechanisms such as organizing the exhibitions, training workshops, awareness programs etc. that suits for the target stakeholders.

PROJECT NO : 9.8

EXTENSION SERVICES

Officer Responsible: D.V.S.P. Bandara, G.J. Ganegama Arachchi

1. Participation at educational exhibition
2. Extension Unit participated as exhibitors representing NARA at education exhibition called “IMPULZ 20”, organized by Hanwella Rajasinghe National School from Jan 13-18, 2020. NARA-Exhibition stall displayed different ornamental fish species and fish and seaweed based value added food products. Scientific and technical knowledge on aquatic resources were disseminated using video programs, Face book Updates on R&D work and leaflets etc with participation of resource personnel from all Technical Divisions including Marine Biological Resources Development, Inland Aquatic Resources Division, Post Harvest Technology, Fishing Technology, Environmental Studies, Oceanography and Marine Science and National Hydrographic Office.
3. A video program was produced on production of fish meal at commercial level in a Fish Meal Plant including all steps from collecting fish wastes as raw materials for the feed to the finished fish feed material which are ready for sale.



4. Media coverage was arranged for the inauguration session of fish feed plant at Ja-Ela on February 05, 2020.
5. Provide tailor-made trainings for Navy personnel and other stakeholders.
6. NARA page book was updated: Forty two (42) technical notes have been posted.
7. Editing the booklet Titled ‘Lagoon crabs in Sri Lanka’ prepared by Dr. Mrs. M. G. I. S. Parakrama
8. Four number of one-day training programs about R&D works and services relevant to the aquatic resources, were conducted for four groups of Navy personnel in February, 2020.

Outcome:

Learned civil groups about sustainable utilization and management of aquatic resources

TITLE OF THE PROJECT 9.8 : AWARENESS THROUGH MEDIA - BUILD AWARENESS ON THE MOST THREATENED ENDEMIC FRESHWATER FISHES OF SRI LANKA AND RESTORATION OF MOST VULNERABLE ECOSYSTEMS

Officer Responsible: R. R. A. Ramani Shirantha, D. V. S .P .Bandara, G. J .Ganegama Arachchi

As a measure for the conservation of *Malpulutta kretsiri*, *Pethia cumingii*, *Dawkinsia srilankensis*, *Labeo fisheri*, *Systomus matenstyni* and *Danio pathirana* in natural habitats it selves, it was planned to install display- boards on these threatened endemic fish species at four selected locations where these fish species are found naturally in Kegalle district (Yatiyanthota, Kegalle, deraniyagala, Mawanella and Rambukkana) with permission of Department of wild life and relevant Divisional Secretariat in Kegalle District. Preparation of four fish- display boards has been completed. Three Display Boards were established at selected sites in Kegalle district: Kithulgala town, Meeoya Bridge, and Kithulagala bathing place near water spring.



Outcome:

Creation of awareness about threatened endemic fish species among stakeholders in Sri Lanka.

PROJECT No : 9.10

AQUA CLUB EDUCATIONAL PROGRAMME

Officer Responsible : D. V. S. P. Bandara, Ms. J. M. N. Jayasundara and Ms. S. H. U. Chathurani
(Kadolkelle Regional Center), G. J .Ganegama Arachchi

This project is implemented with approval and supervision of Ministry of Education. The aim of this project was to enhance knowledge on sustainable utilization and management of aquatic resources among school children.

Activities:

- Four workshops have been conducted at following schools with participation of Scientists from NARA as resource personnel.
 - Ambalangoda Dharmashoka National School
 - Dehiwala Presbritriyan Vidyalaya
 - Modera Ananada Maha Vidyalaya
 - Chilaw Ananda National School



2. Establishment of mangrove plant nursery in NARA regional Center at Kadolkele was included in the revised work plan (July-December, 2020) which was made considering the Covid Pandemic in 2020. Aim of this activity was to create awareness about mangrove plants among school children and mangrove saplings prepared in 2020 will be planted in selected locations with participation of school children in 2021.
3. *Nypa fruticans* (mangrove palm, 'ging pol') is threatened mangrove plant in Sri Lanka mainly due to destruction of natural habitats by unplanned anthropogenic activities and however, it has been shown as economically valuable mangrove plant in other countries. Sap of *Nypa fruticans* inflorescence is suggested for bioethanol industry and various parts of other parts of this plant including leaves, and young shoots are utilized at cottage level industries. Mangrove palm is currently not utilized for any commercial purposes in Sri Lanka.
 - I. Two field visits were made to observe and gather information about current status distribution of *Nypa fruticans* at Kammala village along with the river bank of Hamilton canal to from Negombo lagoon to Maha-Oya River.
 - II. Current threaten factors/ issues regarding the failures of earlier projects on the restoration of *Nypa fruticans*:
4. Sand mining has negatively influenced on the growth of the plant. It has accelerated the root out of the plant along with the force created by water current.
5. Boat riding with elevated speed for tourism and other fishery activities has accelerated of root out of small and mature *Nypa fruticans* plants
6. During field observations, it was also identified that the stilt roots of *Rhizophora apiculata* and *Rhizophora mucronata* have provided the protection of water currents and support for stabilization on the substrate by minimizing the chances of rooting out.
 - I. Secondary plants with economic value:
Communications with resident communities in the area during field visits it was identified that *Nypa fruticans* can be cultivated in suitable environments together with other secondary plants such *Alovera*, *Acrostichum aureum* and *Bacopa monnieri* which has potential for source of income generation for the communities because it takes about 4-5 years to bear *Nypa fruticans* plants which can be utilized for sap based industries.
 - II. Seeds of *Nypa fruticans* were collected for the utilization of a nursery at Kammala village (Latitude: 7o 17' 55.96"; Longitude : 79o 51' 1.82"). Two nurseries were prepared by setting 350 *Nypa* seeds which were collected from Gin-Oya area in Kadolkele Regional Research Center (KRRC) in Negombo.
 - III. Video recordings were obtained for production of video documentary on *Nypa fruticans*



Outcome:

Enhancement the knowledge on sustainable utilization mangrove plants among school children

6.0 ANCILLARY SERVICES

6.1 PURCHASING & SUPPLY UNIT

Head Of The Divison : Mr.N.S.Hewagama

Purchasing & Supply Officer : Ms A.T.P.Kumari De Silva

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

- A. According proper tender procedures Mainly purchase of ongoing projects,
- Purchase of Lab Equipment & Chemical Items
 - Purchase of marine diesel for vessel & maintenance
 - Purchase of Boat equipments & Net
 - Boat/spare parts for repair for boat
 - All diving equipment
 - Covering net
 - Purchase of equipments & materials for work sites
 - Iron /Aluminum goods
 - Brick/Cement
 - All types of electrical accessories
 - Purchase of all vehicle Parts& Service
 - Supply of Tyre, Battery
 - Upholstering, supply of canopies for vehicle
 - supply of vehicle DVD, radio, reverse camera
 - Purchase of all technical equipment & Accessories
 - Computer/ Laptop computer
 - Photocopy machine, Printer
 - Air conditioner
 - CCTV camera etc,
 - Purchase of Stationery Items
 - Library books
 - Stationery required for office
 - Photocopy & Printer Toner
 - Purchase of sanitary items
 - Soap & all cleaning equipment

- Furniture & other goods
 - Office Cupboard
 - Office table & chair
- Construction for office building
 - Minor repairing
 - Aluminium works
 - Construction for building (ICTAD/NCCAL)
- Supply of Services
 - Supply of meals & festival equipment for ceremonies
 - Printing work
 - Security service & Cleaning service
 - Office Transport service
 - Custom clearance & forwarding work
 - Currating & Tailoring work for office

The selection of supplies is use of supplier registration 2020& rainbow pages&paper advertisement. Calling of tenders, Bid from local and foreign supplies for goods /equipments /Lab 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 2020, the division has maintained about 071 Tenders following the tender procedures& 219 major files are process.

- B. 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 clearances of goods received from foreign sources are done & sending equipments for repair Etc: Abroad subject to normal mail & airfreight charges.
- C. Insure all vehicles /motor- cycles/equipment of NARA through proper tender procures. Obtain insurance coverage for the personal perform duty at sea and land.
- D. 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.S.K.S.Liyanaarachchi

ENGINEERING & MAINTENANCE DIVISION

Overview of the Year

Engineering & Maintenance Division is a supportive division of the institution. Engineering & Maintenance division provides and maintains all the services and develops the infra-structure facilities in line with work programs of the institution.

Activities

Engineering & Maintenance Division have several activities. They are categorized as follows;

- Rehabilitation of NARA main buildings & other regional Centers.
- Installation and maintenance of air conditioners & electric/electronic appliances & maintenance of electrical distribution system.
- Mechanical Maintenance and other maintenance.
- Repair & maintenance work of Samuddrika Research Vessel.
- Repair & maintenance of vehicles.

For the year 2020, in addition to the day to day maintenance, below mentioned work has been completed.

REHABILITATION OF NARA MAIN BUILDING & OTHER REGIONAL CENTERS.

Description	Quoted Tender Sum	Work Done	Remarks
Front Gate	2,922,428.00	2,374,872.52	Completed
Museum Upgrading	532,490.00		Completed
Rekawa Boundary Fence	539,500.00		Completed
Kalpitiya Boundry Fence	5,099,235.70		Completed
Marine Steel Building	33,815,689.38		Work Ongoing
Auditorium Renovation			Tendering
Renovation of Biotechnology lab			Tendering
Quarters Renovation	Done by NARA staff	170,460.00	

Description	Quoted tender sum	Work Done	Remarks
Renovation Of Accommodation Bldg (Wadiya)	Done by NARA staff	131,540.00	
Work top Histopathology Laboratory	Done by NARA staff	80,735.00	
Work top Nutrient Laboratory	Done by NARA staff	69,380.00	
Work top Water Quality Laboratory	Done by NARA staff	96,060.00	

02 : INSTALLATION AND MAINTENANCE OF AIR CONDITIONERS & ELECTRIC/ELECTRONIC APPLIANCES

- IPHT QC / Chemistry Lab –Replace New Air conditioner.
- ESD – Replace Airconditioner.
- Library -Replace Airconditioner.
- Rekawa Regional Center - CCTV Camera system Installed.
- Renewal of Service Agreement for Office Equipment(Fax, Photocopy Machine , PABX system, Finger print Machines).
- Renewal of Service Agreement for Lab Equipment (IPHT & IARAD)

03 : MECHANICAL MAINTENANCE AND OTHER MAINTENANCE

- Fabricate Mobile Maldivefish Making Unit for IPHT.
- Fabricate & Install Name Board atPeliyagoda Fish Market with Extension Unit
- Fabricate Name Board to Install at Yatiyanthota Region about Indigenous fisheries of Sri Lanka
- Fabrication work of outdoorHatchery at IARAD
- Fabricate Steel Rack for Stores

04 : MAINTENANCE WORK OF SAMUDDRIKA VESSEL

Provided required spare parts & services for the day to day maintenance of the research vessels per the Bureau Veritas Classification.

05 : REHABILITATION OF VEHICLES (09 NOS.)

There are 20 vehicles& 14Motor cycles in NARA fleet and 09out of fleet taken for rehabilitationduring the year. The vehicles undergone rehabilitations were;

Reg No. –61-4803	PH - 0676
PA – 5262	NA - 7487
PC – 4035	PB - 7365
PH – 0673	

Addition to above Rs.2,023,109.72 spent for services, running repairs, license and insurance of the fleet during the year. 20 vehicles &14 Motor cycles effectively utilized for the running of 619501km during the year.

Cost (Rs.) for the Year (for NARA fleet)

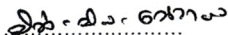
a) Rehabilitation running repairs, Services cost Insurance & License fee (From recurrent Budget)	Rs. 6,523,998.67
b) Semi luxury Tax	Rs. 48,150.00
c) Vehicle Monitoring System	Rs. 335,523.40
c) Fuel Cost	Rs. 6,495,976.09
Total operated mileage	61950 km

* Excluding drivers salary, overtime,subsistence and maintenance staff cost

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY
STATEMENT OF FINANCIAL POSITION AS AT 31ST DECEMBER 2020

	Notes	31.12.2020 Rs. Cts.	Restated 31.12.2019 Rs. Cts.
ASSETS			
CURRENT ASSETS			
CASH AND CASH EQUIVALENTS	1	167,669,283.93	99,004,002.52
TRADE AND OTHER RECEIVABLES	2	31,700,297.93	24,734,764.63
INVENTORIES	3	2,958,449.25	2,920,425.91
PREPAYMENTS	4	1,450,428.98	1,538,270.61
		<u>203,778,460.09</u>	<u>128,197,463.67</u>
NON-CURRENT ASSETS			
RECEIVABLES-DISTRESS LOAN	5	13,732,576.31	10,578,469.81
INFRASTRUCTURE, PLANT AND EQUIPMENT	6	239,184,659.63	277,422,218.33
LAND AND BUILDINGS	6	3,609,143,934.07	3,647,040,562.08
CAPITAL WORK IN PROGRESS	7	12,195,031.04	9,837,303.00
		<u>3,874,256,201.05</u>	<u>3,944,878,553.22</u>
TOTAL ASSETS		<u>4,078,034,661.14</u>	<u>4,073,076,016.89</u>
LIABILITIES			
CURRENT LIABILITIES			
ACCOUNTS PAYABLES	8	123,991,609.33	99,689,913.86
ACCRUED EXPENSES	9	49,060,250.09	67,070,620.47
		<u>173,051,859.42</u>	<u>166,760,534.33</u>
NON-CURRENT LIABILITIES			
PROVISION FOR GRATUITY	10	140,662,961.50	128,574,013.50
		<u>140,662,961.50</u>	<u>128,574,013.50</u>
TOTAL LIABILITIES		<u>313,714,820.92</u>	<u>295,334,547.83</u>
NET ASSET		<u>3,764,319,840.22</u>	<u>3,777,741,469.06</u>
ACCUMULATED FUNDS	11	431,514,008.42	440,060,435.36
RESERVES	12	3,332,805,830.84	3,337,681,033.70
TOTAL EQUITY AND LIABILITIES		<u>3,764,319,839.26</u>	<u>3,777,741,469.06</u>

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

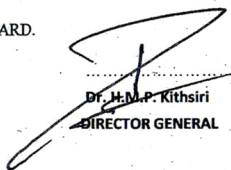


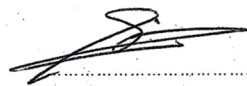
N.S. HEWAGAMA

HEAD / FINANCE

APPROVED AND SIGNED ON BEHALF OF THE BOARD.


Prof. A Navaratnerajah
CHAIRMAN


Dr. H.M.P. Kithsiri
DIRECTOR GENERAL


BOARD MEMBER
S.N.B.K.S. Senaratne
Additional Secretary (Administration & Human Resources)
Ministry of Fisheries
New Secretariat Building,
Maligawatte, Colombo 10.

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

PERFORMANCE STATEMENT FOR THE YEAR ENDED 31ST DECEMBER 2020

		2020		Restated 31.12.2019	
	NOTE	Rs.	Cts.	Rs.	Cts.
REVENUE					
GOVERNMENT GRANT	13	441,387,642.43		465,538,417.27	
OTHER INCOME	14	29,556,002.28		30,971,531.92	
PROJECT CONSULTANCY INCOME		36,419,522.79		92,221,412.45	
AMORTIZATION OF LOCAL & FOREIGN GRANT	15	110,908,171.19		122,709,168.83	
TOTAL REVENUE		<u>618,271,338.69</u>		<u>711,440,530.47</u>	
EXPENSES					
PERSONNEL EMOLUMENTS	16	331,910,292.48		309,713,671.13	
TRAVELLING & SUBSISTENCE	17	1,179,374.49		747,429.23	
SUPPLIES & CONSUMABLES USED	18	2,665,871.02		3,025,043.46	
MAINTENANCE EXPENDITURE	19	20,114,010.00		28,170,083.31	
CONTRACTUAL SERVICES	20	32,047,629.02		39,310,795.77	
RESEARCH & DEVELOPMENT EXPENDITURE	21	80,482,642.43		115,538,417.27	
PROJECT CONSULTANCY EXPENDITURE		36,419,522.79		92,221,412.45	
DEPRECIATION & AMORTIZATION EXPENSES	22	110,908,171.19		132,114,014.74	
OTHER OPERATING EXPENSES	23	8,396,356.41		12,511,848.02	
		<u>624,123,869.83</u>		<u>733,352,715.38</u>	
TOTAL EXPENSES					
SURPLUS (DEFICIT) FOR THE YEAR		<u>(5,852,531.14)</u>		<u>(21,912,184.91)</u>	

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 2020

	ACCUMULATED FUND			ACCUMULATED EXPENDITURE OVER INCOME	REVALUATION RESERVES	TOTAL
	GOVERNMENT CONTRIBUTION	FOREIGN GRANT	LOCAL GRANT			
BALANCE AS AT 1 ST JANUARY 2019	456,966,574.44	3,857,323.00	41,281,108.36	(684,009,843.55)	4,095,231,343.00	3,913,326,505.25
FUNDS RECEIVED DURING THE YEAR	152,000,000.00	3,374,470.00	14,945,767.62		(7,276,600.00)	163,043,637.62
FUNDS UTILISED DURING THE YEAR	(115,538,417.27)	(1,960,026.08)	(10,994,584.73)	(63,831,414.16)		(192,324,442.24)
FUNDS TRANSFERS DUE TO REALLOCATION	(110,543,399.46)			19,122,948.42		(91,420,451.04)
ADJUSTMENTS FOR THE YEAR	656,089	(3,374,470)	9,390,000	(4,131,471.32)		2,540,148
NET SURPLUS/ (DEFICIT) FOR THE YEAR				(16,444,930.50)		(16,444,931)
BALANCE AS AT 31.12.2019	383,540,846.75	1,897,296.92	54,622,291.25	(750,273,709.30)	4,087,954,743.00	3,777,741,469
BALANCE AS AT 01 ST JANUARY 2020	383,540,846.75	1,897,296.92	54,622,291.25	(750,273,709.30)	4,087,954,743.00	3,777,741,468.62
FUNDS RECEIVED DURING THE YEAR	171,578,150.00	4,914,793.68	6,351,443.00			182,844,386.68
FUNDS UTILISED DURING THE YEAR	(80,482,642.43)					(80,482,642.43)
FUNDS TRANSFERS DUE TO REALLOCATION	(101,882,638.99)	(1,226,622.07)	(7,798,910.13)	977,328.28		(109,930,842.91)
NET SURPLUS/ (DEFICIT) FOR THE YEAR				(5,852,531.14)		(5,852,531.14)
BALANCE AS AT 31 ST DECEMBER 2020	372,753,715.33	5,585,468.53	53,174,824.12	(755,148,912.16)	4,087,954,743.00	3,764,319,838.82

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

Disclosed to the Financial Statements 2020

No.	Description	Situation
01	Land in the head office	❖ Crow Island, Mattakkuliya, 26 Acres 01 Rude 15.7 Perches Land has been transferred to us by Gazette Notification No. 489/28 dated 09.01.1988. We have informed the Divisional Secretary on 22.09.2020 to take action to transfer this land to us and to register it in the relevant forms of the Land Registration Office. Its work is in progress.
02	Rekawa RRC	❖ It has been agreed to lease 02 acres 02 rude and 25.5 perches of land at the Rekawa Regional Research Center on a long term lease basis and It has been requested from the Tangalle Divisional Secretary to take necessary steps to acquire the remaining land.
03	Kapparatota RRC	❖ The land of Kapparithota Regional Research Center has been transferred to the Government in terms of Section 44 of the Land Acquisition Act subject to the terms and conditions set forth in the Second Schedule. Given to us by the Ministry of Fisheries.
04	Beruwala RRC	❖ The Budget Department has approved the cost of acquiring the relevant lands under the Acquisition Act to bear the cost under the Collective Expenditure Head of the Ministry of Land and Parliamentary Reforms in terms of 53 basic regulations. Acquisition documents are to be submitted to the Ministry of Land and Parliamentary Reforms.
05	Kadolkele RRC	❖ 99 leased by the Board of Investment of Sri Lanka on 04 January 1990.
06	Kalpitiya RRC	❖ Plans have been prepared by the Survey Department and submitted to the Kalpitiya Divisional Secretary on 21.12.2019 to carry out the necessary preliminary work for the transfer of the government owned land owned by our institution located in the Anavasala (631 A) Grama Niladhari Division in the Kalpitiya Divisional Secretariat. The Kalpitiya Divisional Secretary is carrying out the transfer of the 14.6679-hectare land on a long-term lease basis with the recommendation of the relevant institutions. ❖ The Line Ministry has referred this extent of land of 10 Acres 01 rude 31 perches to the Council for the acquisition that owned by the Land Reforms Commission.

07	Panapitiya RRC	❖ 1. The National Aquaculture Development Authority of Sri Lanka (NAQDA) has handed over the Kalutara Panapitiya Freshwater Fish Breeding Center to NARA. ❖ 2. Kalutara Divisional Secretariat has been instructed to hand over the land located in 711B Panapitiya North Grama Niladhari Division to us under the Land Registration Program (Bim Saviya) to obtain title certificates. ❖ 3. The Divisional Secretary has informed us on 08.07.2020 that further steps are being taken to transfer the Panapitiya land as per the Land Development Ordinance.
08	Trincomalee RRC	❖ The land belonging to the Trincomalee Regional Research Center is a land given to us by the Fisheries Harbor Corporation. The land is currently occupied by the Sri Lanka Navy.
09	Kalpitiya Kandakuliya Marine Fish Breeding House	❖ 1.2148 hectares of government land in Kandakuliya, Kudawa 629 / C Grama Niladhari Division of Kalpitiya Divisional Secretariat has been recommended to be given to us on long term lease basis with the approval of the Cabinet of Ministers dated 23.11.2016 but so far no recommendation has been received from the Tourism Development Board. A project report will be prepared to promote tourism and the recommendations of the Tourist Board will be obtained accordingly.
10	Punahari	❖ Plans have been prepared by the Senior Survey Superintendent of the Jaffna District to give us 25 acres of land in the Pallikuda (KN / 65) Grama Niladhari Division of the Poonahari Divisional Secretariat.
11	Annual Financial Statements	❖ Annual Financial Statements of 2019 reinstated
12	Lessing Vehicles	❖ Arrange to transferred to owner ship to NARC for Lessing vehicles
13	Vesical KX 8224	❖ Fully depreciation and amortization considered to current year
14	EPF arrears	❖ EPF arrears of 39.93 Mn out of 66 Mn. Is considered as current liability as at 31/12/2020

NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

CONSOLIDATED CASH FLOW STATEMENT FOR THE YEAR ENDED 31ST DECEMBER 2020

	31.12.2020
	Rs.
CASH FLOWS FROM OPERATING ACTIVITIES	(5,852,531.14)
SURPLUS(DEFICIT) FROMORDINARY ACTIVITIES	
ADJUSTMENT FOR :	
DEPRECIATION ON PROPERTY PLANT AND EQUIPMENT	110,908,171.19
AMORTIZATION OF DEFERRED EXPENDITURE	(110,908,171.19)
PROVISION FOR RETIRING GRATUITY	22,223,043.18
PREVIOUS YEAR ADJUSTMENTS	2,913,503.98
INTEREST ON STAFF LOANS	(698,349.17)
OPERATING PROFIT/(LOSS) BEFORE WORKING CAPITAL CHANGES	18,585,666.85
WORKING CAPITAL CHANGES	
(INCREASE) DECREASE IN INVENTORIES	(38,023.34)
(INCREASE) DECREASE IN TRADE & OTHER RECEIVABLES	(6,965,533.30)
(INCREASE) DECREASE IN PREPAYMENTS	87,841.63
INCREASE (DECREASE) IN ACCOUNTS PAYABLES	24,301,695.47
INCREASE (DECREASE) IN ACCRUED EXPENSES	(18,010,370.38)
CASH GENERATED FROM/ (USED IN) OPERATIONS	17,961,276.93
RETIRING GRATUITY PAID	(10,134,095)
NET CASH GENERATED FROM/ (USED IN) OPERATING ACTIVITIES	7,827,181.75
CASH FLOWS FROM INVESTING ACTIVITIES	
PURCHASE OF PROPERTY PLANT AND EUIPMENT	(20,579,205.58)
INVESTMENT IN DISTRESS LOAN	(3,154,106.50)
INTEREST ON STAFF LOANS	698,349.17
OTHER RECEIVABLE	(6,351,443.00)
WORK IN PROGRESS	(7,472,445.00)
NET CASH GENERATED FROM/ (USED IN) INVESTING ACTIVITIES	(36,858,850.91)
CASH FLOWS FROM FINANCING ACTIVITIES	
CAPITAL GRANTS RECEIVED	97,446,950.57
DISPOSAL OF MOTOR VEHICLE	
NET CASH GENERATED FROM/ (USED IN) FINANCING ACTIVITIES	97,446,950.57
NET INCREASE / (DECREASE) IN CASH AND CASH EQUIVALENTS DURING THE YEAR	68,415,281.41
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	99,254,002.52
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	167,669,283.93
ANALYSIS OF CASH & CASH EQUIVALENTS AT THE END OF THE YEAR	
CASH AT BANK	167,669,283.93
	167,669,283.93

Chairman

National Aquatic Resource Research and Development Agency

Report of the Auditor General on the Financial Statements and Other Legal and Regulatory Requirements of the National Aquatic Resource Research and Development Agency for the year ended 31 December 2020 in terms of Section 12 of the National Audit Act, No. 19 of 2018

1. Financial Statements

1.1 Qualified Opinion

The audit of the financial statements of the National Aquatic Resource Research and Development Agency for the year ended 31 December 2020 comprising the statement of financial position at 31 December 2020 and the statement of financial performance, statement of changes in equity and cash flow statement for the year then ended, and notes to the financial statements, including a summary of significant accounting policies, 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 provisions of the National Audit Act No. 19 of 2018 and Finance Act No. 38 of 1971. My report to Parliament in pursuance of provisions in Article 154 (6) of the Constitution will be tabled in due course.

In my opinion, except for the effects of the matters described in the basis for Qualified Opinion section of my report, the accompanying financial statements give a true and fair view of the financial position of the Agency as at 31 December 2020, and of its financial performance and its cash flows for the year then ended in accordance with Sri Lanka Public Sector Accounting Standards.

1.2 Basis for Qualified Opinion

- (a) Although, the agency had been rectified in the year under review the error of accounting Rs. 3,374,470, the purchased property, plants and equipment from the consulting services revenue as foreign grants in the previous year, the comparative information relating to corrections of previous years had not been provided in the financial statements according to paragraph 53 of Sri Lanka Public Sector Accounting Standards No. 03. Furthermore, Comparative Information related to the assets and liabilities in the projects and creditors, work in progress and debtors which stated in the notes of the financial statement had not been provided.
- (b) Although Income and Expenses should not be offset in terms of Section 48 of the Sri Lanka Public Sector Accounting Standards No. 01, Expenditure of Rs. 102,804 had been deducted from other income and the total debit balance of the project creditors of Rs. 432,448 had been similarly offset.
- (c) According to Sri Lanka Public Sector Accounting Standards No. 07, motor vehicles which were cost of Rs 99,663,068 and fully depreciated are still in use and those assets had not been disclosed in the financial statements. Also, the error in lifetime estimation of these assets had not been corrected and adjusted to the financial statements in accordance with the Sri Lanka Public Sector Accounting Standards No. 03.
- (d) Although it had been stated in the financial statements that the revenue of the service will be identified according to the status in completion of the service provided in accordance with paragraph 19 of the Public Sector Accounting Standards of Sri Lanka No. 10, Rs. 93,848,483 of Consultancy income received during the year under review had been accounted under Project Creditors and the expenses incurred had been deducted from Project Creditors. However, the revenue to be identified according to the level of completion of the projects had not been calculated and stated in the financial statements.
- (e) According to the agency's depreciation policy, vehicles are required to depreciate by 20 per cent, A sum of Rs. 6,707,000 for provision of depreciation related to 05 motor vehicles that were purchased at cost of Rs. 33,535,000 as at 15 March 2016, had not been adjusted to the financial statements for the year under review. Also, Rs. 1,676,750

from the value of motor vehicle in the year under review had been mentioned less in the financial statements.

- (f) No action had been taken to vest the ownership of 02 lands of 3.416 hectares and 1.025 hectares located respectively in Panapitiya and Kapparithota used by the Agency and to assess and account the value of lands. Even though the value of lands in Rekawa and Kalpitiya had been stated as Rs. 268,750,000 in the financial statements, actions had not been taken to vest the ownership of those lands.
- (g) Even though the value of a motor vehicle worth of Rs. 9,390,000 received as a grant to the Agency in the year 2014 had been accounted to the Treasury Grants Accounts as an adjustment to the previous year, the value of amortization of this vehicle had not been adjusted to the Treasury Grants Accounts. As a result, government grants for the year under review had been higher by this amount.
- (h) Rs. 2,500,157 previous year adjustments, which did not affect the cash flow generated by the operations, had been adjusted to the cash flow statement and the amount of Rs. 2,230,389 which invested in the purchase of fixed assets in the year 2020 had been less stated in the cash flow statement. Also, the building construction advance of Rs. 6,351,443 had been adjusted to the cash flow statement twice under working capital changes and investment activities.
- (i) 5 per cent of the consulting services net receipts Rs. 2,630,159 which credited to the Own Income Medical Scheme fund account, had been presented under other creditors in the financial statements instead of Fund.
- (j) Annual Depreciation for Fixed Assets is Rs. 110,908,171 but the accuracy of the depreciation expense stated in the financial statements could not be verified during the audit due to non-submission of depreciation calculations for the fixed asset type. Also, Due to non-submission of utility documents pertaining to 3 work in progress items amounting to 8,928,589 stated in the financial statements, the accuracy of those balances could not be satisfactorily monitored during the audit.

(k) Although a difference of 16,263,138 was observed between the value of the 09 items of assets stated in the financial statements and the corresponding values in the financial statements, those changes had not been explained to the audit.

I conducted my audit in accordance with Sri Lanka Auditing Standards (SLAuSs). My responsibilities, under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of my report. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my qualified opinion.

1.3 Other information included in 2020 Annual Report of the Agency

The other information means the information included in the Annual Report for the year 2020 of the Agency, which is expected to be released after the date of this audit report, but is not included in the financial statements and my audit report. Management is responsible for other information.

I do not cover other information in my opinion regarding financial statements and I do not express any kind of assurance or opinion about it.

My responsibility in relation to audit of financial statements, is to read the other information identified above when available and to consider whether other information is quantitatively inconsistent with my knowledge of the financial statements or obtained during the audit or otherwise.

If I conclude that this other information is quantitatively incorrect based on the other information I received prior to the day of this audit report and the work I have done, I will need to report that fact. I have nothing to report on this.

1.4 Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of financial statements that give a true and fair view in accordance with Sri Lanka Public Sector Accounting Standards, and for such internal control as management determine is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Agency's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Agency or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Agency's financial reporting process.

As per Sub Section 16(1) of the National Audit Act No. 19 of 2018, the Agency is required to maintain proper books and records of all its income, expenditure, assets and liabilities, to enable annual and periodic financial statements to be prepared of the Agency.

1.5 Auditor's Responsibilities for the Audit of the Financial Statements

My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Sri Lanka Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with Sri Lanka Auditing Standards, I exercise professional judgment and maintain professional scepticism throughout the audit. I also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit 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.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the management.
- Conclude on the appropriateness of the management's use of the going concern basis of accounting and based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Agency's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. My conclusions are based on the audit evidence obtained up to the date of my auditor's report. However, future events or conditions may cause the Agency to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

I communicate with those charged with governance regarding, among other matters, significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

2. Report on Other Legal and Regulatory Requirements

2.1 National Audit Act, No. 19 of 2018 includes specific provisions for following requirements.

2.1.1 Except for the effect of the matters described in the Basis for Qualified Opinion, I have obtained all the information and explanation that required for the audit and as far as appears from my examination, proper accounting records have been kept by the Agency as per the requirement of section 12 (a) of the National Audit Act, No. 19 of 2018.

2.1.2 The financial statements presented is consistent with the preceding year as per the requirement of section 6 (1) (d) (iii) of the National Audit Act, No. 19 of 2018.

2.1.3 The financial statements presented includes all the recommendations by me in the previous year as per the requirement of section 6 (1) (d) (iv) of the National Audit Act, No. 19 of 2018.

2.2 Nothing caught my attention to make the following statements, in restricting the action taken and the evidence obtained and quantitative facts.

2.2.1 To state that any member of the governing body of the Agency has any direct or indirect interest in any contract entered into by the Agency which is out of the normal cause of business as per the requirement of section 12 (d) of the National Audit Act, No. 19 of 2018.

2.2.2 To state that the Agency has not complied with any applicable written law, general and special directions issued by the governing body of the Agency as per the requirement of section 12 (f) of the National Audit Act, No. 19 of 2018 except for following observations.

Reference to law, rules, direction	Description
(a) Financial Regulation of the Democratic Socialist Republic of Sri Lanka	
(i) Financial Regulation 384(3)	No action had been taken to maintain a formal register for every check books received.
(ii) Financial Regulation 395	The statement of bank reconciliation for previous month had to be prepared on or before 15th of the next month and certified by the relevant payment officer and should submitted to the Auditor General for review, but no action had been taken in this regard by the agency.
(iii) Financial Regulation 570 & 571	No action had been taken to account Rs. 1,312,000 the tender deposit from the year 2014 to the year 2018 as revenue.
(b) Public Administration Circulars No. 30/2016 and dated 29th December 2016	
(i) 3.1 Paragraph	Even though consumption of fuel must be tested on existing vehicles in government agencies, Fuel consumption tests had not been carried out on 25 vehicles owned by the agency.
(ii) 3.3 paragraph	Vehicle records including vehicle registration number, number of liters burned, distance traveled, and distance

traveled per liter and repair fees had not been maintained.

(iii) 4.3 Paragraph

The spare parts removed from the vehicle at the repairing should be handed over to the warehouse along with the relevant bill but the spare parts had not been handed over to the warehouse along with the bill.

2.2.3 To state that the Agency has not performed according to its powers, functions and duties as per the requirement of section 12 (g) of the National Audit Act, No. 19 of 2018 except for following observation.

(a) According to the section 34 of the National Aquatic Resources Research and Development Agency Act No. 54 of 1981, the Director General had not maintained a register that contain data, reports and details obtained in relation to the researches, studies, tests, experiments and other investigations and explorations and findings conducted by the Agency.

(b) According to the National Aquatic Resources Research and Development Agency Act No. 54 of 1981 and Section 18 of the Amended Act No. 32 of 1996, although a scientific and technical committee should be appointed, new members had not been appointed to the Scientific and Technical Evaluation Committee which remained in inactive position.

2.2.4 To state that the resources of the Agency had not been procured and utilized economically, efficiently and effectively within the time frames and in compliance with the applicable laws as per the requirement of section 12 (h) of the National Audit Act, No. 19 of 2018.

2.3 Other Audit Observations

- (a) The project cost of Rs. 3.90 million had been non-performing due to the completely cessation of the installation of Fisheries Aggregating Devices (FADs) and Fisheries Enhancement Devices (FEDs) to enhance fish production in coastal water in 2020.
- (b) 27 projects worth Rs. 20,420,827 which were included in the project creditors list have been inactive for 4-7 years but no action had been taken to look into those projects and settle the relevant liabilities. Also the audit could not confirm that project reports had been duly submitted to the relevant client related to 54 projects valued at Rs. 70,554,695 as per project schedule and tender deposit documents.
- (c) According to the recruitment procedure approved by the Department of Management Services for the post of Director Finance, an officer who has not completed the basic qualifications had been recruited for the post of Director Finance and sum of salary and allowance of Rs. 7,666,842 had been paid from May 2017 to 31 December 2020. No action had been taken to rectify though this had been pointed out in the previous two years.
- (d) In a land which has not been duly acquired by the Agency, a fish stall had been built in Beruwala area by incurring Rs. 15,245,000 in the year 2014 contrary to the objectives of the Agency and this stall had been remained inactive until the end of 2021.
- (e) Even though 02 high powered boat engines were purchased in the year 2011 for Rs. 4,493,052 for production of two boats and Rs. 2,902,938 had been spent additionally thereon after commencing the construction works of 02 boats. The two engines and unfinished 02 boats had kept idle in the storage until the end of 2021.
- (f) Even though Rs. 1,612,898 had been over paid to an outside institute for the preparation of a feasibility study report for the development of 06 fishery harbours, action had not been taken to recover it for a period more than 07 years and no legal actions had been taken against those officers after identifying the officers who responsible for over payment.

- (g) As per the decisions of the Cabinet of Ministers No: 17/2512/725/032 and dated 14 November 2017, arrears and surcharges Rs. 39.93 million which paid by the General Treasury for provident fund had not been paid to the Consolidated Fund from the earnings of the agency.
- (h) An amount of Rs. 8,338,757 had been paid from self-generated income during the year under review for the medical leave saved by the officers and the approval of the general Treasury had not been obtained even though the approval of the Board of Directors had been obtained to pay the allowances.
- (i) The accuracy of the amortization calculations for the year under review could not be ascertained due to the non-availability of local and foreign grants for Rs. 40,269,931 additions of purchased asset during the year under review.

W.P.C. Wickramaratne
Auditor General

ACTIONS TAKEN WITH REGARD TO THE MATTERS POINTED OUT BY THE AUDITOR GENERAL AS PER THE SECTION 12 OF THE NATIONAL AUDIT ACT NO. 19 OF 2018 ON FINANCIAL STATEMENTS AND OTHER LEGAL AND REGULATORY REQUIREMENTS FOR THE YEAR ENDING BY 31ST DECEMBER 2020 OF THE NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY.

1.2 Foundation for the Statistical Opinion

MATTER		ACTIONS TAKEN
a	Although the fault of crediting an amount of Rs. 3,374,470/= as foreign receivables out of the income of the consulting services, which was the value of property and equipment purchased by the Agency last year from the consultancy services income, has been corrected during the reviewed year as per the Section 53 of Sri Lanka State Sector Accounting Standards No. 03, comparative information related to previous year corrections was not provided in the financial statements. Further, comparative information of previous years related to assets and liabilities of projects and other creditors, ongoing work, debtors was also not provided.	Although comparative data for previous years have been shown in the revenue and expenditure statements and balance sheet of the financial statements of 2020, as pointed out in the audit, comparative data of previous years with respect to previous year corrections and notes will be presented from the preparation of accounts for the year 2021.
b	As per the Section 48 of Sri Lanka State Sector Accounting Standards No. 01, income and expenses should not be offset. But, an expenditure of Rs. 102,804/= was deducted from other incomes and the total debit balance of Rs. 432,448/= of the project creditors has also been offset.	The shortcomings pointed out are acknowledged and ensure that this situation will be avoided in future financial statements.
c	As per the Sri Lanka State Sector Accounting Standards No. 7, motor vehicles with total depreciation cost of Rs. 99,663,068/= are still using and those assets have not been revealed in the financial statements. Further, actions have not been taken to adjust the estimated shortfalls regarding effective lifespan of aforesaid assets in the Financial Statements after revising according to the Sri Lanka State Sector Accounting Standards No. 3.	Relevant disclosures that are pointed out will be included when preparing future financial statements. Further, action will also be taken to correct the estimated shortfall of effective lifespan.
d	As per the Section 19 of Sri Lanka State Sector Accounting Standards No. 10, although it is stated in the financial statements that the revenue of the service transaction will be identified according to the completion of the service provided, consultancy income of Rs. 93,848,483/= received during the reviewed year had been deducted from the project creditors and expenses incurred were deducted from the project creditors. However, the income that should be identified by the level of completion of the projects was not calculated and stated in the financial statements.	When preparing future financial statements, action will be taken to make necessary adjustments and correct this accounting shortcoming.
e	According to the Institute's depreciation policy, vehicles should be depreciated by 20% each. But, allocation of depreciation of Rs. 6,707,000/= for 05 motor vehicles which cost Rs. 33,535,000/= and bought on March 15, 2016 was not	When preparing financial statements relevant for the year 2021, steps will be taken to rectify after making

	matched in the financial statement. Hence, the deficiency in the reviewed year was depicted less than that amount. Further, value of motor vehicles in the reviewed year was depicted Rs. 1,676,750/= less in value.	depreciation and deficiency adjustments relevant for previous years.
f	In order to take over the ownership, no action had been taken to assess and account the values of two lands of 3,416 hectares and 1.025 hectares and located at Panapitiya and Kapparatota respectively and used by the Agency. Further, no action had been taken to take over the ownership of lands depicted the values in the financial statement as Rs. 268,750,000/= and located at Rekawa and Kalpitiya areas.	Relevant assessments should be done for Panapitiya and Kapparatota lands. Transfer of Rekawa and Kalpitiya lands is in progress.
g	The motor vehicle valued Rs. 9,390,000/= and received as a gift in 2014 and had not been accounted was adjusted to the Treasury Grant Account as an adjustment to the previous year. But, amortization had not adjusted the value of that vehicle to the Treasury Grant Account. As a result, government grants for the reviewed year were higher in the financial statements.	Action will be taken to make appropriate adjustments and corrections regarding amortization when preparing financial statements for the year 2021.
h	Rs. 2,500,157/= generated from operations which are not affected by the previous year adjustments had been adjusted to the cash flow statement. And, the amount invested to purchase fixed assets in 2020 was stated Rs. 2,230,389/= less in the cash flow statement. Further, an amount of Rs. 6,351,443/= which was paid as construction advance was adjusted twice to the cash flow statement under investment activities and working capital.	Attention will be paid in this regard and steps will be taken to prevent such shortcomings.
i	Rs. 2,630,159/=: which was credited 5% of the net income of the consulting services of the institution to the Own Income Medical Scheme fund account, had been stated in the financial statements under other creditors instead of being expressed as funds in the financial statements.	This will be stated as Medical Funds in the Accounting Statements in 2021.
j	Although annual depreciation value of fixed assets had been accounted as Rs. 110,908,171/=: due to not stating depreciation calculations for asset types in the auditor, the accuracy of the depreciation expense stated in the financial statements could not be verified during the audit. Also, as a result of non-submission of utility documents pertaining to 03 ongoing work items amounting Rs. 8,928,589/= mentioned in the financial statements, the accuracy of those balances could not be satisfactorily monitored during the audit.	Arrangements will be made to provide the auditor with all supporting documents related to the factors represented in the financial statements.
k	Although a difference of Rs.16,263,138/= was observed between the value of 09 items in the financial statements and the corresponding values in the financial statements, those differences were not explained to the audit.	Since the given explanations were not quantitative, action will be taken to provide a detailed explanation.

2.2.2 Reference to Laws & Regulations / Orders

(a) Financial Regulations of the Democratic Socialist Republic of Sri Lanka

Description		Actions Taken
(I)	According to 384 (3) Although a formal record has to be maintained of each check book received, this was not done.	Steps have been taken to maintain a formal record in this regard.
(II)	According to 395 The previous month's bank reconciliation statement had to be prepared before the 15th of the next month, certified by the payroll officer and referred to the Auditor General for verification, but the Agency had not done so.	Action will be taken to rectify this shortcoming and submit the relevant documents to the Auditor General.
(III)	570 and 571 No action had been taken to get the tender deposit of Rs. 1,312,000/= from 2014 to 2018 to revenue.	Actions have been taken to get this amount for revenue in the year 2021.

2.2.3. According to the requirement mentioned in Section 12 (g) of National Audit Act No. 19 of 2018, the powers of the Agency have acted in a manner inconsistent with the functions except below mentioned observations

Description		Actions Taken
a	A document including data, repots and details obtained from the research, experiments, other investigation, explorations and findings conducted by the National Aquatic Resources Research and Development Agency under the Section 34 of NARA Act No. 54 of 1981 has not been maintained by the Director General.	The Director General has taken necessary steps to maintain records of explorations and findings in accordance with the Section 34 of NARA Act of 1981. Accordingly, that register has been maintained under the library with effect from 1994.
b	Although a scientific or technical committee should be appointed as per the NARA Act No. 54 of 1981 and Section 18 of revised Act No. 32 of 1996, no new members had been appointed to the currently inactive Scientific and Technical Evaluation Committee.	The Scientific and Technical Committee will be operational from December 2020.

2.3 Other Facts

Description		Actions Taken
a	The amount of Rs. 3.90 million spent on the project had been an inactive expenditure due to the complete cessation of the Fish Assembling Installations (FADs) and Fish Enhancement Installations (FEDs) by 2020 to enhance fish production in coastal waters.	Following the success of this research and its recommendations, the Department of Fisheries has set up Fish Assembling Installations (FADs) in Trincomalee and Galle Seas using dilapidated buses and boats. The research has been completed on that.
b	The 27 projects valued Rs. 20,420,827/= included in the project credit balance list have been inactive for 4-7 years, but no action has been taken to look into those projects and settle the relevant liabilities. Also, according to the project schedule and tender deposit list, project reports for 54 projects valued Rs. 70,554,695/= could not be verified during the audit submitted to the relevant client.	Relevant project officers will be informed and necessary action will be taken to settle inactive projects. In the future, action will be taken to obtain a certificate that the service has been performed properly.
c	An officer, who had not fulfilled the basic qualifications as per the recruitment procedure approved by the Department of Management Services for the post of Director Finance, was recruited for the post of Director Finance and a total payment of Rs. 7,666,842/= from May 2017 to December 31, 2020 has been paid. Although this had been pointed out in the previous two years, no action had been taken to rectify it.	Will act according to Governing Board decisions.
d	Contrary to the objectives of the agency, a fish market was built in 2014 on a land not formally transferred to the Agency in Beruwala while spending Rs. 15,245,000/=-, and that fish market remained inactive until the end of 2021.	As per the instructions given by the State Minister at the Ministry Review Meeting held on February 22, 2022, actions will be taken to hand over this to a suitable party after calling bids. Necessary steps are being taken to acquire the land.
e	For the production of two boats, two high powered boat engines were purchased in 2011 at a cost of Rs. 4,493,052/= and commenced the production of two boats and an additional Rs. 2,902,938/= had been spent for that. However, the two engines and two uncompleted boats remained in stores until the end of 2021.	Regarding buying the two boat engines, with the approval of the Parliamentary Committee on Accounts and the recommendations made at the meeting of the Audit and Management Committee of the Ministry, the Sri Lanka Navy has been invited to procure these two boat engines. Also, necessary actions will be taken in the future regarding uncompleted two boats after submitting to the Audit and Management

		Committee Meeting.
f	Although an overpayment of Rs. 1,612,898/= has been made to an external institute on behalf of preparing a feasibility study report for the development of six harbours, no action has been taken to recover it for over 07 years and to identify the officers responsible for the overpayment and to take legal actions against them.	Board of Directors has approved to write regarding the amount that should be recovered for the feasibility study conducted for 06 harbours and further action in this regard is being taken on the instructions given at the meeting of the Audit and Management Committee of the Ministry.
g	As per the Cabinet decision No. 17/2512/725/032 and dated November 14, 2017, no action had been taken to settle the arrears of Rs. 39.93 million of contribution arrears and surcharge, which paid by the General Treasury to the Provident Fund, from the earnings of the Institution to the Consolidated Fund.	Measures were taken to inform the Board of Directors in this regard and will act in accordance with the decisions taken by the Board of Directors in future.
h	An amount of Rs. 8,338,757/= had been paid from self-generated income in the reviewed year for the medical leave saved by the officers and although only the approval of the Board of Directors was obtained to pay the allowances, the approval of the Treasury was not obtained.	Necessary documents have already been sent to the General Treasury to obtain the approval in this regard as per the explanations of this audit.
i	The accuracy of the amortization calculations for the reviewed year could not be confirmed due to non-submission of local and foreign grants related to the total of assets of Rs.40,269,931/= purchased during the reviewed year.	Action will be taken in the future to rectify the shortcomings pointed out here.

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Prof. M. J. S. Wijayarathne
Chairman