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NATIONAL AQUATIC RESOURCES RESEARCH AND DEVELOPMENT AGENCY

Crow Island, Mattakkuliya

Colombo –15

CONTENTS

MARINE BIOLOGICAL RESOURCES DIVISION

Programme1: Assessment and Management of Fisheries Resources

Project 1.1: Assessment and Management of Large Pelagic Fisheries Resources.

This project targets to identify the trends of the fishery and to estimate the production.

- The large pelagic production shows an increasing trend over the last six years. The following are some observations are appeared below respective total production for the years 1995, 96, 97, 98 and 99 and 2000 were 76112 mt, 85050 mt, 113697 mt, 11405 mt, 122036 mt and 144534.
- The large pelagic production in 2000 is about a two fold increase of that of 1995.
- This increasing trend has been a result of increased offshore and deep-sea fish production annually. However, in the coastal sector, the production has shown a marked decline through the period 1995 - 2000.
- The offshore production increase in 1999 is over two fold of the production of 1995 while the production decrement of the coastal sector in the same year is one third of the production of 1995.
- A rapid increase of tuna production in offshore sector was reported in 1999 and it was five fold of the 1995 production, but the coastal tuna production has declined by about a half fold during the same period.
- The trend of the billfish production in both the offshore and coastal sectors was increasing. The increment in offshore sector was 1.8 fold and that of in coastal sector was 1.3 fold for the period 1995 - 1999.
- The shark production was markedly declined in both sectors for the same period. The decrement in the offshore sector was 0.8 fold and in the coastal sector that was 0.08 fold.
- The tuna species constituted 69% of the total large pelagic production. The representations made by billfishes, sharks, rays, seer-fishes and other bony fish were 13%, 10%, 3%, 1% and 4% respectively.
- Among the tunas, skipjack and yellow-fin made 62% and 32% of the total tuna production.
- Silky shark, *Carcharhinus falciformis* was the dominant species among sharks and it contributed 61% of the total shark production. The second dominant group of shark was thresher sharks. Their contribution was 12%.
- The total number of craft engage in this fishery was 2634 and 64% of it was multi-day fishing vessels. The maximum number of craft (686) was reported from the Western zone and the minimum (239) reported from the north-eastern zone.

Achievement – 90%

Project 1.2: Assessment and Management of Small Pelagic Fishery

Monitoring of small pelagic fishery is a continuing process with the development of a proper data collecting procedure introduced under the TCP programme since 1996. Information on catch, effort, species composition and length frequency data of economically important species were collected by research assistants and 12 data collectors appointed Negombo, Beruwala, Matara, Tangalle, Oluwil and Trincomalee. Data were fed in to Excel work sheets and analyzed manually.

Presently a large number of fishing gear/craft combination has been reported and has created problems in managing the resources. Continuous monitoring is therefore, essential to address these issues. This project helps to check on the trend and any harmful effects on the resource and resource utilisation.

- Catch effort statistics and length data were collected from Chilaw, Negombo, Kalutara, Galle, Matara, tangalle and Trincomalee throughout 2000. The catch data from all areas and all craft gear combinations for the whole year have been incorporated in the database. The production estimates show that Negombo has produced 11311 MT,. Which is half of production from last year. Although the production at Negombo has decreased, the total production from other areas has increased from about 600MT during the year 2000.

- The mean catch per unit effort (CPUE) at Negombo, Kalutara, Matara, Tangalle and Trincomalee were 60.15, 34.3, 22.2, 20.2 and 19.8 respectively. The average CPUE for whole areas has been around 31.82 kg per boat trip indicating a gradual reduction in the CPUE values of the FRP boats from 1998 onwards.

- A study of reproductive status of fish in beach seines at Beruwala was carried out during year 2000. According to the analysis some areas around Beruwala were identified as spawning areas of *Stolephorus heterolobus*.

- Preliminary studies on squid fishery were initiated and data collection is carried out covering the area from Kalpitiya to Hambantota. Preparation of lab exhibits and preparation of field identification keys are in progress.

Achievement – 100%

Project 1.3: Assessment and Management of the Shrimp Fishery in the West Coast of Sri Lanka

During the present investigation the focus has been on to study the fishing activities targeting shrimp resources in the Negombo lagoon and the associated coastal eco-system in the West Coast of Sri Lanka. The fisheries in the system were multi-gear and multi-species. There was an expanding year-round fishery for shrimps in the lagoon and the associated coastal eco-system. There were 4 major fishing gears, trammel net, drag net, brush piles, cast nets used within the lagoon and 1 gear at the mouth (stake-seine net) targeting shrimps, to exploit especially the juveniles and pre-adults of shrimps in the lagoon. In addition the adults were exploited in the off shore areas by trawling.

The prime objective of the present investigation was to conduct a comprehensive analysis in view of evaluation of the biological and economic aspects of the shrimp fishing activities taken place in the Negombo lagoon and the associated coastal eco-system.

The annual catch from all gears was determined as 2258 t. This was comprised of 883 t of shrimps and 1375 t of others (mostly others). The contribution from lagoon was 613 t of shrimp and 1136 t of others. The single most productive gear was the trammel nets. These produced 304 t of shrimps (mostly Penaeus indicus) and 1044 t of others. The production from the trawlers operated outside the lagoon was 270 t of shrimps and 239 t of others.

The estimated total annual fishing effort (number of fishing operations of all gear) for the study period was 132,222. The proportional distribution of the annual fishing effort in the Negombo lagoon indicated that in 2001 around 85,000 fishing efforts i.e. around 64% of the total effort was by trammel nets. The other major contributor was brush piles with 27,268 fishing efforts. This was around 20% of the total number of fishing operations conducted inside the lagoon environment. In general the periods February to May and August to October/November could be considered as the peak periods in terms of fishing effort.

The estimated total annual fishing effort of the trawl fishery for the study period was 31,080 fishing efforts (total number of fishing operations). Contribution of non-mechanized trawlers to the annual fishing effort of the shrimp trawl fishery was 62% with 19,296 fishing operations. The fishing effort of mechanized trawlers was high during the period June-July to October-November. On the other hand for non-mechanized trawlers from February to May and September to November/December could be considered as the peak periods in terms of effort.

Achievement – 90%

Project 1.4: Monitoring of lagoon fisheries in the western and southern coasts of Sri Lanka.

The Negombo lagoon fishery comprised of about 25 fishing methods, 1200 crafts, 10,000 fishermen and 66 big and small landing sites. Trammel netting for fish and prawns is the dominant fishery in the entire lagoon. The annual shrimp and fish production from the lagoon is about 800 t and 1750 t respectively.

The estimated annual fish production from Mawella lagoon is 2500 kg which is mainly comprised of freshwater fish species. Sea born shrimp species and fish species are not found in the catches due to the low salinity of the lagoon. The *Oreochromis* species caught in the lagoon have shown a stunted growth, this may be due to the thick growth of the aquatic plant *Najas marina* in the water body. This weed also distrusts the fishing operations in the lagoon. Low level of salinity and spreading of *Najas marina* in large quantities disrupts the ecological balance and fisheries of the lagoon. Several management recommendations were suggested to improve the quality of the lagoon (HICZMP report).

The estimated average monthly fish production of the Kalametiya/Lunama lagoon system is 500 kg. As other southern lagoons this lagoon system exhibits fresh water conditions except the area near the mouth. This is due to high flow of fresh water from the upstream area and closure of the lagoon mouth during March to December. The lagoon fishery is significantly low, there are only 5-8 gill nets operate in the inner part of the Kalametiya lagoon. 4 pocket nets and 5 cast nets operate immediately inside the lagoon mouth during Jan- Feb. for migratory species. Fisheries at Lunama lagoon is limited to 6-8 crafts which are operated for fresh water fishes. Most parts of the lagoon is highly silted and covered with aquatic plants.

Achievement – 90%

Programme 2: Coral Reef Research for Conservation and Management

Project 2.1: Monitoring the abundance of protected marine species

Field work was carried out at nine locations to determine the abundance of protected and restricted species of fish, soft corals and gorgonians in Sri Lanka with a view to make recommendations for retaining these species in the list of protected and restricted organisms.

Several reef sites were surveyed within each of the nine locations using 50 m belt transects according to methods specified in Wilkinson et al. 1997. In addition information on the distribution of individual species was collected by wide ranging underwater surveys. The nine survey locations were Bar Reef Marine sanctuary, kandakuliya, Negombo, Colombo, Hikkaduwa Nature Reserve, Rumassala, Uanwatuna, Kapparatota/Weligama Great Basses and Trincomalee.

Most shallow coral habitats within the depth range 0-5 m have not recovered after the coral bleaching event in 1998 except for a few isolated patches at Weligama and Rumassala. As a result several species of butterfly fish have shown a sharp decline in their abundance. The abundance of soft corals harvested for the ornamental fishery trade (*Dendronephthya* spp) was in relative low abundance in the areas where these species occur in former (prior to the ban on export) grounds off Colombo. There was also bleaching of *Dendronephthya* spp at this location. Reasons for bleaching are unknown. The abundance of Purple Gorgonians used in the trade was also found to be very low.

Achievement – 90%

Project 2.2: Survey of Coral Reefs and Conservation and Management of Coral Reefs in Marine Protected Areas

The survey locations were Bar Reef Marine Sanctuary, Kandakuliya, Negombo, Colombo, Hikkaduwa Nature Reserve, Rumassala,Unawatuna, Kapparatota/Weligama, Great Basses and Trincomalee. Surveys of benthic cover by corals and other sessile organisms such as sponges, soft corals, algae were determined using 50 m line intercept transects according to methodology specified in Wilkinson et. al. 1997.

Location	Depth (m)	Percentage of live corals
Bar Reef	0-8	<1
Colombo offshroe deep coral reef habitats	15-22	6.0
Negombo offshore deep coral reef habitats	15-22	14.4
Hikkaduwa Nature Reserve	0-4	7.0
Rumassala coral reef	0-5	19.6
Unawatuna coral reef	0-6	<1
Kapparatota/Weligama	0-4	28.0
Pigeon Island (Trincomalee)	0-5	40.0

Achievement – 90%

Project 2.3: Impact of Crown of Thorns Starfish of the recovery of bleached corals at the Bar Reef Marine Sanctuary

Fieldwork was severely restricted in the Bar Reef Marine sanctuary due to the prevailing security situation in the coastal waters off the northern section of the Kalpitiya peninsula and the Karativu Island. Therefore it was not possible to survey sufficiently large areas for quantitative assessments in the first quarter of year 2000, which is the season with favourable sea conditions.

However in the limited areas surveyed in the shallow coral reefs indicated that the Crown of Thorns starfish could be a significant problem for the recovery of corals. In patch reefs with an extent of about 450 sq.m. Approximately 10 adult starfish were recorded.

Achievement – 90%

Programme 3: Conservation and management of marine mammals and turtles

Project 3.1: Study on the variations of nesting frequencies, density and diversity of sea turtle fauna, along the South coastal belt of Sri Lanka and study on farming requirements of Loggerhead turtle.

This project was designed to establish a turtle nesting data collection programme for the Galle and Hambantota District. The frequencies, densities and the diversity of nesting were calculated based on the data provided by the data collectors. Numbers of loggerhead hatchlings were kept in captivity to get their growth increment data for one year period. These data could be used for farming and rehabilitation programmes. Some observations are appeared below.

- The five species of marine turtles (*Lepidochelys olivacea, Caretta caretta, Chelonia mydas, Eretmochelys imbricata* and *Demochelys coriacea*,) which are reported previously (Daraniyagala, 1952), are still being reported from the Southern beaches of Sri Lanka.

- All the nesting beaches are confined into the Galle and Hambantota District. 13 beaches (18.2 km) in Galle and 6 beaches (17.7 km) in Hambantota were identified as critical habitats in the conservation point of view.

- Six beaches of them are frequented by all 5 species. They are the only beaches of the world where five of the living turtle species are nested.

- The estimated nesting frequencies and densities for Galle and Hambantota Districts were 185 $month^{-1}$ and 110 km^{-1} $year^{-1}$ and 147 $month^{-1}$ and 140 km^{-1} $year^{-1}$ respectively.

- The stretch of beach between Bentara river mouth and Balapitiya court has been identified as the most suitable area for establishment of a turtle based eco-tourism programme coupled with a ex-situ conservation stratergies.

- The estimated mean annual number of nesting in the area was 4980. Out of them 62%, 20%, 11%, 5% and 2% were made by *Chelonia mydas, Lepidochelys olivacea, Demochelys coria, Eretmochelys imbricata* and *Caretta caretta* , respectively.

- The estimated annual egg production was 622,500. Out of them 65% was consumed by the people and 33% was sold to the hatcheries; as per estimations made.

- Annually the egg collectors earn about Rs. 1,966,800 (US$24,585) by selling eggs. The income generated by the hatcheries is about Rs. 27,244,960 (US$.340,562).
- The identified major threats for the survival of turtle fauna were the massive collection of eggs and the unscientific hatchery practices.

- Pilot project conducted to estimate the growth rate of Loggerhead turtle revealed that within two years a hatchling attains a size of 50 cm (curved carapace length). This size is recommended as the suitable size of juvenile to release back to the sea after a farming process / period of culturing.

Achievement – 95%

Project 3.2: Monitoring of offshore multi-day fishery through logbook information

Thirty two new log books were distributed among boats built under the new subsidy scheme. With this, a total of 397 books have been issued among multiday boat owners since 1997. The rate of submission of required returns was about 47% during this year. However, noticeable reduction in the number of returns submitted was observed over this year. This is primarily due to 26 boats who were submitting regular returns have been taken into custody due to violation or abundant after ferrying illegal refugees to east Europe countries.

Achievement – 90%

Seminars / Workshops Attended / Organized

- "Introduction and Demonstration of the Marine GIS to Conduct the Spatial Analysis for Fisheries and Oceanographic Data" - at NARA - 30th March 2000).

- "Capacity Enhancement of the Mundel lake and Dutch Canal System for sustainable multiple use" - Organized by NARA and Wayamba Development Project - (20th June 2000).

- "Remote sensing for forecasting of potential fishing zones", India - (16th - 29th January 2000).

- "Remote sensing and GIS for coastal zone management" Thailand - (6th - 17th November 2000).

- "Coral reef survey design, data analysis" - India (1st - 10th May 2000).

- 20th Annual Symposium on Sea Turtle Biology and Conservation, Orland Feb. - 4th March 2000.

- Arjan rasuriya, M.M.C. Karunaratne, P.A.T. Fernando participated in the training workshopon "Coral Reef Survey Design and data Analysis", Chennai, India, May 2000.

- Arjan Rajasuriya together with the Socioeconomic Division of NARA participated in the training course on "Socioeconomic Monitoring of Coral Reefs", Puttalam, Nov. 2000.

Extension Work

Delivered lecture in following schools

- "Marine Resources" - Joseph Vaz College, Wennappuwa - (10th Feb. 2000).

- "An introduction to marine life and related eco-systems" - Dharmaloka Maha Vidyalaya, Trincomalee (9th March 2000).

- "An introduction to marine Life" - Vidyaloka Maha Vidyalaya, Arawwala - (32rd June 2000).

- "Fish resources in Sri Lankan continental shelf" - Bandaranayake Madya Maha Vidyalaya, Weyangoda (19th September 2000).

- "Forecasting of Potential Fishing Zones (PFZ) using satellite derived information and it's applicability in Sri Lankan waters" at the NARA Auditorium (1st March 2000).

- 'Sagara Patulata Krathrima Nivahan' (A 20 minute video documentary on the introduction of Casita structures in the southern coastal waters and Kirinda). This documentary video film was edited and produced at the Open University.

- Leaflet in Sinhala language on the present status of coral reefs in Sri Lanka. Printed at NARA extension services.

Consultancies

- Investigation of sand burrow area for Colombo Katunayake Expressway Project. NARA, June 2000
- Investigation of sand burrow area for Colombo Katunayake Expressway Project.NARA, June 2000
- Report - Establishment of a coastal pollution monitoring programme for Hambantota Integrated Coastal Zone Management Project (HICZMP)

Meetings Attended

- Arjan Rajasuriya, M.M.C. Karunaratne and S. Vidanage participated at the 9th International Coral Reef Symposium, Bali Oct. 2000.

Other Activities

- Participating at the final phase of the postgraduate study programme (Ph.D) at the Dept. of Biological Sciences of the University of Stirling, United Kingdom since September 2000 to date.
- Tentative title of the thesis: Fishery biology and population dynamics of shrimps of *Penaeus indicus* and *Metapenaeus dobsoni* in the Negombo lagoon and the associated coastal area of the west coast of Sri Lanka.

- Currently participating in field work under the project of coral reef degradation in the Indian Ocean (CORDIO) which comes under the coral reef monitoring programme (Since January 2000).
- A report with the recommendations for employing an additional beach seine to the Ambalpola beach seine landing centre was submitted to the Department of Fisheries.
- Rumassala reef survey for the Development of Galle Harbour
- Investigations regarding removal of black corals by divers at Kirinda (Report to Chairman and DG, NARA).
- Response to the newspaper article on the fish feeding at the Hikkaduwa Marine Sanctuary (Report to Chairman, NARA).

Publications

- M. Sanders, A. Jayawardane and S. Ediriweera (2000). Preliminary assessment for the shrimp fisheries of the Negombo lagoon (Sri Lanka). FAO Fisheries Circular 958. FAO, Rome. 98p
- P. A. A. T. Jayawardane and D. S. Jayakody (2000). Observations on the artisanal prawn fishery in the shallow coastal waters off Chilaw during 1994-1995. Journal of National Science Council of Sri Lanka 28 (1): 17-27.
- Fernando P.A.T. and P.R.T. Cumaranatunga (1998). Status of the beach seine fishery in the Hambantota district. The Journal of the National Aquatic Resources Agency Sri Lanka 1998.
- Karunasinghe W.P.N., Fernando P.A.T. and E.K.V. Samaraweera (1998). Status of the gill net fishery for the small pelagic fish species around Sri Lankan coastal waters during 1995 - 1997. The Journal of the National Aquatic Resources Agency Sri Lanka 1998 (36:00).
- Fernando P.A.T. (2000). Small meshed gillnet fishery in the southern coastal waters of Sri Lanka during mid 90's. Abstract of the paper presented at the sixth SLAFAR sessions - 20th July 2000.
- Amarasooriya, D & Jayathilaka M. (2000), Marine Turtle Nesting on the Beaches of the Northwestern, Western and Southern Provinces of Sri Lanka. 20th Annual Symposium on Sea Turtle Biology and Conservation, Orlando, Florida, USA 29th Feb. - 4th March 2000.
  A colored field guide for the identification of sea turtles was published (Sea turtles of Sri Lanka).
  A hand out in Sinhala (samuganna hithwathun) was published.
  A displayed poster was setup at the MBRD named Sea Turtle fauna of Sri Lanka
- Amarasooriya, D. (2000), Large Pelagic Fisheries Statistics of 1999 with a comparison of 1995 to 1999 statistics.
- Contributions made to prepare the proposed SAM plan report for Mawella Lagoon and Kudawella Blow Hole area and the surroundings by Prof. K N J Katupotha.
- Rajasuriya, A., Zahir, H., Muley., E.V., Subramanian, B.R., Venkataraman, K., Wafar, M.V.M., Khan, Munjurul S.M. and Whittingham, E. 2000. Status of coral reefs in South Asia.
- Rajasuriya, A. and De Silva, M.W.R.N. 2000. Marine Protected Areas and Conservation of Coral Reef, the Sri Lankan Experience.
- De Silva, M.W.R.N. and Rajasuriya, A. 2000. A new threat to the Coral Reefs of Hikkaduwa Nature Reserve, Sri Lanka.
- Wood, E.M. and Rajasuriya, A. 2000. Assessing the Status of Ornamental Fish and Invertebrates in Sri Lanka: A dual Approach Using Underwater Surveys and Collectors' knowledge.
- Christoffelsz, A., Fernando, M. and Rajasuriya, A. 2000. REEF CHECK 9, A New Threat to the Pigeon Islands, Corals? Sri Lanka Nature, march 2000. Pp. 18-23.
- Rajasuriya, A. Zahir, H., Muley, E.V., Subramanium, B.R. Venkataraman, K., Wafar, M.V.M., Khan, Munjurul S.M. and Whittingham, E. 2000. Status of coral reefs in South Asia: Bangladesh, India, Maldives and Sri Lanka. In C. Wilkinson (ed) *Status of coral reefs of the world, 2000.* Australian Institute of marine Science.
- Rajasuriya, A. and Premaratne, A. 2000. Sri Lanka (Chapter 64). In Sheppard, C.R.C. 2000. *Seas at the Millenium.* Vol II. Elsvier Science. UK.

- Rajasuriya, A. and Karunarathna, M.M.C. 2000. Post bleaching status of coral reefs in Sri Lanka. In Souter, D., Obura, D. and Linden, O. 2000. *Coral Reef Degradation in the Indian Ocean: Status report 2000.* CORDIO/SAREC Marine Science, Sweden.

INLAND AQUATIC RESOURCES AND AQUACULTURE DIVISION

Programme1: Shrimp / Prawn Culture and Resources Management

Project 1.1: Health and Environment Management in Shrimp Farming Systems and Hatcheries

Shrimp culture industry in Sri Lanka has faced 3 major disease out-breaks in 1988/1989 and again in 1996 to 1998. The main pathogens responsible were MBV and WSV and YHV. During the 2nd out-break 90% of the farms became non functional. Sub-optimal water quality conditions and poor sediment environments were found responsible for out-breaks and their rapid spread. The present project was carried out to collect information necessary for health and environment management in shrimp culture systems for its sustainability.

SEMBV diseases out-break continued to occur and some of the monitored parameters in ponds were found in sub-optimal levels.

Although some of the farmers were informed on good management practices most of them failed to adhere to those during out-breaks.

Bacterial population was found in unfavorable levels.

Break-even points have been detected for farming activities during outbreaks.

Avifaunal population during out-breaks of disease indicated considerable influence on the spread of the disease.

Achievement - 85%

Project 1.2: Determination of the factors affecting survival level of giant fresh-water prawn *Macro brachium Rosenberg ii* and economic feasibility of its culture.

Freshwater prawn has been identified as a potential species for aquaculture by the National Fisheries Development plan for 1995-2000. There is a considerable amount of resource potential for the development of its culture in the country. The project has investigated the factors affecting the survival rate during larval phase to find out the economic feasibility of culture. Further, availability of brood stock of *Macro brachium* sp. in different areas was investigated.

Brood stock survey conducted in the southern province indicated that adult *Macrobrachium Rosenbergii* are present in Kalametiya Lagoon, Udukiriwila Tank and Madu Ganga. *Macrobrachium malcomsonii* and *Macrobrachium rude* were also recorded from these areas. Fishery for *Macrobrachium rude* exists in the lower reaches of Nilwala Ganga and Kalametiya Lagoon. There is no fishery for other species although they were caught rarely with *M. rude*.

Food type and feeding strategy were identified as the major factors deciding the survival rate of *M. rosenbergii* larvae. Feeding with live feed at night was found to be quite important and was difficult to control due to limitation of overtime for workers. Deterioration of water quality due to overfeeding, lack of aeration due to power failures also affected the survival rate of larvae. Locality of the mother prawn was also a minor factor affecting larval survival as the mother prawns from several locations were infected with bacteria.

Use of insecticides for catching *Macrobrachium rosenbergii* and *Macrobrachium malcolmsonii* was observed in Yan Oya area. This practice is detrimental to the resources and has to be stopped in order to conserve the resources in the area.

Achievement - 100%

Project 1.3: Evaluation of grow-out conditions in different water management systems with special reference to health of shrimps.

The present shrimp culture industry practices different water management systems to reduce the risk of diseases. Despite these water management systems disease occur frequently in grow-out ponds. The present project was carried out to understand the occurrence of diseases and the relationship between the pond environment and pathogen. The information required to assess the effectiveness of different water management systems in improving the pond environment were collected.

The unionized 0.1 mg/l ammonia and dissolved oxygen 5.0 mg/l concentrations in closed system tend to exceed and fall below their water quality criteria, respectively, towards the latter part of the culture cycle indicating a drop in carrying capacity than that of semi-closed and open systems.

pH tends to exceed its water quality criteria during the third month of culture cycle in the closed system. This increases the ammonia toxicity in the pond and causes stress to shrimp.

The occurrence of disease condition in shrimps in closed system is higher than that of semi-closed and open systems.

Deterioration of water quality and occurrences of disease condition in closed systems are higher during the latter part of the culture cycle. Hence, close system may be successfully operated to grow small shrimp (18 - 20 gm) limiting its culture cycle for 90 days.

Achievement - 90%

Project 1.4: Screening of carrier species in the wild for SEMBV at different taxonomic levels

The commonly occurring other *Peneaid* shrimps in both the farms and water ways such as *P. merguiensis*, *P . indicus*, and *Metapeneaid* species such as *M. ensis, M. monoceros* are found to be carries of WSSV.

It has now been demonstrated that SEMBV can be present in post larvae and that this can be a significant route of infection of the disease to shrimp grow out ponds. Screening the broodstock and selecting quality post larvae for stocking can close this route of infection. Another potential route of SEMBV infection to the shrimp ponds is via carrier species. These species may be asymptotic or non-asymptotic. The possibility of this carrier species get infected and enter the production ponds was investigated. Screening of the potential carriers was performed both outside the farms and within the ponds.

Achievement - 85%

Project 1.5: Feasibility study on polyculture of *Penaeid* species in Low salinity water bodies in Sri Lanka.

Shrimp culture industry in Sri Lanka has faced 3 major disease out-breaks in 1986, 1988 and 1996. The main pathogens responsible were MBV, SEMBV and Yellow Head. During these out-break 50 - 90% farms become non-functional. Sub-optimal water quality conditions, poor sediment environments and destruction of natural habitats were food responsible for rapid spread of disease out-breaks.

In the Indo-Pacific region low salinity shrimp culture has been identified as one option to reduce the risk of White spot virus out-breaks. There are several adverse environmental impacts also identified in low salinity shrimp culture.

The present study investigated the feasibility of low salinity shrimp culture together with ploYculture and identified possible adverse impacts on the environment.

Based on the results of the experiments it is possible to acclimatize post larvae of *P. monodon* from 30% to 5% salinity level with high survival rate.

Culture of *P. monodon* with *C. carpio* could be implemented in this area. Average growth rate was observed as 20 g for *P. monodon* within 3 months while *C. carpio* reached to an average of 100 g within a period of 4 months.

Growth rate of *L rohita* was low compared with *C. carpio* in this environment.

However, further experiments should be carried-out to investigate the impact of surrounding environment before extending low salinity culture system to farm level.

Achievement - 100%

Programme 2: Ornamental Fish Culture

Project 2.1: Experimental ornamental fish culture in small inland water bodies in Southern and North Western Provinces with special reference to economical, technical and sociological aspects.

The ornamental fish industry in Sri Lanka presently depends on the exploitation of marine and fresh water fish from wild stocks with regards to local endemic fish species. Captive-bred fresh water fish also contribute in very proportions to this profitable export industry.

Attempt were made to make use of disused inland water bodies in Southern and North Western province areas in Sri Lanka, such lime pits, clay pits, seasonal reservoirs and village tanks to gain additional income for the rural communities.

Research findings:

A technology was developed to utilize abandoned clay pit resources by rearing commercially important ornamental fish species.
Floating net cages were developed to rear fish in clay pits.

It was found that following ornamental fish species could be cultured in clay pits by using floating net cages. Guppy, Platy, Molly, Angle, Carp, Gold fish

Survival of fish ranged form 26% to 82% . Survival of fish is depend on size of the fry stocked, quality of the fry, Mesh size of the cage material, feed and feeding frequency and management practices.

Achievement - 95%

Project 2.2: Identification of factors causing major diseases of economic significance in cultured guppy in Sri Lanka.

Guppy fish is the main stay in fresh water ornamental fish exports. In the recent past heavy production losses of guppy were reported from areas where ornamental fish culture is developed. It seems that one of the main reasons for frequent disease occurrences in guppy is due to improper water quality management. The project investigated the facts causing diseases in guppy fish in order to prevent disease occurrences.

The major diseases in guppies that cause significant economic losses are *Tetrahymenosis* infection, fin and body rot, *costiosis, Tricodinosis*, and Mouth fungus.

A leaflet has already been printed and distributed among the ornamental fish farmers on the identification and prevention methods of *Tetrahymenosis*.

Deterioration of water quality with regards to high ammonia, and nitrite concentration showed a strong positive relationship with the occurrence of fin and body rot, mouth fungus and stress gill condition.

Installation of small farmer-made bio filter units is recommended and being tested to prevent deterioration of water quality.

Inadequate aeration and water depths have aggravated the disease condition in grow-out tanks.

Preparation of a treatment guide is in progress for the ornamental fish farmers.

Achievement - 90%

Project 2.3: Experimental trials on propagation of commercially important plants in ornamental fish industry.

Although the ornamental fish trade has expanded in the export market, aquarium plant trade is not that popular in Sri Lanka. Some of the internationally popular aquarium plants which are endemic to Sri Lanka however, have been successfully propagated by aquarium plant traders abroad. Since Sri Lanka has many economically important aquarium plants species, promotion of culture and trade as a small scale cottage industry for the export market could be important as it could generate self employment as well as revenue. In this project propagation of some species of aquatic plants was investigated.

Several species of aquatic plants were used in propagation trials. However the necessary conditions for plant propagation could not be provided in the trials. Shading to provide the required amount of light for each species could not be performed the trials as the required facilities were not available in time.

Achievement - 50%

Project 2.4: Experimental out-grower system for determination of stocking densities and feeds suitable for culture of aquarium fish important in the export market.

The project investigated a suitable out-grower system for commercially important ornamental fish species. Experimental trials were carried out to determine the suitable stocking densities, feeding for out-grower system.

This project is not completed. Culture facility has been constructed to continue this project for the year 2001. It was found that following raw materials are available at the local market to formulate fish feed, to use for out-growing system.

Fish meal (Local and imported)
Rice bran
Soya meal
Corn flour
Vitamin & mineral mixture
Shrimp head meal
Cod liver oil

An experimental diet was formulated using above raw materials and feed preparation technology was disseminated through training programmes.
Machinery and equipment required for feed preparation have been identified and collected.

Achievement - 50%

Programme 3: Inland Aquaculture and Fisheries Management

Project 3.1: Potential productivity of seasonal tanks to enhance fish Production

Seasonal reservoirs are filled with water during inter-monsoonal rains in November-December each year and retain water for 6-10 months. The project investigated the possibility of using these water bodies for culture-based fisheries.

The studies on the potential productivity of seasonal tanks to enhance domestic fish production showed that the fish production of seasonal tanks is positively correlated to the chlorophyll content, conductivity and alkalinity of water. Hence, one or combination of more of these parameters can be used in determining the stocking densities of seasonal tanks. Data analysis is in progress to assess the potential productivity of selected seasonal tanks and determine the suitable stocking densities, suitable species for polyculture in seasonal tanks.

Achievement - 100%

Project 3.2: Rice fish culture integration with community participation in Sri Lanka

Fish species that spawn naturally could be stocked in fallow fields and collect fingerlings later. Rearing ornamental fish species in rice fields may provide supplemental income to farmers and it could be developed as income generating activity among "farming community". The project evaluated the feasibility of culturing food fish in rice fields to develop production of fish culture in wet zone and to supply cheap animal protein to rural community.

Tilapia fish could be used as pest controller. It shows 25 - 50% survival in paddy fields. Tilapia fingerlings (8 - 10 cm = L) could be used in this process.

The paddy fields close to the perennial tanks or seasonal tanks have great rice-fish farming potential as the reservoir could supply water in any time.

Rice -fish culture would be a successful operation in the dry zone only of Mahaweli water is supplied on daily basis.

Achievement - 95%

Project 3.3: Classification of lowland, perennial reservoirs of Sri Lanka based on fish production.

There is a high potential for the development of the inland fishery in Sri Lanka due to the extensive availability of ancient and recent perennial reservoirs. It has been estimated that in every km^2 of Sri Lanka, about 2.7 ha is covered by reservoirs. The inland fish production has reached its peak in 1980s and it that time, contribution of the inland fishery to total fish production was about 20%. However inland fish production has drastically declined from about 39 x 10^3 MT 1989 to 12 x 10 MT in 1994 due to lack of proper management strategies. The project attempted to define basic criteria for classification of reservoirs with the purpose of creating uniformity and helping to evolve common strategies for optimal utilization of the resource.

Capture per unit effort data were found to be significantly different between the reservoirs. Therefore production capacities can be reliably used as a criterion for classifying Sri Lankan reservoirs in order to treat them as separate fisheries management units.

Depending on the catch per unit effort, exploitation rate, catchments characteristics, reservoir morphometry and limnological characteristics attempts will be made to classify reservoirs using Bry-Curtis similarity analysis and Multidimensional scaling.

Achievement - 100%

Programme 4: Sea Farming

Project 4.1: Determination of factors affecting breeding, larval survival and fattening of mud crab (Scylla serrata).

The mud crab *Scylla serrata* is an important commercial commodity in Sri Lanka. Fattening mud crabs in captivity was found economically feasible of high according to the initial studies conducted by RRC at Kadolkele. Further investigations are required to find out the optimum conditions required for fattening mud crabs. Lack of adequate amounts of crabs for fattening is a hindrance to the further development of fattening technology as a commercial venture. The project intended to develop hatchery technology, simultaneously with the fattening process to ensure a consistent supply of crabs required for fattening.

Breeding and larval rearing part of the project was not carried out, as the hatchery building is still not completed. Findings on the brood stock survey and crab fattening are given below.

Two species of Genus *Scylla* were identified from the southern province. They were *Scylla serrata* and *Scylla loivaceous*. Another species was found in the Negombo Lagoon and is identified as *Scylla paramamosain*. *Scylla serrata* is the most valuable species in the export market while other two species are low priced and not used for fattening.

In the southern province, Koggala Lagoon is the only Lagoon where *Scylla serrata* were found as a commercial catch. Fishing for crabs exist in Dondra Lagoon, Lower reaches of Nilwala Ganga, Madu Ganga, Benthara Ganga and Gin Ganga as there is a good demand for crabs. However, the quantity caught from these places, are not of commercial scale.

Salinity is the crucial factor, for the survival rate of the crabs. Survival rate also depended upon the factors such as duration spent on land before stocking, presence of minor damages to the body, sex (mortality rate was higher in females), positioning of the cages. Blooms of filamentous algae also affect the survival rate of the crabs to some extent.

Stocking density over 10 Kg/ square meter caused mortality by bacterial diseases.
Crab fattening proved to be a lucrative industry giving a profit of 80%, 200%.

Achievement - 90%

Project 4.2: Determination of the factors affecting breeding, larval survival and Culture of brackish water fish species.

There are 136 edible brackishwater fish species in Sri Lanka. Only one species of these, namely, *P.monodon* is being used for commercial aquaculture in Sri Lanka at present. There is an increasing demand by the private sector to develop technology for other brackish water species as alternate species for *P. monodon* as a preventive measure for the occurrence of diseases. Brackishwater species such as Milk fish, Sea bass and groupers are selected to conduct culture studies to fulfill this demand.

The growth rate of *Chanos chanos* (milk fish) was very slow but the survival was 90% up to August. *Chanos* fingerlings were not found in the Negombo lagoon during the same period in which the fingerlings were found in Kalpitiya. Transportation of fingerlings from the high saline water creeks (salinity -up to 60 ppt may be a successful practice to getting a good growth rate in Negombo area(with low salinity levels). But it can be recommended for stunting the fish for using as baits in the marine fishing industry. Growth of fingerlings of *Chanos* in the net cage within the water holes of Kadolkele premises was not successful and the survival was 10%.

According to the fish landing survey marketable size *Lates calcarifer* were caught from June to December mainly by fishing gears such as brusparks and gillnets. The sufficient amount of fingerlings of seabass were not found during the study period thus the culture experiments could not carried out during year 2000.

Achievement - 90%

Project 4.3: Feasibility of culture of *Gracilaria edulis* in abandoned shrimp ponds

Gracilaria edulis is a seaweed species, which has been experimentally proved to be successful for culture in brackish water.

There is an increasing demand by the private sector to develop alternative sea farming practices. Due to the recent viral infections in the shrimp culture industry experienced severe economic losses. This has led to many farms to abundant land under cultivation without a proper management plan. This land has to be used economically to provide alternative productions to minimize social and environmental impacts. Attempts were made to culture *G. edulis* in abundant prawn farms and as a effluent treatment in sediment tanks.

Growth of seaweed in the constructed mud ponds at Kalpitiya research station was compared to the growth of seaweed cultured in the pen constructed at the Puttalama lagoon from August 2000. The results of the growth studies of the first three months were obtained.

Growth rate of seaweed on the constructed rafts with nylon ropes and PVC frames laid in the ponds were comparatively lower than the growth rates observed in the same type of rafts submerged in the lagoon.

Growth of *Gracilaria edulis* in the ponds with the 8 cm planting spacing (vegetative propagation) of the seaweed was 13% less than that of the growth of seaweed in the same spacing in the lagoon, while growth was 37% and 33% lower with the planting spacing of 10cm and 15cm respectively. It can be recommended raft culture methods for the ponds with 8cm planting spacing for a good growth but further research should be done for determination of more factors for getting maximum yield per unit area.

Highest biomass in the lagoon also were obtained in the rafts planted with the 8cm on nylon ropes spacing and it was 697g of average fresh weight per square meter raft in the three months period.

Achievement - 75%

Seminars / Workshops Attended / Organized

- Forecasting of possible fishing zones using satellite derived information and it's applicability in Sri Lanka wasters on 1st March 2000 at NARA auditorium.
- Workshop on Capacity Enhancement of the Mundel lake and Dutch Canal System for sustainable multiple use, June 20th 2000, NARA Auditorium.
- Attended and delivered a lecture on Market and present status of ornamental fish industry for the work shop organized by SLAFAR on 10th June 2000. At Wayamba Campus.
- Conducted seminar on Piranha and Knife fish at the BMICH on 1st December 2000.
- Workshop on marine sanctuary location at Yala area on 05.05.2000. Organized by MOFA.
- Organized the seminar for the Lagoon fishermen on the topic of bivalve removing in Rekawa Lagoon 09. 11.2000.
- Meeting on educating the villagers about the disadvantages of bivalve removing and coral removing from Rekawa area held at Netolpitiya Maha Vidiyalaya. On 02.02.2000 jointly organized by Divisional Secretary Tangalle and RRC. NARA Rekawa.
- FAO/Government of Australia Expert Consultation on Good Management Practices and Good Institutional and Legal Arrangements for Shrimp Culture(in co-operation with the World Bank, NACA, WWF). 4 to 7 December, Brisbane, Australia.
- IIRR, FAO, NAC, IDRC, ICLARM, DWW and Netherlands Embassy organized workshop on utilizing different aquatic environments for small - scale aquaculture. 18 to 28 September, 2000, Manial , Philippines.

- National Science Foundation, Sri Lanka Association for Fisheries and Aquatic Resources and National Aquatic Resources Research and Development Agency organized workshop on issues and challenges in aquaculture in Sri Lanka. 16 August 2000, NARA, Colombo, Sri Lanka (as a resource person)
- Workshop on shrimp culture case studies. 03 July 2000, Dhaka, Bangladesh (as resource person).
- FAO/ NACA Conference on aquaculture in the third millennium. 20 to 25 February 2000, Bangkok Thailand (as a panel member in section for establishing legal, institutional and regulatory frameworks for aquaculture development and management).

Extension work

- ITN & Rupavahini News item on Piranha fish on 5th December 2000.
- Conducted ornamental fish and aquaculture lecture at Buttala University for the B.Sc degree programme (15 hours).
- Conducted the Lectures on Mangrove and arranged the field visit for school children of Vijitha Madya Maha Vidyalaya, Dickwella on 18.02.2000.
- Provide assistance in the preparation of a booklet on ornamental fish culture for students in Rahula College, on 05.04.2000.
- Lecture series on mangrove ecosystem for students in Sujatha vidyalaya on 28.09.2000 .
- Identification, Classification and Compilation of Molluscan shells for establishment of shell museum for NARA.

    - As a visiting lecturer and examiner to:
    - University of Peradeniya
    - University of Kelaniya
    - University of Sabaragamuwa

- "Crab fattening " a lecture delivered to fishermen in the Chilaw area.

- "Crab fattening" a lecture given to Fishermen from Trincomalee.

- A lecture on crab fattening on Dheewara Dinaya at BMICH.

- "Mangrove ecosystem " a lecture delivered at the Bolawalana Maha Vidyalaya.

- "Mangrove fauna" a lecture delivered to teacher trainers at NIE, Maharagama.

Articles /Leaflets

- Seaweeds (submitted to the Extension division for printing).
- Crab fattening (Sinhala)
- Crabs as a fishery resource (Sinhala)
- Piranha
- Knife fish
- Ornamental fish
- Capture ornamental fish- for the book to be published by NARA
- News paper article on piranha on 16th December 2000 in the Lankadeepa.
- The Mollusc culture in Sri Lanka- Sinhala.
- Indication of the Pond condition of culture ponds of *P. monodon*
- Pond environmental condition for culture of *P. monodon*.

Meetings attended

- Meeting on Piranha and knife fish at MOF on 13th July 2000
- Review meeting at NARA board room on 21st March 2000.
- Meeting on"Benthara Ganga Abayaboomiya" at MOF on 24th July2000.

- Meeting on "Benthara Ganga Abayaboomiya" at Bodimaluwa Rajamaha Viharaya Benthara on 8th August 2000.

Other activities

Exhibitions Conducted

- Beliatta Maha Vidyalaya From 29.03.2000 to 31.03.2000
- Sooriya Wewa National school - Hambantota, from 01.11.2000 to 02.11. 2000
- BMICH Min Visithuru from 28th Novmeber to 3rd December 2000
- Lumbini Maha Viddyala Colombo from 25th to 29th January 200

Publications

- Impact of excessive aeration and some biological and physico chemical aspects of pond water, farm performance and health.
- Corea, A.S. L.E. and Jayasinghe, J.M.P.K.,Time series changes in avifauna associated with shrimp culture ponds 2nd Pan-Asian Ornithological Congress.
- Shrimp culture in Sri Lanka.Technical, Environmental social concepts. 92 pp.
- "Seaweeds of Sri Lanka" appeared in "Business Lanka" journal published by the EDB.
- Final report on the " Establishment of a pollution monitoring programme for Hambantota District". (A report prepared by Mr. H. Dassanayake, Dr. C. Amarasiri, Dr. Sepalika Jayamanne and Mrs. V. Pahalawattaarachchi) Submitted to Hambantota Integrated Coastal Zone Management Project.
- Final Report on the "Distribution of filamentous algae in the Negombo Lagoon" (A report prepared by Dr. Sepalika Jayamanne, Mrs. V. Pahalawattaarachchi an Mr. H. Dassanayake.) Submitted to Integrated Resources Management Project, Central Environment Authority.
- Jayamanne, S.C. Trophic model of the coastal fisheries ecosystem of west and southwest of Sri Lanka. A paper to be presented at the final workshop organized by the ICLARM ADB-RETA 5766 project.
- Jayamanne, S.C. Demersal fish assemblages of Sri Lanka. A paper to be presented at the final workshop organized by the ICLARM ADB-RETA 5766 project.
- Wijesekara, R.G.S. and Yakupitiyage. A, 2000, Aquarium Science and conservation, Kluwer Academic Publishers, Printed in the Netherlands Ornamental Fish Industry in Sri Lanka.: Present Status and Future Trends.
- Status report on Knife fish and Piranha to submit MOF.
- Report on Fish Sanctuary in Bentara River
- Suitability report on ornamental fish culture at Raththota AGA division to submit NAQDA.
- Status report on Dimitta fish Bentara river.
- Senadheera, S.D., W.M.T.B. Wanninayake and S.P. Jayasuriya 2000. Assessment of the selected microbial flora of some edible bivalve molluscs in four major lagoon system s along the west coast of Sri Lanka. Sri Lanka Assoc. for Fish. And Aqu. Res. (SLAFAR) 6th Annu. Ses. Colombo., Sri Lanka.
- Wanninayake, W.M.T.B. 2000. Inland Fisheries and aquaculture Development in North Western Province, Sri Lanka. Workshop on "Capacity enhancement of Mundel Lake and Dutch canal system for sustainable multiple use". 20th June 2000,NARA Colombo 15, Sri Lanka.

Books

- Shrimp culture: Brackish water shrimp culture: Technical, Economical and Sociological Concepts, Dr. J.M.P.K. Jayasinghe, R.G.S. Wijesekara.

FISHING TECHNOLOGY DIVISION

Programme1: Development of New Fishing Technologies.

Project 1.1: Development of the existing "Alagodu Course" fishing net.

A new net was designed to catch Tuna and Tuna like fish efficiently. The length of the net and mesh sizes was changed. New material was used to reduce the "Closing Time' of the net. Hanging ratio was also changed to improve the catching efficiency. This net was tested with the commercial fishermen of the Weligama area. The results indicate that to increase the catching efficiency, they have to use a 25 Hp engine along with this modified net. To arrive at a firm conclusion more research is needed.

- A new "Alagodu Course" fishing net was designed
- Closing time of the fishing time was minimized

Achievement - 80%

Project 1.2: Development of suitable fishing gear to exploit the lobster resource

Lobster traps were constructed and tested off Kirinda. Results indicate that some lobster species such as *P.ornatus* & *P.versicolor* did not enter traps. The species composition of the trap catches consisted of following major groups,
Demersal fish
Few lobsters.
Still some more work has to be done to analyze the cost effectiveness of lobster traps when compared to bottom set gill nets. It was able to conclude that traps are environment friendly when compared to bottom set gill nets. As far as catch rates are concerned nets are more efficient when compared to lobster traps.

The three fishing gear types tested can be classified as follows according to their catching efficiency:

Fishing gear type	Environment friendly or not	Catching efficiency
1. Bottom set trammel net	Harmful to the environment	High
2. Bottom set gill net	Harmful to the environment	Average
3. Lobster trap	Environment friendly	Poor

- Traps are not suitable to catch some species of lobsters as they do not enter traps.
- Results indicated that lobster stocks on Hambantotoa banks are depleting.

Achievement - 80%

Seminars / Workshops Attended/Organized

- One seminar was arranged to discuss the findings with fishermen of Weligama/Mirissa area
- Three seminars were held at Kirinda, Amaduwa and Patnangalle

Extension Work

- Demonstrations were made to fishermen on the newly designed net
- Above three seminars were arranged to explain fishermen on new lobster regulations.

Constraints

- Lack of cooperation by the fishing community
- Rough sea conditions hampered most of the field work (Sea work)

Publications

- Poster was prepared on spiny lobster of Sri Lanka

OCEANOGRAPHY DIVISION

Programme 1 :- Offshore oceanographic survey

Project 1.1: Monitoring of physical, chemical, geological and biological properties of Sri- Lanka's territorial water, using vessel " Sayuri"

The territorial waters of Sri Lanka have not been explored oceanographically except for the sediment sampling and geochemistry, which were conducted during the late eighties. The cruises made during that period have led to the identification of the possible placer deposits in the continental shelf from Kalpitya to Batticallowa. Since 1990 offshore oceanographic surveys on territorial waters have been hampered due to the unavailability of a suitable Research Vessel. However with commissioning of the new survey vessel of National Hydrographic Office, there are possibilities to launch the offshore oceanographic surveys around our territorial waters.

The aim of this oceanographic research program is to provide supporting data and knowledge, which could be used to assist the fishing industry within Sri Lanka's Exclusive economic Zone (EEZ). Also this program can assist in investigating and monitoring all the oceanographic properties of our territorial waters including water quality aspects, seawater circulation pattern and areas of high primary productivity.

Main direction of the wind induced long shore water current velocity, along the Hikkaduwa and Kahawa is southerly and varied between 20 to 40 cm/sec. Also erosion or accretion on the above said stretch is a "temporary phenomen" due to the high variability of monsoonal winds, wave action and current patterns.

Achievement –100%

Programme 2: Near shore oceanographic surveys and Data management

Project 2.1: Establishment of a National Oceanographic Data Centre (NODC)

Since the establishment of oceanography division of NARA there is no proper documentation of existing knowledge on oceanography data sources. In order to help other National Institutes, Research Institutes, Universities and Various Development programs in the country and other international organizations to increase their efficiency and effectiveness and to facilitate ocean data exchange, the NODC will be established. Also the NODC assists national users in developing and enlarging their competence in the field of marine sciences. The data generated through national and international small and large scale and long term programs are increasing at a rapid rate. Besides the instantaneous nature and spot measurements of various oceanographic parameters at different sea levels, the synoptic observations covering the ocean space through remote sensing techniques also add to the bulk of the data. For making better use of this voluminous, invaluable information and for use by the researchers of the present and for those to come by, the data should be properly documented and stored in suitable media and managed efficiently.

International Research cruises conducted within the India Ocean under the world ocean circulation experiment were incorporated into the NODC. It was found that, fresh water from Ganges-Brahamaputras delta spreads southward along the Indian coast (July – November) and reaches Sri-Lanka late autumn. Thus low saline water (33.3 psu) extending southwards from Sri-Lanka to 100S is observed.

Achievement – 55%

Project 2.2 : Physical oceanography survey in the coastal lagoons and brackish water

Physical oceanography research has been conducted in-depth in some of the lagoons and estuaries of the western coast of Sri Lanka (ex. Puttalam Lagoon, Mundal Lake and Negombo

Lagoon), but the data and reports were not made easily available to the researchers and others, who were interested in it. Unaware of the availability of past research work, there are possibility of repetition of research activity. Hence it is necessary to compile all the existing physical oceanographic research of the oceanography division.

The earlier studies in Pollwatte, Nilwala and Kelani Ganga have indicated that sea water intrusion into the rivers is in an increasing trend. Also, the studies in the estuaries indicate decreasing trend in water mixing (ex. Puttalum Lagoon). The above two phenomenon, which are indicators of the degradation of the physical environment are common to most of the coastal water bodies of Sri Lanka. More supplementary data are to be collected to understand the internal mechanics of water mixing and salt-water intrusion. Classification of an estuarine system runs into difficulties because a given estuary may show either well mixed or stratified conditions as a function of longitudinal distance along the estuary, season of the year, or even in some cases depend on phase of the tidal cycle. Here the study intends to propose a classification based on the interdependency of the stratification and circulation parameter.

The research program facilitated to understand the water exchange mechanism of Puttalum, Negombo and Chilaw lagoon, which could be used for better management and multi use of them. Also resulted in separating and quantifying different mixing agents, which was long being a desire of every physical oceanographers involved on the coastal oceanography.

Achievement – 85%

Project 2.3 : Sea level data collection and tidal model investigations around Sri-Lanka's coastal waters.

Sea level variations result from the integrated effect of a variety of physical processes spanning a broad range of spatial and temporal scales. Sea level changes over the hundred-year time scale are related to crustal movements, to changes in ice and water volume, as well as to the mean warming expansion of the ocean. Shorter-term sea level variations are more local in extent, from several days to years may be due to changes in the ocean density structure and in circulation patterns or changes in sea level over periods of hours and days due to meteorological effects and tides (astronomical forces).

A rise in sea level could cause major impacts in many coastal areas of the world. Consequences include: the inundation of coastal wetlands and lowlands with associated disruption of ecosystems; increased coastal erosion and breaching or destruction of coastal structures; frequent and widespread flooding of low-lying coastal areas; and salt contamination of freshwater supplies and agricultural land. Sea levels also have many practical applications for both operational and engineering design activities. The analysis of tides, one of the more traditional aspects of sea level observations as a basis for navigation, will continue as an important practical consideration in addition to the intrinsic scientific interest.

However, it is not easy to collect wide range of spatial and temporal continuous sea level/tide data, because it required large number of instruments, man power etc. Thus numerical models can be used to interpolate the temporal and spatial gaps of the field data. Also the numerical tidal models are not only used to describe present physical environment of coastal water bodies; moreover to predict future tidal environment resulting from changes in bathymettry, climate etc.

This research program, in addition to monitoring long-term global sea level rise, predicted sea level tables for the southern coastal towns – 2001, could be used for navigational purposes.

Achievement – 88%

Project 2.4: Studying of coastal erosion in Wadduwa –Kaluthara coastal strip

Coastal erosion is a severe problem in Sri Lanka that results in damages to or loss of houses, hotels and other coastal structures, roads. The literature sources illustrates monitoring and

studying of 80's Coastal Conservation Department carried out a comprehensive study on monitoring of erosions, in where as a result published a detail coastal erosion map. This map was useful in National and even International scales. Due to the unavoidable circumstance monitoring programs were weakened in the past. Present situation of erosion is worsening than past and no proper monitoring program under going. This project proposes to monitor coastal erosion on selected stretch (above mentioned) as a primary step. It is suggest working in close association with National Hydrographic Office and CCD. The project proposed to measure coast every two months period and collect meto-oceanic parameters. Proposed to purchase wave gauge, which can use in selected places to measure coastal waves. At the end of the project it is expected to estimate erosion and accretion budget and to prepare a plan.

Major coastal erosional and accretional sites were identified on the Wadduwa – Kaluthara stretch. The stretch at the proximity of the Kaluthara undergoes less erosion than that of Wadduwa stretch. However long shore sand movement in this area is seasonal.

Extension Work

The following person was trained by the division for the year 2000

Mr. Dinesh Attigala (University of Colombo) – B.Sc Special Degree

The following officers delivered lectures, to National Institute of Fisheries and Nautical Engineering (NIFNE) students during the year 2000.

Name	Course	Subject area
Dr. T.K.D Tennakoon	Post Graduate Diploma	Law of the sea/ Ocean Energy
K.Arulananthan	Post Graduate Diploma	Physical Oceanography
E.M.S Wijeratne	Post Graduate Diploma	Physical oceanography
H.B Jayasiri	Post Graduate Diploma	Biological Oceanography
J.K Rajapaksha	Post Graduate Diploma	Remote sensing Oceanography
S.U.P Jinadasa	Post Graduate Diploma	Geological Oceanography

Achievement – 88%

Seminars / Workshops Attended/ Organized

The divisional staffs were actively participated at various scientific forums. Following are some of them.

Mr. K. Arulananthan

Ph.D course work at Gothenburg University, Sweden

Mr. E.M.S. Wijerathne

Ph.D course work at Gothenburg University, Sweden

Dr. K. Tennkoon

Workshop on Capacity enhancement of the Mundal lake and dutch canal system for sustainable multiple use, June 2000, NARA

Workshop on Oceanography, Postgraduate Institute of Science, June 2000, University of Peradeniya

Workshop on Productivity Improvement Tools, June , Postgraduate Institute of Management

Seminar and workshop on Indian Remote Sensing, June , BMICH

Training course, Environmental Impact Assesment, SriLanka Institute of Development Administration, November 2000, Colombo

Mr. J.K. Rajapakha

Workshop on Remote sensing, National Remote Sensing Agency, Hydrabad, India

Workshop on Capacity enhancement of the Mundal lake and dutch canal system for sustainable multiple use, June , NARA

Mr. H. B. Jayasiri

Monitoring & modeling of coastal marine process (India)
Workshop on Capacity enhancement of the Mundal lake and dutch canal system for sustainable multiple use, June , NARA

Mr. Priyantha Jinadasa

Sri-Lanka Institute of Development Administration (Public Speaking and presentation Techniques)

Atomic Energy Authority (Quality Control and Operation of Nuclear Electronic Equipment)

Mr. W.A.J.P. Wijendra

Computer programme training, Arthur C. Clarke Center (Data Communications & Computer Networks),

Consultancy

Investigation for Dodanduwa Fishery Harbour

Achievement – 87%

Constrains

Lack of training on handling of instruments is a major constrains in the division. In addition lack of some laboratory and geophysical instruments affected the progress of the division

Meetings attended: Other activities

- The following divisional members were serving in various capacities in national and International scale scientific forums

- Dr. K. Tennakoon has worked as National Coordinator of National Oceanographic Data Center (NODC) for the International Oceanographic Data exchange.

- Mr. E.M.S. Wijerathne was serving as a member of the Technical Advisory Committee (TAC) of the Center for Climate Change Studies (CCCS)

- Mr. E.M.S. Wijerathne was worked as a coordinator for the M.Sc Oceanography programme at Postgraduate Institute of Science at University of Science

Publications

The following papers were presented and submitted for the publication on the proceeding of the "Workshop on estuarine biology" at Battacalowa.

K. Arulananthan "An inverse estuarine circulation – Puttalam Lagoon"

H.B. Jayasiri " Remedy to avoid extreme estuarine conditions in Mundal lake"

J.K. Rajapaksha " Variability of chocking for different tidal frequencies in Negombo Lagoon.

The following papers were submitted to the publication of the NARA journal

Jayasiri H. B. , Rajapaksha J.K. " Salt and water balance in the Mundel lake. A strongly choked lagoon, Sri-Lanka.

Rajapaksha J.K., Jayasiri H. B. Restricted water exchange in tropical lagoon, The Negombo lagoon on the west coast of Sri-Lanka,

Arulananthan K. "Salinity measurements and use of a new salinity scale."

NATIONAL HYDROGRAPHIC OFFICE

Programme1: National Charting Programme

Project 1.1: Offshore data collection by "Sayuri"

Hydrographic data acquisition by S.V."Sayuri" in an offshore area of about 500 Sq.km of Negombo and 100 Sq.Km. of Weligama

Providing bathymetric data for the Hydrographic data base and incorporating them into the preparation of Negombo & Weligama to Matara nautical charts.

Project 1.2 : Nearshore data collection by "Tharanga"

Hydrographic data acquisition by "Tharanga" boat in nearshore area of about 200 Sq.km. in the Negombo Lagoon

Providing bathymetric data for the compilation of Negombo & Weligama to Matara sea charts.

Project 1.3 : Shoreline detail survey

Shore line detail survey of 75 km. from Negombo Lagoon and North of Negombo

Providing shoreline data for the compilation of Negombo & Weligama to Matara sea charts.

Project 1.4 : Data processing

Data processing & fair sheet production of about 800 sq.km. in the Negombo Lagoon & offshore area.

Providing fair sheet for compilation and cartographic work of Negombo & Weligama to Matara sea chart.

Project 1.5 : Compilation, cartographic work and printing of Nautical charts.

Compilation, cartographic work and printing of Nautical Chart covering the Mirissa Fishery Harbour and its approaches and Weligama (200 Sq.km.

Printing of Nautical Chart covering the Mirissa Fishery Harbour and its approaches.

Seminars Workshops : Attended/Organized / Attended

Seminar to present the report on commonwealth states and the implementation of Article 76 of the UN Convention on the Law of the Sea, Hydrographic Office, Cape Town, South Africa.

Workshop on Electronic Navigational Charts (Development and Usage) in collaboration with DARTCOM, U.K. and Marine Overseas Agency (Pvt) Ltd.

Bentota to Ambalangoda Hydrographic Survey

Gas pipeline corridor survey – Mirijjawila

Achievement - 100%

Constrains

- Only limited number of days were favorable for hydrographic surveys due to the bad weather.
- Shortage of Hydrographic Surveyors

Meeting Attended

Representation of Technical Committee meetings on delimitation of the outer edge of continental margin of Sri Lanka.

Other Activities

- Preparation of poster depicting lobsters (NARA)
- Preparation of sea chart depicting proposed sea corridor for Sri Lankan Fisherman for approach to Arabian Sea
- Preparation of Sediment thickness map which is using for delimitation of outer limit of the continental shelf

Publications

Nautical chart of Mirissa Fishery Harbour and its approaches.

SOCIO – ECONOMIC AND MARKET RESEARCH DIVISION

Programme 1 : Socio -economic and Market Research on Fishery Related Activities

Project 1.1 : The role of fisheries corporation (CFC) in fish marketing in Sri Lanka

Fish marketing and distribution in 1950s to 60s was completely handled by private sector. To break this monopoly situation, Ceylon Fisheries Corporation (CFC) was established in 1964. CFCs intervention in fish marketing and determination of market prices during normal market situations has not been successful. At present it was only around 1.5% share of fish marketing in Sri Lanka. This study carried out to examine the role of CFC, constraints and possible improvements to achieve its objectives.

- The existing fish distribution method to regions is inadequate and thus resulted an insufficient supply of fish for sales.
- Determination of purchasing price of fish in CFC is not appropriate to the present marketing situation and competition of the industry.
- Many regions suffer from inadequate facilities and even a space for administration.
- Most regions operate with inadequate retail outlets and skilled sales assistants.
- Due to absence of promotional prospects for sales most regions are running with a lost.

Achievement- 90%

Project 1.2 : A Sociological study of an inland fishing community in Udawalawe Reservoir in Ratnapura District.

In Udawalawa reservoir out of 208 registered fishermen 62 fishermen have owned non-mechanized boats and in Chandrika wewa out of 62 registered fishermen 12 fishermen owned non mechanized boats. The study revealed that the boat owners fishermen are full time fishermen while others practice cultivation, work as labour and do other casual jobs as their subsidiary occupation.

- During months of February to October the main fresh water fish catch consisted of Tilapia that is in Udawalawa reservoir 60% and in Chandrika wewa that is around 41% and the second highest contributers were Catla and Rohu respectively.
- In Udawalawa 52 fishermen were sampled and revealed that 21% of the fishermen were engaged in fishing activities as the main occupation. In Chandrika wewa out of, 16 fishermen 13% of were engage in fishing as the main occupation.
- The findings revealed in Udawalawa reservoir 67% of the fishermen's houses are in improvised houses and while in Chandrika wewa it was 69%. Rests of the families are enjoying comparatively better housing facilities.
- The education levels of these families are generally high. In Udawalawa out of 52 fishing households 59% of the population have studied up to primary level and in Chandrika wewa it was 54%.
- The trading pattern, scaling methods, the number of fish vendors and mode of transportation of fish differs from Udawalawa reservoir to Chandrika wewa reservoir.
- Strong patron client relationship was evident in Udawalawa reservoir between fishermen and fish vendors.
- In Udawalawa, large number of out side fish vendors are coming to purchase fish, that is more than 90 out side fish vendors are coming to purchase fish to the 3 landing centers daily. In Chandrika wewa non-of the out side fish vendors are coming to purchase fish.

Draft Project Report completed

Achievement- 90 %

Project 1.3: Socio-economic status of the beneficiaries of "Diyawara Gammana" Programme

This socio-economic study on Diyawara Gammana programme was carried out to assess the socio-economic improvement of the beneficiaries under the programme and to evaluate the overall success of this programme for improving the living standard of the beneficiaries.

By the 31st December of 1999, Fisheries and Aquatic Resources Development Ministry had started to construct 60 Diyawara Gammana in 19 districts. In this study, Eleven Diyawara Gammana were selected from nine districts. Major findings of the study are given below.

- About 42% of the total families benefited under this programme are fishing families. Rest of the beneficiaries are farmers, Laborers etc.

- About 82% of the total fishing families studied were full time fishermen or engaged in fishing related activities.

- Average monthly family income of the beneficiaries is Rs.4,688. But average monthly income of the fishing families is Rs. 4,577.

- About 42% had their own houses before coming to Diyawara Gammana. However, only 25% of fishing families had their own houses. Further, most of the beneficiaries early houses had been temporary construction.

- About 98% have received the total amount or Rs. 50,000 for construction of their houses. Further all most 100% of this amount has been fully utilized for the construction of the houses.

- Over 84% of the beneficiaries have been provided lands for construction of the houses under this programme. Rest of the families had their own lands. Extent of these received lands varies from 10 p. to 40 p. and it depends on the total extent of the whole land of the Diyawara Gammana and the number of beneficiaries of the Diyawara Gammana.

- In addition to the received money, 88% families have spent additional money for the construction of their houses. Only few families (5%) have spent over Rs.200,000 for the construction.

- Under this programme, socio-economic status and the living conditions of the beneficiaries have been increased to satisfactory level. Almost all the beneficiaries believe that there has been an improvement in their living condition and socio-economic status with the Diyawara Gammana programme.

Achievement- 90%

This project was substituted in place utilization by shrimp by products as micro economic ventures.

Project 1.4: Upgrading shore based facilities and improvement in the productivity and efficiency of fishing operation

The project was carried out to assess the existing status of shore based facilities of fishery harbours, anchorages and beach landing centres in eight DFEO district from Puttalam to Tangalle. There were 346 fish landing centres including 11 fishery harbours, 16 anchorages and 319 beach landing centres in the study area. Data were collected by observation, interviews with stakeholders and administering a questionnaire. Mainly data were collected on fishing operation, marketing and handling and welfare oriented facilities in the fish landing centres.

Distribution of shore based facilities show wide disparity along the coastal belt from Puttalam to Kirinda. Many landing centres from Colombo to Puttalam were lack of essential shore based facilities for fishing operation, marketing and handling. As a consequence of this situation majority of fishermen in these area were compelled to engage in coastal fishing. This was resulted an increased pressure on coastal resources.

Essential shore based facilities such as fuel, water and ice supply, repair and maintenance of crafts and engines, availability of engine spare parts and fishing gear at the vicinity of landing centres were scarce or lack in most landing centres including fishery harbours. Private sector should be encouraged to provide these facilities with a proper monitoring plan of their implementation. This will generate new employment opportunities while satisfying fishermen's needs.

Existing facilities at most of anchorages and beach landing centres were not maintained or controlled by any authority. This state of affairs resulted the situation to be worsened. Therefore, a programme should be established to monitor all landing centres probably under supervision of Ceylon Fishery Harbours Corporation. Under this programme all service suppliers should be registered for better management of landing centres.

Achievement - 85%

Constrains

Collection of the questionnaire for information on regional activities was delayed.

Programme 2 : Publications of Fisheries Year Book 2000

Final report completed - A Sociological study of an inland fishing community in Udawalawe Reservoir in Ratnapura District.

POST HARVEST TECHNOLOGY DIVISION

Programme 1 : Development of Hazard Analysis Critical Control Point (HACCP) for fisheries and Aquaculture Products to ensure food safety and product quality.

Shrimp is a major fisheries product exported from Sri Lanka accounting for nearly 65% of the exports. Over the last few years earnings from shrimp industry has shown a steady increase. However, loss of Rs. 300 million per annum have been reported due to post - harvest losses related to quality including disease and bad handling, Occurrence of pathogenic bacteria (*Vibrio cholerae, Vibrio paraheamolyticus and Salmonella*) has been detected in consignments of frozen food by importers. This will adversely affect the industry and there is a necessity to continuously monitor the pathogens in environment and products to for quality assurance.

Sampling was done to find out the sources of contamination of pathogenic bacteria. Main water sources for shrimp farming (water samples) and shrimp farms (water, sediment, shrimp and feed samples) in North western province were monitord for following bacteria.

Vibrio parahaemolyticus, Vibrio cholerae, Salmonella spp. Coliforms,Fecal coliforms *E. coli,* Sucrose fermenting and sucrose non fermenting Vibrios

Vibrio cholerae and *Salmonella spp.* were not detected in all samples tested. Sucrose fermenting Vibrios and Sucrose non fermenting Vibrios were detected within the range of from 10^2-10^3 cfu/ml/g. Water sources for farms were heavily contaminated with coliforms (1800+/100ml), fecal coliforms (900/100ml) and *E.coli* (900/100ml). Low levels of colifoms were detected in shrimps and sediment of ponds.

Programme 2 : Accreditation of Quality Control Laboratory

There are new rules and regulations imposed for export of Fish and Fishery products.Exported product have to be tested for selected quality parameters by a accredited laboratories. Quality control laboratory & Chemistry laboratory of NARA have been identified to perform the laboratory tests for quality parameters by the Ministry of Fisheries & Aquatic Resources. The facilities and the performance of the laboratory has to be upgraded to meet the requirements of the industry.

Expansion of the quality control laboratory.

Preparation of quality routines and preliminary steps were taken for implementation.

Laboratories were prepared for EU inspection

Purchases of equipment was done.

The quality manual was upgraded in accordance with ISO 17025.

Programme 3 : Investigations on Post Harvest Losses and remedial measures in the Fisheries and Aquaculture Products

This project is a continuing project and the objectives are to investigate the quality of fishery products; post harvest losses of fish from multi-day boats quality of ice and water used in the fishery industry in Sri Lanka and to suggest remedial measures to improve the quality.

Total off-shore fishery production was 73,240 mt in 1998. Tuna fishery has become the major fishery from MDB. Production of tuna has shows gradual increase in recent past. Total production of yellow fin tuna (*T. albacares*), big eye tuna (*T. obes* and skipjack (*K. pelamis*) from off shore fisheries, was around 40,000 mt in 1998. Tuna species has become second largest single export commodity of food fish, which accounts for 1390.98 mt, valued at Rs178.86 m in 1999.

Quality of the fish produced, is becoming increasingly important in national and international fish trade. There has been no information on handling practices and quality of fish from MDB in Sri Lanka. Quality of water and ice play a significant used role in producing high quality fish produce. These information are useful in formulating and developing strategies to improve the productivity in fisheries sector.

Dried fish is one of the main protein source for Sri Lankan communities. Local dried fish production is around 15,000mt in 1998. About 75% of fishery products consumed are as dried fish in Sri Lanka. Around 64,000mt of dried fish has been consumed in 1998.

Programme 4 : Product Development from Fisheries, Aquaculture and Aquatic Plant Resources

Present production from inland culture based capture fishery is expected to increase up to 60,000mt in near future. With the introduction of Tilapia the inland fish production has increased significantly, leading to a commercial fishery. At present, 90% of the total fish landings from inland waters comprise of Tilapia. Still the prices of Tilapia are in the range of Rs.30-40 per kg at farm gate. Development of new improved products using these fish resources and value addition will increase the demand by consumers and will enhance the socio-economic status of the fisher community. The objective of the present study was to develop surimi based fish balls from Tilapia species *(Oreochromis spp)* harvested from inland reservoirs.

Programme 5 : Management of effluents from aquatic food processing plants.

There are about 15 processing plants processing 5000 MT. of shrimps, 8000 MT of fisheries & fishery products. There is an increasing concern on the quality and quantity of the discharges from processing plants. There are stipulated quality guidelines but still the effluent discharge dose not confirm to the standards. Effluent samples were collected from 9 factories in Wattala, Gampaha, Ja-ela, Negombo and Chilaw areas.

Out of nine factories, four are processing Tuna, four are is processing Shrimps and the one factory is processing Crabs. The process flow line for Shrimp factories are generally similar. Sky Way Foods has different product flow line than the other three Tuna processing factories.

Quantity of discharged effluents from factories are different from each other. Among the Tuna processing factories, the highest quantity of effluents (to process 1 MT of Tuna fish) are discharged by Tropic frozen Co. (6040 Lit/ MT) where the lowest quantity is discharged by Jay Sea Foods Ltd (2000 Lit/ MT) Sky Way Foods recorded the lowest effluent quantity, 250 Lit/ MT, may be due to a different flow line. Among the Shrimp processing factories, Ceylon foods recorded the highest quantity of effluents, 4335 Lit/ Mt, and the lowest quantity was recorded at Aqua Gardens Lts (2000 Lit/ MT).

Analysis of effluent samples are in progress for, pH, Total Residual Chlorine, TotalAlkalinity, Total & Dissolve Sulphides, BOD, Total suspended solids, Ammonical Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen, Total Phosphorus, Chlorides and COD.

Programme 6 : Assessment of alternate feed resources for shrimp brood stock and formulated feed for fish brood stock.

The research programme was carried out to evaluate the nutritional quality of the natural feeds widely used in the farming industry and to identify other potential natural feeds to improve the performance of the broodstock.

Out of the widely used natural feeds, clam sp. Polycheate worms , squids, sea crabs, crab eggs & cow liver samples were subjected to the analysis for moisture, protein, ash, total lipids and for the fatty acid profile. In addition, a blood cockle sp. from Negombo lagoon and a cockle sp. from Kalpitiya lagoon were also analysed for the above parameters as potential natural diets.

Polycheate worms were found to have the highest moisture percentage (90.%) and the lowest percentage of moisture, 69.85% was recorded from crab eggs. Cockles had the highest ash content (2.66%) and cow liver contained the least amount (1.47 %). The highest amount of protein (22.27%) recorded from cow liver was followed by crab and crab eggs (19%) .The lowest amount of protein (6.12%) was found in polycheate worms. Clam sp. contained relatively a low amount of protein (6.5%) than in the other two species of bivalves (10%).

The total lipid content varied between 1.00 – 3.40% among the different natural diets. Cow liver recorded the highest (3.4%) while cockle sp. contained the lowest amount (1.07%).

The fatty acid profile of the natural diets comprised of 36 – 56% of saturated acids (SFA), 7-26% of monounsaturated fatty acids (MUFA) and 28-41 polyunsaturated fatty acids (PUFA). Altogether nearly 28 fatty acids were detected and the major fatty acids recorded were palmitic, steari ,oleic, arach idonic, and docosahexanoic acid (DHA). Clam sp. and squids reported to have highest percentage (around 30%) of omega 3 (n-3) PUFAs which are very essential for the broodstocks. Blood cockle sp. , polychete worms, crabs and crab eggs had around 26% of omega 3 PUFAs and the lowest amount reported from cow liver (17%). The amount of long chain PUFAs (C 20 - C 22) was highest in squids (38.%) followed by crabs, clam sp (33%) and polychete worms (31.32%). Two cockle species recorded comparatively similar levels of SFAs, MUFAs and PUFAs. The polychete worms recorded higher level of eicosapentenoic acid (EPA) (6%) but with least amount of DHA which are also very important for the brood shrimps. However, other natural diets contained less than 1% of EPA but contained considerable levels of DHA (2 - 19%) .

The results obtained revealed that the except for cow liver, other natural diets used in the hatchery industry of Sri Lanka specially the squids and clam sp. exhibit betternutritional qualities for the brood shrimps. Results indicated the potential of using ccockle spp. especially the blood cockle sp. to fulfill the nutritional requirements for broodstock.

Programme 7 : Utilization of shrimp waste and product development (With Socio-Economic Division)

During last decade shrimp exports increased from 6276 MT in 1991 to 8641MT in 1998. The highest shrimp landings are recorded from Puttalam, Negombo, Chilaw and Galle. The project was aimed to assess waste and present processing practices by local communities.

The common processing methods at community level are cooked salted and dried form. In the first process shrimps rea steamed in a half-oil barrel at 15 minutes and salted. This type of processed shrimps are transported to colombo and packed in cardboard cartoons and marketed. The cooked dried prawns can be kept for nearly one week. Steamed cooked polythene packed prawns by some processers are with head and shell. The waste consist mainly of Head and Exoskeleton. The regular supply of shrimp waste can be easily obtained from plants located at Colombo for industrial purposes. In Sri Lanka there is a prawn cracker manufacturing factory at Matara. The main protein source available in this cracker are shrimp powder. The laboratory analysis showes that the shrimp waste has a total crude protein level of 55%. Dried shrimp waste powder can be added in developing products such as shrimp noodles ,crackers, savory biscuits, snacks. etc. But at preset industry depend on imported prawn flavour. Preset annual total waste & production is estimated at around 7650MT. The waste drying ratio is 5:2 . This waste can be utilize as a source of shrimp meal preparation for feed industry.

The trials were carried out to develop the dried prawn paste. The dried powder of prawn waste and prawns were used as protein source. Chilli, vegetables, onions were the other ingredients. The organoleptic quality of the Indonesian dried prawn paste purchased from the market were compared with the dried prawn paste prepared using prawn waste powder and prawn powder prepared in the laboratory.

There were no significant differences of the organoleptic quality.

Trials were carried out to develop the keeping quality of dried prawns for commercial market. The cooked salted dried (60^0C) prawns can be kept more than three months in ambient temperature. The uncooked salted dried (60^0C) prawns organoleptically scored the higest quality than the cooked prawns.

Programme 8 :Survival of pathogenic bacteria in fish and fishery products 'in fish industry

The fish quality chain has been found to be contaminated with pathogenic organisums. It is essential to identify critical control points in order to improve the quality. The major food and water borne pathogens, E. coli, F. coliforms, coliforms, Total Bacterial Count and TVN (Total volatile nitrogen) value were determined. The different marketing channels were categorized according to their handling practices.

The common unhygienic sanitary conditions identified in the sales outlets are poor drainage, un proper waste handling, unhygienic utensils, contaminated cutting and display areas, unavailability of water.

The highest total bacterial counts were observed in fish outlets build near roads. The lowest count were indicated in markets where fish were stored in deep frezzers without contaminated displaying areas. *V. cholera* and *Samonella* were not record from fish sales outlets.

The sanitary conditions in 50% of the fish stalls observed did not fall within the accepted evels. It could lead to further contamination with pathogenic bacteria. The fish outlets were categorized and given scored levels according to accepted sanitary standards. In wet zone there were not significant differences between TBC and E coli , coliforms and Feacal coliforms. counts among different outlets.

Programme 9 : Assessment and management of Histamine in fish and fishery products.

Fish is a major source of histamine poisoning . Several countries, especially European union have recommended safety levels of histamine. Histamine is commonly available in imported fishery products too. It has been observed that the histamine formation can be controlled adopting proper handling and processing technology. During the experiments investigations were carried out to examine the formation of histamine in fresh water fishes and in imported fishery products.

Nineteen different varieties of fresh water fish were collected from Victoria, Thabbowa, Minneriya, Chandrikawewa, Kirilbbanwewa, Gampaha (Attangalu Oya) The edible protion of the collected samples was analyzed for histamine. Histamine content of fresh water fishes were found to be lower than 50 ppm (maximum allowable limit). Histamine contents in the samples varied from 1.1± 0.14 ppm to 42.5 ± 7.7 ppm. The lowest value (1.1 ± 0.14 ppm) was reported from the Half beaks (*Hemiramphus limbatus)* while the highest value (42.5 ± 7.7 ppm) from Bar eyed goby (*Glossogobius giuris*). Low values were recorded in cat fish, Common labeo, Common carps, Common rasbora and in Long snouted barb, Murre Dwarf cat fish and Silver carplet contained high histamine content (more than 30 ppm).

The variation of histamine in fresh water fish during spoilage were very slow. In *Oreochromis nilotics* histamine increased from 1 ppm to 2.5 ppm over a 12 day storage period.

Histamine in imported fishery products

Different brands of canned fish packed in different media, with different net weights and belongings to different brands with different expiry dates were analyzed. Of the different species of canned fish examined, canned Mackerel and Dace had the highest histamine content. Canned Mackerel contained 135.6 ± 39 ppm of histamine in the flesh and 158.3± 37.2 ppm in the juice. The lowest histamine content was reported in wood smoked Kipper fillet and 27.4± 1.5 ppm in the juice. The different packing material were found to affect the histamine content in flesh. The fish packed in brine contained low histamine in flesh and the fish packed with sunflower or fish oil contained high levels. These results indicate the possibility histamine to leach in to the brine or natural juice.

The imported dried fish and Maldives fish contained very high levels of histamine. The highest level, 7476 ppm, was recorded in Skip jack dried fish.

Project 10 : Investigation of quality of ice and contamination points of *Escherichia coli* (*E.coli*) in Ice Plants in Southern coastal area

At first stage of the study, sixteen ice plants were investigated and water used for ice production, block ice/ flake ice, and crushed ice for sale, were sampled and analysed for aerobic plate count (APC), Coliform, Fecal coliform, and *E.coli.* Following tables summerize the findings.

Ranges of Aerobic Plate count (APC), Coliform, Feacal coliform, and *E.coli* in ice making water, ice in stores and ice at sale of the Ice Plants in Southern coastal areas are as follows:

Sample	APC (cfu/g)	Coliform (MPN/100ml)	Feacal coliform (MPN/100ml)	*E.coli* (MPN/100ml)
Water	$1.6x10^1$-$4.4x10^4$	<02-2400	< 02-1600	<02-2400
Ice in store	$1.2x10^2$-$4.4x10^5$	<02-2400	<02-2400	<02-540
Ice for sale	$9.1x10^1$-$2x10^6$	<02-2400	<02-2400	< 02-1600

Ice for sale from all the plants were found with unacceptable levels of APC. Study indicates that the ice available for fishery industry does not comply with SLSI and EEC standards. In 15/16 plants, crushed/flake ice available for sale were found to be *E. coli* positive. In 14/16 plants, ice in stores were found to be *E. coli* positive. However, ice producing water sources were found to be *E. coli* positive only in 8/16 plants. Therefore, the results indicate that the contamination occurs along the ice producing process. Ice in storage and at sales were found as two of the contamination points. The above findings were submitted to the Department of Fisheries and Aquatic Resources and conveyed at a meeting of ice manufactures. They were enlighten on the sources of contamination of ice and remedial measures to rectify the situation.

Following remedial measures were suggested based on the study to produce for the quality assurance of Ice.

- Use of potable quality water to produce ice.
- Correct layout of the processing and storing areas to prevent cross contamination.
- Use of clean, non corrosive and impervious supporting and handling items/tools in the plant.
- Educate personnel in the plant on the hygienic handling practices.

Programme 11 : Development of surimi based fish ball (instant food product) from *Orechromis* spp. fish mince (under-utilized, low value inland fish) .

Surimi was developed by leaching the deboned mince of Tilapia in 0.2% salt solutions and mixing with 0.3% sodium polyphosphate and 2% sugar under $<5^0C$. Leaching efficiency of mince was determined by protein extractability, folding test, penetration test and texture profile analysis (TPA), and water holding capacity (WHC). Fish balls were formulated using surimi and other ingredients at suitable proportions to obtain the acceptable sensory qualities. Fish, tomato, and soya flavoured fish balls were developed. Those were compared with commercial fish ball for some parameters. Leached mince was found superior to non leached mince with respect to WHC, folding test values and TPA profiles. Developed product fell in to the acceptable ranges in the sensory evaluation by in-house panelists at 5% level.

Gel strength, hardness (fracturability), and chewness of surimi from mince of *Oreochromis* spp. are as follows:

Sample of Surimi	Gel strength (gmm)	Hardness /Fracturability (g)	Chewness
First leach	314.542±79.106	10.677±0.173	6.993±2.424
Second leach	348.287±68.705	10.846±0.447	10.392±4.820
Third leach	328.704±61.495	10.532±0.171	7.760±2.831

Gel strength, hardness (fracturability), and chewness of fish sauce, Soy Sauce and tomato sauce flavored fish balls developed from surimi from mince of *Oreochromis* are as follows:

Type of fish ball	Gel strength (gmm)	Hardness /Fracturability (g)	Chewness
Fish sauce flavoured	321.633±41.184	10.282±0.124	10.981±7.226
Soy sauce flavoured	208.569±30.786	10.125±0.266	14.682±6.098
Tomato puree flavoured	348.165±63.688	10.399±0.267	14.961±6.983

This study concludes that the Tilapia resources can be utilized successfully to produce surimi of acceptable functional properties. Fish ball developed from surimi was acceptable as a value added product at a statisticaly highly significant level.

Shelf quality: Fish balls packed in laminated plastic pouches and stored at < -20^{0}C had minimum of six month shelf life.

Target group:Consumers - general
Producers - Enterprises and cottage industries
Cost:100 / RS. 30.00 (material cost)

Programme 12 : Development of minimally processed, instant vegetable product from Lotus bamboo (*Nymphea* stylone).

Lotus bamboo (*Nymphea* stylone) is a vegetable with medicinal & nutritional values. Freshly harvested, open dump, lotus bamboo can be kept for about 2-3 days only under the tropical ambient storage. Currently, one kilogram of good quality lotus bamboo fetches about Rs. 60-70 in the retail market. Therefore, development of simple preservation methods to prolong shelf life will secure the post harvest losses.

This study was aimed to develop minimally processed vegetable product from Lotus bamboo.Freshly harvested Lotus bamboo were cleaned, sliced, blanched and packed in moisture proof bags. Shelf quality was assessed under ambient (30^{0}C), chill storage (8^{0}C) and frozen storage (-20^{0}C). Shelf life of the chill stored and frozen stored product were 10 days and >3month respectively with respect to acceptable levels of microbiological, physical and sensory qualities. This product is being experimented for the reproducibility of the results and further improvements.

Seminars / Workshops Attended / Organized

The members of IPHT participated in following seminars, workshops & Training

The workshop on the Calibration of ISO 9000 Quality System, at 27th November 2000 at SLSI

PGIS University of Peradiniya, Fisheries and Aquaculture, NIFNI Diploma for Post Harvest Technology

Training Workshop on "Scientific Writing" organized by National Science Foundation Sri Lanka (23-24 June 2000)

Training on "Public Speaking and Presentation Skills" organized by Sri Lanka Institute of development administration (1-13 July 2000)

National Seminar on "International Property Rights (IPR) and Commercialization of Research" organized by National Science foundation Sri Lanka (24 November 2000)

International workshop on "Biotecnological tools in pathogen detection and fish shrimp health management" organized by UNESCO Microbial Resources Centre in Mangalore, India (30 November - 4 December 2000)

Training

The program on training of school teachers on "Marine Living Resources Technology" in Tangalla area, organized by Fisheries Community Development & Resources Management Project (FCDRMP), Department of Education and MFARD at Tangalla.

Three training programms were conducted on maldive fish production as promoting self employment oppourtunities for community.

- Puttlam Distric - National Youth centre -(2000 - 11-03).
- Anuradhapura North Central Province Rural Development Project (2000 -04 -08).
- Matara District - NAFSO (2000 - 05- 15).

Extension Work

Teaching at Universities
Members of the staff served as visiting lecturers in following Universities/ Institutions:

- Post graduate Institute of Aagricultute, University of Peradeniya.
- Department of Annual Science , University of Peradeniya
- University of Kelaniya (M.Sc course in Aquaculture)
- University of Sri Jayawardanapura.
- University of Colombo.
- Eastern Universitiy of Sri Lanka
- Animal husbandary School, Ragama.
- NIFNE

Curiculam Development
Staff members got involved in preparation of course contents for following:

- Diploma programme on Post Harvest Technology (9 months)

Consultancy

Test services to the Industries
During year 2000, 169 Test Reports were issued. Total earning from consultancies was Rs.515550. 00.

Other Consultancies

Microbiological analysis for sanitary quality of tools, surfaces and ambient air in processing plants:

- Tropic Frozen Foods Pvt. Limited (4 - 9/11/00)
- Aqua Garden Pvt. Limited (7 -10/11/00)

Achievement - 97.9%

Constrains

Lack of Training and Exposure

Meetings Attended

Mr. R. Edirisinghe attend number of meetings with representatives from Sida on the implementationof ISO quality control Program at NARA.

Ms. G. J. Ganegama Arachchi was invited by Department of Fisheries and Aquatic resources to make presentation on Good Manufacturing Practices based on research findings for Ice manufactures, Kalutara District - 14- 09- 2000.

Ms. P. Jayasinghe participated at meeting held on 2000 - 02 - 07. Improvements of Quality of Fisheries and Aquaculture Products Organized by Ministry of Fisheries Aquatic Resources and Development.

Other Activities

Mr. R. Edirisinghe conducted the laboratory practical classes at IPHT, for postgraduate students following the M.Sc. program in Aquaculture and Fisheries Management, University of Kelaniya.

Preparation of project proposals

Following research project was develop in collaboration with Sida. Project is to be implemented in year 2001.

Project : Development of a distribution system for fresh fish from the Beruwala Harbour to secure a safety and quality of the fish available to consumer.

Exhibitions

Prepared exhibits on convenience food products from underutilized fish species and test services available for food industry in NARA for a exhibition, which was organized by Ministry of Science & Technology at BMICH (8/2000).

Supervision of Research projects

- Project : Development convenience foods from inland fish species
  Student : Y M P K Yapa
  University : University of Peradeniya
  Degree : B.Sc. Project (Agric.)

- Project : Development of minimally processed instant vegetable product from Lotus bamboo (*Nelumbium* stylone)
  Student : Ranga Piyadigama
  University : University of Sabaragamuwa
  Degree : B.Sc. Project (Food Science & Technology)

- Project : Investigation of microbiological quality of naturalwater resources for the shrimp culture in North Western Coast
  Student : C Rajapakse
  Universit : University of Rajarata
  Degree : B.Sc Project.(Food Science & Technology)
- Project : Investigation of the effect of different sugarconcentrations on microflora in pond water for shrimp culture
  Student : C Perera
  University : University of Rajarata
  Degree : B.Sc.Project (Food Science & Technology)

- Project : Histamine concentration of Fish & Fisheries
  Name : S. Sashikala, M Sc. Project
  University : University of Kelaniya
  Degree : M Sc. Project

- Project : Effluent quality of processing plants
  Name : Anton Fernando, M.Sc.
  University : University of Sri Jayawardanapura
  Degree : M Sc.

- Project : Market survey of pathogenic bacteria in Fish outlets in Central Province.
  Student : G. Rajakaruna
  University : Faculty of Agriculture , University of Peradeniya
  Degree : B.Sc. Agric.

- Project : Influence of white spot disease on lipid content and fatty acid profile of *Peneus monodon*
  Student : M.D.S. T. de Croos
  University : University of Colombo
  Degree : B.Sc. (Special))

- Project : Development of food suppliment from Aquatic resources to combat malnutrition
  Student : P.P.M Heenatigala
  University : University of kalaniya
  Degree : M.Sc (Project)

Publications

Books

Brackish water shrimp culture in Sri Lanka Technical, social and Environmental, concepts Dr. J. M. P. K. Jayasinghe & Mr. S. Wijesekara

Other scientific communications

Ganegama Arachchi G.J, K. Hettiarachchi, D. N. Wijendra, and J.M.P.K. Jayasinghe. (2000). Quality of Salted Dried Fish Produced in the Kalpitiya Peninsula. Proceedings of Sixth Annual Sessions: Sri Lanka Association for Fisheries and Aquatic Resources, 29th June 2000, SLAAS Auditorium, Colombo, Sri Lanka :p12

Mendis C.D.M., G. G. S. Gamlath, C. Jayasinghe, G.J. Ganegama Arachchi, and J.M.P.K. Jayasinghe. (2000). Development of Kirala (Sonneratia caseolaris) fruit cordial. Proceedings of Sixth Annual Sessions: Sri Lanka Association for Fisheries and Aquatic Resources,29th June 2000, SLAAS Auditorium, Colombo, Sri Lanka :p12

Ganegama Arachchi G.J., J.M.P.K. Jayasinghe, M. J. S. Wijeyaratne, W.M.K. Perera, S. Jayasooriya, K. Hettiarachchi. (2000). Handling practices and post-harvest losses of tuna catches from multi-day boats operating from fish landing site Negombo, Sri Lanka. Sri Lanka Journal of Aquatic Sciences. 5(2000): 1-00

Ganegama Arachchi G.J., K.G.C. Ariyadasa, W.M.K. Perera, J.M.P.K Jayasinghe.(2000). Investigations of quality aspects of tuna catches of multi-day boats at the Negombo fish landing site, in Sri Lanka. Sri Lanka Journal of Aquatic Sciences. 5(2000): 1-00

Senadheera, S. D, Wanninayake, W. M.T.B & Jayasooriya , S.P. (2000) "Assessment of selected microbial flora in some edible ivalve mollusks in four major lagoon systems of Sri Lanka" Proceedings of the 6th annual session of the Sri Lanka Association for Fisheries and Aquatic Resources (SLAFAR), Colombo, Sri Lanka.

Chamila C.V.L. Jayasinghe, Naohiro Gotoh and Shun Wada (2000) "Lipid composition and triacylglycerol molecular species distribution in liver oil of shark species caught around the Sri Lanka" Oil Chemist Society world congress 2000 kyoto Japan October 2000.

Crooos, M.D.S.T. De , Jayasinghe, J.M.P.K. , Silva D.N. De. (2000) Muscle lipid composition of wild and cultured *penaeus monodon* and possible effects of the white spot syndrome on muscle lipid content and fatty acid profile of cultured prawns. Annual sessions, faculty of Science, University of Colombo.

Jayasinghe P.S., (2000)"Microbial quality of Jaadi stored in different packing methods" Proc. 6th Annual Session SLAFAR, Colombo, Sri Lanka.

Research Reports

- Development convenience foods from inland fish species.
- Development of minimally processed instant vegetable product from Lotus bamboo (Nelumbium stylone)
- Investigation of microbiological quality of natural water resources for the shrimpculture in North Western Coast
- Investigation of the effect of different sugar concentrations on micro flora in pond water for shrimp culture
- Histamine concentration of Fish & Fishery products.
- Market survey of pathogenic bacteria in Fish outlets in Central Province.
- Influence of white spot disease on lipid content and fatty acid profile of Peneus monodon
- Development of food supplement from Aquatic resources to combat malnutrition

ENVIRONMENTAL STUDIES DIVISION

Programme 1 : Studies of Pollution Levels

Project 1.1 : Study of the water quality status and pollution levels in the marine coastal waters of Sri Lanka.

The coastal water bodies in the Galle and Matara Districts were studied for the purpose of compiling the baseline data on the quality of water and pollution status of coastal waters and for developing and upgrading a comprehensive data base on the water quality and to determine the sensitive areas in the coastal zone. The environmental conditions were noted and important water quality parameters were studies.

The results show that the water bodies show considerable variations among the stations and the seasonally in salinity depending on the opening to sea pollution in terms of the general parameters is not in a considerable level in the selected water bodies. Availability of baseline data necessary for the development projects and planning and management activities of the coastal environment.

Project 1.2: Study of the Effects of Land based pollution in Selected Areas on Water Quality and Aquatic Organisms

The study conducted with the objectives of studying the status of pollution of the Negombo Lagoon and studying the effects water quality change on the aquatic environment and organisms in the lagoon.

The Negombo Lagoon was identified for the study as the impute of pollutants due to industrial effluent, urban waste, agricultural runoff etc. and activities related to fisheries are common in the area. The seasonal occurrence of filamentous green algae was studied and the area of extent of algae and the dead algae layer was estimated.

The levels of nutrient i.e. Ammoniacal Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen and Phosphates were determined. The benthic organisms were collected and stored. The identification is in progress. Reporting on the land based sources of pollution, existing pollution stoups of the lagoon, effects on the ecosystem and impacts on aquatic organisms.
Submission of a comprehensive report on the filamentous algae to the Negombo Lagoon Integrated Resources Management Project of the CEA.

Project 1.3: Study on the persistent/toxic chemicals and radioactive residues in fish, sediment and water.

The project objectives are determination of the levels of chemical contaminant in the edible fish varieties and in the environment and studying the potential exposure of fish to the redioactive substances

Very few studies have been done in the accumulation of pollutants in aquatic environment. The information of the possibility of contaminating the fish in Sri Lantern waters due to radioactive substances is not available. The accumulation of toxic constants can cause various degrees of health risks in the consumers of aquatic products. Since most of the countries enforcing regulations on the quality of fisheries products, this has a direct impact on the country's economy. energy Authority and Radio Isotope Center of the Colombo University are the collaborating agencies of this study. The samples are being analyzed at above two agencies and the results are due soon.

The results of analysis from the Radio Isotope Center, University of Colombo and Atomic Energy Authority have still not been received.

Programme 2 : Quality Assessment Natural Research

Project 2.1: Assessment of ground water resources, quality and impacts of human activities

The objectives of the study were determining the quality of ground water in Kalpitiya peninsula and making recommendations on the sustainable utilization of ground water resources

The ground water resources in the Puttalam district are heavily exploited for agriculture and shrimp culture purpose. Leaching out of the agrochemical residues into the aquifer is a possibility in the ground water dependent agricultural areas. Little information is available on the quality of ground water and quantities that can be extracted in a sustainable manner. The results were compared with the quality requirements for each use and following findings were recorded. The results were compared with the quality requirements for each use and following bindings were recorded. The quantitative aspects of the resource are being studied by an external consultant.

The pH and Dissolved Oxygen level in wells used for shrimp farming are not in acceptable level. Apart from Ammonia, other parameters studied are good for the purpose in drinking water wells, Electrical conductivity and Chloride levels are higher in Agricultural wells in Kalpitiya Peninsula. It was revealed that the farmers use excessive fertilizers and other agrochemical without considering the field situation in the area. The findings of the present study can be used for the future development planning purpose in the area and the other similar areas in the country.

This programme was foreign funded.

Seminars / Workshops Attended / Organized

- Mrs.R.K.V.J.Gunasekera participated in the training programme on Analysis for radio activity at PINSTECH, Pakistan.

- Mr. M.H.S.K.Abhayarathna received training in Analytical Techniques in Aquatic Toxicology and Mrs. B.R.C.Mendis in Biological Indicators of Water Pollution-both at Deakin University, Australia.

Extension Work

Mr. N.H.Dassanayake delivered lectures on Coastal Pollution for school children organised by Marine Pollution Prevention Authority.

Consultancy

Test Services were provided to nine industrial establishments related to effluent discharges. All such work was paid for by the client.

Achievement - 80%

Meetings attended

ESD personnel attended meetings related to Environmental Impact Assessment of new projects.

Publications

Report on the Establishment of Coastal Pollution Monitoring Programme for the Hambanthota Integrated Coastal Zone Management Project (HICZMP). Report submitted to the HICZMP, CCD and NARA.

Distribution of Filamentous Algae in the Negombo Lagoon. Report submitted to Integrated Resources Management Project, CEA and NARA.

Assessment of ground water resources in selected areas in North Western Province. Dissertation submitted based on the work at ESD to the Postgraduate Institute of Science, University of Peradeniya by the research student H.M.S. Herath Menike For M.Sc. in Environmental Scinece.

Report on the fish kill in the Mahawewa in Maeliya in Kurunegala District by S.A.M.Azmy and P.K.M.Wijegoonawardena.. Report submitted to Secretary/MFARD.

Report on the fish kill in the Beira lake by S.A.M.Azmy Report submitted to Secretary/MFARD

LIBRARY AND INFORMATION DIVISION

Programme 1: Library Resources

Project 1.1 : Acquisition of Library Resources / Strengthening Library Resources

Books

- Acquisitions: 346 books received by the Library during the year
- 127 books were received complementary though Library cooperation.
- 141 books were purchased
- Other books were received as depository copies

Scientific Journals

Proforma invoices were requested for 24 titles and only 17 have been received. Payments were made for 14 titles. Payments for the rest had to be delayed due to the limitations of funds.
Journals – 08 (Received)
Magazines – 18

Reader Services and Information Dissemination

Monthly Acquisition Lists were sent to

Chairman
Director General
All Heads of Divisions
Chief Administration Officer
Accountant

Current contents page service extended to

Heads of Divisions, NARA
10 outside Libraries

Reader Services – extended to NARA Staff through

Lending
ASFA Searching
Referral
SDI
Current Contents
Inter Library Loan

Programme 2: Dissemination of Information

Project 2.1: Secondary database collection

Disseminated information through CD's and Internet

Project 2.2 : Electronic Publishing in Internet

This programme was initiated with the financial assistance received from Sida / SAREC Information Technology Project operated through Institute of Computer Technology. Therefore the treasury fund allocated for the project was transferred to the programme No.1.

During the year, Network cabling, consisting UTP and fiber optics, were completed in order to set up Local Area Network with in the NARA. Total information outlets provided to NARA are 138. The dedicate line connection between NARA and Lanka Education and Research Network (LEARN) was delayed due to unavalability of DSU's and routers In Sri Lanka Telecom who is the selected dedicate line connection provider for the project. At the year-end 03 servers, which required to set-up Network functions were received. Configuration and setting up of Proxy, Email, Web and Network Address Translation (NAT) servers were carried out with the assistance of Computer Engineering Department of University of Moratuwa. Due to the delay of dedicated line, the registration of NARA web site could not be completed. However arrangements have been made for compilation of the NARA web site by Month of Febrary 2001.

Project 2.3 : Establishing a secondary database collection

The objective of the project is to build up a collection center to collect electronoc databases relating to aquatic resources and to produce CD ROMs relating to the field. During the year, subscription was made to Aquatic Science & Fisheries Abstract (ASFA). 03 CD ROMs received from the different organizations freely.

About 500 searches were done during the year for Aquatic Science and Fisheries Abstract (ASFA) CD database. Fish base, Reef base, Marine Lobsters searches were also done.

Programme 3: Automation

Project 3.1 : Automation of Library

The main project objective is to set-up an automated library system in order to prevent difficulties encountered in previous year and to provide Internet accesses to NARA Library database. Software, "Alice" for Windows, has been purchased with the assistance from Sida/SAREC IT project. The software provider completed fundamental trainings for the Library staff at the end of December. Data entering is continuing and data records were created for error detection purposes.

Programme 4: GIS

Project 4.1 : preparing Spatial Database to identify user conflicts on resources In Negombo Lagoon – Planning Information Unit.

During the year, the unit completed Base map layers pertaining to topography around Negombo Lagoon using map sheets of Department of Survey and GPS. The basic information relating to administration of the area was compiled. In order to detect coastal changes and land use pattems preparation of mosaic form aerial photographs has been undertaken.

In addition, assistance was provided to following consultancy projects

1). Hambantota Integrated Coastal Zone management project - Detail map preparation for following themes on Hambantota District

- Fish landing sites and Chank and lobster fishing areas
- Monitoring sites and pollution points
- Monitoring sites for Benthic communities
- Sea grass distribution in Rekawa, Malala, Embilikala, Kalametiya and Mawella Lagoons.

2). Filamentous Algae Distribution in Negombo Lagoon

- Distribution of sea grass beds
- Variations in monthly distribution of filamentous algae (06 maps)
- Estimation of area of detritus along eastern bank

Programme 5: Resource Sharing

Project 5.1 : Resources Sharing/Interaction with other agencies, through Library network

Preparation of an article index for Fisheries Research Station Bulletin and NARA Journals. Entering Article titles was completed.
Inter Library Loans – 02 Books
Reprints (articles) sent on requests – 05
Exchange – 02 (Ambio) (Conservation Science)
Around 150 papers have been collected up to November 2000

Programme 6: Subject Profiles

Project 6.1 : A Glossary on Fisheries and Aquaculture Related Subjects.

- About 605 English Technical terms related to the title were collected
- Appropriate Sinhala words to those terms were furnished
- Collected terms were processed into alphabetical order
- Work is in progress

Programme 7 : Extension

Project 7.1 : Programme Development

Workshops

A workshop on "Capacity Enhancement of Mundal Lake and Dutch Canal System for Sustainable Multiple Use" was organized in corporation with Wayamba Development Project and was successfully conducted with around 100 participants at NARA Auditorium on 20th of June 2000.

Conducting of Training Courses

Three training courses were carried out on "Culture, Breeding and Management of Ornamental Fish

From 9th – 10th of February 01	-	Two days course
From 10th May – 08th June	-	Eight days course
From 15th – 16th November	-	Two days course

Exhibitions

"Min Visithuru " Exhibition for Fisheries week at BMICH. Participated actively in this exhibition to maintain a stall for NARA from 28th November to 03rd December 2000. Sales worth of around Rs.12,000 was achieved at this stall.

Achievement: 90%

Other Activities

Development of Auditorium Facilities

- Existing air-conditions at NARA main auditorium were replaced by new ones

Provision of Auditorium Facilities

- Facilities were provided for external institutions as well as for in house meetings and other functions as and when required.

Photographic Facilities

- Photographic Services were provided as and when required. Albums were prepared and submitted to Director General.

Video Production

- A video documentary on Mundal Lake was prepared.

Video Supportive Facilities

- New video editing system was purchased
- Editing console was establised

Other involvements of the division

Reorganization of Library Collections

As per the instructions given by Dr. Adrian Senadheera, books received before 1990 were separated from the Library book collection. Then 1985-1990 the books considered as important were again collected and added back to the Library book collection.

Training

Windows based application package 19.04.2000 – 23.04.2000 at Institute of Government Accounts and Finance.

Publications

Annual Report

- Sinhala Translation of the 1998 Annual Report was completed
- 1999 Annual Report collected from the division was compiled into a report

NARA Journal

- Two editorial board meetings were held during the year on the 18th of January 2000 and on the 17th November 2000. The eight papers received for the coming issue of the journal (Vol.36-2000) were sent to the referees appointed by the board and the papers appraised were returned to authors for necessary revisions. All revised papers were collected back before the 2nd editorial board meeting. Payments were made to all referees.

- Since the 2nd editorial board meeting Mrs. S. Thalakada the Chief Librarian assumed responsibilities as the editor. The new set of guidelines formulated by the editor, has been sent to the authors together with their papers in-order to standardize the journal according to the ISO standards level.

NARA Puwath

- " NARA Puwath " volume No.03 Issue 01 was published during July 2000.
- Articles are being collected for the next issue

Leaflets

- Leaflets on Knife Fish, Piranha, Turtles, Crab fattening, and Oceanography were designed and printed as extension materials

GENERAL ADMINISTRATION

RECRUITMENTS

01. Permanent - 10

System Analyst/Programme - 01

Cartographer - 01

Internal Audit - 01

Chief Librarian - 01

Research Officers - 05

Draughtsman - 01

02. Contract Basis – 08

Engine Room Technic - 01

Research Assistan - 01

Skipper - 01

Labourers - 02

Sanitary Laboure - 01

Research Office - 01

Consultant - 01

03. Casual Basis - 18

Research Assistants - 07

Labourers - 02

Drivers - 04

Sampler- 01

Clerk - 01

Typist/Data Entry Operator - 01

Store-Keeper - 01

Technical Assistant (Mechanical) - 01

04. Secondment Basis - 01

Surveying Recorder - 01 (NHO)

05. Promotions

Internal promotions were given to 13 employees

DEPARTURES

01. Retirements – 02

Research Officer - 01

Chief Cartographer – 01

02. Resignations - 08

Research Officers - 03(FTD. MBRD, Oceanography)

Research Assistants – 02 (PHTD, MBRD)

Data Entry Operator - 01 (SED)

Skipper (Sayuri) - 01

Laboratory Labourer - 01(FTD)

03. Vacation of Post - 03

System Analyst/Programmer - 01

Seaman - 01

Labourer - 01(ESD)

04. Demises - 01

Welder - 01

VACANCIES

01. Head Office

Research Officers - 04

Research Assistants - 01

Audit Clerk - 01

Typist (English) - 01

Caretaker / Cook - 01

Driver - 01

Lab Attendant - 01

Supervisor (Mechanical)- 01

Labourers - 02

Welder - 01

02. Research Vessel 'Samudramaru'

Captain - 01

Chief Officer -01

Chief Engineer - 01

E R A - 02

Deckhand - 01

Seaman - 01

03. National Hydrographic Office

Deputy Director/Hydrogarpher - 01

Chief Hydrographic Surveyor - 01

Hydrographic Surveyors - 08

Land Surveyor - 01

Chief Cartographer - 01

Deputy Chief Cartographer - 01

Cartographer - 01

System Analyst / Programmers - 02

Draughtsman - 01

E D P Assistant - 01

Office Assistant - 01

Purchasing Officer- 01

04. Rekawa Regional Research Center

Research Officer - 01

Clerk / Store-Keeper - 01

Labourer - 01

Watcher- 01

DISCIPLINARY INQUIRIES

Labour Court Cases

Mr Gratien Fernando

Ms Suramya Wijesekara

The case is being heard at the labour courts

Mr Upali Edirisinghe

The case is being heard at the labour courts

Supreme Court Cases

Mr T S Dharmarathna

Mr Denise Fernando

Refusal of permission for Prawn kraals at Chilaw – Case is being heard

Disciplinary inquiry against the Accountant – Mr Y Samararathna is being conducted

Interdictions

Mr Sarath Wijesiri - Samudra Maru

Mr H A Donald Perera - IARAD

Mr A M Pushpananda - IARAD

Welfare

Piliyandala - NARA

Kottawa - NARA

Gampaha- NARA

Borella - NARA

Fort - NARA

Negombo – NARA

These transport services are maintained for employees on concessional rates. An extra bus was allotted from 07/11/02 to provide more space for passengers

Construction Work

A building for a laboratory was constructed for Trincomalee Regional Research Center

SCHOLARSHIPS TRAININGS/SEMINARS/CONFERENCES & PERSONAL TOURS ABROAD-2000

NAME	COUNTRY	PERPOSE	PERIOD	FUNDS	ACTING ARRANGEMENT	DL/PL
Mr.J.K Rajapakshe Research Officer (Ocea. Divi.	India	Training Programme	16.01.2000 27.01.2000	Indo –Sri Lanka Sub-Commission in Science & Technology.	Mr.T.S. Dharmarathne	D/L
	Thailand	IAEA/RCA Regional Training Course on Application of Tracers to study Transport processes and Sedimentation Rates in the Marine Environment	21/02/2000 04/03/2000	International Atomic Energy Agency	Mr.H.B.Jayasiri	D/L
Mr.P.A.T. Fernando Research Officer (MBRD)	India	Training Programme	17.01.2000 27.01.2000	Indo –Sri Lanka Sub-Commission in Science Technology. UNESCO	Mr.P.D.K.D. Amarasooriya	D/L
	India	GCRMN South Asia Training Workshop in Survey Design & Data Analysis.	01.05.2000 12.05.2000	GCRMN	Mr.P.D.K.D. Amarasooriya	
	Thailand	Workshop on remote Sensing & GIS Application for Coastal Zone Management	05/11/2000 18/11/2000	NASDA (National Space Development Agency)	Mr.P.D.K.D. Amaraooriya	D/L
Miss M.H.S. Ariyarathne Research Officer	Thailand	To presentation a paper	15/02/2000 18/02/2000	ACIAR – Project	Mr.R.G.S. Wijesekara	D/L
Mr.H.B. Jayasiri Research Officer	Iran	3rd Session of the IOC Regional Committee for the Northern & Central Indian Ocean & Regional Workshop on Integrated Coastal Area Management.	19/02/2000 23/02.2000	Intergovernmental Oceanographic Commission	Mr.E.M.S. Wijerathne	D/L
	India	Training Programme in Modeling & Monitoring of Coastal Marine Process.	06/11/2000 17/11/2000	IOC & NSF	Mr.J.K. Rajapakshe	D/L
Mrs.V. Pahalawatta-arachchi Research Officer OIC Kadolkale RRC	Thailand	Study Tour on Mangroves & Sea grass Research.	20/03/2000 30/03/2000	SIDA/SAREC Project	Dr.S.C. Jayamanne	D/L
	Sweden	For Ph.D. Studies	28/08/2000 31/10/2000	SIDA/SAREC Project	Mr.P.A.D.A. Kumara & Mrs.A.D.W.R. Rajapakshe	D/L
Mr.N.H. Dassanayake	India	Workshop on Esturine Systems of the South Asia Region	14/02/200018/ 02/2000	Institute of LOCZ (Land Ocean Interaction	Mr.S.A.M.Azmy	D/L

Research Officer Head/ESD				Coastal Zone)		
Mr.P.D.K.D. Amarasooriya Research Officer (MBRD)	USA	To participate 20th Annual Symposium on Sea Turtle Biology & Conservation (To present a paper)	29/02/200004. 03/2000	NARA	Mr.P.A.T. Fernando	D/L
Mrs. P.K.M. Wijegoona-wardena Research Officer (IARAD)	Thailand	Workshop on Molecular diagnosis for shrimp viruses in the Asian Region	21/03/2000-25/03/2000	ACIAR	Mr.H.M.P.Kithsiri	D/L
Dr.P.P.G.S.N .Siriwardena Head/IARAD	Thailand	Conference on Aquaculture in the 3rd Millennium and other Assignments.	17/02/200010/ 03/2000	NACA	Dr.W.M.T.B. Wanninayake	D/L
	Bangladesh	NACA Mission To Assist with the implementation of a case study on Shrimp aquaculture.	02/07/2000 09/07/2000	NACA	Dr.W.M.T.B. Wanninayake	D/L
	Philippines	Workshop on Utilization of different aquatic environments for small- scale aquaculture.	18/09/2000-28/09/2000	IIRR (International Institute of Rural Reconstruction)	Dr.W.M.T.B. Wanninayake	D/L
	Australia	To attend Expert consultation on Good Management Practices & Good Institutional & legal Arrangements for Shrimp Culture.	04/12/2000 07/12/2000	FAO	Dr.S.C. Jayamanne	D/L
Mr.D.L.P. Hewage Hydrographic Officer (NHO)	Japan	Programme of Hydrographic Survey (International Accredited Category "B" Course) – Japan.	04/04/2000 12/11/2000	JICA	Mr.S.N.S. Amarasinghe	D/L
Mr.S.A.M. Azmy Research Officer ESD	India	Regional (RCA) workshop on Advanced Application of Radiotracers to study effluent dispersion into Sea.	23/04/2000 30/04/2000	International Atomic Energy Agency	Mr.N.H. Dassanayake	D/L
Mr.A. Rajasuriya Research Officer	India	GCRMN South Asia Training Workshop in Survey Design & Data Analysis	01/05/2000 12/05/2000	GCRMN	Mr.L.Ginige	D/L
MBRD	Indonesia	To attend 9th international Coral Reef Symposium	22/10/2000 28/10/2000	GCRMN	Mr.L/Ginige	D/L
Mr.M.M.C. Karunarathne Assistant Diver	India	GCRMN South Asia Training Workshop in Survey Design & Data Analysis	01/05/2000 12/05/2000	GCRMN	Mr.Mr.H.M. Wasantha Bandara	D/L
(MBRD)	Indonesia	To attend 9th international Coral Reef Symposium	22/10/200 28/10/2000	David & Lusily Foundation	Mr.W.D.Me de Mel.	D/L
Mr.E.M.S. Wijerathne Reseach Officer/Ocean	Thailand	Regional (RCA) Workshop on Application of Radio Tracer Techniques to the validation of sediment transport models.	24/05/2000 30/05/2000	International Atomic Energy Agency	Mr.K. Arulananthan	D/L
Division.	Sweden	For Ph.D Studies	15/08/2000 20/11/2000	SIDA/SAREC Project	Mr.J.K. Rajapakshe	D/L
Mr.M.A. Ariyawansa Head/NHO	South Africa	Seminar on the Extended Continental Shelf.	29/05/2000 31/05/2000	NARA	Mr.K.S.Fernando	D/L
Dr.D.S. Jayakody Director General	United Kingdom	Discussion of the Progress of two Postgraduates students of NARA(Mrs.Maldeniya and Mr.Jayawardena)	24/07/2000-04/08/2000		The Chairman & Chief Admini. Officer	D/L

	Seychelles	5th Session of the Indian Ocean Tuna commission	11/12/2000 15/12/2000	NARA	The Chairman & Chief Admini. Officer	D/L
Mr.M.H.S.K. Abeyrathne Research Assist./ESD	Australia	Training on Analytical Techniques in Aquatic Toxicology.	01/08/2000 28/08/2000	Asian Development Bank	Mr.RW.Fernando	D/L
Mrs.B.R.C .Mendis Research Assis./ESD	Australia	Training on Biological Indicators in Aquatic water Pollution	01/08/2000 28/08/2000	Asian Development Bank	Mr.R W.Fernando	D/L
Mr.K. Arulananthan Research Officer Oceano. Division	Sweden	For Ph.D Studies	15/08/2000 20/12/2000	SIDA/SAREC Project	Dr.T.K.D Tennakoon	D/L
Mrs.K.W.S. Ariyawansa Research Officer-IPHT	Iceland	Training on Quality Management of Fish Handling & Processing	21/08/2000 /02/2001	United Nation University	Miss G. J. Ganegama-arachchi	D/L
Mrs.R.R.P. Maldeniya Research Officer/MBRD	United Kingdom	For Ph.D Studies	01/09/2000 31/05/2001	SIDA/SAREC Project	Dr.C.Amarasiri	D/L
Mr.P.A.A.T. Jayawardena Research Officer	United Kingdom	For Ph.D Studies	01/09/2000 31/05/2001	SIDA/SAREC Project	Dr.C.Amarasiri	D/L
Dr.C.Amarairi Research Officer Head/MBRD	Thailand	Study Tour	20/08/2000 29/08/2000	SIDA/SAREC Project	Mrs.R.R.P. Maldeniya & Co-ordinating work of SAREC Project Dr.J.M.P.K. Jayasinghe	D/L
	Seychelles	2nd meeting of the working party on Data Collection & statistics & 3rd session of the Scientific Committee	04/12/2000 08/12/2000	NARA	Mr.P.A.T. Fernando & Co-ordinating work of SAREC Project – Dr.J.M.P.K. Jayasinghe	D/L
Mr.S.P. Vidanage Economist & Head/SED	Indonesia	To attend 9th International Coral Reef Monitoring Symposium.	22/10/2000 28/10/2000	GCRMN	Mr.S.S.K. Haputhanthri	D/L
Mr.N.B.P. Punyadewa Research Officer(FTD)	Thailand	Training on Environmentally friendly Fishing Methods	25/09/2000 24/10/2000	Asian Development Bank	Mr.S.S.K. Haputhanthri	D/L
Mr.S.SC. Peiris Research Assistant (FTD)	Thailand	Training on Environmentally friendly Fishing Methods	25/09/2000 24/10/2000	Asian Development Bank	Mr.W.G.Sirisena	D/L
Mr.M.G.K. Gunawar-dena Research Assistant MBRD	Thailand	Training on Environmentally friendly Fishing Methods	25/09/2000 24/10/2000	Asian Development Bank	Mr.R.A.M. Jayathilake	D/L
Mr.H.A.R.E. Perera Research Assistant	Thailand	Training on Environmentally friendly Fishing Methods	25/09/2000 24/10/2000	Asian Development Bank	Mr.T.A. Rajapakshe	D/L
Mr.W.D.A.J.P Wijendra Research Assistant	Italy	Earth Systems Science Course in Watershed & Coastal Zone Simulation Modeling	02/10/2000 13/10/2000	ICTP (International Centre for Theoretical Physics	Mr.B.H.M.de Silva.	D/L

Ocean. Division						
Mr.D.A. Athukoral Research Officer IARAD	China	Training workshop on Inland Fisheries Management & Aquaculture for Sustainable Development	15/10/2000 10/11/2000	NACA (Network of Aquaculture Centre in Asia)	Mr.H.M.P.Kithsiri	D/L
Miss G.J. Ganegama-arachchi Research Officer IPHT	India	UNESCO MIRCEN Workshop	30/10/2000 04/11/2000	UNESCO & NARA	Mss. S.P.S.D. Senadheera	D/L

<u>විගණකාධිපති සටහන</u>

රාෂ්ට්‍රීය ඵලදා සම්පත් පර්යේෂණ සහ සංවර්ධන නියෝජිතායතනයේ 2000 දෙසැම්බර් 31 දිනෙන් අවසන් වර්ෂය පදනම් වූ මූල්‍ය ප්‍රකාශන 1971 අංක 38 දරන මුදල් පනතේ 13(1) වගන්තිය සමඟ සංයෝජිතව කියවිය යුතු ශ්‍රී ලංකා ප්‍රජාතාන්ත්‍රික සමාජවාදී ජනරජයේ ආණ්ඩුක්‍රම ව්‍යවස්ථාවේ 154 (1) ව්‍යවස්ථාවෙහි ඇතුළත් විධිවිධාන ප්‍රකාර මාගේ විධානය යටතේ විගණනය කරන ලදී.

මුදල් පනතේ 14(2)(සී) වගන්තිය ප්‍රකාර ප්‍රකාශයට පත්කළ යුතු මෙම මූල්‍ය විමසුම් පිළිබඳ මාගේ නිරීක්ෂණයන් රාෂ්ට්‍රීය ඵලදා සම්පත් පර්යේෂණ සහ සංවර්ධන නියෝජිතායතනයේ සභාපතිවරයා අමතන ලද සමදින දරන මාගේ වාර්තාවේ ඇතුළත්ව ඇත.

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<u>NOTE OF THE AUDITOR GENERAL</u>

The accounts of National Aquatic Resources Research and Development Agency for the year ended 31 December 2000 were audited under my direction in pursuance of provisions in Article 154(1) of the Democratic Socialist Republic of Sri Lanka read in conjunction with Section 13(1) of the Finance Act No. 38 of 1971.

My observations on these accounts that should be published in terms of Section 14(2)(c) of the Finance Act are contained in my report of even date addressed to the Chairman of the National Aquatic Resources Research and Development Agency.

(Sgd. S.C. Mayadunne)
Auditor General
// April 2002
Auditor General's Department,
Colombo 07.

NATIONAL AQUATIC RESOURCES RESEARCH & DEVELOPMENT AGENCY

BALANCE SHEET AS AT 31-12-2000

283,215,380	CAPITAL GRANT	(13)		342,615,380.00
267,895,663	REVALUATION RESERVE	(14)		267,855,663.60
143,840,997	FOREIGN GRANT	(15)		143,840,997.00
22,330,225	LOCAL GRANT	(16)		22,330,225.00
(397,097,360)	EXCESS OF EXPENDITURE OVER INCOME			(463,850,389.44)
320,184,905				313,091,876.16
	FIXED ASSETS			
81,708,955	FREE HOLD LAND	(17)	81,708,955.00	
9,493,508	LEASE HOLD LAND	(17)	9,493,508.00	
71,792,379	BUILDINGS	(17)	73,129,901.55	
1,530,900	MACHINERY	(17)	1,317,020.00	
51,090,523	EQUIPMENT	(17)	67,936,378.03	
6,592,090	COMPUTERS & PRINTERS	(17)	7,041,729.25	
10,598,455	VEHICLES	(17)	7,073,538.04	
466,429	BICYCLES	(17)	309,197.00	
6,191,399	FURNITURE & FITTINGS	(17)	6,310,869.82	
4,611,760	LIBRARY BOOKS	(17)	5,469,797.00	
110,705	FISH TANKS	(17)	135,943.00	
449,333	ENGINEERING EQUIPMENT & TOOLS	(17)	489,399.38	
31,390	ADMIRALTY CHARTS	(17)	27,168.00	
75,404,174	BOATS & VESSELS	(17)	64,808,002.00	
320,072,000				325,251,406.07
2,730,324	WORK IN PROGRESS			4,514,963.06
	CURRENT ASSETS			
3,090,873	STOCK AS AT 31.12.1999	(18)	2,743,507.06	
2,417,572	DEBTORS & PREPAYMENTS	(19)	1,874,407.19	
203,472	DEPOSITS	(20)	61,000.00	
489,465	ADVANCES	(21)	3,220,852.23	
7,157,292	DEBTORS (EMPLOYEES)	(22)	7,064,128.10	
7,886,617	CASH IN HAND & AT BANK	(23)	6,109,805.58	
21,245,291				21,073,700.16
	CURRENT LIABILITIES			
12,716,202	CREDITORS & ACCRUED EXPENDITURE	(24)	21,038,632.04	
220,831	PROJECT CREDITORS	(25)	2,840,384.82	
1,563,448	CONSULTANCY PROJECTS	(26)	999,946.52	
14,500,481				24,878,963.38
6,744,810	NET CURRENT ASSETS			(3,805,263.22)
(9,362,229)	DEFERRED LIABILITIES	(27)		(12,869,229.75)
320,184,905				313,091,876.16

Prof.P.W.Ebasinghe
CHAIRMAN

M.A.R.Kularatne
DIRECTOR GENERAL

M.D.Senarathne
ACCOUNTANT

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கணக்காய்வாளர் தலைமை அதிபதி திணைக்களம்
AUDITOR-GENERAL'S DEPARTMENT

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දිනය / திகதி / Date 17 April 2002

The Chairman,
National Aquatic Resources Reserch and
Development Agency. (NARA)

Report of the Auditor General on the Accounts of the National Aquatic Resources Research and Development Agency (NARA) for the year ended 31 December 2000 in terms of Section 14(2)(c) of the Finance Act No.38 of 1971.

The audit of accounts of the National Aquatic Resources Research and Development Agency (NARA) for the year ended 31 December 2000 was carried out under my direction in pursuance of provisions in article 154(1) of the Constitution of the Democratic Socialist Republic of Sri Lanka read in conjunction with Section 13(1) of the Finance Act. No.38 of 1971. In carrying out this audit, I was assisted by a firm of Accountants in public practice. My observations which I consider should be published with the annual report of the agency in terms of Section 14(2)(c) of the Finance Act appear in this report. A detailed report in terms of Section 13(7)(a) of the Finance Act was forwarded to the Chairman of the Agency on 02 January 2002.

1:2 Scope of Audit

Audit comments and findings in this report are based on a review of the financial statements presented to audit and substantive tests of samples of transactions. The scope and the extent of such review and tests were such as to enable as wide an audit coverage as possible within the limitations of staff, other resources and time available to me. The audit was carried out in accordance with Sri Lanka Auditing Standards, methods and practices to obtain reasonable assurance as to whether the financial statements are free of material misstatements. The audit included examination of evidence supporting the amounts and disclosures in financial statements and assessment of accounting principles and significant estimates and judgements made in the preparation of financial statements, evaluation of their overall presentation and determining whether accounting policies adopted were appropriate, consistently applied and adequately disclosed. Sub-sections (3) and (4) of Section 13 of the Finance Act,No.38 of 1971 give discretionary powers to the Auditor General to determine the scope and extent of the audit.

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2. Accounts

2.1 Audit Opinion

Except for the effects of the adjustments arising from the matters referred to in paragraph 2:4 of this report, I am of opinion that the financial statements have been satisfactorily prepared to present fairly in all material respects, the financial position of the Agency as at 31 December 2000 and the results of its operations and cash flow for the year then ended in accordance with Sri Lanka Accounting Standards and the stated accounting policies as set out in Notes No.1 to 7 to the financial statements.

2.2 Financial Results

A summary of the financial results for the year under review and preceding year is given below.

	Year ended 31 December	
	2000	1999
	Rs.	Rs.
Grants		
Government Contribution	60,500,000	49,500,000
Other contributions(Capital Projects)	4,741,021	3,522,251
	65,241,021	53,022,251
Expenditure		
Administration	77,113,658	66,383,099
Establishment	22,572,822	17,982,498
	99,686,480	84,365,597
Depreciation	34,236,301	23,228,650
	133,922,781	107,594,247
Deficit for the year	(66,493,029)	(49,765,392)
Accumulated deficit brought forward	(397,097,360)	(347,331,968)
Revaluation Reserve	40,000	
Accumulated deficit carried forward	(463,550,389)	(497,097,360)

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2.3 Financial Structure

According to the accounts presented, the summary of the financial structure of the Agency as at 31 December 2000 compared with that as at 31 December 1999 is given below.

	As at 31 December	
	2000	1999
	Rs.	Rs.
Resources		
Net total Contribution	508,786,602	449,386,602
Revaluation Reserve	267,855,663	267,895,663
Accumulated Deficit	(463,550,389)	(497,097,360)
	313,091,876	320,184,906
Utilization		
Fixed Assets	325,251,406	320,072,000
Work-in-progress	4,514,963	2,730,324
Net Currents Assets	(16,674,493)	(2,617,418)
	313,091,876	320,184,906

2.4 Comments on Accounts

2.4.1 Inappropriate Disclosures in the Accounts

Following inappropriate disclosures in the accounts were observed.

(a) A sum of Rs.855,139 paid to a private party on account of laboratory equipment during the year under review had been erroneously shown as a capital commitment as at 31 December 2000.

(b) Depreciation charged against the computers at 20 % per annum, appears to be inadequate as the Informations Technology is changing rapidly, in that these computers would be outdated or redundant before the expiry of 5 years. It was further observed that the capital allowances for computers and other accessories could be obtained at 33 1/3 % per annum as per the provision under the Inland Revenue Act.

2.4.2 Overstatements and Understatements in the Accounts

Following overstatements and understatements were observed.

(a) Gratuity provision was understated by Rs.19,502 due to incorrect calculaton made during the year.

(b) Printing charges and prepayments were understated by Rs.95,850 and Rs.65,800 respectively due to incorrect postings against each account.

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2.4.3 Accounts Receivable and Payable

The following observations are made.

(a) A sum of Rs7,168 deducted from salaries of respective employees as SNC had been shown as unpaid in the accounts, disregarding the provision of letter dated 14 March 1996 issued by the Commissioner General of Inland Revenue.

(b) Special advances aggregating to Rs.184,732 given to the staff during the period 1991 - 1999 had not been recovered during the year as well, further, the source documents in respect of these advances are also made available for audit.

2.4.4 Lack of Evidence for Audit

The following items in the accounts could not be satisfactorily vouched or accepted in audit due to lack of evidence indicated against each item.

	Item	Value	Evidence not available
(a)	Debtors, Deposits and Advances	11,694,602	(i) Confirmations (ii) Source/Supporting documents (iii) Invoices etc.
(b)	Fixed Assets	325,251,406	(i) Register of Fixed Assets (ii) Board of Survey Reports
(c)	Vehicles (Revalued)	12,000,000	(i) Valuation Certificates (ii) Log Books Certificates of Registration, etc.

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2.4.5 Non-compliance with Laws, Rules, Regulations and Management Decisions

Instances of non-compliance observed in audit are given below.

Reference to Laws, Rules Regulations and Management Decisions :	Particulars
(a) Finance Act, No.38 of 1971 - Section 12	Approval of the relevant Minister with the concurrence of the Minister of Finance had not been obtained for the form and contents of the annual accounts.
Section 13(5)(b)	Report on accounts as specified by the Auditor General had not been furnished along with the accounts.
Section 13(6)	Accounts were rendered for audit only on 21 September 2001.
Section 14(1)	A copy of draft annual report had not been submitted within four months after the end of the financial year.
(b) Board Approval	Prior approval of the Board had not been obtained to make payments in excess of the amounts approved.

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(c)	Public Enterprises Circular No.116 of 24 January 1997.	A sum of Rs.156,129 had been paid, during the year under review, on account of repairs on eighty vehicles that belonged to the Ministry of Fisheries and Aquatic Resources Development.
(d)	Appropriation Act. No.6 of 2000-Section 5(2)	The grant received in respect of Capital expenditure aggregating to Rs.5,510,331 had been utilized for recurrent expenditure during the year.

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3. Financial and Operating Review

3.1 Apparent Management Inefficiencies

Following observations are made.

(a) A sum of Rs.12,460 belonging to the Agency had been lying at the Hulftsdorp District Court since 1995. No action had been taken to settle this matter even upto the date of this report.

(b) A sum of Rs.25,527 being surcharge recoverable from an employee in connection with a cash shortage in March 1993 had not yet been recovered.

(c) A Building had been erected on land at Trincomalee not belonging to the Agency. This building had been revalued at Rs.4,031,200 and shown in the accounts during the year under review as well.

(d) Purchase advances paid to private institutions, aggregated to Rs.143,000 and Rs.65,800 in 1996 and 1997 respectively. These had neither been recovered nor goods had been received by the Agency.

3.2 Repairs and Maintenance of Research Vessel. "Samudra Maru"

The research vessel "Samudra Maru" handed over by the Ministry of Fisheries and Aquatic Resources Development in February 1985 remained inoperative even as at 31 December 2000. The vessel had a crew of 10 upto 1999. It was reduced to 3 during the year under review and deployed them as security guards

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Following observations are made in this connection.

(a) Expenditure aggregating Rs.16,217,213 had been incurred on repairs and maintenance during past 15 years, ended 31 December 2000

(b) The annual cost of salaries and other related benefits of the crew of the vessel amounted to Rs.103,320.

(c) According to the Chairman's letter dated 28.02.2002, this vessel had been sold as scrapfor Rs.2,501,000.

3.3 Funding Arrangement for Provision for Payment of Gratuity

A sum of Rs.12,869,230 had been provided for gratuity as at 31 December 2000. However, a fund to settle the liabilities in future had not been created by the Agency.

3.4 Idle Resources

A certain portion of the land, some vehicles,etc remained idle during the year under review. Appropriate action had not been taken by the Agency to utilize these resources or to take appropriate alternative course of action.

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3.5 Cost of Personnel

A comparative statement of average cost of personnel for the year 2000 and 1999 analysed under each category is given below.

Category	No. of Employees		Average Cost per employee.	
	2000	1999	2000	1999
			Rs.	Rs.
Executives	69	78	167,565	143,883
Non-Executives	242	219	81,962	80,621
	311	297		

3.6 Vehicle Utilisation

The Agency owned a vehicle fleet of 43 vehicles as at the end of the year under review and it was 44 during the preceding year. Running and maintenance cost of this vehicle fleet during the year under review amounted to Rs.11,305,570 and during the preceding year amounted Rs.10,875,137 as shown below.

Item	Year ended 31 December	
	2000	1999
	Rs.	Rs.
Expenses on fuel	645,484	1,775,910
Repairs and maintenance	5,523,396	5,546,747
Drivers' salaries and overtime	5,136,690	3,552,480
	11,305,570	10,875,137
Hiring charges for Private vehicles	2,376,397	1,824,087
Total expenditure	13,681,967	12,699,224

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3.7 Budgetary Control

Significant variations were observed between budget and actual income and expenditure during the year under review thus indicting that the budget had not been made use of as an effective instrument of management control.

4. Systems and Controls

Deficiencies observed during the course of audit were brought to the notice of the Chairman of the Agency by my detailed report furnished in terms of Section 13(7)(a) of the Finance Act.

Special attention is needed in respect of the following areas of control.

(a) Fixed Assets
(b) Debtors and Creditors
(c) Advances for Purchases
(d) Budget
(e) Vehicle Utilisation
(f) Maintenance of proper booksof accounts
(g) Review and Appraisal of operations and records by the Internal Audit
(h) Segregation of functions and Delegation of Authority
(i) Accounting

(S.C. MAYADUNNE)
AUDITOR GENERAL.

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ACTIONS TAKEN ON THE COMMENTS MADE BY AUDITORS REPORT FOR THE YEAR 2000

2.4.1 Inappropriate Disclosure in the Accounts

- That statement is correct. The error in capital commitment of Rs. 855,139 referred to, has been shown as notes to the Accounts by an oversight in the date of payment. However, this has not affected the financial statement of accounts. Action has been taken not to repeat such errors

- The rate of depreciation for computers and printers has been increased from 20 to 33 1/3 in the year 2001 as recommended by auditors.

2.4.2 Overstatement and understatement in accounts

- Comment noted. This has been rectified in the accounts of year 2001

- Comment noted. Steps has been taken not to repeat such errors.

2.4.3 Accounts receivable and payable

- The amount referred to has been remitted in the year 2002 .

- It is correct that special advances amounting to Rs 276,539/- paid to the staff have not been recovered up to the end of year 2000. However all these advance have been recovered in year 2001 except for the following. Also we have made provisions in the accounts of year 2000 for which the recovery is doubtful. (Pl. see schedule 22-G)

Special Advance 1991

• W D G Fernando	Rs	2,000.00)	Pending LT cases
• W D G Fernando	Rs	3,500.00)	-do-
• W D G Fernando	Rs	2,000.00)	-do-
• W D G Fernando	Rs	1,000.00)	-do-
• S . Subasinghe	Rs	4,000.00	- has agreed to pay: in progress
• P M A Jayasooriya	Rs	1,000.00	- matter with the Attorney General
	Rs	13,500.00	

Special Advance 1993

• W D G Fernando	Rs	1,000.00)	Pending LT cases
• W D G Fernando	Rs	1,000.00)	-do-
	Rs	**2,000.00**	

Special Advance 1998

• Y Samararatna	Rs	7,500.00)	Pending LT cases
• Y Samararatna	Rs	5,000.00)	-do-
• Y Samararatna	Rs	3,250.00)	-do-
• Y Samararatna	Rs	10,000.00)	-do-
• Y Samararatna	Rs	5,000.00)	-do-

• Y Samararatna	Rs	16,000.00)	-do-
• Y Samararatna	Rs	7,880.00)	-do-
• Y Samararatna	Rs	5,000.00)	-do-
• Y Samararatna	Rs	2,000.00)	-do-
• Y Samararatna	Rs	7,000.00)	-do-
• Y Samararatna	Rs	14,000.00)	-do-
• Y Samararatna	Rs	5,200.00)	-do-
• Y Samararatna	Rs	4,702.50)	-do-
• Y Samararatna	Rs	14,500.00)	-do-
• Y Samararatna	Rs	12,500.00)	-do-
• Y Samararatna	Rs	5,000.00)	-do-
• Y Samararatna	Rs	12,000.00)	-do-
	Rs	136,532.50	

Special Advance 1999

• Y Samararatna	Rs	2,700.00	pending LT case
• Y Samaararatna	Rs	5,000.00	-do-
• S W Pathirana	Rs	25,000.00*	
	Rs	32,700.00	
Total	Rs	184,732.50	

*Official of the DFOR, Secretary to the Ministry has been requested to intervene to recover.

2.4.4 Lack of evidence for Audit

(a) Debtors, deposits and advances of Rs 11,694,602/-

Confirmation s supporting document and invoices available and can be submitted for audit. Further details are as given in below.

- Debtors

The debtors balances include the amounts reimbursable from the respective projects such as O D A Post Harvest, ACIR, NARESA. The financial records for these projects are being maintained by NARA. Therefore, no confirmation is called for from the respective funding agencies. Some balances are shown under the debtors due to treatment of accounting entries at the year end. Eg. Working progress on long tern contract. Therefore, no confirmation can be called from such debtors. (The total amount is Rs 60,492/-)

- Prepayments

Prepayment includes only the payment of Insurance for vehicle, vessels and service agreement since these payments are treated as prepayments on the basis of time period. No confirmation can be called from respective institutions (The amount is Rs 1,246,810/-).

- Staff Loan

All staff loan balances relating to the respective employees have been included monthly, in their pay slips and this has been reconciled with respective loan registers. Therefore, no confirmation is necessary for staff loans (The amount is Rs 7,064,128/-)

2.Deposits

Confirmation letters have been sent to all depositors. However, no replies were received.

3. Advances

Confirmation letters have been call from the employees who have taken advances but not settled as at 31/12/2000, replies have been submitted for Auditors.

(b) Fixed Asset Rs. 325,251,406/-

Reports of Boards of Survey and fixed asset register are available for perusal.

(c) Vehicles (revalued) have not been disposed during the year under review. However, 02 vehicles (Vehicle No 50/904, 11/9112) which were in our fleet of vehicle but no commercial value has been donated to Vocational Training Institute with the approval of Governing Board and 01 Nos vehicle (vehicle No 27/6999) which belongs to Ministry of Fisheries and Aquatic Resources Development has been handed over at their request. For others Valuations reports ,Log Books and Certificates of registration etc. are available. Therefore, we can not agree with this statement.

2.4.5 Non compliance with laws, rules, regulations and management decisions.

- Request has already been made to the Treasury through Secretary of the Ministry of Aquatic Resources Development and when the approval is received it can be submitted for audit.
  This will be complied with the accounts of year 2002
  This has been complied with the accounts of year 2001
- If required, Governing Board approval will be obtained.
- This statement is not acceptable.
- Yes. Error is accepted. This procedure has continued over years due to severe shortage of recurrent funds. However, we have taken measures in 2002 to prevent such errors. Past errors had been made under unavoidable circumstances with the best of intentions to achieve the objectives of NARA. But certainly not due to careless management of finances.

3. Financial and Operating Review

3.1 Apparent Management Inefficiencies

- It has been verified that the records in respect of this money are neither available in the District Court nor with the Police. Therefore, appropriate provision has been made in the account of year 2000.

- This employee has been dismissed in connection with an unexplained cash shortage and he is entitled to gratuity payment of Rs 23,760/- However, his total dues to NARA amount to Rs 34,231.11 Therefore, no recovery of the excess of Rs 10,473.11 is possible. Available measure in litigation. However, it is expensive to the Government. Therefore, appropriate provision has been made in the account of year 2000.

- Decision has already been taken to get the property transferred through the Ministry of Fisheries to NARA. However, NARA is in indisputable physical possession of the property over 10 yrs. Perhaps prescriptive rights may apply to claim full ownership.

- This matter involving Rs 143,000/- has been reported to the Fraud Bureau and they are taking steps to proceed with this matter. As for the latter, Letter of demand for Rs,65,800/- has been sent through our lawyer.

3.2 Repairing and Maintenance of research vessel Samudra Maru

- It is correct that NARA has incurred cost of salaries and other related benefits. But not for a crew in 2000. This expenditure was for watch duty until the vessel is sold as scrap. In the year 2001 vessel has been sold for Rs 2,501,000/- under due tender procedure.

3.3 Financial arrangement for provision for payment of gratuity.

- We have already sent the letter through Secretary Ministry of Fisheries and Ocean Resources requesting funds to set up a Gratuity Fund. Since NARA does not have sufficient funds for the creation of this fund we have to wait until treasury funds are obtained

3.4 Idle Resource

- Part of the land is reserved for a Mangrove park and now the work is in progress. The other land is earmarked for expansion in terms of building etc.

- Tenders have been called for the disposed of 05 vehicles and 2 has been sold. But other three vehicles have not been removed. Therefore, tender will be called for remaining vehicles. Can not agree with the statement, which states that suitable action had not been taken by the Agency on the above matter.

3.5 Cost of personnel No comments are made

3.6 Vehicle utilization -do-

3.7 Budgetary control

- It is true that there are a few items with significant variation between budget and actual. Reason being that the requested funding on the decided cash plan was not forthcoming from the C,F. We have already given reasons for these variations, and accepted by Auditors. Further these variation are always created due to limitation on the funds allocated by the Treasury.

4. System & Control

Comments for special attention were noted. Action will be taken in future to pay particular attention to those referred to.

Razik Zarook

Chairman.

NARA

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