

ANNUAL REPORT AND ACCOUNTS

1996

NATIONAL AQUATIC RESOURCES AGENCY
Crow Island, Mattakkuliya
Colombo 15

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MARINE BIOLOGICAL RESOURCES DIVISION

GENERAL

A total of 10 research projects (5 funded by NARA and 5 funded externally) were carried out by this Division during the year 1996. Three of the NARA funded projects were continuing projects designed to gather information on sustainable development and management of major commercial fisheries; large pelagic, small pelagic and demersals.. The offshore fishery resource survey of the Fisheries Sector Development Project funded by the Asian Development Bank has completed one year's work on exploratory fishing by August 1996 and is continuing for another year. The Natural Resources Management Study in the Malala Lagoon System and Associated Coastal waters, funded by Swedish Agency for Research Corporation with Developing Countries (SAREC) is also continuing for another four months.

Ms C. Amarasiri who studied overseas for Doctoral Degree has completed her studies and returned to the island in August 1996. Mr T. Fernando was recruited to the permanent carder of the Marine Biological Resources Division and he is continuing work on the Natural Resources Management study in the Malala Lagoon.

Details of the work carried out under each research programme is given below.

Programme 1

1.1 Offshore Fishery Survey of Pelagic Resources within the EEZ of Sri Lanka (Funded by ADB).

The three survey boats continued their experimental fishing and have conducted altogether 69 trips with 503 effective fishing operations during the period January to December 1996. A total of 176 operations were conducted in Zone A (West) and exploited 35.1 MT, 180 operations were conducted in Zone B (South-West) and exploited 42.7 MT and 147 operations were conducted in Zone C (South) and produced 34.9 MT. The results of the survey have been published as a quarterly 'News Bulletin'. Interim report on work done during first year (Sep 1995 - Sep. 1996) was prepared. The log books distributed to the multiday fishing boats were examined and the data collected are being analyzed. A total of 115 new log books were distributed among multiday boats during this year.

Programme 2

2.1 Study of the Large Pelagic Fisheries in Sri Lanka.

This research project covered the fishing activities along the coast in West, South-west, South, South-East and East of Sri Lanka. Sampling was carried out by the field samplers stationed at major landing sites. The activities of samplers were monitored by the NARA research staff by making visits to these landing sites. The data collected were entered into the computer data bases. The Annual Fishery Statistics for 1995 was published. The total large pelagic fish production of the island was estimated about 76000 MT.

2.2 Study of the Small Pelagic Fisheries along the west, south-west, east & north-east coast of Sri Lanka.

The field samplers stationed in West, South-West, South, South-East and East continued collection of fishing information on small pelagics in the above areas. The average catch rates of all the craft categories i.e. Fiber Glass OBM Boats, Motorized traditional craft & Non motorized traditional crafts showed an increasing trend in all the areas during this year. Preparation of scientific papers on the data collected on previous years continued. To strengthen the statistical data collection

on small pelagic fisheries a pilot survey on fisheries at Negombo and Galle DFEO areas was initiated with the assistance of Department of Fisheries in February 1996. The data on this study was also recorded separately.

2.3 Assessment of Bio-economics of Demersal Fisheries in the Western and Southern coasts of Sri Lanka.

Sampling of the demersal fisheries in the western and southern coastal waters were continued. Except in few places, Chilaw, Negombo and Hambantota, fishing in other areas were carried out seasonally and limited mainly to non monsoonal months, January to April and October to December. Fishing with handline was extensively used in all areas. While trammel netting has gained more popular in North-West and West and bottomset gillnetting in South-West and South areas. The data collected during the year were entered into the computer data base.

2.4 Fishing gear type and their productivity in Negombo lagoon

The study was initiated after conducting a frame survey in the study area. Three fish landing centers (Katunayaka, Molawatta and Thalahena) around the lagoon were selected to gather information on major fishing gears operated in the lagoon. The landings of stake seine nets which operate closer to lagoon mouth was sampled at the landing center in Pitipana. Data collection on fishing gear types was conducted for two month while the study on stake seine net fishery continued throughout the year. The estimated average annual catch rate for the craft/gear combination Dug out canoe/stake seine net was 28.9 Kg/ dug out.

Programme 3

3.1 Coral reef conservation and management

Regular monitoring was conducted from Marawila to Tangalle to determine the abundance of fish species and also to determine changes in the habitat structure. Recruitment of most juvenile butterfly fishes, surgeon fishes and wrasses were recorded from the near shore coral reefs along the southern and south-western coast. The abundance of ornamental fishes on the nearshore reefs was low from Ambalangoda to Wadduwa along the west coast. However offshore deep reefs (20-30 m) supported a number of species such as *Forcipiger flavissimus*, *Chaetodon kleinii*, *Apolemichthys xanthurus* etc. The offshore reefs at Negombo (app 15km from shore) were rich in ornamental species as well as several species of corals. The dominant forms being large *Porites* domes (app 5 M in diameter, upto 3 M high). There are similar to the *Porites* domes found at the Bar Reef. This site is not utilised for ornamental fishes. However, a number of small fishing crafts were observed actively fishing in the area.

Programme 4

4.1 A survey on the existing turtle hatcheries and mapping of the nesting beaches of turtles along the coasts of Sri Lanka.

A turtle watching programme coordinating with whole management along the coast from Benthota to Ahungalla was established with a view to reduce the excavation of turtle nests in the area. Several sea trips were made to identify the turtle foraging grounds in the coastal waters of South. Studies were also carried out to measure the growth rate of juvenile green, hawksbill and logger head turtles during rearing in the hatcheries.

Programme 5

5.1 Study of the Fisheries Resources, Population Dynamics & Fisheries in the Malala Lagoon System and associated Coastal Waters (Funded by SAREC).

Data collection along the coastal fisheries continued. Data collection at Malala Lagoon was suspended as fishermen have refused to cooperate in data collection. An attempt to explain the importance of this study at a meeting of Fisheries Cooperatives at Malala on 24 th June has also failed. Data was analyzed and preliminary report was published in the regional workshop on research for the management of coastal resources in the tropics. at NARA. Both day and night fishing for small pelagic with small mesh gillnets was monitored at selected landing centers, Kudawella, Kalametiya, Hambantota and Kirinda. In addition beach seine landings at Mawella, Kalametiya and Welipatanwilla were also monitored Data analysis is in progress.

5.2 Socio-Economic Study of the Coastal Community in Hambantota District (Funded by SAREC)

Data collection of the coastal community in Hambantota District was initiated in March 1996. A discussion was also made with the Fisheries Inspectors work the study area to introduce the project objectives and to obtain a list of households around the sampling locations of Hambantota and Tangalle areas. A total of 675 households in the project area were sampled Data entry was commenced.

5.3 Survey of Coastal Reefs in the south-east coastal waters

Reefs located off Tangalle, Rekawa and other isolated reefs in Ambalantota was monitored. The positions of all investigated sites were recorded with GPS. Fish life was abundant particularly at Nehindi rocks and offshore ridges at Rekawa. The dominant species were belong to the families of Caesionidae, Labridae, Pomacentridae, Heamulidae, Lutjanidae, Acanthuridae and Siganidae. Several species of Labrids and Chaetodontids which are rare in the western and north-west coastal waters were recorded more frequently in the southern and south-eastern coastal areas. Their densities cannot be applied to larger areas as they are highly site specific. The potential for harvesting ornamental fishes will be low compared with the west coast. As near-shore coral habitats are almost absent in the south-east coastal areas the potential for harvesting juvenile butterfly and surgeon fishes that live within coral beds is low.

Research Papers

Research Publications

Jayawardena, P.A.A.T. Population dynamics of *Leiognathus brevirostris* from the Portugal Bay of the Puttalam Estuary on the north western coastal waters of Sri Lanka. Journal of Asian Fisheries Science

Jayawardena, P.A.A.T. Reproductive biology of *Leiognathus brevirostris* from the Portugal Bay of the Puttalam Estuary on the north western coastal waters of Sri Lanka. Journal of Asian Fisheries Science

Jayawardena, P.A.A.T. Trawl fishery in the Portugal Bay of the Puttalam Estuary on the north western coastal waters of Sri Lanka - Some management options. NARA/NARESA/Sida Regional Workshop.

- Jayawardena, P.A.A.T. Prawn Fishery of Sri Lanka. Orientation Workshop organized by the Ministry of Fisheries and Aquatic Resources Development.
- Wood, E and A. Rajasuriya, 1996. Handbook of protected marine species in Sri Lanka. Marine Conservation Society and National Aquatic Resources Agency 26 p
- Dayaratne, P. 1996. Environmental aspects of marine fisheries of Sri Lanka. Asia-Pacific Fishery Commission.
- Dayaratne, P. 1996. Research and information needs for Fisheries Management in Sri Lanka, BOBP/MFARD workshop.
- Rajasuriya, A. 1996. Marine ornamental fishery in Sri Lanka. BOBP/MFARD workshop.
- Maldeniya, R. Review of Demersal fishery characteristics in the western and southern coastal areas. Paper submitted to Department of Fisheries and Aquatic Resources Development.
- Maldeniya, R. Marine Fisheries in Sri Lanka : A Review of Resources, Exploitation and Management. Paper presented
- Dayaratne, P. Study of the Puttalam/Mundel estuarine system and associated coastal waters; Integrated approach for the Coastal Resources Management in Sri Lanka.
- Rajasuriya, A. A Management Plan for the Bar Reef Marine Sanctuary.
- Kularatne, M.G. Socio economic study of the coastal community in the Puttalam district.
- Fernando, P.A.T. & P. Dayaratne. Beach seine fishery in the North-Western Coast of Sri Lanka.
- Jayawardena, P.A.A.T. & P. Dayaratne 1996. Trawl fishery in the Portugal Bay area of the North-Western coastal waters of Sri Lanka - Some management options.
- Karunasinghe, W.P.N. Taxonomy and population variability of species of Australian mullet using allozyme variants.
- Karunasinghe, W.P.N. Population variability of *Mugil cephalus* (Pisces: Mugilidae) from the South Pacific and North and East Indian Oceans.
- Amarasooriya, D. New record of Longfin mako shark, *Isurus paucus* from Sri Lanka.
- Maldeniya, R. Trends in offshore fishery development of Sri Lanka as reflected by the fishing fleet.

Jayawardena, P. A. A. T. and P. Dayaratne 1996. A preliminary analysis of the reef fishery in the associated coastal waters of the Puttalam estuarine system. Sri Lanka Journal of Aquatic Sciences.

Karunasinghe, W. P. N. and M. J. S. Wijeyaratne 1996. Effects of monsoonal currents, rainfall and luna phase on the abundance of *Amblygaster sirm* in the coastal waters off Negombo, Sri Lanka. Sri Lanka Journal of Aquatic Sciences.

Reports & other documents

- Turtle Hatcheries; it an additional deserter to the turtle fauna of Sri Lanka? Proceedings. Presented at the workshop on Northern Indian Ocean Sea Turtle.
- Present status of the Turtle fauna of Sri Lanka. Accepted to present at the Northern Indian Ocean Sea Turtle workshop. Submitted to donar agency NARESA Colombo.
- Some observations of Turtle Hatcheries of Sri Lanka - I.F.S. Kandy. Presented at the workshop Ministry of Fisheries and Aquatic Resources Development.
- Report on the washed ashore Turtle carcasses in southern coastal area. Presented at the workshop Ministry of Fisheries and Aquatic Resources Development.
- Master Thesis on Trawl fishery in the Portugal Bay of the Puttalam Estuary and population dynamics and some aspects of biology of *Leiognathus brevirrostris*. Submitted to University of Colombo.

Trainings/Workshops/Conferences

- Rajasuriya. Identification of Sponges, Tunicates and Echinoderms . June 1996
- Amarasooriya, P.D.K.D. International symposium on the biology and conservation of Amphibians and Reptiles in south-east Asia. August 1996, Kandy.
- Maldeniya, N. Karunasinghe, D. Amarasooriya, T. Fernando. FISAT computer program. ADB/ICLARM, NARA Colombo on March 1996.
- Amarasooriya, P.A.A.T. Jayawardena, T. Fernando. Scientific Data Presentation. Sida/SAREC, NARA Colombo on April 1996.
- Amarasooriya, P.A.A.T. Jayawardena, T. Fernando, A. Rajasuriya. Marine Zooplankton Ecology, Sida/SAREC University of Ruhuna on September 1996.

- Jayawardena, T. Fernando. Taxonomic Aspects of certain groups of Marine Invertebrates, Bio Diversity Enhancement Project/March For Conservation, Coral Sands Hotel/Hikkaduwa on November 1996.
- All officers of MBRD. SLFAR attended Annual Sessions. SLAFAR, SLAAS Auditorium on July 1996.
- All officers of MBRD. NARA/NARESA/Sida a Regional Workshop. NARA/NARESA/Sida NARA Auditorium on October 1996.
- Mr. Chaminda was trained in open water scuba diving
- Dr P. Dayaratne. Integrated coastal management in tropical developing counteies People Republic of China, 24-28 May, 1996
- Dr. P. Dayaratne. Symposium on environmental aspects of responsible fisheries. Scoul, Republic of Korea, October 1996.
- Ms. R. Maldeniya. Workshop-ADB-ICLARM on Sustainable Exploitation of Tropical Coastal Fish Stocks in Asia. Philippines.

Other activities

Assisted the IUCN in identifying Dolphins at sea in filmings Risso's Dolphins off the coast of Colombo.

INLAND AQUATIC RESOURCES AND AQUACULTURE DIVISION

The main projects and officers involved are listed below:

Development of Effluent Treatment Systems for shrimp culture.

Dr. J.M.P.K. Jayasinghe

Dr. T.B. Wanninayake

Dr. M.D. Amarasinghe

Miss. A.S.L.E. Corea

Mr. R.G.S. Wijesekara

Disease out-breaks in shrimp culture systems on problem soils. ARP Research Grant - ARP / 12/ 153/ 163

Dr. J.M.P.K. Jayasinghe

Miss. A.S.L.E. Corea

Mr. R.G.S. Wijesekara

Ornamental Fish Culture

Dr. M.M. Kuruppu

Miss. S. Ariyaratne

Mrs. V. Rajapaksa

Mangrove and Wetland Management and Conservation

Dr. M.D. Amarasinghe

Mrs. V. Pahalawattarachchi

Mollusc culture

Dr. T.B. Wanninayake

1.2 Development of effluent treatment systems:

The main objective was to develop appropriate treatment systems for small scale shrimp farming systems and large scale shrimp farming system to minimize the risk of disease out-breaks and the adverse environmental impacts of farm effluents on environment for sustainable shrimp culture development.

Chlorination is a widely used treatment. Investigations were carried out to determine the effects of chlorination on bacterial quality of pond water, sediments and farm performance together with Post harvest Technology Division.

Chlorination was found effective during initial growth stages of the shrimp culture reducing the bacterial load in pond water, sediments and in reducing bacterial counts in cultured shrimps. The incidences of common disease signs / symptoms were low during initial stages in treated ponds when compared to non treated ponds.

Difference in critical water quality parameters were found and growth of the shrimps in chlorinated ponds were found slightly lower when compared non chlorinated ponds.

Detail research findings are included in two detail research reports and in research communication listed. Extension manual has been published on treatment system inco-operating findings.

Investigation on utilization of mollusc in effluent treatment systems were continued. Following 4 species were found to be used in effluent treatment systems.

Crassostrea madrasensis

Meretrix casta

Graff rarium sp.

Perna perna

Growth rates of above 4 species were assessed in effluent treatment system and were found 1 cm/ month 3 - 4 mm, 3. 4- mm, 8 - 9 mm respectively in effluent water. Survival rates were found between 75 to 90% in favourable salinity ranges. For low salinity areas *M. casta* and *C. madrasensis* were found suitable for high salinity areas *P. perna* and *G. tumidum* were found suitable. Experiments were conducted on their filtering efficiency. Two detail research reports were produced on the funding.

Investigation on utilization of ground water for shrimp culture and detail study on comparison of complete recalculation systems and semi-enclosed systems were initiated. Critical water quality, farm performance and health of the cultured shrimp were monitored.

1.3 Disease out-breaks in shrimp culture system on problem soils. ARP/ 12/153 /163 A project funded by ARP was continued.

The main objectives of this programme included identification of different problem soils in the areas earmarked for shrimp culture in NWP and their properties useful in managing those soils for shrimp culture and , to identify common symptoms shrimp culture systems on these soils and to find relation ships between soil quality and the farm management with disease out-breaks. Several management strategies

to minimize the risk of disease out-breaks due to problem soils have been found . The final report incorporating research findings in preparation. Two detail research reports have been produced (Ref. Research reports).

1.4 Mollusc culture

The final objective of this long term project was to develop appropriate technologies to collect spat and culture of Mollusk in brackish water areas of Sri Lanka and to transfer the technology to farms.

Appropriate technologies have been develop and proved successful. The technology transfer aspect was concentrated during 1996. With the help of Southern Development Council and Industrial Development Board a community participated projects were completed and technology was transferred. Extension : Manuals were prepared and several workshops/ seminars have been conducted.

1.5 Mangrove - Wetland Management Conservation

Completed work on productivity and biomass distribution of sea grasses in Negombo lagoon and preliminary studies on food web analysis were commenced and monthly data collection is underway.

Mangrove and seagrass distribution in Negombo, Chilaw and Puttalam lagoons were mapped using recent aerial photographs to ascertain the temporal changes. The funding have been presented at the SAREC workshop in Oct. 1996. Detail fundings are given in research communications.

Participated in the preparation of management plan for the mangrove protection sites , identified for the National Mangrove conservation programme by Department of Forest. The detail management plan has been prepared and published. Management plan has been presented to Forest Department and Ministry of Environmental.

1.6 Assessment of freshwater ornamental fish resources in selected areas and building up of a broodstock of fish being bred for export.

Areas selected :

River basins of Kelani, Kalu and Bentara area (Walawe Ganga) and Ambagamuwa Ganga in Ginigathhena

Survey included study of following characteristics

i. Habitat

Bottom topography and structure _ e.g Sand / pebbles / detritus / silt

Depth of water

Presence of aquatic plants.

Temperature

ii. Chemical characteristics

pH, Hardness

iii. Fish fauna

a. Location

Open stream

along the banks

under roots /logs etc.

b. Species identification

endemic , common/ scarce
indigenous, common/ scarce

c. Size range

Results

d. Endemic species observed

a. *Puntius nigrofasciatus*

size range 10 mm - 70 mm, in 1 to 4 m wide slow - flowing streams , pH range = 5.8 to 6.7, fish in breeding colours from February to April. , Juveniles in March

b. *Puntius cuningii*

Size range 15 mm - 65 mm in restricted numbers in the Kelani river basin, in specific areas , pH range = 5.7 to 6.2, broodstock observed from February to March

c. *Puntius titteya*

in very small numbers in Ginigathhena and Elpitiya. , all adults

Rasbora vaterifloris observed in the Kalu Ganga and Bentara Ganga tributaries and varied from fry to adult stages.

Other cyprinds observed:

Puntius bimaculatus

Garra ceylonensis

Family Balitoridae

Acanthocobitis urophthalmus

Schistura notostigma

Family Aplocheilidae

Aplocheilus dayi

Family Belontiidae

Belontia signata observed only in the Balangoda (adults) and Elpitiya areas (juvenile stage). , Temperature = 26 - 28_°C, Water hardness = 10 - 20 ppm

2. Indigenous species identified

Puntius sarana

Puntius dorsalis

Puntius filamentosus

Puntius vittatus

Danio malabaricus

Rasbora daniconius

Danio aequipinnatus

Puntius pleurotaenia

Chela laubuca

Mystus vittatus

Rasbora caverii

Tilapia spp.

Aplocheilus weneri

Xenentodon cancila

Residents of the area mentioned that the streams were being fished regularly, except in one area and that leaf extracts were being used as sedatives.

Work is being continued.

1.7 **Experimental induced breeding of selected freshwater fish species of Sri Lanka. CARP 12/242/189**

Species selected

Puntius nigrofasciatus

Puntius cuningii

Danio pathirana

Natural breeding was studied prior to induced breeding.

Fish collections were carried out from small streams in Hanwella, Avissawella and Parakaduwa areas. The fish were reared on minced ox heart and trash fish upto adult stage.

Males with breeding colours and gravid females were mated using fine leaved plants and mesh frames as egg receptors for the two *Puntius* species while *D. Pathirana* was bred using aquatic plants.

Induced breeding was successfully carried out on *P. Nigrofasciatus* and *P. cuningii*.

Puntius bandula was successfully crossed with *P. nigrofasciatus* and the progeny has been reared to adult size.

Danio pathirana was found to be an egg scatterer and preferred to spawn on long days.

P. nigrofasciatus spawned at pH values ranging from 6.5 to 6.8 while the other two species spawned at a pH range of 7.0 - 7.3.

The fry were reared on live feeds such as rotifers and *Daphnia* reared in NARA.

Method of administering hormones into the body cavity was found to be more effective than intra-muscular administering.

Effective dosage of hormones was 0.006 mg /2 -3 g body wt of fish.

1.8 **Utilization of Mollusc to treat effluents.**

Selection of species suitable for effluent treatment systems in Sri Lanka.

Following species were assessed.

1. *Crassostrea madrasensis* - Oyster
2. *Meretrix casta* - Clam
3. *Gaffrarium tumidum* - Cockle
4. *Perna perna* - Mussel

C. Madrasensis

- | | |
|-----------------------|--|
| Growth rate | - 1 cm/ month |
| Salinity tolerance | - 5 % - 35 % |
| Survival rate | - 90 % |
| Fry grounds | - Wanathavillue, Udappu, Chilaw, Negombo |
| Fry collection season | - November - April |

Meretrix casta (Clam)

Growth rate	-	3 - 4 mm/month
Salinity tolerance	-	5 % - 35 %
Survival rate	-	90 %
Fry grounds	-	Chilaw, Mundal, Madurankuliya
Fry collection season	-	Year round

Gaffrarium tumidum (Cockle)

Growth rate	-	3 - 4 mm/month
Salinity tolerance	-	25 % - 45 %
Survival rate	-	75 %
Fry grounds	-	Kalpitiya / Puttalam lagoon
Fry collection season	-	Year round

Perna perna (Brown mussel)

Growth rate	-	8 - 9 mm/month
Salinity tolerance	-	25 % - 40 %
Survival rate	-	75 %
Fry grounds	-	Chilaw to Tangalle (Coastal area)
Fry collection season	-	May to August

Recommendation

For low salinity	-	<i>M. casta</i>
Shrimp culture areas	-	<i>C. madrasensis</i>
For High salinity	-	<i>Perna perna</i>
Shrimp culture areas	-	<i>G. tumidum</i>

2. Training of officers

Two officers were trained at AAHRI (Aquatic Animal Health Laboratory Bangkok) on shrimp Health Management.

One officer was trained at Fresh water fisheries Research Station at Batuberendam on captive breeding of ornamental fish species.

Two officers were trained at Sabah, Malaysia an Aquaculte of Coral fish and sustainable reef fishery.

Mr. S. Wijesekara was successful in obtaining a grant to follow a M.Sc course at Asian Institute Technology, Thailand on the basis of merits obtained for research work he has carried out at NARA.

Initiated a Ph.D training for one officer on Shrimp Health Management with SIADA Project and FAO / TCP project on shrimp Health Management.

Initiated a Ph.D training programme in for one officer Fresh water aquaculture management with the assistance from ACIR, Kelaniya University - Research programme.

3. Training and Extension programmes

- Conducted Seminar on Mollusc culture in Sri Lanka for media personnel at Governors auditorium, Galle.
- Inspection of ornamental fish pond culture sites around Thalatu Oya, Kandy, belonging to the beneficiaries of the Kandy Regional Rural Development Programme. Organized by the veterinary Surgeon's office.
- Lectures to Year 10 and 11 students of Bandaranayake Maha vidyalaya, Gampaha, on "Ornamental Fish breeding and culture". Freshwater fish /prawn culture, fish culture in mud ponds and mangrove ecosystems.
- Talk on " Rearing of ornamental fish on a commercial scale" to a gathering at the office of the Pradeshya Sabhawa, Wennappuwa, at the request of the Ministry of Fisheries and Aquatic Resources Development.
- Lectures to staff and trainees of the Sathyodaya Centre, Mahakanda, Kandy on "Breeding and Pond culture of Ornamental and food fish" .
- A buy-back ornamental fish culture programme was initiated for out -growers with Inland Fisheries Development Division MOFAR at Avissawella electorate.
- Seminar on mollusc culture - Kadolkele for media person.
- Awareness programme on freshwater prawn culture.
- For school teachers : Baddegama, Meepawala
- For Gramasewa Niladari : Balapitiya AGA Division
- Training programme on oyster culture for fishermen , Moratuwa.
- Seminar on Fisheries Investments for Bank Managers, Bank loan officers. Bank of Ceylon, lecture on Minimizing Investment Risks in Shrimp Culture.
- Work shop on environmental Protection at Mahamaya Girls College, Kandy. Lecture on Mangroves of Sri Lanka.
- Workshop on Shrimp Disease, Organized by EDB at Vikkala. "Health Management Problems in Sri Lanka".
- Workshop on Management strategies of Mangrove Habitats in the coastal Belt between Negombo and Wanathavillu. Department of Forest and IUCN.
- Mangrove fauna in the mangrove habitats between Negombo - Wanathavillu.
- Socio-economic aspects of mangrove habitats between Negombo and Wanathavillu.
- Public lecture on Ecological and Economic importance of Sri Lankan mangrove. Wildlife and Nature Protection Society.
- IUCN - March for conservation. Biodiversity skills enhancement project :- Lecture on Mangrove-bio diversity.
- Workshop on Fish culture in Rice fields. Provincial Rice Research Institute, Bombuwala. Management of Environment in rice fish culture.
- Seminar on Ruhuna Development programme Matara. Aquatic Resources Development in Ruhuna.
- Asia Fisheries and Seafood Conference . Denang, Malaysia , Presentation on Sri Lanka : An Important seafood exporter in Asia and its potential for producing quality culture based commodities.
- Annual seminar. Department of Animal, Science University of Peradeniya. Guest speech:

- Present status of shrimp culture industry in Sri Lanka and the effects of the industry on the environment.
- Training programme on Fish culture for officers of the DOA at Udawalawa: Environmental Problems and management of environment in rice fish culture.
- Series of lectures to workers of the National Zoological Gardens, Dehiwala on "Ornamental Fish Breeding and culture".
- One-day training to 10 participants from Chilaw and Wennappuwa area on "Ornamental Fish culture in mud ponds".
- Introduction to the Ornamental Fish Industry- a seminar for 35 participants at NARA.
- Resource person at the workshop on "Freshwater fishes of Sri Lanka" organized by the Wild Life Conservation Department. Girthale for the Wild Life Rangers. - Dr. M.M. Kuruppu.
- Training Course in Ornamental Fish Culture and visit to fish farms in Arunapura. Aralaganwila in the Maduru Oya System. - Dr. M.M. Kuruppu.
- Training for Fisheries Inspectors in ornamental fish Breeding and Culture, at NARA.

4. Major consultancy

- Colombo port extension project - EIA study on Biological aspects.
- Preparation of management plan for National Mangrove Conservation project together with Department of Forest and Ruhuna University.

5. Scientific Communications / Research papers

- Jayasinghe J.M.P.K., Fonseka, T.S.G, Corea A.S.L.E. and Wijesekara, R.G.S. (1996) Investigation on white spot baculovirus (SEMBV) out-break in shrimp culture systems in Sri Lanka. Proceedings: Sri Lanka Association for Advancement of Sciences - 52nd Annual session.
- Jayasinghe J.M.P.K., Wijesekara, R.G.S. and Corea A.S.L.E 1996.
- Economic problems related to environment in different shrimp culture systems in Sri Lanka. Proceedings: Sri Lanka Association for Advancement of Sciences - 52nd Annual session
- Wijesekara, R.G.S., Corea A.S.L.E and Jayasinghe J.M.P.K., (1996).
- Technology and Performance of shrimp farming industry in the North-western province.
- Proceedings: Sri Lanka Association for Fisheries and Aquatic Resources - 2nd Annual session.
- Corea A.S.L.E, Wijesekara, R.G.S. and Jayasinghe J.M.P.K., (1996).
- Distribution of shrimp farms in the North Western Province in Sri Lanka and Major factors affecting their productivity. Proceedings: Sri Lanka Association for Fisheries and Aquatic Resources - 2nd Annual session.
- Corea A.S.L.E, Jayasinghe J.M.P.K., and Ekaratne S.U.K (1996).
- Autopollution : A major threat to the shrimp farming industry in Sri Lanka. Proceedings : Second International Conference on the culture of Penaeid Prawns and shrimps. The Phillipines.
- Jayasinghe J.M.P.K (1996) Classification of acid sulphate soils in Sri Lanka with special reference to shrimp farming.

- Accepted for Second International Conference on culture of Penaeid prawns and shrimps. (Ilo ilo Phillipines).
- Ariyaratne M.H.S. (1996) Growth and survival of Common carp (*Cyprinus carpio*) fry reared at different stocking densities.
- Sri Lanka journal of aquatic sciences. Sri Lanka Association for Fisheries and Aquatic Resources.
- Jayasinghe, J.M.P.K. (1996) Sri Lanka : An Important seafood exporter in Asia and its potential for producing quality culture based commodities.
- Proc. Asian Fisheries and Seafood conference. Tenong ,Malasia.
- Corea A.S.L.E, Jayasinghe J.M.P.K., and Ekaratne S.U.K(1996).
- Disease outbreak in shrimp culture systems in Sri Lanka with special reference to water quality deterioration : A farm survey.
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- M.M.Kuruppu and S.U.K. Ekaratne (1996) Coastal *Artemia* culture in Sri Lanka for cyst and biomes production.
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- Presented at Regional workshop on “Research for the Management of Coastal Resources in the tropics” (SAREC/ NARA).
- Perer, P.A.J. Chintha, (1996) Marketing channel of reservoir Fishery: a study on Kandalama reservoir.
- Proc. Sri Lanka Association for Advancement of sciences. 52nd Annual sessions.
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- Proc. Sri Lanka Association for Fisheries and Aquatic Resources.

6. Major Research Reports

- Shrimp Production in Relation to water quality management in semi-intensive culture systems.
- Influence of soil acidity and stocking density on farm performance and product quality of shrimp.
- Effects of chlorine treatment on water quality and growth of *Penaeus monodon* in semi-intensive culture ponds.
- Study on the effect of post larval age and stocking density on selected disease condition in *Penaeus monodon* culture.
- Effects of chlorine treatment on bacterial quality and growth of *Penaeus monodon* in Semi-intensive culture systems.
- Influence of the source of water on the quality and disease symptoms of shrimps.
- **Academic involvements**
- National Institute for Education. (NIE)
- Development of New syllabus for 10,11, year students on (Inland Aquatic Resources Technology).
- and preparation of text book for 10 and 11 year students.
- Dr. J.M.P.K. Jayasinghe, Dr. T.B. Wanninayake and Dr. M. Amarasinghe
- Government Annual Husbandry School , Welisara.
- National Diploma on animal husbandry lectures on Shrimp culture - Dr. J.M.P.K. Jayasinghe, Ornamental fish culture - Dr. M.M. Kuruppu

- University of Colombo : Dept. Of Zoology. Special Degree in Zoology - Lecturers on Aquaculture - Dr. J.M.P.K. Jayasinghe, Dr. T.B. Wanninayake, Dr. M.M. Kuruppu.
- University of Colombo. Dept. Of Zoology. M.Sc in Environmental Science, lecturers on - Ecosystem Management. - Dr. M.D. Amarasinghe.
- University of Peradeniya : Dept. Of Animal Science. B.Sc Agriculture. Lecture on Shrimp culture/ mollusc culture, - Dr. J.M.P.K. Jayasinghe and Dr. T.B. Wanninayake.
- University of Ruhuna: Dept of Fish Biology B.Sc special students. Lecturers on Mollusc culture - Dr. T.B. Wanninayake.
- Post graduate Institute of Agriculture, University of Peradeniya. M.Sc degree in Environmental Science. Lecturers on Environmental Management and Assessment in Aquaculture - Dr. J.M.P.K. Jayasinghe.
- Eastern University of Sri Lanka, B.Sc special , Lecturers on Aquaculture - Dr. J.M.P.K. Jayasinghe.
- Sri Lanka Institute of Development Administration
- Lectures on Environmental management. - Dr. M.D. Amarasinghe
- Sabaragamuwa University : Dept. Of Animal Science.
- Supervision of special projects - Dr. J.M.P.K. Jayasinghe.
- Bank of Ceylon Training Center, Maharagama.
- Lecturer on Ornamental Fish Industry - Dr. M.M.Kuruppu

8. Preparation of Extension Material

Manual on Artemia culture -Dr. Kuruppu

Manual on mollusc culture - Dr. Wanninayake

Leaflets (in Sinhala)

Books -

(Culture of freshwater prawn in Sri Lanka National Institute for Education - Dr. Wanninayake)

Bivalve culture in Sri Lanka for National Institute of Education - Dr. Wanninayake

(Mangrove Eco- systems of Sri Lanka Flora, Fauna and their socio-economic significance. - Dr. M.D. Amarasinghe)

Treatment systems for shrimp culture : In preparation

9. Workshops / seminars organized

- Seminar on Health management in shrimp culture system in Sri Lanka with special reference to white spot disease for small scale shrimp farms.
- Collaborators: SLAFA, Provincial Fisheries Ministry.
- Pocket seminars at Chilaw, Udappu, Andrapitiya, Mundal and Mangala eliya on white spot disease identification and prevention.
- Collaborators: Provincial Fisheries Ministry, Aquaculture Division, Ministry of Fisheries and Aquatic Resources.
- Training course on Ornamental Fish breeding culture and maintenance.
- NARA, One month training programme.

- Workshops on Feed and Feeding of ornamental fish.
- Collaborator: AGENT
- Training programme for oyster culture , Moratuwa.
- Collaborator: Industrial Development Board.

FISHING TECHNOLOGY DIVISION

1. PROJECTS

1.1 CASITA

378 CASITA's were deployed during this year. All were deployed off Tangalle and Kalamitiya.

1.2 Ring Net Survey

A study was conducted along the South-Coast of Sri Lanka to find a solution to the Ring Net Conflict. Report was submitted to the Chairman, NARA.

1.3 Experimental Shrimp Trawling off Chilaw

This study was stopped temporarily as per instructions given by the Hon. Minister of Fisheries and Aquatic Resources Development.

Foreign Trainings

Dr. D.S. Jayakody participated at a short-term training in Australia on Research Planning and Management. This study tour was funded by the ARP.

Mr. S.P. Doluweera and Mr. H. Hewawitharana was appointed as Research Officers to the Fishing Technology Division. Mr. H. Hewawitharana resigned from the post.

Miss. Renuka Kumudini was appointed as the Data Entry Operator of the Fishing Technology Division.

Preparation of the Fishing Gear Catalogue with Technical Instructions

Information was collected with respect to the fishing gear types operated on the South Coast of Sri Lanka. More time was allocated to collect technical information on various ring net types operated on the South Coast.

OCEANOGRAPHY DIVISION

1. PROJECTS

1.1 Salt water intrusion and sea water mixing into the river of different climatic zone of Sri Lanka (K.Arulanathan & Tilak Dharmaratne)

An automatic Environmental Monitoring Unit and Weather Station were tested and deployed in the coastal waters to estimate the water, heat budget and residence time. The instruments were capable of providing continuous data of salinity, temperature, wind direction, wind speed, air temperature, air pressure, solar radiation, relative humidity, rainfall, sun duration, net radiation etc.

All the existing environmental data were processed and compiled to form an environmental data base. A sample booklet prepared using the Oceanographic Data Base indicating the availability of data was submitted to Chairman /NARA and to be circulated among the relevant institutions, Departments and agencies.

Salt water intrusion studies made at Nilwala, Kelani, Chilaw, Negombo indicates, almost all the ecosystem were shown the declining environmental trend except the Chilaw lagoon, which has shown decreased residence time and enhanced water exchange. This situation may be a seasonal phenomena due to the high precipitation prevailed during the monsoon period

1.2 Hydrodynamics of the rivers of different climatic zone (M.Bhuvendralingam, E.M.S.Wijeratne)

Instantaneous suspended sediment transport rates over tidal cycle have been determined for Kelani River. The study reveals the effect of tide on the discharge and the suspended concentration near the mouth of the Kelani River. The transport rate of suspended sediment was estimated by dividing river cross section into a sufficiently large number of sub areas and at the centre of each sub areas simultaneous measurements of velocity and concentration were made.

The suspended load level in the Kelani river provide to be subject to distinct to seasonal variations. The results shows that the variation in discharge did not coincide with the variation in particulate concentration. Maximum sediment concentration was attained in February (24.2 mg/l), while peak discharge occurred in September (162.57 cu. m/s.).

The highest rate of transport of suspended particles (2.768kg/s) through the cross section was observed during the month of September. Annually a total of 2.7×10^7 Kg of suspended sediment was fluxed into the sea through the river with the mean annual discharge of 67.1 cm/s.

1.3 Tide gauge installation, sea level data analyses around Sri Lanka - sea level data collection around Sri Lanka. (E.M.S. Wijeratne)

Continuous tidal data were collected from Galle and Kalpitya using permanent self recording tide gauges. TOGA SLPRC (standard tide program) computer program was used to predict the "Tide Tables" for the year 1997 at Galle and Kalpitya. The tide tables were published and distributed among the relevant Institutions, Department and Agencies. Tidal data have been contiguously monitored to predict the Future Tide Tables for more locations.

Portable tide gauges were installed at the Coastal Lagoons to study the shallow water tidal wave propagation. Detail numerical models were prepared to understand the hydrodynamics and insight of the tides in the coastal water bodies.

1.4 Assessment of wave energy potential along the south coast of Sri Lanka K. Tennakoon

There are sub projects have been carried out under this title

A. Wave energy assessment in Southern Coast- Selected a location at the pier of Gotawaya ancient fishery off Ambalantota and collected wave data periodically. There is a natural pond situated at the centre of the pier (6 m in width 9 m in length and 1.3 m in depth). It is an ideal point for the tapchan channel type plant. Wave period in this area between 8-14 Sec. and Oscillation height is around 1-2 m. During monsoon it is above 2.5 m and there are visualising data.

B. studying of energy consumption in isolated fishing villages.

Selected Mukkuthoduwawa off Udappuwa fishing community study area. Distributed questionnaire to study their energy consumption. It shows that 10-20% of their income spend for the energy+lighting purposes. Distributed energy conserving clay burners among villagers. The results shows that 20-35% of their expenses for cooking purposes.

C. Solar pond

It was proposed to build up Solar pond to moister absorption of solar radiation in artificial tanks (Thermal energy conversion). Build up 10x16x1m tank, due to the various constructions problems it was delayed to start the monitoring.

1.5 SAREC Project (J.K.Rajapaksha, H.B. Jayasiri)

The Malala Lagoon is completely isolated from the sea by the sand bar, and there is no direct interaction. The inflow of water into the Malala through Welligatta Aru and Lunugamwehara Canal is high during the beginning of the year but the flow is negligible during the month of Apr. to May and no fresh water supply upto November.

Though it remained as a fresh water lagoon, during the dry period considerable amount of salt water seepage into the lagoon was observed and the salinity range from 1ppt to 7.5 ppt. The sand bar formation was the widest during the Southwest monsoon trapping the longshore drift by the Pathiraja point situated in the east side of the mouth. Reef act as a groin, and trap the sand drifted as the result of longshore current pointed to the east. The silation rate was high during the land preparation for the paddy cultivation.

1.6 Offshore Exploration of Heavy Minerals in Sri Lanka. (Tilak Dharmaratne)

Oceanographic Equipments checked out and tested to the extent possible, included a sub-bottom profiling system, a side scan sonar system, an echo sounder/pinger system and a digital echo sounder. Details of these are documented in a report, with recommendations for remedial action

A review of regional offshore geological information, the results of previous exploration and mining along the Southwest coast of Sri Lanka, and the main factors controlling the formation of detailed heavy mineral deposits indicate that the prospects for the occurrence of such deposits in the area are good. The Geo physical investigations will be commenced on March 97.

2.0 Abstract & reports

Two presentations were made at the regional workshop (SAREC) on 10th and 11th Oct.

1. Arulananthan, K. and Jayasiri, H.B. The major salt and water exchange mechanisms of the coastal lagoons of Sri Lanka.

2. Wijeratne, E.M.S and Rajapaksha, J.K. Tidal propagation of different types of lagoons in Sri Lanka.
3. M.Bhuvendralingam has submitted an abstract on " Indian Ocean Circulation and Climate change" for National Symposium on climate change".
4. Dr. K. Tennakoon. Utilisation of ocean wave energy as an alternative recourse for power crisis in Sri Lanka.
5. Dr. K. Tennakoon. Oscillation water column type wave power plant with tapered harbour walls.
6. E.M.S.Wijeratne. "Impact on sea level rise"
7. E.M.S.Wijeratne. Sea level data collection around Sri Lanka -report
8. Tilak Dharmaratne , 1996 , Half year progress report on offshore heavy mineral exploration in Sri Lanka submitted to National Aquatic Resources & Research Development Agency.

3. Other activities

1. Dr. K. Tennakoon Supervised the civil construction works of Feed formulation laboratory at IPHT, Wet lab and Head office constructions, New Toilets at Kadolkele RRC, Main building repairs at Kalpitiya RRC, Circuit bungalow at Kalpitiya RRC, Improvements for the Socio-economic division.
2. Mr. Dharmaratne and Dr. K. Tennakoon participated on 12th October to participate to "Deewara Navodaya" exhibition of Tangalle and to the ceremony of laydown of foundation stone for Rakawa Research institute of NARA.
3. Dr. K. Tennakoon Presented a paper on at the 17th Asian Conference on Remote Sensing from 4-8 November on the use of Radar Remote sensing Imageries for the developments in Southern Coastal belt of Sri-Lanka".
4. Dr. K. Tennakoon Presented a paper at the ESCAP conference on GIS application 4-8 November on "Monitoring and Investigation Radar Remote sensing Imageries for the developments in Southern Coastal belt of Sri-Lanka".
5. Dr. K. Tennakoon Participated at the Global Ocean Observing System and International Oceanographic Commission Regional Committee for the central Indian Ocean (IOCINDIO-II) conferences from 18-22 November at Cidade de Goa organized by DOD India and IOC.
6. Tilak Dharmaratne 1996 , Radio programme on "Oceanography" in Sri Lanka at Sri Lanka Broad Casting Corporation.

4.0 Training

1. H.B Jayasiri and J.K Rajapaksha were participated a workshop on "Data presentations and publications" at University of Ruhuna from 8-13 Dec.96.
2. M.Bhuvendralingam has participated a workshop on "Marine Zooplankton Ecology" at University of Ruhuna.
3. Mr. Wijeratne and Mr. K. Arulananthan have participated on their Ph.D training programme in Sweden.

NATIONAL HYDROGRAPHIC OFFICE

1. NATIONAL CHARTING PROGRAMME

- 1.1 Location of near shore reefs of sheet No.09101 was completed.
- 1.2 Bathymetric surveys of about 50 Sq.km.for location of near shore reef Submerged Rocks of Sheet No. 09202 also completed.
- 1.3 Data Acquisition of Sheets No. 11301, 11302, 11305 & 11306 - about 50 Sq.km completed.

This programme was affected due to equipment repairs & bad weather conditions.

2. HYDROGRAPHIC & LAND SURVEYS UNDERTAKEN

2.1 Feasibility Study for the development of Port of Colombo - JPC Survey

The following tasks were completed.

- (a) Bathymetric Survey
- (b) Plans of Shore line & detail survey
- (c) Littoral current observation maps
- (d) Sediment Quality survey maps

2.2 Hydrographic Survey of Koggala Lagoon (about 10 Sq.km.)

On a request made by ESD/NARA hydrographic & detail surveys were completed

and maps have been handed over.

2.3 CCD/Panadura - Kalutara Bathymetric Survey & Beach Profiles

The field work of above task was completed during the previous year and hydrographic plan & plans of 54 beach profiles were completed & handed over to CCD.

- 2.3.1 The field work of the repetition survey of the same 54 beach profiles, as a part of the monitoring programme, was completed.

2.4 Hydrographic Survey of Mundal Lagoon

The field and plan work of the hydrographic & detail survey of Mundal Lagoon was completed.

2.5 ADB Projects

The field & plan work of the hydrographic surveys, of the additional areas at Kottegoda & Kudawella were completed.

2.6 Hydrographic Survey at Marawila

On an urgent request made by Sri Lanka Navy, a Hydrographic Survey of near shore at Marawila was conducted & completed.

2.7 Map showing Area from Mutwal Fishery Harbour to Kelani River mouth for CCD

Completed.

2.8 Training Programme for undergraduates of the Institute ISM Diyatalawa

As a part of the co-operation between the NHO and the Survey Department, a practical and field demonstration programme was conducted for a period of one week for undergraduates following the Bachelor of Survey Science Degree..

INSTITUTE OF POST HARVEST TECHNOLOGY

1.0 Progress of the Projects

- Project 1.1 Microbiological pathogens and indicator organisms in farm shrimp culture systems and during processing - Dr T.S.G. Fonseka
- Project 1.2 Effect of cooking treatment with additives and packaging on histamine production - Dr T.S.G. Fonseka
- Project 1.3 Development of convenience foods using under utilized fish - Miss G. Gunagamaarachchi
- Project 1.4 Development of an alternative technology to improve traditional fermented fish of Sri Lanka - Mrs P. Jayasinghe
- Project 1.5 Utilization of low value fish and fish waste to extract oil for food and feed purpose - Mrs V. Jayasinghe and Mr R. Edirisinghe
- Project 1.6 Developing feeds for farm shrimp and fresh water fish using locally available ingredients - Dr M. Perera

Project 1.1 Microbiological pathogens and indicator organisms in farm shrimp culture systems and during processing - Dr T.S.G. Fonseka

Visited Chilaw and Putlam area and selected the prawn farms namely, Hy-shrimp farm and Link shrimp farm and also selected several sources of main water supply to prawn farms such as the Hamilton canal, Putlam lagoon, Mundal lake and Dutch canal for the study. Samples of shrimp, water and sediment for microbiological analysis (total bacterial count, total vibrio count, total coliform, faecal coliform and total luminous count) were collected fortnightly. The growth rate of shrimp in chlorinated ponds were significantly low compared to unchlorinated ponds. There were no significant differences of the log total bacterial counts between the treated and untreated pond water. However significantly higher values of total coliform and faecal coliform were observed in non treated pond water. Chlorination also effect the bacterial quality of the pond sediments and work is continuing.

Project 1.2 Effect of cooking treatment with additives and packaging on histamine production - Dr T.S.G. Fonseka

This is a collaborative project with the University of Peradeniya. Formation of histamine was observed during preparation of Maldive Fish under laboratory conditions. More histamine was produced in dorsal loins containing a higher amount of dark tissues than the ventral loins containing less dark tissue. Histamine concentration increased in dorsal and ventral loins of skipjack tuna when Maldive Fish was prepared by smoke-drying followed by sun-drying. Histamine concentrations of the innermost portions was higher than that of the outermost portions in commercially available Maldive Fish samples. Smoking and application of wood ash appeared to inhibit histamine production in fish.

Project 1.3 Development of convenience foods using under utilized fish - Miss G. Gunagamaarachchi

Project activities commenced in November 1996.

Project 1.4 Development of an alternative technology to improve traditional fermented fish of Sri Lanka - Mrs P. Jayasinghe

Study - Some bio chemical changes of fermented fish (Jaadi) during bio-preservation

Jaadi was made in the laboratory using *Sardinella* sp. by altering the fish to salt ratio i.e. fish:salt 2:1, 3:1, 4:1 and 5:1 while keeping the Goraka (*Garcinia gamboges*) to fish ratio as 1:10. Samples were removed at monthly intervals for determination of several parameters i.e. total volatile nitrogen, try methyl amine, amino nitrogen, oil, peroxide value, salt, dry matter, pH, protein, and total bacterial counts. Organoleptic assessment of the samples were also performed. The development of a cheesy aroma which changed from faint to strong was observed during the study period. The ratio of fish:salt 3:1 showed the highest oil content, amino nitrogen, total nitrogen and highest organoleptic score when compared to other treatments used in the study. The large variation of chemical changes occurred after 28 days in all four salt concentrations. Further lowest total volatile nitrogen and peroxide values were observed in the fish fermented at 3:1 fish:salt combination. The results suggested that best quality Jaadi can be obtained at 3:1 fish:salt concentration.

Project 1.5 Utilization of low value fish and fish waste to extract oil for food and feed purpose - Mrs V. Liyanage and Mr R. Edirisinghe

Shark Liver - Mrs V. Jayasinghe

Sixteen visits were made to Beruwala and Negombo landing sites for the purpose of collecting samples and four studies were carried out using the same.

Study 1 - Effects of some acidic fruit extracts in the extraction of shark (*Carcharhinus falciformis*) liver oil by the silage method

The aim of the study was to evaluate the effectiveness of fruit extracts on producing shark (*Carcharhinus falciformis*) liver oil by ensilage method. Silage were treated with the extracts of Tamarind (*Tamarindus indica*) seed and fruit, Goraka (*Garcinia cambogia*) fruit, Bilin (*Averrhoa bilimbi*) fruit, butylated hydroxy toluene and ascorbyl palmitate. Control test was conducted without a treatment. The results suggested that good quality fish oil could be produced when silage is treated with Bilin (*Averrhoa bilimbi*).

Study 2 - Evaluation of natural antioxidants for the preservation of shark (*Carcharhinus falciformis*) liver oil

A storage trial was conducted with the ethanolic extracts of Turmeric (*Curcuma domestica*), Tamarind (*Tamarindus indica*) seed and fruit, butylated hydroxy toluene and ascorbyl palmitate to evaluate the antioxidant properties with shark (*Carcharhinus falciformis*) liver oil. Oil samples treated with Turmeric extract showed significantly lower hydrolytic rancidity and oxidative rancidity compared to other treatments used in the study.

Study 3 - Further studies on the effect of Turmeric (*Curcuma domestica*) extract on the preservation of shark (*Carcharhinus falciformis*) liver oil

The requirement of optimum level of turmeric extract to prevent the oxidation of shark liver oil was investigated by this study. The results showed that the level of >250ppm of ethanolic extract of Turmeric was required to prevent the oxidation and it was comparable to 200 ppm butylated hydroxy toluene.

Study 4 -

The study was initiated to evaluate the synergistic effect of turmeric extract with cardamom, clove, pepper, nutmeg and cinnamon extracts on shark liver oil. This study is continuing.

Small pelagics - Mr R. Edirisinghe

Twenty four visits were made to Chilaw, Negombo and Gandara landing sites for sampling and following studies were carried out using the samples.

Study 1- Seasonal variation of oil in small pelagics

Seasonal variation of the oil content and its quality in selected pelagics was studied. Sudaya (*Sardinella albella*) showed two high levels occurring in November and during February - March (14.1%). The lowest content of oil was reported in May. The highest amount of omega-3 polyunsaturated fatty acids, 30.9%, was reported in August where the lipid content was 5.2%. In Lagga (*Tryssa sp.*) two high values were reported, one in November and the other in February (15.8%). There were two low values but the lowest was reported during May - June. The highest amount of omega -3 polyunsaturated fatty acids, 28.1%, was reported in August where the lipid content was 3.5%.

Karalla (*Secutor ruconius*) and Orawa (*Siganus javus*) showed low oil content compared to the above two species. In general the oil content was lower for all species used in the study during the period of April - June.

Study 2 - Quality changes of fish and fish oil in frozen fish in freezer storage (-18° C)

An experiment was carried out using Salaya (*Sardinella albella*) to study the quality changes of fish and fish oil in frozen fish during freezer storage (-18°C). The amount of oil extracted from frozen fish was lower than the unfrozen fish. The free fatty acid values of oil from frozen fish were higher than that from unfrozen fish but the peroxide values were low in both samples. After the 375d the recorded total volatile nitrogen for fish was 22.1 mg/100g and it indicated that the quality of fish was still acceptable. Changes in fatty acid composition were very low in both samples. The total omega - 3 polyunsaturated fatty acids decreased from 29% to 24% in fish oil for both stages.

Study 3- Fatty acid composition of some pelagics

Fatty acid composition of some small pelagics was studied by gas chromatography. The amount of omega -3 polyunsaturated fatty acids present in each species is given below.

Bigeye baracuda (<i>Sphyraena forsteri</i>) - Theliya	-	33.6%
Dorab-wolf herring (<i>Chirocentrus dorab</i>) - Katuwalla	-	33.9%
Yellowstrip scad (<i>Selaroies leptolepis</i>) - Sura parawa	-	34.4%
Indian scad (<i>Decapterus russelli</i>) - Linna	-	32.4%
Blacktip sardinella (<i>Sardinella melanura</i>) - Salaya	-	32.0%
Smoothbelly sardinella (<i>Amblygaster srim</i>) - Hurulla	-	32.3%

The most important fatty acids i.e. Eicosapentaenoic acid (EPA) (C20:5w3) and Docosahexaenoic acid (DHA) (C22:6 w3) contributed to nearly 90% of the total omega-3 polyunsaturated fatty acids for all species studied.

Study 4- Preservation of fish oil using natural anti-oxidants

The use of natural preservatives is increasing due to the undesirable side effects of synthetic preservatives. Preservation of fish oil using seven different plant components, i.e. Malabar cardamom (*Elettaria cardamum*), Indian Gooseberry (*Phynanthus emblica*), Cinnamon (*Cinnamomum zeylanicum*), Kekirindiya (*Eclipta prostrata*), Fenugreek (*Trigonella foenum-graecum*), Khus-Khus grass (*Vetiveria zizanioides*), Tamarind (*Tamarindus indica*) extracts were studied. The results showed that Indian Gooseberry has high protection value against oxidation. The values of peroxide and free fatty acids in samples treated with Indian Gooseberry were very low i.e. 214m.eq/1kg and 3.2% respectively. Stability of omega-3 polyunsaturated fatty acids were very high when oil was treated with an extract of Indian Gooseberry. In general the quality of fish oil could be maintained at best for 60 days when oil samples were treated with an extract of Indian Gooseberry. Further studies show that the active component in Indian Gooseberry can be extracted using water but however, maximum activity is achieved when ethanol is used.

Project 1.6 Developing feeds for farm shrimp and fresh water fish using locally available ingredients - Dr M. Perera

Study 1 - The use of fermented fish silage and soybean meal as a protein source in diets for common carp (*Cyprinus carpio*) fry

The potential of dried fermented fish silage and soybean meal blend (1:1 w/w) in formulated diets for common carp was evaluated. The dried FS: SBM mixture was used to replace 0% (control), 20% (low silage), 40% (medium silage) and 80% (high silage) of the fishmeal protein in diets containing 40% protein. Triplicate groups of forty fish in each group (mean wt.0.30g) were fed one of the four experimental diets at the rate of 5% body weight per day for 138 days. The specific growth rates (%/d) and feed efficiency were determined on ten occasions (day 13, 27, 41, 54, 68, 83, 97, 111, 125 & 138). Total NH₃ excretion and apparent protein absorption efficiency in each group were measured over a two month period. The mean weights of the experimental fish in different groups were not significantly different at the beginning but they were by the end. The specific growth rates and feed efficiency were highest in fish fed on the diet containing 40% FS:SBM (medium silage) and did not significantly differ with the 0% (control) and 20% (low silage) silage diets. However higher dietary level of silage (80%) resulted in significantly reduced growth rate and feed efficiency. The absorption efficiency of protein, increased with increasing dietary silage level of the diets and highest silage indicated a significantly higher value compared to others. Analysis of the results of ammonia excretion and protein efficiency ratio is continuing.

2.0 Reports and Publication

- 2.1 C.V.L. Jayasinghe, A. Bamunuarachchi and M.U. Jayasekara - The effects of natural and artificial antioxidants on shark (*Carcharhinus falciformis*) liver oil during storage (29°C). Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.2 C.V.L. Jayasinghe, V. Jayaweera and A. Bamunuarachchi - Studies on quality changes of skipjack (*Katsuwonues pelamis*) and trevally (*Carangoides fulvoguttatus*) during frozen storage at -18°C. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.3 Edirisinghe, E.M.R.K.B., Bamunuarachchi, A. and De Alwis, A.A.P. - Studies on some process parameters of ohemic heating. Paper presented at the 52th annual session of SLAAS held in University of Kelaniya, November 1996.

- 2.4 Edirisinghe, E.M.R.K.B., Bamunuarachchi, A. and De Alwis, A.A.P. - Ohmic heating - The process impact on nutrients. Paper presented at the 52th annual session of SLAAS held in University of Kelaniya, November 1996.
- 2.5 E.M.R.K.B. Edirisinghe, A. Bamunuarachchi, V. Jayaweera and R. Samaradiwakara - Studies on the effect of some plant component extracts on the preservation of fish oils. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.6 E.M.R.K.B. Edirisinghe, A. Bamunuarachchi, V. Jayaweera and R. Samaradiwakara - Further studies on the effect of Indian Gooseberry (*Phynanthus emblica*) extract on the preservation of fish oil. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.7 P. Jayasinghe, T.S.G. Fonseka and A. Bamunuarachchi - Some bio-chemical changes of fermented fish (Jaadi) during bio - preservation. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.8 S. Gunaratne, U. Samarajeewa, T.S.G. Fonseka and I.V. Ranjani - Histamine in Maldive fish. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 2.9 S. Luckman, G. Fonseka and U. Edirisinghe - Melanosis inhibition in shrimp treated with metabisulphate and "Ever Fresh" held under different storage conditions. Paper presented at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996.
- 3.0 Extension work, Test services and Dissemination of Information**
- 3.1 Dr T.S.G. Fonseka delivered a course of lectures on fish technology, for the final year Zoology (Special) students of the University of Kelaniya.
- 3.2 Dr T.S.G. Fonseka participated as a resources person at the workshop aimed at preparing text books for GC E (O/L) on aquatic resources.
- 3.3 Dr T.S.G. Fonseka carried out a training programme on processing of Maldive fish for the benefit of fisherfolk (about 25 people) as requested by an NGO.
- 3.4 Dr M. Perera functioned as an examiner of a Master of Applied Science student of the University of Tasmania, Australia
- 3.5 Dr T.S.G. Fonseka and Dr M. Perera supervised the Graduate Diploma students of National Institute of the Fishery Training on fish processing and preservation techniques and assisted in the preparation of their dissertations.
- 3.6 Dr T.S.G. Fonseka delivered a course of lectures on fish technology, for the agriculture students of the University of Rajarata.
- 3.7 Dr M. Perera established the nutrition laboratory in NARA.
- 3.8 Dr M. Perera established the "Aqua Lab" which is used for feeding experiment.

- 3.9 IPHT staff conducted a two day training programme on the application of fish quality control techniques for B.Sc (Agric) students of the Rajarata University.
- 3.10 Dr M. Perera served as a resource person in the workshop on Feeds and Feeding of Ornamental Fish presented by the Agro Enterprise Project of the United States Agency for International Development (USAID) and the National Aquatic Resources Agency.
- 3.11 Dr M. Perera served as a member of the following consultative bodies:
- (i) Sectoral Committee on Agriculture and Food Technology,
- (ii) Sri Lanka Standards Institution's committee to revise the standards for poultry meal, ham, filled milk and shark fins.
- (iii) Sri Lanka Standards Institution's committee on Registration Scheme for Enterprises Processing Fishery Products for Export.
- 3.12 Thirty three fish samples, twenty four prawn samples and a lobster sample were analysed for total bacterial counts, faecal coliform, *E. coli*, *S.aureus*, coliform and *Salmonella* and test reports were issued.
- 3.13 Twenty seven samples of water, and twelve products i.e. Katta sambol, Seeni sambol, Ambul thial, bacon and sausages were analysed for total bacterial counts Coliform, *S. aureus* and Funges and test reports were issued.
- 3.14 Twenty four samples of dried fish and twenty seven canned fish samples were analysed for total bacterial counts, faecal coliform, coliform, *E.coli*, *S.aereus* and *Salmonella* and test reports were issued.
- 3.15 Carried out a training programme on "shark fin processing and extraction of rays from shark fin" for the benefit of clients.
- 3.16 Three prawn feed samples for proximate composition, fishery products (sausages, bacon, dried fish, Maldive fish, sprats) for chemical composition, two fish samples for histamine and seaweed samples for agar content were analysed and test reports were issued.

4.0 Training, Seminars and Workshops attended

- 4.1 Dr G. Fonseka, Mrs P. Jayasinghe, Mrs V. Jayasinghe and Mr R. Edirisinghe participated at the 10th session of the Asia Pacific Fisheries Commission working party meeting on Fish Technology and Marketing held in Colombo, June 1996. A total of seven research papers were presented by the participants.
- 4.2 Dr T.S.G. Fonseka attended a seminar on "Research Need in Livestock Development in Sri Lanka" organized by PGIA.
- 4.3 Mrs V. Jayasinghe and Mrs. C. Jayasinghe participated in the training course on Feeds and Feeding of Ornamental Fish presented by the Agro Enterprise Project of the United States Agency for International Development (USAID) and the National Aquatic Resources Agency.
- 4.4 Mr R. Edirisinghe participated in the workshop on "Scientific data presentation and publication" at the University of Ruhuna from 9-13th December 1996.

5.0 Supervision of projects

- 5.1 Dr T.S.G. Fonseka supervised three B.Sc. (Agriculture) final year students from University of Peradeniya who were engaged in projects based on "Activities related to Shrimp Processing".
- 5.2 Dr T.S.G. Fonseka supervised two diploma students from the affiliated University of North Western Province who had undertaken studies on post harvest processing and analytical methods.
- 5.3 Dr M. Perera is the internal supervisor of Mrs V. Jayasinghe and Mr R. Edirisinghe. (registered postgraduate students of the University of Sri Jayawardenapura for their M. Phil project studies on "Utilization of low value fish and fish waste to extract oil for food and feed purpose".

6.0 Constraints

- 6.1 Long periods of electrical power cuts during the year had been a constraint for many of the projects.
- 6.2 White spot diseases had been a constraint for project No 1.1
- 6.3 Histamine project could not continue due to the breakdown of the fluorophotometer.
- 6.4 Original experimental plan was changed in the feed formulation and development project due to unavailability of grass carp fingerlings. Restricted water supply and electrical power cuts during the year had been constraints for this project.
- 6.5 The project work on product development commenced only in November 1996 since an officers qualified in this field was not available in the IPHT before that.

ENVIRONMENTAL STUDIES DIVISION

Projects

1. Study of river input of pollutants to the coastal region by Kelani River and Kalu Ganga.

This study was carried out with the objectives of determining the water quality baseline data, determining the levels of pesticide residue and the estimation of pollutant loads. The quality of water at upstream samples contained less pollution levels except for the nutrients from plantations. The downstream of Kelani River was more polluted due to the industrial and urban pollutants. Preliminary analysis done in Sweden indicated that some of the agro-chemical residues (ie. DDT, DDE, HCH) were found in fish tissues.

2. Study of the water quality and agricultural residue in Malala Lagoon.

This study was carried out with the objectives of determining the water quality baseline data and determining of agro-chemical residue and other pollutants in water and fish tissues. Monthly field water sampling from Malala Lagoon and inlets was conducted regularly. The laboratory analysis was carried out for the determination of important water quality parameters. The environmental status of Malala/Embilicala system has been changed due to the heavy input of irrigation water from the Kirindi Oya/Lunugam Wehera Scheme. The quality of water was generally within the suitable range for coastal waters.

3. Quality assurance of industrial effluents

This programme was carried out to provide necessary assistance to the industrial sector to control the environmental pollution and to provide test reports for various water related industrial activities. A total of 41 analytical reports on industrial effluent, process water, drinking water and surface water were issued to the clients. The industrial effluent reports were for the submission to Central Environmental Authority to get Environmental Protection License.

4. Emergency Environmental Problems.

This project was carried out with the objectives of studying and reporting the emergency environmental problems and advise on the possible mitigatory measures. The studies were done on the reported fish kill in Marawila (collaboration with IARAD) and on the Leptospirosis disease problem in Piliyandala area.

5. Consultancy Assignments

* Environmental survey on quality of marine sediments for the feasibility study on the development of new port of Colombo (collaboration with Oceanography Division) was carried out. Total of 44 sediment samples from sea and Kelani River were analyzed for physical and chemical parameters. Reports were submitted to the Sri Lanka Ports Authority and Japan Port Consultants Ltd.

* Study on the water quality of Bolgoda Lake was carried out for the Asia Connects Ltd. to see the possibility of culturing of fish.

Other Activities

6. Trainings

- Mr. S.A.M. Azmy/RO, ESD attended a training programme on integrated coastal resources management in China, Philippines and Singapore.
- Mr. P.L.S. Panawala/SAAREC RA, ESD registered for a postgraduate degree in Sri Jayawardenepura University under the SAREC programme.
- Arrangements were made to get a local training on pesticide residue analysis at CISIR.

7. Reports, Publications and Extension work

- Dassanayake, N.H. (1996). Environmental degradation caused by fishery harbours and fishing boats and mitigatory measures. Presented at a national seminar on the prevention of marine pollution of Sri Lanka. May 1996, Colombo.
- Azmy, S.A.M., Padmini de Alwis and P.L.S. Panawala (1996). Coastal input of pollutants from two important river systems - Kelani and Kaluganga. Presented at an International seminar on coastal ecosystems.
- Lecture on Marine Pollution aspects for the coastal communities and school children at Galle organized by the Marine Pollution Prevention Authority.
- Lecture on Marine Pollution at Colombo International Nautical College for Deck Cadets at Mattakkuliya.
- Awareness programme conducted in Hambanthota regarding the present NARA activities in Malala area.

Advisory Services

- Serving in the advisory committees on environmental management issues.

- Activities related to Environmental Impact Assessment of development projects (Scoping, setting of TOR and evaluation of EIA reports etc.)

8. Constrains

- Inadequacy of the staff

Present staff composition

Position	Cadre	Present No.	Remarks
Director	01	-	on leave abroad
RO	03	02	interviews were held to fill the vacancy but the recruitment could not be done
RA	03	02	on leave abroad
Typist	01	01	-
Laborour	03	03	-
Project RA	-	01	on contract basis

* Lack of trained staff to do pesticide residue analysis (a local training was arranged for the project staff at the beginning of the year 1997)

* Procurement of analytical equipment

Some of the equipments ordered for the year 1996 were not purchased due to the non-availability of enough money (the Treasury did not release the capital expenditure allocated during the last quarter of the year).

NATIONAL AQUATIC RESOURCES RESEARCH & DEVELOPMENT AGENCY

BALANCE SHEET AS AT 31-12-1996

130,817,281	BALANCE BROUGHT FORWARD		81,639,721.99
14,650,000	GOVERNMENT GRANT FOR THE YEA	(11)	27,090,000.00
	REVALUATION RESERVE	(12)	91,202,463.00
9,439,829	FOREIGN GRANT FOR THE YEAR		
1,095,818	LOCAL GRANT FOR THE YEAR	(13)	2,175,278.00
(74,363,206)	EXCESS OF EXPENDITURE OVER INCOME		(25,580,428.25)

81,639,722

176,527,034.75

FIXED ASSETS

	LAND	(14)	91,202,463.00
7,225,769	BUILDINGS	(14)	7,815,062.51
740,478	MACHINERY	(14)	538,884.22
17,063,003	EQUIPMENT	(14)	17,419,014.45
	COMPUTER & PRINTER	(14)	2,443,389.63
476,564	VEHICLES	(14)	4,350,035.14
178,023	BICYCLES	(14)	157,974.50
1,645,786	FURNITURE & FITTINGS	(14)	1,716,253.10
222,064	AUDITORIUM	(14)	158,907.72
90,435	MAIN POND	(14)	51,746.74
1,188,112	LIBRARY BOOKS	(14)	1,872,758.97
5,210	ADMIRALTY CHARTS	(14)	11,209.20
10,327,609	RESEARCH & DEVELOPMENT (LOCAL)	(14)	12,053,183.42
31,482,385	RESEARCH & DEVELOPMENT (FOREIGN)	(14)	22,249,020.29
15,103,425	SAMUDRAMARU	(14)	<u>13,949,150.59</u>

85,748,863 **CURRENT ASSETS**

175,969,053.49

765,736	STOCK AS AT 31-12-1996	(15)	1,408,203.88
1,526,104	DEBTORS & PREPAYMENT	(16)	6,518,836.64
158,472	DEPOSITS	(17)	167,472.00
476,078	ADVANCES	(18)	2,588,012.18
2,023,430	DEBTORS-EMPLOYEES	(19)	4,484,405.05
483,925	CASH IN TRANSIT		0.00
<u>6,964,287</u>	CASH IN HAND & AT BANK	(20)	<u>3,530,711.63</u>

12,398,033

18,697,641.38

CURRENT LIABILITIES

9,665,129	CREDITORS & ACCRUED EXPENSES	(21)	11,790,270.80
1,351,351	PROJECT CREDITORS	(22)	224,344.32
254,600	PROVISIONS	(23)	254,600.00
921,902	CONSULTANCY PROJECT	(24)	<u>1,431,102.50</u>

12,192,982

13,700,317.62

205,051 NET CURRENT ASSETS
(4,314,193) DEFERRED LIABILITIES

4,997,323.76
(4,459,342.50)

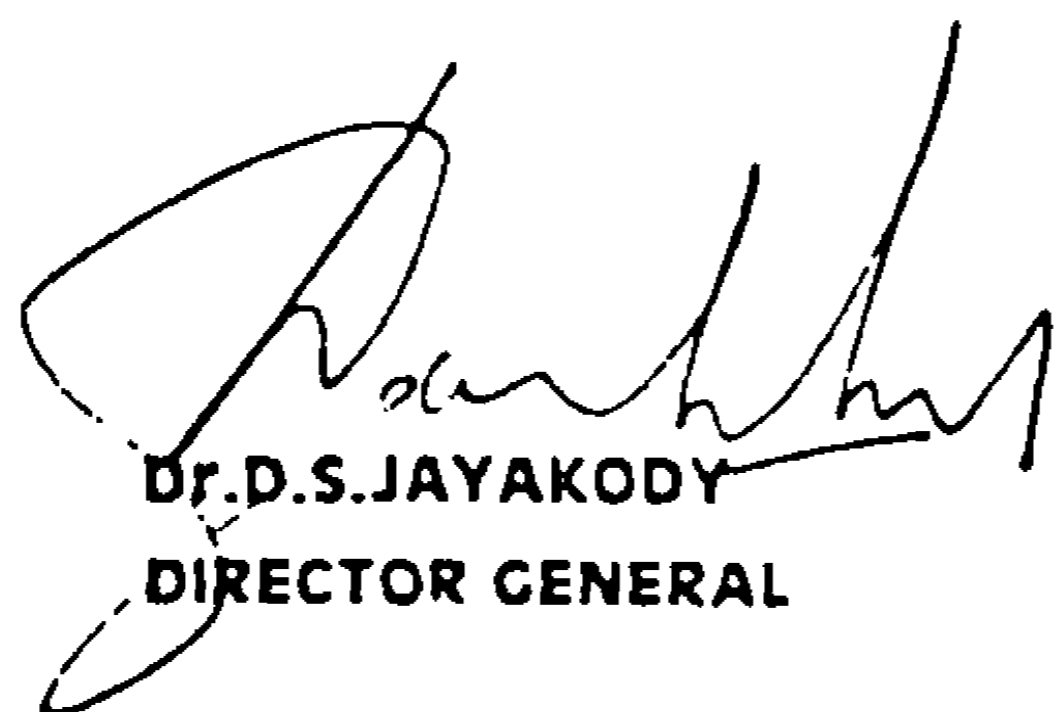
31,639,722

176,527,034.75



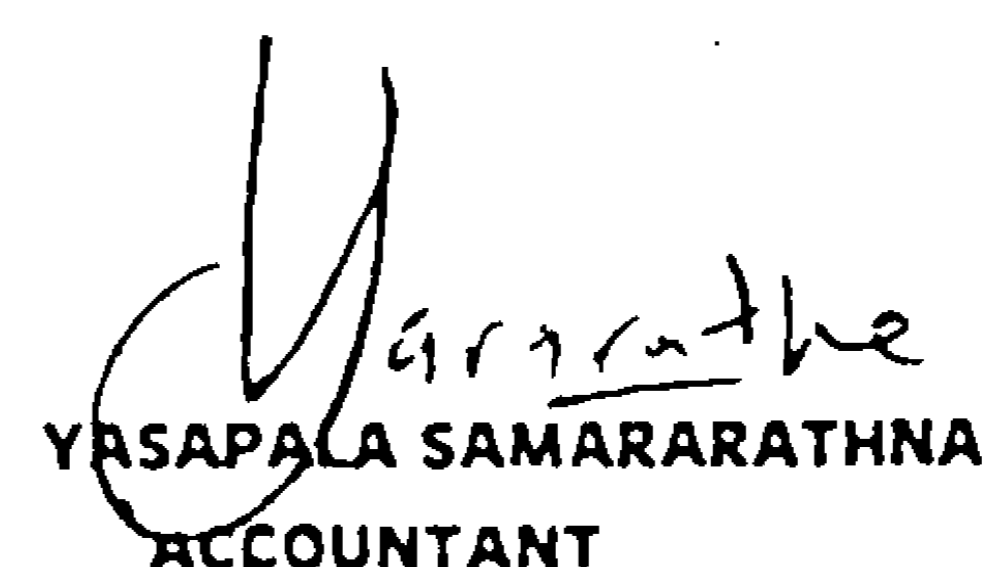
M.H. GUNAWARDANA
CHAIRMAN

20-08-1997



D.F.S. JAYAKODY
DIRECTOR GENERAL

20-08-1997



YRASAPALA SAMARARATHNA
ACCOUNTANT

20-08-1997

NOTE OF THE AUDITOR GENERAL

The accounts of National Aquatic Resources Research and Development Agency for the year ended 31 December 1996 were audited 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.

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 Research and Development Agency.

(Sgd. S. M. Sabry)
Auditor General,
30 September 1998.

Auditor General's Department,
Colombo 07.

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Telephone

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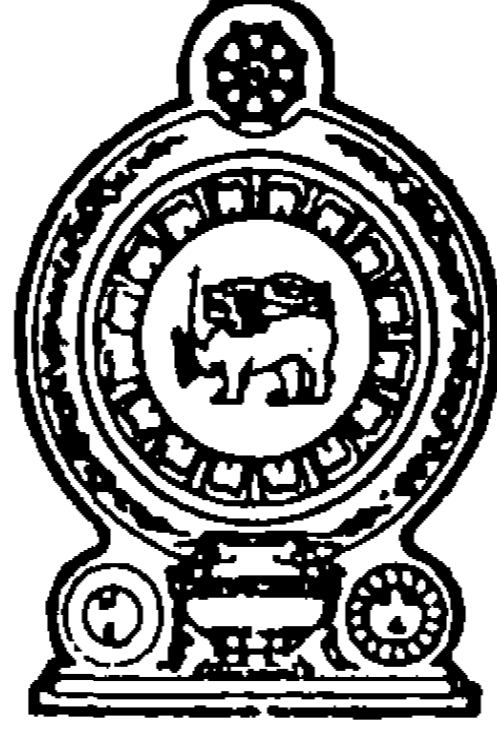
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Fax No.

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මගේ අංකය
எனது இல.
My No.

VM/J/NARA/05/97

ඔබේ අංකය
உமது இல.
Your No.



විගණකාධිපති දෙපාර්තමේන්තුව

නිදහස් වතුරගා, කොළඹ 7, ශ්‍රී ලංකාව

கணக்காய்வாளர் தலைமை அபிபதி திணைக்களம்

சுதந்திர சதுக்கம், கொழும்பு 7, இலங்கை

AUDITOR-GENERAL'S DEPARTMENT
INDEPENDENCE SQUARE, COLOMBO 7, SRI LANKA

දිනය/திகதி/Date: 30 September 1998.

The Chairman,
National Aquatic Resources Research
and Development Agency.

Report of the Auditor General on the accounts of the
National Aquatic Resources Research and Development Agency
for the year ended 31 December 1996 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 1996 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 3 December 1997.

1:2 Scope of Audit

Audit opinion, 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 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. Sub-sections (3) and (4) of Section 13 of the Finance Act give discretionary powers to the Auditor General to determine the scope and extent of the audit.

2. Accounts

2:1 Opinion

In view of my observations appearing in this report, I am unable to express an opinion on the accounts presented. Major deficiencies observed in this connection are given below.

Deficiency -----	Reference to paragraph in this report -----
(a) Accounting Policies	2:5:1
(b) Inappropriate disclosures in the Accounts	2:5:2
(c) Omissions in the Accounts	2:5:3
(d) Overstatements and Understatements in the Accounts	2:5:4
(e) Accounts Receivable and Payable	2:5:5
(f) Lack of Evidence for Audit	2:5:6
(g) Non-compliance with Laws, Rules, Regulations, Management Decisions etc.	2:5:7
(h) Transactions not supported by Adequate Authority	2:5:8
(i) Unreliability of Financial Results and Financial Position	3:1
(j) Weaknesses in Systems and Controls	4

2:2 Financial Results

According to the accounts presented, the working of the Agency during the year under review had resulted in a deficit of Rs.25,355,013 as compared with the deficit of Rs.30,839,267 for the preceding year. The following statement gives a summary of the financial results for the year under review and the preceding year.

	Rs.	Year ended 31 December		Rs.
		1996	1995	
Income				
Government Contribution	29,072,200		26,792,554	
Sundry Income	3,721,446	32,793,646	2,670,114	29,462,668
Expenditure				
Administration	48,847,871		38,927,891	
Establishment	3,477,934		3,386,680	
Depreciation	19,521,183		27,686,530	
	71,846,988		70,001,101	
Less:				
Amount recovered from Projects	13,698,329	(58,148,659)	9,699,166	(60,301,935)
Deficit for the year		(25,355,013)		(30,839,267)
Accumulated Deficit Brought forward	(149,458,087)		(117,474,739)	
Prior Period Items	(225,415)	(149,683,502)	(1,144,081)	(118,618,820)
Accumulated deficit carried forward		(175,038,515)		(149,458,087)

2:3 Financial Structure

According to the accounts presented, the financial structure of the Agency as at 31 December 1996 compared with that as at 31 December 1995 is given below.

	As at 31 December			
		1996		1995
	Rs.	Rs.	Rs.	Rs.
Resources				
Government Contribution		137,553,380		110,463,380
Foreign Aid	109,987,256		109,987,256	
Adjustments for Special) Dollar Account Balance)	(8,853,775)	101,133,481	(8,853,775)	101,133,481
Other Contributions		21,676,225		19,500,947
Revaluation Reserves		91,202,464		-
Accumulated Deficit		(175,038,515)		(149,458,087)
		176,527,035		81,639,721
Utilisation				
Fixed Assets at written down value		127,737,700		29,427,762
Vessel "Samudra Maru"		13,949,151		15,103,425
Foreign Aid Projects (Net)		22,249,020		31,482,385
Other Projects (Net)		12,053,183		9,735,291
Net Current Assets/(Liabilities)		537,981		(4,109,142)
		176,527,035		81,639,721

2:4 Cash Flow

The following statement shows the cash flow of the Agency during the year under review and the preceding year.

	Rs.	Year ended 31 December	
		1996	1995
		Rs.	Rs.
Cash Flows from Operating Activities			
Deficit for the Year		(25,355,013)	(30,839,267)
Adjustments for Items not Involving Movement of Cash			
Depreciation	19,958,164		27,686,530
Provision for Gratuity	419,512		443,916
Adjustment for Fixed Assets	-		950,806
Profit on Sale of Fixed Assets	(3,300)	20,374,376	-
		(4,980,637)	(1,758,015)
Prior Period Items		(225,415)	(1,144,081)
Operating Deficit before Changes in Items of Working Capital		(5,206,052)	(2,902,096)
Changes in Items of Working Capital			
(Increase) in Stock	(642,467)		(1,599)
(Increase) in Accounts Receivable	(9,574,641)		(1,281,434)
Increase/(Decrease) in Creditors and Accruals	2,125,141		(1,708,744)
Increase/(Decrease) in Project Creditors	(617,807)		932,265
Increase Consultancy Project	-	(8,709,774)	921,902
		(13,915,826)	(4,039,706)
Less: Payment of Gratuity		(274,363)	(93,868)
Net Cash Used in Operating Activities		(14,190,189)	(4,133,574)

Cash Flows from Investing Activities

Acquisition of Fixed Assets	(18,995,890)	(18,348,096)
Proceeds from Sale of Fixed Assets	3,300	-
Net Cash Used in Investing Activities	(18,992,590)	(18,348,096)

Cash Flows from Financing Activities

Grant Received - Government	27,090,000	14,650,000
- Foreign Grant	2,175,278	10,535,647
Cash Generated from Financing Activities	29,265,278	25,185,647
Net Increase/(Decrease) in Cash and Cash Equivalents	(3,917,501)	2,703,977
Cash and Cash Equivalents at Beginning of the Year (Note 1)	7,448,212	4,744,235
Cash and Cash Equivalents at End of the Year (Note 2)	3,530,711	7,448,212

Note :1

	Rs.
Bank Balances	6,964,287
Cash in Transit	483,925
	7,448,212
	=====

Note :2

	Rs.
Bank Balances	3,530,711
	=====

2:5 Comments on Accounts

2:5:1 Accounting Policies

Following observations are made.

- (a) Work in progress on long term contracts had not been valued as at 31 December 1996. The cost incurred has been set off against receipts from the customers and the surplus/deficit shown under creditors/debtors.
- (b) The Project expenditure totalling Rs.33,184,493 as at the end of the year under review had been shown as fixed assets viz. Rs.22,249,020 under Foreign Aid Projects and Rs.10,935,473 under Other Capital Projects. The project expenses were made up of both tangible and intangible assets. The project expenditure had been amortized on a straight line method at 20% on cost irrespective of intangible components. The amortisation so provided amounted to Rs.10,989,759.

2:5:2 Inappropriate disclosures in the Accounts

Following inappropriate disclosures in the accounts were observed.

- (a) Research and development costs included in fixed assets, at a book value of Rs.34,302,203 had been incorrectly capitalised. This is not in compliance with Sri Lanka Accounting Standard No. 11.
- (b) Payment made to building contractors in connection with capital work in progress amounting to Rs.1,870,296 had been disclosed under service advances.
- (c) A sum of Rs.2,616,676 transferred to an other Bank account had been incorrectly credited to a Bank transfer account and shown as sundry creditors.
- (d) A leasehold land valued at Rs.9,493,508 had been incorrectly classified as freehold land in the accounts.
- (e) Development and extension costs of Rs.473,889 which is of a revenue nature had been incorrectly capitalised.
- (f) Revenue expenditure of Rs.71,400 had been capitalised under equipment account.

- (g) Expenditure of a revenue nature amounting to Rs.1,012,785 incurred on the ship, "Samudra Maru" had been capitalised.
- (h) Prepaid expenses totalling Rs.238,043 had been charged against income instead of being shown as a prepayment.
- (i) A bank overdraft amounting to Rs.573,919 had been set off against other favourable bank balances.
- (j) Bank balance amounting to Rs.532,686 lying in the Current Account No.3119 in the name of the Agency had been shown in the accounts as debtors.

2:5:3 Omissions in the Accounts

Following omissions in the accounts were observed.

- (a) The ship, "Sayuri" acquired during the year at a cost of Rs.92,700,000 had not been disclosed in the accounts.
- (b) No provision had been made in respect of slow moving and obsolete stock amounting to Rs.96,205.
- (c) No provision had been made in the accounts in respect of long outstanding advances given to employees totalling Rs.136,856, the recovery of which is doubtful.
- (d) A small boat, procured locally by the Project co-ordinator for the SAREC Project had not been valued and incorporated in the accounts.
- (e) Provision had not been made in the accounts in respect of video cassettes valued at Rs.266,700 which had become obsolete.
- (f) Adjustment had not been made in respect of 357 library books lost from the library during 1994.
- (g) No provision had been made for obsolete stock of library books.
- (h) Retention money amounting to Rs.61,803 receivable from the Ministry of Fisheries and Aquatic Resources Development had not been shown in the accounts.

2:5:4 Overstatements and Understatements in the Accounts

Following overstatements and understatements were observed.

- (a) Fully depreciated library books had not been removed from the cost. As a result, depreciation had been calculated on such books.
- (b) Accrued expenditure had been understated by Rs.100,000 due to omission of security charges for September 1996.
- (c) A retention payment of Rs.38,678 in respect of a building had been incorrectly included in the Bid Bond account, thereby overstating this account.
- (d) Stock valued at Rs.20,496 received after the end of the year had been included in the year end stock. As a result, the stock had been overstated.

2:5:5 Accounts Receivable and Payable

Following observations are made.

- (a) Receivables amounting to Rs.6,888,331 did not represent any realisable value.
- (b) A sum of Rs.6,103,830 continued to be shown as arrears of rates and taxes payable to the Colombo Municipality for the period 1979 to 1996.
- (c) Out of debtors, deposits and advances, balances totalling Rs.6,589,966 and Rs.246,000 were outstanding for periods ranging from one to two years and over two years.
- (d) Out of the creditors, balances totalling Rs.9,478,000 and Rs.3,968,000 were outstanding for periods ranging from one to four years and over four years respectively.
- (e) Out of the project creditors balances, Rs.224,345 was outstanding for a period of over four years.
- (f) Petty cash advances totalling Rs.88,281 given to the staff during the period 1991 to 1996 had not been recovered upto end of the year 1996.

- (g) A sum of Rs.15,070 being surcharge recoverable from an employee in connection with a cash shortage in March 1993 had not been recovered upto end of the year.
- (h) Refundable tender deposits received during the period 1993 to 1996 totalling Rs.80,000 were remaining uncleared as at the end of the year.

2:5:6 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 Rs. -----	Evidence not made available -----
(a) Fixed Assets	175,989,053	(i) Properly maintained fixed assets register (ii) Verification reports
(b) Debtors	2,073,901)
(c) Deposits	167,472)
(d) Purchase Advances	519,356) Direct confirmations
(e) Service Advances	2,068,656)
(f) Allowance-Accountant (Marine Research Project)	36,000	Board approval

2:5:7 Non-compliance with Laws, Rules,
Regulations, Management Decisions etc.

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

Reference to Laws, Rules,
Regulations and
Management Decisions

Particulars

(a) Finance Act.

- | | |
|------------------------|---|
| (i) 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. |
| (ii) Section 13(5)(b) | Report on stocks, stores, debtors and creditors had not been furnished to the Auditor General along with the accounts. |
| (iii) Section 13(5)(d) | An internal audit programme had not been settled in agreement with the Auditor General and half yearly internal audit reports for the year 1996 had not been submitted as prescribed. |
| (iv) Section 13(6) | Report on accounts as specified by the Auditor General had not been furnished along with the accounts.

Accounts were rendered for audit only on 28 August 1997. |
| (v) Section 14(1) | A copy of the draft annual report had not been submitted within 4 months after the end of the financial year. |

- | | |
|--|---|
| (b) NARA Act No. 54 of 1981
Section 5(c) | The services of a firm of Chartered Accountants were obtained for assisting the accounts work of the Agency at a cost of Rs.24,000. Board approval was not available for this engagement. The Agency has two accountants, ^{an} assistant accountant and a book-keeper. |
| (c) Financial Regulation
No. 1646 | Daily running charts and monthly performance summaries of vehicles to be submitted to the Auditor General on or before the 15th day of the following month had not been submitted upto 31 December 1997 in respect of the year under review. |
| (d) Treasury Circular No. 842
of 19 December 1978 | Values of individual assets were not shown in the fixed asset register. |
| (e) Public Enterprises
Department Circular No. 95
of 14 June 1994. | Approval was not obtained to pay an honorarium of 3 months salary to the previous Director General who had resigned on his own before the date of termination and whose services were terminated by the Minister with due notice. |
| (f) Sri Lanka Accounting
Standard No. 9 | A cash flow statement had not been furnished with the final accounts. |
| (g) Lease Agreement dated
4 January 1990 | Annual lease rent had not been paid to the Board of Investment as required since 1990. |

2:5:8 Transactions not supported by Adequate Authority

Following instances were observed.

- (a) Ministerial approval had not been obtained to dispose of unserviceable assets totalling Rs.762,068 belonging to other Government Agencies.
- (b) Out of the capital grant provided by the Government, a sum of Rs.9,555,276 remaining un-spent had been utilised to meet recurrent expenditure.

3. Financial and Operating Review

3:1 Financial Results

The working of the Agency during the year ended 31 December 1996 had resulted in a deficit of Rs.25,355,013 compared with the deficit of Rs.30,839,267 for the preceding year.

In view of the material uncertainty reflected in the financial statements as described in paragraph 2:5 above, any attempt to analyse this variance is not likely to lead to any meaningful results.

The financial results disclosed in the annual financial statements of the Agency had been adjusted by the Agency for accounting errors, omissions etc. observed in the subsequent years as regular feature. For instance, the deficit of Rs.30,839,267 shown in the accounts for the previous year had been adjusted during the year under review by Rs.225,415 (net). Similar adjustments made during the previous five years are given below.

Year	Financial Results	Adjustments made in subsequent years
-----	-----	-----
	Rs.	Rs.
1990	(8,715,370)	(1,721,142)
1991	(7,733,944)	(12,317,717)
1992	(8,163,129)	(16,294,750)
1993	(10,406,301)	(12,984,015)
1994	(11,875,069)	(1,144,081)

In this context, the possibility of similar adjustments of the financial results and the financial position for the year under review in subsequent years cannot be ruled out. Therefore, no reliance can be placed on the financial results and the financial position reflected in the accounts.

3:2 Physical Performance

Neither the Project performance Evaluation Reports had been prepared, nor adequate records had been maintained for the year under review. The progress of the projects and the Agency could not therefore be ascertained.

3:3 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.
- (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.

3:4 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 until 31 December 1996 with a crew of five.

Following observations are made.

- (a) A total sum of Rs.13,560,688 had been incurred on repairs and maintenance during the 10 years ended 31 December 1995.
- (b) A sum of Rs.473,836 had been spent on repairs and maintenance during the year.
- (c) The cost of spare parts purchased by the UNDP amounted to Rs.20,310,000.
- (d) The annual cost of salaries of the crew of the vessel amounted to Rs.351,562.
- (e) The vessel "Samudra Maru" has been idling during the year due to a major overhaul.

3:5 Funding Arrangement for Provision for Gratuity

A sum of Rs.4,459,343 had been provided for gratuity as at 31 December 1996. However, a fund to settle the liabilities in future had not been created by the Agency.

3:6 Uneconomic Transactions

Following observations are made.

- (a) Although a sum of Rs.6,103,830 had been provided for rates payable to the Municipal Council since 1979, no action had been taken to settle the outstanding balance.
- (b) An acting salary of Rs.36,000 per annum had been paid to the accountant in respect of a Project which had been terminated over two years ago.
- (c) A payment of three months salary had been made to the former Director General on his resignation from the post. However, in terms of his letter of appointment, three months salary should have been paid by him to the Agency for his failure to give three months notice of his resignation.
- (d) An advance of Rs.19,023 had been paid to a company in January 1992 for purchase of library books. The books had not been received yet. However, no action had been taken by the Agency to recover this advance.

3:7 Idle Resources

Certain portions of the land, research vessel "Samudra Maru", 5 vehicles and some building space remained idle during the year under review. Suitable action had not been taken by the Agency to utilise these resources or to take appropriate alternative course of action. These resources were idling for periods ranging from one to ten years.

In this connection, the Chairman informed me in April 1998, as follows.

- (a) "The unused portion of the land will be used when necessary (expanding of building).
- (b) The security situation at Trincomalee prevented the effective use of "Samudra Maru".
- (c) The said building spaces are used for special Projects activities where necessary. When these Projects are over these spaces remain unused until it is used when other special Projects are started.

- (d) It is a fact that a number of unserviceable vehicles have been lying at NARA premises for a number of years. These vehicles belong to outside organizations and NARA has not taken steps to obtain ownership because this involves the payment of taxes disproportionate to the actual value of the vehicle. Hence, NARA is not able to dispose of them by sale".

3:8 Identified Loss

An officer who had gone on a scholarship to a foreign university on a bond amounting to Rs.2,122,270 had not returned to the Island after completing the scholarship. The Agency has referred this matter to the Attorney General on 12 December 1991 in order to take appropriate legal action to recover a sum of Rs.1,414,847.

3:9 Cost of Personnel

A comparative statement of average cost of personnel for the year 1996 and 1995 analysed under each category is given below.

<u>Category</u>	<u>No. of Employees</u>		<u>Average Cost per Employee</u>	
	<u>1996</u>	<u>1995</u>	<u>1996</u> Rs.	<u>1995</u> Rs.
Executives	55	54	122,716	116,917
Non Executives	228	226	51,767	48,853
	---	---		
	283	280	65,556	65,770
	===	===		

3:10 Vehicle Utilisation

The Agency had a fleet of 29 vehicles as at the end of the year under review. Cost of running and maintenance of this fleet during the year under review could not be ascertained in the absence of proper accounting records showing these expenses under separate headings. The total cost of fuel of this fleet during the year under review was Rs.1,136,714 compared with Rs.1,180,250 during the previous year. It was also observed that the running charts and log books had not been properly maintained for individual vehicles indicating the distance travelled, fuel consumed, repair cost etc. Hence, it was not possible to determine the cost of fuel consumed by each vehicle, the average performance per litre and the cost of repairs per vehicle.

3:11 Budgetary Control

Significant variations were observed between budget and actual income and expenditure during the year under review thus indicating 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) Review and appraisal of operations and records by the Internal Audit.
- (g) Segregation of Functions and Delegation of Authority
- (h) Accounting

(S.M. Sabry)
Auditor General.

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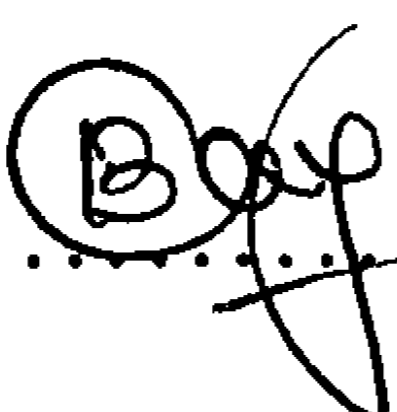
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