

ANNUAL REPORT & ACCOUNTS

2001



National Aquatic Resources Research &

Development Agency

Crow Island, Mattakkuliya

Colombo -15

FOREWORD

Annual Report and Accounts of the year 2001 is fundamentally a compilation of activities undertaken by the respective Technical divisions of the National Aquatic Resources Research and Development Agency.

The programmes and projects undertaken are within the purview, functions and duties covered within the policy frame work.

The contents highlight the summary of activities undertaken and reflect on the performance during the year under review as against the planned set of activities depending on available funding. Most of the activities are not confined only to a period of a single calendar year. They continue over several years, based on the realization of the set objectives.

With anticipated structural changes to the National Policy frame work, NARA plans to forge ahead to contribute towards the national development efforts in field of fisheries, ocean and other aquatic resources..

Razik Zarook

Chairman

September 2002

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GENERAL ADMINISTRATION

National Aquatic Resources Research and Development Agency (NARA) is the principal national institution charged with the responsibility of carrying out and co-ordinating research, development and management activities on the subject of aquatic resources. NARA was established in the year 1982 by restructuring the Research Division of the Department of Fisheries as a full fledged research agency, under the Act of Parliament, National Aquatic Resources Research and Development Agency Act, No. 54 of 1981 and amended subsequently by National Aquatic Resources Research and Development Agency Act, No. 32 of 1996.

Main objects and functions of the Agency are as follows:

- To ensure application and utilisation of scientific and technological expertise for the implementation of national development programmes
- To promote and conduct research activities directed at identification, assessment, management and development
- To co-ordinate and provide advisory and consultancy services on matters relating to exploitation, management and development
- To undertake collection, dissemination and publication of information
- To provide training

Organisation

In order to perform the mandated functions of the agency, organisational structure is designed to constitute eight research and technical divisions supported by administration, services and finance divisions. Dr. D.S. Jayakody who held the Post of Director General from 3rd June 1997, relinquished the duties of the post from 27th July 2001 and Mr. M.A.R. Kularatne (Sri Lanka Scientific Service Class 1) temporarily released on secondment from the Ministry of Land Development and Minor Export Agriculture, assumed the duties of post of Director General with effect from 1st August 2001.

Following members tendered their resignation from the Governing Board

Name	Effective date
Dr. N.P. Wijayananda	10 th Dec. 2001
Prof Eric Karunanayake	28 th Dec. 2002
Dr. Mrs. P.R.T. Cumararatunga	28 th Dec. 2002
Dr. J. Wickramasooriya	28 th Dec. 2002
Mr. H.S. De S. Jayatilaka	28 th Dec. 2002
Mr.N.S. M. Samsudeen	28 th Dec. 2002

1. Recruitments in 2001

Post	No	Permanent	Contract	Casual
Machine operator / Fabricator	01	01 K.A.C.J.Wijesiri	-	-
Draughtsman	01	01 D.C.Udawatte	-	-
Research Officer	07	03 D.R.Jayasinghe D.C.T.Dassanayake K.L.R.C.Wijayasinghe	04 D.C.T.Dassanayake D.R.Jayasinghe R.P.P.K.Jayasinghe L.Panawala	-
Landscaping Officer	01	01 D.N.Leelananda	-	-

Sampler	02	02 M.D.Wijewickrama A.Suriyakumar	-	-
Clerk	-	-	01 W.Samarasekara	-
Work Supervisor(Electrical)	01	-	01 S.P.Keerthipala	-
Research Assistant	01	-	01 R.Wijesinghe	-
Skipper(Syuri)	01	-	01 P.S.A.Fernando	-
Labourer	05	-	03 M.Muralitharan D.M.SDissanayake Lal Chandrasena	02 A.K.Wickramarath e V.Chandrasena (Now in permanent cadre)
Store keeper	01	01 M.D.M.Asanka	-	-

2. Departures from Service in 2001

Name	Designation	Retirement	Resignation	Date
Mr.S.L.B.Fernando	Boatswain	X	-	25.01.2001
Mr.S.P.Keerthipala	Supervisor (Electrical)	X	-	26.06.2001
Mr.B.Galappatti	Chief Admin. Officer	X	-	28.02.2001
Mr.W.A. Fernando	Driver	X	-	29.05.2001
Mr.R.G.S.Wijesekara	Research	-	X	01.03.2001
Mrs.R.K.V.J.Gunasekara	Officer	-	X	01.09.2001
Dr.J.M.P.K.Jayasinghe		-	X	31.12.2001
Mr.B.J.K.Balapatabendi	Skipper(Syuri)	-	-	30.06.2001

3. Vacancies as at 31.12.2001

Action initiated for recruitment. Government's embargoes in filling posts prevented intake. Details are as follows

Post	No. of posts
Chief Admin. Officer	01
Research Officer	05
Research Assistant	03
Audit clerk	01
Typist(English)	01
Data Entry Operator	01
Driver	02
Lab Attendant	03

Unskilled Labourer	02
Skilled Labourer	01
Welder	01
<i>(Samudramaru)</i>	
Captain	01
Chief Officer	01
Chief Engineer	01
ERA	02
Deck Hand	01
Seaman	01
<i>Rekawa RRC</i>	
Clerk/Store keeper	01
Labourer	01
Watcher	03
Deputy Hydrographer	01
Chief Hydrographic Surveyor	01
Hydrographic Surveyor	08
Land Surveyor	01
Chief Cartographer	01
Deputy Chief Cartographer	01
Draughtsman	01
System Analyst/Programmer	02
EDP Assistant	01
Office Assistant	01
Technical Assistant(Mechanical)	01
Purchasing Officer	01
Unskilled Labourer	01

4. Promotions during 2001

Promotion	No.
Grade III to Grade II	01
Grade IV to Grade III	04
Grade VI to V	02
Grade VII to VI	06
Grade VIII to Grade VII	02
Grade IX to VIII	02
Grade X to Grade IX	02

5. Disciplinary Inquiries

(a) Labour Court Cases

- Mr. W. D. Gratien Fernando being heard
- Ms. Suramya Wijesekara -do-
- Mr. U. Edirisinghe -do-
- Mr. Galappaththy -do-
- Mr. J. K. Balapatabendi -do-

(b) Supreme Court Cases

- Mr. T. S. Dharmarathna - Completed
- Mr. Denise Fernando - Completed
- Supreme Court Case (Chilaw – permission for Shrimp Kraal Fishing) – being heard
- Mr. K. G. V. Wickramasinghe – It was decided to pay him the due arrears
- Disciplinary inquiry against the Accountant Mr Y Samarathna is being conducted.

6. Interdictions

- Mr Sarath Wijesiri – Samudra Maru Vessel – Disciplinary inquiry is being conducted
- Mr H A Donald Perera - Called back to service after the inquiry
- Mr A M S Pushpananda - Called back to service after the inquiry
- Ms M G J Parakrama - Files were handed over to the Inquiry Board
- Mr D A Athukorala - Files were handed over to the Inquiry Board

7. Welfare – Transport arrangements

Piliyandala	-	NARA
Kottawa	-	NARA
Gampaha	-	NARA
Borella	-	NARA
Fort	-	NARA
Negombo	-	NARA

Transport facilities were provided as above contributions were made at the demises of the relations of the NARA Employees.

8. Scholarships, Training, Seminars, Conferences, Workshops and Other Tours Abroad

Name & Designation	Country	Purpose	Period	Funds
Dr.J.M.P.K. Jayasinghe R/Officer (H/IPHT)	India	For medical Treatment	02.01.2001- 01.02.2001	Own expenses
	India	Observation tour Cleanflo Technology for Lake Restoration	28.03.2001- 31.03.2001	US – AEP
	Sweden/ Iceland	Working visit – Improvement of quality infrastructure for the fishing industry	30.06.2001- 13.07.2001	CIDA/SAREC
Mr.S.C.V.U. Senevirathne Research Assistant	Japan	Short term Training- Training Programme on age estimating of shark	03.02.2001- 05.03.2001	ADB
Dr.T.K.D.Tennakoon H/Oceanography	U A E	Presentation on "The Sharjah Solar Energy Conference"	18.02.2001- 22.02.2001	Organizing Committee
Mr.P.D.K.D. Amarasooriya Research Officer	USA	21 st Annual Symposium on Sea Turtle Biology & Conservation	24.02.2001- 28.02.2001	NARA
	Australia	For P.hD Studies	04.06.2001- 05.09.2001	ADB
Mr.M.Gammanpila Research Officer	Thailand	Short term Training- Mass Production of live feed	26.02.2001- 06.04.2001	ADB
Mr.Janaka Pushpakumara Research Assitant	Thailand	Short term Training- Mass Production of live feed.	26.02.2001- 06.04.2001	ADB
Ms G.J.Ganegama- Arachchi R O	Singapore	7 th Regional training course in food safety for ASEAN	05.03.2001- 16.03.2001	Colombo Plan Project
	Sweden/ Iceland	Training of R.O's in Laboratory Testing under the SIDA Project.	05.05.2001- 01.08.2001	SIDA Project

Mr.M.A. Ariyawansa Hydrographer	United Kingdom	workshop " Securing your Rights to continental Shelf Territory"	26.03.2001-30.03.2001	NARA
	Denmark	Testing for Multi beam Echo Sounder	12.11.2001-17.11.2001	Access Ltd.
Mr.H.M.P.Kithsiri Research Officer	Israel	Training Course on Intensive Aquaculture farming.	06.03.2001-27.03.2001	Israel.
Mr.P.A.D.A.Kumara Research Officer	Thailand	Short Term Training-Marine Fish Breeding	12.03.2001-06.04.2001	ADB
Mr.A.J.Jayatissa Research Assistant	Thailand	Short Term Training-Marine Fish Breeding	12.03.2001-06.04.2001	ADB
Mr.W.A.Sumanadasa Research Assistant	Thailand	Short Term Training-Marine Fish Breeding	12.03.2001-06.04.2001	ADB
Mr.R.P.K.Tissa Research Assistant	Thailand	Short Term Training-Marine Fish Breeding	12.03.2001-06.04.2001	ADB
Mrs.S.L.Fernando Data Entry Operator	India	Personnel Tour	05.03.2001-13.06.2001	Own expenses
Dr.S.C.Jayamanne Research Officer	Malaysia	Workshop for sustainable management of fish stock	20.03.2001-23.03.2001	ADB/RETA/5766 Project
Mr.A.Rajasuriya Research Officer	Maldives	GCRMN South Asia Phase II Evaluation Meeting	28.03.2001-30.03.2001	GCRMN
	Philipp-ines	GCRMN Global Programme evaluation 2001 & ICRI Coordination & Planning Committee meeting.	03.04.2001-06.04.2001	IOC-UNESCO
	Australia	For Diploma in Research	16.07.2001-30.11.2001	SAREC
Mr.U.S.P.K.Liyanage Research Officer	Thailand	Training Marine Fishing Technology Management & Stock Assessment	23.04.2001-22.05.2001	ADB
Mr.W.D.M. de Mel Research Assistant	Thailand	do	23.04.2001-22.05.2001	ADB
Mr.W.A.D.B.Bonifus Sampler	Thailand	do	23.04.2001-22.05.2001	ADB
Dr.P.P.G.S.N.Siriwardena (Head/IARD)	Malaysia	Meeting & Expert Consultation on Research Priority Setting	26.03.2001-29.03.2001	ICLARM
Mr.N.H.Dassanayake Research Officer	Australia	For Ph.D	28.03.2001 15 months	SAREC
Mr.L.S.C.Siriwardena Hydrographic Assistant	Japan	GTC – Hydrographic Survey Course	03.04.2001-11.11.2001	JICA
Mr.J.K.Rajapakshe Research Officer	Malaysia	Training on Oceanographic sampling for Analysis of Radioactivity.	09.04.2001-20.04.2001	International Atomic Energy Agency
Mr.E.M.S.Wijeratne Research Officer	Sweden	For Ph.D	01.05.2001-31.08.2001	SAREC
Mr.K Arulanathan Research Officer	Sweden	For Ph.D	01.05.2001-31.08.2001	SAREC
Ms S.P.S.D.Senadheera Research Officer	Sweden/Iceland	Training of R.O's in Laboratory Testing under the SIDA Project	05.05.2001-01.08.2001	SIDA Project
Ms.P.K.M.Wijegunawardena Research Officer	Australia	For P.hD	28.06.2001-27.06.2004	ADB
Mr.A.B.A.K.Gunaratne Information Officer	Sweden	For P.hD	05.05.2001-30.06.2001	SAREC
Mrs.R.K.V.J.Gunasekara Research Officer	Thailand	Shrimp farm Effluent Management with special reference to Coastal & Marine Pollution	20.05.2001-14.06.2001	ADB
Mr.N.Sureshkumar Research Officer	Thailand	do	20.05.2001-14.06.2001	ADB
Mr.R.W.Fernando Research Assistant	Thailand	do	20.05.2001-14.06.2001	ADB
Ms. G.R.H.Rupika Research Assistant	Thailand	Fish disease diagnosis	04.06.2001-16.07.2001	ADB

Mr.W.A.L. Wickramasinghe Research Assistant	Thailand	Fish disease diagnosis	04.06.2001- 16.07.2001	ADB
Mrs.M.S.S.Jayasekara Research Assistant	Thailand	Ornamental Fish Breeding Training	23.06.2001- 08.08.2001	ADB
Mrs.A.D.W.R.Rajapakshe Research Officer	Thailand	Ornamental Fish Breeding Training	23.06.2001- 08.08.2001	ADB
Mrs.P.A.J.C.Perera Research Officer	Australia	To present a paper	03.07.2001- 05.07.2001	+NSF+NARA+ Own
Ms M.G.I.U.Kariyawasam Research Officer	Sweden/ Iceland	Visit – Improvement of quality infrastructure for fishing industry	30.06.2001- 13.07.2001	CIDA/SAREC
Mrs.J.M.Chandrika Research Assistant	Sweden/ Iceland	do	30.06.2001- 13.07.2001	CIDA/SAREC
Miss M.H.S.Ariyaratne Research Officer	Vietnam	Training on rice fish culture	20.07.2001- 05.09.2001	ADB
Mrs.P.S.Jayasinghe Research Officer	Japan	Handling & Primary Processing of Fishery Products.	29.05.2001- 02.09.2001	JICA
Mr.H.A.M.Kulathilake Research Officer	Indonesia	Modern Biotechnology approach for controlling & preventing of fish & Shrimp diseases.	23.06.2001- 06.07.2001	ICRO - UNESCO
Mr.S.W.S.Weerasinghe Chief System Analyst	Denmark	Testing for Multi beam Echo Sounder	12.11.2001- 17.11.2001	Access) Ltd.
Mr.S.P.Vidanage Economist	India	Workshop: Integration of sustainable Development principles into Economy wide policy & planning.	17.11.2001- 19.11.2001	SLR/97/20 project
	Mozambique	Coral reef Degradation in the Indian Ocean (CORDIO) – Regional Workshop	25.11.2001- 30.11.2001	ICRI
Ms.A.S.L.E.Corea Research Officer	Taiwan	06 th Asian Fisheries Forum(AFF)	25.11.2001- 30.11.2001	SAREC

MARINE BIOLOGICAL RESEARCH DIVISION

Programme 1: Assessment and Management of Fishery Resources

Project 1.1 : Assessment and Management of Large Pelagic Fishery Resources

This project is a long term data collection programme to update the large pelagic fishery database established in the Division. One of the main objectives of the project is to provide offshore production estimates to the database of the Ministry of Fisheries and Ocean Resources(MFOR), Central Bank and Indian Ocean Tuna Commission (IOTC). The data collection is mainly carried out by the 12 samplers deployed. Basic information of the fishery such as catch per unit effort (CPUE), total effort, species composition are collected from the main beach landings from Negombo to Trincomalee.

The information on production,CPUE for various multiday fishing boats, species composition of the catch up-to year 2000 are available in the database. The information for the year 2001 has to be recalculated as the recent craft survey carried out by the Ministry came up with a new figure for the total number of multiday boats operated (total effort) for offshore fisheries.

Project aim: Assess the exploitation level of shark resources, determine the genetic population structure of economically important sharks and to study their population dynamics

Under this project some population parameters of three shark species useful for scientific research purposes were estimated.

They are as appended below

Species	Asymptotic length	Growth constant	Total mortality	Natural mortality	Fishing mortality	Exploitation rate
Silky shark <i>Carcharhinus falciformis</i>	331.32	0.30	0.91	0.42	0.49	0.52
Oceanic whitetip shark <i>C. longimanus</i>	347.27	0.28	1.18	0.40	0.78	0.66
Blue shark <i>Prionace glauca</i>	355.96	0.26	1.92	0.32	1.6	0.83

Project continues, DNA analysis is to be started

Project 1.2 : Assessment and Management of Small Pelagic Fishery Resources

Small pelagics have contributed to around 40% to the country's fish production. Recent studies have shown that this resource is being exploited to its maximum level. Fishermen also search for new fishing techniques and new fishing grounds to increase their income levels. Consequently, a large number of fishing gear/craft combinations have been reported than ever before. This has created problems in managing the resources. Continuous monitoring is therefore, essential to address these issues. This project helps to check on the trends and any harmful effects on the resource and resource utilization.

Information on catch, effort, species composition and length frequency data of economically important species were collected by research assistants and 12 data collectors appointed from Negombo, Beruwala, Matara, Tangalle, Oluwil and Trincomalee. Data was fed into Excel work sheets and analyzed.

Seasonal variations of catch effort and production estimates of 15 craft/gear combinations belonging to 4 craft categories in 6 District Fisheries Extension Office (DFEO) areas were documented. Highest catch rates have been reported by gill nets operated by Fibre Reinforced Plastic Boats (FRP). Average catch rates by this gear from Chilaw, Negombo, Tangalle, Trincomalee, Beruwala and Matara were 88.8, 59.6, 18.3, 17.3, 17.1 and 7.8, respectively.

Annual small fish production from all craft gear combinations was estimated to be 48,000MT, out of which 85% has come from FRP boats, 8.3% from non mechanized boats, 4.4% from mechanized boats, and 2.5% from log rafts.

Production for each district was also estimated and the highest has been reported from Puttalam (33%) followed by Chilaw (24%) and Negombo (21%).

As an average *Sardinella* species has contributed around 43% followed by *Amblygaster sirm* (26%) and *Stolephorus* sp. (6.7%). Further seasonal variation of catch rate of 72 fish species has also been analyzed.

Previously, fish stock assessment in Sri Lankan waters has been carried out sporadically. However, an attempt is being made to assess the fish stock for the entire country considering it as a single stock. The preliminary analysis indicated that the *A. sirm* stocks in western and southern parts of Sri Lanka are over exploited and that of the eastern part appears still underexploited. However, a detailed analysis has to be completed to arrive at a firm conclusion.

Achievement - 95%

Project 1.3 Assessment & Management of Demersal Fish Resources

Bio-Socio-Economics Demersal Fisheries in the west coast of Sri Lanka. Bio-socio-economic analysis of the demersal fishing along the west coast of Sri Lanka was carried out during 2001. A total of 139 fish species belonging to 68 families have been recorded in the catches but the most important families are *Lethrinidae*, *Carangidae*, *Lutjanidae* and *Scombridae*. Change in the composition of the catch have been noted over the past years. The contribution of squid and cuttlefish to the total demersal catch has increased. Lethrinds replaced the catches of Carangids as dominant fish. This indicates some level of ecological overfishing of demersal resources in the area.

The demersal fish production in the 2001 is about 2,009t. The present fishing effort of the multispecies demersal fishery (110057 standard fishing days) has slightly exceeded the estimated optimum (103421 standard fishing days), which produces the maximum sustainable yield (MAY) (2236 t).

Except traditional handline fishing all boat/gear combinations involved in demersal fishing exhibited good performance and generated positive net profit. However, the rise of fuel price nearly by 27% over the year 2001 has affected the profitability mainly of bottom longline fishing which operate in more deeper waters than others.

Publications

The following research papers have been submitted for publication

- Species composition and taxonomy of groupers (family *Serranidae*) in the waters around Sri Lanka.
- Influence of fish marketing on the income of small-scale fisheries with special reference to demersal fisheries off Negombo, west coast of Sri Lanka.
- Women participation in marine fresh fish marketing in Sri Lanka.
- Examination of sexually and reproductive behavior of two emperor fishes *Lethrinus nebulosus* and *Lethrinus lentjan* in the western coastal waters of Sri Lanka.

Achievement - 100%

Project 1.4: Assessment and Management of the Crustacean Fishery Resources in the West Coast of Sri Lanka

During the present investigation the focus has been on to study the fishing activities targeting crustacean fishery resources in the Negombo lagoon and the associated coastal eco-system in the west coast of Sri Lanka. The crustacean fishery resources from the system were mainly composed of shrimps. The fisheries in the system were multi-gear and multi-species. There was an expanding year-round fishery for shrimps in the lagoon and the associated coastal eco-system. There were four major fishing gears, namely trammel net, drag net, brush piles, and cast nets used within the lagoon and one gear at the mouth (stake-seine net) Moreover, to exploit shrimps, especially the juveniles and pre-adults in the lagoon. Moreover the adults were exploited in the offshore areas by trawling.

The prime objective of the present investigation was to conduct a comprehensive analysis in view of evaluation of one biological and economic aspects of the shrimp fishing activities taken place in Negombo lagoon and associated coastal eco-system. Also included were evaluation of resource status of two major shrimp species (*Penaeus indicus*) and *Metapenaeus dobsoni*) and their reproductive biological study.

The two penaeid shrimp species, *P. indicus* and *M. dobsoni* emerged as the most important shrimps of the shrimp fishery in Negombo lagoon and associated coastal ecosystem. These shrimps possess both estuarine and marine phases in their complex life cycle. They utilise Negombo lagoon as nursery ground during the juvenile phase of life cycle and migrate to off shore areas for subsequent maturation and reproduction. Although *M. dobsoni* is substantially exploited in the offshore areas by trawling, except for dragnets and the stake-seine nets its contribution to the shrimp catches from the lagoon is negligible. On the other hand substantial catches of *P. indicus* were recorded from within the lagoon and their contribution to the trawl catches from offshore areas was relatively small.

Both species spawn in the sea off west coast of Sri Lanka throughout the year with peaks in certain months in the case of *P. indicus* and they both are serial spawners. The present study indicated that the resultant osmotic stress due to low saline waters in Negombo lagoon during the periods with high precipitation levels would presumably influence the onset of emigration of shrimps.

The fisheries are performing satisfactorily in terms of *M. dobsoni* though the present study indicates that *P. indicus* resources in the Negombo lagoon and the associated coastal waters are being over exploited. Although reduction in numbers of fishing units, particularly in the lagoon, would improve shrimp catches for those remaining in the fishery, there would be a serious negative impact on those who were displaced, due to present severe shortage of alternative employment opportunities. On the other hand the formulated biological model provided no justification for either a deliberate increase or decrease in the existing fishing effort on *M. dobsoni*.

Although no investigation was made during the present study, the future performance of the fisheries in the system is highly vulnerable to changes in the environment within the lagoon. The lagoon is a shallow, largely enclosed water body, surrounded by urban development, and industrial encroachment. There are already many instances of degradation, including siltation, loss of sea grass beds, removal of mangroves, water pollution and land reclamation. All these potentially harmful activities should be regulated as part of more effective management of this coastal ecosystem. Notwithstanding, the existence of finfish and crustacean resources in the estuarine environment remains under substantial threat.

Achievement - 90%

Project 1.5: Monitoring of Lagoon Fisheries in the Western and Southern Coasts of Sri Lanka

The main activity of the project during 2001 was maintains of fisheries in Chilaw and Negombo Lagoons. Regular biweekly visits were made to collect fisheries data in order to update the lagoon fisheries database.

The information on annual fish and crustacean production, monthly production, catch per fishing operation for various fishing methods, species composition, exploitation levels of the resources of the Negombo Lagoon and Chilaw Lagoons will be made available at the end of February 2002 as the data analysis is still in process.

Achievement - 90%

Programme 2: Coral Reef Research Programme

Project 2.1: Monitoring of Coral Reef Resources for their Conservation and Management

Coral reefs in Sri Lanka are an important natural resource utilized for fisheries, tourism and the ornamental fisheries. Reefs are also important for the protection of the coastline from erosion. Coral reefs are constantly under threat from human activities such as destructive fishing practices, uncontrolled harvesting of reef resources, unmanaged tourism, coastal development and pollution. Natural threats to reefs are the crown of thorns starfish and sedimentation. A coral bleaching event in 1998 damaged much of the shallow water coral reefs in Sri Lanka. Coral reef surveys are carried out using the Australian Asian Coral Reef Survey methods (AIMS Survey Techniques) to determine their status and to investigate the status of currently protected species under the Fisheries Act and the Fauna and Flora protection Ordinance. This is carried out with a view to manage the natural resources for sustainable utilization. The surveys indicate the percentage of living corals at each selected location and the abundance of selected species as well as their diversity and threats that affect the health of a reef. The main target areas for surveys are the marine protected areas of the Bar Reef Marine Sanctuary, Hikkaduwa Nature Reserve, shallow coral habitats of Unawatuna, Weligama, Rumassala and the offshore reef habitats of Colombo and Negombo. Additional sites offshore are surveyed depending on the time and resources available. In addition educational and awareness on the value and the importance of sustainable utilization of reef resources is carried out for the general public and school children in particular.

a). Bar Reef Marine Sanctuary

The Bar Reef was surveyed to determine recolonisation of corals after the damage caused by the bleaching event in 1998, which reduced the live coral cover in the shallow coral areas from greater than 75% (1995) to nearly 0% in (1998). The shallow coral area at a depth of 1 to 5 m is yet highly degraded with nearly 95% dead corals. However many young coral colonies were present among the dead corals. Several young *Acropora hyacinthus* (table corals) colonies were present. Their maximum-recorded diameter was 30 cm. *Pocillopora damicornis* colonies were also present in the shallow areas. These two species appear to be the first colonisers of the damaged reef. Butterfly fish were scarce in this section of the reef although species such as *Siganus lineatus*, *Scarus dimidiatus* and *Acanthurus* were common.

An area at a depth of 8 to 10 m had a greater number of young colonies, some having a diameter of about 50 cm. Both branching and tabulate *Acropora Montipora*, *Favites*, *Favia* and *Porites* were growing relatively rapidly in this section of the reef among other coral species (*Galaxea fascicularis*, *Hydnophora microconos* and *Podabacea crustacea*). Live coral cover in this area was 14%.

b). Kandakuliya

The Kandakuliya reefs were investigated at depths of 10 m, 18m and 20m. There was regeneration of corals in the shallow reef of 8 to 10m. They were mainly branching *Acropora* and *Montipora* spp. The sandstone/limestone ridge at 18m contained healthy corals although coral cover is low on these habitats. Fish were abundant to the northern section of this ridge, which is within the southern boundary of the Bar Reef Marine Sanctuary. Several small groups comprising 5 to 6 individuals of large 1.5 m Hump head wrasses (*Cheilinus undulatus*) were present as well as schools of snappers (Lutjanidae) and emperors (Lethrinidae). Large groupers (*Epinephelus malabaricus*) were also present. The reef at a depth of 20 m at Kandakuliya comprises entirely of mushroom corals belonging to the genera of *Zoopilus*, *Fungia*, *Polyphyllia*, *Cycloseris* and *Diaseris*. This area is relatively small about 500 m long

and about 100 m wide and is located at the edge of the continental slope. Corals were in good condition and there were many juvenile pufferfish (*Diodon holocanthus*) in this habitat.

c). Hikkaduwa Nature Reserve

The Hikkaduwa Nature Reserve was dominated by branching *Acropora* spp prior to the bleaching event in 1998. The percentage of live corals which was 34% in 1994 was reduced to 7% (results of 1999 survey) as a result of bleaching. Surveys carried out in 2001 indicated that the live coral cover was 12%. This is due to the recovery of several colonies of massive coral species such as *Porites*, *Goniastrea*, and the foliaceous *Montipora aequituberculata*. Dead coral cover was 59%. The reef habitat is dominated by encrusting algae and calcareous alga *Halimeda* sp. There is severe sand accumulation within the nature reserve and it is also preventing the recruitment and growth of corals. No natural recruitment of branching *Acropora* spp have been recorded within the reef lagoon. There are small isolated patches of introduced branching corals from Weligama. Branching corals introduced by NARA in 1999-2000 remain alive but has failed to record any significant growth and remains stunted indicating that the conditions in the environment is unsuitable for recruitment and growth of branching *Acropora* spp. The combined percentage *Halimeda*, sponges and sand is 29% of the reef. Most corallivorous fish such as butterflyfish are scarce. No juveniles recruited have been recorded for 2001 indicating the habitat is unsuitable for recruitment of butterfly fish.

d). Colombo

Three offshore reef sites (Pitagala reef, Itipandama reef and Gigiripita reef) were surveyed. Offshore reefs of Colombo are at a depth of 15 to 20 m. Two of the sites Pitagala and Gigiripita are located about 10 and 20 km offshore, respectively. The corals are in a healthy condition. All three sites support live corals. However these sites do not support large banks of corals similar to the shallow coral banks in nearshore areas. They are dominated by corals belonging to the families of Poritidae and Faviidae. Live coral cover was 26% and the dead coral was 66%. Sponges, soft corals, algae and sand were 8%. Threats to these reefs are from bottom setnets used to capture spiny lobsters and reef fish. These destroy the live corals and other reef organisms such as sponges, soft corals and gorgonians. Furthermore the bottom setnets capture many of the colourful reef species that are important for the ornamental fisheries.

Pollution from land-based sources is a significant factor in affecting the health of reefs in the Colombo area. Non-biodegradable material such as polythene bags are found entangled on reefs and they trap sediment and smother marine life. In addition many of the storm water drains bring in large amounts of liquid waste and chemicals. Types of chemicals and their quantities are unknown. In addition discharge of sewage is an issue. All of these impacts combined will be harmful to the marine organisms and its impacts can be seen on the nearshore reefs where the reefs are coated with algae and sediment. They also contain non-biodegradable matter.

e). Negombo

The main coral reef habitat at Negombo is located approximately 20 km offshore. It is dominated by *Porites* spp and is similar to the offshore reef habitats in Colombo. Corals were healthy at this site although human impacts from fishing activities continue to damage the reefs. A number of pieces of fishing net were seen entangled on coral heads at the Negombo site. A marked reduction was noticed among the schools of surgeonfish and unicorn fish usually present at this site. The reasons for this reduction were not understood.

f). Weligama

Corals in the Weligama nearshore reef was also severely bleached after the 1998. Most of the bleached corals have now recovered. Live coral cover was 54% in shallow areas. Dominant coral species consist of *Acropora*, *Montipora* and *Pocillopora*. Very high pressure from ornamental fish collecting continue to damage the reef due to the use of 'moxy nets' which is an illegal fishing technique under the fisheries ordinance. Other causes of damage are from boats colliding with the reef and anchors. Visitors also trample the reef. Pollution due

to oil discharges from fishing boats is an issue as well as wastewater discharge from a large hotel at Kapparatota.

Management Actions Required

Hikkaduwa Nature Reserve

It is necessary to carry out a study to determine the origins of the sand that is accumulating within the Hikkaduwa Nature Reserve and to carry out a controlled extraction of sand within the reef lagoon. This could be carried out by using a diver operated suction device. The nutrients that may seep into the reef lagoon area from the semi-solid and liquid waste pits of the commercial establishments bordering the nature reserve has to be arrested. However this can be achieved only by establishing a permanent solution to the problem such as a central sewerage facility.

Management actions are needed to control the physical damage caused by the anchoring of boats and by glass bottom boats. Local tourists also contribute significantly to the physical damage of corals by walking and trampling the reef. Some of the fishing boats are still anchored within the reef lagoon despite the completion of the construction of the Hikkaduwa Fishery Harbour. The fishermen should be encouraged to remove all fishing boats out of the protected area. It is necessary to re-demarcate the zones within the nature reserve in order to control human activities.

Colombo and Negombo offshore Reefs

Action is required to arrest the use of bottom setnets, which is an illegal fishing technique under the fisheries ordinance. Pollution can only be controlled under a wide waste management scheme for the city and is beyond the control of NARA.

Weligama

Control the ornamental fish collection at this site and arrest the use of 'moxynets' which is causing serious damage to the reef. In addition it is necessary to prevent the physical damage caused by fishing boats and the pollution arising from oil discharge and from the hotel at Kapparatota.

Achievement - 75%

Programme 3: Conservation and Management of Marine Mammals and Turtles

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

Project aim:

- Study the variations of nesting frequencies, density and diversity of sea turtle fauna, along the Southern coastal belt of Sri Lanka and Study on farming requirement of Loggerhead turtle (*Caretta caretta*).
- Determine the nesting frequency density and diversity of sea turtle fauna at major rookeries along southern coastal belt of Sri Lanka and identify the requirements for loggerhead farming, which is the most endangered species among the five species of turtles inhabiting in Sri Lankan water.

The estimated sea turtle nesting parameters at major rookeries are as follows.

Name of the beach	Nesting rate (nests per month)	Nesting density (nests per km per year)	Nesting diversity (number of species nested)
In Galle district			
Mapalana	6	103	4
Duwemodara	24	814	4
Kosgoda	30	322	3
Bandarawatta	25	283	5
Thibbattawa	17	193	2
In Hambantota district			
Rekawa	53	320	5
Wellodaya	6	39	4
Kahandamodara	18	175	3
Welipatanvila	18	76	5
Walawamodara	21	141	4
Bundala	9	43	5

Inferences:

- Ussangoda and Kosgoda beaches were identified as better locations for the establishment of a turtle based tourism programme

Farming requirements of Loggerhead turtle *Caretta caretta*

- Age suitable for releasing is 18 months.
- Size suitable for releasing is 25cm
- Size of the tank required for 25 hatchlings for three month period is 1.50m X 2m X 0.5m
- Preferable food is herrings or other small blood fishes.
- Preferable site for a head-starting project is Ussangoda in the Hambantota district.

Project 3.2: Study the present status of Duggon (sea cow), *Duggon dugon* population of Sri Lanka.

Project aim:

- Study the present status of Dugong (sea cow) population of Sri Lanka.
- Explore the present status of dugong population through a by catch monitoring study

No by-catch or reliable information was reported. It is reported that the dugong population of Sri Lanka is about to extinct (the population is well below its minimal viable population limit).

Programme 4: Aquatic Molecular Biology

Project 4.1: Gene Bank Project

Establishment of the Gene Bank laboratory, which is a Molecular Biology laboratory where genomes of fish and other aquatic organisms can be carried out.

The most suitable method of DNA extraction for fish is the protocol that uses the chemical CTAB. This method was established by trying out different protocols for the DNA of tilapia and *Danio pathirana*.

Achievement - 100%

Preparation of lists of equipment with specifications, required for the laboratory preparation of technical reports for tenders for equipment.

Preparation of project proposals to obtain funds from the National Research Council (NRC), International Atomic Energy Authority (IAEA), Department of External Resources etc.

Establishment of a standard method that can be used to extract DNA from fish. Different protocols were tested for the extraction of DNA. The method using CTAB was turned out to be the most suitable. The other methods tested required chemicals such as SDS, β -mercaptoethanol, etc for this activity. However, they were found unsuitable as they caused degeneration of DNA. This work was carried out at the Department of Biochemistry and Molecular Biology at the Faculty of Medicine, Colombo.

Preparation of the temporary laboratory for the Gene Bank project. Basic molecular biology work can now be carried out in this laboratory provided the chemicals are made available.

Seminars and Workshops Attended

- 21st annual symposium on biology and conservation of sea turtles Philadelphia, USA, February 2001.
- Seminar on "Use of Indian Remote Sensing Satellite Data"-BMICH-(15th-16th June 2001)
- Workshop organized by the IUCN in connection with an awareness programme titled 'A tomorrow for our coral Reefs'. This workshop was held at the BMICH, Colombo.
- Workshop on Exports of Aquatic Plants held on 20th December at the NARA Auditorium
- Intra-Ministerial Discussion on Fisheries Management Oct 24, 2001- presentation was given on Fisheries Management Issues

Extension Work

- Prepared a leaflet, document and a video documentary on "The present status of the dynamite fishing in Sri Lanka".
Participated at awareness programme for fisher folk at Chilaw - Organized by SEDEC
- Monitored and supervise 20 school students for their GCE / AL study projects
Conduct lectures on fish biology and ecology for the students of NIFNE. Conducted lectures on marine resources for school students at two schools in Gampaha District.
- Awareness programmes were conducted at the following locations
Kandakuliya Sinhala Maha Vidyalaya
Kandakuliya Deewara Samithiya Hall
St. Peters College Negombo
Pihillagoda Vidyalaya, Unawatuna
Unawatuna Daham Pasala
IUCN exhibition on 'A tomorrow for our coral reefs'

Provided display to the University of Jayawardenepura
Information on corals and coral reefs were provided to school children at NARA

Constancy

- A report on the Bar Reef Marine Sanctuary was prepared for the Environmental Resource Management (ERM) consultants in connection with the development of ilmenite mining at Aruakkalu in the Puttalam District. This report was a component of a report prepared by NARA as a consultancy service for the above company.
- Colombo -Katunayake Expressway Project. A study has been undertaken to determine the impacts of construction of the high-way on Negambo Lagoon

Yala Fishery Management Area Consultancy Project

Ecological Investigation of Puttalam Lagoon and Adjacent waters- Pre-feasibility study of environmental investigations for the Iluka Resources Limited.

- Preparation of Socio-economic and Ecological Profile of the proposed Fishery Management Area off Yala National Park for German Development Co-operation / German Technical Cooperation (GTZ)

Constrains

- Fieldwork could not be carried out in the last quarter of the year as anticipated due to interruption in connection with the parliamentary elections.
- A major constraint identified was the lack of a suitable vehicle for fieldwork. It is necessary to have a 4 wheel drive due to the volume of equipment that has to be transported and the need to operate in sandy terrain particularly in the northwest and in locations such as Chilaw and Negombo. It necessary to carry out the fieldwork when the sea conditions are favorable and this is often a problem as a vehicle is not available when the available sea conditions prevailed suitable.
- Monetary constraints. To purchase necessary equipment and chemicals for the molecular laboratory, the inadequacy fund was found a serious deterrent.

Other Activities

- On order of the Magistrate Court Hambantota, a fish sample was analyzed to determine whether it had been killed by dynamite fishing and a report was submitted - (09th January 2001).

Dried Holothurian samples taken into custody by the customs were analyzed to identify whether they belong to a band species and a report was submitted to the Magistrate Court-Puttalam - (08th August 2001).

In collaboration with FGTD, a report with recommendations for employing an additional beach seine to Kalutara- Modarawella beach seine landing center was submitted on 15th January 2002.

- Prepared a check-list of Batoid fishes (rays) of Sri Lanka. Trained samplers and Research Assistants to identify the batoid fishes up to their species level. A Ph.D study was undertaken on shark population genetics at the University of Queensland, Australia from June 2001.

- A survey was carried out to quantify the non-biodegradable matter on the nearshore reef at Wellawatte. This survey was conducted as a component of the ESD survey of non-biodegradable matter in the coastal waters around Colombo. Report was submitted to the Environmental Studies Division of NARA. Assisted in the preparation of the GCRMN supported coral reef database for Sri Lanka.
- Presentation on the Gene Bank Project to the Atomic Energy Authority.
- Completion postgraduate degree (Ph.D) at the Dept. of Biological Sciences of the University of Stirling, United Kingdom. Titled of the Thesis is Fishery biology and population dynamics of shrimps (*Penaeus indicus* and *Metapenaeus dobsoni*) in the lagoon and the coastal area of Negombo, Sri Lanka.

Publications

- Status of the fisheries in the Koggala lagoon. Submitted to CCD.
- Development of beach seine in Sri Lanka. J. Nat. Aq. Res. Rese. Dev. Ag. Sri Lan,37: 00
- Beach seine fishery in the northwestern coast of Sri Lanka (Submitted to Ceylon Journal of Science)
- Small Pelagic Fishery Resources in Sri Lanka - (Annual statistics 2000)
- Small Pelagic Fishery Resources in Sri Lanka - (Annual statistics 2001 - in preparation)
- Amarasooriya.D., 2001. The role of the sea turtle hatcheries, in conservation of sea turtle fauna of Sri Lanka. Prceeding journal of the 21st annual symposium on biology and conservation of sea turtles (the journal is yet to be published).
- CORDIO newsletter 2001, 'Current status and management issues on Coral Reefs in Sri Lanka'
- Report was submitted to CORDIO project on the Status of Coral Reefs in Sri Lanka, 2001. This report will be included in the CORDIO annual report for 2001 (to be published).
- Community based socio-economic monitoring plan for two demonstration coral reef sites in Sri Lanka. Edited by Arjan Rajasuriya and Shamen Vidanage. (In preparation).
- Ecological Investigation of Puttalam Lagoon and Adjacent waters- Pre-feasibility study of environmental investigations for the Iluka Resources Limited. Country paper the Status of Tuna Fishery in Sri Lanka - submitted to IOTC Scientific Committee meeting.
- Some observations on the shrimp fishery in the Negombo lagoon on the west coast of Sri Lanka P. A. A. T. Jayawardane, C. Amarasiri, D. S. McLusky & P. Tytler (under consideration for publication – Journal of the National Science Council of Sri Lanka)
- Present status of the shrimp trawl fishery in the west coast of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (under consideration for publication – Journal of the National Science Council of Sri Lanka)
- Factors influencing migration of *Penaeus indicus* (H. Milne Edwards, 1837) in the Negombo lagoon on the west coast of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (Accepted for publication – Fisheries Management and Ecology)

- Some observations on the artisanal fishery for shrimps : Stake-seine net fishery in the Negombo Lagoon, Sri Lanka P. A. A. T. Jayawardane & H. A. R. E. Perera (Accepted for publication – Fisheries Management and Ecology)
- Fishery biology of *Metapenaeus dobsoni* (Miers, 1878) from the western coastal waters of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (under consideration for publication – Fisheries Management and Ecology)
- Estimation of population parameters and stock assessment of *Penaeus indicus* (H. Milne Edwards) in the western coastal waters of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (Accepted for publication – Asian Fisheries Science)
- Reproductive biology of *Metapenaeus dobsoni* (Miers, 1878) from the western coastal waters of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (under consideration for publication – Asian Fisheries Science)
- Reproductive biology of *Penaeus indicus* (H. Milne Edwards, 1837) from the western coastal waters of Sri Lanka P. A. A. T. Jayawardane, D. S. McLusky & P. Tytler (under consideration for publication – Asian Fisheries Science)
- Factors influencing migration of *Metapenaeus dobsoni* (Miers, 1878) in the Negombo lagoon on the west coast of Sri Lanka P. A. A. T. Jayawardane & M. G. K. Gunawardane (under consideration for publication – Indian Journal of Fisheries)
- An artisanal shrimp fishery of a coastal lagoon in southern Sri Lanka : Fishery, distribution and recruitment D. S. Jayakody & P. A. A. T. Jayawardane (under consideration for publication – Indian Journal of National Aquatic Resources Agency of Sri Lanka).

INLAND AQUATIC RESOURCES & AQUACULTURE DIVISION

Inland Aquatic Resources and Aquaculture Division of NARA has carried out research under four main programmes. They are as follows.

- Shrimp/prawn culture and management
- Ornamental fish culture
- Inland aquaculture and fisheries management farming
- Mangrove and wetland management

Programme 1: Shrimp/ Prawn Culture and Resources Management

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

This project looked into disease incidence in shrimp ponds in the Northwestern province and tried to understand the environmental conditions and other factors that promoted disease spread with the view of introducing better options for disease management and improve economic conditions.

Only 60% of the farms were functional of which 75% was affected by white spot disease. Due to the low market prices it was not profitable for farmers to grow shrimp to large sizes. Therefore most farms harvest as soon as the first signs of WSV was observed. Shrimps larger than 15 g were sold to exporters while others were produced to the local market. 40% of the farms affected by WSV were at a loss, while the others were just able to cover their expenses.

70% farmers used probiotics to treat water however less than 25% successful in continuing a 4 1/2 month culture cycle without disease even though water quality control with probiotic was used.

Use of eggs, mussel and trash fish as feed supplements have increased with the high feed price. Deterioration of the pond environment leading to common bacterial and fungal infections - tail rot and antennae rot was recorded from many farms after this practice.

Use of Cl₂ to treat incoming water has reduced by 20% as farmers felt that it did not help in disease prevention. Use of probiotics has increased by 2% however 40% farmers did not follow any instructions and therefore the use of these bacterial cultures may cause more damage to the environment deteriorating the condition of coastal water bodies due to improper use of probiotics.

Achievement - 95%

Project 1.2: Closing of routes of virus infections in shrimp aquaculture

Systematic investigation to determine all possible routes of virus infections at each larval rearing stage in the hatchery was carried out to find out preventive measures to close routes of virus infections and production of healthy post larvae.

In a previous study, it was revealed that the shrimp larvae produced by the non-infected brooders have shown virus infection during one or more hatchery rearing and grow out stages. So this project was designed to,

- Determine the routes of virus infection during hatchery operation
- Determine the routes of infection within and out side the grow-out pond operations.
- To propose mitigatory measures to close the routes of infection.

It was found that 60% of brooders collected from Hendala, Wattala, Negombo area are infected for WSSV, and brooders from, Beruwala, Kalutara and Pothuwil are so far non infected.

Study revealed that clear larvae produced by non-infected brooders, could get infected during any hatchery stage may be cross-contaminated by air, water droplets or tank water. Clear larvae, stocked at well prepared pond also could get infected due to viral carriers, such as crabs, planktons and contaminated water intake.

Achievement - 95%

Project 1.3: Experimental culture of freshwater prawn *Macrobrachium rosenbergii* in seasonal tanks of Southern Province in Sri Lanka

Criteria have been developed to select the seasonal tanks of the southern province suitable for culturing giant freshwater prawn *Macrobrachium rosenbergii*. Monitoring of the current status of the tanks, water quality, accessibility and the availability of fishing community were regarded as the most important criteria in selecting tanks. One small tank was stocked and the culture trial was monitored monthly.

The results show that there is a lot of scope for development of Giant freshwater prawn culture in Southern province where numerous seasonal tanks are in existence. Survival and growth of cultured shrimps were comparable with those of other countries.

Stocking programme and water quality monitoring was affected by drought prevailed in the area during latter part of the year.

Achievement - 85%

Project 1.4: Development of suitable technology for larval rearing of *Macrobrachium rosenbergii* in inland areas and determination of the factors affecting larval survival level

The project concentrated on finding out the availability of brooders in the western province and improving the technology for breeding and larval rearing of the giant prawn in captivity. The breeding and larval rearing has been carried out in collaboration with a private hatchery at Marawila.

Studies on the *Macrobrachium rosenbergii* brood stock revealed that they are available in Kalu Ganga, Bolgoda Ganga, Kelani Ganga, Ja-ela and Dandugam oya area but their availability is highly seasonal. The recovery of prawns, which were not in existence in Bolgoda River during last decade, shows that the opening of the lagoon mouth has made improvement to the existence of stocks. Regular supply of brood stock is not possible as there are no fishermen fully engaged in fishing freshwater prawns and no specialized gear to available to catch them.

Experimental trials carried out on breeding and larval rearing of prawn showed a survival rate of 90% up to stage 9 but high mortality occurred between stages 9 and 10, which resulted a low survival rate of 15% at post larval stage. Further studies are needed to determine the factors affecting the survival rate to improve the production of post larvae.

Achievement - 95%

Project 1.5: Assessment of shrimp fishery in Rekawa lagoon

Chemical parameters were monitored monthly. Studies on the recruitment pattern will be continued to the next year.

Project is still in progress

Achievement - 90%

Programme 2 : Ornamental fish culture

Project 2.1 : Study on the development of a closed system for ornamental fish culture

The studies intended to develop a closed system for ornamental fish culture and study the environmental conditions to determine the advantages of a closed system.

Delay in completion of closed system hindered commencement of the experiments.

Achievement - 90%

Project 2.2: Use and impact of chemotherapeutants in ornamental fish culture.

Two large scale farms, their out growers and randomly selected small scale farms were selected for the study.

Ornamental fish exports have increased from Sri Lanka, during recent years, primarily due to increased fresh water ornamental fish breeding and culture and increased importation of wild caught marine fish from Maldives. Foreign exchange earnings from ornamental fish exports increased from Rs. Million 96 in 1990 to 560 in 1998, recording a growth rate of 18%. This indicates the potential and importance of the industry as a foreign exchange spinner. The industry experienced significant production losses due to disease despite the heavy use of chemotherapeutants to treat and prevent diseases. The majority of farmers lack knowledge on either the type of chemotherapeutants need to use or the efficacy of chemtherapeutants as treatment as treatment or preventive measures. Moreover certain chemotherapeutants, which are prohibited in use in other countries, are being freely used in this industry. Hence there is a need to assess the types, relevance, sensitivity and to suggest alternate chemotherapeutants to be used to treat and prevent diseases.

Therapeutic in a fish culture includes administration of therapeutants in feed as well as in dips on baths. Mostly our aquarium trade confined to the latter.

Therapeutants are used in aquaculture as tropical disinfectants, antimicrobials, probiotics and anesthetics . 11 chemicals, 6 antibiotics and 4 disinfectants, which are being used as therapeutants has been recognized from aquarium trade.

The study recognized that improper choice of chemicals and use of incorrect dosage and incorrect optimal time for treatment create problems in connection with the use of chemicals in aquaculture. Further, development of drug resistant strains has been observed due to the application of low dosage to lower the high cost of drugs. Use of chemicals readily available in the market without prior diagnosis disregarding the nature of the disease and related to the quality of the drug products and their commercial advertisements has been identified as the other problems in aquarium trade.

Achievement - 60%

Project 2.3: Improvement to the techniques on propagation of commercially important plants in ornamental fish industry

Aquatic plants are mainly collected from wild and exported. However a few species are propagated and exported by some farmers. This project investigated the possibility of introducing cheap methods for aquatic plant propagation so that the strain on wild resources would be minimized. It was also decided to have a reference collection of aquatic plants at NARA together with a resource survey.

The resource survey was carried out in the Mahaweli areas and Polonnaruwa, Dehiattakandiya, Dambulla, Naula, Matale and Kotmale areas visited. 17 species of aquatic plants were collected including 3 species of Aponogeton and 2 species of Cryptocoryne. Experimental culture trials carried out on *Echinodorus* sp. showed that use of organic manure (cow dung) responded equally well as to commercial foliage fertilizer. Therefore it could be cultured easily using organic fertilizer at a low cost. Experiments are continuing on *Ceratophyllum*.

Achievement - 90%

Project 2.4: Evaluation of nutritional value of different forms of plankton to replace Artemia as a live food in ornamental fish culture

The possibility of replacement of *Artemia*, the main live feed used in ornamental fish culture with other planktonic species was studied. The planktonic species such as *Moina*, *Daphnia* and *Brachionus* species were cultured in tanks using cow dung and yeast to enhance their production. Their suitability as a live feed for ornamental fish was tested with ornamental fish species, Guppies and Mollies.

The studies revealed that *Moina*, *Daphnia* and *Brachionus* could be cultured using simple techniques and at low cost and could be used effectively as live feed for guppies and mollies.

Achievement - 90%

Programme 3: Inland aquaculture and fisheries management

Project 3.1: Classification of low land, perennial reservoirs of Sri Lanka based on fish production.

Perennial reservoirs of Anuradhapura and Polonnaruwa were selected for the study and collection of data on the fish production was carried out. The project was discontinued in the middle of the year due to interdiction of the two officers involved in the study.

Achievement - 70%

Project 3.2: Culture based fisheries of Nile tilapia (*Oreochromis niloticus*). Indigenous *Labeo* (*Labeo dussumeiri*) and Common carp (*Cyprinus carpio*) in small-sized seasonal tanks in Rekawa area.

Culture trials were carried out on red Tilapia in floating cages in perennial reservoirs. Stocking of fish was delayed due to severe drought prevailed in the area and the trials were started late. Monitoring of water quality and growth of fingerlings is being carried out.

Trial is still on progress.

Achievement - 60%

Project 3.3: Determination of the factors affecting breeding larval survival and culture of sea bass and milkfish.

Survey was carried out for collection of brood stock in North-western province and the natural environmental conditions of which sea bass exploited was studied. Studies on production of live feed required for larval rearing was carried out.

Five brooders were collected from Mundel lagoon and acclimatized to hatchery condition.

Production of live feed was started with *Nanachlorophis* and after several crashes successful production under minimum laboratory facilities has been achieved. Out door mass culture was also carried out successfully for 2 months.

Achievement - 75%

Programme 4: Sea Farming

Project 4.1: Experimental culture of pearl oysters. *Pinctada* sp. (sea water) and *Anodonta* sp. (fresh water) in North western and southern provinces in Sri Lanka

Two species of marine pearl oysters, *Pinctada vulgaris*, *P. margaritifera* and fresh water oyster *Anadonta* sp. were identified for the experiment. Growth studies and other parameters were recorded only for freshwater pearl oyster inhabiting in two fresh water reservoirs in Puttalam District. Tissue implantation was carried in December for *Anadonta* sp. for the formation of pearl.

Freshwater bivalve, *Anadonta* sp. was identified as the species suitable for pearl formation. Most suitable culture substrates and water quality parameters were identified to determine growth rate of fresh water bivalve.

Achievement - 90%

Programme 5: Wetland Management

Project 5.1: Structural and functional properties of mangroves around Rekawa lagoon and their importance to the lagoon's productivity.

Structural and functional properties of the mangroves at two major locations of mangroves of Rekawa lagoon were studied. The predominant species found in the lagoon was *Ceriops tagal*. NPP (net primary productivity) of the mangroves were obtained by growth increment method. Variation of litter production was studied in the two stands.

Data analysis on progress.

Seminars Workshops Attended & organized

- Workshop for Research Leaders on SWOT Analysis
- ZOOB workshop for the development of project development and identification of project components 3-5 Oct. 2001.
- Seminar on "Bridging Science and Technology with shrimp Breeding" 5 March 2001.
- Workshop on Delegation of Financial authority 3 Oct 2001.
- Workshop on problem solving of Decision making 22 Mar. 2001.
- Workshop on Institute-Industry towards aquatic resources productivity.
- Workshop and field visit to ornamental fish and plant industries in Padukka Area.
- Workshop and field visit to the prawn farm area (Chilaw – Puttalam).
- 7th Annual Congress-PGIA-University of Peradeniya
- 1st symposium on Agricultural Research Wayamba University of Sri Lanka.
- Workshop on BME for IPCU personnel (benefit monitoring and evaluation) conducted by Ministry of science and technology in NARA auditorium 16.05.2001.

- Workshop on fisheries project "Strategies for partitioning the productivity of Asian reservoirs and lakes between capture fisheries and aquaculture for social benefits and local market without neative environmental impact in University of Kelaniya form 14 April 2001 - 26 April 2001.
- International workshop on "sustainable management of fish stocks in Asia" held at ICLARM, Malaysia.
- Workshop on Fisheries management: Reservoir fisheries
- Foreign training on " seed production of sea bass and milkfish and live feed production" in Thailand.
- Workshop on white spot disease management organised by shrimp farmers association.
- Fifth Asian Fisheries Forum.
- Organized a workshop on farmer made aqua feed and setting of cages for fishers in Kiriibbanwewa /Sooriya wewa area.
- Organized a workshop on Code of best practices for shrimp Aquaculture in Sri Lanka 22nd Feb. 2001.
- Organized a workshop on "Exports of Aquatic Plants". 20 December 2001.

Extension work

- Training of farmers on preparation of farmer made aqua feed using minor cyprinids
- Prepared 11 leaflets on fresh water fish farming for extension officers, students and fish farmers
- Prepared a manual on crab fattening for crab fishers and extension officers
- Prepared a list of threatened and unthreatned exportable aquatic ornamental plants for the Department of Forestry and Environment.
- Conducted awareness programmes/ Training programmes on the following;
- Sea weed farming in abandoned shrimp farms at Chilaw and Puttalam
- Crab fattening at Trincomalee (District Fisheries Extension Office and GTZ IFSP Programme) and Pitipana (Janatha Ekabadda Dheewara Sanvidanaya)
- "Workshop on wetland Ecoystems" for the students
- 3 weeks programme on Ornamental fish culture training for NIFNE
- 3 Short training programmes on Ornamental fish culture
- Supervision of graduate and undergraduate students

Consultancies

- 170 reports on PCR analysis of shrimp samples
- 12 water quality reports for proposed and operating fish farms
- 4 officers from NWP fisheries Ministry were trained on PCR technology

Constraints

Lack of regular supply of brood stock due to weather changes has reduced the number of trials carried out in Fresh water prawn breeding.

Drought conditions prevailed during the fourth quarter has affected progress of projects in seasonal tanks and breeding and larval rearing projects.

Delay in construction of tanks and experimental systems affected progress of ornamental fish culture projects

Problems in maintaining stable culture conditions affected the trials in ornamental plants especially during the last four months of the year due to elections and financial constraints

Unavailability of suitable vehicles for fieldwork due to financial constraints has also affected progress

Lack of a pond system and a hatchery system at NARA affected the progress of work in diseases. Farmers harvested their ponds without informing NARA when sudden disease conditions appear and when the prices are high.

Other Activities

Modification to hatchery facilities at Kalpitiya RRC

Publications / Research Papers

- Wanninayake, W.M.T.B., Ratnayake, R.M.T.K. and Edirisinghe, U. Experimental culture of Tiger Shrimp (*Penaeus monodon*) in low salinity environment in Sri Lanka.
- Wanninayake, W.M.T.B., Kumarasinghe, H.K.M.A. and Edirisinghe, U. Experimental culture of Tiger Shrimp (*Penaeus monodon*) in low salinity environment in Sri Lanka.
- Jayamanne, S.C. (2001). Demersal fish Assemblages in Sri Lanka (in press).
- Rajapakse, A.D.W.R. and Hettiarachchi, M. (2001). Study on the feasibility of culturing three ornamental fish species in abandoned coral pits and irrigational reservoirs, Proceedings of SLAFAR 2001.
- Corea, A.S.L.E. Effect of salinity on growth and survival of *Meretrix meretrix* and *Crassostrea madrasensis* cultured in shrimp farm effluent canals in the Kalpitiya area of Sri Lanka. A paper presented at the 5th Asian Fisheries Forum, Philippines.
- Corea, A.S.L.E. Environment and the major epizootics in shrimp culture. The Sri Lankan experience. A paper presented at the 5th Asian Fisheries Forum, Philippines.
- Corea, A.S.L.E. Investigation of the potential of using *Gracilaria edulis* to treat shrimp farm effluents in the Kalpitiya area in Sri Lanka. A paper presented at the 5th Asian Fisheries Forum, Philippines.

FISHING TECHNOLOGY DIVISION

Programme 1 : Development of New Fishing Technologies.

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

- To solve the existing fishing conflict between "Alagodu Course Net" fishermen and artisanal fishermen. Improve the catching efficiency of the Ring Net.
- Fishing gear constructed by NARA scientists was tested at Weligama Sea with commercial fishermen. Two modifications were later introduced to the ring net, that is (a) increased the height of the net (b) increased the number of sinkers. It was able to increase the catchability through these modifications.
- It was found that there was 28.6 % fishing success in experimental fishing operations while the fishing successes of the other commercial fishing boats were (using Ring Net) 14.3%.

Achievement - 80%

Project 1.2 : Development of an Efficient Fishing Gear for Harvesting Squids

The purpose of this project is to demonstrate the technical and economic feasibility of operating the stick held dip net to small-scale fishermen as an efficient method of harvesting squids.

Stick held dip net was found to be an efficient fishing method to catch squids under calm sea conditions. It was also found that this net is a suitable device to operate from traditional fishing crafts and is a practical fishing method for small-scale fishermen for harvesting squids. It was revealed that squids are not available throughout the year to support a large-scale fishery.

November –February period supports an average scale squid fishery on the south coast of the Sri Lanka (20-25 kg per boat per day). Total squid production on the south coast is around 22 mt per year (season).

Achievement - 80%

Project 1.3 : Development of a suitable fishing gear to exploit spiny lobsters on the South Coast of Sri Lanka

Spiny Lobster fishery is an important fishery to Sri Lanka as 90% of the catch is exported both in the form of frozen or as live lobsters. Live lobster export industry developed rapidly during the last 05 years mainly due to the attractive prices paid to fishermen. Lobsters are mostly caught by set nets (3", 3 ½ " & 4" mesh sizes).

The quality of lobsters retrieved from the fishing gear are poor in trammel nets and are not upto the export market. As majority of the production comes from trammel nets, the revenue gained by the fishermen becomes less. Trammel nets also cause considerable damage to the environment.

Fishing Technology Division (FTD) of NARA proposed that fishing trials should be carried out to introduce a suitable fishing gear which causes minimum damage to the animals when retrieving them from the fishing gear. Hence this project proposal was submitted for funding.

- It was noted that *P. homorus* does not enter traps and hence cannot be caught using traps.
- Lobsters are available in shallow water (5 – 10 m) during the beginning of the season. Only., few species (*P.longipes* & *P. versicolor*) were available even in deep sea reef areas (20 – 25 m depth) towards the end of the season.
- 7 ½” to 9” meshed bottom set nets could be recommended for harvesting spiny lobsters.

Achievement - 80%

Seminars Workshops

- A presentation was made to the fishing community at a workshop organized by CRMP at Miriggawila / Hambantota.

Extension Work

- Experimental fishing operations were carried out with the community participation. Stick held dip net was demonstrated to fishermen at sea.
- Three awareness programmes were held at Kirinda, Amaduwa and Patnangalle.
- Experimental fishing operations were carried out with the community participation. Net was demonstrated to fishermen at sea

Constrains

- Short of trained research officers, Unavailability of a fishing gear laboratory, Short of vehicles for fieldwork, Accommodation problems.
- Short of trained staff. Lack of a research vessel.
- Short of trained research officers, Unavailability of a fishing gear laboratory, Short of vehicles for fieldwork, Accommodation problems.

Other Activities

- Under the 100-day programme of the government action was taken to promote this fishing gear among selected group of fishermen of the Weligama area.

Publications

- A complete report was prepared on the findings of the project NARA /FTD/2002/R3.
- Report was prepared on the findings of the project. NARA/FTD/2002/R/1.
- A complete report was prepared on the findings of the project NARA /FTD/2002/R2.

OCEANOGRAPHY DIVISION

Programme 1: Near Shore Oceanography Surveys

Project 1.1: Physical Oceanographic Survey of Coastal water Bodies

Understanding the insight hydrodynamics of the coastal water bodies to formulate a sustainable water balance plan.

Classification of tropical shallow water estuaries to prepare a national plan for the coastal water bodies.

During the last decade, extensive physical oceanographic research was conducted in the lagoons and estuaries of the western coast of Sri Lanka (ex. Puttalam Lagoon, Mundal Lake, Chilaw Lagoon and Negombo Lagoon). These studies were used to design structural changes needed to be made to enhance the multi-use of these coastal water bodies. All the physical oceanographic research on these coastal water bodies were compiled under the title "Physical Oceanography of Coastal Water Bodies of Sri Lanka.

The Puttalam Lagoon is identified as a hypersaline estuary and its circulation is established as an inverse estuarine circulation. These types of estuaries are rare and the hydrodynamics is just opposite to that of a typical estuary. It is believed that, in this type of estuaries contaminants will tend to accumulate instead of flushing out found in the typical estuary. This may create serious repercussion to the water quality and ecological status of the estuary. However, the mechanism of water exchange need further studies.

The heat budge of the Negombo lagoon is indirectly estimated using bulk formulas. This results were found to be well correlated with the direct observations. These results are used to devise a computer program to predict the water temperature of the Negombo Lagoon without any direct observations and will be extended for the prediction of water temperature of the coastal waters.

Achievement - 95%

Project 1. 2 : Sea level data collection around Sri Lanka and modeling of southern coastal water bodies.

The sea level variations of Sri Lanka were analysed based on past sea level records. The variation of sea level feature both tidal and non-tidal fluctuations superimposed on surprisingly large seasonal oscillations with a range of approximately 20 cm. The maximum sea level *varistirs oscillation* were observed in December where as it was low in August.

Sea level data were continuously collected at several stations around Sri Lanka. Based on sea level data collected during the year 2000, tides were predicted for the year 2001 at stations Colombo, Kochchikade, Kalpitiya, Galle, Tangalle and Hikkaduwa. Predicted times of high and low water for the stations of Colombo, Tangalle and Kalpitiya were provided on daily basis for broadcasting through "Deewara Praja Guwan-viduli" Programme.

A numerical tidal model was developed to study tidal co-oscillations and water exchange in Rakawa Lagoon.

Achievement - 95%

Project 1.3 : Biological Oceanography of Coastal Lagoons in Sri Lanka (Negombo, Chilaw and Rekawa Lagoons)

Phytoplankton is one of the principal source of organic carbon (food) for higher trophic levels in an aquatic environment. Pytoplankton production is controlled by nutrient dynamics, hydrodynamics and physical factors that vary on temporal and spatial scales that make these

relationships difficult to observe. Several types of phytoplankton exist, including dinoflagellates, diatoms and variety different "color" algae. Phytoplankton have rapid turn-over times (in the order of days) and are sensitive indicators of environmental stresses. Excessive phytoplankton biomass can suggest eutrophication. Therefore study of lower trophic levels (zoo and phyto plankton) is important in aquatic eco-systems.

A combined effect of physical, chemical and biological features have been thought to control the phytoplankton community dynamics. Measuring the chlorophyll in a sample yields an estimate of the quantity of phytoplankton living in the water.

Summary of physical, Chemical and biological parameters of lagoons

Site	Spring Tidal Range (cm)	Salinity (ppt)	Temperature (°C)	DO(mg/l)	Primary Productivity (mgC m ³ day ⁻¹)	Chlorophyll a (mg m ⁻³)
Rekawa	5	14-36.5	28-32	6.4-6.8	46-53	6-11
Negombo	20	9.3-31	28-31	6.0-8.5	139-213	6.5-13
Chilaw	10	17-28	29-31	6.9-9.9	20-145	5.5-20

Achievement - 100%

Project 1.4: Coastal erosions in Wadduwa-Kaluthra Coastal Strip

Coastal erosion is a severe problem in Sri-Lanka that results in damage to or loss of houses, hotels and other coastal structures, roads, contributes to the loss or degradation of valuable land and disrupts navigation, recreation and other activities. Flood due to formation of sand bars at river mouths, water pollution, siltation of corals, debasement to fishers prawns, lobsters ornamental fish are another bad accepts of erosions and accretions. About 90% of coastal strip of the island severely been damaged and enormous amount of properties loosing annually. One of most valuable areas in the Island, which heavily damaging Wadduwa-Kaluthra coastal stretch been selected to study coastal and accretion process in hoping to expand other areas in future.

Five land surveys have been carried out during the year 2000. For the validation purposes two surveys were done in 2001. 43 profiles have been selected for the beach profiling and sand sampling in every 250m. The soil samples have been taken in +1, 0 and -1 elevations. As such, in every survey 129 samples have been collected and altogether 903 samples were collected at the end of the survey. All the samples have been analyzed and feed to the computer compilations. The calculations for sand budget movement are in progress at present.

Achievement - 100%

Programme 2: Sea level data collection around Sri Lanka and modeling of southern coastal water bodies

Project 2.1: An Application of Satellite Remote Sensing for Forecasting of Potential Fishing Zones (PFZ).

Space science is widely used to scan the earth processors for forecasting and Natural Resources for monitoring and mapping etc. Oceanography from space is a part of the space science to be initiated in Sri Lanka for better understanding of ocean processes and interactions of physical, chemical and biological parameters to assist judicious exploitation, conservation and management of marine resources. As one application of remote sensing technology, the Forecasting of Potential Fishing Zone (PFZ) using Satellite Remote Sensing is proposed.

This project was initiated to start with the assistance of NRSA (National Remote Sensing Agency), Hyderabad, India. In this connection DG/NARA addressed to Dr. Radhakrishnan/ Director INCOIS (Indian Center for Ocean Information Services) at NRSA. DG/NARA

addressed to the Head, NRSA Data center through the Secretary, Ministry of Fisheries and Aquatic Resources Development to obtain required satellite data for the fishery forecasting. There is a delay from the Indian side.

The NRSA has organized an International Remote Sensing Seminar and Workshop in Sri Lanka at BMICH on 16th and 17th June 2001. On this workshop the NARA was invited to make a presentation on "Potential of Usage of Remote Sensing for Oceanography" and it was presented by Mr. Rajapaksha of the Oceanography division. After the workshop the NARA addressed Dr. R.R. Navlgund/ Director, NRSA and received a positive reply in October 2001 with his willingness to support for the PFZ program. To proceed with the work the NARA is expecting NOAA satellite data from the Meteorological Dept. of Sri Lanka and the DG/NARA also has officially addressed the Director/Met. Dept. is requesting a sample set of NOAA data which will send to the NRSA for testing whether the Met. Dept data can be used with their software. After testing, two Scientists from NRSA will visit Sri Lanka to provide necessary training to NARA Officers.

Achievement - 100%

Project 2.2 : Offshore Oceanographic Investigations (Offshore Sand deposit investigation at off Galle)

Placer deposits are very important resources, which can be used as raw materials while sand and gravel aggregates are another important materials for civil constructions. At present minerals are the most important mining materials in the coast and nearshore region. Coastal and nearshore mineral resources are not enough for the future demand. Therefore offshore mineral resources will be the important in the near future. As a result of increasing population, urbanization, industrialization there will be a great demand for sand and gravel.

Offshore Oceanographic survey included three survey cruises, which were conducted from 14.01.01 to 18.01.01, 16.03.01 to 19.03.01 and 10.05.01 to 12.05.01. Entire survey was completed within 10 days. Total number of 42 samples was collected on the continental shelf area. Samples were collected using cylindrical dredge and Ekerman type grab sampler. The spacing of two samples and survey lines were 600m's and 1km respectively. The depth of sample locations varied from 20m to 60m. The sample positioning was done using Global Positioning System (GPS).

The weighed sample, using an electronic balance was chosen for sieving. The samples were passed through a set of sieves of known mesh sizes (4, 2, 1, 0.5, 0.25, 0.125 and 0.63) The mesh size of sieves were arranged on descending order, with larger mesh size on the top. The sieves were mechanically vibrated for a fixed period of time (15 mins). The retained weight of sediments on each sieve was weighed and converted into a weight percentage of the total sediment sample. Both graphic and statistical methods of data presentations were used for the interpretation of sieve data.

The grain size of most of the sediment samples ranged between 2mm and 0.63mm. These grain sizes could be used for civil construction work. The sand percentage of every sample is over 95% while the carbonate content is varying from 40% to 50%.

The high carbonate content indicate that the quality of the aggregates is less for civil engineering construction purposes. Also the placer mineral content is less in this area. Magnetite rutilite and ilmenite could be observed with less percentage.

Achievement - 90%

Programme 3: Data Management

Project 3.1 : National Oceanographic Data Center

A National Oceanographic Data Centre (NODC) is a centralized facility for providing on a continuing basis ocean data/information in a usable form to a wider user community. This facility acquires, processes, quality controls, inventories, archives and disseminates data in

accordance with national responsibilities. NODCs are normally charged with the responsibility of exchanging Oceanographic Information.

Established a web site [www. Geocities/nodcsi](http://www.Geocities/nodcsi) for the NODC. Although the website is installed at the Geocities, there is no facility of Server at present. Purchase of server has been arranged during the year 2002. Digitizing of R/V Samudra Maru cruises is in progress. The data collected during the past years are being stored in the programs. Arrangements were made to collect and compile all information gathered previously. Collected scientific & technical reports for the use in the NODC.

Achievement - 95%

NATIONAL HYDROGRAPHIC OFFICE

Programme 1 : National Charting Programme

This is a programme which continue through out

Project 1.1 : Offshore data collection by " S.V. Sayuri"

Hydrographic data acquisition by S.V."Sayuri" in an offshore area of about 400 Sq.km of Galle Harbour and 200 Sq.Km. of Harbour approaches

Providing bathymetric data for the hydrographic data base and incorporating them into the preparation of Galle Harbour & its approaches.

Project 1.2 : Nearshore data collection by "Tharanga"

Hydrographic data acquisition by "Tharanga" boat in nearshore area of about 200 Sq.km. in the Galle Harbour and its approaches

Providing bathymetric data for the hydrographic data base and incorporating them into the preparation of Galle Harbour & its approaches.

Project 1.3 : Shoreline detail survey

Shore line detail survey of 50 km. in Galle Harbour and its approaches.

Providing shore line data for the compilation of Galle Harbour chart and its approaches.

Project 1.4 : Data processing

Data processing & fair sheet production of about 800 sq.km. near and offshore of Galle Harbour.

Providing fair sheet for compilation and cartographic work of nautical charts of Galle Harbour and its approaches.

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

Compilation, cartographic work and printing of Nautical Chart covering 100 Sq.km. of Negombo and its approaches.

Printing of Nautical Chart covering 100 Sq.km. - Negombo Lagoon & its approaches.

- Seminars Workshops - Attended/Organized
- Attended - Securing your nation's rights to Continental Shelf Maritime Territory, University of Southampton Oceanography Centre.

Consultancy

Conducted hydrographic survey and Geotechnical Investigation collaboration with Oceanography Division and National Institute of National Building Resources Organization for following Coastal Resources Management Projects

- Fishery harbours component - Hambantota, Kalametiya & Ambalangoda
- CCD component - Chillaw, Lansigama, Dikovita, Wadduwa & Hikkaduwa

Achievement - 92%

Constrains

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

Meetings Attended

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

Other Activities

- Collecting of relevant seismic data for delimitation of outer edge of the continental margin of Sri Lanka from - Institute of Oceanology, Russia
- Scripps Institute of Oceanography, U.S.A.
- Lamont-Doherty Geological Observatory, U.S.A.
- University of Bremen, Germany
- Desktop study on delimitation of the outer edge of continental margin by using the above seismic data.

Publications

- Nautical chart of Weligama - Matara

SOCIO-ECONOMIC AND MARKET RESEARCH DIVISION

Programme 1 : Research Project on Socio-economics and Marketing Aspects of Fisheries

Project 1.1 : Role of formal and informal sources in financing Sri Lankan fisheries

Fishery credit is inevitable for fish production and distribution process and which provide short term as well as and to analyze cost and benefits of such credit programmes. Data collection were carried out long term funds requirement of the fishing community. These credit requirement are provided by the financiers of formal and informal sector. This project is carried out to assess the role played by them administering a questionnaire in eight DFEO districts from Puttalam to Tangalle.

Informal sector dominates in providing credit for the fisheries sector. Estimated amount of credit disbursement of formal and informal sector for the year 2001 was Rs. 1450 million. Out of the total debt requirement formal and informal sector finance institutions were provided Rs. 710 and 740 million respectively.

Estimated yearly debt requirement of the coastal fishery was about Rs. 930 million and that for the off shore/ deep-sea fishery was Rs. 520million. This is invariably a result of rapidly increasing number of coastal fishermen and fishing fleet.

The market share of debt service of informal sector was comprised of 51.1% of the total fishery credit.

Developing competitive fish markets in the fish landing centres will eliminate dominance role of informal fishery credit sector.

Fishing community organizations such as Fishermen's co-operatives fulfilled only 14.1% of total fishery credit requirement.

The main opportunity costs of borrowing for the fishermen were loss of expected consumption and loss of gaining competitive fish price for their harvest.

There were two important social cost of fishery credit has been identified. They were excessive mental stress and unable to meet social obligations where needed.

There is a great opportunity to target fishery credit market for the formal finance institutions. However, strategies of credit channeling and recovery should be based on hybrid features of formal and informal credit. An adopted version of PPN System (Praja Naya Niyamaka-Community Credit Facilitator) could be practiced on pilot scale.

Achievement - 90%

Constraints

Not availability of vehicles for field survey

Project 1.2 : Assessment of Socio-economic impacts of releasing fingerlings to selected inland water bodies of Sri Lanka

Study areas - Udawalawa reservoir, Chandrika wewa, Hurulu wewa and Nuwara wewa

In stoking of fish fingerlings Nuwara wewa and Chandrika wewa have achieved a good progress for the year 2001 with respect to other two water bodies.

Terminating the free issuing of fish fingerlings to the inland water bodies has caused for the poor stocking. Further fishing community participation in purchasing of fish fry and stocking

them in water bodies is not successful in order two reservoirs except Nuwara wewa and Chandrika wewa.

There is a growing trend in culturing of craps fry in cages provided by National Aquaculture Development authority and fry are grown about three months on those cages on reservoirs until stocking in respective water bodies.

Cage culture seems to be successful in terms of higher recovering rates of fish fingerlings. But, poor growth rate of the fishes is shown probably due to the absent of plankton especially zoo plankton needed for their initial growth.

Achievement - 95%

Constrains

Non availability of vehicles for field survey.

Publication

Draft final report of project 3 is completed.

Project 1.3 : Marketing pattern and markets of fresh water fish in Sri Lanka

The total fish production of Sri Lanka comprises of three major sub sectors. Of the total fish production in 1998, 11.5% was contributed by inland fish production, but in 1994 it was only 5.4%. On the other hand out of total fishermen 11.6% or 12891 derived from inland fishery (Department of fisheries/1990) and 201832 hectares covers fresh water tanks and reservoirs under DFEO divisions and administrative divisions in Sri Lanka. This study plans to examine how and who handle the production of fish and what was the consumer given price and how this price was divided among the involving persons.

The available marketing channels in the fresh water fish trade are as follows

- Producer- Assembler- Retailer- Consumer
- Producer- Assembler- Wholesaler- Retailer- Consumer
- Producer- Retailer- Consumer
- Producer- Consumer

Marketing costs per one Kg of fresh water fish.

The table shows that total marketing cost for one Kg of fresh water fish in Anuradhapura district was 15.70 rupees, which, incurred by the assembler was Rs. 1.22, the motor bicycle retailer was Rs. 8.96 and the foot bicycle retailer was Rs. 5.52. Among the marketing cost, motor bicycle retailer cost was the highest in Anuradhapura district. In Pollonnaruwa district it was Rs.14.90, which, incurred by the assembler was Rs. 1.85, the motor bicycle retailer was Rs. 7.05 and the foot bicycle retailer was Rs. 5.98. Among the marketing cost, motor bicycle retailer cost was the highest in Pollonnaruwa district it. In Nuwara Eliya district it was Rs.17.01, which, incurred by the motor bicycle retailer was Rs.10.41, and the foot retailer was Rs. 6.68. Among the marketing cost, motor bicycle retailer cost was the highest in Nuwara Eliya district. In Kandy district it was Rs.14.50, which, incurred by the motor bicycle retailer was Rs. 7.24, and the foot bicycle retailer was Rs. 7.29. Among the marketing cost, foot bicycle retailer cost was the highest in Kandy district.

Marketing Margins and price spread

Table 01 it is clear that the producer received the maximum share of consumer's rupee in Anuradhapura district (67.85) followed by Kandy (62.50), Pollonnaruwa (60.60), and Nuwara Eliya (55.17) respectively. Among all the marketing functionaries retailers got the maximum margin in all the districts.

Marketing problems

All the traders irrespective of the functionaries seriously complained the small size fish harvesting by most of the fishermen in every reservoir, which, in turn lead to the deterioration of total production and resources. In addition to that there were no sound marketing system and initial marketing facilities in most of the landing centre.

Achievement - 95%

Draft final report completed.

POST HARVEST TECHNOLOGY DIVISION

Programme 1 : Research on Fishery dated Post Harvest Activities

Project 1.1 : Assessment of microbiological quality and associated factors affecting aquaculture products to ensure food safety

An assessment was carried out in main shrimp culture area in Sri Lanka. The prevalence of the pathogenic bacteria, *Salmonella*, *Vibrio cholerae*, *V. parahaemolyticus*, total coliforms faecal coliforms and *Escherichia coli* in shrimps, sediments and water from shrimp culture facilities, pelleted feed used in farms and water samples from brackish water sources for shrimp farms (Dutch canal and Mundal lake) were analyzed. Salinity, pH and suspended solids in water were estimated. The impact of pH and salinity on the growth of pure isolates of *Vibrio parahaemolyticus*, *E.coli* and *Salmonella* were examined. The combined effect of salinity and pH on the survival of *Salmonella* spp., *E.coli* and *V. parahaemolyticus* were determined.

The total coliform count of water varied between 11 to 1800 MPN/ 100ml. The fecal coliforms and *E.coli* were between 2 175 MPN/100ml and 0-95 MPN/100ml respectively. *Salmonella arizonae* was observed in one occasion while *Vibrio parahaemolyticus* observed in two occasions at the population of 10¹ cfu/g. The physicochemical parameters varied among sampling points monitored. Total coliforms, faecal coliforms and *E.coli* were isolated from waters at salinities ranging from 8 to 37 ppt with the majority of samples from 14 to 28 ppt range. Total coliforms, faecal coliforms and *E.coli* were observed mostly in water samples with pH values and suspended solid levels ranging from 7.9 to 10.0 and 50 to 98 mg/L respectively.

The total coliform count of shrimps varied between <3-93 MPN/g whereas in the surrounding waters and sediments were between 0-45 MPN/100ml and 3.6-93 MPN/g respectively. Faecal coliforms in shrimps varied from <3 to 15 MPN/g while surrounding water and sediment contained 0-11 MPN/ 100ml and <3-23 MPN/g respectively. *E.coli* were in the ranges of 0-8 MPN/100ml (water) <3-9.1 (sediment) and <3-7.3 (shrimps) In one occasion feed were highly contaminated with coliforms (>1100), Faecal coliforms (1100) and *E.coli* (460) . *Salmonella* was not recovered from farm shrimp, pond water, sediment and feed. *V. parahaemolyticus* was detected in farm shrimp sediment and water and counts were in the range of 10¹ -10² cfu/g.

Growth of *V. parahaemolyticus*, *Salmonella* and *E. coli* was observed in salinity ranges at 5 - 100 ppt, 5-40 ppt and 2-65 ppt salinity levels and pH range of 3.0 - 10.5, 3.5-9.8 and 3.5-10.3 respectively under experimental conditions.

There was no growth of *E.coli* when the salinities were 35 and 40 ppt and pH values were 9.0 and 9.5. Weak growth of *Salmonella* spp. was observed when the combination of salinity level was 40 (ppt) and pH values were 9.0 and 9.5. Growth of *V. parahaemolyticus* has been observed at all combinations of salinities (ranging from 15 to 40 ppt) and pH (7.5-9.5) and the growth was found optimum at salinity level of 40 ppt and pH values ranging from 7.5 - 9.5.

Achievement - 98%

Project 1.2 : Accreditation of IPHT Laboratory

Preparation of QC laboratory for accreditation procedure

Competition of Quality manual, manual on methodologies and quality routines for the Quality Control Laboratory. Preparation of documents and others for application for accreditation of Quality control Laboratory. Instrument calibration. Purchase of necessary equipment.

Achievement - 98%

Project 1.3 : Impact of industrial effluents on contamination of fish and fishery products and the due of drugs on the quality of aquaculture products.

The research program was carried out to assess the existing levels of selected toxic trace elements (Cd,Pb, Hg,Cr) in cultured shrimp, *Penaeus monodon* and their immediate environment in the farming areas of the North Western Province of Sri Lanka from Chilaw lagoon to Puttalam lagoon.

The aim of the study was to establish a database to cater the needs of the ISO 9000 quality assurance programs where stringent quality guidelines have been established for chemical contaminants by the European Union to export the shrimp products to the international markets.

Shrimps were collected at harvest from twelve shrimp farms that extract water from four main water sources namely Chilaw lagoon, Mundal lake, Dutch canal and the Puttalam lagoon for the analysis of trace elements. In addition, sediment and water samples from each main water source and sediment samples from each farm were also collected at the end of the culture cycles. Further, the artificial feeds used by the farmers were also taken for analysis as a source of possible metal contaminant.

An assessment was carried out on the effluent quality of shrimp and tuna processing plants. Main physical and chemical parameters were monitored in effluents as well as in the main water service to the processing plants. The main collective was to determine the status of effluents and to calculate the effluent loading to the environmental.

Analyses of the different types of samples for the above toxic elements are still in progress as I had to attend to an official training programme abroad for three months from 5th May to 4th August, 2001.

Achievement - 97%

Project 1.4 : Evaluation of the nutritional quality of potential aquatic feed resources and improvement of nutritional quality of aquaculture products.

Proximate composition of maldivian fish prepared from three species; *Oreochromis mossambicus*, *Oreochromis niloticus* and *Katsuwonus pelamis* were studied during this project; total volatile nitrogen, trimethylamine, free fatty acid, peroxide value, total bacterial count, mould count, consumer acceptability. Studies on cost benefits of the using Tilapia (*Oreochromis mossambicus*) for the production of Maldivian fish instead of tuna varieties and the determination of best salt: fish ratio for the production of Tilapia Maldivian fish were also studied under this research program.

The objectives of this study were to produce both whole and peeled dried shrimp by using different processing methods, under several steps such as washing, salting, pressure cooking and drying. After that the end products (dried shrimp) were packed in different types of packaging systems, and analyzed for their keeping quality in weekly intervals. Each of the steps involved sensory analysis (using taste panels), to select the best treatment, which determined the further steps of processing.

Proximate composition of the three varieties of Maldivian fish; *Oreochromis mossambicus* (moisture 14.92%, protein 59.59%, fat 7.91%, salt 6.29, ash 9.89) and *Katsuwonus pelamis* (moisture 15.73%, protein 68.11%, fat 2.46, salt 5.98, ash 6.405) showed that protein content is significantly high in Maldivian fish produced from *Katsuwonus pelamis* while fat and ash contents were significantly high in two *Oreochromis* species.

All the parameters used to determine the keeping quality of two maldivian fish products (*Oreochromis mossambicus* and *Katsuwonus pelamis*) showed that the quality deteriorate more faster in tuna Maldivian fish than in Tilapia Maldivian fish. Tuna Maldivian fish has initial values of 29.58 TVN mg/ 100g, 5.4 TMA mg/100g, 246.51 peroxide value meq./kg, 52.59 FFA%, 6.3×10^5 TBC/g and 1.1×10^4 mould count/g where tilapia has 27.42 TVN mg/ 100g, 4.11

TMAmg/ 100g, 671.45 peroxide value meq./kg, 5.89 FFA%, 6.74×10^4 TBC/g and 0.7×10^1 mould count/g . After four months of storage period these values change to 45.52 TVN mg/100g, 18.54 TMA mg/100g, 108.74 peroxide value meq/kg, 72.62FFA% 7.28×10^4 TBC/g and 1.95×10^5 mould count/g in tuna Maldiv fish here Tilapia has 37.82 TVN mg/ 100g, 14.54 TMA mg/ 100g, 104.62 eroxide value meq/kg, 11.71 FFA%, 9.36×10^3 TBC/g and 1.21×10^3 mould count/g.

Achievement - 98%

Project 1.5 : Investigation on post harvest losses and remedial measures in fisheries

Ministry of Fisheries & Aquatic resources of Sri Lanka has implemented a project on "Strengthening the quality infrastructure for the fisheries industries in Sri Lanka". The present study concentrates on the quality assessment of Skipjack tuna landed from MDB operating from Beruwala fishery harbour and distributed along two main channels ends up at Matugama and Horana with the view of suggesting remedial measures to reduce the quality deterioration through the development of suitable infrastructure this is implemented as a pilot project by the Ministry of fisheries. Main objectives of this study were to investigate the quality deterioration of fish at main handling stages along the distribution chain, to assess the changes in quality deterioration between different handling stages: Samples were taken from MDB, at pier, from transport vehicle, at stall in the market and from retailer to monitor bacterial contamination along the handling chain.. Chilling temperatures of fish along the distribution channel and handling practices along the fish distribution channel were also investigated.

A general trend to increase of APC along the distribution chain was observed . APC in MDB, Pier retailer along Matugama channel were $\log 6.16 \pm 0.94$ cfu/g, $\log 7.08 \pm 0.96$ cfu/g and $\log 6.96 \pm 0.46$ cfu/g respectively. In Horana distribution channel, $\log 5.14 \pm 0.71$ cfu/g, $\log 6.13 \pm 0.49$ cfu/g and $\log 6.40 \pm 0.15$ cfu/g were found in fish from vehicle , stall and retailer stage respectively.

Means of APC at five stages were compared using "Satterthwaite" approximation statistics. There is no significant rise in APC of fish from boat to pier . However a significant increase was found at 5%level in APC from pier to vehicle and vehicle to market in Matugama distribution channel. The increase from pier to vehicle was 104% and vehicle to market was 870%. When consider the Horana distribution channel, significant rise in APC in fish was found from vehicle to market and the increasae was 645%. This reveals that there is very high rate of proliferation of bacteria at some of the latter stages of the distribution chain .

According to ICMSF (1986) specifications for lot acceptability which is based on five unit sampling plan, acceptable APC level is 5×10^5 cfu/g in not more than two sample units.

In the present investigation, three fish lots out of nine lots were found unacceptable in MDB , pier and vehicle while at the fish stall in market, seven out of nine lots were unacceptable. This indicates the poor quality of fish available for consumers.

E.coli count

Table 1. *E. coli* counts of skinned skipjack in Multi-day boats, at pier, in vehicle, at stall and at retail stalls.

Location	E.coli counts (% samples)		Total number of samples
	Count <10 cfu/g	Count > 10 cfu/g	
Boat	83	17	30
Pier	56	43	30
Vehicle	50	50	20
Stall	13	87	30
Retail	-	100	7

Total number of 22 skin on samples from all stages were found positive and counts were in the range of 10²-10³cfu/g. Out of 117 skinned samples from all five stages, 61% samples found with >10cfu of E.coli. An increasing tendency of E. coli contamination was found along the distribution channel. At the retail stage, all samples were E.coli positive (Table 1).

Biochemical quality of fish

Table 2. Variations in TMA and TVB content of skinned Skipjack along the fish handling chain

Handling stage		TMA mg/100g (Mean ± SD)	TVB mg/100g (Mean ± SD)
MDB		9.02 ± 6.71	26.76 ± 13.03
Pier		7.28 ± 3.75	21.76 ± 10.46
Vehicle destination	at Matugama	9.40 ± 6.90	25.87 ± 6.38
	Horana	7.67 ± 3.52	14.96 ± 9.90
Market	Matugama	± 5.47	26.92 ± 8.30
	Horana	26.92 ± 8.30	9.77 ± 6.00
Retail	Matugama	8.43 ± 4.84	26.20 ± 2.96
	Horana	11.89 ± 3.79	13.65 ± 8.04

Among the variance of TMA and TVB values of skinned tuna samples from MDB, pier, vehicle and stall were not significantly change at 5% level, according to the Bartlett's test statistics.

Temperature of fish

Table 4. Temperature fluctuations of Skipjack tuna along the distribution channel from Multi-day boat, at pier, in vehicle, at stall and at retailed stage.

Location	Temperature (Mean ± SD)
Ambient Temperature on Board (in sea)	29.80 ± 3.69
Core Temperature of fish in fish hold	2.767 ± 2.079
Core temperature of fish from pier	6.32 ± 4.05
Core temperature of fish in vehicle	13.00 ± 2.53
Core temperature of fish at stall	16.99 ± 2.43

On average, temperature ranges of 2.767 ± 2.079^oC, 6.32 ± 4.05^oC, 13.00 ± 2.53^oC and 16.99 ± 2.43^oC were recorded in fish in boat, pier, vehicle and market respectively. These temperatures are above the accepted norms.

Handling practices along the distribution channel

Results of the survey on handling practices in multi day boats revealed that there is no significant improvement in the handling practices over last few years.

Higher APC reflects the poor quality of fish. This indicates that there is a significant time – temperature abuse along the distribution channels due to inadequate infrastructure and improper handling practices. Water activity has changed in sun dried vacuum packed, oven dried vacuum packed sun dried non packed, oven dried non packed products from 0.612 to

0.641, 0.598 to 0.636, 0.612 to 0.670 and 0.598 to 0.681 respectively after 12 weeks. Moisture content of these products were 24.97%, 24.13%, 29.31% and 29.38% respectively after 12 weeks. Sulphide test showed that all the products have not decomposed through out 12 weeks of storage. Total colony counts of all the products were below 20,000 through out the 12 weeks. So those values are less than limits (<50,000) of Sri Lanka Standards.

Achievement - 97%

Project 1.6 : Development of convenience food products from inland fisheries and aquatic plants

Development of retorted fish curry from Tilapia :At present fresh water fish is not fully utilized in Sri Lanka. Therefore, there are immense potential to produce food products using inland fish resources and it will contribute to the food security and reduction in post harvest losses also.

During this study, it has been able to develop a retorted fish curry with acceptable sensory quality.

Fish and fisheries products are important to ensure food security of resource poor communities. Sri Lanka is producing 230,200 MT of fish from marine sector and 29,999 Mt of fish from inland water bodies. Although Tilapia contributes 59.3% of the total inland production, utilization of Tilapia is restricted due to its muddy flavour. This study was aimed to develop retorted Ambul Thiyal product from Tilapia thus masks its undesirable characteristics and provides value addition to it.

Ambul Thiyal was developed with the addition of Goraka and spices to fish fillets. It was hot filled into Polyester/Cast polypropylene restorable pouches, sealed and retorted in conventional steam retort at 121^o C for 30 min. Three different types of Ambul thiyal were developed by treating fillets with 15% brine for 5 min and flash frying at 80^o C for 2min and with a control. Sensory evaluation was conducted soon after the processing with 30 in-house panelists. Based on the results all these products were within the acceptable range of 3-5 (5 point hedonic scale). The developed Ambul Thiyal consisted of 19-36% of moisture, 16-17% of crude protein, and 1.5-2.5% of crude fat, 1.5 -2% ash and a pH of 4.1.

Shelf life studies were conducted for 3 months at 4 - week interval. Total anaerobic counts, pH, Free fatty acids (FFA), thiobarbituric acid (TBA), Water holding capacity (WHC), penetration strength and Texture profile (TPA) were measured. Total anaerobic counts were 0-10 cfu/g and there were no significant changes in the 3 month period. pH, FFA and TBA increased as 4.1 - 4.7, 0.7 - 1.3%, and 0.5 -8mg melonaldehyde/kg respectively and penetration strength decreased at the end of 3 month. there were no changes in TPA during the storage period.

The results indicated that the thermal conditions were inadequate which lead to the growth of anaerobic organisms during the storage. Thus thermal conditions for this product should be reestablished and the absence of *Clostridium botulinum* should be confirmed in order to ensure a safe product.

Development of high quality salted dried Tilapia fillets

As a cheap protein source, demand for fish is increasing due to increasing population. Development of new products from fresh water fish is a way to meet the demand as well as to enhance the socio-economic status of the country.

The objective of the study was to develop high quality dried fillets from Tilapia species. The study was carried out to establish processing conditions for salting and drying of fillets. The fillets were brine salted. The strength of brine and duration of brining were determined based on the salt content (>15% wet basis) and water activity (<0.6) should be in the product. Strength of brine and duration of brining were found out as 5% and 3 hours respectively. Salted fillets were sun dried and oven drying (temperature 45^o C, air flow rate 1.5 ms⁻¹) to reduce the moisture content from 80% to 20% . the product contains 56.073% protein, 3.81%

fat, 16.06% ash and 20.4% moisture. The acceptability of sun dried and oven dried products were tested using an in-house consumer panel consisting of 30 panelists and using 5 point Hedonic scale. The overall acceptability was same for oven dried and sun dried products. Suitability of Biaxially Oriented Polypropylene (BOPP) for vacuum packing of dried fillets was tested. Changes of moisture content, water activity, total colony count and decomposition (Sulphide test) in vacuum packed and non packed products were tested for 12 weeks.

Achievement - 97%

Project 1.7 : Influence of food preparation and processing procedures on nutritional quality, acceptability and shelf-life of fish products.

In this program study was concentrated on influence of different processing procedure on the quality and shelf -life of shrimp.

Influence of preparation procedures on the quality and acceptability of Maldivian fish processing using Tilapia and Skipjack tuna was studied (M.SC thesis is being under preparation from the study)The Maldivian fish was prepared using Tilapia and Skipjack tuna was analyzed Sensory, microbiology and chemical parameters to evaluate the comparison of Maldivian fish quality using two species.

Preparation procedures and keeping quality of Ambulthiyal in different temperatures on packed in sterile glass bottles was studied. The Sensory, and Bio-chemical analysis were carried out.

Achievement - 98%

Project 1.8 : Evaluation of Gas Sensor Technology for the Non- Destructive Determination of Taints Associated with Adverse Quality characteristics of Fish Products. (PhD) program)

The determination of quality and shelf - life of fish and fishery products is very important in local and export industry in Sri Lanka. Due to the number of problems associated with the current quality assessment methods, there is a need to develop a rapid and non destructive method that can be used to determine freshness of fish. This project seeks to develop and validate methods for the non-destructive determination of freshness of fish and fishery products using gas sensor technology incorporated with Gas chromatography and mass spectrometry (GC-MS). envisaged that these methods will be used as an early detection system identifying early signs of loss in freshness but also as part of a QC system to monitor the quality/ freshness of produce i.e. on arrival at the processors and during processing and storage. The project also aims to develop methods or 'models' for predicting the storage life of marine products that can be used by industry.

The aroma profile of the frozen tuna has been evaluated using the gas sensor technique. The highest response was obtained from hydrogen sulphide sensor and followed by ethanol sensor. At present, ethanol is used to evaluate the quality of tuna, and these sensor readings may correlate with direct ethanol test. The higher reading of hydrogen sulphide may indicate the microbial spoilage of frozen tuna samples. The five sensors used in the experiment gave considerable discrimination between volatile compounds, The volatile compounds of fresh yellowfin tuna were primarily analyzed.

The volatile profile of fresh tuna mainly comprised of aldehydes such as hexanal, heptanal and nonenal. Most of these compounds contribute to off- fishery order of fish. The low level of sulphur compounds indicated the initial stage of the spoilage. The results showed the ability of solid phase microextraction (SPME) technique in discrimination of volatiles of tuna during storage. The amount of primary aldehydes such as hexanal, heptanal decreasing while the amount of 3 -methyl-1 butanol and 3 -methyl butanol increasing during storage. These two compounds contributed significantly to off-odor in spoiled fish.

Achievement - 90%

Seminars / Workshops- Attended

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

Fisheries training program. Quality Management in fish handling and processing in Iceland - Ms. S. Ariyawansa

Statistical training program on "Discriminant Analysis and Class Modeling of Spectroscopic Data" at the Institute of Food Research (IFR), The University of East Anglia, Norwich, UK from 26 to 30th March 2001. - Mr. R.Edirisinghe

Training program on "Laboratory Testing" in Sweden and Iceland from 5th May to 4th August 2001. - Ms. S. Senadheera & G. J. Ganegama Arachchi

Attended the Fourth biennial European conferences on fish processing at the university of Lincolnshire and Humberiside, Lincoln, UK 3-5 July 200 - Mr. R.Edirisinghe

Participated training program on Fish Primary Processing and handling at JAPAN, Kanagawa Fisheries Training Center on 29 th May- 2 Sep.- Mrs. P. S. Jayasinghe
European conferences on traceability systems in fish industry at Grimsby, UK, 6th July 2001.- Mr. R.Edirisinghe

Seventh Regional Training Course in Seafood Safety for Asian – Singapore Technical Corporation Programme: Asian Training Awards, Marine Fisheries Research Department, Southeast Asian Fisheries Development Center, Singapore (05 March – 16 March 2001) - Ms. G. J. Ganegama Arachchi

Working visits for Laboratory Personnel in Sweden and Iceland SIDA funded project for improvement of Quality infrastructure from 1st July to 13th July 2001. Ms. I. kariyawasam

Work shop on " Processing of food products from inland fish species" to the fish producers in Tambuththegama organized by Mahaweli Rehabilitation Agency (Oct)

Work shop on "Business clinic on product development problems in food industry" in Matara (2001 09. 22) organized by Sarvodaya

Extension Work

Dissemination of knowledge

Conducted Diploma Course in Post – Harvest Technology for National Institute of Nautical Engineering (NIFNE) Colombo, (September , 2000 – May , 2001).

Teaching at Universities

Staff of IPHT serviced as visiting lecturers in Postgraduate Institute of Agriculture - University of Peradeniya
Postgraduate Institute of Science - University of Peradeniya
Department of zoology - University of Kelaniya

Unit of Fisheries Department assisting the preparation of Guidelines for testing Laboratories.

Consultancy

Test services to the Industry

Tests parameters and no of tests carried out by Quality Control lab are as follows

Test Parameters	No. of Tests
Total Bacterial count	262
Total coliforms	261
Fecal coliforms	261
E.coli	261
V. cholerae	200
Salmonella	418
V. parahaemolyticus	39
Staphylococcus aureus	42

During year 2001,. Total earning from consultancies was Rs. 517,550.00

Constrains

Some equipment for the analytical work and some infrastructure facilities to be developed for inadequate safety measures in the Chemistry Laboratory.

Microbiology laboratory repairs and upgrading

Meetings Attended

Meeting held at MFARD with testing laboratories Meeting held at MFARD regarding improvement of quality of fish. Board meetings for Board of Study in Post harvest Technology for BSc. Degree program Meeting with Deputy minister Nandasena Herath Post Harvest Technology and Packing and standardization of Foods.

Other Activities

Laboratory demonstration for undergraduate students from Wayamba University and for graduate students from university of Kelaniya, conduct a market survey on (selected town) microbiological quality and sensory quality of fish. Updating of Quality Control Laboratory Had collaborative program on product development research with Indian Scientist from Central Institute of Fisheries Technology, Cochin. Survey " on the content of formaline in Food fishes on the request of the MOFAR and Her Excellency the President of Sri Lanka.

Exhibitions

Organized a stall on Fishery Products developed from inland fish species Thomian Fair, Mount Lavinia (08, 09 & 10th February).

Supervision of Research projects

- Project : Market survey of fish for microbiological quality
Student : Nilmini
University : Wayamba University
Degree : B.Sc. in Food Science
- Project : Validation of test methods for selected Microorganisms and studying the recovering ability of freeze stressed cells of *Salmonella typhimurium* and *Staphylococcus aureus* in frozen shrimp
Student : Thushani
University : University of Peradeniya
Degree : B.Sc. (Agric) special degree

- Project : Development of retorted fish curry from *Thialpia*
 Student : Saratha Selvaratnam
 University : University of Peradeniya
 Degree : B.Sc. Project (Agric.)
- Project : Development of dried fish from *Tlapia* with reference to the
 quality control aspects
 Student : R C C Pradeepika
 University : University of Peradeniya
 Degree : B.Sc. Project (Agric.)
- Project : Utilization of prawn pond sediment using effective microbes
 and earthworms to produce organic fertilizers
 Student : Mr. N. Rajarathne & Mr. J. M. De Silva
 University : NIFNE
- Project : Influence of different processing methods on self life and
 quality of dried shrimps
 Student : Mr. Mahesan Pathmasankar
 University : University of Jaffna
 Degree : B.Sc. Agric
- Project : Analysis of data on Maldivian fish
 Student : G.M.Rajakaruna
 University : University of Colombo
 Degree : B.Sc. (Statistics)
- Project : Industrial training Final report Preliminary Investigations on
 the quality of the *Katuswonus pelamis* Along the Main
 Distribution Channels from Beruwala Fishery Harbour
 Student : C. N. Kuruwita
 University : University of Colombo
 Degree : B.Sc (Statistics)
- Project : Development of salted fish from *Sardinella*
 Student : S. M. Puviraj
 University : University of Jaffna
 Degree : B.Sc.
- Project : Development of salted dried fish hamburger from *Sardinella*.
 Student : D.M. Devijan
 University : University of Peradeniya
 Degree : B.Sc (Agric)
- Project : Development of *Ambul thial* using different packin methods.
 Student : S. Vijithan
 University : University of Jaffna
 Degree : B.Sc
- Project : Comparison of nutritional quality of three major inland fish
 species: *Oreochromis mossambicus* (Tilapia), *Ophicephalus*
striatus (Lulla), *Anabas testudineus* (Kaviya) and
Heteropneustes fossilis (Hunga)-
 Student : T Dilka Peiris
 University : Wayamba University
 Degree : B. Sc.

Publications

Chapters in books

J.M.P.K. Jayasinghe, Inland Aquatic Resources, In: Natural Resources of Sri Lanka 2000, National Science Foundation (Ed: Cooray PG) 195: 211.

Other scientific communications

Ariyawansa S. (2001) "Evaluation of functional properties of fishmeal" Proceedings of Seventh Annual Sessions: Sri Lanka Association for Fisheries and Aquatic Resources, 28th June 2001, SLAAS Auditorium, Colombo, Sri Lanka

Edirisinghe, E.M.R.K.B. and Graffham. V.K. (2001). Rancidity Development and Spoilage of White Sardinella (*Sardinella albella*) Fish during Storage. *Proceedings of the 24th World Congress and Exhibition of the International Society for Fat Research (ISF)*. P57-58, Berlin, Germany. 16-20 September.

Edirisinghe, E.M.R.K.B. and Chandrika J.M. (2001). Environmental and Feeding Impact of Fatty Acid Profiles in cultured and Wild Shrimps From Sri Lankan Waters. *Proceedings of the 24th World Congress and Exhibition of the International Society for Fat Research (ISF)*. P 19, Berlin, Germany. 16-20 September.

De Croos, M.D.S.T., Edirisinghe, E.M.R.K.B., De Silva, D.N. and Jayasinghe J.M.P.K. (2001) Possible effects of the white spot syndrome on muscle lipid content and fatty acid profile of *Penaeus monodon*. *Proceedings of the 7th Annual Scientific Sessions of the Sri Lanka Association for the Fisheries and Aquatic Resources (SLAFAR)* p 9. Colombo, Sri Lanka. 28th June.

Fernando, W.K.A.R., Edirisinghe, E.M.R.K.B. and Jayasinghe, J.M.P.K. (2001). A Survey on the effluent Quality of Fish and shrimp Processing Industry in Sri Lanka. *Proceedings 7th Annual Scientific Sessions of the Sri Lanka Association for the Fisheries and Aquatic Resources (SLAFAR)*, p 19. Colombo Sri Lanka. 28th June.

Ganegama Arachchi G.J, Karriyawasam M. G. I. U., Hinatigala P.P.M. and Jayasinghe J.M.P.K. (2001).

Preliminary Investigations on the quality of the *Katuswonus pelamis* Along the Main Distribution Channels from Beruwala Fishery Harbour. *Proceedings of Seventh Annual Sessions: Sri Lanka Association for Fisheries and Aquatic Resources, 28th June 2001, SLAAS Auditorium, Colombo, Sri Lanka :p1*

Jayasinghe P., Jayasinghe J.M.P.K.(2001). "Maintain of freshness and keeping quality on *Tilapia mossambica* at different temperatures" aware presented at SLAAS annual sessions.

Edirisinghe, E. M.R. K. , W. M. K. and Bamunuarachci, A. Nutritional Evaluation of Some Small Coastal Fish in Sri Lanka. *Journal of the National Aquatic Resources research & Development Agency*. Vol 36, 47-53 (In press)

Jayasinghe, C. V.L. , Perera, W. M.K., Bamunuarachchi, A. and Jayasooriya, S. P. Evaluation of quality of shark livers using bio-chemical properties and organoleptic score sheet. *Journal of the National Aquatic Resources Research & Development Agency, vol. 36, 1-11 (In press)*

Chamila V. L. Jayasinghe, Naohiro Gotoh, and Shun Wada. Lipid composition and positional distribution of fatty acids in liver oil of five shark species caught arraign the Sri Lanka. *Proceedings of the Japan Oil Chemists society, American Oil Chemists Society world congress 2000, October 22- 27, Kyoto, Japan.*

Chamila V. L. Jayasinghe, Naohiro Gotoh, and Shun Wada. Antioxidant activity of polyphenols from *Ocimum basilicum* L, in a phosphatidylcholine liposome system, *proceedings of the 40th annual conference of Japan Oil chemists Society, 2001, October 4-5, Sendai, Japan.*

Chamila V. L. Jayasinghe, Naohiro Gotoh, and Shun Wada.. Antioxidant activity of sweet basil (*Ocimum basilicum* L) Proceedings of the research session 2001, Sri Lanka Students' Association of Japan, 15th July 2001, Tokyo, Japan.

Corea A.S.L E., Jayasinghe J.M.P.K., Ekaratne S.U.K, .Effect of salinity on the growth and survival of *Meretrix meretrix* and *Crassostrea madrasensis* cultured in shrimp effluent canals in the Kalpitiya area of Sri Lanka.

Corea A.S.L E., Jayasinghe J.M.P.K., Environment and the major epizootics in shrimp culture - the Sri Lankan experience.

Corea A.S.L E., Jayasinghe J.M.P.K., Investigation of the potential of using *Gracillaria edulis* to treat shrimp farm effluents in the Kalpitiya area in Sri Lanka.

M.Sc. Thesis

A comparative study of quality characteristics of Tilapia (*Oreochromis mossambicus*) Malldive fish with Traditional Tuna (*Katsuwonus pelamis*) Malldive fish

Effluent quality and loading of fish and shrimp processing plants in Sri Lanka.

Histamine concentration of fish and fishery products

Research Reports

Development of High Quality Dried Tilapia Fillets

Development of retorted Ambul Thiyal product from Tilapia (*Oreochromis spp*)

Report on statistical analysis of data - Investigations on the quality of the *Katuswonus pelamis* Along the Main Distribution Channels from Beruwala Fishery Harbour)

Comparison of nutritional quality of three major inland fish species: *Oreochromis mossambicus* (Tilapia), *Ophicephalus striatus* (Lulla), *Anabas testudineus* (Kaviya) and *Heteropneustes fossilis* (Hunga).

Awards

Dr. J M P K Jayasinghe - Presidential Merit Award 2001.

Environmental Studies Division

Programme 1 : Status of Pollution in the aquatic environment and there impacts on the aquatic resources

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

The status in the coastal zone has been highly affected due to natural causes and various types of human activities. The pollution caused by human activities has resulted in varying degrees of degradation of the natural ecosystems in the coastal environment. Understanding of the baseline values of the marine coastal environment is considered as an important need. Therefore establishing baseline data by monitoring the marine environmental quality is important for conservation purposes and evaluation of suitable uses of the environment. The parameters analysed were: Nitrate, Nitrite and Ammoniacal Nitrogen, pH, Temperature, Total Phosphorus and Dissolved Oxygen.

Dissolved Oxygen values ranged from 5.3 to 7.8 mg/l, Ammoniacal Nitrogen from 5.3 to 7.8 mg/l, Nitrate Nitrogen from 0.0391 to 0.88 mg/l, Nitrite Nitrogen from 0.002 to 0.005 mg/l , Total Phosphate from 0.008 to 0.114 mg/land pH from 7.00 to 8.5 mg/l. Standards for Coastal and Marine Waters have yet to be established.

Achievement – 95%

Project 1.2 : Study of the effect of land- based pollution in Negombo estuary & environs on the water quality & aquatic organisms.

Land based pollution is one of the major factor contributing to degradation of aquatic ecosystems. The Negombo lagoon is well-recognized as a major water body in the country catering to the fisheries sector. The Negombo estuary receives urban wastes from the Negombo town, Industrial effluents from Katunayaka Export Zone and Ekala Industrial zone. In addition the agricultural residues, industrial and urban runoffs, may come through the Dandugam oya and Ja-ela. Main objectives are to study to establish present pollution status and assess the water quality changes of the ecologically and economically important Negombo lagoon system. Water and sediment samples were collected from Negombo estuary and associated water bodies of Dandugam oya and Ja-Ela for the study. Water quality parameters including Temperature, pH , Conductivity ,Salinity, Dissolved Oxygen, Biochemical Oxygen Demand(BOD), Nitrite, Nitrate, Phosphate, Ammonia and Chlorophyll were analyzed and Sediment Samples were sieved through 500µm, 1mm, and 2mm mesh and animals were picked and preserved in alcohol with rose-Bengal. Animals present in the samples were sorted into groups and were identified up to the lowest possible level and were counted. Data analysis was done by using "minitab" and "primer" statistical packages.

The information related to the sources of pollutants and the water quality of deferent stations is available. The studies on the benthic community structure to see the impacts of pollutant are ongoing. Final report is under preparation.

Achievement – 95%

Project 1.3 : A Survey of Pollution of Coastal Sea Bed Areas due to accumulation of Polythene

The sea bed and the water column have very important interactions in numerous ways. As a habitat for numerous marine species, trapping and release of nutrients, flux of organic and inorganic debris from dying and decaying matter, as a nursery and breeding ground for benthic communities, crustaceans etc. The seabed and water column also interacts in the movement of sand and silt between the shoreline, water and seabed as well. The presence of polythene on the seabed or water can significantly disrupt the above processes and interactions, as polythene are impermeable and degrade very slowly. The crustacean

population may also dwindle with increase of polythene on the seabed or water. Fishery activities can also be affected significantly due to this kind of pollution. In order to establish and quantify the issues related to accumulation of polythene on the sea bed, as a pilot study Kelani river, Dehiwala and Wellawatte canals, and points on the beach from Pamunugama to Lunawa were studied as input sources of Polythene to the Sea Bed. In this regard impacts to following types of fishery activities; beach seine, trawling for prawns and bottom set nets for lobsters were also studied.

It was established that a large amount of kitchen refuse, shoes and other rubber materials as well as polythene debris is affecting the trawling for prawns, bottom set nets for Lobsters and beach seine fishery has been affected by this type of pollution. It was also established that the Kelani River, Wellawatte Canal and Dehiwala Canal are the major sources that bring polythene debris to the sea in the Colombo district.

Achievement – 95%

Project 1.4 :Study of radioactivity levels of toxic chemical residues in fish caught in Sri Lankan waters.

The radioactivity in water and aquatic organism originate from both natural and man made activities. Radionuclides have been pervasive components of aquatic environments since their creation and all aquatic organisms have evolved and developed in the presence of a background radiation exposure of greater or lesser magnitude, depending upon the ecological niche occupied. South and west coast beaches of Sri Lanka have been reported to indicate radiation levels (0.8 – 7.0 $\mu\text{Sv/hr}$) due to presents of monzite. Human activities have resulted in the introduction of additional quantities of radionuclides into the marine environment. The major sources of these additional radionuclides are the fallout from the testing of nuclear weapons and the controlled disposal of radioactive wastes either as effluents or from dumping. Since baseline data of Sri Lankan situation was not available and presence of specified standards under European Union for exports, the study was initiated to assist the fishery industry. The objectives include qualitatively and quantitative assessment radioactivity for gamma emitters in fish according to the species caught in Sri Lankan waters and to correlate the results with fishing grounds in order to ascertain the possible area/s contamination. The study was carried out with the cooperation of Radio isotope center of University of Colombo and Atomic Energy Authority (AEA) of Sri Lanka.

Samples were analysed using NaI(Tl) 3"x3" with a resolution of 8.5 % at 662 keV peak for Cs-137 at Radio Isotope centre and Gamma Spectroscopy at AEA. Analysis revealed that only the naturally occurring radionuclides K-40, Th-232, and U 238 in the samples. Specific activities of K-40 ranged from 122 ± 12 to 677 ± 43 Bq/kg, for Th-232 ranged from <1 to 8.8 ± 0.3 Bq/kg and U-238 ranged from <1 to 22.1 ± 0.9 Bq/kg. The reference material used for the analysis was IAEA-134 Cockle flesh. It was noted that Cs-137 which is an artificial radionuclide, was not detected in any of the samples tested.

Achievement – 95%

Project 1.5 : Determination of levels of trace metals in the Marine and Coastal Environment

Data on trace metals is not available on our Coastal and Marine waters and this project is expected to meet the goals of the divisional mission of Monitoring and Collecting Baseline Information on the Aquatic Environment. This project was done to ascertain the level of pollution with trace metals in the North-western and western Coastal waters of Sri Lanka. Sampling was done from Mi Oya in the Puttalam District to Hikkaduwa in the Galle District. Twenty-Two sampling locations were selected and sampled monthly.

The levels of Iron, Manganese and Zinc have been determined in the samples, which have been preserved. A few more metals like Cadmium, Arsenic, Lead etc have to be determined when the equipment is in working order.

Achievement – 85%

Programme 2 : Accreditation of ESD laboratory under ISO guidelines

The environmental laboratory was identified as one of the laboratories to perform the laboratory tests for water quality parameters by the Ministry of Fisheries and Aquatic Resources Development. In this regard it was planned to accreditate the laboratory under ISO 17025 programme " Competence of testing and calibration laboratories" in order to provide accepted recognition to the laboratory as well as introduce proper quality management systems to the laboratory environment. Under the programme it was anticipated to provide proper training to all staff members related to quality management.

Several quality routines were adapted to the laboratory environment. Safety items were purchased to increase the laboratory safety. Some modifications to the laboratory infrastructures were introduced. A basic training on *Laboratory Quality Management* organised by Sri Lanka Standard Institute was provided to all staff members to acclimatize them with the ISO requirements.

Achievement – 85%

Seminars / workshops and training attended

- Workshop on ' Integrating Environmental Concerns into Sectoral Development Plans"; fisheries, coast & marine environment management -Organised by Ministry of Transport & Environment & CETRAC, held on 7th November at Battaramulla Participated by S.A.M.Azmy
- Research and Development management organised by Science & Technology Personal Development project of ADB held on 25th October, 2001 at Sri Lanka Foundation institute Participated by N.Sureshkumar
- Safety in Chemical laboratories: A need in the new millennium.- held on 23rd November, 2001, organised by Institute of Chemistry Participated by N.Sureshkumar
- Intra-ministerial Discussion on Fisheries management organised by CRMP of Ministry of ports, Shipping and Fisheries- held on 24th October 2001 auditorium of NARA Participated by N.Sureshkumar, S.A.M.Azmy
- Workshop on Exports of aquatic plants organised by IARAD/NARA held on 4th December 2001 at auditorium of NARA Participated by N.Sureshkumar

Local training programs

- Laboratory Quality management; *a need in new millennium*- held on 31st August, 2001, organised by Institute of Chemistry Participated by Mrs. B.R.C. Mendis, Mr. R.W. Fernando & Mr. M.S.H.K. Abhayarathna
- Laboratory Skills Development; *Evaluation of Analytical Data*- held on 24th November, 2001, organised by University of Colombo under the sponsorship of National Science foundation. Participated by Mrs. B.R.C. Mendis
- Laboratory Quality Management- held on 26th to 28th November, 2001 organised by Sri Lanka Standard Institute. Participated by Mrs. B.R.C. Mendis, Mr. R.W. Fernando, Mr. M.S.H.K. Abhayarathna, P.L.S. Panawala, S.A.M. Azmy & N.Sureshkumar

Foreign training programs

- Shrimp farming effluent management techniques- held on 21st May to 14th June, 2001; at Asian Institute of Technology, Thailand (under Science & Technology Personal Development project of ADB) - Participated by R.K.V.J. Gunasekara

- Integrated Coastal resources management with special reference to coastal and marine pollution- held on 21st May to 14th June, 2001; at Asian Institute of Technology, Thailand (under Science & Technology Personal Development project of ADB) Participated by N.Sureshkumar
- Coastal Pollution monitoring and management - held on 21st May to 14th June, 2001; at Asian Institute of Technology, Thailand (under Science & Technology Personal Development project of ADB) - Participated by R.W. Fernando

Extension Work

No extension work was planned for the year.

Consultancy

Test services to industries. The division served a total of 35 clients and test reports were issued. Total earning was Rs. 117,895.00.

Achievement - 91.66%

Constraints

- Shortage of research officers was recognized as a biggest impediment in many ways to the improvement of the division.
- Analysis at Radio isotope center of University of Colombo and Atomic Energy Authority (AEA) of Sri Lanka were considerably delayed due to power cuts.
- Frequent breakdown of Atomic Absorption Spectro photometer delayed analysis of samples of collected under "Determination of levels of trace metals in the Marine and Coastal Environment".

Meetings Attended

- National Wetland Steering Committee Organized by Department of Wild Life Conservation Held in February and April, Attended by N.Sureshkumar
- EIA meeting on Kelani Conservation Barrage at Amabatale Organised by Central Environmental Authority Held in July, Attended & contributed by N.Sureshkumar
- Bolgoda Lake Integrated Environmental Management and Development Project; meeting of users and stakeholders held in September Attended by S.A.M.Azmy
- Review of Prescribed projects gazetted under National Environmental Act (Sub group Ports, shipping, fishery and coastal resources) Held in October, Attended & contributed by N.Sureshkumar
- Beira Lake restoration project organised by Urban Development Authority held in July November, 2001 & attended by N.Sureshkumar
- Updated of Coastal Zone Management Plan working group No 3;-coastal pollution Attended by N.Sureshkumar

Other Activities

- IAEA/UNDP/RCA Project: Management of the Marine Coastal Environment and It's Pollution-RAS/8/083 National Coordinator- S.A.M.Azmy Activities –2001:
Facilitate to under go a training programme on Oceanographic Sampling of Marine Environmental Materials to Mr. J.K. Rajapakse-R.O/Oceanography Division which was held 9-12 April, 2001 in Bangi, Malaysia
Details for Updating of RCA National Home page for Sri Lanka and Comments on proposal for Phase II of this project 2003/2004 Biennium was sent to Chairman, Atomic Energy Authority (AEA) in August
- Sri Lanka National Water Partnership (SLNWP)-Lanka Jalani Focal Point:
S.A.M.Azmy Attended Ceremonial Launch of the programme

Library and Information Division

Programme 1 : Acquisition of Library Resources

Acquisition of books, Periodicals Scientific Journals, Reprints, Reports, Electronic Publications and other Library materials are prepared annually to strengthen and update the Library. The materials were duly organized for easy access.

Lending, reference, Selective Dissemination of Information (SDI), Current awareness services(CAS) were carried out. Literature search through internet and CD Rom supported the research staff.

Library extension services extended to University students, outside researchers, Officers of Ministry of Fisheries, school children and general public.

Programme 2 : Dissemination of Information

Project 2.1 : Electronic Publishing in Internet

Sida/ ICT Information Technology Project

Under the project, Local Area Network consisting 138 outlets was completed after testing for attenuation of the fiber backbone using OTDR was completed . URL for NARA web site (www.nara.ac.lk) was registered at LEARN, University of Moratuwa. NARA main server, Web server, e-mail server, cache server, DNS server and application server were setup. Internet connectivity to more than 60 computers was provided. NARA web site was partially completed. In the event of Network commissioning a lecture on Internet and its usage was conducted at NARA auditorium. Band width of the leased lines increased from 64 kbs to 128 kbs

Programme 3 : Automation of Library

Presently NARA Library is holding a circulation database for using the CDS/ISIS. Union Catalogue Module for Alice for Windows was provided to Library by **Sida/ ICT Information Technology Project**.

Actions were taken to install ALICE software into the computers of the Library in order to create an updated comprehensive library database. Librarians were familiarized in using the software by local agent of softlink but they were not trained sufficiently in using new software. However steps were taken to create Online Public Access Catalogue (OPAC) in the library.

Programme 4 : Setting up of an Audio-visual section in the Library

The idea of this project was to make electronic library materials such as video tapes, CDS, presentations, etc, available to library users. However this project was not progressed beyond tender calling stage for audio-visual equipment due to short of funds.

Programme 5 : Planning Information Unit

5.1 : Preparing a spatial database to identify user conflicts in the Negombo Lagoon and surrounded area.

Preparing a spatial database to identify user conflicts in the Negombo Lagoon and surrounded area Basic Layers for the spatial database were digitised. Layers for distribution of sea grass beds, Brush Park fishery, fish landing centres and locations for stake net fishery is prepared using GPS. Socio economics and demographic data were obtained. However, population statistics for the area for year 2000 needed to be collected and further image classification is being doing to add layers on land use of the area.

Programme 6 : Resource Sharing

Actively Participated ENLINET, SLISTINET, AGRINET Library networks for resource sharing. This project was started to set up a collection of scientific publications. Building up of a Sri Lanka collection of scientific and research papers on aquaculture and fisheries related subjects is in progress.

Programme 7 : A glossary on Fisheries and Aquaculture

This project was started to prepare a collection of Sinhala terms for English technical terms in fisheries and Aquaculture. Around 600 words were collected with the respective Sinhala term and the collection was arranged according to Alphabetical order. Work is in progress.

Programme 8 : Programme Development

Exhibitions and Workshops

Extension unit participated in 03 exhibitions at Bandarawela, Anuradhapura and Wanduramba.

Media Tours, Seminars & Publications

Manuscripts received for Nara Puwath, Ornamental Fish Booklet & Leaflets on Inland Aquaculture were forwarded to Director General for the approval of the Editorial Committee.

Development of Auditorium Facilities

An Overhead Projector and a Casette Lumens Record/Player were purchased

Video Production

The video documentary on Dynamite Fishing is at the dubbing stage. Video filming was done for a documentary on the beach seine Fishery. Extension unit provided video editing and copying facilities for the MFARD throughout the year as and when required.

Photographic Facilities

Photographic facilities were provided as and when required

Provision for Auditorium Facilities

Facilities were provided for external institutions as well as for internal functions and meeting as and when required. An income was earned.

Printing Facilities

Printing facilities were provided for Administration Division, Maintenance Division, SED and FTD

Training Courses

Three Training Courses on Ornamental Fish were conducted on following Themes

- Use of live feed and outcome other than Artemia – from 10-12 December
- Use of Artemia as a larval feed – from 18-19 December
- Use of artificial feed in Ornamental Fish culture – from 20-21 December

Information for Mass Media

Information & resource persons were provided for Journalists in Dinamina, Lakbhima and Vidusara as and when required. Information were provided for 03 new items telecasted by Swarnavahini and Rupavahini. Contributions were made for the production of a one hour line radio programme through Lakhanda radio service.

Workshops / Trainings and Seminars Attended

- Workshop on reservoir fisheries : Biology and Management conducted by NAQDA at Miridiya Hotel, Anuradhapura from 27th to 28th March 2001 – A. B.A.K. Gunaratne
- Inception Workshop on Aquatic Resources Development and Quality improvement project conducted by Ministry of Fisheries and Aquatic Resources Development at Trans Asia Hotel, Colombo on 4th September 2001 – A.B.A.K. Gunaratne.
- Planning workshop on the CZMP Update conducted by Coast Conservation Department at the Sri Lanka Foundation Institute, Colombo on 10th September 2001 – A.B.A.K. Gunaratne
- Training programme on INFORM database for Coordinators and Assistant coordinator conducted by Council for Agricultural Research Policy at Post Graduate Institute of Agriculture, Peradeniya on 24th November 2001 – A.B.A.K. Gunaratne

Other Activities

- Current awareness services carried out through newspaper articles.
- Development of physical infrastructure -A pantry was developed for Library staff
- The library was reorganized and the library stock was verified and completed. Re accessioning and classification was carried out and the backlog cleared. Books and periodicals were arranged, shelves labelled and book supports and pamphlet boxes provided. Old prints were removed to the stores.
- INFORM Database:Collection of information on research personal and projects were completed and completed database for year 2001 was submitted to Sri Lanka Council for Agricultural Research Policy (CARP)
- Online monthly progress reporting system, which was available via Intranet was setup by the Information Officer.
- GCRMN assisted National Coral reef database. Participated in designing phase of the database. Facilities were provided to conduct a training programme for 15 participants on data entering at the GIS Unit.

Publications

- NARA Journal - volume 36 (2000) of the NARA Journal is being printed at State Printing Corporations. Papers received for the next issue were appraised by the referees selected by the NARA Journal Board. Work is in progress.
- NARA Puwath - Articles received for the volume 3: issue 2 of NARA Puwath were typed. Layouting work is in progress.
- NARA Annual Reports - The Annual Report 98' was printed during the year. The Annual report of 1999 is completed and will be handed over for printing in due course. Year 2000 Annual Report sections were collected from divisions and formatting is in progress.
- Leaflets - Reprints of leaflets were made as and when required.



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கணக்காய்வாளர் தலைமை அபிவிருத்தி திணைக்களம்

AUDITOR-GENERAL'S DEPARTMENT

අංකය } VNI/J/NARA/01/2002
පිටුව }
No. }
உமது இல. }
Your No. }

දිනය } 13 August 2002
මගේ }
Date }

The Chairman
National Aquatic Resources Research and
Development Agency (NARA)

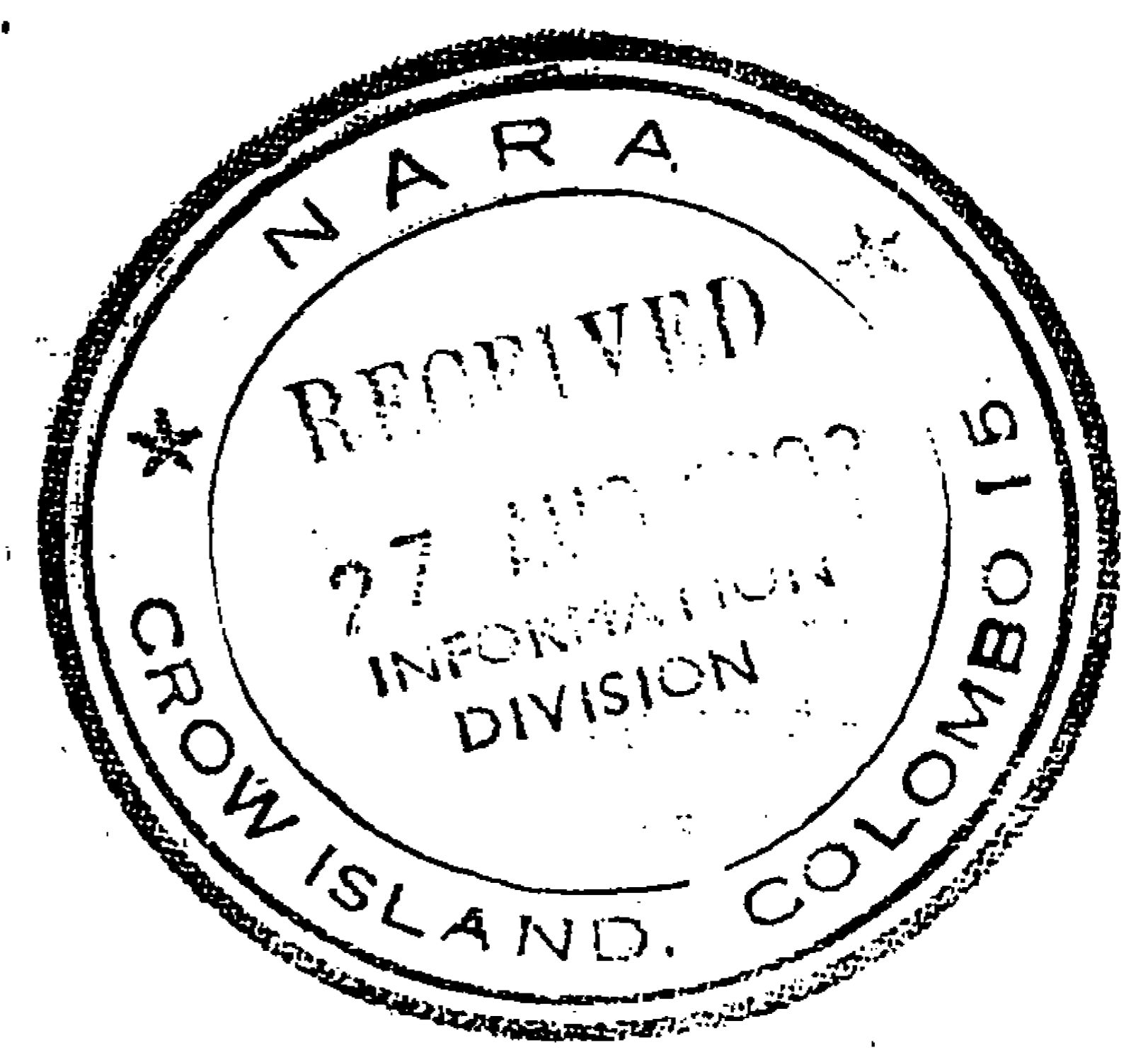
Report of the Auditor General on the accounts of
the National Aquatic Resources Research and
Development Agency (NARA) for the year ended
31 December 2001 in terms of Section 14(2)(c)
of the Finance Act No. 38 of 1971.

A draft of the above mentioned report is sent herewith.

- 02. Please let me know within fourteen days from the date of this letter, whether the said draft contains any matter which is factually incorrect, objectionable or prejudicial to public interest. Further, the AUDIT OPINION is determined on the reply submitted by you on the matters indicated in the said draft report.
- 03. Please note that if a reply is not received within 14 days as referred to above, the final report will be issued based on the draft report with a such audit opinion.

Q: C

(N.N.F. Perera)
Assistant Auditor General
for Auditor General.



Copy to : Secretary,
Ministry of Finance and Planning
Secretary,
Ministry of Aquatic Resources

*cc. to
D.G.
Ady Rana
Int. Audit*

drawn 25/8 at 10.00 a.m.

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තොලම් 07. ශ්‍රී ලංකාව

சுதந்திர சதுக்கம்,
கொழும்பு 07, இலங்கை

INDEPENDENCE SQUARE,
COLOMBO 07, SRI LANKA

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பக்ஸ் இல. } 697451
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The Chairman,
National Aquatic Resources Research and
Development Agency (NARA)

Report of the Auditor General on the accounts of the
National Aquatic Resources Research and Development Agency (NARA)
for the year ended 31 December 2001 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 2001 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 25 July 2002.

1:2 Scope of Audit

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



2. Accounts

2:1 Comments on Accounts

2:1:1 Accounting Deficiencies

An inappropriate disclosure amounting to Rs. 57,872, four instances of overstatements in accounts totalling Rs.39,566 were observed at audit tests. These deficiencies had resulted in overstatement of expenditure, liabilities and assets by Rs.39,566, Rs.2,500 and Rs. 57,872.

2:3 Accounts Receivable and Payable

The following observations are made.

- (a) Confirmation of balances had not been received in respect of project creditors balances amounting to Rs. 3,258,159.
- (b) Special advances totalling Rs. 195,386 given to staff between 1991 and 2000 continued to remain outstanding during the year under review.
- (c) A sum of Rs. 11,320 paid to the Ministry in 1993 in settlement of a distress loan due from the research officer transferred to the Agency had not been recovered up to the date of this report.
- (d) Consultancy profit balances amounting to Rs. 1,432,310 had not been confirmed by the parties concerned.
- (e) A sum of Rs. 12,460 belonging to the Agency has been lying at the Huldroop District Court since 1995. No action had been taken to obtain a refund of this sum even upto the date of this report.

- (f) Purchase advances paid to private institutions amounting to Rs. 145,000, Rs. 70,590 and Rs. 1,801 in 1996, 1997 and 1998 respectively had neither been recovered nor goods received by the Agency.

2:1:3 Lack of Evidence for Audit

Capital commitments, debtors balances, deposits, Advances, Creditors, Balances, Accruals, Project creditors balances, furniture and fittings, incidental allowances on foreign aggregating Rs. 25,564,594 could not be satisfactorily vouched or accepted in audit due to the absence of supporting documents and confirmations from the parties concerned.

2:1:4 Non-compliance with Laws, Rules, Regulations and Management Decisions

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

Reference to Laws, Rules
Regulations and
Management Decisions

Particulars

- (a) Finance Act No. 38 of 1971
Sections 12, 13(5)(b) and
14(1)

Requirements relating to the form and content of annual accounts Report on Accounts specified by the Auditor General and the draft annual report of the Agency had not been complied with.

- (b) Public Enterprises
circular No. 116 of
24 January 1997.

Certain employees attached to the Ministry had been paid a total sum of Rs. 923,405 during the year on account of salaries, overtime and travelling expenses contrary to provisions in the circular.

(e) Guidelines on Government
Tender Procedure Chapter 1
Section 1 & 2

Air conditioner valued at
Rs. 488,000 had been purchased
outside the specified tender
procedure in 1998

2:1:5 Transactions not Supported by Adequate Authority

Budgeted project expenditure had been exceeded without Board approval.

3. Financial and Operating Review

3:1 Financial Results

According to accounts, the operations of the Agency during the year ended 31 December 2001 had resulted in a deficit of Rs. 75,191,600 compared with the deficit of Rs. 66,493,029 for the previous year showing a deterioration of Rs. 8,698,571 in the financial result.

3:2 Application of Specific Funds

A summary of grants received and expenditure therefrom during the year is given below showing that part of the capital grant had been obliged for recurrent expenditure.

	Revenue Rs.	Expenditure Rs.
	-----	-----
(a) Grant - Revenue	62,500,000 *	97,415,408 *
(b) Grant - Capital	51,550,000 *	30,737,452 ⊗
(c) Other Capital Projects	888,100	888,100

The figures stated above indicate that the grant received in respect of capital expenditure has been utilised for recurrent expenditure.

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51550000 ✓
888100

121709996
124,15,131

3:3 Funding Arrangement for Provision for Gratuity

Rs. 16,133,942 had been provided for gratuity as at 31 December 2001. This sum had not been separately invested.

3:4 Uneconomic Transactions

The following observations are made.

- (a) Construction work : respect of which a mobilization advance had not been commenced up to the date of this report.
- (b) An air blower purchased in 1998 for Rs. 39,480. remained unused.
- (c) The Air-conditioner valued at Rs. 488,000 installed in June 1998 at the Oceanography Division had been returned and lying in the main stores due to non working condition since installation.

3:5 Cost of Personnel

A comparative statement of average cost of personnel for the year 2001 and 2000 analysed under each category is given below.

Category	No. of Employees		Average Cost per Employee	
	2001	2000	2001	2000
			Rs. '000	Rs. '000
Executives	71	69	198	167
Non Executives	<u>249</u>	<u>242</u>	107	72
	320	311		
	===	===		

3:5 Vehicle Utilisation

The agency owned a fleet of 39 vehicles as at the end of the year under review compared with 43 vehicles as at the end of the preceding year. Running and maintenance cost of this vehicle fleet during the year under review amounted to Rs. 9,818,045 compared with Rs.11,305,570 for the preceding year as shown below.

Item of expenditure	Year ended 31 December	
	<u>2001</u> Rs.	<u>2000</u> Rs.
Expenses on fuel	704,176	645,484
Repairs and maintenance	4,157,946	5,523,396
Drivers' salaries and overtime	<u>4,955,923</u>	<u>5,136,690</u>
	9,818,045	11,305,570
Hiring charges on private vehicles	<u>2,883,773</u>	<u>2,376,397</u>
Total expenditure	<u>12,701,818</u> =====	<u>13,681,967</u> =====

3:6 Budgetary Control


Significant variations were observed between the 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) Internal audit
- (g) Segregation of duties and delegation of authority
- (h) Accounting



(S.C. Mayadunne)
Auditor General.

-/dk.

Actions taken on the comments made by Auditors Report for the year 2001

2. Accounts.

2.2 Comments on Accounts

2.2.1 Accounting Deficiencies.

- (A) Payment of Rs.57,872/= is in respect of the purchase and Fixing of new windows to the Buildings at Regional Research Center at Rekawa. Therefore, it is recorded as a capital asset and hence not an inappropriate disclosure in the accounts.
- (B) Payment of Rs.39,566/= is an error. Action will be taken not to repeat this type of Accounting errors in the future.
- (C) Accrued Expenses: Rs. 2,500/= . This is an error. Action will be taken not to repeat this type of Accounting errors.

2.2.2 Accounts receivable and payable

(A) Projects Creditors balance of Rs.3,258,158.74 consists of the following

I SAREC Current Account	267,000.46
ii CORDIO Project	1,168,977.91
iii ACIAR GIs Project	621,636.56
iv ACIAR Cage Culture Project	371,002.24
V Fish Consevation Project	5,000.00
Vi GTZ FM Yala Project	71,112.20
Vii EDB Seaweed Cultivation	92,359.00
Viii NARESA	13,054.00
ix ADB Loan	133,151.00
X GCRMN Project	98,957.40
Xi IRMP- Algae in Negombo Lagoon	195,078.40
Xii NORAD	<u>220,830.57</u>
	<u>3,258,158.74</u>

Figures above reflect the balances after completing certain identified components under each project. Available amounts are meant for other components on going. It is therefore not possible to obtain a confirmation from funding agencies about the balances as at 31st of December without completing the project. We seek your advice in this regard.

- (B) It is correct that special advances amounting to Rs 195,386/- paid to the staff have not been recovered up to the end of year 2001. The details of outstanding advances are as appended below. All under LT cases, shall continue until the cases are over. Others shall be resolved in due course..

Special Advance 1991

a)	W D G Fernando	Rs	2,000.00)	Pending LT cases
b)	W D G Fernando	Rs	3,500.00)	-do-
c)	W D G Fernando	Rs	2,000.00)	-do-
d)	W D G Fernando	Rs	1,000.00)	-do-
e)	S . Subasinghe	Rs	4,000.00 -	has agreed to pay:in progress
f)	P M A Jayasooriya	Rs	1,000.00 -	matter with the Attorney General
		Rs	<u>13,500.00</u>	
			=====	

Special Advance 1993

a)	W D G Fernando	Rs	1,000.00)	Pending LT cases
b)	W D G Fernando	Rs	1,000.00)	-do-
		Rs	<u>2,000.00</u>	
			=====	

Special Advance 1996

a)	Upali Edirisingha	Rs	1,500.00	Pending LT cases
b)	R.M.Premarathne	Rs	1,000.00	Will be recovered
c)	Gamini Tilakarathne	Rs	1,500.00	Will be recovered
d)	M.V.Premasiri	Rs	500.00	Will be recovered
e)	Upali Edirisingha	Rs	2,000.00	Pending LT cases
d)	Y.Samararatna	Rs	<u>4,146.50</u>	Pending LT cases
			10,646.50	
			=====	

Special Advance 1998

a)	Y Samararatna	Rs	7,500.00)	Pending LT cases
b)	Y Samararatna	Rs	5,000.00)	-do-
c)	Y Samararatna	Rs	3,250.00)	-do-
d)	Y Samararatna	Rs	10,000.00)	-do-
e)	Y Samararatna	Rs	5,000.00)	-do-
f)	Y Samararatna	Rs	16,000.00)	-do-
g)	Y Samararatna	Rs	7,880.00)	-do-
h)	Y Samararatna	Rs	5,000.00)	-do-
i)	Y Samararatna	Rs	2,000.00)	-do-
j)	Y Samararatna	Rs	7,000.00)	-do-
k)	Y Samararatna	Rs	14,000.00)	-do-
l)	Y Samararatna	Rs	5,200.00)	-do-
m)	Y Samararatna	Rs	4,702.50)	-do-
n)	Y Samararatna	Rs	14,500.00)	-do-
o)	Y Samararatna	Rs	12,500.00)	-do-
p)	Y Samararatna	Rs	5,000.00)	-do-
q)	Y Samararatna	Rs	12,000.00)	-do-
		Rs	<u>136,532.50</u>	
			=====	

Special Advance 1999

a)	Y Samararatna	Rs	2,700.00	pending LT case
b)	Y Samaaratna	Rs	5,000.00	-do-
c)	S W Pathirana	Rs	25,000.00*	
			<u>32,700.00</u>	
			=====	

Total		Rs	184,732.50	
			=====	

* Official of the DFOR Secretary to the Ministry has been requested to intervene to recover. Another reminder has already been sent.

Special Advance 2000

i)	D.S.P. Mohotti	Rs	1,000.00	Vacation of Post.
ii)	J.M. Kalawilla	Rs	<u>1,765.50</u>	Action will be taken to recover.
			2,765.50	
			=====	

- (C) Action has been initiated already to recover this advance from the employee concerned
- (D) The amount Rs.1,432,310/- is the balance from advance paid to NARA by the client for the consultancy service. It is therefore not possible to obtain a confirmation from client about the balances as at 31st of December without completing the project
- (E) It has been verified that this money is neither available in the District court nor with the police. Further we came to know that the case record has been lost. Therefore, steps will be taken to write off this amount after obtaining Board approval.
- (F) This matter involving Rs 143,000/- has been reported to the Fraud Bureau and it is now under their purview. As for the Rs.70,590/-, Letter of demand for has been sent through our lawyer. Response awaited. Regarding Rs 1,801/=, steps have been taken to recover Rs. 1,400/= and Rs. 340/= from the employee concerned, and balance of Rs.61.96 will be set off against the payments due for Building Materials Corporation.

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

- (a) Request has already been made to the Treasury through Secretary of the Ministry and the approval is awaited for submission for audit.
- (b) There is no release of staff of Ministry. On request they only serve the Ministry but remain as NARA employees. Therefore, no error has been committed. However, reimbursement has been called for from the Ministry.
- (c) This matter is now under investigation.

2.2.4 Transaction not supported by adequate Authority

Based on that the monthly Capital as well as Recurrent expenditure statement has been submitted to the Board. Depending on changes of research needs individual activities have to be adjusted. The Governing Board has noted and taken cognizance of exceeding expenditure in individual activities. However, total assigned to this project has not been exceeded.

3. Financial and Operating Review

3.1 Financial Result

3.2 Application of Specific Funds

We agreed with the statement, but the amounts given in the statement are not correct. However, the steps have already been taken not to utilize Capital Grant for Recurrent Expenditure

3.3 Uneconomic Transactions

- (a) The construction work has been delayed due to technical fault in the BOQ. The negotiation are being made to commence work as and when the matter is resolved.
- (b) Action has been taken to issue this item to Rekawa Regional Research Center
- (c) The explanation has been called from the relevant officers for not following the Government Tender Procedure and suitable action will be taken on the consideration of their answer.

3.4 Cost of personnel No comments

3.5 Vehicle utilization -do-

3.6 Budgetary control

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

4 System & Control

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

M.A.R. Kularatne
Director General/NARA

Sgd. Razik Zarook
Chairman/NARA

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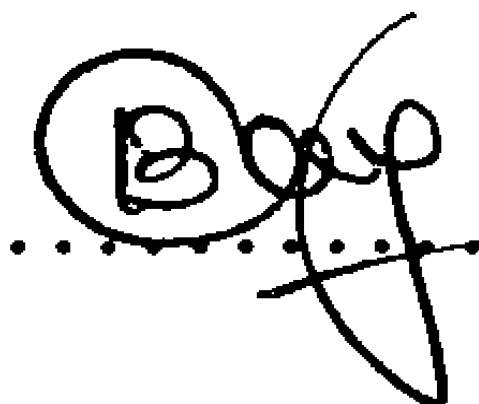
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