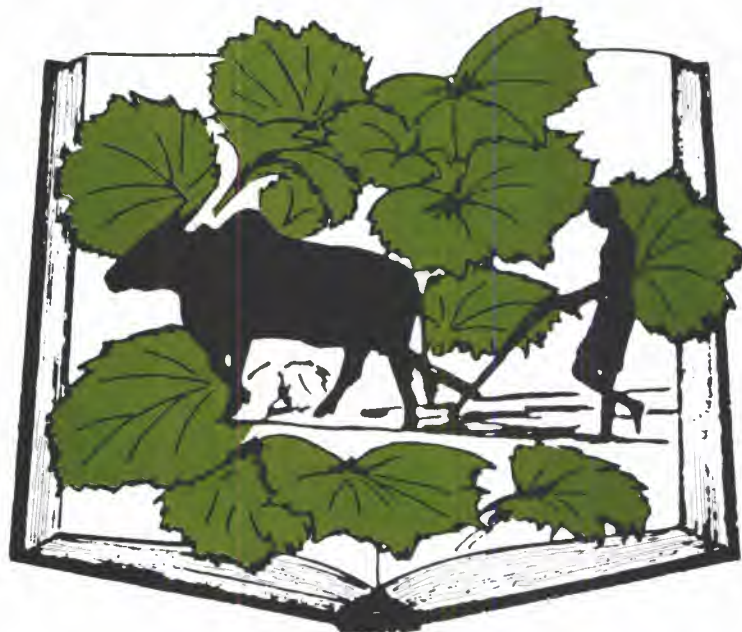


THE NEED FOR AND STEPS TOWARDS A MASTER PLAN FOR SUSTAINABLE UTILISATION OF THE BATTICALOA LAGOON

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**Report to NORAD
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Table of Contents

| | |
|--|----|
| 0.0 Summary..... | 1 |
| 1.0 Introduction..... | 1 |
| 2.0 Terms of Reference | 2 |
| 3.0 Present utilisation of the lagoon and the main user groups | 3 |
| 4.0 Constraints to Sustainable Utilisation A Conceptual Framework..... | 4 |
| 5.0 The Status of Management of the Batticaloa Lagoon..... | 9 |
| 6.0 Institutional Capacities..... | 13 |
| 7.0 The Need for and Objectives of a Master Plan..... | 13 |
| 8.0 Institutional Reforms and Enforcement..... | 14 |
| 9.0 Filling the Information Gaps Basic Studies..... | 15 |
| 10.0 BLMPU Institution and Competence Building - Some Suggestions | 17 |
| 11.0 Strengthening the Fisheries Department..... | 18 |
| 12.0 A More Active Role for DELEC..... | 18 |
| 13.0 Sources of Scientific Expertise for the Proposed Studies..... | 18 |
| 14.0 A Follow up Workshop..... | 20 |

List of Tables

1. Fishing Families and Lagoon fishermen in Batticaloa District (1992)
2. Fish Production in Batticaloa District (1980-1992)

List of Maps

1. Map of Batticaloa Lagoon

Appendices

1. Proposal for Research and Development of the Lagoon Based Fisheries Industry in Batticaloa. By Dr. M. Darmaratnam
2. Project Proposal: Study of Ecto and Endo Parasites of Economically Important Fish in the Batticaloa Lagoon. By. Dr. P. Vinobaba
3. The Case for Establishing a Laboratory at the District Fisheries Extension Office, Batticaloa. By S. T. George

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The Need For and Steps Towards a Master Plan For Sustainable Utilisation of The Batticaloa Lagoon

0. 0 Summary

This paper reviews the status of the Batticaloa lagoon with reference to its management problems and the need for and steps towards a master plan. It examines the institutional environment and highlights its inadequacies from a perspective of sustainable utilisation of the lagoon as a renewable resource system. The paper argues for a master plan and identifies its objectives and outlines an institutional approach. The major information gaps are also identified and several basic studies proposed towards bridging the gaps. A Batticaloa Lagoon Master Plan Unit with a comprehensive mandate to carry out the tasks of planning, co-ordinating implementation, and monitoring is proposed .

1.0 Introduction

Lagoons are an important part of the cultural landscape of eastern Sri Lanka. The Batticaloa lagoon, the largest of the three lagoons (the other two are Vakaraï and Valaichenai) in the district is, perhaps, the most celebrated because of its scenic beauty and the 'singing fish'. Occupying an area of 168 square kilometres and extending from Kalmunai in the south to Eravur in the north, and opening into the sea at Batticaloa and Kallar, the lagoon is 56 km long and nearly 13 fathoms deep in some parts. It is a complex ecosystem with a rich variety of aquatic life and mangroves. About 5, 500 fishermen from eight of the 11 Fisheries Inspectors' Divisions of Batticaloa, fish in the lagoon into which several seasonal rivers drain their waters. However, the lagoons natural seasonal changes in water flow and salinity are notably altered by the inflow of drainage waters from the Gal Oya and from several local irrigation schemes. These inflows are also a source of pollution of the lagoon as they transport agricultural chemicals leached from the paddy lands. There are other sources of pollution too; for instance dumping of untreated municipal and domestic waste and, since a few years ago, the disposal of human waste by the Sri Lankan military camps around the lagoon. The rich mangroves around the lagoon are being damaged due to cutting of firewood by local people for domestic use as well as sale as there is a growing scarcity of fuelwood in the district. In recent times, the Sri Lankan military has been clearing mangroves in some parts of the lagoon for security reasons. Apparently, the lagoon suffers from a lack of overall resource and ecosystem management. The present paper, commissioned by the NORAD funded Batticaloa Integrated Rehabilitation and Reconstruction Project (BIRRP), addresses the need for and the steps towards a Master Plan for the lagoon.

2.0 Terms of Reference

The mandate of the present study is to produce a concept paper addressing the following issues:

- The present utilisation of the lagoon and the user groups
- Problems of sustainability: present situation and future problems and constraints to sustainable utilisation
- Need for and objectives of a Master Plan
- Information gaps and the technical studies required for a Master Plan
- Technical expertise available
- Organisational follow-up

Box 1

Basic Data on the Batticaloa Lagoon (1989)

A very large and relatively deep estuarine lagoon which opens into the sea through two narrow channels during the wet season and is then tidal. Sand bars are built up by wave action during the dry season, blocking these connections with the sea. The lagoon receives fresh water from numerous small rivers and streams during the wet season. Rice cultivation is practised on several large islands. The lagoon is almost entirely surrounded by a fringe of mangroves, and there are extensive seagrass beds. The maximum depth is about 4m. The water is brackish with salinity increasing to 30 ppt at certain times of the year.

Principal vegetation: Mangrove swamps and seagrass beds. Some patches of mangrove remain in good condition. Surrounding areas are mostly under rice, coconuts and other crops.

Land use: Prawn fishing, aquaculture and the discharge of urban waste, agriculture (mainly rice) and housing in surrounding areas. A small shrimp farm (0.7 ha) on the edge of the lagoon came into operation in 1977. A further 7.2 ha of ponds have been constructed since then and the owner has leased an additional 40 ha of the lagoon.

Source: Derek A. Scot (Ed), A Directory of Asian Wetlands
IUCN, The World Conservation Union, Cambridge, 1989.
605-606

3.0 Present utilisation of the lagoon and the main user groups

Paucity of information does not permit even a complete general description of the lagoon as an ecosystem and its patterns and trends of resource use (see Box 1 above for some basic information). Existing documentation is very elementary and partly obsolete. Discussions with scientists at the Eastern University and officials of the Departments of Fisheries and Planning revealed that several baseline studies have to be undertaken to obtain a comprehensive profile of the lagoon in terms of its abiotic and biotic properties. Socio-economic and anthropological studies of the main users of the lagoon are virtually non-existent. The lagoon is seen by the district administration mainly as a source of fish and other species of economic value (shrimps, crabs and bivalves, for example) and as a source of livelihood for thousands of fishermen and their families. Of course, it is recognised by senior government officials that the lagoon has high potentials for prawn and oyster farming, tourism and transport.

Fishing is the major economic activity on the lagoon. The numbers of fishing families, lagoon fishermen and seagoing fishermen as estimated by the District Fisheries Extension Office are shown in Table 1. It should be noted that the table also includes lagoon fishermen who normally use the Vaharai and Valaichenai lagoon. It would thus be reasonable to exclude the fishermen in the first three Fisheries Inspector's Divisions and assume that about 5,500 fishermen are dependent on the Batticaloa lagoon. Lagoon and seagoing fishermen of the district are organised into 115 Fishermen's Co-operative Societies. Normally, a wide range of fishing activities can be observed in different parts of the lagoon from the coast and mangroves to its deeper areas.

Table 1 Fishing Families and Lagoon Fishermen in Batticaloa District (1992)

| Fisheries Inspector Division | Fishing Families | Lagoon Fishermen | Seagoing Fishermen |
|------------------------------|------------------|------------------|--------------------|
| Vaharai | 1778 | 710 | 1182 |
| Valaichenai East | 2256 | 805 | 1500 |
| Valaichenai West | 1171 | 322 | 863 |
| Chenkalady | 1671 | 910 | 1270 |
| Batticaloa North | 2017 | 1015 | 1112 |
| Batticaloa South | 1088 | 463 | 705 |
| Batticaloa West | 678 | 754 | 00 |
| Kattankudy | 608 | 304 | 354 |
| Kaluwanchikudy | 1616 | 585 | 1225 |
| Vellavelly | 885 | 925 | 00 |
| Paddipalai | 850 | 895 | 00 |
| Total | 14618 | 7288 | 8211 |

Source: District Fisheries Extension Office, Batticaloa

Fishing goes on in the lagoon throughout the year and is more intensive in the 3 1/2 - 4 months between October and end of January when sea fishing is suspended due to the monsoon. According to fishermen, the best part of the year for lagoon fishing is March-November. However, in all probability, overall fishing intensity is below average at present as there is a complete ban on night fishing and day fishing is permitted only during a limited number of hours due to security reasons. There are 1389 lagoon fishing canoes today as opposed to 1900 in 1990. A large number of canoes were destroyed by the Sri Lankan military in 1990. Since 1992, NORAD, ADB and some NGOs have been providing new canoes to replace the lost ones. So far 890 such canoes have been received by fishermen at subsidised prices.

As revealed by Table 2, both sea and lagoon fishing outputs have been declining over the years although the former shows a more consistent declining trend than the latter. The table also shows that the total catch of fish (this excludes prawns and crabs) from the lagoon is only a fraction of that from the sea. Yet lagoon fishing is an important source of income or direct subsistence for the poorer fishing families. It is also likely that the total catch of fish is normally underestimated as accurate quantitative data on subsistence fishing are not easy to collect. This difficulty is compounded by the professional inadequacies of the Fisheries Department.

Table 2: Fish Production in Batticaloa District

| Year | Sea Fish MT | Lagoon Fish MT |
|------|----------------|-------------------|
| 1980 | 6675 | 402 |
| 1981 | 8837 | 375 |
| 1982 | 9283 | 342 |
| 1983 | 4098 | 271 |
| 1984 | 3582 | 360 |
| 1985 | 3256 | 375 |
| 1986 | 3256 | 142 |
| 1987 | 3382 | 141 |
| 1988 | 3432 | 207 |
| 1989 | 3218 | 223 |
| 1990 | 2938 | 21 |
| 1991 | 1472 | 310 |
| 1992 | 2380 | 368 |

Source: District Fisheries Extension Office

4.0 Constraints to Sustainable Utilisation: A Conceptual Framework

Sustainable utilisation of the lagoon as a resource system and as an integral part of the environment implies that it is managed in such ways as to meet the needs of the present dependants without undermining its natural capacity to meet the needs of future generations. Of course, it is not possible to ascertain at present how generations that are unborn will value the lagoon. However, it is not so difficult to imagine that future generations will be happier to inherit a lagoon that is rich in biodiversity, free of

pollution, and a source of aesthetic pleasure than one that is largely devoid of living resources and polluted to levels that make it a hazard to human and non-human life. Once this is recognised, the moral responsibility of the present users of the lagoon to adhere at least to some safe minimum standards to preserve its ecological integrity, and of the state to provide the appropriate institutional mechanisms to ensure sustainability, is not hard to imagine. Moreover, resource depletion and degradation can also lead to adverse effects within a single generation. For instance, it does not take many years for the communities depending on the lagoon to be affected by the consequences of destruction of mangroves, over-fishing, chemical pollution, or faecal contamination of the lagoon water. Thus there are valid short-term and long-term considerations that justify an adherence to enlightened principles of sustainable resource utilisation.¹

The lagoon's value to society derives from the following:

- i) consumptive uses of its renewable resources, which involve harvesting of these resources;
- ii) various forms of non-consumptive recreation;
- iii) the biodiversity of the lagoon;
- iv) the functions of the lagoon in local hydrology, and in the hydrologic and other ecological cycles;

These uses and properties show the complex nature of the lagoon as a *multiattribute environmental asset*. Not all of them can easily be valued in monetary terms and resource and environmental valuation is an area of many controversies. However, some conceptual understanding of the valuation problem is a prerequisite to frame a management system for an asset like the Batticaloa lagoon. For instance, the four items stated above involve different types of values and time frames.

The first one refers to the direct use value of the lagoon as a source of harvestable resources which may be partly marketed and partly consumed by the resource users; e.g. fish, prawns, crabs and bivalves. Of concern here are the rates of harvest of the different species. Should they be determined entirely by current prices and needs or should there be some effective regulation to ensure the renewability of the resources concerned? Sustainability requires that renewability is ensured. Renewability is automatically ensured as long as the rate of harvest remains below the rate of increase of the biological population concerned. As already observed, prospects of overfishing in the lagoon are remote in today's circumstances. However, it is conceivable that in a different situation high prices and profitability may encourage over-fishing which may lead to stock depletion and final extinction of species. It is also conceivable that commercialised

¹Deep ecologists may insist that this way of valuing the lagoon is anthropocentric and that the lagoon as a living ecosystem has its intrinsic value. It is beyond the scope of this study to deal with this controversy. This paper is admittedly anthropocentric in addressing the question of sustainability.

prawn culture around the lagoon can impose environmental damage and social costs if adequate precautions, which involve extra private costs to the investors, are not taken. Whether or not these are permissible is a fundamental policy as well as an ethical question. From a narrow economic perspective, it appears rational to maximise net present benefits, even if it involved the depletion of the resource stock to zero, if the profits can be capitalised in some form so that society's aggregate capital either remains constant or grows. Indeed, this approach had held sway for a long time as a powerful rationalisation of natural resource depletion, but not any more. Today, there is a greater awareness about the possible irreversible environmental damages caused by an ecologically unenlightened pursuit of present net benefit maximisation and about our imperfect state of knowledge about ecosystems.

The benefits to society from the other three factors can be adversely affected if the first type of use is unregulated and if pollution is not controlled. Recreation is an indirect use value and it is one of the factors that strongly support conservation. It has potential for commercialisation and, hence, income generation. This can be undermined by pollution and neglect of overall management of the lagoon. Preservation of biodiversity in itself does not generate any direct use value to the present generation but is undertaken out of concern for future generations and non-human life. Economists categorise this as existence value, which is a form of non-use value. The lagoon's hydrologic roles are complex too. They include, among others, serving as a reservoir for drainage water from the various catchments connected to the lagoon and the impact it makes on the ground water resources. Siltation and chemical pollution are two major negative factors associated with the drainage function of the lagoon. Variation in salinity is another factor with implications for the living resources of the lagoon. On the other hand, the seasonal inflow of fresh water into the lagoon may make it a source of supplementary irrigation for paddy in some areas. The hydrologic properties of the lagoon can also be affected by the construction of bridges across it and by the destruction of mangroves. These in turn can affect migration and spawning of fishes, crustaceans and other species.

Whether or not we are able to quantify all these positive and negative values in monetary terms, the fact remains that an ecosystem like the lagoon has attributes that are valuable to society at present and in the future. *Seen in this perspective, sustainable use of the lagoon entails setting and enforcing limits on extraction of living resources with respect to their renewability, preservation of biodiversity, and ensuring optimal hydrological conditions. The last includes prevention of pollution and the setting and enforcing safety standards for the lagoon as a medium for its living resources and as a part of the human habitat.*

The lagoon is a renewable common pool resource system². Although it is like a public good in the sense that it is not divisible as an ecosystem, it is not a pure public good as the resources it contains are divisible and can be appropriated by private agents. This property of subtractability distinguishes a common pool resource system from a pure public good as it implies that there is rivalness in consumption. (Pure public goods are characterised by non-rivalness in consumption.) What it means is that, at a given point in time, when a private user appropriates a certain quantity of a resource (say a particular kind of fish), the stock of that particular resource is reduced by the amount appropriated. To be more precise, the actual stock reduction is equal to the quantity harvested minus the quantity added by reproduction. The latter, however, depends on the rate of reproduction and the size of the initial stock. The Batticaloa lagoon is the habitat for the biological species it contains. These diverse biological populations interact among and between themselves through the food chain. Each of them has its specific population dynamics determined by genetic and environmental (logistical) factors. One of the minimum necessary conditions for sustainable utilisation of the lagoon as a resource system is a basic understanding of the population dynamics (including migratory patterns) of these living resources.

Of course, more conditions have to be satisfied to develop a resource management system to ensure sustainability. Information should be available on the demand for the living resources of the lagoon, the sources of demand, the means and methods used for their extraction, and the number of fishermen and how they are organised. *Of fundamental importance are the institutional arrangements concerning ownership of the lagoon, fishing and other use rights, resource management systems, ecological monitoring, enforcement of safety standards and public relations.* After all, the central challenge in natural resource management is that of building appropriate institutions based on sound ecological principles and to suit the particular socio-economic and cultural setting. As Hodgson, an institutional economist, puts it, an institution is a set of rules which, operating in the form of legal constraints and customs and traditions, tends to create *durable and routinised patterns of behaviour*. Stability and legitimacy are two key factors determining the actual working of an institution. The former is an organisational attribute while the latter refers to the degree of recognition and respect enjoyed by the institution among the members of the larger society. Institutional stability is a result of 'durable and routinised patterns of behaviour'. In regard to the lagoon, this means that the individual resource user has a strong sense of belonging to a group of resource users and has a high inducement to abide by a commonly accepted set of rules and norms and to avoid free riding. The latter is also constrained by sanctions that are legitimate. This reduces uncertainty among resource users and makes it easier to predict their behaviour

² A distinction should be made between a Common Property Resource and a Common Pool Resource. The former refers to a resource held under a well defined common property regime. In other words, it belongs exclusively to a group of individuals whose rights to the resource are well defined. The latter may or may not be governed by such a property regime.

concerning resource appropriation. However, this presupposes that the resource users are well defined as a group with exclusive rights to the lagoon. When the property rights governing the lagoon are recognised and respected by the members of the larger society, their enforcement is made simple and achieved at a low cost.

The institutional arrangements for managing a resource system like the Batticaloa lagoon may be identified and analysed with reference to: a) the property rights to the lagoon its different resources, b) state agencies concerned with resource management, and c) participatory mechanisms involving the resource users and state agencies in resource management. These aspects are first elaborated before they are examined in relation to the lagoon.

i) The Legal Framework for and Legitimacy of Property Rights:

The laws and by-laws that define the property rights and their enforcement mechanisms; Definition of users and their rights and obligations (customary and new); Legal restrictions on appropriation of resources with regard to species and their diversity; Ordinances governing fishing with regard to the type of nets and other equipment, and to the temporal and spatial aspects of harvesting operations, and penalties for violations; Regulations regarding the type of vessels that are permitted on the lagoon; Legalised environmental standards and their enforcement mechanisms; Public recognition of and respect for the property rights and environmental standards.

ii) State Agencies:

State agencies that are responsible for the protection of the lagoon and are participants in its management with respect to the following functions:

- Environmental Planning, Policing and Monitoring

Body or bodies responsible for management planning and for policing of the lagoon to protect it from pollution and other harmful illegal practices, and for monitoring the status of resources and the ecological health of the lagoon.

- Training and Advisory Services

Agency responsible for transferring relevant and up-to-date knowledge and skills to resource users and advising them and others who seek assistance on matters related to the use of the lagoon.

- Links With Research Institutions

Institutional mechanisms to enable a regular flow of information on research needs from the management system to research institutions and of research findings from the latter to the former.

- Public Relations

Agency responsible for informing and educating the public on the value of the lagoon and its recreational and commercial prospects.

iv) Participatory Mechanisms

These include resource users' institutions and their formal and informal linkages with concerned state agencies to participate in management of the lagoon and to defend the rights of resource users. These mechanisms generate routine guidelines, based on accepted rules, norms and sanctions, for individual resource users to make decisions regarding appropriation of particular resources. They serve to build and sustain co-operation and facilitate enforcement of environmental standards.

5.0 The Status of Management of the Batticaloa Lagoon

Seen in the above perspective, several constraints to sustainable utilisation of the Batticaloa lagoon become more evident. The most obvious is the absence of a functioning management system for the lagoon as a whole. The lack of information is also an evident constraint. The present situation is discussed with reference to the above conceptual framework:

Property Rights, Fishing regulations and Enforcement

The ownership of the lagoon rests with the state while its use is open to the public. In practice, this makes the lagoon a common pool resource system. Even though such a dichotomy is not uncommon with resources like lagoons and forests, there are legal flaws and other institutional shortcomings that add to the constraints to sustainable utilisation of the resources of the lagoon. The major resource components of the lagoon include its water, fishes, crustaceans and other harvestable species, the mangrove forests and other flora, and the birds and other species that use it as sanctuary. There is a need to thoroughly evaluate all the enactments that apply to these different resources with reference to their ownership, protection and utilisation. Such an exercise is beyond the scope of the present assignment. Based on a limited review, some critical observations are made.

At the district level, the Government Agent is the most senior authority representing the state on matters concerning the lagoon. The Ministry of Fisheries is the final authority on matters concerning the use of the aquatic resources. At present in Batticaloa, the most senior official of the Fisheries Department is the District Fisheries Extension Officer who is also responsible for the enforcement of the Fisheries Ordinance governing fishing in the lagoon. The Forest Department is responsible for protecting the mangrove forests along the lagoon. However, there is no specific legislation declaring the Batticaloa lagoon's mangroves as a protected reserve and assigning enforcement responsibility to any state agency. The Forest Department's jurisdiction over state-owned mangroves in general

can be justified by invoking the Forest Ordinance³. This does not seem to be legally sufficient and existing legislation⁴ may have to be amended to provide a more authoritative and foolproof legal instrument to protect mangroves.

The Fishing communities around the lagoon enjoy customary rights to fish in it. There are no specific subdivisions of the lagoon into common fishing grounds for specific groups. The entire lagoon is open to all fishermen from the villages around, and even beyond. Strictly speaking, there is no functioning mechanism to distinguish those fishermen who hold customary rights from those who do not. This formal absence of restriction of entry makes the lagoon an open access common pool resource, although it does not cause any major problem at present as there is no threat of too many fishermen entering the lagoon. Though the customary rights of the fishermen who have traditionally used the lagoon are recognised in practice, they have not been codified as a part of the formal legislation governing the lagoon. The customary rights of the fishermen could be eroded in the future if entry remains unrestricted and if commercialisation of prawn farming and lagoon fishing takes place without due consideration to the well-being of the traditional fishing communities. From a long-term perspective, the question of legalising the customary entitlements of lagoon fishermen cannot be ignored. The existing institutionalisation of fishermen's status vis-a-vis the lagoon through their membership in Fishermen's Co-operative Societies is inadequate from an entitlement or a resource management point of view (see below).

The open access character of the lagoon is most evident when it comes to legal inadequacies and enforcement failures in regard to use of fishing nets and other equipment, pollution and depletion of mangroves. These problems are already serious enough to call for action.

The Batticaloa Lagoon Fishing Regulations, 1972 and Enforcement Failure

The most important piece of legislation concerning fishing regulations for the lagoon is the Fisheries Ordinance of 1972 (Chapter 212: The Batticaloa Lagoon Fishing Regulations). For purposes of regulating fishing, the Ordinance divides the lagoon into three areas. Area 1 includes the channel area from the mouth of the lagoon to Kallady, the area around the eastern shore of Puliyantivu and Buffalo island, and Urani Kudah. Area 2 consists of Siruvamunai Kadal and Manmunai and Kallar areas. Area 3 comprises that part of the lagoon lying east of Ondachimadam and Kallar Causeways. The Ordinance provides more detailed demarcations of these three areas.

The following regulations apply to the three areas:

³ IUCN (1993) Management of mangrove Ecosystems in Sri Lanka

⁴ Besides the Forest Ordinance, there are other enactments that may have bearing on mangroves. These include the Coast Conservation Act, the Fauna and Flora Protection Ordinance, and the National Aquatic Resources Research and Development Agency Act (Ibid)

1. The use of cast nets or *veechuvalai* and fishing lines is permitted in all parts of the lagoon.
2. No person shall for the purpose of taking fish use any net other than a cast net in Area 1 or Area 2.
3. No person shall use any drift net or *adasivalai* with a mesh less than 3 inches in Area 2.
4. No person shall use a *karaivalai* or drag net in any part of the lagoon at any time of the year.
5. No person shall use any incandescent lamp or other artificial light other than a hurricane lantern or *chulu* light for the purpose of taking fish in the lagoon.
6. No person shall erect kottus or enclosures for fishing in any part of the lagoon. The Government Agent or any officer authorised by him at his discretion can permit the erection of *kottus* or enclosures for prawn fishing specifying the size of such *kottus* or enclosures and the area where they may be erected.
7. No person shall use any net other than a cast net at the mouth of the lagoon or within a radius of 200 yards from the mouth.
8. No person shall use a mechanised fishing boat in the lagoon for the purpose of taking fish: provided, however, that the Government Agent may at his discretion allow the use of any mechanised fishing boat on such terms and conditions and on such areas as may be specified by him.

Most of these regulations are relevant and reasonably specific as means to promote sustainability and equitability. However, the main problem is the inability of the authorities to enforce the most important regulations. A concrete case of enforcement failure that constantly figured in our interviews with lagoon fishermen is the use of drift nets with less than three inch mesh in areas where they are not permitted by the Ordinance. Interviewees told us that this type of fishing deprived the subsistence beach fishermen and fisherwomen of their livelihood. They also said that influential persons were involved in this illegal appropriation of fish resources from the lagoon and that the officials responsible for enforcement of the regulations were either afraid to perform their duty or are in collusion with the offenders. It must be added that no instances of use of mechanised fishing boats were mentioned by anyone.

The discretion enjoyed by the Government Agent or any officer authorised by him/her regarding the use of enclosures for prawn fishing or of mechanised fishing boats may also need to be constrained by environmental and social considerations. *A major flaw of the Ordinance is that it does not provide for participation of fishermen's organisations in enforcement.*

Destruction of Mangroves: A Case of Continuing Enforcement Failure

Mangroves are an essential component of the lagoon's ecology. They serve as breeding grounds for crustaceans and as a sanctuary for migratory birds though very little is known about the latter. The lagoon is supposed to be having one of the largest reserves of mangroves in the country. But they are

being destroyed at an alarming rate. According to the District Forest Officer, about 75% of the mangroves has been destroyed in the past 25 years. The historical causes of this deforestation which still operate are twofold: firewood and timber extraction and conversion of mangrove lands into paddy plots. A third cause has been introduced in recent years with the Sri Lankan army engaging in clearing mangrove forests for security reasons. The Tamil Tigers use the mangroves as a sanctuary, the army says. The Forest Department, which had failed to protect the mangroves in the past, is totally helpless to stop the army from destroying these forests at present. The Consultant was told by high ranking government officials that the matter was raised on more than one occasion with the Brigadier in charge of Batticaloa and that although he agreed to stop further clearing of the mangroves, it continues. This problem may become worse as the armed conflict continues and escalates in the future unless a concerted effort is made to avoid any further clearing. The danger to the mangroves seems to have increased as most of the remaining mangroves are found on the western coast of the lagoon in areas where armed clashes are likely to take place in the future, given the fact that LTTE is now in control of the western sector of the district.

Destruction of mangroves due to firewood extraction is a serious problem which may worsen unless alternative sources of firewood are not created in the form of fuelwood plantations and community woodlots. On the demand side, promoting adoption of more efficient stoves by households to save energy is an urgent consideration.

Pollution: Another Case of Continuing Legal Inadequacy and Enforcement Failure

It is highly probable that pollution by agrochemicals washed by drainage water into the lagoon poses a serious threat to its biotic resources. Unfortunately, there has not been any monitoring of this. No studies have been carried out on the impact of this form of pollution. There are other sources of pollution too, such as discharging of hospital waste, dumping of household and military camp wastes into the lagoon. Until recently, the municipality was also discharging its wastes into the lagoon. At present, there is no environmental policing of the lagoon. The national environmental legislation, which can be used to protect the lagoon from pollution, is not effective as no local agency is charged with any enforcement responsibility. There is no anti-pollution ordinance that applies specifically to the lagoon.

Fishermen have been reporting to the DFEO about a new disease affecting fishes in the past three years. The Department does not have any laboratory facilities or scientific personnel even to carry out elementary tests and analyses. In the absence of any scientific data and analysis, both fishermen and officials engage themselves in speculation on the causes of the disease.

Fishermen's organisations and Lagoon management

Fishermen's co-operatives do not play any role in lagoon management. However, contrary to the views expressed by some officials, the Consultant found the fishermen interviewed by him to be aware of the management problems of the lagoon. They were concerned about enforcement failures as already discussed. They were aware that agrochemical pollution and waste disposal could cause serious damage to fishes and crustaceans. They complained about the destruction of the mangroves. But they have no formal role in the environmental monitoring or policing of the lagoon, a role they can and should be called upon to play in the future.

War and Fishermen

The ongoing war has imposed sufferings on the fishing communities. Apart from loss of canoes in the past, the ban on night fishing has deprived fishermen of a major part of their income. According to the fishermen interviewed, the decline in income is around 75%. Some fishermen also complained that at times army personnel take away fish from them without paying for it or paying too little. Muslim fishermen in Kattankudy complained that eight of their canoes had been taken away by LTTE guerrillas.

6.0 Institutional Capacities

It should be evident by now that the Batticaloa district's institutional capacities are inadequate to manage the lagoon in a sustainable manner. The Fisheries Department will not be able to perform its role in lagoon management without a substantial improvement in its professional competence and without a laboratory. Recently, a body called the District Environmental Law Enforcement Committee (DELEC) has been set up with the Government Agent as the head. It consists of all the Divisional Secretaries, an officer representing the Central Environmental Authority, other key officials and representatives from the Eastern University and NGOs. The formation of DELEC is a welcome step. It certainly can play a role in bringing up environmental problems and exploring what should be done to solve them. However, DELEC may need further strengthening in terms of a formalised system of information flow from different sources in the district and professional and material resources to take meaningful steps to deal with environmental issues. Overall, professional competence within the district administration to deal with resource management and environmental problems is highly inadequate.

7.0 The Need for and Objectives of a Master Plan

The foregoing analysis of the status of the Batticaloa lagoon shows that there are so many institutional inadequacies. Apart from the absence of any management, there are also information gaps on basic aspects of the lagoon as an ecosystem and on the social relations and administrative systems governing its utilisation. The need for framing and operating a comprehensive management system for the sustainable utilisation of the

lagoon is only too obvious. Such a management system is best conceived as an integral part of a master plan to rehabilitate the lagoon and to utilise it as a living system for the social and economic development of the district. However, existing basic information gaps have to be filled before embarking on the project of developing a workable master plan. These information gaps can be more concretely identified if the objectives of the master plan are clearly formulated.

7.1 Objectives of the Master Plan

The main objectives of the master plan should be to rehabilitate and conserve the lagoon as a living resource system, and enable its utilisation in sustainable ways to enhance the well-being of the local communities through fishing, recreation including tourism, and any other feasible economic activities, and to promote the long-term economic and social development of the district as a whole. It should also be an objective of the master plan to ensure the participation of bodies representing stakeholders like fishing communities, environmentalists, local residents and commercial interests in the planning and implementation processes. These objectives are elaborated below:

i) Rehabilitation:

This includes cleaning the lagoon of pollutants, desilting, regeneration of mangroves, regulation of opening and closing of the lagoon mouth and cleaning up of the lagoon coast. It may also be necessary to construct fences or bunds in some parts of coast to protect mangroves and/or to prevent dumping of solid wastes into the lagoon.

ii) Conservation/Sustainable Utilisation:

This includes the preservation of biodiversity, identification of endangered species that may have to be preserved, conservation of the mangroves, setting of rules to harvest living resources and establishing mechanisms to enforce them, formulating and enforcing guidelines for commercial uses of the lagoon, and the maintenance of the quality of the lagoon as the habitat for its living resources. The reader is also referred to the conceptual framework above on sustainable utilisation of the lagoon as an ecosystem.

iii) Participation:

This involves the mobilisation of the stakeholders identified above and providing an institutional mechanism to ensure the participation of their representative bodies in the planning process and in the regular management of the lagoon.

8.0 Institutional Reforms and Enforcement

The achievement of the above objectives presupposes appropriate property rights, resource users' institutions, and enforcement mechanisms. Based on

the evaluative studies proposed below (see 9.3 and 9.6 in particular), necessary institutional reforms should be introduced to create an enabling environment for the Master Plan to be formulated and implemented.

9.0 Filling the Information Gaps: Basic Studies

9.1 Several basic studies need to be undertaken as a first step towards developing a master plan and a management system for the lagoon. Some of the more important areas and topics are identified below. A tentative prioritisation is also suggested. However, the final choice of topics and prioritisation of the studies should be left to the proposed Advisory Committee on Lagoon Studies. Obviously, the proposed studies cannot be undertaken without funding. Possible Norwegian sources of funding are NORAD and the Ministry of Environment. Other international sources and the government of Sri Lanka may also be approached.

9.2 Baseline Ecological Studies

Disciplines: Ecology/Biology, Microbiology, Geography/Hydrology, Chemistry

- Up to date and detailed maps of the lagoon
- Detailed surveys of the biotic and abiotic components of the lagoon ecosystem;
- Hydrological changes in the lagoon throughout the year;
- Biodiversity;
- Population dynamics and migratory patterns of fishes and crustaceans;
- Bird life on and around the lagoon;
- Environmental health of the lagoon with reference to pollution levels, pathogens, health hazards to fish and other species, and to changes in salinity, turbidity, pH and other properties;

Detailed terms of reference should be prepared by an expert group. For valuable information for terms of reference see research proposals from Dr. Meena Darmaratnam and Dr. P. Vinobha (Appendices 1 & 2).

9.3 Baseline Socio-Economic studies

Disciplines: Resource and Institutional Economics, Sociology, Anthropology, Political Science/ Political Ecology

- Review of Environmental Legislation, Property Rights and Enforcement Problems with reference to the lagoon's main resources (water, fishes, crustaceans, bivalves and other harvestable species, mangroves, and species that use the lagoon a sanctaury) and with a view to identify shortcomings and propose reforms to facilitate sustainable use and participation;

- Socio-Economic survey of fishing communities with reference to demographic trends, household economic status, customary rights, dependence on the lagoon, subsistence and commercial production, and attitudes towards and assessment of governmental agencies;
- Evaluation of Fishermen's organisations with reference to their potential for participation in lagoon management and Identification of feasible and better participatory alternatives;
- Survey of waste disposal by institutions, households and individuals into the lagoon and valuation of the environmental damages caused;
- Survey of public awareness about the importance of the lagoon and its environmental health;

9. 4 Economic Studies of Lagoon Fishing Activities

Disciplines: Resource and Environmental Economics

- Types of fishing and techniques used;
- Quantitative and qualitative analysis of subsistence and market oriented fishing;
- Quantities of fish, crustaceans and bivalves caught and their values;
- Market analysis with reference to demand for and supply of fish, prawns and crabs and the seasonal variations; and to marketing channels, producer prices, consumer prices, profit margins and role of traders;
- Evaluation of the present marketing systems;
- Demand functions and projections for the future and implications for sustainability;
- Assessment of fishing intensity with reference total quantities, species, number of canoes and fishing devices, and seasons;

9. 5 Survey of Future Prospects for Commercial Development

Disciplines: Resource/Environmental and Institutional economics, Ecology, Sociology/Anthropology.

- Commercial prawn farming and its environmental and social implications;
- Development of eco-tourism as a means to raise incomes and to protect the lagoon as an environmental asset.

9 . 6 Institutional Framework and Human Resources for a Lagoon Master Plan Unit

Disciplines: Institutional Economics, Political Ecology/Science, Ecology

- Formulate the mandate for the Batticaloa Lagoon Master Plan Unit (BLMPU) (see below for consultant's suggestions)
- Evaluate the existing institutions and their professional competence with reference to the needs of the BLMPU;
- Identify the most appropriate department to house the BLMPU
- Identify the resource persons and their training needs;

9.7 A Socio-Ecological History of the Lagoon

Disciplines: Anthropology, Political Ecology/ Institutional Economics, Ecology.

There is a need to have on record a socio-ecological history of the lagoon covering the last 100 years. The study should document and analyse the major changes in the lagoon with reference to: legal and administrative framework and customs and traditions governing the use of the lagoon; local ecological knowledge and beliefs about the lagoon as a part of the local cultural landscape; changes in physical conditions including the effects of construction of bridges; the economic importance of the lagoon; fishing communities and other user groups.

10.0 BLMPU: Institution and Competence Building - Some Suggestions

10.1 It is recommended that a Batticaloa Lagoon Master Plan Unit (BLMPU) be set up under the direct authority of the Provincial Council or the Government Agent of the District. In either case the BLMPU should be housed at the Government Agent's office and mandated to i) appoint expert committees to conduct studies and co-ordinate such studies; ii) formulate a participatory model for the planning, implementing and monitoring processes; iii) constitute a team of resource persons including representatives of stakeholder groups to formulate the master plan; iv) seek professional assistance, in the form of experts or of training of BLMPU personnel, from regional, national and international bodies; and v) co-ordinate with government departments and non-governmental bodies to accomplish the task of delivering a sound and workable Master Plan

10.2 The BLMPU should be headed by a senior professional (Co-ordinator) with proven competence in the fields of natural resource planning and management and in giving leadership to teams of scientific researchers and planners. He or she should be assigned this job on a full-time basis for a period of two years with a proviso for renewal /discontinuation of contract depending on performance.

10.3 The Co-ordinator should be assisted by two professional colleagues with competence in natural resource management and commanding sufficient knowledge of the relevant natural and social sciences, and a secretarial staff.

10. 4 The BLMPU should appoint a top level Advisory Committee to prioritise the studies identified above and formulate them in more concrete terms. It is recommended that the Advisory Committee should include senior academics from the natural science and social science faculties of the Eastern University and from NARA, Colombo. The Advisory Committee should advise the BLMPU on the most effective ways and means of carrying out the studies. It should consider the approach of forming expert groups for particular studies or groups of studies and advise the BLMPU on the choice of resource persons. The Advisory Committee should determine the time frame, and progress monitoring and quality control procedures for the studies and assist the BLMPU in putting them into practice.

10. 5 The BLMPU should begin considering possible candidates for the Master Plan Team (MPT) while the studies are on and establish the team. The MPT should immediately commence work on the conceptual framework and phases of the Plan. It should work closely with the study groups and develop appropriate documentation and data processing systems for the Plan.

10. 6 In the Consultant's view, items 9. 6, 9. 3 and 9. 2 should be treated as highest priority studies to provide basic information for the Master Plan.

11.0 Strengthening the Fisheries Department

The Fisheries Department is a key actor in matters concerning the lagoon. But, as mentioned already, it needs to be strengthened in terms of personnel and basic laboratory facilities. The Head of the department has submitted a proposal to BIRRP for establishing a fisheries laboratory. The BLMPU should evaluate the proposal with reference to needs of lagoon management and arrive at a decision. (see Appendix 3)

12.0 A More Active Role for DELEC

DELEC's role should be formalised and activated as suggested above. It may serve as a consultative body in conceptualising the BMPLU and choosing members for the Advisory Committee and expert groups.

13. 0 Sources of Scientific Expertise for the Proposed Studies

13. 1 Eastern University of Sri Lanka (EUSL)

The natural and social science faculties of the EUSL should be called upon to participate in the field studies and in other activities where their expertise is useful. Members of the science faculty and the department of sociology have expressed their interest in participating in the studies. The Consultant had discussions with the following scientists who are among the locally available resource persons:

Prof. Mano Sabaratnam, Department of Zoology

Dr. Meena Darmaratnam, Department of Zoology (see Appendix for research proposal)

Dr. M. Vinobaba, Department of Zoology (see Appendix for research proposal in collaboration with Dr. P. Vinobaba@)

Dr. T. Jayasingham, Department of Botany

Dr. Y. Thangaraja, Department of Sociology

@ It may be added that Dr. P. Vinobaba, specialist in Aquatic Veterinary Pathology and residing in Batticaloa, is also available.

More resource persons can be found in the departments of Economics and Geography, Faculty of Agriculture, and the Centre for Sustainable Agriculture and Resource Management (CENSARM) at the EUSL.

13.2 CORD, Batticaloa

CORD is a consultancy firm in Batticaloa consisting mainly of university academics. It has expressed interest in participating in the Batticaloa lagoon studies. Contact: Dr. T. Jayasingham

13.3 National Aquatic Resources Authority of Sri Lanka (NARA)

NARA is an important central government institution dealing with aquatic resources with a professional staff. It has senior researchers with competence relevant to the ecological studies proposed. Contact: Dr. H. U. Jayasekera and Dr. N. M. P. T. Dayaratne.

13.4 Norwegian Institutions

The Centre for International Environment and Development Studies, Noragric, Agricultural University of Norway and the Norwegian Institute for Water Resources Research (NIVA) are two potential partners for the Batticaloa lagoon studies.

Noragric is an international academic unit of the Agricultural University of Norway (AUN). It is an interdisciplinary centre dealing with education, research and consultancy pertaining to agriculture, environment, and development. Noragric operates closely with other AUN departments (which specialise in diverse areas like crop science, forestry, ecology, animal science, soil science, land use planning, economics, and sociology) and represents also the Norwegian College of Veterinary Medicine in Oslo. It has extensive experience in development co-operation in Africa, Asia and Latin America. Address: NORAGRIC, Box 5001, Agricultural University of Norway, 1432 Ås, Norway.

NIVA is Norway's foremost research centre on water resources with an international network. It is engaged in a wide range of research activities concerning water quality and pollution with reference to industry, agriculture, marine resources, municipal waste disposal, aquaculture, and automobiles. NIVA offers professional services on water resource planning

and management to Norwegian and foreign clients. High level expertise is available on 17 different aspects of water resources. Address: NIVA, Box 173 Kjelsås, 0411 Oslo, Norway.

14.0 A Follow up Workshop

A follow-up workshop based on this paper may be held at an appropriate time in Batticaloa. The participants should include members of DELEC, local resource persons, BIRRP representatives and the author. The paper should be distributed in advance to the participants to give them sufficient time to read and reflect on the contents. The main objectives of the workshop should be to i) critically review the findings and recommendations, ii) more concretely formulate and elaborate a model for BLMPU, iii) identify potential members for the Advisory Committee and key resource persons for the proposed studies, iv) estimate the medium term (12-24 months) financial needs, and v) work out a tentative activity plan.

APPENDICES

Appendix 1

PROPOSAL FOR RESEARCH AND DEVELOPMENT OF THE LAGOON BASED FISHERIES INDUSTRY IN BATTICALOA

"...Off the landward margin of this labyrinth of fresh water lagoons or Gobbs, in the Batticaloa district there lies a level plain. Here the eye may rest on the vastest expanse of rice fields to be seen in any part of Ceylon"
- Brohier 1965

1.0 PREAMBLE

"Ceylon has no fresh water lakes. The lake like lagoons which lie scattered over so great a portion of the coast line, parallel to sea therefore holds a special interest. These peculiar esturine formations were named by the Arabian geographers of old 'the Gobbs of Serendib'. They hold the waters of many rivers prevented from entering the sea by strips of deltaic land, and sand bars of their own making. The east coast offers a more striking development, as one may see in Batticaloa. The rivers along that stretch of sea board have helped in forming an indented network of waterways, fully 50 miles in length, which stretches from Valaichenai to Sammanthurai.

writes Brohier(1965) on the natural resources of Batticaloa.

This excerpt typifies the traditionally agricultural and fisheries based region of Batticaloa. Fifty four percent of the population practice either Agriculture or Fisheries or both. There are 146 fishing villages - 22.1% of the total population of the Batticaloa district which depend on fishing alone (Agriculture Extension, Batticaloa District, 1991).

There appears to be an asymmetrical development of the above two livelihoods in the East. In Agriculture one finds programmes, and extension services reaching out to the cultivators - giving advise, disseminating knowledge on new varieties, current disease control methods etc. Thus attempts are being made for scientific advancement to infiltrate to the field to attain new heights of productivity levels in agricultue.

In contrast, fisheries sector has been much neglected: fishing is done in old traditional ways; resources of lagoon and sea have not been studied to be exploited fully. In short it is a necessity for science to intervene to exploit the resources of the lagoon and sea of Batticaloa and for developing sustainable fisheries.

Rationale

Need to do basic research of the lagoon

Lagoons, estuaries and backwaters of the tropics are among the most productive ecosystems, possibly second to the coralreefs. The smaller number of energy pathways and the large energy input in the form of detritus are factors contributing to the high productivity of these ecosystems. Aquaculture could be practiced in lagoons to increase yields. The lagoons also play an important role in acting as nursery grounds for many species of juvenile finfish as well as shellfish. They benefit from the availability of food and protection from predators in the lagoon ecosystem.

'There is little information on the hydrology and biology of most of Ceylon lagoons and there is an urgent need for atleast the type of information that is basic to the efficient exploitation of available resources' complains Arudpragasm in 1974.

A review by DeSilva and DeSilva on coastal lagoons (of SriLanka) proclaims the major lagoons of the island as Jaffna, Puttalam, Negambo, Batticaloa and Trincomalee. This review discusses studies carried out in first three of these lagoons Sachithanathan and Perera (1970) on Jaffna lagoon, DeSilva and DeSilva (1981) on Negambo Lagoon and Durairatnam (1963) on Puttalam lagoon. Exhaustive studies these may not be, they provide some insight to hydrography and the flora and fauna of the above three lagoons.

The above studies also demonstrate the need for such basic data on each of the major lagoon systems of SriLanka. Each lagoon is unique* in the sense that fresh water inclusions, topography of the lagoon, access to the sea is different for each of them. In addition the Batticaloa lagoon has another problem inherent: the influx of chemicals from the paddyfields.

Thus there is a real need for basic research to be conducted in the Batticaloa lagoon on which there has been no proper studies so far. It is ostensible that such research will lead to maximizing production of the lagoon; having an impact on the lives of atleast 54% of the population of Batticaloa.

Special problems

In addition to basic research of the lagoon there are also other problems which awaits solving.

Monitoring and solving fish disease

An epidemic of fish disease identified as the Epizootic Ulcerative syndrome (NARA report, 1990) had a

tremendous impact on the fisheries industry in the early parts of 1990 in the Batticaloa district. Another epidemic but to a lesser extent occurred in January 1991. We need training of personnel to tackle such specific problems.

Encouragement of culturing organisms

As pointed out in Annex 2 there has been very little attempts at culturing species like oysters, crabs etc. We would like to play a role in demonstrating the viability of aquaculture to the public and to provide guidance when necessary.

2.0 OBJECTIVES

We aspire to establish a unit specialising in fisheries in the Eastern University.

The aims of this unit will be:

1. To conduct basic studies on the lagoon and marine resources. These studies will primarily include information on hydrology and biology across time and space: physical and chemical measurements, distribution and fluctuation of the biological resources - the main emphasis on edible fish and prawns
2. Monitoring environment of the lagoon system with particular reference to affluence from chemicals from paddy fields etc.
3. To conduct pilot studies on aquaculture to promote and to assist local development of aquacultural programmes.
4. Specialising in the study of fish disease to cope with problems arising in the wild stock as well as in future aquacultural ventures in the lagoon.
5. To liaise with the government and public sector to give guidance in:
developing sustainable fisheries
minimising post harvest loss
6. Maintain interaction with the fishing community for extension services.
7. Training programmes, diploma and masters degree courses are envisaged in later stages. This will create a system of feed back of the expertise into the community.

8. Establishing a documentation (audio, visual) center in the proposed unit. This will cater to dissemination of knowledge and know how to the community; to those engaged in fisheries or otherwise. Efforts will also be made to bring in schools by awareness programmes as well as participation in research.

(Refer Annex 1, page 6 for a summary of interactions of the proposed unit)

3.0 INPUTS AVAILABLE FROM UNIVERSITY

1. Use of infrastructure: laboratories etc.
2. Teaching, research and support staff.
3. local travel.
4. Administrative and financial staff.

4.0 REQUIREMENTS

To achieve the above objectives we need assistance for the following

1. Training of staff:

technical - training in a tropical situation is desired.

academic - link with a Canadian University and split degree programmes with research in the Batticaloa lagoon is desirable. This is an essential requirement as we do not have any expertise in fisheries in Batticaloa. Exchange of staff from Canadian Universities is also envisaged.

Development of a library to cater to the needs of the fisheries unit.

2. Financial assistance is required for:

research
pilot studies
infrastructure and equipment

4.0 BENEFITS OF THE PROJECT

1. Development of a specialised unit in the University very much relevant to the environs of the region of Batticaloa.

The establishment of such a unit in turn will provide towards an overall development of the University.

2. Maximising yield from the rich resource of the lagoon system.
 - 2.1. impact on employment
 - 2.2. increase in percapita income for 54% of the population.
 - 2.3 Diversification of the exploitable resources e.g eel, oysters.
3. Development of the community: fishing and otherwise - fish processing' etc.
4. Above all, contributing towards a nation in which the majority do not consume sufficient protein.

ANNEXURE 1

PROGRAM OF STUDY

| | | | |
|----------|--|---|--|
| Year I | Training of staff (technical and research) | + pilot studies | |
| Year II | " | + commencement of research +pilot studies | |
| Year III | " | + research +pilot studies | /-----\ completion of training \-----/ + local training programmes + extension work |
| Year IV | " | + research +pilot studies | " |

ANNEXURE 2

WATER RESOURCES OF BATTICALOA

The water resource of Batticaloa is of three types:

- a. the numerous irrigation tanks and other fresh water bodies
- b. the lagoon
- c. the bays and the sea

a) Fresh Water Systems

There are 16 major tanks and 195 minor tanks in the Batticaloa district. The area of the major tanks total to about 130,000 acres. There are fishing villages which entirely depend on fishing from these fresh water tanks (data not available).

Biological resources of the Fresh water tanks

Several species of fish like Ophiocephalus, Etroplus, Gobids are found endemic in these tanks. These species have good marketability. Other endemic species (around 53 fresh water species has been recorded in SriLanka - Munro, 1955) could also be introduced into these tanks. Of the introduced species Tilapia mossambica is very common in these fresh water tanks.

There has been no systematic effort to culture or increase productivity of these tanks so far. Transport and processing of the fresh water fishes is also important as most of the tanks are situated in remote areas where transport is problematic.

b) Brackish Water System

SriLanka has about 120,000 Ha of brackish water of which the third largest is the Batticaloa lagoon having an area of 13,500 ha. The Batticaloa lagoon is about 23 miles long opening out th the sea at locations: Batticaloa and Kallar in the south (Fig.1). Around 15 rivers open into the lagoon. Apart from this there are also influxes from the paddyfields and the irrigation tanks.

An estimated 7,288 fishermen depend on the lagoon resources (Status report on Batticaloa, 1991). This number may be an underestimation as there are numerous part time fishermen, even government servants indulge in fishing, specially prawning to make a quick buck.

A total of 125 fish species has been described in the brackish waters of SriLanka (Pillai, 1965). Eighty of these were immigrant marine species. A pilot study on two

shoreline locations in the Batticaloa lagoon has revealed the presence of 21 species of fish (S.Kalyarasy pers. comm). This estimate is obviously an underestimation as only two shoreline sites were studied.

Biological resources of the lagoon and their status of exploitation

Finfishes:

The common finfishes found in the Batticaloa lagoon includes: *Siganus* spp, *Etroplus* spp, *Mugil* spp, *Gerris* spp, *Hemiramphus*, *Epinephalus* spp, *Leiognathus*, *Sillago* spp, *Pertica* spp, Anchovy, *Nematalosa* spp, *Eleutheronema* spp, *Allanetta* spp, *Tylosurus* spp, *Glossogobius* spp and *Tachysurus* spp.

Eels (*Anguilla* spp) is another resource which has hardly been exploited. These are commonly found in the lagoon and consumed by a fraction of the community.

Crustacians:

Of the Caridids, *Macrobrachium* species increases in population in the lagoon during monsoonal rains; these usually carry eggs. Very little is known about the biology of this species in terms of migrations etc.

Penaeids include *Penaeus indicus*, *P. monodon* (tiger prawn) and *P. semisulcatus*. *Metapenaeus* species occur but they are less abundant. Here the post larval stages seek the lagoon from the sea. Growth of the post larval stages occur in the lagoon (Bardach). Our preliminary study indicates that abundance of the postlarval stages increase when the bar mouth is fully open.

Attempts have been made at shrimp culture at two sites in the Batticaloa lagoon. These efforts ought to increase considering the fact that Batticaloa has the largest area available for shrimp culture (Samaranayake, 1986). Of the 15,000 acres of land area adjoining lagoons viable for shrimp culture in Sri Lanka, around 4,000 acres are in the Batticaloa lagoon.

Crabs (*Scylla* spp) are commonly caught in most parts of the lagoon. Experimental crab culture in the Negambo lagoon was promising (Samaranayake, 1986).

Molluscs:

An edible species of oyster - *Ostrea* spp. is found in certain areas of the lagoon. These are harvested from a few rocks and the Dutch Fort ramparts in Batticaloa. There is a high potential for oyster culture by providing more substratum for the oysters to attach on. It is imperative that we should have data on the optimal time and space for spat collection; economical spat collectors etc.

c) Marine Resources

There are bays which has biological resources like sea-cucumber, gracillaria, lobsters etc.

In marine fisheris, off shore fisheries and deep sea fisheries need to be given full encouragement as it is not fully exploited at present.

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07-7-1995

BATTICALOA.

Project proposal

Study of the Ecto and Endo Parasites of Economically Important Fish and Ulcerated Fish from Batticaloa Lagoon

Introduction:

Batticaloa is situated at the Eastern coastal region of Sri Lanka. Batticaloa lagoon has an area of 168 square kilo meters, supporting 6756 fishing families. The fishermen are depending mainly on day to day catch from the lagoon, since the off shore and deep sea fishing comes to a stand still very often after the turmoil in Sri Lanka.

Mortalities of fish has been reported in Sri Lanka since early years. Some of these mortalities reportedly occurred due to sudden and adverse changes in the environment or water pollution. Mass mortalities of fish due to the disease were not reported from the water bodies in Sri Lanka until 1987, where angel fish were found dead due to an unknown disease condition in Colombo.

Out breaks of fish diseases have been recorded in Batticaloa lagoon since 1989. In the following years mass mortalities were observed after the on set of monsoonal rain fall. This unknown ulcerated condition would be the clinical sign of the dead fish. Due to the appearance of the fish disease, the marketability and the market value were on the decline. The out break of such fish disease affect the socio-economic status of the fishermen depending on the lagoon.

The main source of cheaper protein for the increasing human population is obtained from the fish. Such increasing demand is balanced by the steady increment in the lagoon based fishing activity. In otherwards the number of personnel involved in fishing is also in increasing trend. The increased fishing activity too being affected by the appearance of diseased fish. So it is very important and urgent need to study such a disease in detail.

Objectives

A very little study has been made on fish disease situation in the lagoon. General public is not aware of the disease aspects. The proposed objective in this study are as follows:

- i) Study the causative agent
- ii) Conduct sampling studies to ascertain the epidemiology.
- iii) Histopathological sectioning to elucidate the pathology of affected tissue or organ from the diseased fish.
- iv) Explore the possibilities of the marketability and find out the market value of susceptible fish of commercially important.
- v) Carry out a survey for ecto and endo parasites on edible fish.

Work Plan :

Experimental design - Duration 3 years.

Phase I

1. Get alive fish samples from different locations of Batticaloa lagoon at biweekly or weekly intervals throughout the whole year.
2. Carry out a survey for ecto and endo parasites on edible fish.
 - a. Skin scrapings
 - b. Gill
 - c. Kidney
 - d. Liver
 - e. Pericardium
 - f. Eye
 - g. Visceral cavity
 - h. Air bladder
 - i. Intestine
 - j. Flesh
3. Count the total number of each species parasitising fish.
4. For gill parasites eg. monogenean worms or arthropods, count the number of parasites in each gill from right and left gill arch.
5. Explore the pericardium, air bladder etc. for any cysts. Identify the species as far as possible.
6. Count the number of *Trichodina* spp from skin smears after staining.

27-7-1985

BATTICALOA.

7. Kidney squashed preparation has to be observed under the high power microscope to find out the existence of protozoan parasites.
8. Visceral cavity, intestine has to be checked thoroughly for the presence of larval and adult cestodes. If any cestodes present, the gut diverticula, intestine has to be sectioned to see the finer details of pathology of infection.

Phase II

1. Maintain the infected wild fish in the aquarium and proceed with the physiological and physical changes of fish.
2. Conduct transmission experiment to show whether the infective agent can be transmitted via contacts or via aquarium water and to find out other possibilities, with the main concern about ulcerated fish disease transmission and the degree of its spread.

Phase III

1. From the laboratory based study and field trial results, may reflect the severity of disease i.e. with the peak of disease existence etc. These such findings may give an important clues to the fish farmers or aquaculturists.
2. The findings of the pathological study, leads to categorise the disease more precisely, which remove the unwanted and unacceptable rumours in the community.
3. As all research aspects approaching towards the end with the results and pooled findings it is possible to draw a conclusion.
4. Since general public did not aware of the disease situation of fish, it is utmost important to conduct regional seminars or talks with the explanatory charts, positive slides etc. to disseminate the knowledge among armature fishermen and the general public. This can be done at the beginning and some closer to the end.
5. Once the laboratory get enough facilities, a couple of workshops have to be carried out to train the Fisheries Inspectors to gain detailed knowledge about fish disease.

FISH PROJECT OFFICE
27-7-1935
BATTICALOA

6. If the prior step get through successfully, then it become virtually possible to train some personnel from the Fishermen's Co - operative societies or any others.

Co - ordinator : District Extension Officer, Batticaloa.

Chief - Investigator : Dr P Vinobaba, No 1A Suriya Lane, Batticaloa.

Dr P Vinobaba has got trained at the Institute of Aquaculture, University of Stirling, UK., in Fish Disease. He has been awarded with PhD in Aquatic Veterinary Pathology.

Field Study Assistant: Dr M Vinobaba, Department of Zoology, Eastern University, Chenkalady.

Dr M Vinobaba has got trained at the University of Sussex and awarded with a PhD in Developmental Biology.

Sampling Assistants: Fisheries Inspectors.

Site of the Laboratory and Aquariums : Within the premises of the Fisheries Office, Batticaloa, which is in close proximity to the Batticaloa lagoon.

Cost and Budget

- | | T.E.C |
|--|-----------------------|
| 1. Building for the laboratory and aquarium with compressor pump, pipe lines, water pumps, air supply lines and plastic tanks. | (Rs. 1000) 2000.00 |
| 2. BH2 Olympus fitted with camera and camera lucida Research Microscope to take photographs of parasites which can be seen through microscope only and to show the details of pathology of | |

- diseased fish as positive slides and photographs). 560
3. Olympus HSC - Student Microscope for routine disease or health checks. 80
 4. Slide boxes and coverslips to make skin smears or to prepare permanent slides. 10
 5. Olympus stereobinocular microscope to dissect out eye air bladders, pericardial cysts and to gill parasites. 120
 6. Dissecting equipment especially with fine scissors, needles etc. 2 sets. 12
 7. Slide storage boxes to keep the permanent slides with histological sections or with parasites. 2
 8. pH paper different pH ranges. 2
 9. Environmental kit or probe - Philip harris (Hack kit) could be used and is very expensive costs (4,000 sterling pounds) so is better to use pH, DO₂ and conductivity meter with one meter extra cable 60
 10. Refracto salinometer to measure the salinity at sampling sites. 20
 11. Thermometers 10 numbers. 4.5
 12. Specimens bottles 200 numbers. 4
 13. Chemicals necessary to prepare 10% buffered formalin. 5
 14. Waxes and items necessary to take sections from a microtome. (50% methylated spirit, 80% methylated spirit, absolute spirit, absolute alcohol, chloroform, rapid decalcifier, microtome blades - Richard Jung disposable blades, staining solutions - eosin, haematoxylin). 15
 (Since the microtome will cost much, it is decided to seek assistance from the Department of Zoology, EUSL, Chenkalady or the Base Hospital, Batticaloa, or will find out other sources, for the use of the microtome). As the cost of the microtome is not included in this budget)
 15. Disposable gloves (medium, large, extra large sizes) 3 boxes.

(60)

| | | |
|-----|--|---------|
| 16. | Solutions necessary to determine Cl-, NO2-, NO3- , NH3+ etc. | 10 |
| 17. | Jouan water bath consisting of J.T 18 analogue regulator, circulation pump temperature range . 5 °C - 150 °C. | 10 |
| 18 | Aerators - 10 numbers. Necessity for aquarium facilities - to maintain the alive diseased fish in separate tanks, to carry out transmission experiments, if required naive fish (did not have any previous exposure to any parasite in its life). It is essential to have a set up for fish breeding and hatchery in a small scale at the initial stage. | 3.5 |
| 19. | Stationary items. | 15 |
| 20. | Honourary payments (3 years). | |
| | a. Co - ordinator | 36 |
| | b. Chief Investigator | 360 |
| | c. Field study Assistant | 180 |
| | d. Sampling Assistants (Fisheries Inspectors - 5) | 180 |
| 21 | Contingencies | 42.5 |
| | Total | 2734.50 |

Benefits

The fishermen who depends on lagoon fishing for their livelihood will be very much benefitted by this project. Perhaps they could have an unhindered harvest of fish once the cause of fish disease is found out and measure taken to control the spread of disease. The general public could have a clear picture of the fish disease condition through the talks and seminars to be conducted. This would clear the wrong impression formed in the minds of the public that eating lagoon fish is injurious to health. Fish

(76)

production, marketability and market value of lagoon fish will be increased. The Fisheries inspectors of the Fisheries Office, Batticaloa and some representatives from Fishermen's Co - operative society, Batticaloa, will have the opportunity to learn the laboratory disease diagnostic work with regard to fish disease, fish culture etc. Once laboratory is established, it will be able to provide salinity test and other similar tests required by the fish farmers and shrimp culturists, in a long run. The established laboratory will be able to provide diagnostic service to all fish farmers and shrimp farmers, where regular health checks are vital for the prevention of diseases transmission for a longer period in the mean time such facilities can be updated with the scientific advancement. In short it will be a great asset to the Fisheries Office, Batticaloa. The office can either charge for the facilities or they provide such facilities free of charge depending on their funding in the future.

Justification :

Though this project is not an income generating one at the beginning, it could be turned into an income generating project in a long run by providing technical advice and assistance to fish culturists and shrimp culturists who are much in need of such advise and assistance. Further this project is expected to uplift the socio - economic status of the lagoon fishermen.

Monitoring and Evaluation :

Implementing Agency : The District Fisheries Extension Officer, Batticaloa.

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The project shall be monitored and evaluated by the project co - ordinator and the chief investigator.

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(S. F. P. FISHERIES
DISTRICT OFFICE
District Fisheries Extension Officer,
Batticaloa.

District Fisheries Extension Office,
Batticaloa.

BIRRP PROJECT OFFICE
05-7-1995
BATTICALOA.

Appendix 3

The Case for Establishing a Laboratory at the District Fisheries Extension Office, Batticaloa. By S. T. George.

Case for the laboratory to set up within the DFEO's office boundary

The fisheries department is governing the activities of the fishermen and gearing the development via fisheries extension office situated close to the lagoon at the lake road. The office is trying to get as much as data possible to access the fishing activities with the help of fisheries inspectors and fishermen. They could not able to do the water quality management due to the lack of facilities and equipment. Presumably the salinity of the water changes in the lagoon associated with monsoonal rainfall and drought etc. It has not monitored along the lagoon like dissolved oxygen content and biological oxygen demand. In the same lagoon they have reports of fish disease since 1989. This may or may not be associated with the water quality. If the district fisheries extension office has got a laboratory facilities then it is virtually possible to do the water quality tests by them selves from the expertise assistance.

The followings can be monitored by DFEO's office with a laboratory:-

1. The laboratory with basic equipments can render the office to collect data such as salinity, dissolved oxygen content at different depth, turbidity, biological oxygen demand etc, in water quality.
- 2 They can able to find out the micro organisms found in the lagoon water, parasitic organisms present in any host fish with the help of different kind of microscopes.
3. Pollution of the lagoon can be monitored to some extent via turbidity, dissolved oxygen content, biological oxygen content.
4. Fisheries inspectors can learn to use the equipments by themselves to collect datas at sites belongs to their division.
5. DFEO's office with a laboratory consiting of microscopes, environmental kit can provide diagnostic service to the shrimp farmers and fish farmers where salinity, oxygen concentrations are vital parameters to maintain the growing organism to be maintained in healthy situation.
6. Fish, shrimp samples for diagnostic work obtained at different site by respective fisheries inspector and do the parasitic survey on the same day in the lab. If the fish has got heavy infection it may not possible

to do the studies on the same day. If the fish left alive in aquarium and can do the parasitic survey or studies at a later time which suits the fisheries inspector, so the aquarium facilities coupled with a laboratory is essential to maintain fish, shrimp alive for the studies.

7. Preliminary studies on fisheries census work has undertaken by DFEO, where they have collected data of total catch of fish, shrimp, crab etc, at different sites of the lagoon. This aspect can be expanded to species level by setting up a laboratory to study the aspects of lagoon with the assistance of experts from the Universities, NARA and others.

8. Vital quality measurement can obtained for the lagoon with the laboratory facilities. So that the DFEO can have a record of water level with period of year and at which level the bar mouth should be opened etc can be studied and recorded for the use in the following years. Similarly the records of water quality parameters must go on the record from different sites along the lagoon.

9. Study the biology of economically important food fish, shrimp, crab from the lagoon has to be started along with setting up of a lab and from the datas it is possible to conclude about the mesh size regulation and place bans to catch female fish during spawning season.

10. To conduct sampling along the 23 miles stretch of the lagoon would be feasible with a research vessel owned by the DFEO's office, or with atleast a speed boat.

11. For to carry out the fish disease, fish nutrition trials to select the feed composition trails, crab farming trials may need properly constructed cement tank. The tank has to provide two ways to get the water in from lagoon and to send the water back to the lagoon this can be achieved by placing two motors. This set up will not give any environmental hazards to the civilian population living close by for a longer period.

Personnels :

- i. Fisheries inspectors can act as field study assistants.
- ii. Research assistant with a knowledge of marine biology, fisheries biology and aquaculture can be appointed on extendable temporary basis or contract basis.

iii. Dr(Mrs) M Vinobaba, Department of Zoology, Eastern University, Chenkaladi will assist in using the equipments such as to measure salinity, dissolved oxygen content and train the fisheries inspectors to use the research microscopes.

iv. Dr P Vinobaba will give advise and assisting regarding the use of equipments, monitoring research projects and formulate the lab with necessary equipments and other related activities.

Necessary Equipments:

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(Next page)

Necessary Equipments

1. BH2 Olympus fitted with Camera and camera lucida research microscope
(Olympus research microscope with automatic photographic system)
Bx50 - 32H01 , PM10 - AK3 -35B Rs 710,500.00
2. Olympus HSC - Student microscope
3. Olympus stereo microscope x-2-w Rs 200,000.00
4. Dissecting equipment especially with fine scissors, needles etc.
Rs 20,000.00
5. Environmental kit or probe - Philips harris(Hack kit)
£ 4,000.00
6. PH meter, oxygen meter and conductivity meter
7. Thermometers
8. Referactosalino meter to measure salinity at sampling sites
9. Microtome - for section cutting
10. Disposable gloves (large and extra large sizes)
11. Water bath
12. Aerators (6 numbers)
13. Air stones (12 numbers)
14. Plastic and or glass aquarias - 12 numbers initially then add more.
15. Eheim filter pumps
16. Slide boxes
17. Cover slips
18. Slide storage boxes
19. PH paper at different pH range
20. Reagent bottles
21. Petric dishes, aseptic and septic once, 12 packets.
22. Bunsen burners
23. Embryo dishes (12 numbers)
24. Watch glasses 20 numbers
25. Specimen tubes
26. Specimen jars
27. Glass storage tanks of different sizes to store rare fishes
28. Disposable knives for the microtome use
29. Luminiscent markers, and permanent markers to mark in petric dishes.
30. *Computer and printer (dot matrix).*

Lagoon fishing methods

1. Cast net Shrimp net
 Nethali net, *Fish net*
2. Athangu (Scoop net) - with different handle size
3. Drift nets
4. Gill nets
5. Hand line
6. Pole line
7. Fish cage fishing, a pattern similar to surrounding
gill net
 (Maya valai .T)
8. Crab cage
9. Fish cage
10. Trap (Kottu fishing .T)
11. Karappu. T
12. Filtering net for Raal Kuni
13. Shrimp catching via cocunut leaf mid rib
14. Anethetic sap use (this has been banned)
15. Fishing with sward
16. Catching (maddi. T) mussels or bivalves
17. Manda