P R O J E C T D O C U M E N T

INTERNATIONAL CENTRE FOR SEA FARMING RESEARCH, EDUCATION, TRAINING AND DEMONSTRATION

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
P.B. No. 2704, Cochin-682 031

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

P.B. NO. 2704, COCHIN-682 031

PROJECT DOCUMENT

TITLE : INTERNATIONAL CENTRE FOR SEA FARMING RESEARCH, EDUCATION, TRAINING AND DEMONSTRATION

Number: Duration : Seven years (7 years)

Primary Function: Institution Building-cum-Research and Education Support

Sector : Agriculture : Class & Code

Sub-Sector : Education & Research

Implementing Agency : Indian Council of Agricultural Research (ICAR) - Central Marine Fisheries Research Institute (CMFRI)

Executing/Sponsoring Agency :

Date of submission : Starting Date : 1 Jan. 1990

ICAR Inputs : Sponsoring Agency inputs:

Signed _____ Date :
(on behalf of the Government)

Signed _____ Date :
(on behalf of the Executing Agency)

Signed _____ Date :

PART I. Legal Context

This Project Document shall be the instrument (therein referred to as a Plan of Operation) envisaged in of the Agreement between the and concerning assistance under the signed by the Parties on .

PART II. A. Development Objective

Planning and development of sea-farming in India and the adjacent regions have been hindered due to lack of comprehensive information on the technology, species characteristics, suitable sites, trained personnel and economic resources available at the national, regional and ecosystem levels of Organisation. Sensu stricto, mariculture is not practised in any part of the country at present, although fish farming in brackish water regions is an age old practice and has attracted greater attention in recent years. There are vast opportunities for sea farming in the intertidal and sub-tidal areas, coastal lagoons and bays, and along the open inshore sea outside the breakwater to increase marine fish production. Therefore, there is an urgent need for an approach which could rapidly provide information on the kinds and quantities of sites, species, appropriate technologies and infrastructure for the various kinds of sea farming systems. The main objectives of the project are therefore,

- to develop a centre of Excellence for intensifying research on different aspects of tropical sea farming systems, and for strengthening the post-graduate education and training facilities in mariculture;

- to establish a Regional Demonstration Centre for facilitating transfer of technologies developed at the Centre for wide propagation and extension in the region; and

- to provide continuous information for the rational management, development, planning and conservation of the natural and introduced resources in the sensitive sublittoral ecosystem, which are subjected to conflicting exploitation interest, but play a vital role in the socio-economic milieu of the coastal rural population.

PART II. B: Immediate objectives

The research activities on mariculture carried out at the Central Marine Fisheries Research Institute (CMFRI) during the past one and half decades have provided basic information on the feasibility and development prospects of sea farming of 1) molluscs (mussel, edible oyster, and pearl oyster and pearl production), 2) pond and cage culture of marine finfishes, 3) shrimp farming in salt ponds and 4) seaweed culture in the inshore sea. The Institute has been imparting post-graduate course leading to Master of Science degree and providing research facilities for Ph.D. programme in mariculture since 1980. However, the basic constraint in the establishment, and planning for the expansion of sea farming has been inadequate infrastructural facilities for mission-oriented research on various systems of mariculture which could provide reliable information on the kinds of resources, material and techno-economic data essentially required for the development of the sector. The immediate objective of the project is to make available these information as well as the support which are basic to tackle the needs of sea farming development and which could eventually aid for its expansion in India and the adjoining region. The Project envisages to achieve this by the following activities.

- developing resource-system-environment specific technology of culture of marine finfishes, crustaceans, molluscs and seaweeds;
- evolving technologies for the development of brood stock and their maturation under controlled conditions to phase out dependence on natural breeders, the procurement of which is seasonal/unreliable and costly;

- developing suitable breeding techniques of candidate species selected for mariculture through biological and environmental manipulations;
- intensifying studies on seed production technology of candidate species;
- undertaking physiological, biochemical, genetical and biotechnological research to understand the species characteristics and to select/evolve varieties with high growth/reproduction/production efficiency and disease resistent stock;
- intensifying research on nutrition to develop balanced practical feed for different life stages for obtaining optimum growth, quality and production.
- taking up advanced studies on fish and shellfish diseases and their control, and to advise farmers on fish health;
- conducting research on marine organisms of pharmaceutical importance and that produce bioactive material;
- developing suitable methods for the culture of marine ornamental fishes and live bait organisms;
- augmenting the heavily exploited natural stocks of prawns and chanks through ranching of their seed;
- investigating on an ecological approach for sea farming development and conservation of endangered species through remote sensory techniques;
- imparting post-graduate courses on different aspects of mariculture to meet the core personnel requirement for research and developmental activities;
- strengthening the infrastructural facilities for teaching, education and research in mariculture;
- offering in-service training to extension officers and Scientists

of various maritime Agricultural Universities and State Departments of Fisheries, by which the improved/new technologies developed at the project are transferred quickly to the farmers.

- collecting information on natural resources in the sublittoral zone, their exploitation pattern, the ecological changes taking place in the regime and their effect on the resources for evolving a comprehensive and integrated functional plan of action for appropriate development, management, and conservation measures of the resources and the ecosystem.

PART II. C. Special consideration

Among the fish producing countries in the world, India ranks seventh (1985) in terms of production out put. However, the per capita consumption of fish and fishery products is one of the lowest in the world. Besides, due to intense exploitation of the fish resources in the inner half of the continental shelf, the marine fish production has been stagnating in the recent past, and along certain areas of the coast and for certain exploited resource, the production has reached the level of sustainable yield and is showing a declining trend. This situation is not only affecting the endeavour of the country to provide protein rich food at reasonable price to the under nourished population, but also the overall performance of the export trade. In this context, the major thrust for the marine fisheries sector has been 1) diversification of fishing with emphasis on management of heavily fished stocks and exploitation of under exploited resources 2) deep-sea fishing and 3) mariculture.

Along the long coastline of India, several promising locations for mariculture are available. Similarly, studies hitherto carried out have shown that atleast five kinds of aquaculture development opportunities in terms of biological, ecological and production aspects are available: 1) suspended culture of mussels in open sea, 2) culture of edible oysters in the intertidal and subtidal regions, 3) culture of pearl oyster and pearl production in open sea, 4) culture of finfishes and prawns in the sea water fed earthen ponds and 5) culture

of seaweeds in rope mats in open sea. However, there is hardly any culture is undertaken at present in this ecosystem. The reasons or the limiting factors for this paradoxical situation are identified to be the inadequacy of present state of technology, lack of demand for such seafoods and their consumption, manpower and organisation. Given these needs, it is indicated that there is great growth and production potential to meet the internal as well as the external markets. And, the present project is proposed to provide this R & D support to the sector.

As observed worldwide, the coastal areas are subjected to a variety of activities and are used by several competitors for land, water and resources. Therefore, a comprehensive knowledge of the biological, ecological and socio-economical aspects of the area and their inter-relationship or inter-dependency is essential for an integrated treatment ensuring rational development of the sector. The project being implemented in such a fragile area envisages to provide relevant information as to the advantages and constraints to plan an area development programme.

The project thus deserves a special consideration as it attempts to usher a new frontier of fish production for internal consumption and for export, and for the economical and social benefits of the coastal rural population and area development including coastal zone management.

PART II. D. Background and Justification

An ever increasing population demands sustained food production and supply. To meet this requirement, every nation including India has assigned high priority to food resources development. In this endeavour, aquaculture has emerged as a definite means of augmenting fish production. Aquaculture activities in fresh water ponds and tanks and in brackishwater regimes have been in practice in India since ancient times. It is only in the early seventies, the importance and role of mariculture in the coastal waters in protein food production, rural economy and employment generation are recognised.

India is endowed with the basic requirements of water (several bays, lagoons, creeks and an appreciable extent of productive inshore waters) and species (Fishes: milkfish, mullets, giant perch, pearl spot, sand whiting, rabbit fishes, and groupers; crustaceans: penaeid prawns, spiny lobsters and crabs; Molluscs: edible oyster, pearl oyster, clams and cockles; seaweeds and other organisms such as sea cucumbers, cephalopods, king crab and turtles) resources for immediate development of mariculture. As a result of research efforts put in during the past one and half decades, particularly by the CMFRI, valuable information is now available on the breeding, seed production and field culture of marine prawns; culture of mussels on ropes suspended on rafts; edible oyster culture in trays and cages, culture of pearl oyster and pearl production; and culture of seaweeds on coir mats. The production in experimental culture of these organisms and in those simulated commercial scale programmes have also indicated encouraging rates. Following the development of these technologies, organised education and training courses were started in 1980 to meet the manpower requirements at different levels. Despite these research and developmental efforts, mariculture could not so far reflect in the commercial production front nor could attract the entrepreneurs of the country. The seasons for this situation, as indicated earlier, may be, firstly, the mariculture, unlike the fresh water or brackish-water fish culture, is not a traditional practice and forms almost a new system to the country and hence the pace of adoption is slow. Secondly, sound technology with information on the sites, seed, feed, production potential and economics is not available owing to lack of sufficient research data. Thirdly, lack of demand for such seafoods and their consumption. Fourthly, there is a lack of trained personnel with adequate knowledge on different aspects of the system to execute the projects and skilled operatives to implement the operation as a commercial business. Finally, mariculture being a location specific system, cannot be developed on the basis of information available elsewhere, but has to be developed in an environment prevailing in the country, so as to base it on a sound footing.

Thus the problems encountered in developing mariculture in the country are unique and attempts so far made on research, education, training, demonstrations and transfer of technology have been inadequate. The paramount need of the present, is therefore, is concerted and direct efforts designed specially to tackle the problems by way of undertaking research which could act as a catalyst and ultimately support the system both in qualitative and quantitative aspects. This research effort should be integrated with transfer of technology to accelerate the process of development. Such an integrated approach, when it is achieved, should support all the mariculture development programmes planned for the country.

In achieving this task, the expertise, the basic information and the facilities already available at the CMFRI could be exploited for advantage. The Institute conducts active research and imparts post-graduate education in mariculture. Thus excellent opportunities exist at the Institute for the development of an International centre in sea farming research, education, training and demonstration by utilising the available infrastructure at various research centres and expertise.

An international centre is proposed because, the problems and constraints and the environment in developing mariculture in India and the neighbouring countries of Bangaladesh, Pakistan and Sri Lanka are almost similar or identical. The benefit of India's location and the lead she has taken already should be most favourable to organise and establish such a centre to cater to the needs of the region.

In the background of above information and premise, the project attempts to identify the following aspects of research which need special emphasis and are required to fill up the existing gaps in our knowledge as well as to support the developmental programmes in mariculture in the region. The training on these fields among other relevant disciplines is also to be imparted to post-graduate students through appropriate syllabus and course curricula.

(a) Resource and system specific technology

Besides culture of organisms in the sea water fed ponds along the edge of the sea, mariculture is undertaken in different systems such as in cages, pens and off bottom. The technology of culture in the system is not only specific to resource, but also entails a knowledge of the dynamics of the ecosystem. To develop appropriate technologies of culture, it is essential that well designed and planned research is undertaken on these systems and relevant data to obtain background information on basic aspects are collected to propagate the system in similar other locations.

(b) Brood stock development and maintenance

One of the major constraints encountered in sustaining the hatchery production of seed is the non-availability of spawners as and when required for breeding programme. Procurement of spawners from nature is either not reliable or costly. The development of brood stock and their maintenance with a knowledge of the biology, physiology, endocrinology, water quality and nutrition are essential to overcome this difficulty and requires a multidisciplinary research effort.

(c) Finfish seed production

The availability of quality seed of the candidate species selected for culture in time and in desired quantity is a major input for successful fish farming. Although information on distribution pattern and abundance of seed of certain cultivable species from nature is now available, often the required quantity is difficult to procure. Further, continued collection of seed in large quantities from nature would affect the capture fisheries. The need for the development of hatchery technology and establishment of hatcheries has already been well recognised. The technology of hatchery production of seed for penaeid prawn, edible oyster and pearl oyster is now available in the country. However there is an urgent need to develop technologies for seed production of marine fin-fishes, and research work in this direction has been meagre. Concerted effort to develop and perfect fin-fish seed production is essential and would form an important activity of the project.

(d) Marine ornamental fish culture

Several species of multicoloured, attractive fishes inhabit the lagoons, rocky areas and coral regions along the Indian coast as well as in the inshore waters of Lakshadweep and Andaman-Nicobar Islands. They have in recent years attracted greater attention in the export trade. However, this resource is not exploited at present to any appreciable extent mainly due to lack of information on the resource availability, its abundance in space and time, fishing grounds, and on sustaining the resource generation through breeding and rearing under captivity. In view of their importance in the export trade and foreign exchange earnings well planned research programme is envisaged to develop viable technologies of breeding, rearing and culturing them under controlled condition.

(e) Live bait-fish culture

One of the major constraints in the development of Skipjack tuna fishery of the country is the non-availability of live-bait and desirable bait species. There is strong evidence that continued exploitation and destruction of the ecosystem have already affected the natural habitat of bait fishes. Regulatory measures to protect the ecosystem for stabilising the natural resources and culture production of bait fishes are the two steps considered for augmenting tuna production. The latter requires studies on the biology, reproduction, growth of the bait species for species selection, and later to develop technologies of their culture in large scale, maintenance and transportation. Several species of forage fishes available in the country need evaluation for their suitability as live bait and for culture in pens or cages in the lagoons and bays.

(f) Fish and Shellfish nutrition

One of the major requirements for successful sea farming is the availability of suitable, balanced practical feed (live/artificial) for accomplishment of optimum growth, survival, maturation, seed production and superior quality fish and shell-fish. The development

of such a feed should cover wide range of topics reflecting diverse aspects of food source, feeding behaviour, nutrition, metabolism, feed technology and food preservation. The research activities would therefore emphasise on establishment of nutritional characteristics and requirements of the species selected for mariculture; digestion, absorption and metabolism; development of suitable balanced and economical compounded feed for use in large scale culture and feed technology, larval nutrition and development and larval feed for hatchery production of seed and feed toxicology.

(g) Fish and shellfish disease

Diseases caused by biotic and abiotic factors form a major factor influencing the production, value and economics. In India, the information on diseases/parasites affecting the farmed animals is very much limited and hence would form an exciting field of research. This would cover the identification, prevention and control of diseases of fin-fish and shell-fish. Particular attention will be given to the diseases in culture system. It also envisages to provide a diagnostic and consultative services on fish health and diseases and to advise on preventive and remedial measures; to conduct research on fish/shell fish parasites to reduce economic loss to the production.

(h) Physiology, biochemistry and biotechnology

Physiological functions in marine animals change even in stable environmental conditions due to circadian rhythm, moulting cycle in crustaceans, changes of physiology during growth and reproduction. In nature, where temperature, salinity, photophase etc vary simultaneously in a non-programmed manner, the animals adjust their life processes through a complex physiological and behavioural pattern, the knowledge of which is little known at present. Similarly, the knowledge concerning several key factors in the biochemical functions of the system and their cyclical change is scarce. Metabolism, physiology and biochemistry of the animals are directly or indirectly regulated by hormones and hormonal application in manipulating the growth and reproduction would play a major role in the success of culture

of marine animals. Recently, in the background of these information, chromosomal manipulation and gene transfer for sex determination and growth enhancement are emerging as a new field of research in fish production under controlled conditions. The thrust of research in this sector would therefore be on physiological cycle, ecophysiology and behavioural pattern; biochemistry and biochemical cycles, endocrinology and biotechnology of candidate species in the culture fisheries.

(i) Studies on marine organisms of pharmaceutical importance

Several species of holothurians, starfishes, corals and fishes are of medicinal value and are known to produce bioactive material. The work would include identification of such organisms, factors influencing the production of the material and methods of extraction. Studies will also be undertaken on the breeding and culture of these organisms under controlled conditions.

(j) Remote sensing technology to plan mariculture

Remote sensing technologies are increasingly used in recent years to provide information useful for general planning for aquaculture development, to study site characteristics, to identify suitable location as well as the natural fish resources. This field is only in the primordial state of development in India. By concerted collaborative research with necessary infrastructure, remote sensing can be a useful tool for accelerated development and planning of aquaculture, resource exploitation and conservation.

(k) Sea-ranching of commercially important shell-fishes

The release of hatchery raised postlarvae/juveniles into the natural environment has emerged as an important activity to increase production, to stabilise the production through adjustments of time of release for post-larvae. and to supplement the recruitment over those from the natural breeding population. In the context of an urgent need to augment the resources such as prawns, pearl oysters and

which are intensively exploited from the inshore waters, this programme should be taken up for advantage. This necessitates infrastructural facilities and technical input for hatchery development for seed production in massive scale, nursery rearing of post-larvae and monitoring of the resources to understand the effect/advantages of sea ranching. New or unproductive wild area could also be stocked for increasing production.

(1) Conservation of endangered resources and coastal fisheries management.

The Gulf of Mannar and Palk Bay on the south-east coast of India, where the main centre of the Project at Mandapam Camp and one of the sub-centres at Tuticorin are located, are an unique ecosystem. The Gulf of Mannar in this region has a chain of islands off the shore and the Palk Bay is a shallow, protected bay. Ecologically, the inshore sea at this region is one of the most productive areas possessing sea grass beds, seaweeds, coral reefs interspersed with sandy, rocky and muddy areas. The general fauna of the region are represented by organisms belonging to most of the phyla. The region supports offshore industrial fisheries and a near shore coastal artisanal fisheries of considerable significance. Biologically, it provides nursery areas for fishes and crustaceans. Further, endangered species such as Dugong dugon, marine turtles inhabit this region. Clearly, this ecosystem with its complex and dynamic resources serves as an exciting area to study the development, management and conservation of the continuously inter-acting and dependent resources, their exploitation by different interests imbeded in the socio-economic frame work of the region in an integrated manner.

PART II. E. Out puts

1. From the results of research it is envisaged that technologies for the culture of fishes, crustaceans, molluscs and seaweeds in different systems in the inshore waters and connected salt water lagoons, bays and creeks would be developed, perfected and propagated.

2. From the present shrimp-oriented culture, the technologies developed under the project would enable to diversify culture fisheries to the much neglected, but possessing great potential fields of finfishes, molluscs and seaweeds not only to provide protein-rich food for internal consumption in the country but also to earn foreign exchange by stepping up export of fish and fishery products.

3. Unlike the capture-culture fisheries in the freshwater and brackish-waters, there is greater scope for blending of the capture and culture fisheries in the marine region. This would bring in more economic benefits to fishermen/fish farmers.

4. While the production potential from mariculture (1000-2000 kg/ha) would be enormous, the social benefits in terms of employment generation in the main production sector as well as in the ancillary activities, enhanced income to fishermen/fishes, reduction in income disparity among fishermen and self reliance would be much more.

5. Studies on brood stock development would enable to dispense with procurement of spawners from nature and to domesticate the species by closing in their life cylce under controlled conditions.

6. The research results on fish and shell-fish diseases would not only help to increase production, but also to reduce economic and quality loss. Besides, the studies would enable development of suitable crop protection techniques and finally in the formulation of a comprehensive Fish Diseases Act for preventing the spread of diseases among fish and shellfish bred or reared.

7. The development of suitable practical feed for prawns and fishes would meet the immediate requirements of the industry to increase production, and in the long range, to develop a total technology of culture. Similarly, the studies on the physiology, biochemistry and genetics of cultivable species would help to improve the resources and to select out fast growing, disease resistant varieties.

8. The sea ranching activities and the culture of marine ornamental

fishes and live bait fishes would not only augment the production but also help to improve the export trade.

9. The comprehensive information to be gathered on the management and conservation of the coastal resources would illustrate how the different kinds of exploitation in the coastal waters would interact, compete or conflict with each other and the future needs of management/conservation.

10. During the seven years of the project, approximately 40 Ph.D. and about 80 Master's degree holders in mariculture would be trained under regular academic programmes. They would utilise their specialised training in varied aspects of mariculture development in the country and in improving standards of teaching and research in other parts of the region.

11. It is anticipated that a large number of extension personnel of departments of Fisheries in different maritime States and Agricultural Universities would be imparted the necessary training in various aspects of improved mariculture technologies developed and this would in turn result in quicker transfer of technologies to the fishermen/fishfarmers.

PART II. F. Activities

The following are the proposed project activities for the seven year period.

Project activities	Location	Duration
1. Reorientation of research programmes - The ongoing research programmes relating to sea farming and cognate subjects will be critically reviewed and the programmes reoriented in breeding and culture of selected species with the existing facilities	Mandapam Camp Tuticorin Madras	January to March, 1990
2. Establishment and equipping of laboratories - Establishment of tissue culture and Biotechnology	-do-	-do-

Project activities	Location	Duration
laboratories and equipping of physiology, nutrition and pathology laboratories and field culture facilities		
3. Construction of fish ponds (Phase I) hatchery and reorganisation of aquarium	Mandapam Camp	April - December, 1990
4. Construction of hostel for students and a Scientists Home	Mandapam Camp	-do-
5. Transfer of Post-Graduate education programmes in mariculture from Cochin to Mandapam Camp	-do-	January 1991
6. Filling up of staff position proposed for the project	-do-	January - April 1990
7. Imparting education for Master's degree and Doctoral programme in mariculture	-do-	January 1991 and later years
8. Intensification of research as envisaged in the project on different aspects of mariculture and related subjects	Mandapam Camp Tuticorin Madras	January 1991 and later years
9. Deputation of Scientists for training abroad in the identified fields of specialisation	Cochin Mandapam Camp	August - December 1991 and later years
10, Offering advanced courses in different facets of mariculture; holding Seminars, Workshops, Specialised lectures	Mandapam Camp Tuticorin Madras	1990 and later years
11. Expert consultancy in the selected fields of disciplines	Cochin Mandapam Camp	1991 and later years
12. Construction of Fish ponds phase II	Mandapam Camp	January 1991
13. Development of oceanarium	Mandapam Camp	January 1991
14. An International team of experts would review the progress of work, and based on their recommendations necessary modifications and addition would be made to tone up the activities from the second year	Cochin Mandapam Camp	1992

PART II. G. Inputs

The project activities and functions will be implemented from two sources, namely, (a) from the I.C.A.R. and (b) from the Sponsoring Agency.

The inputs from the I.C.A.R. would be (1) providing for additional staff proposed for the implementation of the project (Appendix I), (ii) providing Junior and Senior Fellowships for M.Sc. (Mariculture) and Doctoral courses, and for the teaching activities, and (iii) contingency for holding seminars and workshops. For research activities, the facilities available at the CMFRI and its centres would be available. The existing Staff and facilities would be fully utilised for the successful implementation of the project. The cost estimates for the assistance to be received from the ICAR are given in Appendix IV.

The Sponsoring Agency inputs would cover the additional laboratory facilities, physical facilities such as culture ponds, hatchery, rennovation of Aquarium and establishment of Oceanarium. These infrastructural facilities are essential to implement the project activities and cannot be met either from the Institute or ICAR resource. The visits of experts from outside India, who come to work as visiting Professors/Scientists and the training of Indian Scientists of the Project in overseas laboratories would be financed by the Sponsoring Agency. Similarly, the various sophisticated equipments essential for successful running of the programme will have to be imported through the assistance of Sponsoring Agency. A tentative list of the different areas of specialisation in which the assistance of Foreign Experts are proposed and the fields in which training of Indian Scientists are required is given in Appendix IIa and IIb. The equipments required is listed in Appendix III a-c. The cost estimates of infrastructural facilities (fish ponds, hatchery, Aquarium renovation and oceanarium) are given in Appendix V.

PART II. H. Preparation of Work Plan

The project activities and their timing are broadly indicated in "Activities" (Part II.F.). A detailed plan of work for the smooth

implementation of the project will be prepared by the Team Leader in consultation with the representative of the Sponsoring Agency, Director, CMFRI and representative of the ICAR. This would be done at the start of the Project and brought forward periodically. Whenever, a specialist is recruited/assigned to the project, a specialised plan of work relating to the field and specific jobs to be undertaken will be drawn up. The detailed plan of work and the specialised plan of work will be annexed to this document and considered as part of it thereafter.

PART II. I. Preparation of Frame work for effective participation of National and International staff in the Project

The respective roles of the national and International staff to be involved in the Project to accomplish its objectives would be determined by their leaders by mutual discussion and agreement at the beginning of the Project and set out in a Framework for effective participation and implementation. This would be in the established concept and specific purposes of technical cooperation.

PART II. J. Development support communication

The CMFRI has a Fishery Economics and Extension Division and an attached Krishi Vigyan Kendra for Mariculture (Farm Science Centre) for communication of research findings to fishermen and fish farmers. The Extension teams from these units would visit the fish farmers and advise them on various improved technologies and provide technical assistance to solve their problems. In addition, field lectures, "Field days", "Fisheries Melas" where fishermen/fish farmers activity participate, visit laboratories and experimental/demonstration fields in large numbers and the results of research are explained to them. The Project and the Institute would maintain close liaison with the Extension Departments of the State Fisheries Departments and Agricultural Universities and hold Seminars/Workshops/group discussion periodically to finalise recommendation on cultural practices for various systems for adoption. The information gathered by the Project would be disseminated through

bulletins/News letters for the widespread of the the technologies and their practical adoption. Thus all the extension channels would be utilised to propagate the technologies to farmer and entrepreneurs.

PART II. K. Institutional Frame Work

The Project will be implemented through the Indian Council of Agricultural Research (ICAR) under the Department of Agricultural Research and Education (DARE) of the Ministry of Agriculture, Government of India through the Central Marine Fisheries Research Institute, Cochin. The I.C.A.R. is the nodal coordinating Agency in India for all the educational and research programmes relating to Agriculture including fisheries in the country, and those carried out at by the Agricultural Universities.

The CMFRI, established in 1947 has its headquarters at Cochin, Regional Centre at Mandapam Camp and Research Centres at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada, Waltair and Minicoy (Lakshadweep). Additionally, fisheries resources information is collected from 28 field centres located along the east and west coasts.

Organisation and management of the current research programmes:

The CMFRI is the premier national fisheries research Institute devoted to research on marine capture and culture fisheries of the country. The main objectives of the Institute are: conduct research for assessing and monitoring the exploited marine fisheries resources leading to rational exploitation and conservation; assess the under-exploited and unexploited marine fisheries resources of the Exclusive Economic Zone; understand the fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel-based programmes; develop suitable mariculture technologies for finfish and shellfish in open sea to supplement marine-fish production; and conduct transfer of technology and post-graduate and specialised short term training programmes.

National and regional research progrmmes are carried out under 8 research Divisions, namely (1) Fishery Resources Assessment Division,

(2) Pelagic Fisheries Division, (3) Demersal Fisheries Division, (4) Crustacean Fisheries Division, (5) Molluscan Fisheries Division (6) Fishery Environment and Management Division (7) Physiology, Nutrition and Pathology Division and (8) Fisheries Economics and Extension Division. In addition, the Library and Documentation Division functions as a service division.

The Director of the Institute is overall incharge of the research management and administration. The Heads of Divisions manage the research and technology transfer programmes in their respective Divisions. All the research programmes, their priority and implementation are decided by the Staff Research Council which also reviews the progress and constraints of the research activities. The research projects are handled by the competent Scientists in the field and are tackled through inter-disciplinary approach. Inter-Divisional programmes within the Institute and inter-institutional programmes with collaborating agencies are carried out for greater utilisation of expertise and facilities. The total number of research staff in all the Divisions including out-stations are 238.

Research facilities

Over the years, the Institute has developed several facilities for research in capture fisheries and mariculture. The headquarters at Cochin is housed in the permanent laboratory-cum-administration building. The Regional Centre at Mandapam Camp has a large campus with permanent laboratories and residential facilities.

Well equipped laboratories for undertaking research on the biology and ecology of marine organisms and for fishery oceanographical studies are available. Need-based facilities for physiological, nutritional and pathological studies are also available. All the Research Centres have required facilities for fisheries work.

Several equipments/instruments which are essential to undertake research on different aspects of marine fisheries are available. A combination of transmission scanning electron microscope and computer form common facilities.

For facilitating field collection, the Institute possesses Jeeps, smaller research vessels (13.4 m OAL), larger research vessels such as R.V. Skipjack (32.1 m OAL) and FORV Sagar Sampada (71.5 m OAL). Besides, there are farm and hatchery facilities at Tuticorin (shellfish hatchery and grow out ponds); running sea water aquarium, marine prawn hatchery, sea water - fed ponds, and lagoon at Mandapam; shell-fish breeding laboratory and fish/prawn culture ponds at Kovalam near Madras and facilities for open sea raft culture at Tuticorin, Calicut, Vizhinjam and pen and cage culture at Mandapam Camp.

The Institute has a good library possessing literature on different aspects of marine science including mariculture. It has also reprographic and documentation facilities.

Marine Capture Fisheries

In the marine capture fisheries, the Institute's direct interests are on trend monitoring and stock assessment of exploited fishery resources, and survey and assessment of under-exploited, unexploited and new resources in the EEZ of the country. As a corollary to these efforts, marine fish production estimates are made on a multi stage stratified random sampling basis for the different maritime States and Union Territories. The National Marine Living Resources Data Centre of the Institute handles all the information pertaining to marine fisheries. Fisheries Oceanography and environment management programmes link the resource information with environment. Fisheries forecasting is attempted on the basis of relevant data. The Institute is also engaged in frontier areas of research such as remote sensing in fisheries.

Current research programmes in mariculture and facilities

In the mariculture front, the Institute conducts research for the development of technologies for open sea mariculture of candidate species and field testing of these technologies in farmers fields and under pilot projects. Seed production techniques form an important component of mariculture research. As part of results of investigations conducted so far, hatchery technologies for penaeid prawns, edible

oyster and pearl oyster seed production are now available and taken up for the establishment of commercial hatcheries. An indigenous technology for pearl production has been developed and tested in commercial scale production. Similarly, seaweed culture in coir mats floated in the inshore waters is undertaken in development projects implemented at Mandapam region. Multidisciplinary research on physiology, genetics, reproduction, nutrition and pathology are directed towards enlargement of frontiers of knowledge, improvement of quality and better management of production.

For undertaking researches in mariculture, the Institute has developed facilities at Cochin, Mandapam, Tuticorin and Madras. At Cochin, physiology, nutrition and pathology laboratories are available with need-based equipments. Water and soil analysis facilities are also available here. At Mandapam, an experimental penaeid prawn hatchery, running seawater aquarium, fish ponds covering 3 ha of land and 200 ha of tropical lagoon are utilised for mariculture research. At Tuticorin, the stress being on molluscan culture, a shellfish hatchery and farms are available. Similarly at Madras, the developed facilities include a shrimp/lobster hatchery, earthen ponds for fish/prawn culture.

Although, the Institute has the above facilities, under the present proposal, laboratories of some disciplines need strengthening. Laboratories for tissue culture and biotechnology research are to be developed and the field facilities to be enhanced. These have been detailed in the document.

5. Teaching programmes

Post-graduate programmes leading to M.Sc.(Mariculture) and Ph.d. are offered at the Headquarters of the Institute at Cochin. These programmes were started in 1980 under the UNDP/FAO/ICAR project of Centre of Advanced Studies in Mariculture and conducted in collaboration with the Cochin University of Science and Technology. Continuing as a regular programme of the Institute, candidates have so far been produced under the M.Sc.(Mariculture) course and they are now engaged in coastal aquaculture projects undertaken by Government and private agencies and employed by nationalised banks.

The Ph.D. in mariculture is a three-year programme and includes course work and thesis. Scholars have so far been awarded with Ph.D. degree and are employed in research and development projects relating to coastal aquaculture/mariculture.

In addition to the above programmes, training of extension/ development officers is imported at the Trainers' Training Centre. Similarly, the courses offered at the Krishi Vigyan Kendra (Farm Science Centre) are devoted to fish farmers. The training at this centre includes not only coastal aquaculture/mariculture, but also on aspects such as synergetic culture of fish-live stock-agriculture, fish processing and preservation, and social science. Fish farmers including farm women have so far been trained at the Krishi Vigyan Kendra for mariculture at Narakkal, near Cochin.

PART II. L. Proposed Frame-work of the Project

The International Centre for Sea Farming Research, Education Training and Demonstration will be located at the Regional Centre at Mandapam Camp. The Regional Centre is situated on the south-east coast, on the Madras-Rameswaram route, 144 km north-east of the Temple city, Madurai and about 19 km west of Rameswaram. It is located on an impressive and picturesque elevated sand dune overlooking Palk Bay and Gulf of Mannar, in the narrow strip of peninsular land. The sprawling campus has a land area of 40 ha. The calm and serene locus of the centre provides an ideal background for concentrated research on marine science.

The centre has need-based laboratory facilities, a running seawater aquarium, a Marine Museum containing an impressive collection of marine fauna and flora, farm facilities in about 3 ha adjoining Palk Bay, 200 ha of salt water lagoon, boats and vehicles for field collection facilities, a good library, furnished guest house, a Central School, cold storage facility and a generator for continuous supply of electricity. The centre is recognised by certain Universities as a Centre for post-graduate research leading to M.Sc. and Ph.D. degree in marine science.

In consideration of the above facilities, the Centre besides functioning as the main coordinating centre, would provide facilities for post-graduate education and research in finfish culture, tropical lagoon ecosystem, seaweed culture, sea ranching of marine prawns, unique coastal ecosystem as indicated earlier. Besides, the Gulf of Mannar region between Rameswaram and Tuticorin possessing a chain of islands and several endangered marine animals has been declared recently as a National Marine Park for conservation and development of the fauna, flora and the ecosystem of the region.

The sub-centres of the project will be located at the Research Centre of the Institute at Tuticorin and Madras. Tuticorin located about 140 km from Mandapam is an important developing city with a natural harbour and growing fishing industry. The centre has developed a shell-fish hatchery and is provided with facilities for undertaking research on different aspects of mariculture on molluscs, crabs, and finfishes. The College of Fisheries belonging to Tamil Nadu Agriculture University is also located here. In view of the facilities and expertise already available, researches on molluscan culture will be concentrated here.

The Madras Research Centre of the Institute occupies a Central place. For undertaking mariculture research the centre has developed field laboratory facilities at Kovalam and pond facilities at Muthukad on Madras-Mahabalipuram road, about 40 km from Madras. The important research activities here being on spiny lobsters, penaeid prawns and fin-fish culture, the centre would continue concentrated research activities on these aspects.

On developing the facilities at Mandapam, the post-graduate education programme now implemented at Cochin will be transferred to Mandapam Camp. A close liaison will be maintained between the main centre and sub-centres for efficient conduct of education and research programmes.

PART II. M. Prior obligation and prerequisites

All needful formalities with regard to the fulfilment of obligation from the ICAR side will be considered before seeking assistance of sponsoring Agency. Budget sanction from ICAR side and providing of necessary facilities will be made in time so that the proposed work could be implemented without any delay or constraint.

PART II. N. Future programme/assistance

Although the project activities are indicated at present only for seven years, in fact, it is envisaged for fifteen years. At the end of five year of the project, it should be possible to review/ reassess the programme and the need for reorientation and help for expanding the programme to maintain high level of academic research activities.

PART III. Schedule of Monitoring, Evaluation and Reports

The project will be subject to evaluation in accordance with policies and procedures established for the purpose by ICAR and Sponsoring Agency. Periodic review may be undertaken with mutual arrangements. The progress reports on the subject will be prepared by the Project Coordinator at an interval of six months and sent to ICAR and to the Sponsoring Agency and the terminal report will be presented at the end of the project.

Appendix

Details of additional posts proposed, scale of pay and Justification

Name of post	Location	No. of posts	Scale of pay	Justification
Scientific and Technical Staff				
1. Project Coordinator (Scientist S-4)	Mandapam Camp(MC)	One	1800-100-2000-125/2-2250 (pre-revised)	To coordinate the project, supervision and execution of project activities and function
2. Scientist S-2 (Tissue culture)	M.C. Tuticorin (TC)	One One	1100-60-1600 (pre-revised)	1) To organise tissue culture laboratory and to work on tissue culture of seaweeds 2) to work on tissue culture of pearl oyster for improving pearl production.
3. Scientist S-2 (Biotechnology)	M.C. TC Madras (Md)	One One One	-d-	One post each to research on marine prawn reproduction and growth on pearl oyster and pearl oyster and pearl production and on micr algal production improvement.
4. Farm Manager (T-6)	M.C. TC Md	One One One	2200-75-2500 EB-100-4000	To manage the fish/ shellfish culture ponds proposed at respective centres.
5. Instrumentation Technician (T-6)	M.C.	One	-d-	To maintain and operat the sophisticated instr ments/equipments provided for tissue cultur biotechnology and othe laboratories.
6. Laboratory Attendant (T-1)	M.C. TC Md	Two One One	975-25-1150-EB-30-1660	To provide assistance in the Tissue Culture and biotechnology labo tories at the main cen and for the general Lab-assistance in the sub-centres.

Name of post	Location	No. of posts	Scale of pay	Justification
Non-Technical Staff				
1. Assistant Administrative Officer	M.C.	One	2000-60-2300-EB-75-2900-3200	To look after the administrative matters of the project and to assist the Project Co-ordinator in the implementation of the Project, essential post in view of the activities and budget provision
2. Superintendent	M.C.	One	1640-60-2600-EB-75-2900	To assist the Asst. Adm. Officer and to supervise the establishment, administration and stores procurement.
3. Assistant	M.C.	Three	1400-40-1800-EB-50-2300	One post each for administrative section, Stores procurement and accounts.
4. Junior Clerk	M.C.	Three	950-20-1150-EB-25-1500	To assist in the administrative matters, establishment and for general typing work.
5. Junior Stenographer	M.C.	One	1200-30-1560-EB-40-2040	To provide stenographic assistance to the Project Coordinator, correspondence in that office, report typing and maintenance of personnal matter.
6. Fieldman	M.C. TC Md	Four Two Two	750-940	To assist the Scientists in the field and farm work
7. Messenger	M.C.	One	750-940	To provide assistance in the Administrative Section and in the office of the Asst. Adm. Officer.

Appendix IIa

List of Experts/Consultants needed in different areas of Specialisation

Subject of Specialisation	Duration
1. Tissue culture (Invertebrates)	3 months
2. Tissue culture (Seaweeds)	3 "
3. Biotechnology (Germ transfer for improving reproduction in fishes)	3 "
4. Biotechnology Growth and reproduction in crustaceans)	3 "
5. Fish breeding and seed production	3 "
6. Fish farm Engineering	3 "
7. Open Sea Farm Engineering	3 "
8. Cage culture of finfishes	3 "
9. Off bottom culture of fishes and shellfishes	3 "
10. Ornamental marine fish culture	3 "
11. Environmental physiology	3 "
12. Coastal ecosystem management with special reference to conservation of endangered species such as Dugong	3 "
Total	36 "

Appendix II b

Special areas in which National Scientists who are associated with the Project need Training in foreign Institute

Subject of specialisation	Duration
1. Tissue culture	6 months
2. Biotechnology	6 "
3. Open sea farm Engineering	6 "
4. Fish and shellfish genetics	6 "
5. Marine ornamental fish culture	6 "
6. Bioactive agents from marine organisms	6 "
Total	36 months

Appendix III a

List of Equipments to be procured and supplied through external assistance for the main centre at Mandapam Camp

Name of Equipment	Source	Quty.	Approx. Price Rs. in lakhs.
1. Tissue Culture equipments			10.00
2. Top-loading balance digital, readability 0.01 mg	Sartorius	One	0.75
3. Refrigerated centrifuge		One	2.00
4. Tissue homogeniser		One	0.20
5. UV-VIS Spectrophotometer, double beam, digital read out	Perkin-Elmer Hitachi or Beckmen	One	2.00
6, Liquid Scintillation counter with 200 sample capacity, three independant channel, Two additional windows, full adjustment counting windows, amplifier, Rate meter and digital display etc.	Packard instruments	One	2.00
7. Gas liquid chromatography	Beckmen Instrument	One	5.00
8. Fraction collector		One	0.25
9. Tissue Incubator with O_2 and Co_2 control		One	0.85
10. High pressure liquid chromatograph		One	6.00
11. Freezing microtome		One	0.25
12. Sterioscopic microscope		One	0.20
13. Freeze dryer		One	1.50
14. Water management and engineering equipments			10.00
		Total	51.00

Appendix III b

List of equipments to be procured and supplied through external assistance for in sub-centre at Tuticorin.

Name of equipment	Source	Quty.	Approx. price Rs. in lakhs
1. Freeze dryer, 10 l capacity	Dura Dry FTS System	One	2.20
2. Refrigerated centrifuge		One	2.00
3. Top pan balance Readability 0.01 mg accuracy 0.1 mg	Sartorius	One	0.75
4. Leitz-sledge microtome with cryo-attachment	Leitz	One	1.75
5. Constant Temperature bath 10/12 l. capacity, -10°C to 200°C	Haake	One	1.75
6. Shaker water bath 10 l capacity; 110°C ± 0.2°C		One	0.75
7. Constant volume dispenser, low profile, Acid and alkali proof; 250 ml, 250 ml, 500 ml, 1000 ml	Cole-Parmer	8 (2 each)	1.60
8. Reinforced fibre glass tanks	Tufflite	20	1.20
		Ttal	12.00

Appendix III c

List of equipments to be procured and supplied through external assistance for the sub-centre at Madras

	Name of equipment	Source	Quty.	Approx. price Rs. in lakhs
1.	Feed gromder amd ,oxtire	Indian	One	0.05
2.	Pulveriser	Indian	One	1.00
3.	Pelletiser	Indian	One	0.10
4.	High speed homogeniser	Vortex	One	0.75
5.	Rotary vaccum Evaporater		One	1.00
6.	Freeze dryer	Dura Dry FTS	One	2.20
7.	Spectrophotometer, exsyme analyser		One	0.50
8.	Electrophormetic apparatus	Indian		0.50
9.	Thin layer chromotograph	Indian		0.05
			Total	6.15

PART IV. PROJECT BUDGET COVERING ICAR ASSISTANCE

Project Title: International Centre for Sea farming Research, Education, Training and Demonstration

Project duration: Seven years - Estimated cost in Rupees

Name of the post	No.of post	Scale of pay	Total	1990	1991	1992	1993	1994	1995	1996
Scientific and Technical										
Scientist S-4	One	1800-100-2000-125/2-2250(Pre-revised)	4,82,860	59,990	62,670	65,340	68,690	72,040	75,390	78,740
Scientist S-2	Five	1100-50-1400(Pre-revised)	16,42,850	2,20,700	2,25,350	2,30,000	2,34,650	2,39,350	2,44,050	2,48,750
Technical T-6	Four	2200-4000	10,21,240	1,34,680	1,39,160	1,40,600	1,45,040	1,49,480	1,54,920	1,58,360
Technical T-1	Four	975-1540	4,51,080	60,000	61,440	62,920	64,400	65,920	67,440	68,960
Component Total			35,98,030	4,75,370	4,88,620	4,98,860	5,12,780	5,26,790	5,40,800	5,54,810
Administrative Staff										
Asst.Adm.Officer	One	2000-2900	2,34,570	30,720	31,610	32,500	33,390	34,270	35,600	36,480
Superintendent	One	1640-2900	1,98,[illegible]0	25,420	26,290	27,180	28,070	29,250	30,430	31,610
Assistant	Three	1400-2300	4,89,390	63,780	65,580	67,920	72,920	72,420	73,920	75,420
Jr.Clerk	Three	950-1500	3,25,740	43,890	44,790	45,660	46,590	47,430	48,270	49,110
Jr.Stenographer	One	1200-2040	1,37,510	18,310	18,760	19,200	19,650	20,090	20,530	20,970
Component Total			13,85,460	1,82,120	1,87,030	1,91,890	1,98,620	2,03,460	2,08,750	2,13,590

Contd....

Name of the post	No.of post	Scale of pay	Total	1990	1991	1992	1993	1994	1995	1996
Auxillary Staff										
Fieldman	Eight	750-940	6,76,000	91,520	92,960	95,520	96,960	98,320	99,680	1,01,040
Messenger	One	750-940	84,500	11,440	11,620	11,940	12,120	12,290	12,460	12,630
Watchman	Seven	750-940	5,91,500	80,080	81,340	83,580	84,840	86,030	87,220	88,410
Driver	One	950-1500	1,08,550	14,630	14,930	15,220	15,530	15,800	16,070	16,370
Component Total			14,60,500	1,97,670	2,00,850	2,06,260	2,09,450	2,12,440	2,15,430	2,18,450
Travelling Allowance			13,00,000	1,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
Fellowships										
Jr. Fellowships	20*	1200/- (Consolidated)	20,16,000	2,88,000	2,88,000	2,88,000	2,88,000	2,88,000	2,88,000	2,88,000
Sr. Fellowship	30*	1800/- "	45,36,000	6,48,000	6,48,000	6,48,000	6,48,000	6,48,000	6,48,000	6,48,000
Post-Doctoral Fellowship	10	2100/- "	17,64,000	2,52,000	2,52,000	2,52,000	2,52,000	2,52,000	2,52,000	2,52,000
Contingencies			30,80,000	4,40,000	4,40,000	4,40,000	4,40,000	4,40,000	4,40,000	4,40,000
Component Total			1,13,96,000	16,28,000	16,28,000	16,28,000	16,28,000	16,28,000	16,28,000	16,28,000

Contd....

Name of the post	No.of post	Scale of pay	Total	1990	1991	1992	1993	1994	1995	1996
Equipment										
1. Expendable Equipment			17,00,000	2,00,000	2,50,000	2,50,000	2,50,000	2,50,000	2,50,000	2,50,000
2. Non-Expendable Equipment			14,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
3. Operation and Maintenance of Equipment			3,50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
4. Workshop, Seminar			3,50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
5. Short courses			3,50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
6. General Contingencies			14,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
Component Total			55,50,000	7,50,000	8,00,000	8,00,000	8,00,000	8,00,000	8,00,000	8,00,000
GRAND TOTAL			2,46,90,040	33,33,160	35,04,500	35,25,010	35,48,850	35,70,690	35,92,980	36,14,850

** This is an ongoing expenditure, minusing this and the related contingent expenditure, Total cost of the ICAR input would be Rs.1,56,86,000 for seven years or Rs.22,40,850 per year

PART IV: PROJECT BUDGET COVERING EXTERNAL ASSISTANCE

Project Title : International Centre for Fish Farming Research, Education, Training and Demonstration

Duration of the Project : Seven years Cost estimates in lakhs of Rupees

	Total		1990		1991		1992		1993		1994		1995		1996	
	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost
1. Personnel																
1.1 Experts	36	25.20	-	-	6	4.20	6	4.20	6	4.20	6	4.20	6	4.20	6	4.20
1.1.1 Consultants in specialised areas																
1.1.2. Internal travel on duty		1.80	-	-	-	0.30	-	0.30	-	0.30	-	0.30	-	0.30	-	0.30
1.1.3. Other costs		0.90	-	-		0.15		0.15	-	0.15		0.15		0.15		0.15
Component Total		27.90				4.65		4.65		4.65		4.65		4.65		4.65
2. Individual Fellowship	36	10.80			6	1.80	6	1.80	6	1.80	6	1.80	6	1.80	6	1.80
2.1. Group training		3.0				0.50		0.50		0.50		0.50		0.50		0.50
Component total		13.80				2.30		2.30		2.30		2.30		2.30		2.30
3. Equipment		59.16				9.86		9.86		9.86		9.86		9.86		9.86

Contd...

	Total		1990		1991		1992		1993		1994		1995		1996	
	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost	m/m	Cost
4. Construction work																
4.1. Construction of fish farm (20 ha)		51.00		26.00		25.00		-		-		-		-		-
4.2. Aquarium rennovation and provision of filling seawater		10.00		5.00		5.00		-		--		-		-		-
4.3. Finfish hatchery establishment		15.00		10.00		5.00		-		-		-		-		-
4.4. Development of an oceanarium		15.00		10.00		5.00		-		-		-		-		-
4,5. Hostel for students for accommodating 50 students including messing nall, kitchen etc.		20.00		20.00		-		-		-		-		-		-
4.6. Scientists House for accommodating 20 Scientists		10.00		10.00		-		-		-		-		-		-
5. Other items																
5.1. Motor vehicle (Van 24 seats)		2.00		2.00												
6. Other costs		3.50		0.50		0.50		0.50		0.50		0.50		0.50		0.50
TOTAL external assistance		227.36		83.50		57.31		17.31		17.31		17.31		17.31		17.31