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SEMINAR ON THE ROLE OF SMALL-SCALE FISHERIES AND COASTAL AQUACULTURE IN INTEGRATED RURAL DEVELOPMENT

6-9 DECEMBER 1978, MADRAS

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
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Bulletins are issued periodically by Central Marine Fisheries Research Institute to interpret current knowledge in the various fields of research on marine fisheries and allied subjects in India

Published by
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PREFACE

India is one of the few countries in the world where the traditional small-scale fisheries co-exists with the modern fishing industry and retains a dominant place in terms of production For a major fishing nation which occupies the seventh rank among the fish-producing countries of the world this fact is very significant. India has gone through the process of planned development over the last 30 years. Modernisation of the fishing industry was taken up from the fifties with the hope that it would be possible in course of time, to change the face of the fishing occupation from its artisanal nature to one of modern industry. However, experience has shown that it is neither possible to replace the traditional crafts, nor would it be possible to increase production without the help of the traditional sector. The process of mechanisation took a skewed turn and, instead of assisting the fishermen to acquire, own and operate these boats, it assisted a large number of non-fishermen to make riches and a very small percentage of actual fishermen. Thus the common fisherman stands at the same spot where he stood three decades ago, witnessing the changes taking place around him, prosperity acquired by others and the process of planned development becoming a mere mirage as far as he is concerned.

The human resource of the small-scale marine fisheries sector consists of 1.435 million fishermen population who live in about 2,000 coastal villages spread over a coastline of 6100 kilometres. Active fishermen number 0.323 million. The 0.106 million indigenous crafts operating about 0.739 million numbers of fishing gear units from the capital assets of the small-scale fishing industry. This sector accounts for 0.8 million tonnes in the total marine fish production of 1.3 million tonnes. These figures would signify that fisheries development should not only be in terms of production and economics but should be in terms of an all-round development of a large section of the population which has so far remained outside the main stream of National development by assisting them professionally and socio-economically.

Paradoxically, interest in the development of this sector has been recent although fishing as a vocation is as old as human civilisation. World bodies such as FAO have realised the importance of this sector and have recently turned their attention towards the development of small-scale fisheries in different regions.

The Central Marine Fisheries Research Institute whose R&D programmes have been to a large extent based on small-scale fisheries over the last 30 years, considered that it should give lead by providing a forum for a discussion on the small-scale fisheries of the country and its problems. This led to the idea of organising a seminar on small-scale fisheries. For the purpose of the semiar, the term small-scale fisheries would embrace all fisheries activities carried out traditionally by artisanal fishermen employing indigenous crafts and gears.

Importance of having subsidiary avocations to provide a stronger economic base has been recognised in all sectors. The fishermen for centuries have known only the sea and little else. He must be assisted with appropriate additional occupations which can support him. The techniques of coastal aquaculture which have been developed in the recent years would admirably suit this need.

An overall development of the fishermen community can come about more speedily if attempts at upgradation of professional efficiency are coupled with the development of his environment as a whole through integrated planning of technologies and services.

The above three concepts resulted in the formulation of the focal theme of the seminar and were reflected in the title - **"Role of small-scale fisheries and coastal aquaculture in integrated rural development"**. The seminar

was held at Madras from 6 to 9 December 1978. There was good response from scientists, technologists, administrators, entrepreneurs, financiers, social scientists and others. Research organisations, development departments, universities, training institutes, financial institutions, fishermen welfare organisations and voluntary community development agencies were adequately represented. Special efforts were made to involve the actual fishermen through their representatives in the discussion. Over 200 participants attended the four-day seminar and contributed to the discussion.

On the occasion of the seminar a publication entitled "Present status of small-scale fisheries in India" was brought out by the Central Marine Fisheries Research Institute to serve as background information. Papers for the publication were contributed by the Departments of Fisheries of the maritime States and Union Territories.

The seminar was organised under the following eight sessions:

i) Present status of the small-scale fisheries and coastal aquaculture, (ii) Socio-economic conditions of the coastal rural sector, (iii) Resource potential for capture and culture fisheries in the coastal region, (iv) Technological base for integrated rural development, (v) Postharvest technology, (vi) Man-power requirements and training, (vii) Financing of integrated projects and (viii) Public policies and planning of rural fisheries. The seminar concluded with a plenary session which reviewed the discussions and made the recommendations. Seven keynote addresses and 33 working papers were presented at the seminar.

The participants made 21 recommendations relating to small-scale fisheries, coastal aquaculture, integrated rural development, infrastructure facilities, education, training, extension, fishermen cooperatives, fisheries, financing public policies and planning, and protection against damages to environment. These have been communicated to the concerned agencies for implementation.

The present volume contains the proceedings of the seminar including the papers presented, discussions and recommendations. The Abstracts of Papers were published at the time of the seminar as CMFRI Special Publication No.5.

I wish to record my grateful thanks to Dr. M. S. Swaminathan F. R. S., then Director General of Indian Council of Agricultural Research, and President of this seminar for the unfailing guidance given in organising the seminar. The success of the seminar was entirely due to the cooperation received from various sources. The chairmen and rapporteurs of the Technical Sessions helped in the smooth conduct of the business of the seminar. Shri K. S. Ramakrishnan, then Director of Fisheries, Shri A. Sreenivasan, Shri S. T.Chari, Shri K. M. Md. Sultan and other senior officers of the Department of Fisheries, Government of Tamilnadu extended their full cooperation in conducting the seminar at Madras. The scientists and staff of the Madras Research Centre and also of the headquarters and other Research Centres of the Central Marine Fisheries Research Institute who attended the seminar extended valuable assistance. From the time of the first announcement of the seminar, through the organisation and conduct of the proceedings, to the publication of the present volume Dr. K. Alagarswami assisted me with a deep sense of responsibility. He has also edited the papers for this volume. Able secretarial assistance was given by Smt. K.M. Fatima Beevi and Smt. N. Ambika. Shri K. N. Krishna Kartha has been responsible for getting this volume printed and issued. Grateful thanks are due to all those who have assisted in this first effort in the country in discussing the problems of the small-scale fisheries, identifying the scope of coastal aquaculture as an instrument to bring about integrated rural development in the coastal sector and evolving a plan of action for consideration of the implementing agencies.

April 1980.

E. G. SILAS
Director
Central Marine Fisheries
Research Institute
Cochin.
CONVENER

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WELCOME ADDRESS

By DR. E. G. SILAS
Director, Central Marine Fisheries Research Institute, Cochin

HON'BLE Minister for Food and Fisheries, Government of Tamil Nadu, President Dr. Raghu Prasad, Secretary, Forest and Fisheries, Thiru Thirumal, Director of Fisheries, Thiru Ramakrishnan, Thiru Kuriyan, Dr. Jones, Dr. Ganapati Thiru Alikunhi, Thiru Gopalan, distinguished delegates and participants in the Seminar, ladies and gentlemen;

In recent years, we have been witnessing an ever increasing gulf between two major sectors of marine fisheries, the artisanal fishermen on the one hand and those fishing with mechanised boats and trawlers on the other, resulting in a widening social disparity and consequent imbalances and frictions. In order to critically analyse this pressing problem and examine the various additional inputs that would be required to uplift the socio-economic status of the small frshermen, it was felt that a Seminar on the "Role of Small-scale Fisheries and Coastal Aquaculture in Integrated Rural Development" should be organised.

The city of Madras was chosen as the venue of this Seminar as, within its urban limits, a major part of the fisheries activity is of artisanal nature. The theme of this Seminar inculdes three subjects — small-scale fisheries, coastal aquaculture and rural development, each in its own right important enough to receive independent attention, but in totality are closely linked up, forming a 'trinity'. For the first time in India. we are going to discuss such an interlinked theme in the fisheries sector, with the small fishermen in focus.

In this Seminar we are considering "small-scale fisheries to embrace all fisheries activities carried out traditionally by artisanal fishermen employing indigenous crafts and gears".

The phrase 'small-scale fisheries' may convey an impression that it constitutes an insignificant fishery of little consequence. On the contrary, the major portion of the fish catches in almost all the developing countries of Asia and the Far East comes from this source; it meets the greatest demand of fish consumed, it forms the livelihood of fishermen living along the coast, on the banks of estuaries, backwaters, rivers and reservoirs; it offers employment to a large number of processors and distributors, and supports a variety of ancillary industries.

Small-scale fisheries plays a very significant role in Indian Fisheries. Prior to the introduction of mechanised fishing vessels, the entire fish production of the country was realised by this sector. At present it contributes to above 60% of the marine fish landings of 1.3 million tonnes. All the inland fish produced is by the effort of the small fishermen. Despite its impressive statistics, the sector remains, by and large, underdeveloped, and the men engaged in it are economically lean and socially backward. The sector is not organised and the operational and marketing aspects are still individual based beset with the middleman problems.

The situation poses a great challenge to us— a challenge to face and solve the technical, social and economic problems and issues of the small-scale fisheries; a challenge to meet its policy, strategy and planning requirements and a challenge to implement projects and programmes formulated for its development.

Realising the value and the urgent need to develop this fisheries, not only to provide more food but to relieve the social and economic distress of millions of people, various measures are being taken by the Government and other development agencies. In this context the coastal aquaculture plays a vital role

Aquaculture of fishes and shellfishes in the coastal waters is known in this country for long. However, the state of art as practised in the traditional way has not undergone any appreciable change over the years. Consequently, the

production as well as its value remains low. The problems confronting the development of coastal aquaculture are equally complex.

Our country is endowed with rich fishery resources in the seas around, in the estuaries and backwaters, in the rivers, reservoirs, tanks and ponds. Our coastal waters are highly productive and harbour several commercial fish stocks that can be harvested, by simple crafts and gears. The ecosystems in the coastal zone are equally congenial to culture a variety of organisms. Valuable information on the resources of our inshore waters and on the culture of some cultivable organisms are available The present juncture thus appears to be very opportune to take the best advantage of the resources available through rational exploitation, increased adoption of aquaculture in the coastal sector and proper management to achieve greater fish production, national economy and a new era of rural development of the coastal zone.

In fisheries development projects, human dimensions of development are invariably lost sight of. Frankly, fisheries development projects have hardly given any thought to built-in activities such as socio-economics, quality of environment, health care, family planning literacy, training programmes aimed at self reliance and useful skills, role of women and so on.

Massive efforts by way of developmental assistance, financial investment, use of modern technologies, provision of infrastructure facilities and training of personnel are necessary. This also calls for suitable measures to solve the economic, social and legal issues, and consideration of the hopes, needs and aspirations of fishermen and their community. An integrated action plan with active co-operation at different levels is needed. A coordinated approach by fishery and social scientists, administrators, economists, planners and policy-makers and full involvement of fishermen and fish farmers and agriculturists is highly essential to make an all-round development of the sector. It is in this context that the Seminar is organised to serve as a forum to exchange views, to discuss various aspects of the problems of small-scale fisheries and coastal aquaculture, to formulate views and approaches, and to indicate policies, strategies and other requirements for an accelerated development of the sector. The subject matter of the Seminar has been arranged in eight sessions commencing from this afternoon. We shall look forward to the discussions at each of the sessions to be free, frank and fair so as to identify the problems and the ways and means of solving them We shall look forward for the guidelines that may emerge from the Seminar to go a long way to help accelerated rural development in an integrated manner for the betterment of the small fishermen.

I must welcome the President, Dr. Raghu Prasad, Assistant Director-General (Fisheries) of the Indian Council of Agricultural Research for coming all the way from Delhi for this Seminar. He represents the fisheries interest in the Indian Council of Agricultural Research and has contributed considerably to the marine fisheries research in the country.

To our distinguished Chief Guest, Thiru G. R. Edmud, the Hon'ble Minister for Food and Fisheries, Government of Tamil Nadu, I extend a hearty welcome. He has always evinced keen interest in the welfare of the coastal communities of this State and is intimately seized of the several problems and lacunae in their way of life which needs remedies. During the past few days he has been deeply involved with the redressal of the great distress that has been caused in parts of coastal Tamil Nadu by the severe cyclone which hit the southern districts. With his untiring zeal he will be able to give proper orientation and dimensions to the integrated rural development of the coastal sector.

The Director of Fisheries, Thiru Ramakrishnan is in charge of one of the oldest fisheries organisations in the country. He is already seized of many of the socio-economic problems that beset the small-scale fishermen. We are sure he will be able to aid constructively the fisheries development programmes in the State and also give us the benefit of his ideas and views in this Seminar. I extend to him a hearty welcome.

We have in our midst, today, eminent personalities, experts from different disciplines, leading fishermen and leaders, fish farmers, industrialists and representatives of International organisations such as the F. A. O. of the United Nations, To our humble invitation you have made it conveinent to come all the way to Madras to participate in the deliberations of this Seminar I extend a hearty welcome to one and all.

PRESIDENTIAL ADDRESS

By DR. R. RAGHU PRASAD
Assistant Director General (Fisheries), Indian Council of Agricultural Research, New Delhi.

I consider it a privilege to have been chosen to preside over the inaugural function of this Seminar which has brought together policy makers, research scientists, representatives of fishing industry and the small-scale fishermen and fish culturists. As Dr. Silas has rightly said, we should be particularly grateful to the Hon. Minister for taking special interest in this Seminar, which should be a matter of inspiration for all of us who are interested in the subject. Similarly, the presence of those who are actually engaged in the industry or farming should be of help to the scientists in getting a first-hand knowledge of the field problems so that they could try to suitably reorient their work to meet the immediate needs of the people. Thus it is a happy augury to have all the concerned agencies meeting and discussing matters at a common forum.

This Seminar, as has been mentioned by Dr. Silas, is intended to review the present status of the small-scale fisheries in the context of technologies which are being developed in the field of fisheries, both for capture and for culture, to consider measures for effective integrated operations in order to help in improving the socio-economic conditions of the primary producers and to accelerate the tempo of development in coastal fishery activities. The Indian Council of Agricultural Research, which has always been endeavouring to give adequate research support to the development of the broad spectrum of agriculture, including animal husbandry and fisheries, has thus fully supported the proposal from the Central Marine Fisheries Research Institute to organise this Seminar, also in view of the extreme importance given by the Government of India in furthering the cause of the traditionally weaker sections of the society. We cannot ignore the fact that the present affluence we see in the fisheries industrial sector is largely as a result of the untiring labour of a very large number of artisanal fishermen. In a recent Regional Conference of the FAO, the Prime Minister of Malaysia rightly emphasised that it is not fair that those who produce food are the ones who suffer poverty most. This is perhaps true in all sectors of agriculture, and much more so in fisheries. Any effort to improve the lot of the fishing community, either through direct assistance or by introduction of improved technologies, should be a welcome step. This Seminar, I am sure, would also be discussing about the recent developments in coastal aquaculture technologies and their transfer to the field for adoption at the grass-root level.

While I do not wish to go into the various details at this stage, I thought it my duty as one who has been handling research management for some time, to mention a few general aspects that occurred to me in this context. The foremost is a request to my scientist colleagues to bear in mind the imperative need to evolve technologies that are applicable to our conditions and not to be carried away blindly by the high input and capital intensive technologies of the developed countries. Taking coastal aquaculture itself as an example, this is a field in which many other countries have been making rapid progress in recent times while we here have just started our work. We certainly have made a good beginning too. However, we must always remember that the methodologies developed elsewhere may not be directly relevant to our conditions where the socio-economic level of the people is somewhat different from that prevailing in the affluent countries. The highly successful prawn culture methods of Japan or the various high-input, high-energy and capital-intensive technologies being followed in other regions cannot be followed in toto

by us. Mechanisation of capture fisheries is another area which requires increasing input of energy material for which there is a global shortage and where large capital investments are required. Locally available resources involving low costs and waste-recycling processes might constitute more appropriate techonologies for our conditions.

As far as capture fisheries are concerned, we have a fairly well-established traditional system for the entire coast, with indigenous craft and gear suited for the local conditions. With the fishermen community sometimes adversely involved with unscrupulous middlemen for their finance, and with an increasing trend in mechanisation in coastal fishing operations, the traditional fishing has not developed significantly in the country. While modernisation should be welcomed, it should not be at the expense of the traditional methods. Essential improvements and adequate support to the existing practices alone can encourage the small-scale fisheries development.

We have also been fortunate in having a traditional and age-old system of fish culture being practised even now in many regions, in fresh, brackish and salt waters. With the realisation of the great potentials for developments in this field what is perhaps required is to extend the area under culture, increase productivity through the use of existing technology and increase productivity through the use of new technology. In this effort, the scientists should not lose sight of the main objectives which lie in the economic uplift of the rural population through effective utilisation of available resources and generation of self employment. For achieving this goal, I feel that there is urgent need for establishing effective linkages amongst the various components into a sort of science-technology production system. It is necessary to bring about proper operational collaboration and coordination of all the concerned agencies like research institutions, goverment development departments, agricultural universities, industries and the fishing community. While the research institutions would work out the technologies based on scientific research and undertake limited extension and training, the agricultural universities should be in a better position to render effective technology transfer and spread the technologies through proper extension, demonstrations and training. What has been sometimes called the "open-door" policy on research/extension has achieved remarkable success in China through the 'there -in-one' combination. Leaders or administrators, research and extension workers and the farmers jointly identify production problems and work together to solve these. For example, artificial fish propagation methods which are even now a specialised field generally adopted only by the research scientists or technicians in our country, are being widely used by ordinary fish farmers in Chnia. This is one of the practical effects of the "open-door" policy referred to by me.

In any development process we have to surmount a series of constraints like technical, legal and socio-economic problems Water pollution, for example, is threatening the existence of aquatic organisms in many regions, often rendering the organisms unfit for human consumption. Nursery and feeding grounds of juveniles are fast disappearing due to land reclamation and/or water pollution. Oyster and mussel beds in coastal and estuarine areas are perhaps the worst affected by this. Similarly, the toxic effects of insecticides and pesticides are generally interfering with the culture activities in paddy fields. The concept of aquaculture should take into account within its framework an unified planning in land and water use. Aquaculture, if properly planned and developed can be an effective means for rural upliftment.

If aquaculture has to take proper roots in the country, better development strategies will have to be adopted, particularly by the state governments concerned. A pragmatic review of the present land leasing policies is called for as has been pointed out by many others in different forums. Most of the culturable waters are presently under the control of the government. In order to promote culture work, water areas will have to be leased out for sufficiently long periods of time and on easy terms so that the fish farmer develops a feeling of security for making any investments. Similarly, in many cases it may even be necessary to extend some financial support to the farmer in the form of loans for subsidies in the initial stage at least. This will prevent individuals from getting indebted to greedy financiers. Fortunately there are some credit facilities available through fin-

ancial institutions but even these may require some liberalisation. Therefore, suitable financial packages designed to be responsive to the needs of the small-scale fishermen will have to be worked out and implemented. When once the system gets a foothold and the small farmers or fishermen gain confidence in the viablity of the technologies developed the income of the artisanal fishermen could be increased considerably.

Another area which requires attention is the development of appropriate post-harvest technology covering the entire gamut of preservation, processing, packaging and transportation so that spoilage and wastage can be reduced to the minimum and the produce could fetch higher prices. Similarly, there is much to be desired in our marketing system. Lucrative markets should be develcped so that the primary producers should be able to get reasonably gainful prices. While prices are basically ruled by the market forces, these could be influenced decisively by well-aimed policies.

In the organisation of this Seminar, as I mentioned earlier, participants have been drawn from active fiehermen, agriculture, animal husbandry and fishery scientists, administrators, representatives from cooperatives, corporations financial institutions and voluntary social organisations, social scientists and economists. This is indicative to the enormity and complexity of the problem of finding solutions to upgrade the secio-economic condtion of the small-scale fishermen or fish farmers, in the national policy, this has been given a very high priority. FAO/ UNDP have initiated projects for the development of small-scale fisheries in this region. With the available resources and the potentials it should be possible to achieve more positive results provided we do not go about doing things in a perfunctory manner but feel an emotional involvement in the endeavour to fulfill the task before us. Only when science helps the poor to obtain the basic needs of their life and thereby improve the quality of their life can it claim that it is discharging its social functions. I am hopeful that the deliberations of this Seminar would result in leading to some positive action for the betterment of one of the weaker sections of our society. As Swami Vivekananda said 'let us give up jealousy and conceit and learn to work unitedly for others'. Let us, therefore, make a better use of our human capital and abundant aquatic resources especially for the betterment of the small-scala fishermen.

INAUGURAL ADDRESS

By THIRU G. R. EDMUND
Hon'ble Minister for food and Fisheries, Government of Tamil Nadu

Dr. Raghu Prasad, Dr. Silas, Thiru Kuriyan, Thiru Thirumal, Thiru Ramakrishnan, Ladies and Gentlemen;

It is indeed a great pleaure for me to take part in this Seminar on 'The Role of small-Scale Fisheries and Coastal Aquaculture in Integrated Rural Development' organised by the Central Marine Fisheries Research Institute.

Fish and other aquatic organisms form a cheep source of protein food, essential to meet the nutritional requirements of our population, and they are being exploited from very ancient times. Small-scale fisheries, which denotes all traditional fishery activities carried out by the artisanal fishermen is contributing to a major portion of the fish catch amounting to 70% of the total marine fish production in Tamil Nadu and about 60% of our country. About 25 million fishermen, processors and distributors all over the world and about 55 lakh fisherfolk of our country depend on this fisheries. This emphasises the importance of this sector in production and economy.

The marine small-scale fisheries carried out from about 1,800 fishing villages scattered all along the coast, is rural based. Three lakh active fishermen employing about one lakh traditional craft and 7 lakh gear are engaged in this sector. Although the mechanisation programme, started about three decades ago, witnessed the introduction of 14,000 mechanised boats in our country and 2,200 in Tamil Nadu, the traditional craft still form the principal production means of our fisheries. In Tamil Nadu, the traditional crafts have increased from 28,500 in 1972 to 42,000 in 1977.

In spite of the above impressive statistics, I regret to say that there has not been much progress in this sector over the years. Owing to the unsophisticated methods of fishing, the production continues to be low. Added to this, problems of middlemen and inadequate marketing opportunities have denied the enonomic benefits to the fishermen. Thus they belong to an economically and socially backward sector and lead a life of poverty and privation.

Tamil Nadu Government are taking keen interest in improving the economic conditions of the small fishermen through improved catches of fish. Till 1973-74, we distributed 1.24 lakh kg of nylon, costing Rs. 25 lakhs as subsidy alone. In addition, loans were disbursed to the tune of Rs. 73 lakhs. All those were mainly to the traditional sector. In the VI Plan this Government have drawn up ambitious programmes to assist the small-scale fisheries. 3,400 of the Catamarans and Vallams will be motorised with a subsidy of 50% on engines. It is also proposed to mechanise 800 Vallams with inboard engines giving 50% subsidy. In addition, 2,000 fibreglass boats of 18-20' size are proposed to be distributed to replace the country craft, with a subsidy of 33⅓%. The traditional sector will be given 25% subsidy for nylon gear. For this, a sum of Rs. 20 lakhs has been allotted. In order to enable the fish caught by small scale fishermen to be brought ashore in prime condition, 3,300 insulated boxes will be supplied on 50% subsidy basis. To facilitate rapid movement of fish from the landing centres to marketing places, the Government have allocated Rs. 200 lakhs in the VI Plan for link roads. This will enable us to increase the consumption of fresh fish from 65% to a higher level.

With the increasing fishing effort, the demand for 180 tonnes of fish nets produced at present in our State may go up and this gives vast scope for developing a large number of net making orgonisations in the cottage industry small-scale industry or cooperative sectors. This

will provide plenty of employment opportunities for womenfolk.

Tamil Nadu Government will be embarking on a small-scale fisheries project with the assistance of FAO. Initially the project is likely to be located in Thanjavoor District.

I would request the delegates assembled here to thoroughly discuss the various aspects of the problems of the small-scale fisheries and the artisanal fishermen, introduction of powered boats, and their impact on coastal rural development. Thought may also be bestowed on the elimination of conflicts between the traditional sector and mechanised sector.

I am told by the scientists that the resources of the seas are limited and we have to have recourse to coastal aquaculture to augment fish production Further, it is job-oriented and labour-intensive. All over India we have shallow coastal belts, backwaters, lagoons, estuaries and mangrove swamps which could be put to good use to raise fish, prawns, mussels and oysters and seaweeds. It is reported that mussel culture would yield a production of over 200 tonnes per ha per year. Prawns and lobsters which are high value species will bring us much needed foreign exchange. Recent work done by our fisheries department had indicated that culturing of tiger prawns and the white prawns is highly profitable. This seminar can throw more light on the important aspects of coastal aquaculture. It is also essential to transfer the technologies developed to fishermen and fish farmers for their adoption in the field.

Our ultimate aim is to improve the status and economy of the rural population and the Seminar should have deliberations on how best this can be achieved through the twin tools of small-scale fisheries and coastal aquaculture.

To develop an industry, Government assistance alone is not enough. An integrated approach involving the planners, administrators, sociologists, scientists, economists and financial agencies is essential for harmonized growth of the sector. Finance is available for large-scale fishing enterprises but the small-scale fisheries does not get the benefit of financial support. I therefore suggest that the nationalised banks must come in a big way to finance viable small-scale fisheries enterprises as well as coastal aquaculture efforts. That will remove the major bottleneck in development of fisheries in these areas.

I wish the Seminar all success.

Thank you.

ADDRESS TO THE PLENARY SESSION

By M. S. SWAMINATHAN
Director General, Indian Council of Agricultural Research, New Delhi

I am glad that there is a broad spectrum of expertise available here today. I heard views expressed by several fishermen representatives, scientists and government officials. Unless we get together and pool our knowledge, as you have rightly done at this seminar, it is very difficult to approach problems in an integrated manner, as it is so in the case of human body which consists of several parts and is healthy only when all the parts work in a coordinated manner. The seminars like this, unlike symposia which are aimed at enlarging the frontiers of knowledge, are intended to advance frontiers of production — in this case fish production. I am happy to see here the eminent doyens of fisheries science, fisheries administrators, fishermen representatives, scientists' social workers and also people involved in developmenal journalism With this enlightened group it should be possible for you to come to action-oriented conclusions, so that this seminar would serve as a milestone in our progress to improve fish production.

I heard somebody raising a question this morning as to why the name small-scale fisheries. To me a distinction appears wrong, for all fishermen must be treated alike. Of course there are four major points of distinction between what is generally termed as small-scale fisheries and large-scale fisheries. First is that the human being play a much more important role in small scale fisheries than in large-scale fisheries. Second is capital input: while small-scale fisheries are labour-intensive the large-scale enterprises are capital-intensive. The third distinction is an ecological one. The large-scale industries have got problems of pollution and many other repercussions which are associated with it. The last, but not the least is in the kind of energy used. The small-scale industries use the recycling or renewable type of energy. In large-scale industries more and more energy of non-renewable type is used. Here we have Mahatma Gandhi's concept or what is now called Small is Beautiful concept, by which the dignity of human labour is respected, and, by conservative use, the non-renewable type of energy is not exhausted. As far as scientists are concerned, this last distinction is all the more important because any technology which can be adopted by a person with small means can be adopted by a person of large means, and the reverse is not ture. This is an important parameter in the development of scientific strategy. The scientists must see that everyone, whether a small fisherman or a big fisherman, must have a role to play in the exploitation of the technologies developed. The fishery scientist must also take into account the cost-benefit effects.

Aquaculture, whether it is coastal or inland, has a very high potential for increasing fish production. Fish is a most efficient converter of energy, converting plant food into nutritious animal food, and therefore has a number of advantage in terms of productivity. But if you want to develop the aquaculture industry on a sound basis you must first attend to the ecological aspects of aquaclture because it is very basic. In other words, we must protect the assets upon which aquaclture is based. If we start damaging the numerous large rivers, backwaters and estuaries, and the vast ocean, then we will sooner or later be exhausting them.

The preservation of the genetic material is equally important. One of the immediate steps we have taken for this purpose is to establish a National Bureau of Fish Genetic Resources. In our country, starting from the very-cold-water fisheries in the Himalayas in the north to the warm water fisheries both in inland and seas in

the south, we have a tremendous amount of fish resources. The Bureau will be involved in catalouging, classifying, preserving, and helping in the proper utilsation of all our valuable fish genetic resources. The preservation of the genetic material may be in situ preservation in the from of marine parks and sanctuaries, as we have sanctuaries for the wild life.

We have the classical example of depletion of a wonderful asset of marine fauna in Krusadi Island. The island was once a biologists' paradise. But since we have not taken care to preserve it we have lost some of the valuable strains. My appeal to the Government of Tamil Nadu will be to ensure that this island is soon developed into a very fine national park. The scientists on their part must identify similar assets as the pearl-oyster beds, and the governments take steps in preserve them so that we do not deny to posterity thousands of years' work of Nature.

You have discussed at length the technologies for production and also for post-harvest utilisation both for culture and capture fisheries But, I must tell you that fish is only a secondary converter of energy and not a primary producer. It requires food and, therefore, a lot of research effort must go into aspects of fish nutrition. Another important thing is fish disease. We must remember that when we change the micro-environment in any production system there are bound to be reactions which may not be favourable. When the ecology of a pond is changed with a very high stock of fishes new fish diseases will develop, which has happened in every high-production system. The poultry people are faced with new kinds of diseases which were not there before. Similarly, the rice people are faced with brown plant-hopper disease. The fishery scientists may also face such problems when they go in for high production systems. They must do impact analysis and see what are the repercussions favourable or unfavourable. The analysis must include also technologcial, ecological and social consquences.

Our research base will have to be strengthened to deal with all these problems. Besides the research programmes under the Indian Council of Agricultural Research, we have the Department of Science and Technology concerned with our ocean resources. The National Remote Sensing Agency is concerned with thermal mapping of the oceans and also mapping of fish shoals Our Agricultureal Universities too have programmes concerning fisheries. Thus we are strengthening our efforts in terms of capabilities in research field. We must pool all these resources for the benefit of improving our fisheries.

Any country which has tried to launch big developmental projects based on foreign technology has not succeeded. Each technology has to be adapted to the conditions of the country which adopts it. We have Japan as a classical example in adaptive research. They made tremendous progress by getting some technologies, innovating them and adapting them to their own conditions. Of course, unless a country has its own strong research and training base it will not be able to sustain a dynamic programme.

We have fisheries colleges now in Karnataka, Tamil Nadu and Kerala, and practically every other state is planning to develop such colleges. These colleges in our country will have scope only if the curricula are intended to promote self employment, and not merely to train people to take up jobs in fisheries departments. The curricula must be reoriented in such a way that the fisheries graduates will know something about horticulture, agriculture, silviculture and so on, so that they will be perpared for developing integrated farming systems. Again, the curriculum must not be standardised one. It will be successful only when the unique is in marriage with the universal. There are certain universal principles of science or the ground rules which everyone should know. But there are some unique possibilities in each area which will have to be included in the curriculum of that area. The graduates coming out of the fisheries college with such curricula will thus be equipped for self employment. If we can achieve this, coastal aquaculture can make great progress in our country.

Indian Council of Agricultural Research is not a developmental agency. But, as an agency in charge of research and education it is very importont for us that we are able to convince the field extension workers the economic viability of the projects we are advocating. We have developed three mechanims

for this. One of them is the Operational Research Project. This is intended to involve the people themselves in the exploitation of the technology and to assess the operational problems in the transfer of technology. You have seen one project, on the blending of culture fisheries with sea farming, at Kovalam which is being run by the Central Marine Fisheries Research Institute. Similarly, the Central Inland Fisheries Institute have rural aquaculture projects in Orissa and West Bengal. We would be starting a few more operational research projects in the next few years.

The next important device is the National Demonstration programme. This concept was devised by the Indian Council of Agricultural Research in 65-66 on the experience that for a farmer seeing is believing, at a time when the high yielding varieties were introduced. This programme was an immediate success. In fisheries, too, we must develop a series of such programmes.

The third mechanism is the Krishi Vigyan Kendra. This morning the fishermen's representative from Gujarat mentioned that there must be more Krishi Vigyan Kendras. Certainly there is more need for this, but we must see that the principle of the institution does not get diluted. The kendra is based on two things One is that there must be some new technology we impart to the fishermen, such as aquaculture, induced breeding or fish-seed bank. The second principle is learning by doing. This is very important and must be related to local requirements. Utmost care has be taken in the selection of teachers because they must practice what they preach. They themselves must work in the farms and make the farmers learn the technology by doing what the teacher himself does. The Krishi Vigyan Kendra must be a radiating centre and be able to reach the farmers in their fields. It must be a mobile training institution. Therefore, those who are interested in setting up Krishi Vigyan Kendras should bear in mind these ground rules which should be adhered to.

In our country there is a lot of discussion on technology vis a vis social conditions. Technology can be an instrument of social change and vice versa social change can also trigger technological change. Our farmers on the land have shown that a green revolution is possible. In a recent article in London Economist it is stated that it is not green yet everywhere, but it can be green. It can be because the Indian farmer is capable of progress, if he is properly helped by the scientists, administrators, and above all, by the political leadership by formulating proper policies. I am confident that this is in *toto* applicable to the fisherman. I am pretty sure that if our fisherman is given proper back-up he will bring about an era of aquaplosion in the near future.

SESSION I

PRESENT STATUS OF THE SMALL-SCALE FISHERIES AND COASTAL AQUACULTURE

Keynote Address

By Dr. T. A. MAMMEN
Director, Marine Products Export Development Authority, Cochin

The subject of small scale fisheries is of considerable importance and coastal aquaculture is one of the new areas of development that can benefit the small-scale sector.

India has a fishermen population of 5.58 million, representing about 1% of the total population. Of this, 328,900 are full-time fishermen, 210,000 are part-time fishermen, 175,600 are engaged on marketing, 117,200 on fish processing and 103,700 on ancillary industries. Taking the average size of a fisherman family as 5.5, there are about a million families depending on fishing for their livelihood.

The developmental effort during the last 30 years has benefitted only about 50,000 fishermen (and their families) enaged in about 12,000 mechanised boats. The rest still continues their relentless fight with the wind and the waves to make out a living. It is indeed a blemish in our planning that this sector, which accounts for 95% of the fishing population, has not been significantly helped to a better living in the successive plans. Of late, at least an awareness has been created on the need for schemes specially designed for the development of small-scale fisheries. I shall briefly discuss some of these development efforts.

The small - scale sector is employing about 100,000 fishing crafts, of which about 50% are catamarans. In the initial stages, the planners thought that one day in the distant future, country-boats and catamarans would be replaced by the more respectable looking motor boats, but the fact has been contrary to this expectation. The 1976 live-stock census indicates that the number of unmechanised boats is increasing at an alarming rate, while the pace of introduction of mechanised boats has not been far beyond the annual replacements. The question naturly arises as to whether these primitive crafts are going to be replaced at all or any improvement in the design of catamaran would be possible, if they cannot be replaced by mechanised boats.

The catamaran, despite its primitive design, is the most versatile craft, unsinkable, capable of operating from any type of shore, can be dismantled and assembled without any difficulty and repairs and replacement do not present a problem. Yet so far as the fisherman is concerned it gives him no protection against wind, sun or water. Like the bullock cart, a suitable replacement is hard to find. But, of late, some thought has gone into it. At least one naval architect is designing a rubber catamaran, while the first fibreglass catamaran with some innovation is getting ready to be launched.

Take the canoe or the plankbuilt boat. Under a World Bank-assisted scheme canoes are proposed to be given a fibreglass sheathing in Gujarat. Under another scheme with DANIDA assistance in Tadri in Karnataka, soft wood boats are proposed to be upgraded using radiation technique. Unfortunately the canoes cannot take the conventional in-board engine. Petrol out-board engine is too costly for operation. No wonder the petrol version of out-board motors

by M/s. Veegal Industries, Calcutta, was a non-starter. The results of introduction of a 100 Evinrude petrol driven out-board engines at Muttom revealed that only the above-average fishermen who judiciously used the outboard engine were benefitted, while the below average lost heavily. Now M/s. Escorts Ltd., Faridabad is licensed to manufacture diesel outboard engines under licence from the Japanese 'Yamaha' Company. Yet a simpler method is the 'long tail engine' of the type one finds in Bangkok. It is a small pivoted engine carrying a long propeller shaft at one end and a handle at the other end, with none of the usual fittings like rudder, stern tube, reduction gear etc. The Marine Products Export Development Authority is proposing to try this out on a dinghy. I am told that under the Small Scale Fisheries Project of the FAO/UNDP, this sort of 'long tail engines' are being introduced in Pakistan.

Coming to gear, the conventional cotton twine has largely been replaced by synthetic twine and this perhaps is one instance where the traditional sector has benefitted.

On the introduction of mechanised boats we have a fairly impressive record. Starting with the 1st Plan, over 16,000 mechanised boats were introduced out of which an estimated 12,000 are in operation. Initially they were mostly motorised boats for gill netting Then came the trawler in search of prawn. During the last 3 years about a 100 small purse-seine boats were introduced in Karnataka. This wave of interest is expected to sweep to northern part of Kerala in the coming few years. Here it should be noted that it was the intermediate technology that survived. The boat, though 43½ ft long, is in wood and has a manually operated purse-seine, with none of the sophistications like power-block or triplex, while the world trend is for super-seiners, carrying even a helicopter for spotting of shoals. Trap fishing, light fishing etc. are the other promising lines of diversification. However, as already mentioned the benefits of modernisation have been reaped only by a small fraction of the fishermen, leading to a familiar' situation, where the rich has become richer and the poor poorer.

The Govenment of Kerala has a scheme for mother-vessel fishing, a scheme tried out by the erstwhile Travancore University in the late' forties. Here countrycrafts will be towed to and from fishing grounds. This is yet another intermediate technology.

Regarding storge of fish on board, still the age old practice of bringing fish on the open deck is continuing. Country-crafts have no fish-hold and the fishhold in small mechanised boats is not found to suit the fishermen. Recently MPEDA has evolved a suitable design of a fish box, which is now taken up for mass production.

Fishermen housing has received a fair attention in almost all maritime states, particularly in Kerala. The newly formed Fishermen Welfare Corporation in Kerala has ambitious scheme for providing more and more houses

During the V Plan, under a Centrally Sponsored Scheme an Integrated Area Development Scheme was launched. Under this scheme, approach road, water supply, fish curing yard, ice plant, insulated trailer, community hall etc. were provided as a package programme for 2 fishing villages in each State. The scheme was a success and many States included sizeable plan allocations to provide such facilities in many more centres in the VI Plan.

Interest on coastal aquaculture is relatively recent. Viewed in the context of employment, coastal aquaculture has great prospect, both in on-shore and in-shore areas. In most of the developed countries, entry into fishing is strictly controlled. This is because, with the high cost on labour, governments restricted indiscriminate entry of new fishing units, lest the entire fishing operation becomes uneconomical. In India, we have no such restriction. Yet, a good number of fishermen are unemployed or under-employed. Catch per unit effort is poor.

Viewed in this context, there is need for an alternate vocation. There are extensive derelict brackishwater lakes, estuaries and backwater. We can put the surplus manpower to produce something by culture from these derelict water. Can we not take this idea of aquaculture to the edge of the sea or to the protected bays. The field is tremendous. First the technical feasibility has to be established, then the economic viability. There are many administrative problems like land ceiling, land utilization acts, security, clash of economic interests etc. Yet I do not subscribe to the view that we should wait for

answers for all our problems before we embark on a scheme of this nature. There is no ready-made prescription to all eventualities and it is always the early bird that catches flies. I would call upon my colleagues from the industry to show the entrepreneurship and take a calcuated risk, at least in such areas where the technology is more advanced. I would at the same time, request those in possession of technology to arrange for the transfer of technology. As a result of efforts on the transfer of technology, currently there is a wave of interest on shrimp farming. Central Marine Fisheries Research Institute has a proposal for undertaking elver culture on a pilot project basis. In one of my recent market survey reports, I have suggested culture of the freshwater cray-fishes like marron and the yabbie, the culture of which is already popular in Australia.

CMFRI has some very encouraging results on mussel culture and pearl oyster culture; both are economically attractive. Even in countries where the cost of labour is high, mussel culture has been found to be economical. Pearl oyster culture is considered even more economical, once the technique is perfected. I am sure this seminar will give proper direction in this regard to researchers, administrators, fishermen and the fishing industry.

PRESENT STATUS AND ROLE OF SMALL-SCALE FISHERIES OF INDIA

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INTRODUCTION

India has a coast line of 6100 km and fishing is one of the oldest professions practised by a large section of people living along the coastal areas. About 2000 fishing villages are spread over along the coast line and over 0.32 million active fishermen are engaged in small-scale fisheries, employing indigenous crafts and gear, adopting traditional methods Prior to the introduction of mechanisation in the fifties, the entire marine fish production in the country was by the small-scale sector. At present, the contribution from this sector is estimated at about 65% of the total marine fish landings in India and 0.5% of the Gross National Product (GNP). The indigenous crafts and gear deployed by this sector represent one of the largest collective private investment in the fishing industry.

The small-scale sector is essentially rural and the fishermen belong to the economically weaker section of the society living in social isolation in remote villages. This sector was largely ignored till the dawn of Independence. In recent years, the term 'integrated rural development' has gained general acceptance by politicians, planners, administrators and scientists. This aims at promotional activities in areas such as agriculture, livestock, fisheries, cottage industries etc. with the ultimate object of achieving a fuller utilisation of available human and natural resources resulting in a better quality of life for the rural population.

Nearly 100 million people in the country are reported to be chronically malnourished and poor. India's total population is expected to touch 1000 million mark by 2000 A. D. and the food grain requirement alone would be of the tune of 220 million tonnes. Since land is definitely going to be a limiting factor in increasing food production, we have to turn to fisheries as the source from which the immense protein-calorie requirement has to be met. Capture combined with culture fisheries has to become the principal alternative.

Although, considerable progress in development of fisheries has been achieved during the last three decades, the problems of small-scale fisheries concerning the methods of operation, ineffective craft, low production rate, marketing of the catch, procurement of fishing implements,

conservative nature of the fishermen and their reluctance to adopt new techniques and methods of fishing require immediate attention. It is here that the scientists have a vital role to play in achieving the rural transformation through professional scientific skill. The important step is to prepare a balance sheet of assets and liabilities of the small-scale fisheries sector, the analysis of which will help to identify the developmental opportunities that exist and the bottlenecks to be removed.

FISHING CRAFTS

Table 1 shows the statewise break up of the coast line, fishing villages, active fishermen, indigenous crafts and fish landing centres. There are about 17 principal types of indigenous crafts, falling under 6 broad categories based on their construction, found suitable by experience for the surf conditions in different areas. They are:

1. Plank-built boats of north-west coast
2. Dugout canoes of south-west coast.
3. Plank-built boats of south-east coast.
4. Catamarans of Coromandel coast
5. Plank-built boats of Andhra coast
6. Plank-built boats of north-east coast

All of them use oars and sails for propulsion.

The traditional plankbuilt boats of North-west coast are one of the best types of indigenus crafts and compare well with the modern craft invloving naval architecture and design. They vary in size ranging 12-15 m in length. The most important feature of these crafts is the long bow and the rather abrupt and round stern. The bow shape and profile varies from place to place giving the boat specific features such as 'Satpati' type, 'Bassein' type, 'Machwas' etc. They are generally built of teak frame and planking with subsidiary upper strakes of mango wood to reduce costs. They carry a single mast and a great press of sail. These are free-board boats low in waist without deck or accommodation for crew or nets.

As the name implies, the dugout canoe of the south-west coast is made by scooping out a large log of wood, keeping the keel portion thicker than the sides. The average life of a dugout canoe is estimated to be 10 years. They are predominantly used in Kerala and southern parts of Karnataka. Fewer numbers are found in Gujarat and Maharashtra. Outrigger canoes are prevalent in Karnataka. The outrigger is formed by two curved poles and a float. The poles are laid across the waist of the boat and extended 1.5 to 2 m on one side of the boat to give stability. In North Karnataka a layer of planks is stitched to the dugout canoe to increase its size and capacity.

Catamaran is a keel-less craft formed by lashing together several curved logs and shaped like a canoe. The logs may be lashed together either by ropes or by wooden pegs. There are local modifications of the catamaran such as Orissa and Ganjam type, Visakhapatnam type, Coromandal type, boat-catamaran and raft. The latter two

TABLE 1. *Statewise information on coastline, fishing villages, active fishermen, Indigenous crafts and fish landing centres.*

State	Coast-line (Km)	Fishing villages	Active fisher-men	Indigenous crafts	Fish landing contres
Gujarat	1500	179	22,518	4,197	108
Maharashtra	600	299	41,539	8,288	173
Goa	110	40	4,067	1,118	40
Karnataka	270	145	21.740	6,248	95
Kerala	600	268	80,898	21,718	228
Tamil Nadu & Pondicherry	960	395	72,105	32,268	395
Andhra Pradesh	970	408	64,592	25,976	280
Orissa & West Bengal	1080	179	15,076	6,667	51

are found along southern Tamil Nadu and Kerala. They vary in size extending up to 8 m in length. The boat-catamaran is a large catamaran composed of three logs semi-permanently secured by cross pieces at either end in such a way that the side logs rise higher than the upper surface of the central one. Thus a longitudinal hollow is formed similar to the depression in the boats.

Masula boat is a non-rigid craft which is constructed with planks without frames or ribs so as to withstand the severe knocking from the surf. There are various patterns such as 'bar' in Orissa, 'Daduga' or 'Padugu' on the Andhra Coast. A variant with ribs inside has been developed in some parts of Andhra Pradesh. These boats are up to 8 m in length, although they are generally smaller. The 'Nava' is another important craft of Andhra Pradesh which is a keelless sail boat, strong enough to land with full load on sandy beaches. even in surf. The Tuticorin type of carvel boat is about 11 m in length. The 'dinghi' and 'nauka' are well-designed boats of West Bengal and Orissa ranging up to 13 m in length.

'Mas odies' are traditional crafts about 9.75 to 12.2 m in length with a beam of 2.13 to 2.74 m, peculiar to Minicoy. They are streamlined and keeled for windward sailing. These boats are provided with 14-18 oars, according to the size and are engaged in pole and line fishing

Table 2 shows the salient features of some of the important indigenous fishing crats. The different types of non-mechanised crafts at present are estimated at 106,480 in coastal small-scle fisheries. The first estimate made in 1951 was 69,915 indigenous crafts, which shows a considerable increase in three decades.

FISHING GEAR

There are a number of gears indigenously developed by the fishermen for exploiting differeni fisheries in the coastal areas, to suit local conditions Broadly, the gear employed in small-scale fisheries can be grouped under 8 principal categories which may have local modifications. There are 1) fixed nets, 2) seine nets, 3) cast nets, 4) scoop nets, 5) drift nets. 6) traps, 7) hook and line, and 8) miscellaneous appliances like fish spears. harpoons, etc.

Among the fixed nets, 'Dol' is the most popular gear of the north-west coast. It is a large

TABLE 2. *Salient features of important indigenous inshore fishing crafts of India.*

Crafts	Size (Meters)	Construction	Life time (Years)	Propulsion	Crew
Catamaran	L: 4-7 W: 0 7-1 4	2-5 logs tied together in a raft fashion.	10	Manual	2-4
Dugout boats	L: 3.6-10 W: 0.5 1 25 D: 0.45-0.7	Hollowing out single log of wood	10	Manual	2-3
Dugout canoe, Flat bottom	L: 9.5-5.4 6.6 W: 1.6;0.9-1.3 D: 0.7;0.5-0.6	Hollowing out a single log of wood	10	Manual	
Plank-built boats	L: 6-14 W: 0.9-3.3 D: 0.6-1.0	Wooden Planks stitched or nailed to form a rigid frame	10	Manual (Some are machanised)	7-12

L - Length; W - Width; D - Depth. Source : 'Indian Fisheries 1947-1977'

conical bag net which is fixed to wooden pikes driven in the sea bottom or to thick moored ropes using floats and sinkers. All types of fish and prawns which have the habit of moving inshore with the tidal current are liable to be caughr in this gear This method of capture is most common in Gujarat and Maharashtra.

Seines are mainly of two types, *viz.* 1) shore seines and 2) boat seines. Shore seines are common along the south-west and south-east coasts of India. The shore seines of east coast are invariably with bags and scare lines which drive the fish into the bag. The biggest shore seine popularly called 'Rampan' is a wall-like net operated in South Konkan and Karnataka regions. The 'Rampan' is mostly used to catch mackeral and sardine which strike the coast in huge shoals. Boat seines are conical nets with or without wings and are mostly operated in the Kerala, Tamil Nadu and Andhra coasts. They are either single-boat type or two-boat type.

Gill nets and entangling nets are single walled nets which may be of the set or drift type. Drift nets are of considerable importance in catching most of the prime varieties of fish. Their operation involves the drifting of the boat as well as the net along with the current. The fish while moving about are either gilled or entangled. A bottom-set drift net is characteristic of Gujarat and Maharashtra coasts for catching pomfrets and 'Dara'. On the coasts of Karntaka and Kerala the drift nets are of the surface type mainly meant for shoaling fishes Surface drift nets are also used on the east coast for catching lesser sardines. Similar nets with larger mesh are used mainly for catching seerfish and catfish

Hook and lrne fishing consists of four types, *viz.* hand lines, long lines; pole and line, trolling lines. Long line fishing is the most important commercial gear in this category It consists of a very long horizontal main line with vertical branches spread at uniform intervals, each branch bearing a series of baited hooks Pole and lIne is mostly used for tuna, and trolling lines for seerfish in Minicoy.

Table 3 shows the salient features of import-

TABLE 3. *Salient features of the important indigenous fishing gears.*

Gear	Size (length in metre)	Mesh size (cm)
Fixed Nets		
a) 'Dol'	12-200	1-at Cod end; 4-12 near mouth
b) Ghaja	5	1-at Cod end
c) Bagnet of E. coast	13-7-35	0.5 10 at Cod end; 4 10 at mouth
d) Stake nets	12-30	1 2 at Cod end.
Seine Nets		
i) Boat Seines		
a) Kollivala	73	1 at Cod end 2 at mouth
b) Thanguvala	50-65	2 at Cod end
c) Boat seine of E. Coast	22-26	1 at Cod end 9 at mouth
d) Madivala	49	2 at Cod end
ii) *Shora Seines*		
a) Rampan	200-600	1.2 to 5
b) Yendi	80-150	1.2 to 5
c. Kanebavalla	316	0.8 at Cod end
d) Korubalai	9	1.0
e) Bari	5 5	1.0
f) Karavalai	317	1-2 at the centre
g) Alivivala	364-634	1.2
h) Drag Nets	3.6-18.3	0.6 - 1.2
Cast Nets	2.5-6 in radius	1.2
Scoop Nets	9.10 square	0.2 at Cod end
Drift Nets		
a) Kantha bala	48-125	5-6
b) Pattavala	216-270	3.0
Traps	0.5-1.8 high	
Longline & Head line	Several hooks of 1-3 numbers	

Source : Indian Fisheries 1947 - 1979

ant gears used in small-scale fisheries. The different types of nets in use are estimated at 738,984 numbers.

The catch composition from the small-scale sector is shown in table 4. Oil sardines, lesser sardines, mackerel, Bomby-duck and shrimp are the prinicipal fisheries, together accounting for nearly 62% of the catch. The three major fisheries mainly come from the west coast.

TABLE 4. *The 5 year mean (1972-1976) of the marine fish landings in India and the approximate catch landed by the small-scale sector by indigenous carfts and gears (in tonnes).*

Name of fish	5 year Mean All India Marine catch	%	Catch landed by the small scale sector	%
1 Elasmosbranch	56210	4.24	28105	3.21
2 Eels	5309	0.40	265	0.03
3 Cat fishes	131658	9.93	52663	6.02
4 *Chirocentrus*	10485	0.79	2621	0.30
5a Oil Sardine	145367	10.97	145367	16.62
b Other Sardines	191567	14.45	138886	15.58
6a *Harpodon nehereus*	72756	5.50	72758	8.32
b *Saurida* and *saurus*	8158	0.61	4079	0.47
7 *Hemiramphus* and *Belone*	1910	0.14	287	0.03
8 Flying fish	2448	0.18	2203	0.25
9 Perches	25477	0.92	12739	1.46
10 Red mullets	4871	0.38	2486	0.28
11 Polynemids	11169	0.84	5585	0.64
12 Sciaenids	82195	6.20	41093	4.70
13 Ribbon fish	55499	4.10	27750	3.17
14 Carangids	28654	2.16	14327	1.64
15 *Leiognathus* and gazza	44023	3.32	26414	3.02
16 *Lactarius*	10835	0.82	1086	0.12
17 Pomfrets	25170	1.90	22653	2.59
18 Mackerel	70571	5.32	70571	8.07
19 Seer fish	20273	1.53	12164	1.39
20 Tunnies	10298	0.78	5149	0.59
21 Sphyraena	3076	0.23	154	0.02
22 *Mugil*	3074	0.23	1844	0.20
23 *Bregmaceros*	2599	0.19	2599	0.30
24 Soles	13156	1.00	13156	1.50
25a Penaeid Prawns	111418	8.86	58190	6.71
b Non-penaeids	72713	5.49	58170	6.65
c Lobsters	2641	0.20	264	0.03
d Crabs and other crustaceans	17239	1.30	13791	1.58
26 Cephalopods	5022	0.38	100	0.01
27 Miscellaneous	73588	5.55	36794	4 20
	13,25,541	100.00	8,74,832 (65.9%)	100.00

Source : CMFRI, Cochin.

COST-BENEFIT ANALYSIS

Small-scale fisheries is an enterprise created, manned and managed by fishermen from time immemorial. It is an enterprise producing food for the society and the principal source of income of the participants. Based on 1973-74 estimates, the contribution from this sector to the GNP was 0.5%, the GNP being Rs.5,21,930 million. In a commercial enterprise, it is easy to assess the costs and benefits that can be quantified in terms of money. The inputs in case of small-scale fisheries are:

1. Cost of the craft
2. Cost of the gear
3. Labour
4. Maintenance, and
5. Depreciation on capital.

The benefits are;

1. Value of the output and
2. Value of by-products and shadow benefits.

In the present analysis only direct benefits relating to the value of the output, *i.e.* catch only is taken, as the by-products or shadow benefits are marginal. So also only direct costs are considered here. Since depreciation is taken into account, the capital costs do notfigure in. However, the estimated capital costs are shown in Table 5.

Direct costs

Under this, wages, maintenance cost and depreciation charges are included. Wages are calculated at Rs.8 per fishing day for 365 fishing days a year engaging 0.32 million fishermen. For maintenance, Rs. 50 per catamaran and Rs 200 for all other types of crafts, Rs 100 for all the gear are taken for calculations. To determine depreciation, the life of the craft is taken as 10 years and the life of a net as 3 years and a straight line depreciation at 10% for crafts and 33.33% for gear is provided.

Direct benefit

Estimating the landed value of the marine fish production at about Rs. 360 crores, the share of the small-scale fisheries sector at 60% production would amount to Rs.216 crores.

Net gain – Rs. 216 crores - 157.41 crores

- Rs.58.59 crores.

The captial investment in the small-scale sector is estimated at Rs.201 crores, the indigenous crafts accounting for about Rs. 53 24 crores of instrument and the gear for about Rs. 147.80 crores. Keeping in view the large number of fishermen involved in the venture, it will be seen that the profits earned by the fishermen are only marginal (Rs. 58.59 crores). Thus the net annual income of individual fishermen works out to Rs 1817 or Rs.151 per month, exculding his wages.

No interest on the capital investment is included in the present estimate, the wages and

A. *Labour*: Rs.8.00 x 365 x 3,22,532		- Rs. 94,18 crores.
B. *Maintenance*:		
1) Catamaran - 58,392 x Rs.50		- Rs. 29,19,600
Other types - 48,088 x Rs.200		- Rs. 96,17,600
		- Rs. 1,25,37,200 or
		- Rs. 1.25 crores or
2) Gear - 7, 38, 984 x Rs. 100		- Rs. 7,38,98, 400 or
		- Rs. 7.39 crores
	Total of B	- Rs. 8.64 crores
C. *Depreciation*:		
Crafts 10% of Rs. 53.24 crores		- Rs. 5.32 crores
Gear 33.33% of Rs. 147.80 crores		- Rs.49.27 crores
	Total of C	- Rs.54.59 crores
Total recurring expenditure (A + B + C)		- Rs.157,41 crores.

maintenance costs are kept at low level and a very reasonable price taken for the produce.

It may not be out of context to point out here that the small-scale fisheries need considerable governmental support if the industry has to survive Both agriculture and fisheries and food producing ventures. The farmer today enjoys considerable public support in the from of irrigation facilities, land lagislation and financial support such as easy loans for procurement of inputs like fertilisers, seeds and pump sets. Besides, the farmer gets the benefit of price support and warehousing facilities for his produce. Contrary to this, fishermen produce food with a very high content of protein and fat without much public support, financial aid or price support The fluctuation in the price of his produce is very wide and he suffers on either account. The prawns are the only commodity which gives a good return in view of export value. But they form barely 7-8% of the catch. It may also be pointed out that the landed price of fish has not shown any appreciable increase as compared to all other agricultural commodities while cost of inputs like timber for boats, different types of twine for gear are all the time on the increase. The small-scale fishermen cannot afford to store his produce, being highly perishable. Therefore there is a strong case to provide some sort of price support to the fishermen as an incentive.

The inshore area usually harvested by the small-scale sector is being fished by the mechanised boats also. The artisanal fishermen need some protection to be able to fish in the traditional zone without competition from the powered boats. Otherwise the small-scale sector which contributes almost 65% of the total marine catch is likely to wither out in course of time in view of the competition it is facing from the organised sector.

For more than 100 years, India has been exporting to neighbouring South-East Asian countries fish and prawns cured and sundried. During the last three decades, with the new technology of processing shrimp by quick freezing and canning, and with the growing demand for this commodity, the export earnings have increased. The growth of exports from Rs.24.5 million in 1950 to Rs. 1797.4 million in 1977 is really spectacular and deserves every encouragement.

MECHANISATION OF FISHING CRAFTS

During the first three Five-Year Plan periods and the following three Annual Plans. the main emphasis in marine fisheries development was on the mechanisation of existing fishing crafts and introduction of new mechanised fishing boats. The programme of mechanisation has been the most significant aspect of development towards increasing fish production. The progressive total number of mechanised boats by the end of each Plan period was as follows:

Pre-Plan Period	13
First Plan	863
Second Plan	1298
Third Plan	3045
Three Annual Plans	6458
Fourth Plan	10613
1977	13352

Credit for the use of mechanised vessels goes to the private sector. The first attempt to convert a 22-ft sailing craft into a mechanised vessel with the installation of 22 BHP engine was made by the then Burmah-Shell Oil Storage and Distribution Co. of India Ltd., around 1933 in Bombay. The boat was named "Shelmari" and placed under the control of the Deparment of Industries, Bomby, to demonstrate to the fishermen the possibility of similar conversion of their own vessel with advantage. Credit for the capture of fish by power propelled vessels on a large scale goes to the fishing village of Satpati near Bombay. The lead given by Satpati was followed by neighbouring villages which made rapid strides in this direction.

The implementation of craft mechanisation programme can be broadly divided into a base and four developmental phases. The 'base' was provided by the country crafts in which engines were installed in the first instance. In many of the maritime states in India, there is a general dearth of indigenous fishing boat types which could take a motor. A survey undertaken showed that Machwas, Satpati and Versove type boats of the N. W. region, Tuticorin type boats of S. E. coast, Navas of Andhra, Chot and Batchari boats of the N. E. coast were suitable for mechanisation. The mechanisation of the existing crafts first started in Maharashtra and was subsequently followed by other states. In Tamil Nadu, a few Tuticorin type boats were mechan-

ised on an experimental basis; however this was not readily accepted by the fishermen and the scheme was discontinued. In Andhra Pradesh, the trials of mstorisation of Nava has shown encouraging results but it was found necessary to modify the design. Since majority of traditional crafts were considered unsuitable for mechanisation, the question of improvements has still remained unsolved.

The next logical step was to evolve a suitable small open motor boat as a beach landing craft. The initial attempt in this line was made in Kerala with the help of the Indo-Norwegian project Subsequently naval architects of FAO in India had designed and fabricated prototypes and conducted experiments in Tamil Nadu and Andhra Pradesh. As the landing and hauling of this motorised beach craft still required elaborate arrangements, expert opinion and usage did not favour their introduction as a substitute for canoe or catamaran in India. Attention was subsequently paid to designing suitable craft to facilitate the operation of traditional fishing gear and the result was the famous 'pablo' boat for gill netting.

Fishing nets prior to 1955, were all made from cotton and hemp twine and coir ropes. They easily absorb moisture, thus becoming heavy for fishing operations. Their durability was also short and were susceptible to decay, thus making gear preservation an essential feature. In the last 20 years, the twines of synthetic fibres have progressively replaced the natural fibres in the fabrication of gear. The former has several advantages over the natural ones besides having improved catching efficiency. Initially the synthetic fibres had to be imported but now they are being manufactured in India. Nylon (polyamide) is very useful for gillnets and polyethilene and polypropylene are used for the fabrication of parts of bag nets.

FINANCIAL ASSISTANCE

The first and the foremost need of the fisheries sector is finance and loans are the commenest form of assistance. Prior to the commencement of the Second Five-Year Plan, the entire finance was met from the middlemen and money lenders. Public sector finance in the from of subsidy and soft loans, considering fishing as an industry, was first initiated during ihe Second Plan. Introduction of improved craft and gear was implemented through subsidy and loans issued by Government to fishermen and their co-operative organisations. The grant of subsidy and loan was of a uniform pattern throughout the country while the workjng details of the schemes varied from state to state While some states supplied marine diesel engines on subsidy and loan basis to be fitted into indigenous crafts other states issued completed boats of modern design fitted with engines which helped in the development of ancillary industries such as boat building yards. Subsidy and loan assistance was also extended to new material for fishing gear. Till the end of Third Plan, parctically all developmental schemes were mainly financed through the outlays provided in the public sector and the only institutional financing available to the industry was from the co-operative banks to the co-operative societies, The approach adopted by the Government at the beginning of the Fourth Plan was to transfer the liability for meeting loan requirements from Plan schemes to the financial institutions like Agricultural Refinance Development Corporation and banks. The ARDC provided financing facilities for giving medium and long-term loans to fishermen co-operative societies through the co-operative banks. The commercial banks started advancing medium and short-term loans but favoured private enterprises and the fishermen did not get any benefits. The total finance from public financial institutions made available to the fisheries sector is of the order of Rs. 14.42 crores as on 30th June. 1978, out of a total of Rs. 1049.32 crores made available to the agricultural sector as a whole. Thus the share of the fisheries sector is just 1.4% which appears to be insignificant. The major part of this finance has gone to the corporate sector.

The present situation in case of finance to small-scale fisheries is not encourging and it is high time that financing institutions thought of assisting the small-scale fisheries. The basic structure of economic organisation in marine fishing industry in India, at the production level, comprises mainly of non-mechanised crafts which is characterised by inherent economic uncertainty because of the high degree of risk involved and the high investment structure in proportion to its economic profitability. In view of these economic constraints, loans, subsidies and other incentive supports are a must for the small-scale fisheries sector.

Even to-day the economic condition of the fishermen is pitiable. They borrow money from the middlemen for their essential needs. While taking these loans, they are compelled to sell theis catch to the middlemen at rates dictated by him. The loan accounts are manipulated and at the end of the season they always find themselves deeper in debt. As a result, they remain in the clutches of money lenders. In many cases, they have to surrender boats and nets to the middlemen and work as their employees. These middlemen do not like to become active entrepreneurs striving for the promotion of the industry. They just finance and leave the business of operating the boats to the crew. Being deeply in debt, the fishermen find no point in improving their industry, because whatever gains it might bring, would be appropriated by the middlemen. Thus finance by middlemen has become detrimental to the development of small-scale sector. The fishery co-operatives have a very important role in ameliorating the socio-economic condition of the fishermen, in increasing fish production and proper marketing.

FISHERIES COOPERATIVES

The promotion of fisheries co-operatives is an important part of Government plans to improve the economy and social welfare of fishermen. This, in turn, calls for a significant improvement in the participation of the fisherman himself.

Sustained attempts to promote fishery co-operatives were made in the Five-Year Plans. Based on the need for marketing of the catches, marketing unions and regional marketing societies / federations were also organised in some of the states, although in most of the cases, the primary societies themselves undertook the marketing operations as well. In recent years apex federations of the fishery co-operatives have been set up in a few states to improve organisational set up of primary co-operatives. There are about 5,000 societies including six apex societies in the country with a membership of 5.3 lakhs and a total paid-up share capital of Rs. 3.6 crores, the Government share being Rs. 2.24 crores. However, of these 5,000 fisheries Co-operatives Societies, about two-thirds are reported defunct or dormant. A large section of fishermen are still outside the co-operative fold and it is necessary to bring them within it. This will help in the flow of income generated by fishing operations to them. Moreover, the co-operatives could become viable and purposeful and can handle multi-purpose functions like credit, production, storage, marketing and other services as a package scheme.

Evidently strengthening of the management aspect of fishery co-operatives deserves priority The poor performance of co-operatives is due to absence of genuine co-operative leadership, lack of financial resources, competent management personnel and growth of vested interests. Generally instances have been noticed where co-operative leadership comes from closed groups of economically, socially and politically dominating sections. It is this peculiar environment that has restricted the growth of co-operatives and so long as this situation continues, successful co-operatives will be only a mirage.

The important need of the hour is proper management of small-scale fisheries with definite objectives. This will help in evaluating the achievements at regular intervals. Qualified management, proper supervision and guidance by Government agencies will have a very important role to play, in order that the objectives laid down for the welfare of the small fishermen could be achieved in the shortest possible time, and the enterprise could be put on an even keel.

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OPERATIONAL CONSTRAINTS OF ARTISANAL FISHERMEN

By P. M. TANDEL

Binaga Ice & Cold storage Priviate Limted, Binaga, Karwar

ADVENT OF MECHANISATION AND ITS IMPACT ON TRADITIONAL FISHERIES

Traditional methods of fishing such as the shore seines, boat seines, gill nets and cast nets are in vogue in almost every coastal fishing village of India. In the recent past, new methods of fishing such as the trawl net for demersal and purse seine for pelagic fishery resources have been adopted

Encouraged by the results of the early exploratory phase, small private entrepreneurs took to mechanised fishing mainly using trawl nets in the offshore areas. The financial support given by the Central and State Governments gave a boost to the mechanisation programme in the maritime states. The private entrepreneurs who took to trawling for fish in the 'fifties soon switched over to shrimp trawling, particularly along the south-west coast, lured by the high prices offered for shrimp in the export market.

In all, about 16,000 mechanised boats have been introduced so far in various states through successive Five Year Plans. Of these, about 14,000 are in operation which constitute about 5% of the total fishing crafts in the country. In the initial stages, the boats started using trawl nets without winches. Later, with the indigenous development of trawl winches, small trawlers became very popular. Initially, 9 metre boats powered by 30 to 40 h.p. engines were used. In the past few years, private parties have taken to larger boats with engines of greater horse power. Lately, government has been encouraging fishing by other methods with a view to ensuring greater utilisation of all the resources. With this trend in diversification of fishing effort other methods of fishing such as purse seining and gill netting from mechanised boats have come into vogue recently.

In Karnataka, after the first ever attempt at trawling was made by the Japanese trawler, M S.Kaiko Maru in 1961, and after the systematic exploration of fishing grounds carried out by the vessels of the Indo-Norwegian Project from 1963 through 1967, a spurt in mechanised fishing activity was witnessed. Since 1968, a large number of mechanised vessels have been introduced. These vessels initially fished beyond the range of fishing (10-15 km from the shore) of the traditional sector but subsequently shifted their operations to shallow waters known to yield good catches. Though the Union Territory of Goa had pioneered purse seining' Karnataka has made a break-through in large scale purse seining in the country with about 100 purse seine boats already in operation and another 80 under different stages of construction. The South Kanara District accounts for the bulk of the boats; only 11 boats are in North Kanara District. The State will reach the targetted figure of 200 purse seiners in the near future. With a mere 2 units In 1975 76, the number rose to 20 in 1976-77 and 50 in 1977-78, and still higher in the current year. In all, there are 1680 mechanised boats in Karnataka. Of these, 495 are in North Kanara District and the rest in South Kanara. Perhaps, this is the highest concentration of mechanised boats per km of the coast line in the country. Other maritime states also witnessed similar activity in mechanised fishing.

The impact of mechanisation on the traditional methods of fishing has been felt all along the Indian coast. The use of trawl nets, and lately purse seines, in the near-shore areas has caused serious damage to the economy of fishermen, particularly of those dependent for their livelihood on shore-based operations.

In spite of the impressive development of mechanisation, the traditional fisheries sector remains a stable fishing force accounting for about 65% of the total marine fish production of 1.4 million tonnes of the country.

The bulk of foreign exchange earning of marine products is also accounted for by this sector. There are as many as 0.2 million traditional crafts and 2.6 million gears operated by about one million active fishermen in 1800 fishing villages of India. All the same, this sector has been subjected to severe pressure because of mechanised fishing operations in near-shore areas.

OPERATIONAL CONSTRAINTS OF ARTISANAL FISHERMEN

Ever since the mechanised vessels took to shrimp trawling, the inshore areas which were till then the domain of the traditional sector have become the fishing grounds of trawlers. This made serious inroads into the meagre earnings of the artisanal fishermen. This is especially so on the west coast. On the south-west coast, the coastal mechanised fishing for shrimp has been so intensive that the stocks are showing a level of stabilisation of boat, effort and catch. Any further increase in the effort for shrimping is not likely to bring in proportionately increased catch. Since there is some scope for expansion of coastal shrimping in limited pockets on the west coast and more significantly on the upper east coast, mechanised vessels converging on these areas are likely to create problems for the traditional sector there too.

In Tamil Nadu, the catamaran fishermen and mechanised boat owners have been in a state of confrontation for the past few years. In Madras, the catamaran fishermen are hard put to fishing in inshore grounds. The large fleet of mechanised vessels literally converge on these areas within the 5 km zone making fishing operations of catamaran fishermen almost impossible. As a result, a longstanding feud has been in existence between the two sections of fishermen. The mechanised vessels while fishing for prawns within the 5 km zone invariably cut through the nets of catamaran fishermen. The latter already poor, find it extremely hard to repair the damaged nets much less to replace the lost ones. The rivalry between the two has accentuated to such an extent that clashes take place periodically in the sea resulting in loss of life and property.

In other states too, similar confrontation, though in varying degrees of intensity, exists between the mechanised boat owners and traditional fishermen. In Gujarat and Maharashtra, there are oft-repeated complaints of trawlers cutting across the gear of local fishermen such as gill nets, 'Dol' nets, etc.

In Goa, the problem has its own dimensions The Union Territory has about 400 mechanised boats which operate often in areas traditionally the zone of local fishermen known as 'Ramponkars' and catch large quantities of the prawn, *Metapenaeus dobsoni* (locally called 'Solar'). The species is generally caught by the local fishermen in good quantities using small meshed shore seines and cast nets from mid-August to October. The prawn approaches mid-surface at night. Fishermen pay out 'Rampan' at dawn when it is still at mid-surface and haul the catches which are usually very heavy. But, unfortuanately at day-break, the trawlers move out and start trawling the same species thereby disturbing the shoals. This has caused havoc to the traditional fishermen. The Government of the Union Territory had promulgated the five-fathom Fisheries Rule in 1974 to the effect that no person should fish with the help of mechanised fishing craft in inland waters and sea up to a depth of five fathoms. The trawlers have been ignoring the rule and intruding into the areas earmarked for use of the traditional fishermen. As elsewhere, trawlers cutting across the costly nylon nets of the fishermen is common in Goa too thus accentuating the animosity already engendered between the mechanised boat operators and 'Ramponkars'. The situation took a violent turn in December 1977 and early this year. Subsequently, the Government of Goa, Daman & Diu acceded to the protracted demand of the 'Rumponkars' that the five-fathom line be demarcated. These fishing grounds will be out of bounds for all mechanised fishing crafts.

In Karnataka, the large fleet of trawlers has caused harm to the traditional fishermen, especially those operating shore-based gear such as 'Rampan'. The trawlers have not only been encroaching upon the Rampan zone but also inshore areas up to a depth of about 10 metres where the boat seines, gill nets, etc. operate. The trawlers cut across gill nets and other gears of local fishermen causing severe loss to them. In the process, the daily earnings of the fishermen are affected as a result of small catches brought in. Further, because of indiscriminate fishing with small meshed shrimp

trawl, young ones of many food fishes are caught thereby endangering the fisheries of these species.

Recently, because of the steep rise in the number of purse seiners operating in Karnataka considerable increase in the catch of mackerel and oil sardine has been registered. This has no doubt brought in good financial returns to the men operating the purse seines while enlarging the area of operation to more distant grounds where the shoals could be encircled and captured. The aerial and acoustic surveys carried out along the south-west coast by Government organisations have indicated an average stock size of about 80,000 tonnes of mackerel in the offshore waters particularly between 24 and 72 metres Similarly, the average standing stock of oil sardine in the fishing grounds has been estimated to be of the order of 400,00 tonnes. These estimates indicate that there is scope for considerable increase in the catches of both the species by stepping up fishing pressure in the offshore grounds with suitable craft and gear.

Invariably, the purse seine boats are fishing in areas close to the 20 metre line where the traditional fishermen operate gill nets. Because of the high efficiency of purse seines, the catches of gill nets have dwindled lately. Further, the shoals around the 20 metre line which generally move forward and strike the coast during the season, contributing to bumper catches in the 'Rampan' are hindered in their shoreward movement, thus bringing down the catches in the shore-based units. This has greately affected the livelihood of the traditional fisherman.

For years, 'Rampan' has been the most popular gear of the Kanara coast whose operation sustains the economy of a large segment of the fishing community. The bulk of the catches of mackerel and oil sardine is accounted for by this gear. Each 'Rampan' unit is operated by 60-80 fishermen and the total number of about 165 units in North and South Kanara give productive employment to over 12,000 active fishermen. In addition, another 5000 fishermen are engaged in the transport and preservation of catches. As compared to the total man-power generated by 'Rampan' units, each purse seiner (including the carrier boat) employs about 25 fishermen. Nearly 2500 fishermen are employed in the 100 purse seiners presently operating in Karnataka. The targetted 200 purse seiners will give productive employment to about 5000 fishermen in the State. This situation deprives the livelihood of a large segment of the fishing community gainfully employed in the 'Rampan' units. Further, the landings of purse seine units are confined to places where berthing facilities for the vessels are available. This restricts the distribution of employment to very limited landing centres thereby denying opportunities to a good number of active fishermen and their dependents all along the coast. It is of interest to note that a single unit of 'Rampan' at Chendia in the North Kanara District of Karnataka in the recent past encircled and impounded in one operation a mackerel shoall numbering about 10 million fish weighing approximately 1000 tonnes. Perhaps, 'Rampan' is the only traditional gear capable of capturing such a large quantity of fish in one operation in the country. Such an important gear has now become almost ineffective in the face of competition from the purse seiners

As elsewhere in the country, the traditional fishermen of North Kanara District have been in a state of confrontation with the mechanised boat operators over the past few years. In October 1977, there were clashes between the coastal fishermen and mechanised vessel operators at Keni, near Ankola resulting in loss of property of the former. Hundreds of traditional fishermen of the coastal villages between Belekeri and Gokarn staged a demonstration last October in front of the Tahsildar's office at Ankola demanding protection from the mechanised vessels by preventing them from fishing within the 20 metre zone. They also demanded that the mechanised boats bear identifiable numbers at night and have lights. During last month, the feelings of the traditional fishermen of Karwar and Belekeri were so exacerbated that they took away the mackerel catches of purse seiners which were operating in inshore waters. The local fishermen felt that they were not able to capture shoaling fishes in their 'Rampan' units since the beginning of the season because of operation of purse seiners in inshore waters. The feeling still persists among the traditional fishermen.

WAYS OF OVERCOMING OPERATIONAL DIFFICULTIES

Different sections of traditional fishermen have differing views on how best the operat-

ional difficulties could be got over. Three main viewpoints stand out among them. One section of the fishermen who are affected by the purse seine operations in the Goa and Karnataka regions opines that purse seiners should be totally banned in the areas where 'Rampan' units are operated. However, a sober section of the fishermen does not oppose purse seine operations but feels that it is desirable that they be carried out in September (when the mackerel and oil sardine shoals are away from the operational range of shore-based units) and from March onwards (when the shoals are on the outward move). According to their experience, there is a tendency for mackerel and oil sardine to move towards the coastal waters within the operational reach of 'Rampan' units during October – March. In the opinion of another segment of the fishing community, it is more prudent to operate purse seiners throughout the season beyond the 30 metre line where mackerel and oil sardine are avilable in abundance as per recent findings. Incidentally, it may be stated that mechanised boat owners operating purse seines report that it is difficult to locate mackerel and oil sardine shoals in deeper waters.

Realising the difficulties encountered by the traditional fishermen, the Government of Karnataka have already taken steps to bring this important sector of the fishing industry into the fold of mechanisation. Recently, 20 'Rampan' units have been assisted to acquire purse seiners by providing them with seed capital which enables them to raise loans from commercial banks. Other states, similarly placed, may follow suit to alleviate the sufferings of the traditional sector.

The author is of the opinion that in the interest of all segments of the fishing community the mechanised boats operating trawl nets and purse seines need to confine their activities to waters beyond certain specified depths. Since the problem is of all-India nature, enactment of suitable legislation by the Central Government restricting the operation of mechanised vessels to certain definite and well-demarcated areas in the sea is the only remedy for the present internal strife in the fishing community.

IMPROVEMENTS IN THE TRADITIONAL CRAFT AND GEAR

The traditional crafts used by the small-scale fisheries sector such as the catamarans, dugout boats, plank-built boats, etc., are well suited for local conditions. Since many of the maritime states have taken steps to motorise the indigineous crafts to enable the traditional fishermen to reach distant fishing grounds and land the catches in a short time, some minor modifications in the existing designs may be called for.

Tradition-bound fishermen are not only slow to adopt-modern gears but also to change over to relatively efficient gears used by their counterparts elsewhere in the country. Though some improvements in gear material have been effected in the past few years, practically no attempt has been made in improving designs of traditional gears to make them more efficient. Regarding improvements in gear material, fishermen have already adopted nylon twine and monofilament which are more efficient than cotton and hemp twines used in the past. In the field of gear research, except for some studies on structural details, investigations carried out on the relative efficiency of different gear systems operating in the same type of fishery are scanty. It is necessary that a study of the traditional gear system in all aspects of gear characteristics be taken on hand at the earliest. It is in the general interest that the Central Institute of Fisheries Technology and fisheries organisations in the maritime states take up and intensify researches in this field.

PROSPECTS FOR DEVELOPMENT OF SMALL-SCALE FISHERIES

Since Independence, maritime states of India have carried out developmental work pertaining to the small-scale fisheries sector on all fronts, *viz.*, providing fishery requisites and infrastructural facilities, training fisheryouth in modern fishing techniques and providing them mechanised vessels, educating the children of fishermen, etc. If one looks back at the lot of the fishermen in the pre-Independence period, the conclusion that the development has reached different strata of fishermen community to some extent is inescapable. but, much more remains to be done.

Even to-day, the artisanal fishermen who are engaged in coastal fishing using traditional crafts and gears have no relief from financial indebtedness. Uncertainty of fish catches often make the borrower as well as lender in the fishing industry apprehensive of each other.

There is no comparable 'crop insurance' in the fishing industry. During years of distress due to fish famine, assistance in the form of 'interest holiday years' for bank loans for borrowers in the fishing and ancillary industries is absolutely necessary Easy credit facilities with marginal interest should be extended to them by financial institutions. In case, financial institutions cannot lower the interest rates and service charges, the differenec may be adjusted under some development assistance scheme.

Motorising the traditional crafts to enable the fishermen to reap rich harvests from distant grounds will also go a long way in uplifting the fishermen from their present economic condition. They should also be given financial inducements to take to mechanised fishing in this direction, much effort has to be put in to bring down ihe cost of engines to economic levels and optimum horse power requirements have to be worked out to save on maintenance and operational costs. Alternate boat building materials have to be evolved to bring down the cost of hull.

Because of well-planned research and managerial programmes, our marine fisheries has developed considerably over the past 30 years. Since independence, marine fish production has increased nearly three-fold. This is mainly reflected in our earnings from the export sector. Many industries connected with fishing and processing have got established. The benefit of development has not reached the large number of fishermen in the small-scale fisheries sector. This is mainly so because of the conservative nature and high rate of illiteracy still prevalent in the community. They are not enthusiastic to change rheir traditional fishing methods. Hence, it is suggested that the fishermen be uplifted on all fronts' *viz.*, educational, economic, etc. Unless this is done, fishermen will not be able to share and enjoy the prosperity that is there in their own profession.

In the prevailing condition of our fishing industry, recourse to large scale aquaculture in coastal salt water and marine environments would go a long way in not only supplementing the income of the traditional fishermen but also providing much-needed fish to our people. The technology for culture of fish, prawns, oysters, mussels, etc. has been developed at the Central Marine Fisheries Research Institute. What remains now is to transfer the technology to the fishermen as a means towards integrated rural development. Many states offer vast scope for such work. The State of Karnataka, especially North Kanara District has immense scope for coastal aquaculture.

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DIVERSIFICATION OF COASTAL FISHERIES WITH REFERENCE TO PURSE-SEINE OPERATIONS

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INTRODUCTION

No doubt the last three decades have witnessed a dynamic change in the development of fishing industry of India. From a humble beginning after Independence India has already crossed Rs. 1700 million mark in export of sea food and occupies 7th place among the world fishing nations. Perhaps because of the ready market and high profits, initially our approach to adopt modernised technique was aimed towards exploitation of demersal source only and very little attention was paid to develop a balanced exploitation of all types of resources. Shrimp was the only item on which the foundation of our whole fishing industry was based. When we see the quantum of our export in terms of value we definitely feel very proud, but looking at the rate of increase in production during last 30 years, compared to the amount of investment made in the sector, I am sure most of us would agree that increase in production has not been commensurate with investment. Had we not been favourably assisted by trend of increase in prices perhaps the picture would have been very different. In certain years when the prices in foreign markets have shown downward trend, our fishing industry has faced serious recession and anxious moments for survival.

Had our approach been rational mainly based on expolitation of all types of resources perhaps our achievement would have been much more creditable both in providing much needed protein to our countrymen and also to occupy a high place on the export side. Such an approach would have also helped in achieving proper sustainabls yield of shrimps for many more years and proper conservation of our shrimp resources. Now we all know that the initially introduced small shrimp trawler is no longer a viable unit because of the concentration of such units in a limited area and because the effort and yield are showing an inverse relationship. This imbalanced development has brought with it several drawbacks and adverse trends in the fishing sector.

The awareness for diversified fishing with mechanised boats, to save the fishing industry, is catching the attention of our fishery experts. The purse seine is an active gear introduced to exploit the shoaling pelagic ffshes. It is a long rectangular net which is used to encircle the shoal, gradually drawing the net closer to vessel, and removing the fish without giving them a chance to escape. This method was first tried on the west cost of America. From there it has spread to several countries such as Japan, Peru, Norway, Ireland, U. S. S. R., South and West Africa, Portugal, Spain, France, and Angoal.

THE PURSE-SEINE SUCCESS IN GOA

Purse seining in India is in the developing stage. The erstwhile Indo-Norwegian project had conducted experiments with various sizes of boats, H P. and different size of purse-seine net. However, it was Goa which for the first time successfully introduced purse-seine operations by 43' to 45' wooden vessels fitted with engine of 75-105 H. P. range using net of 250 fathoms length and 25 fathoms depth. In fact, purse-seining was introduced in Goa in 1957 by the Portuguese. However, the work could not be completed by them for various reasons. The two 45' boats used by them were made sea worthy in 1964 by the Department of Fisheries and put into operation. Initially the experimental work was done departmentally and later its advantages were demonstrated to fisherfolk. The technology was transferred to fishermen at commercial level, the proof of which is evident from the fact that Goa today has 45 purse-seine vessels along a small coast line of 104 km expoliting the pelagic resources.

The use of purse-seine has helped to extend the area of fishing as well as fishing season. Mackerel and Sardine shoals are mostly spread over a belt along the coast up to 30 km almost throughout the fishing season from September to May. Only a small portion of the shoals seems to move nearer to the shore after the monsoon. This untapped zone of pelagic resource has now been brought under exploitation. Since 1964 the purse-seiners have enabled Goa to reap a richer harvest of the state's capture fishery. This is evident from the fact that the contribution of mechanised fishing in Goa has increased from 2% in 1966 to 25% in the total catch.

The private enterprise took to purse-seining with Government assistance from 1969 and, as stated before, Goa has over 42 units. All of them are economically sound. This has been proved by the fact that almost half the number of units have been commissioned by obtaining finance from banks at a very high rate of interest of 14 to 15%. These units are not only regular in repayment of loans but each of them within a short span of time have gone for 2 or 3 units. All the requirements of purse-seine fishing including the skilled labour with proven ability and competency are available in Goa. This development is worth encouraging.

The Department of Fisheries came out with a design of purse-seine net which has undergone considerable improvements in material and operation method. It has also constructed two vessels of 14.2m length with its own design duly approved by Mercantile Marine Department. The net designed and operated by the Department has caught up to 30 tonnes of fish, both mackerel and sardine, on many occasions in single hauls. The performance of two departmental vessels is shown in Tables 1 and 2.

TABLE 1. *Fish landed by two departmental purse-seiners (in kg).*

Year	Mackerel	Sardines	Others	Total catch
1965-66	76,856	127,006	54,783	258,645
1966-67	494,554	164,627	13,249	672,430
1968-69	65,264	45,136	1,327	111,717

TABLE 2. *Landings by 2 purse-seiners along Goa coast from 1966-70*

Total number of fishing days	Year	No of days when boats returned empty	% of nil catch days	Total fishing hours	Total catch in kg	Average catch per hour in k.g	Average catch per day in k.g
219	1966-67	31	14.2	290	672,430	2319	3070
85	1967-68	8	5.9	149	111,717	750	1314
138	1968-69	8	5.8	241	471,946	1958	3419
29	1969-70	4	13.8	38	30,861	812	1064

Recent survey conducted along South West Region of the West Coast of India under UNDP programme, has established that the magnitude of pelagic resources along our coast is of the order of 3 to 4 millon tons and at present India is only exploiting one tenth of this. This pelagic resource consists of Anchoviella (white bait), shallow water mix, oil sardine, other sardisnes, mackerel and others. The advantage in operation of purse-seine vessel of small size are that one requires less fishermen, larger catches are obtained, the fish is caught in better condition with less operational effort, and the expenditure is less.

ECONOMICS OF OPERATIONS

Often a question is asked about economic viability of such a small purse-seine boat of 43 feet length, using purse-seine net of 250 fathom length and 18 to 25 fathom depth (Fig.1). A description of the net is given in Appendix-1. Each such vessel should have two small carrier boats of 32 feet length so as to enable them to fish for maximum period and increase the catch.

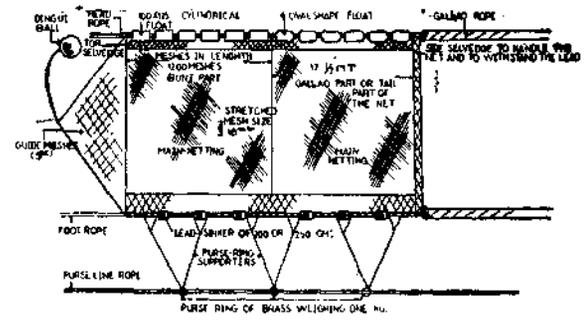

Fig. 1. Sketch of two parts of purse-seine (bunt and gallao) used in Goa. Description of net given in Appendix 1

An attempt has been made here to show the actual economics of such fishing based on the operation of departmental and private vessels in Goa.

Initial investment:

Cost of 43.5 ft (country wood) vessel fitted with 89 h. p. engine with purse seine net and other accessories	Rs.	3,00,000
Cost of 2 carrier launches and (country wood) fitted with 37 to 40 h. p. engine	Rs.	1,30,000
		4,30,000

Expenditure:

1. *Main vessel & 2 carriers boats* For purse seining 24 crew, salary for 140 days, at Rs. 250/- per month. For trawling 18 crew, for 110 days, and Bosun for 250 days	Rs.	80,000
2. Fuel, lubricant etc. charges for 16 hrs. trip for 250 days (diesel required 100 litres per day) with interest on investment and repayment of loan, depreciation 5% of vessel and gear	Rs.	2,50,000
Insurance vessel per year	Rs.	10,000
Repair and maintenance etc. yearly	Rs.	20,000
Unforeseen expenditure-breakdown, loss of fishing days etc. and salary of staff	Rs.	1,00,000
Total expenditure	Rs.	4,60,000

Income:

Purse seine operation for 140 days, per day average catch of 2500 kg mackerel, sardine, ghol at average rate of Rs. 1000 per ton	Rs.	3,50,000
Trawling operation by 3 vessels for 100 days, per day average catch 250 kg (Prawn 10% average rate Rs. 12 per kg and fish average rate Rs. 1.50 per kg)	Rs.	1,91,250
Total income	Rs.	5,41,250

Total income for 3 vessels	Rs.	5,41,250
Total expenditure for 3 vessels	Rs.	4,60,000
Net profit	Rs.	81,250

This calculation is based on the assumption that 60% of catch during purse-seining will be mackerel and 'ghol' and the season will be reasonably good. However, keeping in mind the fluctuation in the fishing season and unforseen breakdown, loss of nets and fishing days, the net profit on such a combination of 3 vessels per annum can be rounded off to Rs. 80,000. The correctness of this economics can be verified from the fact that many parties who have taken loans for such purse-seine and carrier units from banks and are able to repay the loans within a period of 5 to 6 years after meetling all expenses and many such parties are going in for 2nd or 3rd unit within 3 to 4 years. However, working of these units depends mainly on the control, proper management of the vessel and hard labour.

PROSPECTS

Each purse-seine vessel which is operated by a team of 15 people is able to catch more fish than a 'Rampan' unit which is operated by 60 to 80 persons in the same period. This is possible because purse-seine has an advantage over 'Rampan' as it is able to catch fish in offshore areas wherever fish is available. In Goa the purse seine units have landed huge catches of mackerel, lesser sardine, oil sardine, 'Ghol' (*Pseudosciaena diacanthus*), seer fish, tuna-horsemackerel, black pomfrets, cat-fish and anchovy. This type of fishing is able to provide better self-employment to rural youth and others for transportation and marketing. It is seen that a purse seine unit lands approximately 300 to 400 tonnes of fish during pelagic fishing season from September to March and thus results in a better standard of life for the fishing community and more fish food for the people. The annual income of a purse seine unit is equal or rather more than a 'Rampan' unit.

While encouraging this modern technique in our waters we should be very cautious to see that our fishing stocks are properly managed. There should be mesh regulation of uniform size all along our coast and for fish it should not be less than 20 mm stretched mesh. The number of such units to be introduced in a particular area must be very carefully determined after pro-

Fig. 2 Catch filling the deck of the purse-seine boat.

per survey of fish stocks in our offshore waters upto the 40 fathom line. Following the example of Goa, Karnataka has started introducing purse-seines of similar design since 1976. The pace of introduction of purse-seine units in Karnataka is very fast and this may have adverse effects on future fishery. These units should not be allowed to fish in areas less than 8 to 10 fathoms to ensure proper recruitment of stocks to future fishery of the area. The mesh regulation should be enforced strictly if the purse seine fleets are to remain in for a long period.

It has been observed that the introduction of mechanised trawlers for exploiting demersal resources has not yielded a substantial increase in fish production of Indian coast. It is felt that purse-seine which has brought about a break-through in increased fish production in Goa and Karnataka during the last few years will enable us to meet the gap in production and demand by properly tapping the pelagic fishery resources which have been estimated to be in the order of 3 to 4 million tonnes. The purse-seine unit also gives more than 10% annual return on investment after all expenses which is a healthy sign for new investment.

The present impression is that the purse-seiners may only be useful on south-west coast which is the conventional oil sardine-mackerel zone. The experience gained in Goa in catching fishes such as black pomfrets in huge shoals, carangids and, at times, sharks suggests that attempts may be made in the north-west coast in areas like Saurashtra and northern Maharashtra where fishery of Bombay duck, pomfrets, polynemids and shark is important.

Description of purse-seine net

1. 100 x 125 mm cylindrical float specially used for bunt to get more buoyancy and to withstand the load.
2. Top selvedge: Mesh size - ¾"; lengthwise 800 meshes; depthwise - 3 meshes.
3. Bottom selvedge: Mesh size -4"; lengthwise 200 meshes; depthwise-5 meshes.
4. Guide mesh: Mesh size - 4" fabricated in tapered shape.
5. Main netting of purse seine net: Mesh size 18 mm stretched; length - 1200 meshes.
6. Purse ring made of brass of one kg wt.
7. Lead sinkers - 200 to 250 g.
8. Head rope & foot rope to be considered according to the core of the floats & lead sinkers.
9. Length i.e., No. of sub-parts of the purse seine net to be operated for fishing is considered according to the H.P. of the engine and boat deck capacity.
10. Depth of the purse seine net to be considered as per departmental vessel-33 metres.
11. Purse ring supporters are cut in three different sizes to the requirement of the bottom.
12. One sub-part of the purse seine net i.e, of 1200 meshes that comes to approximately 17½ to 18 mts. length and depth of the purse seine net to be considered according to the fishing ground i.e., operating area.

13. For bunt parts 140 to 145 total No. of floats of 100x125 mm cylindrical is required and for other parts 95 to 98 numbers 6'' oval shape floats required.

14. 50 numbers lead sinker for one part.

15. Approximately three rings are rigged to two parts of the purse seine net.

TRADITIONAL PRACTICES OF COASTAL AQUACULTURE AND SUSTENANCE FISHERY IN INDIA

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COASTAL AQUACULTURE

India is bestowed with about 2 million hectares of brackish water areas all along the coast. Though fish culture is as old as civilisation, practically very little of these areas are currently utilised for productive purposes even by traditional practices. On a modest estimate, if 20,000 ha could be brought under scientific culture operations to produce annually an average 500kg/ha, our country could produce an additional one million tonnes of fish (Jhingran, 1975).

There are three principal types of ecosystems where traditional fish culture is practised in India, *viz.* the *bheris* or *bhasabhada* of West Bengal (Pakrasi, 1976), the paddy fields of Kerala and West Bengal (Menon, 1954; Pillay and Bose, 1957) and the perennial fields of Kerala (George, 1974) and these are briefly discribed below.

BHERIS

These are large brackish water impoundments of 50-200ha extent in the inter-tidal zone of the Hoogly-Matla estuarine system. The total area under this type of cultivation is about 9000 ha. The tidal amplitude ranges from 1.8–4.6m. From January till March or April the tidal waters carrying prawns and fish seed are let into the *bheris* through improvised or permanent sluice gates. Split bamboo screens fixed inside the sluice gates prevent the escape of fish during the receding tide. After a period of growth, harvesting commences in September by drag nets. The yield varies from 320-3300kg/ha/year. Fishes, mostly of *Mugil* sp *Lates calcarifer, Polynemus tetradactylus* and catfish (*Mystus* sp.) comprise 70% of the catch and the rest is composed of prawns, *viz* species of *Penaeus, Metapenaeus, Macrobrachium, Palaemon* and crabs (*Scylla serrata*).

PADDY FIELDS

In West Bengal, the paddy fields adjoining the *bheris* are seasonally utilised for brackishwater fish and prawn culture. When the water level in the irrigation canal rises in August due to the outbreak of monsoon, bunds in the paddy fields are cut at selected places to allow the fish and prawn fry into the fields where they grow during the period of paddy cultivation. The capture operations precede the paddy harvest. The species cultivated are more or less similar to those of *bheris* with an yield of 100–300 kg/ha/year.

In Kerala, the low lying paddy fields (*Pokkali* fields) of about 4500 ha adjoining the tidal brackish waters are used for rotation of paddy and fish crops. Paddy is cultivated during June-September when the fields are filled with water of low salinity (1-2‰). After the paddy harvest in October, the bunds provided with sluices are strengthened. During high tide (tidal amplitude 1 m) prawns and fish seed are let in till November. Bamboo screens are used to prevent the escape of fish. Harvesting of fish commences usually in December using sluice nets at nights during low tide and is carried out for a week

around full moon and new moon till April Lights are used to lure the fish and prawns. The yield varies from 700-2100 kg/ha/year. The bulk of the catch (80%) is constituted by prawns (species of *Metapenaeus* and *Penaeus*) and the rest is comprised of mullets, pearl-spot etc.

PERENNIAL FIELDS

These are larger (upto 100 ha) and deeper (1-3.5m) than the *pokkali* fields and are used for culturing prawns thoughout the year. There are about 800 ha of such fields with an average catch of 840 kg/ha.

All the above described traditional practices have several advantages as well as disadvantages. On the plus side, these are simple practices not requiring much capital investment. The paddy fields are usable to raise two crops i.e. paddy and fish, either in combination or by rotation. However, the disadvantages of such extensive culture systems are many. Firstly stocking is indiscriminate and allows entry of predators and undesirable species. This results in great competition for food and space. Further the impoundment is only for short period not allowing any time to attain marketable size. The yield is, therefore, low and is of poor quality consisting of smaller varieties of prawns. It has been shown by George *et al.* (1968) that if the prawns are allowed to grow for a period of one month in the paddy fields, they attain a larger size fetching better returns. Further in the traditional farms, there are wide fluctuations in the yields from year to year due to fluctuations in availability of seed in the wild environment. Through proper management and selective stocking of compatible species these traditional practices can be vastly improved.

SUSTENANCE FISHERIES

India's total marine fish production averages 1.2 million tonnes. The greatest health problem in our country is malnutrition. It is estimated that about 4 million tonnes of fish would be required to meet the nutritional standards of our people (Samuel, 1968) In this context the role of sustenance fisheries is no less important which, if suitably harnessed for development, could, to a large extenrt, meet our needs for animal protein.

India is having a system of backwaters, bays and estuaries which support extensive shellfish resources belonging to diverse groups. These are either exploted indiscriminately to the detriment of the stock in some regions or altogether neglected as in most other regions. The molluscs are highly nutritious being a rich source of glycogen, protein and minerals. Yet, a vast majority of the fish-eating population has not developed a taste for the shell-fish meat. The shells are used for production of lime. Limited but valuable information on the biology and fisheries of commercially important species of mussels, edible oysters and clams is available. However, still there is a lacuna in the precise knowledge of the magnitude of the available molluscan resources in India. The present production is very much restricted. Nevertheless the shell fish potential is regarded as high. Compared to the temperate species, the growth rate of Indian molluscs is fast. They attain sexual maturity early in life and have protracted breeding period. These serve as favourable factors for culture purpose. There is therefore great scope to develop these fisheries through proper management such as assessment of the exploited resources and their rational exploitation, introduction of improved fishing methods, charting of grounds and scientific cultural practices.

MUSSELS

There are only two important species of sea mussels along the Indian coast *viz.* the green mussel *Mytilus viridis* and the brown mussel *Mytilus* sp. The former is widely distributed all along the coast whereas the latter is confined to the southern sections of the Tamil Nadu and Kerala coasts. They form thick beds on rocks and also on man-made structures like piers and wharves The mussel resources are very much exploited in Kerala during November-May resulting in the denudation of the beds, especially of brown mussels (Jones, 1968b). The mussel beds in the Sonapur backwaters of Orissa are reported to have become sparse (Rao, 1974) perhaps due to indiscriminate removal. Elsewhere, the mussels are subject to limited exploitation forming a sustenance fishery.

The production of mussels in India is provisionally estimated to be about 1000 tonnes (Jones and Alagaswami, 1973), compared to

the world production of 8 lakh tonnes. The leading mussel-producing countries are Spain, Holland, France, England and Philippines. Three types of culture are resorted to in these countries (Table 1) which account for bulk of the production, *viz* (1) on poles projecting from the substratum between the tide marks (2) on the sea bed itself and (3) on ropes hanging from either fixed frames or freely floating structures. Thes culture operations depend largely upon the spat collected from the wild. However the wide fluctations in the spatfall in Britain have led to the production of seed in hatcheries (Qasim *et al*, 1977). From Table 1 it could be seen that the best yield is obtained from hanging culture which eliminates the risk from the predators.

As it is, mussel culture is not practised in India on a commercial scale. The experiments carried out by the Central Marine Fisheries Research Institute have shown that mussel could be successfully cultured on ropes hanging from floating rafts in the bays as well as open seas. Qasim *et al.* (1977) have estimated an annual yield of 480 tonnes ha with a return of 181% from similar experiments in the Goa region.

EDIBLE OYSTERS

Among the molluscs the oyster is considered as a delicacy. They thrive on rocks, cement surfaces and hard muddy bottoms. Though substantial resources exist in India, they are underutilised but for some exploitation in certain regions for personal consumption or for catering to the hotel industry. Four species viz *Crassostrea gryphoides, C. discoides, C. madrasensis* and *C. cucullata* occur in our waters. The first two species are important in the northern parts of the west coast. They grow to a large size of 15-17 cm in about 4 years. *C. madrasensis* is the common backwater oyster on the east and also south-west coasts and attains a marketable size of 8 cm in about 2 years. This species has been indiscriminately exploited to the detriment of the stock in Vembanad Lake (Kerala) and backwaters of Pulicat and Ennore (Tamil Nadu) and Sonapur (Orissa). *C. cucullata* is the common rock oyster, widely distributed on both the coasts. It thrives well under marine conditions. The species is economically less important because of its small size and difficulty in shucking.

World production of edible oysters is estimated to be about 8 lakh tonnes. The principal producers are U. S. A., Japan, Mexico, France, Korea, China, Australia and Canada, where the oysters are extensively farmed. The spat are collected from wild on fixed poles or on cultches such as limed tiles and oyster shells, which are

TABLE 1

Details of mussel culture in various countries,

Country	Type of culture	Harvesting period in months	Size harvested in cm	Annual yield in tonnes ha
Spain	Floating suspended	12-18	7.5 - 10.0	600
Holland	Bottom culture	30	5.5 - 6 5	80
France				
(a) West Coast	Bouchot (Fixed poles)	12-15	5.0	5
(b) Southern coast	Fixed suspended	15-18	6.0 - 7.0	-
U. K.	Bottom culture	24-30	6.0 - 6.5	250
Philippines (a)	Fixed poles	10	3.0 - 8.0	250
(b)	Fixed suspended	10	,,	500 (Projected yield)

laid at the bottom or suspended from rafts. After a period of growth, the young oysters are removed and reared adopting bottom or off-bottom culture methods (Table 2). As in the case of mussels, off-bottom culture yields better results. In the bottom culture followed in France when the oysters grow to full size in one year they are transferred for fattening to small shallow artificial ponds rich in diatoms. The oyster meat doubles in weight in 6 months and are then marketed. There is also a seed production industry in Japan. The seed are exposed for several times over a period of several months at ebb tide for hardening. Only the healthy oysters that survive, are transported to meet the local seed demands as well as to U. S. A.

Oyster culture is practically non-existent in India though it was advocated as early as in 1910 by Hornell. In the Kelwa backwaters near Bombay some sort of oyster farming of *C. gryphoides* is practised on a small scale in which one-year old young oystes are transplanted from natural beds on to hard grounds for fattening. They are harvested during October-April. The C. M. F. R. I. has recently initiated experimental oyster culture in the Gulf of Mannar area. The results are encouraging which augur well for an extensive and profitable oyster farming in India.

CLAMS

Though the estimated production is only of the order of 5000 tonnes (Alagarswami and Narasimham, 1973), the resource is considered to have a high potential. The clams support only subsistence fisheries in different parts of the Indian Coast. The meat is consumed by the economically weaker sections of the society. Species of *Meretrix* (*M. meretrix, M. casta*) *Villorita cyprinoides, Tellina pinguis* and *Katelysia opima* are commercially important. Others like *Donax* spp. (wedge clam), *Mesoderma glabratum, Gafrarium tumidum* (cockle clam), *Solen kempi* (razor clam), *Anadara granosa* (ark shell), and *Pinna bicolor* (fan shell) are of limited importance. However, they hold great potential for exploitation.

TABLE 2

Edible oyster culture in various countries.

Country	Type of culture	Harvesting period in months	size harvested in cm	Annual yield in tonnes ha
U. S. A.	Bottom culture	24-60	7.5-9.0	30
Japan	Off-bottom culture			
	a) (Hanging) in inland seas	6-12	5.0-7.0	120
	b) Longline (Hanging) in open seas	12-24	–	200
France	Bottom culture	36-48	7.5	2-6
Australia	Off-bottom culture			
	a) Rack (fixed)	12-24	8.5-10.0	12
	b) Tray (Hanging)	24-36	8.5-10.0	32
Philippines	Off-bottom culture			
	a) Fixed pole	6-9	7.5	–
	b) Platfrom (Hanging)	"	"	84

Species of *Meretrix* and *K. opmia* are injudiciously exploited which has resulted in the dwindling of the beds. Hence these valuable resources need suitable management measures. Comprehensive information on the biology of the various species is a prerequisite. Observance of short closed seasons wherever necessary, especially during the peak spawing periods. minimum legal size, restocking of the areas from other beds besides bringing in barren areas under cultivation through transplantation and pest and perdator control are some of the steps require careful consideration to save the reseurce from depletion

Cultivation of clams is not practised in India though the method involved is one of the simplest. The leading countries in the culturing of clams are Japan, Taiwan, U. S. A. and S. E. Asian countries. Laying out separate beds for culture of seed clams and for fattening is a common practice Durve and Dharmaraja (1965) have shwn that the production of clams can be increased four to five-fold by transplantation to new beds in shallow waters. In Japan, clams are gown in multichambered net cages suspended in the sea. In Malaysis the ark shells are cultured (7000 tonnes annually) on soft muddy bottom with 90% silt. Hatchery techniques nave been evolved in U. S. A. but it takes 5 8 years to grow clams to the marketable size and it is likely that the clam culture industry may shift southward to the subtropics to take advantage of the faster growth rate.

EDIBLE GASTROPODS

The gastropods from the biggest group of molluscs, shells of which are used for making fancy objects. Only a few species are edible which are represented by the limpets, trochids, whelks, sacred chank, olives and the green snail Turbo. Fishermen catch them during the lean season for other fisheries. The button shell (*Umboni vestiarium*) is the only species that finds a place in the stalls of the market at Malwan in Maharastra, In our country, fishing for trochids and chanks is licensed by the government. The edible gastropods are considered as a delicacy in other countries.

Abalones are commerically cultured (growing period 4-5 years) in Japan and in U. S. A involving hatcheries, though feeding of the various life stsges particularly the juveniles poses a problem. The young are reared in indoor tanks and then transferred to plastic waste baskets which are suspended in the sea and are fed on sea weeds. To protect the resource, size limits and closed season are in force in U. S. A.

OTHER ORGANISMS

Among the crustacea, crabs support a sustenance fishery of appreciable importance in the seas, backwaters and estuaries, particularly on the west coast and the southern coast of Tamil Nadu. They form generally an ancillarly catch along with other crustaceans and fishes. Rao *et al.*(1973) have estimated a a potential resource of 49000 tonnes, though the present level of production is about 3500 tonnes. The main species appearing in the fishery are *Scylla serrata Portunus pelagicus P. sanguinolentus, Charybdis* sp. and *Paratelphusa* sp. The ffshery is not well organised at present since the returns are poor. However, there is immense scope for developing the fishery considering the demand tor frozen crap meat for export. Rearing of larval and juvenile stages of craps had met with some degree of success in Japan and U.S.A. It is necessary that the cannibalistic behaviour of crabs has to be controlled to make the farming economically viable.

The brachiopods (*Lingula* sp.)are reported to be of local improtance in the coastal areas around Ratnagiri which are consumed by the economically poor people. More attention has to be paid for the proper utilisation and management of this hitherto neglected, resource.

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MONSOON FISHERY AND MUD BANKS OF KERALA COAST

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INTRODUCTION

The south-west monsoon period is generally an offseason for the fisherfolk who use non-mechanised fishing crafts along the west caost of India, on account of the extremely rough conditions of the sea. However, in some parts of Kerala, areas adjoining the coast become occasionally very calm due to the formation of mud banks while other coastal areas are highly surf ridden. The calm areas formed near to the shore are of varying extent, from about10 km² to 25km² and provide safe harbourage to the non-mechanised crafts when fishing in other regions is almost impossible. Launching and landing of vessels are easy at the mud bank areas.

The monsoon fishery of the mud banks constitute a small-scale fishery of high magnitude during the mudbank season (June-August). When fishing is almost suspended at other places owing to rough conditions, canoes from fishing villages of Cochin-Quilon and Cochin-Ponnani regions congregate at the mud bank areas, and these and the adjacent coastal fishing grounds are intensively fished by hundreds of canoes. Occasionally, the sea becomes calm all along the coast and fishing becomes possible at other centres, besides mudbanks.

The present account deals with the fishery associated with the mud banks at Ambalapuzha-Thottappally region in zone K-4(Tharayil Kadavu -Ottamassery) and Valappad-Nattika region in zone K-6 (Attupuram-Ponnani) during the south-west monsoon months. An attempt has also been made for a critical study of the so called 'mud bank fishery' which is very popular among the fishermen as 'Chakara'. The catch statistics of the fish landed at mud bank and non-mudbank areas of the respective zones during the monsoon season have been compared. For the above studies the fish landing data from 1973 to 1977 have been made use of. A special study of the prawns landed at the mud bank region in zone K-4 from 1972 to 1976 has also been made.

FISHERY CHARACTERISTICS

Crafts and gears of the monsoon fishery

Fishing at the mud bank area is done normally from the early hours of the day till noon. On heavy fishing days, fishing has been observed to continue till late in the afternoon. Dug-out canoes and rigged canoes called locally as 'Vallam' or 'Vanchi' are the crafts used in fishing operations. The canoes are mainly of two lengths a larger one of 9.5 m manned by 15 persons and a smaller one of 6 m manned by 9 persons. The main gears of operation at the mud bank regions are drag nets (Thanguvala) and gill nets (Mathichalavala).

Species composition

The fish landed at the mud banks during the south-west monsoon season are typical of the fishing grounds off the south-west coast of India. About 50 species, of fish and 6 species of prawns are recorded from these regions. Fishes of the families Carcharinidae, Clupeidae, Dussumieridae, Dorosomidae, Engraulidae, Chirocentridae, Tachysuridae, Hemiramphidae, Sphyraenidae, Mugilidae, Polynemidae, Ambassidae, Theraponidae, Sillaginidae, Lactaridae, Siganidae, Carangidae, Gerridae, Leiognathidae, Pomadasydae, Sciaenidae, Trichiuridae. Scomberomoridae, Stromateidae, Cynoglossidae, Chirocentridae and Drepanidae were encountered in the landings. Of the prawn species *Penaeus indicus, Metapenaeus dobsoni* and *Parapenaeopsis stylifera* were the abundant ones. *Metapenaeus monoceros* and *M. affinis* were also encountered in smaller quantities.

Catch and effort

The total fish landed during the south-west monsoon at the mud bank and the non-mud bank areas of zone K-4 and K-6 in the year 1973-'77 are shown in Figs. 1 and 2 and the catch per unit effort is shown in Fig. 3. The highest rates of catch per unit effort for mud bank and non-mud bank area were obtained in the years 1975

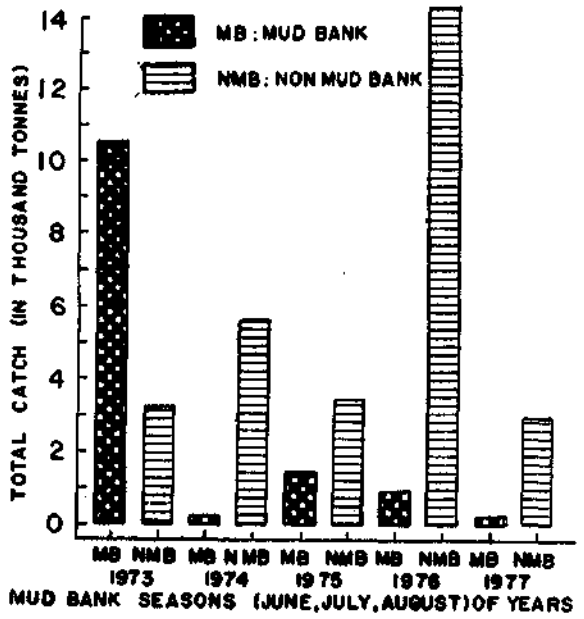

Fig. 1. Total marine fish landings for mud bank and non-mud bank areas of Zone K-4 (Tharayilkadavu-Ottamassery).

and '76 respectively for the zone K-4 (Fig.3). In zone K-6 the high rate of catch per unit effort was recorded in 1977 for the mud bank area and the same was recorded for non-mud bank area in 1973. The catch per unit effort for the mud bank area in zone K-4 was more in 1974 and 1975; but in 1973, '76 and '77 it was the reverse. In zone K-6, the non-mud bank area

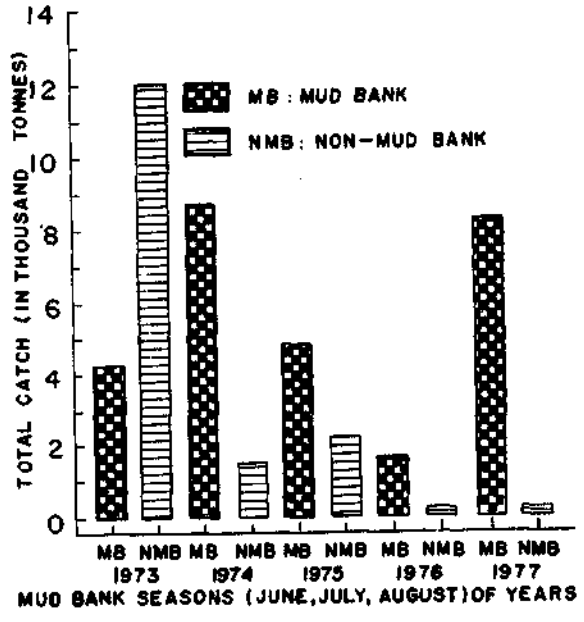

Fig. 2. Total marine fish landings for mud bank and non-mud bank areas of Zone K-6 (Attupuram - Ponnani).

yielded a higher catch rate over the mud bank area in 1973 and '74, while in all other years under consideration the catch per unit effort was higher at the mud bank area. However, the overall catch per unit effort was on the higher side for the non-mud bank area in zone K-4 and for the mud bank area in zone K-6.

Changing pattern of fish distribution

The pattern of fish distribution in the coastal grounds during the monsoon season has been observed to change very frequently, even day to day. The phenomenon is not only with the mud bank area but also for other region of the coast during the monsoon months. This is obviously due to the shoaling behaviour of the fishes. The daily changing pattern of the fish landed at the mud bank area in zone K-4 was studied in July 1971 and the results are given in the following table. Of the major species studied for 13 days in the month, *M. dobsoni*

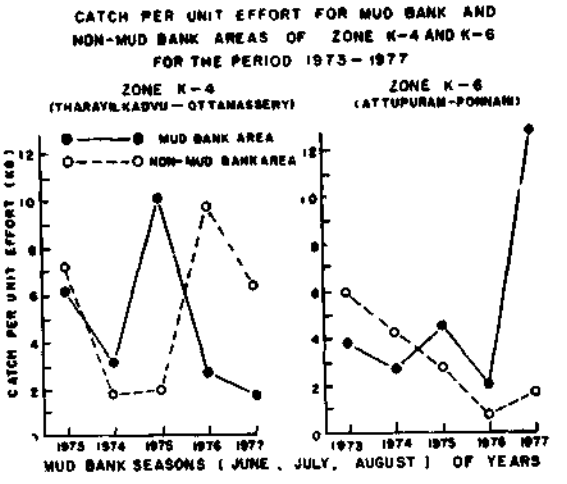

Fig. 3. Catch per unit effort for mud bank and non-mud bank areas of Zone K-4 and K-6 for the period 1973 to 1977.

dominated the catch for 6 days. During these six days, the second dominant species were *P. indicus* on one day, *Leiognathus* spp. and *Stolephorus* spp. on two days each. During the above 13 days, the oil sardine dominated on one day only, while *Leiognathus* spp. and *Stolephorus* spp. were the major catch for three and two days respectively. On one day, the catch was of mixed type without having any predominant species.

It has been found that fishes, especially prawns move towards the shore during the south-west monsoon period. This is probably

due to the process of upwelling (Banse,1959) which starts from the deeper waters. During the monsoon period, the current has been observed to be southerly. The general tendency of fish is to swim against the prevailing current. Thus, as the fishes and prawns move in shoals, a portion may pass through the mud bank area also where they are caught by the numerous canoes operating in and outside the mud banks. The present observation shows that if one such shoal is not caught anywhere on their way, it moves off giving room for another shoal of entirely different composition. Even though there were some gaps in the observations, the overall picture obtained is enough to indicate the phenomenon of daily changing pattern of the fishes.

Prawn landings at the mudbank region in zone K-4

Special studies on the catch statistics of prawns for the period 1972-76 (Fig. 4) showed great annual fluctuations in total landings and species composition. Prawn fishery in general showed a declining trend during the period of observation. The prawn fishery which was of

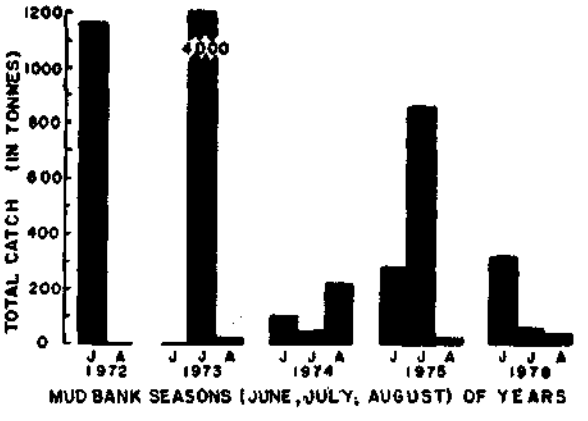

Fig. 4. Total prawns landed at mud bank area (Ambalapuzha-Thottappally), of Zone K-4 during 1972 to 1976.

low magnitude in 1972 with a total catch of 1186.9 tonnes showed a spurt in 1973 with 4284·8 tonnes to dip down to a mere 444.0 tonnes in 1974. The year 1975 showed an improved catch of 1174.4 tonnes to fall again to 490.0 tonnes in 1976.

The month-wise percentage composition of the prawn species during the mudbank season of 1972 to '76 is given in Fig. 5. The fishery is chiefly composed of *M. dobsoni P. stylifera, P. indcicus* and small quantities of *M. monoceros* and *M. affinis* (George, 1961; Kurup and Rao, 1974). During July 1972 and July and August 1973, *M. dobsoni* constituted solely the bulk of the prawn catch while the same species domina-

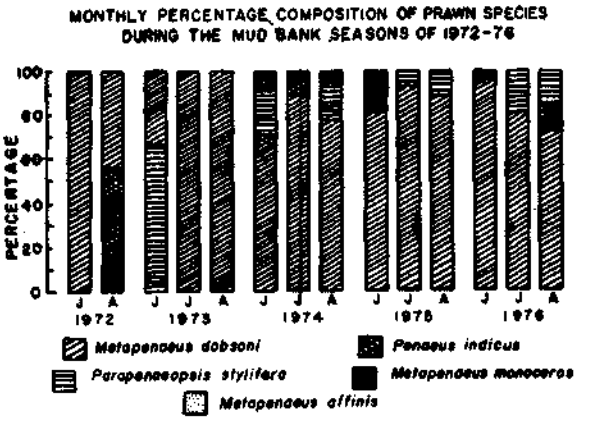

Fig. 5. Monthly percentage composition of prawn species during the mud bank seasons of 1972 to 1976.

ted the catch in the other months except August 1972. The modal size of this species was at 81-85mm for males and 86-90 mm for females, with a size range of 52 - 104 mm for males and 55-130mm for famales. *P. indicus* was the dominant species in August 1972. The principal modal sizes were observed at 126-130mm and 146-150 mm in males and 130-140 and 151-155 mm in females. Among *P. stylifera,* dominance of larger size groups, namely 81-85 mm for males and 101–105 mm for females were recorded.

INFRASTRUCTURE AND SOCIO-ECONOMICS

Infrastructure

With the onset of the monsoon fishery at the mud banks, a small fishing village all on a sudden turns into a big business centre. Thousands of fishermen and other people assemble here. To meet the fishing requirements and other human needs an elaborate infrastructure is needed. Sufficient number of crafts and gears, preservation and marketing facility and also means of quick transportation of fish are the essentials in this regard. Above all every fisherman has to be guaranteed for a reasonable price of his commodity. It will be worthwhile to examine how far these needs are met with at the mud bank region during the monsoon fishery.

The establishment of ice plants in the vicinity of mudbank areas has ensured a steady

supply of ice for the preservation of the catch. At times when there used to be heavy landings, more quantities of ice have to be brought from distant places to meet the requirements. There are very good transportation facilities all along the Kerala coast and hence quick movement of the catches by insulated trucks is possible.

Right of fishing the mud banks

The coastal monsoon Fishery has a legal protection from the state government which provides exclusive operational rights for canoes and catamarans especially in the vicinity of the mud banks. Fishing by mechanised trawlers is prohibited at the mud bank and nearby areas.

Socio-economics

Majority of the fishermen who used to engage in fishing at the mud bank area are not permanent dwellers of this region; but have come from far off places for the sake of fishing during monsoon season. They come with own or hired crafts and gears. At the mud bank region they stay with their relatives, friends or in rented apartments or on the beach itself.

The fisherfolk who assemble at the mud banks are not a homogenous group. They belong to various castes and religions and speak different languages and have their own ways of living. In spite of such diversity in social behaviour, worship and way of life, they all live in perfect harmony.

Majority of the boats and nets operated in the mud bank are hired ones. A major portion of the income may have to be given as rent for the boat and net. Fishermen used to get fairly good amounts as advance from either money lenders or other agents before they start to the mud bank area. Such advance become a burden on them as they are forced to pay heavy interest or give their fish catch at the rates prescribed by the agents.

The business is done through agents and middlemen. In fact they are the people who set the market price every day on knowing the trend in fish landings. The intervention of middle men surely reduces the income of fishermen in the absence of other marketing facilities like Fishermen Co-operative Societies. The fishermen who come to the mud bank area with the hope of prosperity will have to go back with empty hands. There are exceptions too. Many people make good fortunes at the mud banks and with that they purchase boats and nets of their own.

GENERAL CONSIDERATIONS

The monsoon fishery along the south-west coast of India is often called as mud bank fishery. There is a common belief that mud bank and fishery are interrelated (Govindan, 1972; Kurien ,1966) A good mud bank or 'chakara' means a good fishery to the public. The fishermen believe that a good mud bank formation will provide them a good catch. In fact, it has been found that the mud bank and the fishery are independant. During 1974, '75 and '77 when a well-formed mud bank existed at Ambalapuzha – Thottappally region (zone K–4), the fishery was at very low magnitude (Fig.1). Similarly there have been cases of heavy catch from the coastal waters even when there was no mud bank formation. It is evident from the data that the mud bank fishery suffered a set bank after 1973 while the non-mud bank fishery improved quite appreciably. The highest figure for mud bank 10,425.21 tonnes) and non-mud bank area (14,231. 55 tonnes) were recorded in 1973 and 1976 respectively. Similarly, the lowest was in 1977 for both mud bank (37.81 tonnes) and non-mud bank areas (2,884.70 tonnes) in zone K-4. While the highest for mud bank (8,776.84 tonnes) and non-mud bank areas (12,100.61 tonnes) was recorded in 1974 and 1973 respectively for zone K-6, the lowest was recorded in 1976 (2,638.19 tonnes) and 1977 (0.25 tonnes) respectively (Fig.2).

It may be noted that the catch per unit effort (C. P. U. E.) for zone K-4 (Fig.3) was 4.6 kg and 5.4 kg for mud bank and non-mud bank area respectively; showing a high C. P. U. E. for non-mud bank area In the case of zone K-6, the C. P. U. E. was 5.2 kg for mud bank and 3.0 kg for non-mud bank area. The variation in C. P. U. E. clearly shows that the catch is determined by the fishing facility, man power and gear and craft and not by formation of mud banks during the monsaon months. So the present study reveals that the season 1973-77 was favourable for fishing all along the coast and the non-mud bank area having a long coastline and more number of canoes and manpower was able to dominate the catch in the monsoon fishery. The

The Changing Pattern of Fishery in July 1971

(Based on Fish landed at mudbank area in Zone K-4)

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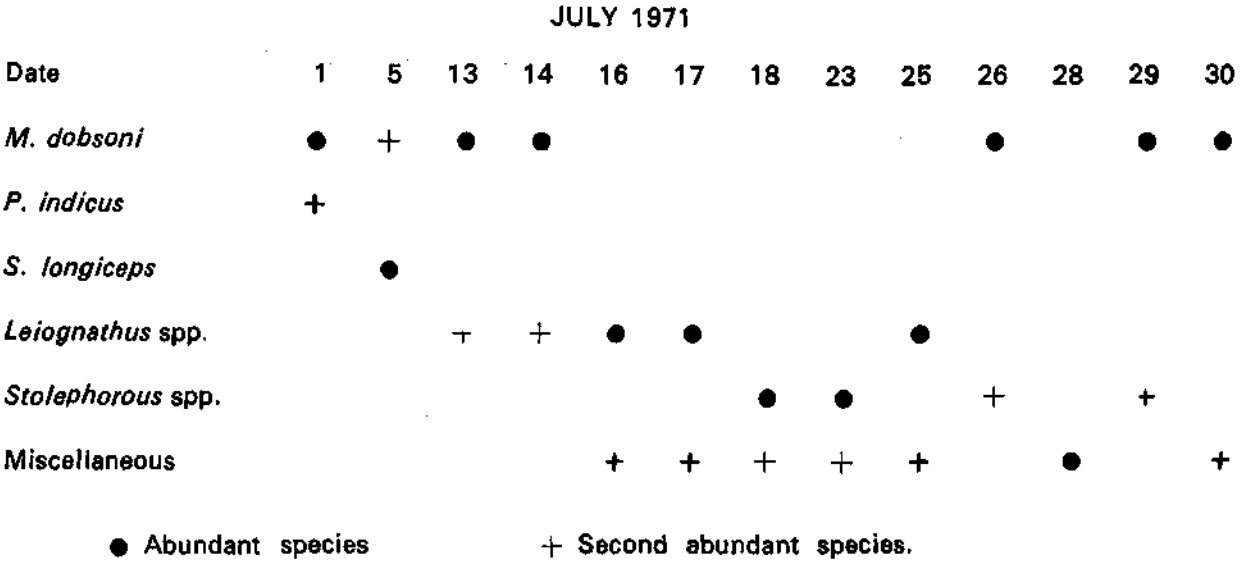

overall landing figures for both the zones show a higher catch for the non-mud bank areas (45,301.53 tonne) than the mud bank areas (41,605 11) It is doubtful at this stage whether the catch of the non-mud bank area would have been realised in the mud bank area if there had been good mud banks and monsoon had been active to prevent fishing at the non-mud bank areas.

During the monsoon months when the sea is roaring and fishermen count upon the fishing days, the formation of mud banks at restricted places is really a blessing for the small-scale fishermen to make their livelihood

ACKNOWLEDGEMENT

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SESSION II

SOCIO-ECONOMIC CONDITIONS OF THE COASTAL RURAL SECTOR

Keynote address

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Director of Fisheries, Maharashtra, Bombay

In this session, we will be discussing the socio-economic conditions of the coastal rural sector with special reference to the fishing community. As I could not readily get details about this subject on an all-India basis, I have attempted a discussion on the basis of available information for the coastal region of Maharashtra State on the presumption that the socio-economic conditions of the rural sector on the east as well as west coast would almost be similar. For meaningful discussion on the economic conditions of fishing community certain specific information about economic indicators is necessary. A sample survey conducted to determine the socio-economic conditions of fishing community in one of the coastal districts in Maharashtra in 1968, though old, provided useful information.

Our country has all the features of a backward and under-developed economy. It has predominatly a rural character with a large majority of the people (80%) living in rural areas. In every under-developed country, there are small highly developed regions surrounded by large very backward areas. This is true of India as a whole and this is also true of Maharashtra even though it is considered as the most industrialised state in India. In Maharashtra, the economic development is practically confined to the Bombay Division and even in that division it is limited to a small area called the Bombay Metropolitan region. Unfortunately, the coastal region, except the Greater Bombay District and a part of Thane District, has remained almost untouched by the progress in the major sectors of State economy for over 100 years. This will be seen from the following account.

High proportion of workers in agricu ture

Proportion of workers in agriculture to the total workers varies from 70 to 80 per cent. This shows that the region is more agricultural and consequently lacks in industrial development.

Poor agriculture

Agriculture of the coastal region is poor in a variety of ways. The net sown area is only a small proportion of total land. Out of the total land 20 per cent is barren, another 20 per cent is covered by forest and, of the remaining, only half is made available for cultivation of food and non-food crops. Most of the cultivation of food and non-food crops is unirrigated with the result that almost all the land is under single crop. Agriculture has been impoverished by complete denudation of the soil. In most parts hardly a few inches of top soil remains for cultivation. Dearth of animal power is acutely felt and the animals are weak and lack in strength. Productivity of agriculture is low because most of the holdings are of uneconomic sizes.

Horticulture

The coastal region is, however, reputed fo- horticultural products particularly mangoesr coconuts, betelnut, bananas, chikoo and cashew nuts.

Other primary occupations

Although the livestock population is fairly large, animal husbandry has hardly developed,

Poultry production also suffers from low productivity. Forestry of this region is still in the development stage. Efforts are made to develop fisheries by introducing mechanized boats and by providing infrastructural facilities for landing, preservation, transport, storage and marketing of fish. But, much remains to be done to bring about an overall development of the industry and improvement of economic condition of the operatives.

Industrial backwardness

The coastal region, in general, has remained industrially backward and large scale industry is virtually absent and the existing industries are either small scale or cottage industries. Of the small scale industries, the more important are cashewnut processing, fruit and fish preservation and silica processings.

Inadequate development of transport and power

The low level of economic development of the coastal region is largely due to the total inadequacy of transport facilities as transport is one of the prominent indices of industrial development in a region. In respect of transport and communication and also the provision of power the coastal region is the most inaccessible area among the States in India. The difficult topography of the region is a barrier to the rapid development of transport and communications. There are comparatively few roads. There are number of tracts which can scarcely be called roads and there are number of villages which have no contact with the outside world. Except for a small portion of the coastal region much of it has remained without railways. Water transport, though convenient, is not available all the year round as it does not function during monsoon.

Power

The extent of electric power development is a good test for economic progress. Though power supply is arranged under rural electrification programme, the progress has not been to the desired extent due to financial constraints.

Urbanisation

Given an under-developed economy, the coastal region has, by and large, remained very much behind in the process of urbanisation.

Migration

Owing to lack of economic development in the region there is continuous exodus of labour from the coastal region. As a result of exodus of male adult labour from the region, the females have to bear most of the burden of economic activity. This large scale migration from the coastal region appears inevitable because of lack of employment opportunities. It can be stopped only by creating scope for employment. Those who remain in the region have very low income and they depend mostly on moneyorders coming from their relatives in Bombay. That is why the coastal economy there is termed as "Moneyorder Economy".

Conditions of living

Conditions of living in the coastal rural area are very much influenced by economic inequality. Living conditions on the whole are deplorable because of the great incidence of poverty of the population. Small cultivators and fisher men generally own their dwelling places but their houses are inferior in every respect. Walls are made of stones and mud and with a thatched roof with almost no ventilation. There are no amenities worth the name. Clothing, utensils etc. are poor both in quality and quantity. Comforts and luxuries are totally absent. Greater part of cash income is spent on purchase of food stuffs Indebtedness is universal and common.

Education

Percentage of literate and educated persons in rural areas is lower than the State average which is 39.2 and very much lower than the urban percentage.

Public health

General health standards as in other parts of the country are poor. Both the general and infant mortality ratio are higher than the national average. Low health standards are primarily due to the nutritional deficiencies in the diet of the people in the coastal region consequent on relatively low *per capita* availability of milk, vegetables and meat. Low health standards are also due to the fact that the public health services are less developed. The sources of drinking water are exposed to pollution of different kinds. Conditions of environmental hygiene are extremely poor.

General picture

Thus, the gencral picture of the socio economic conditions of the coastal rural sector is not at all pleasing. Development of Agriculture in this region has some problems because of the poor soil and uneconomic holdings. The area has not attracted large industries due to lack of water supply, power, transport and communication facilities. Living conditions of the coastal rural population in general is much to be improved. There is wide- spread unemployment or underemployment and this has resulted in migration of labour from this region This may create problem of man-power which is required for building sound economic development structure in the region.

Socio-economic conditions of fishermen community

We have discussed so far the general economic conditions of coastal rural population but in this seminar it would be necessary to discuss the socio-economic conditions of fishermen in particular. Meaningful discussions can be had only if we have precise knowledge of their conditions. Unfortunately, we do not have up-to-date information as no systematic survey has been done recently to study the socio-economic conditions of fishermen. We had undertaken a sample survey to study the socio-economic conditions of fishing community in Thane District in 1968 and no such work could be taken up subsequently. In this survey, quite a few interesting observations were made. Main characteristics of demographic conditions studied were the average size of the household, sex ratio, distribution of population by age, marital status and educational status. The main characteristics of the economic conditions surveyed were employment pattern, economic status, indebtedness, average value of capital assets etc. Following were the important findings :

(a) Sexwise distribution showed that the population was evenly distributed. The number of females per 1,000 males worked out at 997.

(b) Percentage of illiteracy was 54. Percentage of illiteracy in females was higher than in males at 67% against 40%. The higher educational levels were observed for age group 18-30.

(c) Information about the attitude of parents and guardians towards the male children taking up fishery was collected by enquiry. Enquiry revealed that out of the boys under 18 years of age which constituted 52% of the male population 20% of them did not want to take up heriditary occupation. *i. e.* fishing.

(d) 86% household have fishery as principal industry. 59% of the households have income in the range of Rs. 1,500 to Rs. 4,000 per annum. 17% of the household have income less than Rs, 1.500 per annum.

(e) Expenditure on food item was 71% and on non-food items was 29%

(f) Indebtedness in the fishermen community was wide- spread. 65% of the households were indebted.

(g) 29% of the households lived in permanent structures, 39% in semi-permanent and 32% of the households in temporary structures. 43% of the households lived in one living room, 36% in two living rooms and 21% in three or more living rooms.

(h) As regards sanitation, out of 216 households surveyed one household had septic tank and one had bucket arrangement. Rest of the 214 households used open space.

(i) 57% of households possessed major gear (bag nets, gill nets) out of which 18% did not possess fishing boat. Nearly 14% possessed minor gear such as hand net, cast net etc. and 29%of the household did not possess any fishing gear at all.

This showed that the fishermen community in general is also economically weak. There are some households who are much below the poverty line and do not have any fishing gear with them.

Concluding observations

All this will show that comparative lack of development is the cumulative effect of several unfavourable factors discussed earlier. The only way to improve the conditions in this region would be to implement a sound and need-based integrated development programme. The programme will have to be necessarily of integrated type by co-ordinating development activities in all the essential sectors of rural economy such as Agriculture, Animal Husbandry, Fisheries, Horticulture, etc. The necessary infrastructure by way of communication and transport facilities, water supply and

power will have to be provided on priority basis. This will create scope for setting up agro-based and fisheries-based small scale and medium scale industries and also will bring the consumer markets within easy reach of the production centres.

In the process of development it has always been found that certain section of the population gets motivated earlier than the other and this section, because it is more enterprising, takes advantage of development measures quickly. Weaker section among them lags behind and ultimately does not get the advantage. This weaker section which has remained weak will have to be taken care of during the process of integrated rural development by giving some kind of special treatment.

SOCIO-ECONOMIC CONDITIONS OF THE TRADITIONAL FISHERMEN

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INTRODUCTION

The topic assigned to me and the coverage suggested by the seminar organisers is rather vast. It ranges from issues such as the fisherman as a professional, his nature and communal affinities to his economic status, spending and saving patterns and contribution to the modern fishing industry. The limitation of time imposes a very big constraint in doing justice to such a plethora of questions.

It will therefore be appropriate, at the outset, to spell out the scope of this paper. What is highlighted is only the present objective reality, with specific intention of answering the question 'WHY'; rather than portraying the situation 'WHAT', regarding the socio-economic conditions of the small-scale, traditional fishermen in our country.

The term 'small-scale' fishermen can be taken in the literal sense to imply the size of the operation, regardless of the choice of techonology or the operator's socio-economic and cultural conditions. If this is the interpretation, we can say that the present attention (the use of the word 'attention' rather than 'concern' is deliberate) on small-scale fisheries is a global one.

In the developed countries, which have no sizable traditional fishing communities, depletion of fishery resources due to the earlier adoption of aggressive and stunningly over-efficient techniques of fish harvesting, have caused a scare in the fishery circles. This has led to a conscious and rigid enforcement of quotas for fishing, and significantly, wherever possible, the encouragement of small-scale operations In the developing countries, the potential fishery resources are yet to be fully exploited and traditional fishermen are among the poorest sections of the society. The stress on small-scale fisheries in these countries is at best to be considered as a specific case of the stress on improving the lot of the poor at large.

MARINE FISHING COMMUNITIES OF INDIA

Several traditional marine fishing communities inhabit our country's 5650 km coastline. Each community has its own distinct characteristics which manifest themselves most visibly in the very wide variety of craft, gear and tackle which each community has evolved to suit their specific environment. The *catamaram* of the 'Mukkava' and 'Parava' fishermen of the East Coast, the *odam* and *mathikollivala* of the 'Mappila' fishermen of north Kerala; the *rampan* nets of the Nistenkars' of Goa; the *machuwa* of the 'Kholi'' 'fishermen of Maharashtra and the *eklakadi* of the fishermen of Saurashtra are some examples. Each community also has distinct ethnic origins. Under a complex set of socio-religious and cultural phenomenon, which varied from region to region, each community has also evolved differently.

Consider religion, for example. Though certainly the greatest percentage of them are

Hindus, we see several isolated, and at times dominant, strips of coastline, populated with Muslim or Christian fishermen. The forced conversions of the people of Saurashtra during the attacks of Mohamud of Ghazni has resulted in a spattering of Muslim fishermen along the southern coastline of present day Gujarat. The old trade links with the Arab countries and the policy of encouraging them to marry women of the Hindu Mukkuva community in the domain of the Zamorin of Calicut, has resulted in the northern districts of Kerala, historically known for their large landings of oil sardine and mackerel, becoming the habitat of the Muslim Mappila fishermen. The portuguese political conquest of Goa and the mass conversions and preaching of Francis Xavier and his associates along the coastline of present day Quilon, Trivandrum, Kanyakumari and Tirunelveli districts, account for the predominance of Christian fishermen in these regions.

Can we generalise about socio-economic conditions ?

Similar factors can be isolated for their social and cultural differences also. In this context it is probably legitimate to ask if one can talk in generalities about the socio-economic conditions of these several communities of traditional fishermen. However, my personal involvement with traditional fishermen in one district, my research and observations of other fishermen in the other maritime states of the country reinforce my conviction that we can effectively generalise at least about the broad causes of the prevailing socio-economic conditions of our fishermen.

Who is a Fisherman ?

To facilitate generalisation it will be helpful to clarify an often misused word — "fishermen". We notice that the word 'fishermen' is often used to embrace a very wide and heterogenous section of the fishing community. It is this very liberal and wide meaning given to the word which has often led to the failure of several well-intentioned development schemes implemented by many organisations and governments.

In this paper, unless otherwise specified, the use of the word 'fisherman' is a reference *to that category of persons who earn their main source of livelihood by actually actively being involved in the process of catching fish using non-mechanised means of production.* Whether the fishermen own or do not own the equipment they use is no disqualification. Owning fishing equipment, actually handling fish on the shore, active involvement in financing fishermen, being the president of a fishermen's cooperative and other such activities do not qualify the person (s) undertaking them to come into our present definition of 'fishermen'

PSYCHO-SOCIO AND PROFESSIONAL DIMENSIONS

We must begin our analysis by delving into three aspects of a fisherman—as a person, as a member of an occupational community and as a professional. The first will give us an idea about his nature, the second an inkling into his social associations and the third, an insight into his skill and knowledge.

Fisherman as a person

The personality of a fisherman, his concepts and attitudes—in fact his whole 'world-view'—are influenced by Nature. Nature in his case is mainly personified in the form of the mighty expanse of vicissitudinous ocean: now rough, now calm; sometimes providing a bountiful harvest, sometimes barren; but on the average providing sufficient to make ends just about meet. His whole psyche is conditioned by his relationship with Nature. He has a high-strung temper that leaps like high surf. But just like retreating surf, it quickly calms to a low ebb.

He is overtly generous. Just as 'Mother Sea' provides for his needs, he is willing to share what he has with others, who for some genuine reason are physically unable to go to sea.

The sea seems to be constantly in motion with no element of permanence about its form. Fish migrate from shore to shore, from cooler to warmer waters—the whole sea is their home. If other factors permit, the fisherman also prefers a life of mobility with little possessions and much less permanence. He is by instinct nomadic. However, present day demographic, social and political factors largely restrict and constrain his movement.

The faith in the bounties of the sea and his consequent belief that 'Nature will provide' make him carefree and unmindful of the morrow. Once, standing on the beach and trying to impress upon a fisherman the need for a saving mentality, I got this short reply from him in the form of a rhetorical question - "You mean to say", he said pointing to the sea, "that it will dry up tomorrow?". More than revealing his simple and ardent faith in Nature's ability to provide to those who labour, it highlights an important aspect of his world view and his values.

Finally, his closeness to Nature and his dependence on it coupled with a constant element of great risk to life makes him as superstitious as he is generous and carefree.

What have been enumerated above, are certain of the innate characteristics of fishermen in our country. One must, however, hasten to add that modernisation of the society at large and the socio-economic forces that act to break open the old isolation of the traditional fishing communities, have either destroyed these characteristics, distorted them or have used them to exploit the fishermen more effectively.

Fisherman as a member of a community

The fisherman is a member of a community which has always had a very low status in our Indian society. They have been categorised as a lower caste. However, since this community also performed the services of boatmen, and palanquin bearers, the degree of untouchability was probably not as great as in the case of some of the other lower castes. In spite of the fact that several fishing communities have accepted religions which proclaim equality of man, even in these groups they still find themselves on the lowest rung of the social ladder.

As a community they have been isolated and unorganised. Their associations were of a communal nature. Only a year or two ago did we see the emergence of militant non-political fishermen's organisations. There is a great intra community affinity and cohesion which often borders on a sort of chauvinism that leads to action that is sometimes very narrow-minded, shortsighted and destructive. The occasional flare-ups between fishermen of different religious communities living in the same area, over very minor issues, is a manifestation of such intercommunal rivalry arising from an excessive intracommunal affinity. However, much of these tensions are inordinately blown out of proportion by vested interests.

Religion plays a crucial role in their intra-community affinities. Though religion may play a crucial socio-cultural role in such communities, it is unfortunate that the organised religious structure subtly subjugates the fishermen to their control. Church taxes are often as high as 5% of daily earnings. Religion gives a great cohesion to the community, but it serves to unite fishermen through vague and intangible spiritual bonds rather than as a class of persons involved in a common productive activity.

Fisherman as a professional

In 1946, a plan for a Central Fisheries Organisation was discussed by the National Planning Committee. In his introduction, the Chairman of the Committee, says, (quote) though fishery resources have been exploited from time immemorial, they lack scientific utilisation and development. Certainly, in the case of coastal, and still more, as regards deep-sea fishing, the occupation is largely of a primitive character, carried on by ignorant, unorganised and ill equipped fishermen. Their technique is rudimentary, their tackle elementary, their capital equipment slight and inefficient (unquotes).

The professional capacity of traditional fishermen is to be marvelled at. The principles of their profession are unfortunately not available to us in the form which we are all used to. There are no books, no charts, no research papers. They don't even "teach" their profession to the younger ones of their community—it is "learnt" by experience and gradually internalised over time.

The shark fishing off Poonthura in Kerala; the technique of paying out the rampan around an oil sardine shoal in Goa; and hook and line fishing by catamaran fishermen of Kanyakumari district near the famous Wadge Bank, are indicators of their mastery over technique.

Fishing for three or four days beyond land visibility, at depths of 100 and 150 metres

and returning at night exactly to their village landing site with the aid of the stars; an intelligent understanding of the influence of currents, winds and lunar forces on the movement and occurence of fish shoals; comprehensive knowledge of the different fishing grounds; the various species of fish and their food habits; all highlight their comprehensive, scientific and intricate grasp of the totality of their ecosystem.

The whole system of operations relating to their fishing are not determined a priori by a process of inductive reasoning as would be the case of a modern fishing expedition. Having assimilated the nuances of their ecosystem, the progress of their fishing operation is the simultaneous integration of a large number of discrete processes which defy verbalisation in the form of any general theory on the practice of fishing.

In a recent book entitled the "Mappilla Fisherfolk of Kerala", the author, an anthropologist, has taken great pains to describe the intricate details which highlight the extent of the professsional knowledge of that community in their own idiom. More studies of this nature will certainly reveal other aspects.

The psycho-socio-religious and professional dimensions that we have considered relate to the 'superstructural' aspects of society. We must now turn to the "infrastructural" aspects that is, the economic dimensions.

ECONOMIC DIMENSIONS

In our country, the adjective most often used to describe fishermen has been the word 'poor' Rather than describe the visibly manifest consequences of this poverty, we shall here delve into the *cause* of this poverty.

There are two fundamental causes for the poverty of fishermen. Firstly, it is the inequality in the asset holdings among them and secondly the exploitation of all of them by those who are involved in the process of buying what they produce.

The two causes indicated as being fundamental to poverty cannot be substantiated by all-India data. Data collection agencies concentrate only on the total holdings of fishing assets in an area and not its distribution between the fishermen. Indeed, this preoccupation of data collection with the total and its geographic distribution—be it of assets or fish production—is based on the underlying assumption of a growth oriented rather than a growth-through-social-justice approach:

The first cause for poverty

The first document announcing this Seminar carries such information which says that in 1800 fishing villages there are 219,000 non-mechanised craft and 2½ million gear operated by about one million active fishermen. Merely using averages it works out to about 5 fishermen for a craft and 500 active fishermen to a village sharing about 1400 sets of gear between themselves. The implicit assumption behind these averages is that the assets are equally distributed among the active fishermen. Consider a similar assumption being made about per capita availabillty of land in this country. Would not such an assumption deny the existence of big farmers, marginal farmers and landless labourers?

A similar situation exists in the small-scale fisheries sector as well. There are master fishermen owing a wide range of fishing equipment; artisanal, self-employed fishermen and fishermen labourers all of whom fit into our earlier definition of fishermen. Basically therefore, among the active fishermen there are two categories, those who own equipment and those who do not.

Those who are familiar with the sharing and wage system among traditional fishermen know that equipment less fishermen participate either as free labourers, getting a share of the catch; or as bonded labourers, who receive a wage advance and are therefore obliged to continue with the same owner for a certain stipulated period. Consequently, the skewness in the distribution of fishing equipment and the nature of the relationship between those who own the equipment and those who only have their labour to offer, will determine the levels of production, the productivity per fishermen and the different levels of income that accrue to them.

Let us illustrate all these points with examples of case studies conducted in some parts of the country.

This year a study was undertaken in Panayurkuppam, a fishing village 15 kilometres

south of Madras. This village has 91 active fishermen. Nine of them have no equipment. Forty-seven per cent of them have only catamaram and one net that will make them productive for only one season of about three months. Twenty-six of them, or twenty-eight per cent, have one or two catamarans and more than one net.

Thirteen owned one plank canoe, two catamarans and at least three nets. Only this last 15 per cent in the village had all the seasonal craft and gear. The fishermen of the the first two categories—that is 55 per cent of the village—work either all the year round or during the major fishing seasons on the equipment of the more well-to-do fishermen.

This asset situation is not as glaring a caseas of the hook and line fishermen of Tanur, in north Kerala. Of the 122 Beppukar families, 16 families own two fishing units and 3 own one each. The remaining 103 are merely members of the crew who are given wage advances from Rs.500 to Rs.1000 by the 19 owners.

As regards the correlation between asset holding and income of traditional fishermen, the only place to my knowledge where a record of traditional fishermen's daily fish sales are maintained is in the Marianad Fishermen's Co-operative in Trivandrum District. Data for 1972-73 on the basis of a stratified sample of the members indicates the following results: For the fishermen who, on the average, have 3 catamarans, 4 nets (including a net called 'thattumadi') and a hook and line set, that year's sale of fish averaged Rs.4,877. Compared to this, the fishermen who, on the average, owned only 2 catamarans, 2 nets (excluding thattumadi) and a hook and line set averaged only Rs.922. In the case of the former group it may be considered that about 66 per cent of the sale value would be their annual income. In the case of the latter group their earnings from working as labourer-partners would add only about Rs.300 to their income.

The number of equipment can be a misleading indicator because of qualitative differences. We have figures for the capital investment in fishing equipment among 822 fishermen in Tanur village in north Kerala. The valuation is based on actual cost less depreciation. The figures relate to the year 1970-71. It is seen that 75 per cent of the fishermen have an investment between Rs.1,000 and Rs.10,000; 22 per cent have invested between Rs.10,000 and Rs.15,000 and the remaining 3 per cent account for investment above this. Only the investments of the top 25 per cent are sufficient to have complete control over one or more fishing units. Hence, the former 75 per cent, are in one season or the other, partially or totally, dependent on the latter.

In spite of these differences the traditional small-scale fishermen taken as a whole still dominate the fish economy of our country. They contribute 65 per cent of the total marine fish production in the country. In fact, with the exception of Maharashtra, in all the other maritime states, the total fish catch is a direct correlate of the fish catch of the traditional sector. If traditional fishermen catch less fish the total drops and vice versa. A quick look at graphs provided by the Central Marine Fisheries Research Institute on this will illustrate this.

The absolute catch of the traditional fisher men has shown a marginally increasing trend. However, because of the increase in the number of active fishermen, output per worker has declined. In Kerala, for example, between 1970 and 1975 the output per traditional fisherman has declined from 3710 kg to 2820kg. If this is the trend also on the all India basis—and there is no reason to doubt this—the unambiguous conclusion is that a process of marginalisation has set in. Basically it is a fight for survival. In this fight, those who do not own equipment are more affected and more quickly than those who own equipment.

The second cause for poverty

The second cause for the poverty of fishermen is their expolitation by those who are related to the marketing of their fish -that is, all the middlemen and some of the merchants. This is common knowledge. There has always been a lot of talk about 'doing away' and 'replacing' these exploiters.

Fish marketing in India is the breeding ground for middlemen. For every middleman on a marketing chain there is a proportionate decrease in the return on the consumer rupee to the fishermen and an increase in the price

that the consumer pays. The middlemen on the seashore live off the fishermen and the merchants with whom they come into contact. Those at the latter end of the marketing chain thrive at the expense of the wholesale merchants. The consumers finally bear both the whole cost of the movement of the fish along the chain and the exhorbitant profits made by the merchants.

Merchants are of two types—the small merchants who use very labour intensive methods to distribute the fish and the big wholesale merchants who transport large quantities over long distances. Both no doubt, perform essential economic functions. However, in their own way, they exploit both fishermen and consumers. The small merchants often cheat the fishermen by not paying the whole amount due to them. The big wholesalers amass wealth by unequal exchange-buying cheap and selling dear.

To understand the nature of this exploitation let us take a brief look into the patterns of the disposal of fish caught by traditional small-scale fishermen. We can generalise them into three basic forms:

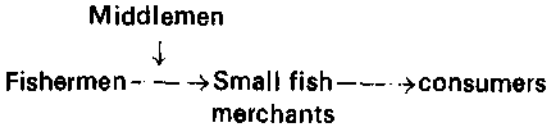
a. Small-scale disposals over short distances

b. Bulk disposals over long distances

c. Disposals for export

Each of these forms can be expressed by what we shall call 'fish chains'—that is, schematic flow diagrams showing the movement of fish from fishermen to consumer.

a) *Small-scale disposal over short distances*

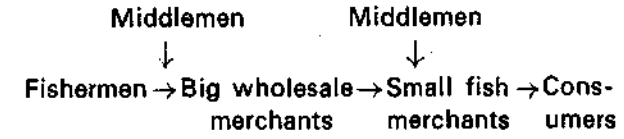


This first chain has three main functionaries and one 'irritant' between the fishermen and the small fish merchant. This 'irritant' or middlemen, as they are more respectably called, enter the scene as an economic and social buffer between the fishermen and fish merchant. Initially they take a payment in fish from the fishermen and cash from the merchant for 'services rendered'—mainly auctioning. Gradually, however, they begin to perform the role of financiers of fishermen. The advance money for buying craft and gear or for immediate consumption. To avail of this, fishermen have to pledge to sell their fish only through the mediation of this financier. The fishermen thus lose their independence to sell their fish through any auctioneer on the shore. They are thus not even sure of a 'fair price'. With this sort of initial footing and control over the fishermen's produce, the middlemen can subsequently even enter the realm of marketing with ease.

Even if fishermen are not tied down to any middlemen they are constantly faced with the possibility of being cheated by the merchants. The initial fish sale on the beach is on a part payment-part credit basis. Recovery of the latter part is always a problem. The merchants always say they incurred losses and expect the fishermen to share the burden.

This sort of fish chain is very predominant in the areas where the normal fish landings per fishing unit are small. On the coastline where catamarans operate this chain is the most common.

b. *Bulk disposal over long distances*



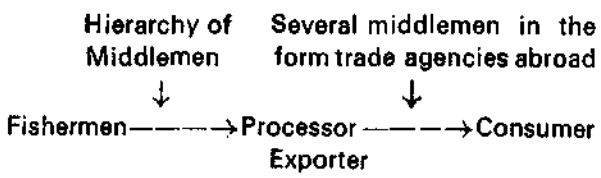
This second fish chain is lengthened by the entry of big wholesale merchants and another "irritant" or middlemen between them and the small fish merchant. Such a fish chain normally tarts in areas where the fish is available in bulks squantities. Oil sardine and mackeral landing in north Kerala, Karnataka and Goa; Bombay-duck landings in Maharashtra and pomfret landings in Gujarat give rise to such chains.

Price levels on such shores are generally low. The high perishability of the product and the total lack of organised infrastructural facilities at the command of the fishermen put them in a very weak bargaining position. Fish is disposed at throw-away prices and the fishermen's total revenue is very much the same although their production may have increased substantially. The high demand for fish also ensures that the merchants need not necessarily pass on this price advantage to the consumers.

Data calculated for one year (1975) in Kerala show that for every one hundred rupees

worth of fish bought by consumers in Kerala only Rs.39 reaches the traditional fishermen (Rs.8 goes to the mechanised sector). The substantial amount — Rs.54 — goes to the big and small merchants. The cut of the middlemen must be considered as coming partly from the fishermen's Rs.39 and partly from the merchant's Rs.54.

c. *Disposal for export*



This third chain is no doubt the longest. It is literally infested with middlemen of various shades. We will concern ourselves with the middlemen in thecountry—that is, those between the fishermen and the processor-exporter.

This chain relates primarily to the movement of prawns and other exportable varieties sent to Japan and USA. In the present circumstances very little real value is added to the product by the processors. They are mainly ensuring a longer period of preservation and there is no transformation of the product.

Many exporters of these marine products are not too concerned about the long term interests of the country. They often pack and export sub-standard material as well. This is rejected by the importers who are also equally unscrupulous. Payment is stopped and the exporter makes a loss. The major portion of this loss is passed down to the fishermen. Though the unit value of the exportable varieties is 15-20 fold higher than the locally consumed fishes, the fishermen is less certain of getting the full promised payment. Data for Kerala for the year 1975 estimate that for every Rs.100 received by the processor-exporter only Rs.20 percolates down to the fishermen. Field experience shows that even this amount is not received because of cheating by the middlemen on the shores

The marketing system presently in operation is certainly no benefit to the consumer. It is a sick and exploiting system. The fishermen whose labour power is what really has created the value, is subjected to a process of systematic deprivation of their right to afair return for their produce.

CREDIT – THE VITAL LINK

We have elaborately described the two primary factors, which in our understanding, are at the root of the poverty of fishermen. On the face of it, the two factors seem to be mutually independent of each other. In reality however, this is not so. What links the two is the continued need for credit. It is credit which prevents the fishermen's economic circuit of low capital-low productivity-low income from breaking down. More important than the mere need for credit, is the phenomenon that the external injection of credit skims all the surplus incomes that accrue in the circuit and *maintains* it at this low level. This sort of credit allows the fishermen to just keep their heads above the water but never really saves them from the surf".

Studies conducted by the Census Operations in 1961 among 107 fisherfolk households in Kerala reveals some aspects of this vicious low key circuit.

Of the surveyed households only 25 had a monthly income of over Rs.100 and it was noticed that the income and the average number of gainfully employed persons were positively correlated. In the households (82 numbers) where the income per month was less than Rs. 100 only an average of 1.4 persons were employed. In the 25 households the average was 2.4.

Taking all the households together it was found that 98 per cent of their income was from fishing and related activities. The rest came as gifts or help from other sources. Out of this, about 78 per cent was spent on food, 6 per cent on clothing, 6 per cent on housing, lighting and fuel, and 7 per cent on miscellaneous expenses. What is significant is that only 2 per cent was spent on the industry itself. Even with this kind of an expenditure pattern the average expenditure over income was of the order of 10 per cent.

Indebtendness was very high; 58 per cent of the households were in debt for an average of Rs.478. Fifty four per cent of the debts were for purchase of net and craft; 10 percent for marriage expenses; 15 per cent for house repair; 5 per cent for clearing old debts; 15 per cent for daily consumption needs and 1 per cent for sickness. It is of significance to note that the largest single cause of indebtedness was the initial investment in the industry.

A systematic study now being conducted by a team of researchers in southern Kerala brings out the type of credit linkages that are established in such low-key economic circuits marked by highly skewed asset distribution and exploitation of fishermen by the middlemen and merchants.

Credit in the form of wage advances is a very rampant phenomenon in traditional fishing communities. This system ensures the more well-to-do fishermen of steady labour and the fishermen labourer of a certain financial security. Wage advances can be as low as Rs. 200 and as high as Rs.1,200.

Credit of other forms may be obtained by pledging ration cards, gold and fishing nets, with individuals in the village who are not necessarily connected with fishing. Interest rates range from 24 to 60 per cent. The lenders are particular that the payment of the monthly interest is prompt. The repayment of the principal is never an issue if the former is carried out regularly.

Fish merchants are a source of big credit. They normally lend large amounts only to fishermen who own fishing equipment. The fishermen in turn would use these big loans for capital investment and for issue of the wage advances. This sort of credit is directly linked to the marketing system and is therefore more exploitative.

It may be of interest to comment that this phenomenal indebtedness situation among fishermen is not only a sign of their poverty but at the same time a clear indication of the very high real return that can be obtained from fishing.

SAVING AND SPENDING HABITS

In the light of the above examination of the asset structure, the marketing system and the credit links, we may also briefly examine the very common discussion among concerned persons about the spendthrift and non-saving habits of fishermen. Often there is a tendency to attribute this as the basic cause of their poverty. This is undoubtedly a myth.

That fishermen have their own rationale for not saving was indicated earlier when dealing with the psychological dimensions. However, the overriding economic reason for not saving is that, for a person at such a low level of income any saving is always at the expense of immediate of consumption. Even if some sort of forced saving were to be introduced, it would certainly take a very long time before sufficient is accumulated to make a worthwhile investment. For the average traditional fishermen saving from his income for invesment is almost as painful a task as that of a middle-class family saving only from the monthly salary to build a two bedroom house in a city.

Excessive spending when they get a bumper catch is again a debatable proposition. Like all of us here, fishermen spend more when they get more. However, one is not convinced that all of it is to be termed lavish or excessive spending. An extra glass or two of toddy or arrack; some good clothes for children and wife;may be a good meal if they live near a town. This may be considered the so called 'excessive' part—something which all of us do when we get a bonus or increment. In other words it's the 'normal human excess'. But what about the other expenses? Windfall gains are used to pay accumulated interest or to return the principal of the loan taken to buy the net which now brought the bumper catch. Alternatively, it could be for the repayment of an interest-free loan taken from a friend for consumption purposes during the lean season. Probably it was used for redeeming the wife's gold chain which was pawned to get money to repair the boat. If the catch was indeed big then the wife may convince the fishermen to buy a sovereign of gold. If a fellow fishermen was in need, it would be lent out to him at the prevailing village interest rate for buying a net or catamaran. Every single one of these expenses is justifiable.

CONTRIBUTION TO THE DEVELOPMENT OF THE MODERN FISHING INDUSTRY

The background note found in the announcement for this Seminar tells about the traditional, small-scale fisheries sector's contribution to the development of the fishing industry and the country, (quote) this sector contributes to about 65 per cent of the total marine fish production of 1.4 million tonnes of the country, 0.5 per cent of the gross domestic product and 60 per cent of the foreign exchange earnings of the marine products. (unquote) This is by any measure an extremely commendable contribution.

But in my understanding, the traditional fisheries sector's most significant contribution

has been their silence. That the genuine small-scale fishermen *have not been* the major beneficieries of the 'development of India's modern fishing industry' is beyond doubt. In spite of this they continue to make the kind of impressive contribution quoted above. Three decades of fisheries development has not meant fishermen's development. The dichotomy between the two has only widened and is now probably at a stage where it cannot be bridged. They continue to catch fish because this is their only means of survival. We can rest assured that it is certainly not out of any intense love for fishing or for the country's fish-eaters and its gross domestic product.

Looking around the country's coastline one realises that the superstructure has now become a trifle too heavy for the foundation to bear. The numerous struggles between traditional fishermen and their not-so-traditional counterparts, is only a visible manifestation of this phenomenon. One only fears that the voice of dissent is a bit too late and will be drowned in the furore being made with slogans that shout—modernisation, deep-sea fishing and development.

One is aware that much of what has been said might sound disconcerting to some and ridiculous to others. If anyone has been hurt, it must be honestly said that nothing of what has been stated was done with any element of malice. However, if any conventional ideas have been upset, then the intention was purposeful.

COMMUNITY DEVELOPMENT AND INFRASTRUCTURE FACILITIES FOR IMPROVING THE SOCIO-ECONOMIC CONDITIONS OF FISHERMEN

AMBROSE FERNANDO

Fish Exporters' Chamber, Tuticorin-628001.

Before the advent of agriculture, hunting and fishing were the occupations of man. For his quest to find adequate food materials for his daily sustenance, man exploited the vast resources of forest and sea. Even when agriculture came to his rescue in the matter of food production, the produces of forest and sea supplemented man's daily requirements of food. Hunting of wild animals became lesser and lesser and it yielded its place to the modern animal-husbandry by which man raised necessary live-stock to meet his requirements of protein food. Thus agriculture and animal husbandry became the twin aspects of man's endeavour in the direction of domesticating the wild to meet his food.requirements. Revolutionary changes were brought about in man's antiquated methods of agriculture by the advancement of science and technology.

When the traditional occupation of hunting was replaced by modern animal husbandry, the fishing practices of man did not undergo parallel changes except in countries where technology and science have far advanced, The great Scandinavian countries in the West and the indomitable Japan in the East have revolutionised the fishing industry by applying modern scientific methods.

Indian fishing industry is as old as the Indian soil. The aquatic resources of Indian waters are varied and abundant. With a coastline of about 3000 miles, a continental shelf of more than 100,000 square miles, the two wide arms of the Indian ocean and large numbers of gulfs and bays along the coast, the marine resources are extensive. The estuarine resources aro also substantial with extensive backwaters, tidal estuaries, lagoons and swamps along the entire coastline. The principal rivers with their main tributaries having a length of about 17,000 miles, the canals along with irrigation channels about 70,000 miles, in length and large numbers of lakes, reservoir tanks and ponds constitute a rich potential source of inland fisheries. Fishing and allied industries provide employment for more than a million fishermen most of whom live on the verge of poverty.

Relative to agriculture sector, the Indian fishing industry has not received its due share at the hands of the national government in the development plans. An analysis of the out-lay on Indian fisheries will reveal the fact of the situation. For the First Plan an out-lay of Rs.2.8 crores was incurred; expenditure in the Second Plan amounted to about Rs. 9 crores and in the Third Plan it came to double the size of the Second Plan and in the Fourth Plan the outlay exceeded over that of the Third Plan.

The following points are worth consideration for the socio-economic uplift of the fishermen;

Immobility of labour in fishing industry:

Despite the arduous nature of fishing, the labour in fishing industry has not exhibited signs of mobility. When any labour does not move from one industry to another, or from one occupation to another, and fail to acquire enough knowledge and experience in different kinds of trades and occupations, such labour is called immobile labour. Isolation from the main stream of Indian life has caused this state of immobility in fishing labour which has been aggravated by lack of proper communications. To the students of economics it may be known that when any labour is static and immobile, the earning capacity of that labour becomes very limited and this has been one of the main causes for the proverbial poverty of the fishermen. Enough attention has not been paid by the national government to afford alternate employment during the off-season and off-time. Sincere efforts have not been made to make fishing industry as a full time occupation as in the case of Japan. The Five-Year Plans have, to a certain extent, brought about mechanisation in fishing industry.

Pattern of development: Fishing industry, either marine or inland, has certain peculiar characteristics which cannot be found in agricultural or animal-husbandry occupations Marine fishing forms the major portion of the Indian fishing findustry as a whole and this requires special treatment and pattern of development. When the Community Development Scheme was introduced by stages, the country witnessed a great upsurge in the socio-economic conditions of the people. Here also agriculture alone received the major impact of this scheme and development of fisheries did not receive its due attention. Although the scheme was said to be an integrated one, agriculture and animal-hnsbandry played the dominant role and fisheries was given a secondclass treatment. If separate Development Blocks were formed exclusiveiy for development of marine fishing along the 3000 mile long coast line, at the rate of one Block for each 20,000 fishermen population, far-reaching results in increasing the out-put of fishing industry through modern methods would have been achieved. Intensive development like the package programmes, crash-programmes and others, which are seen in agriculture have not been thought of in respect of fisheries. The main reason for this ill-thinking was that it was never realised that the wealth of the resources of the sea could supplement and complement the agricultural food production. In the realms of politics popular representation in the legislatures both at the centre and states from among the coastal population was quite inadequate if not altogether absent.

Lack of higher education :

Indian universities have provided higher technical education in agriculture and animal-husbandry, whereas in fisheries no university education is imparted except in a handful of institutions which afford training in the mechanisation of fishing industry. In Japan, education and training in advanced fisheries is imparted at university level and people take to fishing industry in a professional manner.

Risk-bearing social schemes :

Industrial workers have social security schemes such as Employees State Insurance Scheme, Provident Fund scheme, Workmen's Compensation Scheme, etc. against the odds and risks of mechanised industry. Even in agriculture crop-insurance scheme has been introduced. But in fisheries no such insurance or risk-bearing schemes have been formulated and put into practice for the welfare of the fishing labour. In an industry where man has to perpetually brave the turbulent and ferocious waters of the ocean no security scheme has since been evolved by the national government.

Besides the above suggestions the following points also need attention.

1. Increase of marine fish production coupled with development of inland fisheries -

(a) A propaganda unit may be set up for the purpose of appraising the fishermen about the benefits in mechanisation of fishing boats and also to encourage fish eating in the internal areas. Compared to the size of the Indian population, the fish eating community is small and our per capita fish consumption is very much less. It is necessary to increase fish consumption rate to higher levels.

(b) All existing indigenous fishing crafts may be mechanised with inboard or outboard marine engines.

(c) Men engaged in fishing may be trained to preserve fish from the catching point as 50% of the fish caught reach the landing points more or less in the verge of becoming deteriorated.

(d) The Government should come forward to provide insulated boxes, ice etc. on subsidy basis.

2. At all fishing centres sufficient cold storages and ice plant facilities must be provided to prevent fish from going waste.

3. Internal marketing facilities should be developed and suitable transport facilities should be provided for quicker and easier transport by which the fish landed may be delivered at distant places in minimum time in fresh condition. Every important district headquarters should have cold storages to preserve fish for marketing.

4. There is some resistance in consuming iced fish as the present practice is to ice the fish at the nearest point of deterioration which mparts unpleasant taste for the users of such iced fish. Hence it is essential to educate the fishermen sufficiently to preserve fish at the catching point itself.

5. Every fishing village should be provided with suitable road facilities with adequate feeder roads linking every fishing centre and also sufficient telecommunication arrangemet to get firsthand informations about the daily catches and other connected information.

6. Modern fish processing units must be established in all the important fishing centres in alliance with state fisheries units for the use of local fishermen. The fishermen must be given training in fish preserving methods. Also the present 10 months fishermen training course in the states may be converted to a one-year course adding advanced subjects like radio telephone, fish finding etc.

7. Housing schemes for fishermen which are now in existence are not at all adequate considering the needs of small scale and poor fishermen. More housing scheme must be introduced. This may be compared with the supply of boats, Nylon twine, fishing tackles etc. at subsidised rate.

8. Fishermen in the coastal area should be provided proper sanitation and medical facilities drinking water, wells, latrines and other essential requirements. Electrification of fishing villages should also be included.

9. All important minor ports must be given top priority for berthing facilities and processing units with freezer-cum-ice plants for the use of small fishermen.

10. Fishing industry must be taken into priority sector on par with Agriculture and must be included among the small-scale and cottage industries to provide financial assistance to the fishermen, thereby liberating them from the clutches of the middlemen.

11. State fish curing yards established for hygienic curing fish in the traditional methods have been neglected or closed by the government after the introduction of ice plants, etc. The states must restore these establishments and maintain them in full swing which will help the fishermen to cure their surplus catch then and there on landing.

12. Steps should be taken to assess the disposal of fishes in various regions and their potentialities and institute proper distribution system. The export potentialities should also be assessed.

13. Adequate seat reservations in all professional colleges should be given to fishermen without any discrimination of caste, creed or community, and also in the Central and State Government appointements. This will go a long way to promote the socio-economics of the fishing community.

14 Distress reliefs for fishermen and their families are declared in some states which should be followed by all the states.

15. Inland fishing rights in tanks, ponds, resorvoirs etc. must be leased out by the Fishermen Cooperative Societies for their own revenue.

16. Alternative jobs during the off season should be provided to the fishermen and their women folk. They must be educated through fisheries blocks to start cottage level vocations such as weaving, match manufacturing, beedi manufacturing etc.

These are some of the suggestions to overcome the serious draw-backs confronting this age-old traditional industry. Proper implementation of the suggestions would help for the uplift of the socio-economic conditions of the fishermen.

POONTHURA - A CASE STUDY OF SOCIO-ECONOMIC CONDITIONS OF FISHERMEN IN KERALA

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SOCIO-ECONOMIC CONDITIONS

There are two spots that jolts our sense of justice: the slums and fishermen settlements. To the sensitive observer, they are tell-tale signs of the cancer that eats into our social body. An exhaustive examination of these communities will reveal the magnitude of the problem and may suggest the radical nature of the treatment that is called for.

Poonthura is one of the fishing villages along the coast of Trivandrum District. In fact, it forms the southern tip of the Corporation of Trivandrum. This is a narrow strip of land between two waters—the Arabian Sea in the west and the branch of the river Karamana, in the east. It is 0.75 km at its widest. To its north is another fishing village Beemapally and to its south the Kovalam Beach. The estuary formed by the Karamana river cuts it off from Kovalam. It is connected with the outside world by the buses plying between the city and Poonthura, or ferry service. The main strength of population is distributed over a length of one kilometre. Into a narrow space of 0.8 sq.km is crowded a population of 12,000 people. The land is sandy for the most part, with a narrow section of water-logged black soil. The vegetation is scanty except for a few rows of coconut palms along the river bank, and the stray trees in the rest of land.

The population of 12,000 is distributed in 2000 families, with quite a few of them sharing houses for want of their own. The church and the church square, the local school, the market, the petty shops and eating places find their location within this space. The population is divided into two groups: Christians and Hindus The Christians account for over 10,000. They cannot be said to live in harmony and their mutual distrust erupts into violent clashes leading to extensive loss to life and property. The Christians are almost all fishermen, while Hindus have greatly diversified their profession. Of late, the Hindus have made considerable progress economically and socially, thanks largely to the government's policy assisting scheduled castes. Among the Christians there are two caste groups, the Mukkuvas and the Bharathas. The Bharathas have been included in the scheduled caste section, while the Mukkuvas have only the limited advantage of belonging to other backward communities. Economically and socially they are on a par, though prejudices and discriminations have erected many barriers between the two communities. Our survey is limited to the Christian group, since they form a homogenous group.

Population

An overcrowded village with hardly standing ground for all its members is a casualty.

(The density of population is 13,000 per sq.km). People have no place to build their houses. The survey we have conducted shows that only 12% of the families have their own plot of land. The rest are settled on the church property. Recently the church has handed over pattahs transferring ownership of the housing sites to the squatters. This would mean no more than at the most two cents of land. The housing problem is one of the most acute problems. Of the 2000 familes as many as 35% are homeless, meening that they are being tolerated in the houses of their relatives. The majority of the houses (71.8%) are huts, pure and sinple, just palm leaf enclosures on 4 sides with preoarious roofing of the same kind, or mud walls with leaf-roofing. Almost all the walled houses (27.6%) are government supplied.

Food habits

Poverty is indicated by the kind of food people take and the number of times they have meals. The survey indicates that 58% have only one meal a day and 42% twice-a-day. This is while the going is good. Durin g the lean season they have no regular times. Another interesting fact is that 41.5% have only tapioca and fish as their staple food. That is to say, so many people find it difficult to be able to eat rice even once a day. 46.5% take rice, fish and tapioca. In Kerala, tapioca is the poor man's food and by this reckoning 88% of the population are just poor. The children and the women bear this out. The effects of malnutrition are so evident in them. Children with swollen bellies, sunken eyes and emaciated limbs are a common sight. Women are anaemic in a high degree. There is neither vitamin nor sufficient protein in their diet.

Clothing

It is rarely that fisherfolk keep a wardrobe They have just two pairs of dress and often women refuse to appear in public for want of proper clothes. The children are rarely dressed.

The daily expenditure

Twelve per cent of the families spend less than Rs.5 a day. On an average their daily budget is around 60 to 70 paise per head. About 42% spend about Rs. 1.50 per head

Earning capacity

The fishermen's inheritance is the sea. His bare hands and simple implements should provide him with the necessities of life. The number of people working is an important factor in the earning in a fishing village. As the survey shows that 70% of the families have only one person to earn the living for the family; 15% of families have more than 8 members to a family. So the earning of one man is barely sufficient to feed thefamily.

Health and hygiene

Children, especially infants, succumb to early illness in large numbers. Killers like tuberculosis and cancer are very common. Epidemics break out on and off. The main sources of hospital care is the Primary Health Centre in Poonthura, which fails to meet the needs of the place even fractionally. So people resort to all kinds of medicines, helpful or not. The sanitary conditions beggars description. In this overcrowded place, there is no proper drainage, no lavatories, no regular cleaning arrangements.

Lack of ownership

Another measure of poverty is the lack of ownership of the means of production. In Poonthura 80% of the population live exclusively on fishing, another 10% on fish business. The ownership of fishing equipments is confined to 31.9%, of which actual fishermen constitute only 27.6%. Among them 10.6% have only seasonal gear. This would imply that overwhelming majority (83% of the fishing group) are not owners of the means of production. They work on boats or catamarans belonging to the local rich. The majority 53.3% have to sell their labour in order to win a living. This leads to different types of exploitation.

Employment

Regular and secure employment wards of starvation. The fishermen have no such guarantee. It is a seasonal occupation. The majority are seriously employed for a period of 6 months only. Their equipments are not usable beyond a certain depth. In Poonthura less than 10% have access to boats and nets which can be plied around the year. The other 90% remain idle for a substantial part of the year. Under-employment is a major problem in the area. Unemployment—wholly confined to educated youth—is marginal around 2 to 3%.

Indebtedness

According to the survey, 79.2% of the families have contracted debt. Over 50% have debts ranging from Rs.400 to 1000. The amount may be small, but the consequences are terrible, thanks to the system of bonded labour. The scanty income and the numerous demands upon it keep the fishermen in a permanent state of bondage. The interest rate varies from a minimum of 36% to 120%. There are many families kept under the weight of debts made years ago passed from father to son. The evil effects of scarcity spreads like the roots of the passion plants with its withering affects upon the community's life. Exploitation is one of its more serious consequences. This operates at different levels; economical, political, social and religious Scarcity coupled with ignorance is the fertile ground of the exploiting agencies. Economic exploiters are the merchants, money-lenders and owners of fishing implements. Very often the exploiters are all these three.

The fish is sold on the sea-shore to the highest bidder. It may be small merchants or big ones who buy it. When the season is on the price goes down and the fisherman is cheated of his price. The big business men buy of the huge catch and sell them at distant markets at very high profits.

The money-lenders have a field-day during the off season. The poor fishermen have nowhere to go except to the money lenders. Very often money is borrowed for buying the ration. The interest rate is exorbitant, from 60% to 120%, very often involving a labour contract which destroys all bargaining power on the part of the labourer. Until the money is paid back, which the money lender would do his best to get postponed to the limit, the fisherman and his children are bound to work on the money lender's boat or catamaran—a situation which can go on for years or even generations. The percentage of people under this category is a high 59.9%. Owners of fishing implements claim a high divident from the catch - some times as much as 1/3. This cuts deeply into the earnings of the worker.

The state of destitution can be exploited in devious ways. In Poonthura the only asset that people can pawn is their ration cards. The money lender makes a rich haul by collecting many ration cards. The number of families who have been forced to pawn their ration cards comes 45.5%.

Literacy

The low level of literacy is surprising in suburban area where educational facilities are relatively abundant. There is a U. P. School in the village and three high schools within walking distance (2 km). The local school was in existence for well over 50 years. But the rate of literacy is 22.7% Of the literates, 70% have only primary education. Post-metric group is about 1 5%. Though 60 to 70% of the children are enrolled in the school at the proper age, the dropping out starts from the first standard on. 50% fail to cross the primary stage. Boys and girls after 5 or 6 years in the school are unable to decipher alphabet, let alone read and write regular Malayalam. There is no significant upward mobility among the group, The absence of variety in their life, with its narrow confinement to the village traditions and taboos prevents the fishermen group from intelligent participation in any kind of civilised life of to-day. This explains the large - scale social and political exploitation by clever manipulation of fishermen's credulity. Massive illiteracy and consequent ignorance keep the tempo of life in a confused whirl.

Social customs

Social relations are governed by old-world traditions. Urban ways are superimposed on traditional patterns of behaviour. Many of the primitive customs still strongly hold. The coming of age for girls is an occasion of great celebration. Marriages are arranged at the earliest possible and early marriages are a matter of prestige for the parents. These occasions call for extravagant and irrational spending. The dowry system is a vicious tyrant. Many families are destroyed in consequence. The family relations are governed by traditions of mutual obligations. The community problems are rarely taken to civil courts, but are settled through the community elders. There are some vestiges of feudal times in the prominence accorded to certain families on account of their former prestige. On the whole the hold of traditions is still remarkably strong.

Effects of government assistance

In many ways the people of the village have become greatly dependent on the government

agencies. In government's eyes it is a sore spot. Every monsoon leaves many homeless; the rainy season and summer brings in their wake all kinds of epidemics, needing special relief organisation. Free houses have to be built and free rations have to be supplied. Massive aid for education have to be given. This constant demand upon government officials have reduced the people of Poonthura to a state of dependents. The paltry emergency relief measures that is given now and again have only complicated the matters, leading to increased misery and frustration for the people

NEED FOR IMAGINITIVE PROGRAMME

The Socio-economic aud cultural problem in this field are too complex and massive to be solved by any simple, direct and sloganised solutions. Economic relief measures have to be combined with serious reorganisation of the economic operations. If fishing is regulated with the two-fold aim of increased productivity and higher standard of living for the fishermen, a great change can be brought for the betterment of the area. If the Government involvement assures fair prices for the catch during all seasons and keep off the exploiting middlemen and money lenders the secuiity of fishermen can be more easily assured. We have also to look into the looming dangers that the entry of the big business on the scene has raised. The accepted policy of government to promote labour intensive industry together with adequate and suitable modernisation should find its creative implementation in the fishing industry. Thousands of fishermen who have so creatively employed themselves to great national profit should be given a better deal by the community. Modernisation should be so organised that this traditional community is rehabilitated in the process not driven from the field to perish through unemployment and total destitution.

Along with the economic measures should go a systematic and effective educational campaign. To make it effective, the educational programmes have to be necessarily linked with the economic benefit scheme. The National Adult Education Programme could be suitably modified to bring about this. Unless we educate the fishermen community the superstitious and irrational habits, together with the feudal, tribal and social institutions still prevalent among them would inhibit them from entering upon their proper role in the modern society. The idea of co-operative organisation have still to make its impression upon the group. Educational programme aiming at creating new social values should pay special attention to this aspect.

The problem of under-employment and supplementing the woefully inadequate return from the meagre occupation can be solved only by a judicious use of modern techniques and diversification of employment. The development of internal market which is only marginally developed to-day, preservation techniques and adequate financial support through easily accessible financial institutions are necessary components of a practicable development programme. Land-based industries, especially for the women of the community, should be a great contribution to the solution of unemployment. Scientific research in aquaculture with its employment potential and the modernisation of fishing gear are urgently called for.

In short, the rebuilding of the life of the fishermen group is a national challenge. In many ways it offers an advantageous experimental base for the creations of a genuine socialist society inasmuch as the social and economic forces operative in the field have not reached the same level of complexity as, say, in the field of agriculture.What is at test is our political will and the creativity of scientific community as well as socio-political leadership.

SOCIO-ECONOMIC SURVEY OF FISHERMEN ENGAGED IN THE LIME SHELL FISHERIES - A CASE STUDY

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Along the Indian coast line, at some localised centres such as the Kakinada Bay, the molluscan shellfish forms sustenace fisheries of considerable magnitude. As a case study on socio-economics, Balusutippa, a major lime-shell fishing village situated 48 km from Kakinada, was selected and a survey was conducted in March 1978.

PRESENT STATUS OF THE LIMESHELL FISHERIES OF THE KAKINADA BAY

Information on various aspects of these fisheries is available in the works of Narasimham (1969, 1972 and 1973). Only the salient features, incorporating the recent changes in the pattern of these fisheries, are given here. The Kakinada Bay has a water spread of 132 sq. km and is generally characterised by soft muddy bottom with good amount of silt. The total area fished for molluscs is 100 sq. km, confined mostly to a maximum of 4 m depth, with practically no fishing in the deeper northern section.

Fishermen residing in 15 villages (Table 1) fish in the Bay for the lime-shell. Since majority of the fishing villages are located beyond 20 km from the fishing grounds, the fishermen move with their families along with provisions and drinking water in a boat. After fishing for 4-5 h during low tide in the Bay they move to the mouth of a river or irrigation canal which forms a base camp where they unload the catch on the bank. They stay the nights in the boats and conduct continuous fishing from the base camp for a month or two. Usually they break the

TABLE 1

Fishing villages, fishermen population and craft engaged in the lime-shell fisheries of the Kakinada Bay.

Name of village	No. of Navas	No. of Shoe donis	No. of fishermen families engaged full time	part time	No. of batties
Dummulapeta	10	—	5	20	—
Yetimoga	20	—	10	35	23
Putrayapakalu (inhabited in Nov-May only)	4	—	—	10	—
Boddu Chinna Venkataipalem	—	3	—	8	—
lakshmipathi puram	—	75	—	20	—
Gakimoga	—	10	10	18	14
Tirthalamondi	—	15	8	33	—
Bhairavipalem	—	10	6	21	—
Girijampeta	—	4	—	8	—
Yerragaruvu	—	62	81	38	23
Balusutippa	—	134	32	270	12
Kothapalem	—	3	—	10	—
Mulletimoga	—	17	13	32	5
Masanitippa	—	2	—	8	—
Neellarevu	—	3	—	10	—
	34	268	165	541	77

fishing on Fridays to get provisions from Kakinada. The entire family, including women and children, partakes in fishing, which is by hand picking, without any diving aids. Fishing is conducted throughout the year with peak landings in January-May.

A dozen species of molluscs, namely *Placenta placenta* (Linnaeus), *Anadara granosa* (Linnaeus), *Meretrix meretrix* (Linnaeus), *Katelysia opima* (Gmelin), *Paphia malabarica* (Chemnitz), *Donax cuneatus*, (Linnaeus), *Umbonium vestiarium* (Linnaeus), *Cerithidia* spp, *Hemifusus pugilinus* (Born), *Telescopium telescopium* (Linnaeus), *Natica spp* and *Turitella* spp constitute the line shell fishery of the bay. The catch is almost exclusively used for burning into lime in kilns, locally known as *batties*. The estimated landings in 1977 show that the windowpane oyster *P. placenta* ranked first with a production of 5,000 tonnes (valued at Rs. 2,50,000), followed by the blood-clam *A. granosa* with 1,000 tonnes (valued at Rs. 1,00,000). Other molluscs accounted for a catch of 2,000 tonnes valued at Rs. 1,50,000. The value of the lime-shell increases further when converted into lime. Until recently the State Government annually realised about Rs. 7000 by issuing licence for about 300 boats to fish for the molluscs in the Kakinada Bay.

A total of 302 fishing craft comprising 34 Navas and 268 shoe-donies are deployed in these fisheries. Among them, 240 are used in fishing while the remaining 62 are utilised in the transport of lime-shell to the *batties* and for the transport of the lime to marketing centres at Kakinada and Rajahmundry in the East Godavari District, Narsapur, Bhimavaram Palakollu, Tadepalligudem and Eluru in the, West Godavari District and Gannavaram and Vijayawada in the Krishna District.

Out of a total of 706 families in the 15 villages (Table 1), 165 are employed full time either in fishing for the molluscs or in lime preparation and its marketing. The remaining 541 families are engaged part time during January-May in the lime-shell fisheries; they pursue prawn fishing during June-December. Yetimoga, Gadimoga, Balusutippa and Mulletimoga are both fishing and lime manufacturing villages while Yerragaruvu is exclusively a lime producing village.

SOCIO-ECONOMIC CONDITIONS OF THE FISHERMEN AT BALUSUTIPPA

Balusutippa is essentially, a backwater fishing village with little marine fishing activity, and has a population of over 5,000; about 90% of them live on fishing. The economy of the village is mainly dependent on the lucrative prawn fisheries while fishing for finfish and the limeshell is secondary.

The present survey showed that there are 32 full time and 270 part time fishermen families dependent on the lime-shell fisheries. As there was considerable disparity in the income between the two groups of families, they are treated separately.

The total population of the full time fishermen is 170 and the average number of person in the family is 5 3. The male female ratio is 1 : 1.14 and the children (under 12 years) formed 44.7% of the population. Of the 94 adults, 51 persons (54.3%) are self employed; 24 persons (25.5%) work as labourers in shell-fisheries, 9 individuals (9.6%) are employed in vocations other than fisheries and 10 persons (10.7%) are unemployed. Non-powered country crafts are owned by 14 families (43.8%). The boats are in the 2-7 tonnes range, the cost varying from Rs. 2'000-8,000. Twentyseven families (84.4%) live in their own houses and the remaining five families live in rented premises. Majority of the 27 houses (93.7%) are thatched; there are only 2 tiled houses 6.3%). The per capita income per year worked out to Rs. 1850. There was noticeable disparity in the annual income per family; it varied from Rs. 750-4500 and 67% of the families come under Rs. 750-2000 income group. Among the 27 fishermen families having assets such as a house or a boat, the value of assets ranged from Rs. 1,000-14,000; the average value of assets per family being Rs. 4,132. Education is limited to secondary school stage and 25 persons (14.7%) can read and write.

The total population of the fishermen engaged part time in the lime-shell fisheries is 1,620 the average number per family is 6.0. The male female ratio is 1:0.97 and the children constituted 40.7% of the population. Among the 961 adults, 512 (53.3%) are self-employed, 217 (22.6%) are engaged as labourers in the shell-fisheries, 84 (8 7%) are employed in vocations

other than fisheries and the remaining 148 (15.4%) are unemployed. A total of 116 families own 120 boats which are in the 2-12 tonne range their cost varies from Rs. 2,000-11,000. However majority of them are in 3-5 tonne range. Majority of families (90%) have own houses. There are 203 thatched houses (85.2%) and 40 tiled houses. The annual per capita income is Rs. 434 and the income per family; is Rs. 2602. There is significant variation in the annual income per family; it ranged from Rs.1,000 to 7,200 and 44.1% of the families earn income between Rs. 1,000–2,000. Survey of the 234 families possessing assets like house or boat showed that the value of assets ranged from Rs.1,000-22,000; the average assets per family is Rs. 4961. There are 313 literate persons (19.7%) and among them 5 studied in the high school and one went to a college.

Acomparison of the status of full time and part time lime-shell fishers shows that relatively the latter are financially better off. This is because the part time fishers have traditional rights to fish in the creeks close to Balsutippa for prawns and others are forbidden to fish in these areas by age-old social custom.

There are some common features between the two types of fishermen About 90% of them claimed to have debts which varied from Rs.200-3,000. The most common reason offered for incurring the debts is to meet the day to day expenses of the family. All the loans are private loans from relatives and the interest rate varied from Rs. 24-36% per annum. The pattern of expenditure shows that about 40% of the income is spent on food, 20% on entertainment, 15% on repayment of principal/interest, 10% on clothing and the rest on miscellaneous items. The boats are sturdy and last 10-20 years requiring very little maintenance. While unemployment is only 10-15% of the adult population, underemployment is perturbing.

STRATEGY TO IMPROVE THE ECONOMIC CONDITION OF THE LIME-SHELL FISHERS

The foregoing studty clearly shows that the lime-shell fishers are backward, mostly illiterate and live at poverty level. It was observed that there are many constraints inherent in the present system which impede the progress. These are identified and the remedial measures are suggested below.

Chronic indebtedness is a common feature among the fishermen and the remedy lies in making available institutionalised credit facility The credit rules should be liberal and flexible to suit the local conditions.

At present the marketing of lime is in the hands of middleman and the fishermen are not getting remunerative price for the produce. There is need to organise the marketing of lime, by eliminating the middleman and associating the fishermen with it so that price stability of the lime can be ensured and profits accrue to the fishermen.

The lime-shell catches for the last decade are generally static. Recent studies by Murty *et al.* (MS) estimated the window-pane oyster resource of the Kaiknada Bay at 51,000 tonnes. Since the present production is only of the order of 5,000 tonnes there is scope to step up production by deploying more fishermen which would result in additional employment.

At present none of these shell fishes are eaten locally except for the occasional medicinal use of the blood-clam. In the philippines, the meat of the window-pane oyster is used in the preparation of sereval dishes. The protein content of this oyster varies from 42.0-63.8% on dry weight basis (Sarvaiya, 1977). Better prices could be obtained for the shellfishes if they are used for edible purposes, besides the present use of the shells in lime industry.

At present pearls are not extracted from the windowpane oysters. These pearls are used in indigenous medicine and are priced at Rs. 5,000 per kg (Varghese, 1976). A recent study (Murty, 1978) has shown that 26.2% of the windowpane oyster population in the Kakinada Bay produces natural pearls. Extraction of pearls from the oysters before burning them into lime would augment the income of the fishermen.

The blood-clams are extensively cultured for their food value in China, Japan, Philippines, Thailand, Malaysia and Borneo (Cahn 1951; Pathansali and Soong, 1958). Culture of these molluscs using simble techniques would help increase production and provide gainful employment to the fishermen.

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NUTRIENT INTAKE AND DEFICIENCY DISEASES IN FISHERMEN COMMUNITY

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Diet and Nutrition surveys carried out in the various states of India show that the diets consumed by expectant and nursing mothers, infants and young children (vulnerable groups) belonging to the low income sections of the population are grossly deficient in calories, proteins, certain vitamins and minerals. Among the low income groups, the fishermen community is one of the most severely affected.

An attempt has been made in this paper to present the dietary intake, nutritional status and nutritional problems of the vulnerable groups among the fishermen's families of the coastal areas of Kerala and Tamil Nadu. There is a conspicuous gap in the vital data about fisherman community in both the States.

In Tamil Nadu, the fishermen population is estimated to be 2.5 lakhs. Table 1. shows the educational standards of heads of households in this stratum.

A majority of the heads of the households (55%) have primary educatidon, with 18% illiterates. The percentage dropouts in school education among fishermen in this sample was quite high, being 30% at the primary. 70% at the middle and 75% at the high school stage. This high dropout rate was due to several factors. First, most of those who discontinue their school education do so because of poverty in the family. Hence in order to improve the family income position, students dropout from the school and go for fishing or other allied trades at a very early age.

TABLE 1

Eduactional standards of the heads of household groups.

Districts	No. of Heads of the Households				
	Primary Shool	Middle School	High School	Illiterate	Total
Madras	22	7	1	13	43
South Arcot	1	6	5	--	12
Thanjavur	17	3	1	4	25
Tirunelveli	15	8	1	1	25
Ramanathapuram	12	2	-	5	19
Total	67	26	8	23	124

TABLE 2

Heights and weights of children in fishermen community.

Age	MALE		FEMALE	
	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)
12 months	66.6	7.4	65.1	6.8
18 months	70.6	8.1	68.3	7.5
24 months	75.0	8.9	73.1	8.1
30 months	78.7	9.9	76.7	9.3
3-4 Years	83.8	10.9	82.3	10.3
4-5 Years	91.3	12.4	90.5	11.9

TABLE 3.

Average nutrient intake of the preschool children in the coastal Kerala

Nutrients	Average intake	Recommended allowances (Aykroyd *et. al;* 1960
Calories	798.0	1200
Protein (g)	20.8	35
Calcium (mg)	496.2	1000
Iron (mg)	6.9	1500
Vitamin A (INU)	66.2	3000 to 4000
Thiamine (mg)	0.5	0.5 to 1.0
Vitamin C (mg)	61.4	30 to 50

In order to find out the dietary intake it is necessary to find the socio-economic status of the families. There was a wide range of inequality of income between different strata and in different family groups comprising the sample. The average monthly income was in the range Rs. 100-200. The low income traces back to two reasons: first, lack of availability of boats for fishing and second, the institutional factors which determine the economic status of the fishermen.

Figure 1 illustrates that the fishermen community is poor because it was poor, expressing the low level equilibrium trap, which characterises under-development.

Table 2 shows the heights and weights of preschool children as revealed by the studies conducted by the Kerala State Health Department among low income groups (including fishermen community,) in Trivandrum District.

TABLE 4.

Average nutrient intake of expectant mothers in coastal Kerala.

Nutrients	Average intake	Recommended allowances (Aykroyd *et al*, 1960)
Calories	1178	2300 - 2700
Protein (g)	45	100 - 110
Calcium (mg)	798	1500 - 2000
Iron (mg)	11.5	20 - 30
Vitamin A (INU)	51.1	3000 - 4000
Thiamine (mg)	0.63	1.0 - 2.0
Vitamin C (mg)	125.1	50

TABLE 5.

Food and nutrient consumption of low income population.

Food stuff (in grams)	Palght	Kozhikoda	Quilon	Cannanore	Trivandrum
No. of Households	2	9	3	7	4
Fruits (Total)	7	19	-	11	-
Fish fresh	20	61	29	--	31
Fish dry	--	--	10	--	--
Total (Fish)	20	61	29	10	31
Total (Sugar & Jaggery)	14	11	14	19	10
Rice	262	237	261	165	195
Red gram	9	2	-	--	7
Tapioca	144	214	326	198	385
Cocunt fresh	46	22	60	47	45

TABLE 6.

Average intake of different untrients for C. U. per day of low income population

Ingredients	Quilon	Cannanore	Trivandrum	Palght	Kozhikode	Average
No. of Households	3	7	4	2	9	5
Protein (g)	39.5	36.5	31.6	31.0	32.3	34.58
Fat (g)	32.7	32.1	24.6	23.3	14.2	25.38
Calories	2099.0	1585.0	1800.0	1530.0	1418.0	1688.0
Calcium (mg)	432.0	453.0	472.0	259.0	452.0	413.6
Phosphorous (mg)	1089 0	891.0	910.0	758.0	755.0	880.6
Iron (mg)	18.5	18.8	17.6	14.4	14.1	16.68
Vitamin A (g)	62.0	48.0	183.0	45.0	88.0	85.2
Riboflavin (mg)	0.81	0.61	0.79	0.46	0.54	0.642
Thiamaine (mg)	0.78	0.73	0.67	0.40	0.36	0.588
Niacin (mg)	11.4	9.3	6.3	7.2	7.6	8.96
Vitamin C (mg)	93.0	61.0	109.0	42.0	71.0	75.2

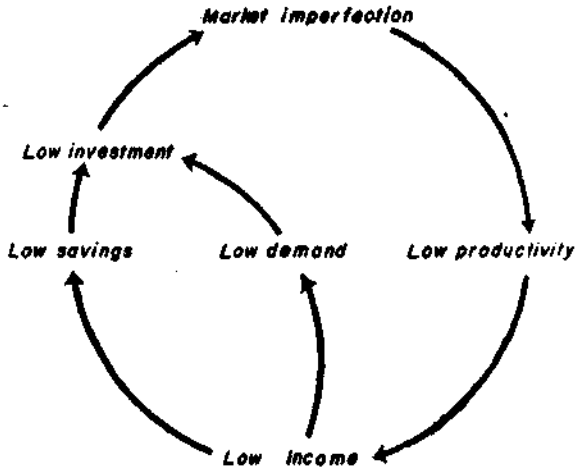

Fig. 1

Frequency of the use of various food items by the fishermen families

Seventy six per cent of the income is spent by these families for carbohydrate foods like cereals and roots whereas only 15 per cent is spent for protective foods like pulses, milk and fish foods. Cereals alone consume 43 per cent of the income. The purchase of pulses, milk and vegetables increases as family income increases. However, some fish is being consumed by the respondents from their daily catch.

Preschool children are being breast-fed for 1-3 years of age. In addition to mother's milk, starchy foods constitute the main bulk of the diet of preschool children. Cereals are given to the children in the form of cooked rice or as rice gruel 'conjee'. Being the main staple food of the people in Kerala, tapioca is given to preschool children from early infancy, that is from the fourth month onwards. Similarly since fish is freely available, it is consumed by the children from the sixth month onwards. Thus, for 93 per cent of the preschool children surveyed, the staple foods are tapioca, cereal and fish. The data analysed showed that on an average 143 g of rice, 62.5 g of roots and tubers and 11.8 g of fish are consumed by the children daily. Protective foods such as pulses, milk and vegetables were included in negligible amounts. Occasionally food items like banana, plantains, backery foods etc. were purchased and given to the children.

Regarding the food habits and meal pattern of fishermen families, 96 families consumed two meals a day; and only 4 families had three meals a day. Although rice was the preferred staple food, tapioca was also very popular. Vegetables were consumed in small quantities whenever available. The consumption of milk and milk products was negligible. Fruits and green leafy vegetables were not popular among these families.

Boiling and steaming were the methods commonly used for cooking by the home makers in the fishermen families. They did not show interest in home production of food. Hence vegetable gardens, poultry keeping, dairying and kitchen gardening were not practised at all by these families. No special attention was given for feeding people in special conditions nor did children in the growing stages receive any special food.

A majority of the families did not include protective foods in their diets. This might be either due to the nonavailability of protective foods such as vegetables, leafy vegetables and fruits in the coastal areas or due to the beliefs and doubts about the utility of those items of food or due to their financial inability to purchase such items. Even the foods included were not in the desired quantity level except roots and tubers. Table 3 gives the average nutrient intake of the preschool children.

Table 4 gives the average nutrient intake of expectant mothers in coastal Kerala.

As revealed by Tables 3 and 4 nutrients, except vitamin C, present in the diets of preschool children and mothers in special conditions were not adequate to meet nutritional requirements. Other nutrients namely, calcium, iron and vitamin A were not adequate since fruits and vegetables were not included in the diets. Furthermore, the protein supplied by cereals was inadequate both in quality and quantity. High quality proteins available from fish which was consumed by the respondents were also not adequate to meet their requirements.

Table 5 and 6 provide districtwise data on food and nutrient consumption of the Kerala population.

The statistics presented are on the diet of the low income people. There is a conspicuous gap in the vital data about fishermen community The authors could not locate any published

scientific information on the dietary intake and nutritional status of the fishermen community *per sc.* Districtwise averages do not help in locating the dietary deficiencies. Hence there is urgent need to commission and finance community nutrition surveys, action research and nutritional surveilance among the fishermen community.

Nutritional status

The most commonly observed nutritional, disorders were calorie protein malnutrition vitamin A and B-Complex deficiencies and deficiency of essential fatty acids. The signs of calorie protein malnutrition were observed more frequently among infants and preschool children, while those of vitamin deficiencies were more cammon among children of school age and adolescents.

Protein calorie malnutrition

The clinical symptoms of Kwashiorkor and Marasmus emaciation relate to failure of growth This is the first and most important sign. It occurs as in marasmus, though oedema and the presence of some subcutaneous fat make the weight loss appear lower and the general appearance less strikingly this. Prevalence of marasmic type of PCM is common in infants, while both the types of PCM, *i. e.* Kwashiorkor and Marasmus are seen in preschool children.

Vitamin deficiencies

Signs of vitamin A and B-Complex deficiencies are relatively more among school children as compared to other age groups. The nutritional deficiency conducts such as Bitot's Spots, angular stomatitis, phrynoderma are prevalent among school going children in Kerala.

The prevalence of vitamin A deficiency sign is found 0.7% in Kerala while it is 8.7% in Madhya Pradesh in preschool age group. In general, the prevalence of B-Complex deficiency signs indicate direct relationship with the consumption of calories. In older age groups, that is, beyond 12 years, varying degrees of vitamin deficiency signs are seen. The prevalence rates tend to be more in males than in females.

Hypochromic anaemia due to iron deficiency

This is by far the most common variety of anaemia throughout the world, affecting mainly women in their reproductive years, infants and children. The anaemia is often well advanced (*e.g* haemoglobin level 7.5g/100 ml) before significant symptoms are apparent. In some severe cases, the spleen might be palpable because some of the function of erythropoiesis is undertaken, there. Hypochlorhydria or achlorhydria is commonly present while paraesthesiae are common.

RECOMMENDATIONS

The following recommendations emerge from this analysis.

Education in nutrition

One of the most neglected aspects in the economy of the small fishermen is education. Illiteracy rates are significantly high. This coupled with the arresting of education at the primary level seems to be the stumbling block to further development. Many fishing hamlets (Kuppams) do not have full fledged high schools. Therefore :

1. At least one high school must be established for two or three adjacent kuppams;
2. At least one Functional Literacy Centre should be opened in each kuppam with a view to making all adults, men and women, functionally literate. They need to be eduated about scientific fishing production, marketing skills and use of fish in daily diet.
3. General education, teaching of children in schools and adult education, should incorporate nutrition education through newspaper, radio and television as vehicles of nutrition education. Nutrition education should form part of higher education, which provides the material, which informed public opinion needs if it is to support sound nutrition and food policies in the country.

The role of health and non-health sectors

Since nutrition is a major determinant of health, the health sector has the major stake in ensuring an optimal level of nutrition for the community. The contribution whtch the health sector could and should make to the solution of the nutrition problem is considerable. Therefore it is recommended that:

4. Medical and sanitation facilities be augmented in the fishing kuppams, to provide a

healthy climate and reduce the birth and death rates.

Model based on expansion of the existing health infrastructure

5. A wide net work of health infrastructure must be created by introducing the first level health worker in every kuppam and linking it up with the existing health machinery. This assumes the ushering in of the multi-purpose worker scheme and graded health services.

6. More health centres should be established with the necassary medical and para-medical staff.

Surveys

7. In order to define the magnitude and nature of the nutrition problem, diet and nutrition surveys should be carried out in carefully chosen representative population samples, using standardised methodologies which will permit comparison in time and space.

Promotion of effective use of local food resources

8. The health aid agencies must recommend appropriate, inexpensive balanced diets for different population groups.

9. Recipes for weaning diets based on inexpensive local foods, suitable for infants and children should be formulated.

10. Improvement in culinary practices, in infant and child feeding practices, and for better distribution of foods in the family should be promoted.

11. Harmful food taboos and dietary prejudices must be identified and corrected.

All these could constitute a meaningful nutrition education programme for poor communities, in order to help them to derive maximal nutritional benefit from inexpensive resources within their reach.

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SESSION III

RESOURCE POTENTIAL FOR CAPTURE AND CULTURE FISHERIES IN THE COASTAL REGION

Keynote Address

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Soon after our Independence, Pandit Jawaharlal Nehru once made an axiomatic statement - "Produce or perish". He was obviously not referring to human population but as in demography the question of optimum population size is relevant to fishery resources also. There is, however, a major difference. The fishery scientists are concerned with ways and means to increase the population size, while the demographers often seem to do the opposite in regard to human population. Fortunately for us, our country is blessed with plenty of human and aquatic resources.

When we talk about the coastal fisheries we are bound to run into the problem of the definition of coastal fisheries. We often come across terms such as 'On-shore fisheries', 'near-shore fisheries', coastal fisheries', etc. which may be understood differently by different persons under different conditions. For the purpose of this address I would confine myself to the area of the continental shelf between 0 and 50 m depth which is estimated to be about 1.8 lakh sq. kilometers, spread along a coast-line of nearly 6100 km, which forms the major portion of the fishing area of the small-scale fisheries. The width of this part of the shelf area varies considerably along and between the east and west coasts, so also the productivity of this region. Investigations have shown that these differences could be attributed to a number of factors such as meteorological, physico-chemical and biological. However, the fact remains that this is one of the most productive regions and it is well known that as we go farther and farther away from the coast the productivity decreases so much so some of the areas of open ocean are nearly barren. It has been reported that along the west coast the mean value of organic production up to 50 m is 1.19 g C/m²/day, whereas beyond 200 m it is 0.18 g C/m²/day. These values are indicative of the relative richness of our coastal waters which were until a few years back fished exclusively by the traditional non-mechanised indigenous crafts. According to a recent survey there are about 3.2 lakhs of fishermen engaged in full-time fishing and over 1 lakh non-mechanized fishing crafts engaged in marine fishing. The efforts of active fishermen employing the indigenous craft and gear and following the traditional methods of fishing account for a substantial quantity of the total marine fish production of the country. Considering our present day socio-economic conditions it is inescapable that non-mechanized indigenous crafts co-exist with the mechanized ones. In this connection the studies conducted by the Programme Evaluation Organization of the Planning Commission are relevant. Their studies indicated that return per unit of investment of non-powered boats is twice that of the powered boats and generate almost seven times more direct employment opportunities than mechanized boats.

Having given an overview of the fisheries of the small-scale sector, I would now pass on to the resource potential in terms of capture and culture fisheries.

Capture fisheries

The provisional estimate of total marine landings made during the year 1977 is about 12.6 lakh tonnes of fish. The year showed a decline of about 0.9 lakh tonnes of fish from the previous year. While these fluctuations could be considered as natural and there is nothing alarming about it, the fact remains that some of our coastal fisheries are being subjected to increasing fishing intensity and any further increase will have to be based on a realistic assessment of the resource potential and the rate of recruitment. Prawns, Bombay-duck, polynemids and sciaenids are some of the varieties which could be included in this category.

One of the significant characteristics of our fisheries is the dominance of the pelagic species. As much as 40% of the catch consists of these and next in importance are the bathypelagic and then the demersal varieties. It is reported that the potential yield from the Indian Seas i. e., from the continental shelf area would be about 40 lakh tonnes of fish. We are at present harvesting only about 1/3 of this potential and exploratory surveys, up to 40 m depth especially along the west coast have indicated the presence of substantial quantities of anchovies, ribbon fishes, catfishes, silverbellies and lesser sardines. There are also catch details of exploratory surveys carried out recently up to 40 m depth and beyond as a result of trawling operations. Although these are not carried out extensively the data are rather revealing in the sense that up to 40 m depth the catch per unit of effort was about 183.5 kg, while beyond this it was only a little over 82 kg. This leads one to the conclusion that for any appreciable increase in catch we have to look to the pelagic and bathypelagic fishes. At the same time, studies carried out on our major pelagic fishery resources such as oil sardine and mackerel have indicated that an increase in the fishing effort in the traditional fishing grounds is not likely to lead to increased yield of these fishes. Since other varieties of pelagic fishes are known to occur in sizeable quantities in the coastal waters one possibility would be diversification of fishing and make conscious efforts to fish for such varieties and develop markets for them.

The surveys carried out therefore have given us some idea of the magnitude of the potential resources especially along the west coast.Compared to the west coast the survey of resources carried out along the east coast is grossly inadequate and our understanding of the resource potential is meagre. Increased fishing activity along the east coast, however, is progressively showing that there is still scope for increasing fishing intensity. The east coast has certain disadvantages both in topography and the nature of fishery. More intensive and extensive surveys along both the coasts will have to be carried out not only to make a better assessment of the standing crop but also of the dynamics of the commercially exploitable populations of finfishes and shellfishes. The National Commission on Agriculture has recommended that fishery resources survey and assessment should be taken up in a coordinated manner involving not only Central Fisheries Organizations but also State Fisheries Departments. Along with these resources surveys, it is imperative that we obtain reliable indices of productive potentials based on a whole eco-system approach. It is becoming increasingly evident that isolated studies on primary organic production will not lead to reliable estimates of harvestable fishery potentials. Suitable models will have to be worked out taking into consideration various physico-chemical and biological parameters including the prey-predator relationship. The construction of such models is highly complex and the development of a general model alone will not meet the requirements of any given situation. Consequently sub-models of certain components of the whole system will have to be worked out. Such detailed work would be required because the development plans and management measures will have to be evolved based on a reliable resource potential base.

In the development of the coastal capture fisheries one major conflict of interest has developed recently. This relates to the operation of small and medium sized trawlers in the areas traditionally fished by the non-mechanized indigenous fishing units. Since this controversy has many implications it is not my intention to go into the pros and cons of this except to mention that with these developments it would be necessary to undertake a critical study of the effect of large scale trawling operations on the ecology of the fishing grounds and the fish populations. This is particularly necessary in view of the apprehensions expressed by some

that such operations lead to irreparable damage to the ecological balance. Such data are also essential for a proper understanding of the productive potential of the resources.

Another important aspect which will have serious repercussions on the productivity and resource potential of the coastal zone is the increasing incidence of pollution. All the organisms living in an area and their environment constantly interact between themselves striving to sustain a dynamic equilibrium. The complex organization within the biological communities enables them to buffer their own physical environment so that they can be self perpetuating. But an adverse impact on any one of the components will affect the equilibrium which may sometimes lead to irreversible or irreparable damage.

Culture fisheries

With the progressive mechanization of capture fishery, some of the traditional coastal fishing grounds are now becoming somewhat overfished. The cost of fuel and unit production cost in capture fishery are also increasing. This has led to the recent trend to intensify aquaculture. Freshwater aquaculture has been a tradition from time immemorial especially in the States of West Bengal, Orissa, Madhya Pradesh, etc. However, coastal aquaculture is relatively of a more recent activity although some kind of culture practices have been prevalent in most of the coastal States. These practices were essentially based on trapping the young ones in estuaries and backwaters during the high tide period, allowing them to grow for varying periods and harvesting them. The prawn filtration in the paddy fields along the coast of Kerala, the Basabadha fisheries in the salt-water 'bheris' of the Sunderbans are examples of these.

It is estimated that we have over 250 lakh hectares of brackish and salt water swamps and tidal areas, not to speak of protected but typically marine environments along the coast suitable for mariculture. Out ef this vast area only a pitifully small fraction is now being used for culture operations. While we have achieved a major breakthrough in the culture operations of the freshwater fishes beginning with development of the technique of induced breeding by hypophysation to the production of as much as 3 or 4 tonness of fish from a hectare of water area, we have a long way to go in the field of coastal aquaculture. The investigations taken up by the Central Inland Fisheries Research Institute and the Central Marine Fisheries Research Institute have begun to yield promising results. Culture of fishes like mullets *Chanos, Sillago, Etroplus*, crustaceans such as prawns, crabs, lobsters, molluscs like mussels, edible oysters, clams and some of the seaweeds offer tremendous potentials. Researches carried out by the Central Marine Fisheries Research Institute have revealed that even the relatively unproductive coastal areas which get inundated during high tides could be made more productive by adopting simple scientific management measures. The concept of synergy, which means that this mechanism results in the product being something more than the sum total of the parts, has been well recognized and is being applied in the field of aquaculture. Biological systems based on synergetic interactions have led to the development of techniques in aquaculture involving multi-species combinations as well as integrated crop-livestock-fish farming. Integration of pig rearing with fish culture or duck-cum-fish farming, to mention a few examples, are being extensively practised in several south-east Asian countries. Such integrated farming systems not only provide the much needed additional protein but also add to the income of the small farmers.

Extensive culture operations are also possible in marine waters along the coast. Pen culture is widely practised in South-east Asian countries. Similarly, culture of fish in floating cages yield very high returns. For example, in Japan floating net cages set up in marine waters produce nearly 30 kg of yellow tail per sq. metre per year which is equivalent to about 300 tonnes per hectare of water area. In our own country experiments conducted on open sea 'raft culture' of mussels have shown a production rate of about 235 tonnes per hectare for a period of 5 months. The development of the techniques for breeding under controlled conditions seven of the commercially important marine prawns and the demonstration of successful culture of prawns, even in the brackishwater irrigation canals of the coconut plantations have opened up tremendous possibilities for accelerating the tempo of coastal prawn culture. Such culture operations need not necessarily be restricted to prawns.

but depending on the ecological conditions culture of a variety of organisms is feasible.

Although the subject matter of this Session is 'Resource potential for capture and culture fisheries in the coastal region', I am tempted to make a few observations on the infrastructural and manpower resource potentials too. We have a number of fisheries and allied institutes and organisations in our country engaged in resarch, development and extension. Similarly, we have also a good band of competent scientific and technical personnel. Better inter-institutional co-operation, closer linkages between research and development and a fuller awareness of our social responsibilities alone can bring about a more purposeful use of our resource potentials.

EXPLOITED AND POTENTIAL CAPTURE FISHERY RESOURCES IN THE INSHORE WATERS OF INDIA

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India has a coastline of about 6100 km with nearly 2000 fishing villages along the coast. The marine fish caught from the inshore waters by indigenous as well as mechanised vessels are landed during almost all hours of the day and often at night round the year at about 1400 fish landing centres. About one million active fishermen use indigenous crafts and gears in the traditional fisheries. This sector contributes to about 65 per cent of the total marine fish production of the country. The pelagic as well as mid-water fish catches are almost entirely landed by the traditional fishery.

Prior to the introducation of mechanised fishing boats, the entire marine fish catch of the country was produced by traditional fishing methods. In 1974, traditional fisheries landed an estimated catch of 8,43,961 tonnes out of the total marine fish catch of 12,17,797 tonnes. In 1975, the contribution of this fishery was 915,058 tonnes in the total marine fish production of 14,22,673 tonnes. The return per unit of investment of non-powered boats has been found to be twice that of the powered boats and generate almost seven times more direct employment opportunities than the mechanised boats. Hence, this sector has been recommended about 15 per cent of the outlay on marine fisheries development. The present paper reviews the status of exploited and potential capture fishery resources in the inshore waters of India.

EXPLOITED FISHERIES

It is well known that the inshore waters where the traditional fisheries operate contain the highly productive fishing grounds. The present area of exploitation extends to 10 to 15 km from the shore and depths up to about 50 m. The gears such as shore secines and drag nets are operated from the beach, while boat seines, drift nets, traps, hooks and lines are operated from boats at sea. Bag nets and stationary types of nets are fixed in the tidal region in the estuaries, backwaters and coastal waters with stakes or with floats and sinkers. Cast nets are operated from shore as well as in the sea. The best fishing season for the country as a whole is the fourth quarter, from October to December The coastal waters of the country yield a wide variety of fishes, crustaceans and molluscs. Of these, some groups or species are commercially very important while others are of lesser importance. Some of them are exploited up to the optimum level while others are under exploited. The relative productivity of different areas is shown in Fig. 1. Recently studies have indicated that there are, in addition, recognisable sources of unexploited and potential fisheries resources also in the seas around India. Rao (1973), Banerji (1973) and silas *et al.* (1976) reviewed the major exploited fisheries resources of the country.

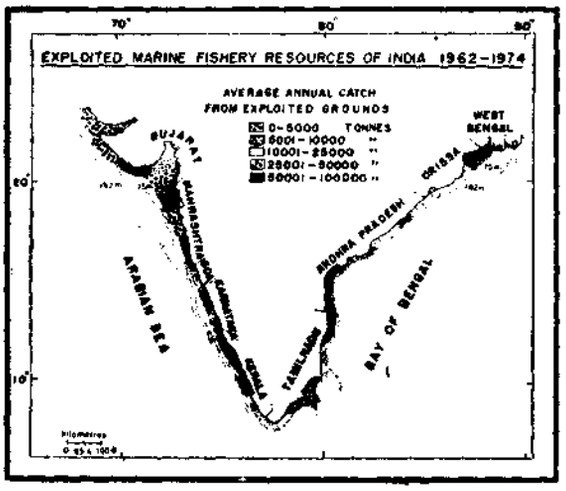

Fig. 1 The relative productivity of different areas.

The major groups or species of the pelagic fishes along the Indian coast consist of the oil sardine, lesser sardines, *Chirocentrus* spp., *Hilsa* spp., *Stolephorus* spp., *Thrissocles* spp., other clupeids, Bombay-duck, half beaks, gar fishes, flying fishes, ribbon fishes, carangids, mackerel, seer fishes, tunnies, barracudas, mullets, and *Bregmaceros* sp. The demersal fishes include elasmobranchs, eels, cat fishes, perches, lizard fishes, red mullets, polynemids, sciaenids, silverbellies, *Lactarius* sp., pomfrets, and soles. Other demersal groups are prawns, lobsters and crabs and cuttle fishes. In Lakshadweep, the bulk of the catch consists of tunas, particulary the skipjack. Perches and anchovies form the major fishery in the Andaman Islands.

The average annual catch composition for the period 1966 to 1976 is shown in Table 1. The fisheries whose landings are more than 35,000 tonnes on an average per year are the oil sardine (*Sardinella longiceps*), other sardines, the Bombay-duck (*Harpodon nehereus*), crustaceans (chiefly the penaeid and non-penaeid prawns) the mackerel (*Rastrelliger kanagurta*), elasmobranchs (sharks, skates and rays), sciaenids, cat fishes, ribbon fishes, silver bellies and miscellaneous fishes. Among the fishes whose landings are between 15 to 35 thousand tonnes are white bait, carangids, other clupeid fishes, perches, seer fishes and pomfrets. Those between 10 to 15 thousand metric tonnes are *Thrissocles*, soles and other crustaceans. Rest of the fishes contribute to less than 10 thousand tonnes. The average annual figures for the period 1961 to 65 given by Rao (1973) are also shown in the table, for comparison

From the table it is evident that the average figures for the period 1966 to 76 are higher than those for the period 1961 to 65 for all the categories, except for the Bombay-duck, eels, *Chorinemus* and *Bregmaceros* which show a decline. Significant increase in average catch was seen for other sardines, *Thrissocles*, other clupeid fishes, lizard fishes, cat fishes, flying fishes, perches, polynemids, sciaenids, ribbonfishes, silver-bellies, mackerel, seer fishes, tunas penaeid prawns, other crustaceans and cephalopods. The trends in catches of the most important species or groups during the period 1966 to 1976 are shown in Figs.2 and 3.

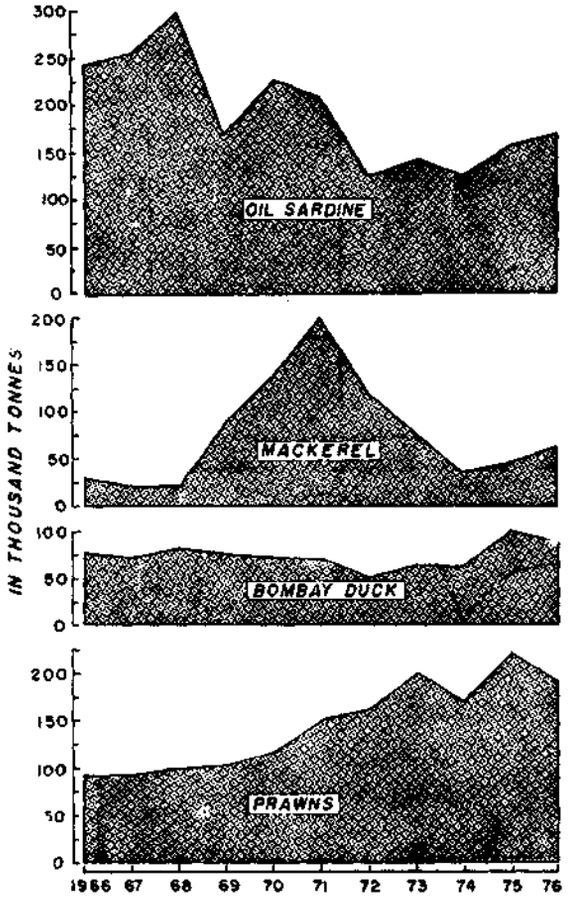

Fig. 2 The trends in crtches of most important species

Species composition and seasonal abundance

Oil sardine : Forms the most important single species fishery, touching about one-third the total marine fish production. The annual fluctuations in the catches of no other species of commercial fish are so marked as those of this species. These fluctuations are due to fishery independent factors and the variations in the

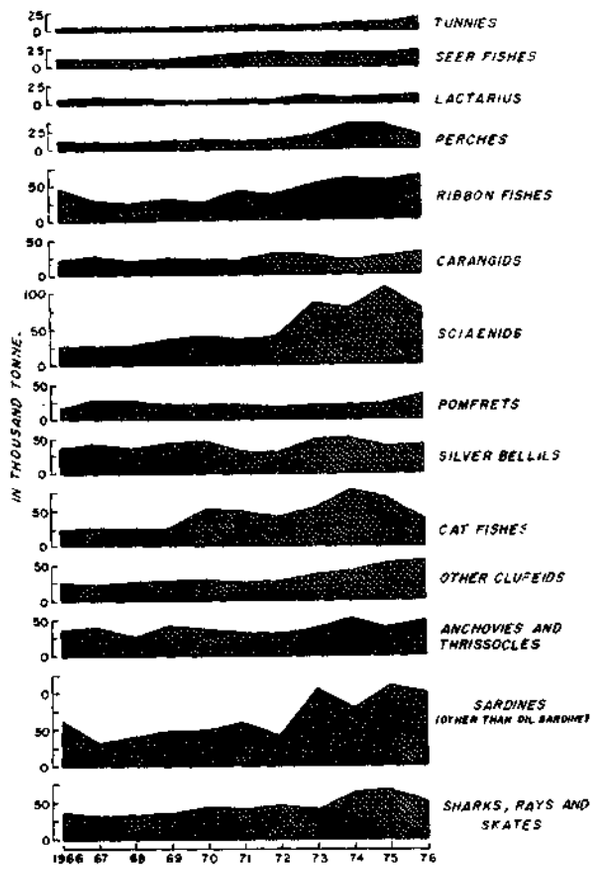

Fig. 3 The trends in catches of important species.

numerical strength of newly recruited year-class to the fishery. The coastal areas between Quilon in Kerala and Ratnagiri in Maharashtra are the traditional fishing grounds for the species. The two states of Kerala and Karnataka produce the bulk of the catch. the former state occupying a unique position in the oil sardine fishery of India. The landings in both the states are highest in the fourth quarter according to calender year). The fishery starts immediately after the south-west monsoon and lasts from August to March with peak during September-December period. The fishery is supported by 10-16 cm fish which are 0-year and 1 year old fish.

Mackerel : This species *(Rastre liger kanagurta)* supports fisheries on both the coasts, although the bulk of the catch (about 90%) is obtained from the west coast between Quilon and Ratnagiri. The fishery is of great importance in Karnataka and Goa. The fishing season starts by July-August and lasts up to April, the peak season being November-December. The landings are highest in the fourth quarter in Maharashtra, Karnataka and Kerala. In Tamil Nadu, the catches are highest in third quarter, in Andhra Pradesh they are more or less uniform in all the quarters. In West Bengal and Orissa they are poor all through the year. The fishery is supported by immature fish 16 to 20 cm believed to be mostly of 0-year class. Wide fluctuations in the catch from year to year are also characteristic of the species, resulting from the fact that the stock consists mainly of a single year class susceptible to large variations in recruitment and mortality.

Bombay-duck : Supports a very important single species *(Harpodon nehereus)* fishery along the north-west coast of India. Gujarat and Maharashtra yield the highest catches. There are practically no landings in Karnataka, Kerala and Tamil Nadu, thus showing a discontinuous distribution. The catches are highest in the fourth quarter. Fluctuations in annual landings are common. The commercial fishery is mainly supported by the 0-year class.

Other clupeoid fishes : These, including the lesser sardines, anchovies and related fishes, are found all along the coasts and form about 12 per cent of the total marine fish catch. The species under the genera *Sardinella, Kowala, Ilisha, Hilsa, Opisthopterus Anadontostoma, Dussumieria, Stolephorus, Megalops, Chanos* and *Chirocentrus* contribute to the bulk of the catches of this group.

The lesser sardine and anchovy catches are obtained almost entirely from Andhra Pradesh, Tamil Nadu and Kerala. The fishery lasts from October to April. About 70% of the catches of whitebait *(Stolephorus)* come from the region between Cape Comorin and Quilon. The fishing seasons are June,July and October-November along south-west coast, May to November along Tamil Nadu coast and November to April along the Andhra Pradesh coast.

Tunas and allied fishes : Tunas (Genera *Auxis, Sarda, Gymnosarda, Thunnus, Euthynnus Katsuwonus)* spear fishes *(Tetrapturus, Makaira)* sail fishes *(Istiophorus)* and the sword fish *(Xiphias)* are economically important food fishes. They range in size from 60 cm to about 450 cm. Although there is no organised fishery along the coast, these fishes are obtained as incidental catches in gears operated for other fishes. Kerala ranks first, followed by Tamil Nadu where the maximum yields are in the fourth quarter. In

Andhra Pradesh, highest catch is obtained in the second quarter. The species obtained from inshore waters are commercially less important than those from the high seas.

Seer fishes : The king seer (*Scomberomorus commerson)*, the streaked seer, *(S. lineolatus)* and the spotted seer *(S.guttatus)* and the Wahoo *Acanthocybium solandri)* are the common species under this group. Major portion of the catches comes from Tamil Nadu, Andhra Pradesh and Kerala. Fair quantities are also landed in Maharashtra and Karnataka. The fishing season extends from October to March. Peak catches are landed in the fourth quarter. Gill nets and hooks and lines account for the major portion of the catches.

Barracudas : The common species of barracudas are *Sphyraena commersoni S. obtusata* and *S. jello*, which attain a maximum size of 150 cm. They are caught commonly on hook and line in coastal waters. Although they do not form any sizeable fishery, these fishes are caught in small quantities along both the coasts, especially around islands in coastal waters.

Carangids and allied fishes : These fishes, comprising several genera and species, are caught all along the coast in a wide variety of gear. Important genera are *Megalaspis, Decapterus, Alectis, Selaroides, Selar, Carangoides, Chorinemus, Trachynotus, Rachycentron* and *Choryphaena*. While a few species grow to large sizes (over 60 cm), majority are under 30 cm. Highest yields are obtained from Tamil Nadu, followed by Kerala. In both the states, third quarter yields highest catches. In Gujarat and Karnataka, highest yields are obtained in the fourth quarter, and in Andhra Pradesh in second quarter. Carangid catches are poor in other states.

Ribbon fishes : They are of particular abundance in the States of Kerala, Tamil Nadu and Andhra Pradesh, though captured all along the coast. In the states, the landings are highest in the third quarter. Four species mainly contribute to the fishery, of which *Trichiurus lepturus* is the most dominant. This species, which attains a length of over one metre moves in large schools in coastal waters between July and September contributing to peak commercial catches at various places along the southern peninsula.

Garfishes and half-beaks : These fishes of the genera *Belone* and *Hemirhamphus* are comparatively more abundant in Tamil Nadu where the catches are highest in the second quarter.

Flying fishes : Belonging to the genera *Exocoetus*, *Parexocoetus* and *Cypselurus*, these fishes are caught in small quantities along with other fishes. They support an important fishery from May to August along the Coromandel coast

Elasmobranchs : The states of Tamil Nadu, Kerala, Andhra Pradesh, Gujarat, Maharashtra, Karnataka, West Bengal and Orissa produce large quantities of elasmobranchs. The genera and species constituting the catches on both the coasts are the same. Species of *Scoliodon, Carcharhinus, Sphyrna, Pristis, Dasyatis; Aetobatus, Rhinoptera* are the more common. Along the east coast, the third quarter's catch is usually the highest while along the west coast, the fourth quarter's catch is the highest.

Cat fishes : Species of the genera *Tachysurus* and *Plotosus* contribute to the catches. The catches are highest in Kerala, where the second quarter yields the maximum catch. Maharashtra, Tamil Nadu, Gujarat, Andhra Pradesh, Karnataka, Orissa and West Bengal also yield catfish catches.

Eels : The common commercial species of eels are *Anguilla bengalensis, A. bicolor, Muraenesox talabanoides* and *M. cinereus*. While the first two species are common along the east coast, the latter two are common along the north-western region. *M. talabanoides* attains a size of about two metres.

Perches : The commercially important genera of perches include *Lethrinus, Lutianus, Epinephelus, Lates, Psammoperca, Sillago, Nemipterus, Pomadasys* and *Siganus*. These fishes are most abundant in Tamil Nadu, other states of importance being Kerala, Maharashtra and Andhra Pradesh. Perches are abundant in coastal waters, particularly around coral reefs and rocky areas. They are effectively captured on hook and line, in gill nets and baited basket traps. Highest catches are obtained in Maharashtra and Karnataka in the fourth quarter, in Kerala and Tamil Nadu in third quarter and in Andhra Pradesh in second quarter.

Polynemids : These occur in all coastal waters and frequent backwaters and estuaries.

Eleutheronema tetradactylum, Polydactylus indicus, Polynemus heptadactylus, P. paradesius and *P. sextarius* mainly support the fisheries. The fishery is most important in the north-western region, covering Bombay and Saurashtra areas. The catches are high in the first two quarters in this region.

Sciaenids : Represented by a large number of species in coastal waters, these fishes occur all along the Indian coast. While species like *Pseudosciaena diacanthus, Otolithoides brunneus, Otolithus ruber* and *O. argenteus,* attain large sizes, a number of other species *(Johnius, Sciaena)* are small sized but abundant. The states of Maharashtra, Tamil Nadu, Andhra Pradesh and Gujarat are important for the fishery. Peak catches are obtained in the fourth quarter (Maharashtra), third quarter (Tamil Nadu) and in first quarter (Andhra Pradesh and Gujarat).

Red mullets : Represented by several species under two genera *Upeneus* and *Parupeneus,* these fishes are common in coastal waters along both the coasts.

Silverbellies : Small, coastal water fishes belong to the three genera, *Leiognathus, Secutor* and *Gazza.* They occur together and contribute to major commercial catches in the states of Tamil Nadu, Andhra Pradesh and Kerala. Heavy landings are obtained along the south-east-coast, around Mandapam. Peak catches are obtained in the third quarter in Tamil Nadu and Kerala and in the first and second quarters in Andhra Pradesh.

Pomfrets : Three species, *Parastromateus niger, Pampus argenteus* and *P. chinensis* represent this group. They are best obtained in the fourth quarter of the year in Gujarat Maharashtra and Kerala. They are not so abundant in the other states.

Grey mullets : The grey mullets represented by the genera, *Mugil, Valamugil, Liza, Rhinomugil, Sicamugil, Plycomugil, Ellochelon* and *Crenimugil* are more abundant along the east coast than along the west coast. Some of them grow to a maximum size of 25 to 45 cm. The more common species like *M. cephalus, L. macrolepis, L. parsia, L. tade. L. seheli* and *V. buchanani* contribute to coastal fisheries of great economic importance. They often enter estuaries and backwaters. They are captured in a variety of gear, the most important of which are stake nets, cast nets and gill nets.

Bregmaceros : The species, *Bregmaceros mcclellandi,* growing to about 13 cm, supports a seasonal fishery around Bombay, from October to March. Along other coastal regions, it is of limited occurrence. The landings are highest in the fourth quarter.

Soles : These are represented in the coastal region by a number of genera, *Psettodes, Poecilopsetta, Bothus, Pseudorhombus, Solea, Paraplagusia* and *Cynoglossus.* Of these, *Psettodes erumei* along the Bombay-Saurashtra coast and *Cynoglossus macrostomus* along the Kerala and Karnataka coasts are the most important from the fishery point of view. However, bulk of the soles are landed in Kerala, little in Karnataka and Tamil Nadu. In all the three states, the third quarter's landings are the highest.

The malabar sole, *C. macrostomus* grows to a maximum size of about 18 cm. The fishery from August to December is supported by one year old fish. Boat seines, cast nets and shore seines account for the bulk of the catch.

Crustaceans : Among the crustaceans, the penaeid prawns form the major component, followed by non-penaeid prawns and other crustaceans. Maharashtra ranks first and Kerala second in total production. For penaeid prawn production, Kerala stands first followed by Maharashtra and for non-penaeid prawn production Maharashtra stands first followed by Andhra Pradesh. In the other states, the catches are less. In Gujarat and Maharashtra, the catches are highest in the second quarter. In West Bengal and Orissa, they are highest in fourth quarter. In the rest of the states, the catches are highest in the third quarter.

The penaeid prawns of commercial importance are *Penaeus indicus, P. monodon, Metapenaeus dobsoni, M. affinis, M. monoceros, M. brevicornis, Parapenaeopsis stylifera, P. sculptilis, P. hardwickii* and *Solenocera indicus.* The important species of non-penaeid prawns are *Palaemon tenuipes. p. styliferus, Hippolysmata ensirostris* and *Acetes* spp. While prawns are captured all along the coast, certain species are dominant in certain regions.

Species comparatively less abundant but nevertheless of high local importance are *Penaeus semisulcatus* (east coast), *P. penicill-*

atus (Maharashtra), *P. merguiensis* (Karwar, Ratnagiri), and *P. canaliculatus* (Madras Pulicat and Bombay).

The giant freshwater prawn, *Macrobrachium resenbergii* is obtained in good quantities in Kerala backwatars in the monsoon and post-monsson months and from December to July along the east coasr from similar environments.

Species of *Acetes* constitiute good fisheries along both east and west coasts. *A. indicus A. erythraeus* and *A. serrulatus* occur in large schools in inshore waters.

The fishing seasons for prawns extend from November to May (west coast) and from December to August (east coast). Prawns are fished in large quantities from the mud bank areas of Kerala in June and July. A monsoon fishery for prawns exists in the Gulf of Kutch. Prawns are captured from coastal waters in stake nets, boat seines, cast nets, dip nets and trawl nets.

Other crustaceans include the lobsters and crabs. The lobsters inhabit rocky bottom areas along borh coasts. The common species are *Panulirus polyphagus, P. ornatus* and *P. homarus*. They attain about 30 cm length. They are captured in gill nets, baited traps and anchor hooks.

Of the crabs,*Portunus pelagicus, P. sanguinolentus* and *Scylla serrata* are the commercially important species. While the first two species contribute to an important commercial fishery in the Palk Bay and Gulf of Mannar, the third species is caught in fair numbers from the brackishwater lakes and estuaries along both the coasts.

The state-wise catch of important groups of fishes and crustaceans is indicated in Table. 2.

Mulluscs : The chief exploited molluscan resources include mussels, oysters, clams and other bivalves, gastropods and cephalopods.

Two species of mussels, the green mussel *Perna viridis* and the brown mussel, *Perna indica* are commercially important. The former is found in rocky regions all along the east and west coasts, while the latter is restricted to south-west coast. They grow up to about 13 cm. Along the Kerala coast, they are fished from October to May.

The oysters, *Crassostrea madrasensis, C. gryphoides, C. cucullata, C. discoidea, C. cristagalli, C. cornucopia C. glomerata* and *C. belcheri* occur along the coast, the first four forming large fishable beds. *C. madrasensis* is found in estuaries and backwaters along the east coast but is confined to the southern region along the west coast. *C. cucullata* is found on intertidal rocks of both coasts. *C.gryphoides* is found in muddy creeks and bays from Kutch to Honavar along the west coast *C. discoidea* occurs in deep waters of the littoral zone.

Clams, represented by several genera and species, are much greater in abundance than mussels and oysters. Though they are widely used as food by the coastal population, the vast resource is inadequately used due to conservative food habits and prejudices. The clams thrive in all estuaries, backwaters and bays. They constitute sustenance fisheries, the important zone being the central and northern parts of the west coast. *Meretrix meretrix* growing to about 7 cm in length, supports good fisheries along the entire Maharashtra coast and the North Kanara coast. *M. casta* is common along the east coast and the southern regions of west coast. Species of *Villorita* are confined to backwaters and estuaries of west coast. Other bivalves of commercial importance belong to the genera *Paphia, Katelysia, Gafrarium, Anadara, Mesodesme, Donax* and *Solen*.

Gastropods of commercial value are the sacred chank, *Xancus pyrum* (Palk Bay and Gnlf of Mannar), *Trochus niloticus* and *Turbo marmoratus* (Andaman and Nicobar Islands) and a variety of smaller gastropods (Palk Bay and Gulf of Mannar).

The common species of cephalopods include cuttle fish (*Sepia rouxii, S. aculeata, S. rostrata* and *Sepiella inermis*), squids *Sepioteuthis arctipinnis, Loligo indica, L. hardwickii* and *L. affinis)* and octopuses (*Ocropus globosus, O. rugosus, O. octopodia, O. herdmanii* and *O. hongkongensis)*. These are caught in nets operated for fishes. *S. arctipinnis* supports an important seasonal fishery in the coastal waters of Palk Bay (March to June) and Gulf of Mannar.

Pearl oysters are represented by *Pinctada fucata, P. margaritifera P. chemnitzi, P. anomioides* and *P. atropurpurea* in the seas around India, of which the first species alone supports the pearl fisheries in Gulf of Mannar. Pearl oysters are also found in the Gulf of Kutch. The windowpane oyster, *Placenta plancenta* available in the Gulf of Kutch, Bombay and Andhra Pradesh also yields pearls.

UNDER-EXPLOITED AND POTENTIAL RESOURCES

The inshore region has been fished intensively all along and has been supporiing important coastal fisheries. The fishing activity extends to about 50 m in certain regions. In recent times, the emphasis has been on shrimp trawling in inshore areas resulting in under-exploitation of certain other resources. Such resources include the threadfin bream, *Nemipterus japonicus* (beyond 50 m. on the shelf along both east and west coasts), the pomfrets and seer fish along the west coast. It is known that in the traditional inshore fishing grounds, an increase in the fishing effort will not yield any increase in the catch of the oil sardine and mackerel. The average annual stock for the period 1960-1971 has been estimated to be 57,000 tonnes for the mackerel and 400,000 tonnes for the oil sardine from the present fishing grounds. The aerial and acoustic surveys along the west coast of India by UNDP/FAO Pelagic Fishery Project have confirmed that both oil sardine and mackerel schools occur in neritic waters particularly between 19 and 40 fathoms. There are also indications that in depths up ro 40 m, along the west coast, potential resources of oil sardine, mackerel, white bait, ribbonfishes, cat fishes silver bellies and lesser sardines are available for exploitation. These resources could be exploited by bringing in diversification of fishing by the small mechanised boats concentrating at present on catching shrimp. These resources are said to be almost completely unexploited, the biomass being largest just prior to south-west monsoon season. Based on these resources, a small vessel fishery with pelagic trawls could be developed round the year, if disposal and utilization of the catches could be organised. Similar resources of white bait, lesser sardines, cat fishes and ribbon fishes are also known to occur along the east coast.

Along the east coast, two species of mackerel, *R. kanagurta* and *R. faughni* are known to occur. The resources of the latter are unknown The mackerel resources of Andamans *R. kanagurta & R. brachysoma*) are also under exploited. There are also indications of good pelagic resources of mackerel and oil sardine along the Maharashtra coast. The flying fish fishery along the south-east coast can be developed further on modern lines. Considerable resources of barracudas, needle fishes and half beaks are known to be available along both the coasts constituting potential resources for future development.

NON-CONVENTIONAL RESOURCES

Cuttle fishes and squids form 2 to 11% of the bye-catch in trawl nets along south-east and south-west coasts up to 40 m depth. These are, also captured in other gears in small quantities along with fishes. Apart from their meat which has high export value, the cuttle bone has both internal and extenal market.

Ancillary resources like the holothurians echinoids, sponges, corals and seaweeds are abundant in coastal areas, which though being exploited to a limited extent, can further be developed and utilised for various purposes. The horse-shore crabs, *Limulus gigas* and *moluccanus* occuring in the Bay of Bengal which form valuable raw material for the manufacture of colour films and medicines are not commercially exploited at present.

In Indian seas myctophids form an important constituent of the deep scattering layers (Silas, 1972). Large concentrations of these fishes occur along the west coast. These fishes have high Vitamin 'A' content and oil. Good concentrations of grenadiers and macrurids are also known to be avilable along the upper continental slope off the west coast of India (Silas, 1969).

Large quantities of the swimming crab, *Charybdis (Goniohellenus edwardsi)* have been found along the continental edge of the south-west coast as well as on the east and north-west coast (Silas,1969). This may be an important source of crab meal.

Exploitation of such resources as mentioned above which are at present not being fished, can lead to diversification of fishing and a balanced development of the fishing industry.

PROSPECTS FOR DEVELOPMENT

The trend in the catch of pelagic fishes along the west coast of India shows wide fluctuations in the catches of the three important fisheries, *viz.*, oil sardine, mackerel and Bombay-duck. Since these are composed of single species, their fluctuations are seriously felt along the west coast unlike those on the east coast where multiple species are involved. For this reason, the impact of mechanisation towards increase in overall production could be more easily seen along the east coast, compared to the west coast.

However, hardly anything is known about the pelagic fishery resources of the north-west coast and of the east coast. There are indications of occurrence of mackerel, sardine, lesset sardines, anchovies and other important groups of pelagic fishes. Epipelagic and mesopelagic fishes such as Myctophidae and oceanic squids may also form important components in these areas. An increase in the catch may be expected with more intensive fishing from the inshore waters along the east coast.

The demersal fisheries show an increasing trend, particularly for penaeid and non-penaeid prawns, sciaenids, silver bellies and pomfrets.

There are localised, seasonal sustenance fisheries like the flying fish fishery along the Coromandel coast, lobster fishery of the south-west coast of Kerala, Tirunelveli and Kanyakumari Districts of Tamil Nadu, the mussel fishery of south and central Kerala coast, and the clam fishery of the South Kanara and south Maharashtra coast which could further be developed by intensive and organised exploitation.

As indicated in Fig.1, certain regions of the coastal waters are more productive compared to other regions. Highly productive areas, yielding an average annual catch of 50 000 to 1,00,000 tonnes have been found off the coasts of Kerala, Maharashtra and Gujarat. Banerji (1973) indicated that most of the pelagic stocks are being exploited efficiently. However, since the same generalised gear are used for the capture of various species, their influence on different stocks has to be monitored while attempts are made to increase the catch. From studies conducted so far on the coastal stocks, it is clear that only a fraction of the pelagic stock may be entering the inshore waters, the fraction probably being small. The entry of the stocks into coastal waters is also subjected to biological and physical influences Though the magnitude of the abundance of each pelagic stock outside the presently intensively exploited region is not known, real increase in the yield is expected to come from outside the present area of fishing. In this context it may be mentioned that, based on observations on primary production in the coastal waters, an estimated annual yield of 3 to 4 million tonnes of fish has been derived for the seas around India, which is about three times the present yield (Anon., 1977). Recent catch trends (Fig.2) indicate that promising fisheries may be those of elasmobranchs, anchovies, cat fishes, silver-bellies, ribbon fishes and perches. Some of these resources and others like the horse mackerels, pomfrets, seer fishes, tunas and related fishes, barracudas, needle fishes, half beaks and molluscs are under exploited and hence constitute potential resources.

For a balanced development of the marine fishing industry and for rational exploitation of the coastal fisheries resources, there is urgent need for diversification of fishing in coastal waters to release pressure on shrimp trawling. It has already been suggested that the existing small mechanised vessels could profitably be utilised for fishing by employing pelagic and midwater trawls and purseseines with suitable modifications, where necessary. A 'small vessel' fishery can thus be developed for fully exploiting the under exploited resources as well as some of the potential and non-conventional resource. One way of bringing in development in this direction is to impose a quota system for shrimp trawling by mechanised boats. This would serve the dual purpose of conserving the shrimp stocks and diversification of fishing in coastal waters.

Future development in the coastal fisheries should take note of the impact of generalised fishing gears on individual fisheries since the same gears account for the capture of more than one species, some of the species being already fished to the optimum level. Hences, a continuous monitoring of coastal stocks is stressed. Another important aspect is the impact of modern developments including mechanisation, on

the indigenous gear and the resultant increase or decrease of catch from the coastal waters. The question, whether the coastal resources which were hitherto very efficiently exploited by indigenous gears (e. g. drift net fishing for several pelagic fishes) should continue to be exploited to the same degree or not should also be examined in detail to ensure that the resources are not left unexploited. While a watch on the exploited resources of the inshore region is necessary, attempts at diversification of fishing in coastal waters to exploit the underexploited and non-conventional resource should be intensified for achieving a rational exploitation of the resources of the inshore areas and for maintaining a balance between the mechanised and non-mechanised fishing.

In conclusion, an optimistic note may be sounded for stepping up fish production from coastal waters in view of the development of modern fishing harbours and the provision of infrastructural facilities for handling, storage, transportation and marketing of fish and fish products at all the major fish landing centres along both the coasts of the country. Mechanisation and modernization of the marine fishing industry should not be at the expense of obliterating the traditional fisheries, some signs of which are evident in some parts of the coast (south-east coast, Karnataka coast etc). Modern developments should, however, go hand in hand with the encouragement that is due to the small scale fishermen for the improvement of their capability in harvesting the coastal resources. With all the modern developments taking place, the small scale fishermen and their traditional methods still remain the backbone of the marine fishing industry of the country.

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TABLE 1

Average annual marine fish catch composition (in tonnes) for the periods 1961 to 1965 and 1966 to 1976

Name of the spicess/group	1961-65	1966-76
Elasmobranchs	36,851	45,209
Clupeiform fishes:		
a) Oil sardine	175,605	191,879
b) Other sardines	29,931	69,008
c) *Hilsa ilisha*	2,096	2,628
d) Other *Hilsa*	7,278	9,046
e) *Anchoviella*	23,904	27,068
f) *Thrissocles*	5,594	11,235
g) *Chirocentrus*	7,641	9,862
h) Other clupeid fishes	15,463	33,271
Bombay-duck and *Saurida:*		
a) *Harpodon nehereus*	84,977	75,515
b) *Saurida* and *Saurus*	983	5,130
Cat fishes	17,893	43,660
Eels	6,727	4435
Belone and *Hemirhamphus*	1,360	1,617
Flying fish	1,536	3,589
Perches	10,808	17,922
Red mullets	2,369	3,842
Polynemids	3,403	7,592
Sciaenids	26,759	86,626
Ribbon-fishes	24,873	43,722
Carangids:		
a) *Caranx*	18,403	22,119
b) *Chorinemus*	3,154	2,972
c) *Trachynotus*	34	71
d) Other carangids	147	355
e) *Coryphaena*	299	248
f) *Elacate*	—	308
Silver-bellies:		
a) *Leiognathus*	21,413	41,749
b) *Gazza*	110	229
Lactarius	7,539	8,051
Pomfrets	19,379	23,856
Mackerel	41,505	19,179
Seerfish	10,420	16,044
Tunnies	4,651	6,974
Barracudas and grey mullets:		
(a *Sphyraena*	1,471	2,488
b) *Mugil*	1,515	2,915
Bregmaceros	4,338	2,528
Soles	10,027	11,524
Crustaceans		
a) Penaeid prawns	45,976	91,306
b) Non-penaeid prawns	34,422	54,888
c) Other crustaceans	2,417	10,824
Cephalopods	236	2,850
Miscellaneous fishes	21,358	49,203

TABLE 2

Average annual landings of the important species or groups of fishes and crustaceans in various states during the period 1962 to 1974 ('000 tonnes)

	Species / group	Gujarat	Maha-rashtra	Karnataka	Kerala	W. Bengal & Orissa	Andhra Pradesh	Tamil Nadu
1.	Elasmobranchs	5.92	4.84	1.85	6.99	0.59	6.51	13.36
2.	Eels	0.70	3.17	—	—	—	—	—
3.	Cat fishes	3.74	7.01	2.38	9.85	0.40	5.15	5.57
4.	*Chirocentrus*	—	—	—	0.49	0.58	1.77	3.82
5.	Oil sardine	—	—	29.97	161.66	—	—	—
6.	Other sardines	—	—	—	15.29	2.12	14.08	15.77
7.	*Hilsa*	—	—	—	—	—	—	2.80
8.	Other clupeids	4.46	8.38	0.64	1.57	2.18	4.52	2.97
9.	*Harpodon & Saurida*	45.45	27.95	—	—	0.97	0.77	—
10.	*Hemiramphus & Belone*	—	—	—	—	—	—	1.12
11.	Flying fishes	—	—	—	—	—	—	3.07
12.	Perches	—	1.96	0.17	4.00	—	1.37	5.62
13.	Polynemids	1.22	1.43	—	—	—	—	1.10
14.	Sciaenids	7.20	10.48	1.82	4.85	1.42	5.11	7.58
15.	Ribbon fishes	1.11	6.47	—	10.69	0.79	6.09	9.37
16.	Carangids	0.70	—	0.87	7.46	—	3.04	9.35
17.	*Leiognathus & Gazza*	—	—	—	10.82	0.72	3.13	18.68
18.	*Lactarius*	—	—	—	2.56	—	1.22	2.31
19.	Pomfrets	6.30	7.54	—	1.94	0.50	3.09	1.52
20.	Mackerel	—	4.89	21.97	27.07	0.27	20.0	4.13
21.	Seer fish	—	1.45	0.97	2.03	0.46	3.48	3.85
22.	Tunnies	—	—	—	21.6	—	0.48	0.96
23.	*Sphyraena*	—	—	—	—	—	—	1.00
24.	*Bregmaceros*	—	3.39	—	—	—	—	—
25.	Soles	—	—	0.73	8.40	—	—	0.81
26.	Prawns	4.13	57.41	4.58	36.19	3.77	6.32	5.19
27.	Other crustaceans	0.09	0.70	0.39	0.58	0.01	0.45	4.71
28.	Miscellaenous	12.46	15.76	11.88	24.49	4.38	14.91	22.21

PROSPECTS FOR COASTAL AQUACULTURE IN INDIA

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Coastal aquaculture is one among the age-old avocations of man. The Romans and the Japanese are known to have practised oyster culture in its primitive form for several centuries and the South-East Asian countries have been carrying out fish culture for at least five centuries now. While the developed countries, where aquaculture was started in recent times, have far advanced in the field with sophisticated technology, in the few developing countries, including India, which have traditional forms of aquaculture, it still remains at subsistence level, almost as it was in the distant past. But the recent developments in coastal aquaculture in this region signify the beginning of a new era in fisheries development with a thrust on the culture fisheries.

TRADITIONAL COASTAL AQUACULTURE IN INDIA

The traditional coastal aquaculture system of India is represented by the 'pokkali' fields of Kerala, 'bheries' of West Bengal, 'gazani' farms of Karnataka and 'khazan' lands of Goa. These are natural systems operated with the tidal resources of water as well as organisms. About 5120 ha of low-lying coastal areas in Kerala are utilised for growing a salinity-tolerant variety of paddy called 'pokkali' during the south-west monsoon season and prawns during the rest of the year. Besides the seasonal fields,there are perennial fields where prawn farming is done throughout the year. The estimated production in paddy-cum-prawn culture varies from 500 to 1200 kg of prawns per hectare for six months period. The total production from these fields is around 4800 tonnes.

The 'gazani' farms of Karnataka have a total spread of about 2320 ha mainly in the North Kanara district. In the brackishwater areas nearer to the coast, prawn/fish culture is carried out along with salt production, while in the interior areas, paddy-cum-fish culture is practised. The total production in these farms amount to about 600 tonnes of which 65% is constituted by prawns.

In Goa, prawn culture is done in the 'khazan' lands extending over an area of 1800 ha. Khariff crop of paddy is grown in the fields and after its harvest, the supply canals, as well as the fields in some cases, are used for culturing prawns.

In West Bengal, the 'bheries' extending over an area of about 20,000 hectares in the Hooghly-Matlah estuarine system are used for the culture of fish and prawns. The production rate in these fields is around 300 kg/ha/annum.

RESOURCES FOR COASTAL AQUACULTURE

Species resources

A rich variety of fishes, crustaceans molluscs and marine algae constitute the cultivable species resources. Traditionally the milk fish, *Chanos chanos* and mullets *Mugil* spp. form the two major cultivable finfish groups. Culture of the pearl spot *Etroplus suratensis*, 'bhekti' *Lates calcarifer*, threadfins *Polynemus indicus* and *Eleutheronema tetradactylum* has gained importance in the recent years. Experimental culture of sand-whiting *Sillago sihama* has indicated that it is a species with good potential. Other finfishes suitable for culture are species of *Caranx, Trachinotus, Megalops* and *Elops*. Besides the above species for direct use as human food, culture of anchovies and a few species for other use as live bait in tuna fishing has wide scope. Culture of *Tilapia mossambica*, a fast growing species and a prolific breeder, and an establisher in fresh as well as brackishwater areas, needs control for making it more useful.

Prawn culture or shrimp farming as it is called in commercial parlance, has attained great importance in the recent years because of the very high unit value of prawns. Among these, the 'naran chemmeen' *Penaeus indicus* and 'kara chemmeen' *Penaeus monodon* are the prize species, because of their fast growth, large size and high economic value. Other prawn species of importance for culture are *P. semisulcatus, P. merguiensis, Metapenaeus dobsoni, M. monoceros, M. affinis, M. brevicornis* and *Parapenaeopsis stylifera*. The recent results on

culture of spiny lobsters *Panulirus homarus*, have shown that it is possible to rear the puerulus stage to marketable size in 18 months' time. Similarly, among the crabs, the green crab,*Scylla serrata* has a good potential.

The edible molluscs at present support only sustenance fisheries at several centres along the coastline. Paradoxically, they are harvested more for their shells than for their meat. However, with the accent on diversification in the fishing industry and the emerging export potential, changes are already visible. The culture of mussels, *Perna virids* and *P. indica* by rafts in the open sea has shown their high production potential. The oysters *Crassostrea madrasensis* and *C. gryphoides* and clams of genera *Meretrix, Katelysia, Paphia* and *Villorita* which have an extensive distribution are the major resources for culture in brackishwater areas. The blood clam *Anadara*, although it has a restricted distribution, is another cultivable species. Among the culture of molluscs which have predominant industrial uses, pearl culture has a good scope. Besides *Pinctada fucata*, the most important species of pearl oyster on the mainland, the blacklip *P. margarifera* occurring in the Andaman and Nicobar Islands has a moderate potential. Culture of window-pane oyster, *Placuna placenta* for the shells and seed pearls could form a minor activity. Other molluscs suitable for culture are the abalone. *Haliotis* and the cuttlefishes.

Culture of seaweeds could meet the growing demands for the raw material for the production of agar and algin. The agar-yielding *Gracilaria edulis, G. corticata* and *Gelidiella acerosa* and the algin-yielding *Sargassum cinctum, S. wightii* and *Turbinaria* spp. form the major species of cultivate seaweeds.

There is also scope for culture of ancillary marine resources such as holothurians (*Holothuria* spp. and *Stychopus* spp.) and sponges (*Spongia officianalis* var. *Ceylonensis*).

Water resources

India with a 6100 km long coastline and varied ecosystems has immense water resources suitable for culture of a multitude of organisms. The potential inshore area (within 18 m depth) available for open sea farming has been estimated to be about 9 million hectares. The open sea is subject to the influence of the two monsoon systems and sea conditions remain rough for certain periods of the year. But, seasonal culture practices could be adopted for the fast growing species so that harvesting could be completed before the onset of monsoon. Sheltered natural bays with purely marine conditions are found mostly in the Andaman and Nicobar Islands and the Lakshadweep Archipelago. The paucity of calm bays along the coastline is greatly compensated by the extensive brackishwater areas present at the numerous river mouths. It has been estimated that along the Indian coast about 2 million hectares of brackishwater area including estuaries, backwaters, mangrove fields and lagoons are available. Of these, the currently used area for traditional culture practices is barely 30,000 hectares mainly in West Bengal, Kerala and Karnataka. Gujarat with 0.376 million hectares of brackishwater area is hardly using 100 ha for fish culture. In Maharashtra (with 0.081 million ha), Tamil Nadu (0.080 million ha) and Andhra Pradesh (0.200 million ha), there is practically no utilisation of the brackishwater resources for culture purposes. Thus there is vast potential of water resources for taking up coastal aquaculture in the country

Technical knowhow

Although it is only about five years since India started research programmes in mariculture in some of the laboratories, notably at Central Marine Fisheries Research Institute, the results obtained are impressive. Several species of marine penaeid prawns have been bred and their larvae reared in the laboratory/ ponds to marketable size. Indigenous techniques have been developed for pearl oyster culture and production of pearls of good quality. Culture techniques for mussels in the open sea and in sheltered bay have been established Techniques for the collection of oyster spat and growing them in the estuaries and tidal creeks have been developed. Elvers of eel have been grown to commercial size in running fresh water system. Vegetative farming techniques have been developed to increase production of seaweeds. Other areas where some encouraging results have been obtained are *Sillago* culture, crab culture, lobster culture and clam culture. Culture of milkfish, mullet, pearl spot and 'bhekti' at different centres has given valuable results. Food organisms required for the

different growth stages of fishes, crustaceans and molluscs have broadly been identified and some success has been achieved in mass culture of plankton components. Extensive surveys have been and are being conducted for locating the seed grounds and estimating the abundance of seed of fishes, prawns and molluscs in space and time.

The areas which require further research inputs have been identified. These relate to development of hatchery systems for mass production of seed under controlled conditions, nutrition of cultivable species, fish diseases and control, reproductive physiology, genetic resources and upgradation of stocks and coastal farm engineering. These programme have already been started.

Transfer technology

A good system for effecting transfer of technology is essential for the development of coastal aquaculture industry in India. It has to be done at different levels to suit the specific needs of the industry. The Central Marine Fisheries Research Institute which has the technologies for prawn culture, pearl culture, mussel culture, oyster culture, seaweed culture and eel culture has been seized of its obligations for transferring them to the end-users.

The technology transfer is effected through (i) training programmes; (ii) deputation of competent scientific and technical personnel, (iii) demonstrations, (iv) Summer Institutes in specicfic topics, (v) Consultancy Service and (vi) the courses of Krishi Vigyan Kendra, Traininig courses are conducted both in advanced and operative levels. The maritime States, Agricultural Universities and private entrepreneurs get their nominees trained under these programmes. The Krishi Vigyan Kendra trains actual fish farmers, both men and women. A Trainers Training Centre is also shortly to be added to these facilities. Besides imparting practical training, the Institute provides follow-up monitoring and advisory services wherever necessary. Thus, we already have some infrastructure for effectively passing on the technical knowhow in coastal aquaculture to the developmental agencies and industry.

PROSPECTS

Production potential

The recent developments in the culture of many of the organisms have shown their high growth rate and production potential. The prawns grow very fast in culture fields and reach marketable size in 3-4 months. By intensive culture of prawns a production rate between 1000-1500 kg/ha/annum could be realised. The mussels could give perhaps the highest yield in sea farming. The production rate as derived from experimental work is 150 tonnes/ha/year for the brown mussel and 235 tonnes/ha/5 months for the green mussel. In pearl culture, the rate of production is 60-70% and multiple implantation enhances it further by three times. Oysters grow to marketable size within 10 months and the estimated production rate is about 100 tonnes/ha/annum. Eel culture has given a production rate of 3.8 tonnes ha/2 years. *Sillago* grows to about 20 cm in seven months. In seaweed culture the growth obtained is 4-5 kg from an initial 1 kg of seed material within 80 days.

Some of the production rates reported from experimental culture farms at different centres are as follows: 1054.81 kg/ha/year and 514.7 kg/ha/70 days for *P. monodon*: 595 kg/ha/105 days for *P. indicus;* 871.75 kg/ha/320 days in mixed culture of prawns; 2759.5 kg/ha/240 days for 'bhekti'; 710 kg/ha/for milkfish; 2238.4 kg/ha/510 days for mullet (*L. tade*) 1100 kg/ha/6 months in mixed culture of fishes; and 2579.8 kg/ha/9 months for polyculture of prawns and fishes.

The reported present yield per hectare per year under the traditional coastal aquaculture system is 35.5 kg in Gujarat, 258 kg in Karnataka, 300 kg in West Bengal, 500 kg in Goa and 700 kg in Kerala. Compared to these low yields, production under controlled culture conditions is far greater and the species used are those of high unit value. The total production under traditional systems in India is around 12,000 tonnes a year in an area of about 30,000 hectares. Even if 10% area of the total 2 million hectares is brought under culture by scientific methods the production can be increased considerably.

Economics of culture

Intensive prawn culture has proved to give one of the best returns in brackishwater culture. In the demonstrations conducted by the Central Marine Fisheries Research Institute in the farmers' fields good returns have been obtained. Under the Cooperative Intensive Prawn Farming project, a net profit of Rs. 7478 was realised in a

perennial field of one hectare area in 105 days on a total expenditure of Rs. 7016. Such demonstrations have created a great interest in the coastal areas of Kerala with many farmers coming forward to take up prawn culture. At other centres, monoculture of *P monodon* in one hectare area has yielded a net profit of Rs. 17,400 per annum for 2 crops and culture of *P. indicus* has yielded Rs. 8,000 per annum for 2 crops.

In the culture of many organisms the economic viability is being worked out under pilot projects. Mussel culture, with very high yields, is bound to give good returns. The profitability in oyster culture would largely depend upon creating an increase in demand both in the urban and rural areas and also establishing export markets. Pearl culture is one of the areas with potential for high returns. In fish as well as prawn culture, the major factor that would contribute to economic success is the availability of quality seed in adequate quantities at reasonable cost. In the case of nonconventional products such as the mussels, oysters and clams the determining factor would be marketability. Culture of sea weed would yield high returns when coupled with post-harvest technology.

Employment potential

The country has an excellent scientific and technical manpower which has made the recent technological breakthrough in the field of coastal aquaculture and this would form the nucleus for further developments. Since the technical problems in future will be greater and more complex, the present teams will have to be adequately strengthened and personnel from the component disciplines should be involved.

There is already a need for managerial personnel and at present some *ad-hoc* arrangements are made to manage the farms of some of the private concerns. In the near future the demand for managerial and supervisory personnel will be greater as more and more entrepreneurs come to this field.

It has been realised that the existing extension services in the country are inadequate even to serve the current development programmes relating to capture fisheries. This has necessitated the scientific and technical community to directly engage themselves in extension programmes. Coastal aquaculture would need competent extension personnel to effectively spread the technologies and assist the farming communities as in the case of agricultural extension service.

The major area for employment potential would be at the primary level of culture operatives and skilled workers. The youth of the fishing communities in the coastal zone with training at the required levels, could form the source of this base.

In the capture fisheries sector, in spite of well established training programmes, the shortage of operative personnel is keenly felt to meet the needs of the current development programmes. It is, therefore, necesary to develop adequate training facilities for coastal aquaculture as a part of the programme for the development of this sector. The establishment of a Krishi Vigyan Kendra for Mariculture at the Central Marine Fisheries Research Institute has been a timely action and much programmes need strengthening and expansion.

The rural base of coastal aquaculture

Coastal aquaculture should form an integral part of rural development for the coastal sector. In inland areas, the need of integration of agriculture with aquaculture has been well recognised. An FAO case-study in Thailand has shown that a famrer's income can be increased 21 times by combining aquaculture with agriculture. In the coastal areas similar integration of aquaculture with traditional fisheries has good possibilities. The fishermen have plenty of leisure time during off seasons and this is being frittered away. They have an intimate knowledge of the sea and its resources and their life base is sea. Thus, logically and ethically, the benefits of coastal aquaculture must accrue first to the small fishermen. The aquaculture system for combining with traditional fisheries must be selected on consideration of several factors relating to the technical aspects of culture as well as socio-economic aspects of the fishermen community of the region. Such integration wolud necessitate identification of talents among fishermen and imparting basic training. Effective monitoring and consultancy services will have to be provided by the aquaculture extension workers.

It is worth mentioning here that the Central Marine Fisheries Research Institute, under the

auspices of the Golden Jubilee Celebrations of the Indian Council of Agricultural Research, has taken up programmes for the release of new technologies in coastal aquaculture and demonstrations in farmers' fields with the specific objective of providing a new means for uplifting the economy of some coastal rural families.

Strategies

An over-view of the prospects for coastal aquaculture in India has been attempted in the foregoing sections. The country is rich in water resource and species resource for coastal aquaculture. The technical knowhow for the culture of presently valuable species has already been developed and it is under constant improvement. Interest among the fishermen and commercial enterprencurs is not lacking. Training systems in ceastal aquaculture have also been developed. In the initial stages subsidies and loans will have to be provided as was done in the case of mechanised fishing when the vessels were introduced. The marketing potential is already good for the conventional species. In the case of non-conventional products there is need for finding new channels both in the internal and external markets. With the realisation of its potential, it is urgent that coastal aquaculture is taken up on priority basis not only from the standpoint of increasing production but also for its strategic importance as means of employment and as one of the tools for the development of the coastal sector.

PROBLEMS AND PROSPECTS IN COASTAL AQUACULTURE IN GUJARAT

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Gujarat has about 0.376 million hectares—next to West Bengal—of coastal saline swamps. large parts of it are found to have good potential for brackishwater aquaculture. If these areas are converted into fish farms, taking a very humble rate of production of 400-500 kg/ha to begin with, it would be possible to produce about 150-180 thousand tonnes of additional fish annually. With this in view, a pilot collaborative project on aquaculture was undertaken by the Department of Fisheries and M/s Tata Chemicals Ltd., Mithapur, at Arambhada salt condensors. The results have been encouraging and have been discussed by Chhaya *et al.* (MS). From 1976, the Marine Biological Research Station, Okha has surveyed major parts of Saurashtra peninsula and Kutch District for the development of brackishwater fisheries in the state. The places surveyed are shown in Fig. 1.

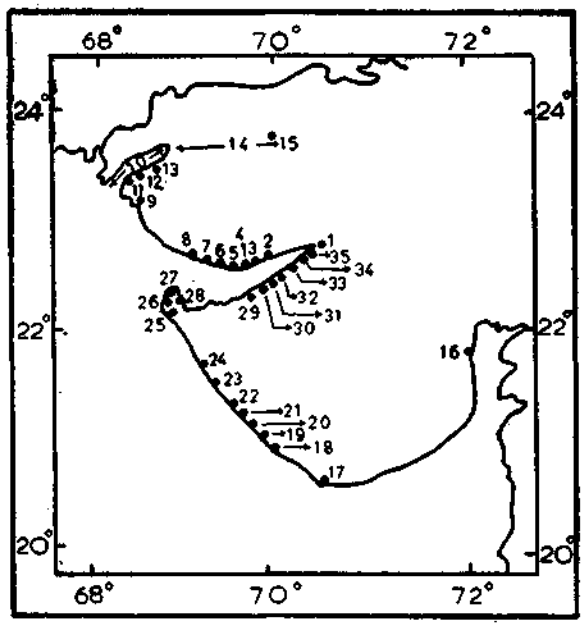

Fig. 1 Map of the areas surveyed for coastal aquaculture in Gujarat. Kutch District: (1) Surajbari, (2) Kandla, (3) Tuna, (4) Bhadreshwar (5) Mundra, (6) Zarpara, (7) Nana and Mota Laeja, (8) Mandvi, (9) Jakhau, (10) Korinar, (11) Koteshwnr, (12) Narayan Sarovar, (13) Lakhpat, (14) Bunny and (15) Khavda; Saurashtra region: (16) Sultanpur, (17) Madhvad, (18) Veraval, (19) Mangrol, (20) Mangrol Bara, (21) Shil, (22) Gossa Bara, (23) Porbundar, (24) Harshad (Miyani), (25) Dwarka, (26) Mithapur, (27) Okha, (28) Arambhada, (29) Sikka, (30) Bedi, (31) Rozi, (32) Jodiya, (33) Malia, (34) Vavania, (35) Navalakhi.

POTENTIAL AQUACULTURE SITES

Among the places surveyed, the following look potentially suitable for establishment of brackishwater aquaculture farms.

Mundra : Mundra (Fig. 1, site 5) is at the southernmost point of Kutch district. There

are no permanent fishermen residents here, but fishermen of Luni, Bhadreshwar and Jalapura camp at this area for fishing. The area is distinguished by the presence of thickly populated extensive 'Cher' (mangrove) land. It functions as a protective barrier against wave action. The area between the old port and new port is flat and water covers the entire spread during high tide. The soil is muddy and clayish.

A project for aquaculture has been sanctioned in 1977 under Integrated Rural Development Programme for establishing a 25-hectare fish farm. Over thousand hectares of suitable land is available around this which could be converted into small fish farms by fishermen who could be trained at Mundra farm.

Seedlings/adults of *Mugil* spp, *Lates calcarifer, Penaeus indicus P. monodon, P. semisulcatus, Metapenaeus brevicornis, M. monoceros,* and *M. kutchensis* have been collected from this area.

Vavania: Vavania (Fig. 1, site 34) is 6 km away from Dahisara. Vast muddy areas are lying idle near the salt works. Mangroves are scattered.

The Vavania Fishermen Cooperative Society has established for the first time in Gujarat's conventional brackishwater prawn culture farm, applying the principles of 'bheris' of West Bengal and paddy-cum-prawn fields of kerala. The Society has earned about Rs. 75,000 this season. This area presents good potential for the collection of prawn and fish seed and farming.

Seedlings/adults of *Metapenaeus kutchensis* and *Palaemon styliferus* have been collected from this area.

Jodiya: The site (Fig.1, site 32) is near the new port and is approximately 4 km north of jodiya village. It is demarcated by a jeepable earthern reclamation bund, leading towards Navalakhi, from the intertidal area. Westward, near new port, there is an estuary of Und river. There is a small check dam on Und river near Jodiya. A small creek of 2-3 km (Jodiya creek) connets the gulf and new port area. On the light side of channel, there is a thicket of mangrove on mudflat.

The entire area (72 sq. km) of proposed site has an almost even muddy bottom. During monsoon, the site is covered by freshwater, discharged by the rivers Aji and Demi. Brackishwater conditions lasts up to March. As soon as the farm at Jodiya is operational, fishermen could be trained and could be alloted fish farm sites. The Central government has sanctioned a project on brackishwater fish farm development at Jodiya.

Seedlings/adults of *Tilapia mossambica, Mugil dussumieri, M. tade, M. parsia, Polynemus tetradactylum, Metapenaeus kutchensis, Penaeus indicus, Barbus sarana, Puntius stigma, Chela bacaila* and *Mystus vittatus* have been collected from this area.

Arambhada: Arambhada (Fig.1, site 28) in Okhamandal Taluka forms the north-westernmost part of the country. It has the Arabian sea on its west and north-west side and the Gulf of Kutch on the east and north-east side. Arambhada condensors are modifications of Netar creek, and belong to M/s Tata Chemicals Ltd, Mithapur. There are ten condensors, having salinity range from 33 - 100‰. Condensor No. 1-5 have a salinity range of 33 - 45‰. A portion of condensor No.1 of above 3 ha was modified into fish farm with four nurseries and two stocking ponds where mullets, milk-fish and prawns are being reared. Extension of farm is in progress. The production is about 250 kg/ha/month during season.

Seedlings/adults of *Mugil cephalus, M. seheli, M. parsia, M. tade M. waigiensis, M. connesius, M. macrolepis, Chanos chanos* and prawns have been collected from this area.

Dwarka : An area of about 22 ha is available near Rupen port, about 1 km from Dwarka Town (Fig. 1, site 25). It is well protected on three sides. Seawater enters by gravitational force into the creek area. Towards east, there are a number of dwarf, scattered mangroves. During 1977, about 24,000 mullet fingerlings were collected from this area.

Seedlings/adults of *Mugil cephalus M. seheli, M. parsia, M. waigiensis, M. connesius, Aphinus dispar, Sillago sihama,* Perches, *Penaeus* sp. and *Metapenaeus* sp. have been collected from this area.

Harshad : (Miyani Creek) : Miyani creek (Fig. 1, site 24) is in Junagadh district. It is 37 km from Porbundar. The creek is about 8 km

in length and 2 km wide. The entire area is muddy and in the centre of creek there is a deep channel. Rivers Vartu, Sorthi and Santu meet this creek. The north-west side is muddy and protected. The bank of the creek is cemented by dwarf mangroves. The potential area for fish farming is covered by water during high tides,

Seedlings/ adults of *Penaeus monodon, Penaeus* spp. *Mugil* sp., *M. cephalus* and *M. parsia* have been collected from this area.

Madhvad: From the open sea, Madhvad creek (Fig. 1, site 17) enters the shallow area and divides into two branches, each having more than 60 ha area which could be developed for brackishwater fish farm. The area is about 16 km away from Kodinar in Amreli District and is well connected by road. This backwater area receives rain water in the monsoon but no flooding is reported. During low water, the channel has about 2 to 4 feet water. Nature on bottom is muddy.

Seedlings/adults of *Mugil* sp., *Pellona* sp. and prawns have been collected from this area.

Sultanpur: Setrunji estuary is located near Sultanpur village (Fig.1, site 16) of Bhavnagar District and opens into the Gulf of Cambay. It is 70 km away from Bhavnagar and 4-5 km from Talaja. The area is muddy with thickets of mangroves The State Government is developing a brackishwater farm here

Seedlings/adults of *Penaeus indicus, P. canaliculatus, Macrobrachium rosenbergii, Metapenaeus monoceros, M. brevicornis, Parapenaeopsis sculptilis, Palaemon styliferus, Mugil* sp., *Polynemus tetradactylum* and mudskipper have been collected from this area.

PROBLEMS

Bionomics of prawns: Considerable amount of data on bionomics of commercially important, species of penaeid and non-penaeid prawns have accumulated. However, information on species such as *Metapenaeus brevicornis* and *M. kutchensis* are not available and such studies have been undertaken.

Seed production: There are no data on seed availability for culturable species like mullets, milk-fish, prawns etc. in Gujarat coastal waters. The Marine Biological Station has undertaken a seed resources survey along the coast. It has also been decided to concentrate on breeding and rearing of euryhaline fishes like prawns mullets, milk-fish etc.

Engineering aspects: The higher tidal amplitude, higher gradient of coastal lands and the influx of flood waters are some of the major problems in developing coastal aquaculture in Gujarat. The State Fisheries Department has created an Engineering Cell which will work with the biologists on farm engineering.

Technical personnel needs: At present there are only a few qualified / trained personnel to handle these projects. With the increasing role of brackishwater fisheries in Gujarat and keen interest evinced by a large number of industries, fishermen and private entrepreneurs in brackishwater culture it will be necessary to quickly create a cadre of trained scientific, technical and engineering at different levels. It will be necessary for the Department of Fisheries of Gujarat to start short- term and long-term training courses to meet this requirement.

Pollution problems: At present most of the potential sites are located away from industries. However, enough care and caution will be taken to ensure that the effluents of even distantly located industries do not cause harm to the seed collection site as well as the fish production programme. This may also need adequate legislative measures.

Administrative aspects and public relations: While acquiring the sites for aquaculture, there are certain administrative difficulties. Public acceptance of the programmes also needs equal attention.

SCOPE

Extensive literature on brackishwater 'bheries' in West-Bengal and paddy-cum-prawn culture in Kerala, and recent developments in brackish-water fish culture is readily available and has helped to develop the base of coastal aquaculture in Gujarat. The initial expenditure such as acquisition of land, construction of farm and management is low compared to future returns. The capital cost on construction of farm could be minimised if the marshy kharlands, lagoons

etc. are utilised conventionally. It is a happy augury that even in this beginning stage of the coastal aquaculture programme, large number of industries, private entrepreneurs and fishermen have shown keen interest in the programme. This will have to be sustained.

Gujarat coast line is stringed with large number of marine salt works which take up a total area of about 90,000 acres of coastal land for salt production. These salt works have a series of condensors through which seawater passes with increasing concentration of salinity, resulting in final formation of salt. The first few condensors in each of these salt works have salinity conditions which are suitable for aquaculture, particularly for prawns, mullets and milk-fish and also for monoculture of marketable fishes like *Lates calcarifer*. As discussed before the Marine Biological Research Station, Okha has successfully proved the potential and possibilities of utilising such areas for fish culture at Arambhada. It is hoped that if the first 15-20 thousand acres of these salt works are fruitfully utilised for aquaculture it could contribute towards the production of 6-10 thousand tonnes of fish. This will add to their economy without appreciably interfering with their inputs. It will also provide employment for about 3000-5000 unemployed youths and under employed fishermen.

Gujarat waters are rich for marine fishery resources. There is a well-established fishery of mullets between Navalakhi and Okha, and Dwarka along Kathiawar coast. Gulf of Kutch has rich prawn grounds. Surajbari area is well known for its monsoon prawn fishery. Adult and mature milk fish have been reported to occur in the salt water condensors (Panicker and Menon, 1972). According to Narayan and Buch (1976), availability of *Chanos* fry on large scale is notable. During resource surveys in the Gulf of Kutch and adjoining areas areas abundant wild stocks of prawns, mullets and other cultivable species were noticed.

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SESSION IV

TECHNOLOGICAL BASE FOR INTEGRATED RURAL DEVELOPMENT

Keynote Address

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For the last three decades our developmental efforts in marine fisheries have been towards increasing production in the capture fisheries, rightly so in view of the vast resources in the coastal waters and the continental shelf which remained to be exploited and the base for development was available in the form of the traditional fisheries. Therefore, our research efforts were also aimed in that direction. The Seventies has been a significant decade in the sense that, on a global basis, there has been a shift from the thinking that capture fisheries could be depended upon for a steady increase in production to the realisation that aquaculture has immense potential for development after witnessing the stagnation of world fish production around 69 million tonnes over a period of three or four years. In India, too, we are passing through a stage of such stagnation in the marine capture fisheries with a production of around 1.3 million tonnes during the last three years. Although the Exclusive Economic Zone has good prospects for increasing production the efforts would be concentrated at a few centres in view of the sophisticated technology and high capital costs involved.

Coastal aquaculture as an additional vocation

Therefore, aquaculture in the coastal areas and the contiguous brackishwater bodies would form an important component in our future plans and programmes for the development of fisheries. Coastal aquaculture is highly suited for the social and economic conditions prevailing in the coastal zone to put to use the unutilised and underutilised water areas for increasing production and provide employment opportunities to thousands and would lead to a balanced develoment of the coastal economy in view of the decentralised and spread effect coastal acquacultur would have.

We are aware of the despendent conditions of our fishermen community. The only profession they know of is fishing. Lack of additional vocations has been one of the reasons for their present state of poverty. The allied occupation of coastal aquaculture would fit into their social, economic and professional setup and the blending of farming with fishing will be a solution for the economic uplift of the fishermen community. It is a happy augury that the Government are giving high priority to the programmes on aquaculture.

Present technological base

Any development involving technologies would dooend on the availabilty of a sound technological base coupled with adequate research support. Although our efforts on coastal aquaculture research has been relatively recent, we have made tremendous strides in poviding a viable technological base. This has been possible because of the right priorities fixed and the will of our scientific community. We have had successive and quick breakthrough in coastal aquaculture technologies. Breeding and culture of marine prawns, technology for production of cultured pearls, oyster farming, mussel culture and seaweed culture are the major advances made in the recent, years. We have developed the technology for the culture of eel in running freshwater system. Attempts have been made to evaluate the

potential of salt-pan reservoirs for fish and prawn production. Fin-fish culture in the coastal lagoons and in mixed farming, crab culture lobster culture and pen culture are some of the other areas where we have made considerable progress.

Most of these technologies have been tested in field conditions for their techno-economic feasibility. While some have already been adopted by the farming community others are in the process of being taken up. Transfer of these technologies is being effected through several programmes such as the Krishi Vigyan Kendra (Farm Science Centre), Operational Research Project, Lab-to-Land Programme, Demostration Projects, *ad hoc* training courses and consultancy service. Due to all these efforts, today there is a general awareness among the people of the coastal zone of the possibilities of aquaculture and this is a healthy sign for the development of a coastal aquaculture industry.

Additional thrusts for strengthening the technological base

While the scientific community can be proud of its achievements so far, there is no room for complacency. On a macro-level we have developed the various culture systems to provide the immediate technological base. But on a micro-level, there is a lot that remains to be done. Researches on the different ecosystems and their reacations and interactions should be investigated in great detail as these aspects would be the deciding factors in limiting production when we go in for large-scale operations. The warm waters of the tropics enable faster growth of the organisms and consequently yield quick harvests. But the same factor, in combination with other changes, could be deleterious causing ecological and biological changes leading to spread of diseases and growth of pests and predators. Intensive culture could cause large-scale disease problems and prophylactic and control measures will have to be developed. In the current stage of coastal aquaculture the input on nutrition is minimal. This is an area of considerable importance and appropriate nutrition technology and cheap production of feed need our immediate attention. Fish genetics is another field requiring initiation of research. The genetic potential of the wild stocks which we are introducing in culture will have to be properly evaluated, preserved and upgraded for providing better yields. The value of monosex culture should be ascertained. Physiological and endocrine control of mobility, feeding, growth and reproduction and adaptation problems need invtisegations.

An aspect of major and immediate concern is the development of hatchery systems for large-scale production of seed of the cultivable organisms at economic levels. Even at this initial stage of development we are faced with the problem of supply of adequate quantities of seed to the culturists. If coastal aquaculture has to develop into an industry production of seed will be the primary need.

Coastal farm engineering would be an area needing the involvement of engineering disciplines. The biologists have had very little interaction with this vital group so far and time has come for developing designs and construction of farms for open-sea and coastal farming for different culture systems and different areas.

Thus we realise that a multi - disciplinary approach is necessary, and it can brook no further delay, to strengthen the technological base for coastal aquaculture. The over-riding factor in the development of the industry would be the costs. We very well know that the Indian consumer cannot pay high prices for the prawns, fishes, oysters mussels etc. as his counterpart in aquaculturally advanced countries such as Japan or the U.S.A. could afford. Our technology should, therefore, be relevant to the set of conditions prevailing in India if a sustained growth of the industry is to be ensured.

RECENT TECHNOLOGICAL ADVANCES IN COASTAL AQUACULTURE IN INDIA

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INTRODUCTION

The importance of coastal aquaculture in the context of augmenting fish production, improving rural economy and productive utilisation of derelict waters was recognised only recently in India. The need for an urgent development of coastal aquaculture received further stress as certain fish stocks in the marine capture fishery indicated optimum level of exploitation, and their catch returns, despite increased efforts, showed declining trend. Following this, several national Institutes concerned with research and development of marine and brackishwater fisheries, initiated a series of investigations on the coastal aquaculture of suitable commercial organisms. The important results of these investigations, and the technological progress made in the field in recent years are presented in this paper.

RESOURCES AVAILABLE FOR COASTAL AQUACULTURE

India possesses the essential basic resources required for immediate development of coastal aquaculture. The potential coastal water area available in the country includes about 8.9 million ha of productive inshore waters for open-sea farming, and 1.7 million ha of estuaries, backwaters, brackishwater lakes and swamps. A variety of suitable fishes, crustaceans molluscs, seaweeds and other marine organisms, possessing high reproductive capacity, short larval development, fast rate of growth, and physiological features to adjust to wide changes in the environment are available in our coastal waters. For immediate establishment of culture fisheries, adequate seed resources of the cultivible species are also available. As the active fishermen engaged in the coastal fisheries form only 21 per cent of the total marine fisher population in the country, there are large number of unemployed and under employed fishermen who could adventageously take up coastal aquaculture.

RECENT ADVANCES IN COASTAL AQUACULTURE TECHNIQUES

As the entire marine fish production and the bulk of the brackishwater fish catch of our country are realised through the capture fisheries, the main emphasis of research and developmental activities has so for been in this field. Except for a few isolated studies and experimental and pilot-scale projects taken up by the Fisheries Departments of certain maritime states, there have been no detailed investigations or concerted efforts to develop coastal aquaculture until recently. However, following the recognition of the potentials in the field, its importance and the high priority assigned to its development, several intensive research programmes have been taken up during the last seven years. Most of these investigations are centred around the culture of prawns, lobsters, crabs, mussels, pearl oyster and pearls, edible oysters, clams, fin fishes and seaweeds because of their commercial importance.

Prawn cultura

Researches on the culture of prawns are being mainly carried out at the Central Marine Fisheries Research Institute, the Central Inland Fisheries Research Institute, the National Institute of Oceanography, the Central Institute of Fisheries Education, the Konkan Krishi Vidyapeeth, certain Universities and by the All-India Coordinated Research Project on "Brackish water prawn and fish culture". The investigations are mainly directed towards developing an indigenous technology of large-scale culture of prawns on scientific lines. The techniques of breeding and rearing of larvae of the commercial penaeid prawns, namely, *Penaeus monodon, P. indicus, P. semisulcatus, P. merguiensis, Metapenaeus dobsoni, M. monoceros, M. affinis M. brevicornis* and *Parapenaeopsis stylifera* under controlled conditions have been developed. Laboratory experiments on mass production of seed of certain species such as *P. indicus* and *M. dobsoni*, up to stocking size have given encouraging results with a survival rate above

40%. These are accomplished by the knowledge accumulated over the years on the biology of these species and their ecological requirements, and the techniques evolved for the culture of suitable species of diatoms, the brine shrimp *Artemia salina*) and zooplankters, which form the food of larvae and postlarvae. Field experiments on the culture of selected species of fast growing prawns such as, *P. indicus* and *P. monodon*, have shown that they attain marketable size within 3½ to 4 months. Surveys carried out on the prawn seed resource have enabled to locate several grounds in the estuaries, backwaters and surf regions and to know about their availability and seasonal abundance, particularly along Tamil Nadu and Kerala coasts. Suitable gears to capture the prawn seed have also been developed.

The most significant result of research recently recorded, is the domestication of two marine penaeid prawns, namely, *M. dobsoni* and *P. mondon* in the brackishwater. In that medium, these prawns have been successfully grown, and they attained maturity and spawned viable eggs. Induced maturation and breeding through ablation technique have been achieved in the case of *P. monodon*.

Considerable progress has also been made on the experimental culture of the commercial palaemonid prawns, *Macrobrachium rosenbergii M. malcolmsonii* and *M. idella*. Studies conducted at the Central Inland Fisheries Research Institute have shown that the berried *M. rosenbergii* could be obtained at any time of an year, and their larvae could be reared on compounded diets, plankton raised in the laboratory, pieces of *Tubifex* worms or egg custard. The young prawn grows well in fresh water ponds and reaches a size of 200 to 250 mm in one year.

The larval development of *M. malcolmsonii* has been studied. Natural seed grounds of the species have been located in the rivers Godavary and Mahanadi. Field culture experiments have indicated a production rate of 285-300 kg/ha/year. Techniques of rearing of larvae of *M.idella* have been developed and perfected, and it has been shown that the species can be maintained over generations under controlled conditions.

The technical feasibility and economic viability of intensive culture of *P. monodon* and *P. indicus* have been established. A simple technique which could easily be adopted by the small farmers with advantages of better production and higher income, has been evolved; and it is based essentially on selective stocking, culturing for longer duration and better management of the culture system. The production of prawns by adopting this improved technique could be increased by 3 times over that obtained from the traditional culture practice, and the value by 4.5 times, Besides the congenial estuarine and brackish water areas, fallow ecosystems such as the canals in between the bunds in the coconut grove and the salt pans in the coastal areas could also be utilised for productive prawn culture.

Lobster culture

Although isolated experiments on the breeding of the spiny lobsters (*Panulirus* spp.) and rearing of phyllosoma larvae were conducted earlier in our country, directed research on lobster culture, particularly on *Panulirus homarus* was taken up only an year back at the Field Laboratory of the Central Marine Fisheries Research Institute at Kovalam, near Madras. Techniques of collection of pueruli that migrate into the coastal waters, by special collectors have been developed. The young ones of lobsters thus collected are reared in the laboratory. The results of these experiments have indicated that the young lobsters of 35 mm carapace length grow to a size of 57-58 mm carapace length in about 15 months and that they reach marketable size in 18 months. During this period of growth in the laboratory both males and females attained maturity and mated. Subsequently, the female released the eggs on to their pleopods, where the eggs underwent further development and hatched out into free swimming phyllosoma larvae (Radhakrishnan, MS). Encouraged by this result, intensive studies on the controlled breeding and rearing of phyllosoma larvae are in progress.

Crab culture

Among the edible crabs occurring in our country, ths most suitable species for culture is the green crab, *Scylla serrata*. The species grows to a size of 200 mm across carapace and is available in the estuaries and backwaters all along the coast. It can withstand wide ranges of salinity from almost fresh water to that of sea

water. The culture experiments carried out on the species involve collection of seed crabs from the wild and growing them either individually in baskets which are arranged in rows in the field or in cages, each containing a few crabs. They are fed with the easily available trash fish. These experiments have indicated that the young crabs grow at a relatively faster rate of about 12–15 mm carapace length per month.

Mussel culture

Great strides have been made in the technology of culture of both the brown mussel (*Perna indica*) and the green mussel (*P. viridis*) since 1971 when the Central Marine Fisheries Research Institute started researches on the subject. Mussels can be cultured in protected inshore waters either by raft culture method using ropes in 10-20 m depth zone, or on poles in shallow areas. In the raft culture method, the ropes (12-20 mm thick) are suspended from the floating raft during the breeding season (July-November) so as to facilitate settlement of mussel seed on the ropes or collection of spat from the natural source for transplantation to the ropes. Seed mussels (20-30 mm size) are transplanted by arranging them around the ropes and covering with a mosquito netting which gets disintegrated in about a week's time within which mussels get attached to the ropes. Open-sea farming experiments on the brown mussel carried out at Vizhinjam, and on the green mussel at Calicut have shown a production rate of 150 tonnes/ha/year and 235 tonnes/ha in 5 months respectively. Further studies on the economic viability of large-scale culture of mussels and on the problems associated with it are in progress.

Pearl oyster and pearl culture

One of the remarkable contributions made to promote mariculture in our country, is the successful development of an expertise on the techniques of production of pearls under controlled conditions. Researches leading to this achievement were started in 1972 at the Field Laboratory of the Central Marine Fisheries Research Institute at Veppalodai, near Tuticorin. Pearl oysters (*Pinctada fucata*) collected from the natural beds are cultured by the raft culture method. The techniques of pearl culture involve conditioning of the pearl oyster in the laboratory, careful operation for grafing a piece of mantle in the gonad or hepatopancreas region of the oyster, implantation of suitable nuclei, transfer of the operated oysters to the rafts in the inshore sea for post-operative culture, and regular monitoring of the growth of the pearl.

Average production of pearls in the experiments conducted so far is found to be 60-70%. The time required to obtain pearls of 3 mm to 8 mm size, varies from 3 to 18 months. Multiple pearls in individual oysters have also been obtained. Tools required for the surgery have been fabricated indigenously. The nuclei developed locally from the conch-shell wastes have been successfully employed to produce pearls of good quality. The current research programmes on the project mainly relate to the investigations on the problems of commercial-scale culture of pearls and pearl oysters and the economics of pearl culture.

Edible oyster and clam culture

Hornell, in 1910, made some efforts to culture edible oysters at Pulicat in Tamil Nadu. Subsequently, experiments on transplantation and rearing of *Crassostrea gryphoides* were also carried out in Maharashtra. However, directed research on the culture of edible oysters, particularly *C. madrasensis*, was initiated only recently at Tuticorin. Techniques of collection of spat from the wild on different kinds of material such as lime coated tiles, oyster shells and empty coconut shells and growing them by rack and long line culture methodts, on poles as well as in trays are being developed. Investigations on the abundance of spat in space and time and on the breeding of oysters under controlled conditions are progressing.

Very little information is available at present on the culture aspects of clams occurring in our waters. As they form an important group that can advantageously be cultured in the estuaries and backwaters, pre-farming studies on the biology and ecology of the commercial backwater clams, and preliminary experiments on their transplantation and field culture have been taken up by the Central Marine Fisheries Research Institute at Kakinada and Mangalore.

Fin fish culture

Although several fin fishes such as mullets, milkfish, pearl spot and perches suitable for

culture in the coastal waters are available, there is no organised farming practise for these fishes in India. The existing salt-water fish culture forms only a part of the traditional brackishwater fish culture prevalent in Kerala, West Bengal, Karnataka and Goa. In the commercial culture of mullets in West Bengal and the mixed culture of milkfish, mullet and pearl spot in Kerala, the producton has been found to be very low due to poor management of the culture operation. However, considerable progress has been made abroad on the marine and brackishwater fish farming by adopting the modern techniques of pond management, feeding and monitoring of stocked fishes A production of over 4 tonnes/ha/year has been obtained in the commercial mullet culture in Taiwan and Hong Kong and in the milkfish farms in Indonesia, philippines and Taiwan. Realising the great scope for salt-water fish farming, a series of experiments are now being carried out in different parts of the country. Surveys are being carried out on the seed resources of cultivable fishes to locate seed grounds and to understand their seasonal abundance. Field experiments have shown that the milkfish fry (4.5 cm size) grow to marketable size of 45 cm in about 4½ to 5 months.

Since 1971, studies on the culture of the eel, *Anguilla bicolor*, are being carried out at Mandapam Camp. The eels breed in the sea and their larvae (Leptocephali) after metamorphosis into elvers immigrate into the rivers. During this process, they are caught by dip nets, scoop nets and by the specially designed net called the 'elver net'. The elevers can be cultured in running water tanks. Several collection grounds of elvers in the river mouths along the south-east coast have been located. Elvers grow very fast under controlled conditions and attain marketable size of about 35 cm (106 g) at the end of an year. They feed on fish and clam meat. A pilot project covering survey of elver resource, collection of elvers and transportation, export of live elvers and culture of elvers to eels, is being implemented by the Central Marine Fisheries Research Institute at Mandapam Camp with the financial assistance of fhe Marine Products Export Development Authority.

Another fish which has great potentials of culture in the Karnataka State is the sand-whiting, *Sillago sihama*. The species grows to about 200 mm in seven months. Its seed occur abundantly in the estuaries of all the major rivers of Karnataka.

The ongoing experiments in fin fish culture are mainly directed to induced breeding and pond culture of mullets, milkfish, pearl spot and *Sillago sihma*.

Seaweed culture

The seaweeds such as the species of *Gracilaria*, *Gelidiella* (which yield 'Agar'), *Sargassum* and *Turbinaria* (which produce 'Algin') can easily be cultivated in the near shore waters. The techniques of seaweed culture are simple. A mat or a frame of coir ropes is fabricated and it is tied to wooden poles in the coastal waters. Fragments of seaweed *G. edulis* are planted in the twists of the coir ropes. The growth of the seaweed is carefully monitored, particularly by preventing their grazing by the herbivorous fishes and other animals.

Recent experiments on the field culture of *G. edulis* and *G. acerosa* have shown an yield of about 3-5 kg fresh harvest from an initial seed material of 1 kg within 80 days and that about three harvests could be taken in an year. In *Sargassum*, a growth of 37-52 cm from an initial plant height of 10 cm has been recorded within forty days of culture. Studies on the economic viability of largescale culture of seaweed are carried out from Mandapam Camp.

Polyculture

Combined culture of compatible species of prawns and fishes is gaining considerable importance in the context of augmenting yield from the field and effective utilisation of the available ecological niches of the pond system. Polyculture techniques involve selection of suitable species for combined culture on the basis of their feeding and behaviour characteristics, determination of the proper stocking rate of different species, pond management with correct manuring and fertilisation and monitoring of the growth of the stocked animals. Recent experiments on polyculture of the mullet, milkfish and *P. monodon*, and the milkfish and *P. indicus* at Kakdwip have shown a total production of 1463 kg/ha/7 months and 2196 kg/ha/6 months respectively. But relatively low production has been recorded in similar experiments conducted from the other centres along

the coast. Intensive studies are, therefore' essential to perfect the techniques of polyculture, especially in the dynamic environment of the coastal waters.

Integrated farming of crop livestock-fish and prawn

A synergic system of farming of crop-live-stock-fish/prawn in an integrated manner is another field which is gaining a great deal of attention in the recent years. In India, there is already a well-established traditional practice of paddy-cum-fish/prawn culture in the seasonal fields of Kerala, Karnataka and Goa. Further, it has recently been established that the prawns and the salt-water fishes can be cultivated in the canals of the coconut groves. However, coor-dinated resarch on this system of farming which requires knowledge of different subjects, is necessary to establish it on scientific lines and to tackle the problems involved in it.

REMARKS

From the foregoing brief review, it is evident that valuable data/information on the culture of several organisms are now available or are being gathered rapidly. Basic technologies have also been developed to start immediately intensive commercial culture fisheries for prawns, mussels, pearls and seaweeds. These techniques can easily be adopted by the fish farmers as they are simple and neither require huge investment nor great skill.

Having the basic information and the technology, the time is opportune now to take the results of research to the field. In order to transfer the technology developed in the laboratories and to demonstrate the technology and economic feasibility of culture operation, operational research projects / demonstration, programmes are being taken up on prawn, mussel pearl, edible oyster and seaweed culture from different centres. Further, training of fish farmers as well as the developmental and managerial personnel on the above culture systems is also offered. Although, these measures would considerably help to promote the coastal aquaculture of our country, an integrated approach involving the R & D pro-grammes as well as the active participation of the planners, administrators, financial agencies, and the fish farmers is essential for its rational development.

SMALL-SCALE FISHERIES DEVELOPMENT PROJECTS AT MUTTOM, KANYAKUMARI DISTRICT - A CASE STUDY

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INTRODUCTION

At the extreme south of Tamil Nadu, the Kanyakumari District has a coastline of 45 km and a high density of fishermen (1000/sq.km) settled in crowded villages which are distributed almost one per km. Fishermen do not own land but put their hut on the seashore on surveyed land commonly owned. Ninety percent are indebted at different degrees and dowry is a rule at the time of marriage.

The main part of the coast faces the Arabian Sea and each village depends mainly on the fishing grounds which are normally restricted to the strip of sea facing it. The traditional fishing craft is the catamaran.

In the recent years the fishermen have been moving out of their villages and are now found all over the west coast up to Karnataka and along the east coast up to Paradeep. Many of them are manning mechanised boats on wages, but a few as partners. During the lean season January to June, till now as a rule, no trawler is allowed to operate close along the shoreline. As there is no harbour facility nearby, this rule is enforced by seizure of catches when landed.

During the fishing season, many species are caught from August to November. Fish is auctioned on the shore itself and sent by cycle to interior markets. Prawns, lobsters, and recently, cuttlefish are collected by agents on behalf of Kerala based companies, which send their insulated vans to provide ice and take delivery of the products. Surplus landing are normally auctioned at a very low price and sent by lorries to distant markets to be dried or turned into manure. A few species like 'nettoli' (anchovies) are salted and dried by local fisherfolk and sold to a few merchants who export them to Sri Lanka via Tuticorin. Thirtyfive miles south of the coast lies a very rich fishing ground, the Wadge Bank, which is not fully exploited at this moment.

REVIEW OF PROGRAMMES AND ACTIVITIES OF THE INDO-BELGIAN FISHERIES PROJECT

Started in 1968, at Muttom, the Indo-Belgian Fisheries Project (IBFP) was active till 1973 in three main fields, namely 1) Introduction of nylon nets; 2) Mechanisation of catamarans; and 3) Test of beach landing crafts.

1. *Introduction of nylon nets*

Introduced first in Periakadu, and manufactured in Cape Comorin centre, the Nylon nets have today practically replaced cotton nets except the bell-shaped net "Thattumadi". Since 1968 twelve centres have been organised along the coast, employing 1200 women offering improved wages and non-formal education. All these centres were supplied with Nylon twine at factory price and nets were made under the direct supervision of the fishermen. As nets are acquired piece by piece, this results in a saving-cum-productive investment An initial trial of giving 50 nets on loan basis has been a failure.

Nylon net making is a cottage industry in the district. Some 30,000 women are engaged in webbing nets at home. Their livelihood has been threatened recently by the licensing of a few Japanese webbing machines. Coastal people agitated against this decision and the Government has promised to shift the machines to places where net webbing is not home made. However, the struggle of the local people is not ever.

Mechanisation of catamarans

The IBFP imported with the help of Government of India 100 out-board motors (Evinruda 18 HP powered by petrol and kerosene). One hundred fishermen, each owning a big catamaran and a set of nets received special training of 3 weeks duration. Out-board motors had to be brought back to the Project workshops daily where they were given free cleaning in fresh water to prevent blockage of cooling system by salt deposits. A scientific survey of 50 mechanised and 50 non-mechanised catamarans revealed that in one year the gross income of mechanised catamarans was 3 times higher than that of non-mechanised ones and the net income was nearly double (1971-72). This success was attributed to the greater mobility of the fishing craft and the excellent prawn catches of that year. But very soon coast of repairs began to increase, petrol prices soared high and prawns were also not so abundant in the fishing grounds. The fishermen, one after another, stopped paying for repairs and were waiting for better times. However the project had to repay the loan of Central Government and therefore had to put pressure on the fishermen. The latter, in return, started considering the project as an interference and stopped gradually their cooperation. A few of them managed to dispose of their engines mainly to fishermen outside the district. The outboard motorisation lasted 3 years and the approach needed a fresh look.

Evaluation : The experiment was *technically* sound. Motors proved useful and profitable. Maintenance of motors and training of Indian Technicians were very good. Spare partes were in regular supply eventhough more and more difficulties cropped up in importing them. But the fact was that motors were no more used after 1972. The reasons for the failure are as follows: i) The project was partly staffed with foreigners and funds were coming from abroad. This created false expectations among the fishermen. For the same reasons, while technically excellent, the Project could not take into account the social structure of the village and the marketing system. ii) Motors have been issued free, but customs duty had to be recovered. This job gave a hard time to the Project staff and the relationship between the Project staff and fishermen soon deteriorated. iii) Mechanisation of fishing operation implies a basic change in the

pace of activity. Fishermen operating non-mechanised crafts work less during "peak season", cover their needs and enjoy life. It is the time for social functions (marriage season), entertainment and pilgrimage. But during the "lean sesaon" these fishermen work very hard to earn a few rupees needed for their sustenance. Mechanisation requires a different attitude. Qne has to work hard during "peak season" to have good returns for the capital invested, but all activities may be stopped during the "lean season" due to the recurring expenditure on fuel etc. It is not fair to say that all fishermen cannot adapt themselves to a new rythm. Quite a few from Muttom accomplished it and managed to get boats from Government and are now really doing well. iv) Mechanisation of catamarans no doubt offered greater mobility, but fishermen failed to use the machines judiciously and economically. The use of sails was dispensed with even when wind was favourable. They seemed to enjoy the "power at your fingertip". v) Other technical reasons must be also pointed out: (a) The steep rise in the cost petrol and 2 T oil; (b) the increase in the consumption of spare parts and their high cost (c) the 18 HP motors were too powerful as they propelled catamarans at 16 knots, overtaking mechanised boats. In fact technicians had to adjust the carburettors to reduce the speed from 5000 to 3500 RPM so as to reduce fuel consumption and premature condemnation; and (d) the decline in prawns catches.

Conclusion: The failure of the experiment cannot be attrlbuted to any single factor but to a set of negative factors as enumerated above. Moreover the experiment did not expand much because few places have such easy access to sea as Muttom and surf crossing remains a problem for all mechanised catamarans. Technical dependence for skill and equipment was a major handicap. Technical success is not social acceptance. Unforeseen developments require critical evaluation and flexibility.

3. *Test of beach-landing crafts*

In a country where fishing harbours are few in number, it is normal that surf landing crafts are in great demand. The Indo-Norwegian Project worked first on that line and finally turned to keel boats and protected harbour in Neendakara backwaters. The IBFP worked on testing two types of beach-landing crafts at Muttom.

21 ft flat-bottom dories: The IBFP acquired a few beach-landing crafts, 21' flat bottomed imported dories equipped with 2 cylinders 15 HP diesel engine and retractible propeller. Imported by a Madras based project, they were found to be of iittle use there but proved useful in the hands of Kanyakumari fishermen who appreciated the low fuel consumption of the diesel engine. Five boats were issued on hire purchase against and initial deposit of 1/5th of the value.

They were operated off the west coast and lasted for 5 to 7 years with different fortunes. Afterwards two have been rebuilt in 'Aini' and given a new lease of life. The others have been condemned and their engines provided the necessary spare parts for the two rebuilt ones. Indigenous engine (Ruston YWAM) has been tested on a bigger model of 24 ft boat built at Tuticorin and found suitable.

24 ft surf-crossing beach boat: In the meantime IBFP got 24' surf crossing beach boat (FAO design) equipped with out-board motor. Built in Cochin with indigenous marine plywood under FAO supervision, this boat demonstrated brilliantly her surf-crossing abilities in Muttom beach with the FAO surf-crossing device (long rope fixed in the sea by 2 anchors and by firm attachment on land). Manned by local crew under a Canadian master fishermen, the boat went on fishing up to the Wadge Bank and recorded bumper catches which provoked riots of the local population, accusing the Project of emptying the fish wealth of the sea. The surf-landing device was destroyed and the boat was put into inaction for a while. After a few weeks, she was sent to Cochin to be fitted with a Kirloskar diesel engine and was operated there for the last 5 years. She needs fibreglass sheeting to get a new lease of life as wood-borers have affected plywood hull.

Conclusions: i) The two types of boats experimented by the IBFP proved useful as gillnetters. They demonstrated the superiority of the diesel engine in terms of low recurring expenditure but as they have been operated mainly in Cochin waters and only seasonally in Kanyakumari coast, they really did not work as beach-landing crafts. Being open boats their range of operation is limited and they are sensitive to bad weather conditions. Only the small dories of 21 ft may be beached easily even under bad weather. Other types are heavier and thier

beaching is more difficult if the sea is very rough. Retractable propeller is a very important feature of these beach boats but it may be a source of trouble if not properly installed. ii) the hire purchase system looks very attractive and permits fishermen to get equipment with low initial deposit. But without control on marketing of the catches the regular repayment of instalments is nearly imposible. All kinds of pressure have to be applied to get a few instalments. Fishermen may have real good will, but money disappears in their hands as soon as it is earned unless some system can control the sale of fish.

REVIEW OF PROGRAMMES AND ACTIVITIES OF THE KOTTAR SOCIAL SERVICE SOCIETY (KSSS) FISHERIES DEVELOPMENT PROJECTS (FDP)

In January 1974 the Kottar Social Service Society Fisheries Development Projects (hereafter denoted as FDP) succeeded the IBFP. The nylon net webbing centres were attached to the Women Welfare Coordinator of the Social Service Society. The FDP came forward to provide maintenance and spare parts for the out-board engines and to take care of the boats given on hire purchase by the IBFP. But the main effort of the new project was turned to the following new fields:

1. the creation of young fishermen "sangams" (Societies),
2. the Boat Building Training Centre and
3. some need-based pilot experiments.

1. *Young Fishermen Sangams*

The evaluation of the working of IBFP led the organisers to have a fresh look at it. It was clear that until the marketing was put under control, no loan could ever be repaid by the fishermen and the hire purchase system will always be in difficulty. The first young fishermen sangam was started in Manakkudi in 1974, where a certain awareness had been created by the local parish priest.

The first meeting was attended by 75 fishermen. Forty were free from debts and could start selling their fish through the auctioneer. This nucleus of organisation grew in strength and resulted in organised savings to help other members to get rid of debts and enter the marketing scheme. The members marketing their catch through the sangams benefitted immediately obtaining 10 to 15% higher prices. A service charge of 2% and compulsory saving of 3% were collected. This compulsory saving is kept to build up the share capital of Rs. 300. For the first time. the fishermen clearly accounted their income. A survey of the money lenders revealed that while a few big money lenders controlled more than 25 families majority of them had hold on 10 to 20 families. The immediate result was that the merchants began to look at the Sangam as a threat to their business, and decided to suppress the Sangam's activities by all means, Including an appeal to the Bishop. As the Church is normally collecting 5% of the total catch the merchants have a strong influence on the church establishment. The merchants accused that the Sangam has put them out of business, disturbed the peace and equilibrium of the village and made the fishermen ungrateful for the help they gave in the form of loans. In fact, one has to keep this in mind that this service is real. Fishermen have no other source of obtaining cash credit in times of necessity or starvation, but they never calculate the 'cost' of this service. The Bishop after due consideration of the situation, gave his full support to the Sangam. In the mean time 35 fishermen who were members, had already taken action for getting equipments. The Banks had issued some loans on common guarantee. Repayment was enforced by the Sangam with a daily deduction of 10% of the catch. The regular repayment of the first batch of loans gave confidence to the Banks who came forward to provide loan for boats. Some Sangams have acquired boats owned in common and operate them in turn for 3 to 12 months according to their by-laws. After their turns on mechanised boats, members get back to the use of their catamarans. Three Sangams are now having mechanised boats.

Evaluation: Of the 8 Sangams started since 1974, 6 are operating and two had been wound up because the task is not so easy. Manakkudi Sangam which stood up strongly against the merchants could hardly stand internal divisions. Other Sangams benefitted from the Manakkudi struggle and grew more quietly. Members are very much interested in getting their own equipment and operating boats. Problems facing the Sangams are numerous. They must resist the temptation of closing on themselves to enjoy

their new economic status; they must resist the temptation to become money lenders themselves; and they have to rely upon themselves and not on the Social Service Society which helps to organise them. The Sangams are largely operating under KSSS which is a registered society. They are reluotant to be registered as co-operative society. Being primary societies, the sangams face the problem of competition with big business people.

Conclusion: As primary level marketing societies, sangams have an impact on the socio-economic conditions of their members demonstrating the fact that fishermen are not poor but made poor by the social system. But they need continuous encouragement, education and devoted leadership.

2. *Boat Building Training Centre (BBTC)*

Conceived as a logistic support to the Sangams for the mechanisation programmes, the BBTB provides technical training in fibreglass boat building and produces different kinds of mechanised boats.

The training is both theoretical and practical and covers two main subjects namely fibreglass technology and boat building techniques. Three batches of seven trainees each have already completed this course, majority of them were graduates, or I.T.I. Diploma holders without employment. This training course lasts for 7 months followed by one year in-service training in production. A few of these trainees got employed later in the industry. The three types of boats produced at the Centre are as follows:

i) *21 ft gillnetters*- Fitted with 30 HP Ruston or Kirloskar engines. These boats proved useful. Hull is made of fibreglass, and deck in 'aini'. The price of fibreglass boat remains higher than that of equivalent wooden boat. The advantages of fibreglass over wood are well-known one piece hull, resistance to the borers and long life; but repairs and maintenance remain a problem in remote areas.

ii) *33 ft trawlers*- Fitted with 66 HP Leyland marine engine. This boat is a fibreglass version of the CIFT 32 footer STB model. It is made of one piece hull in FRP and the deck and wheelhouse are in wood. Results are comparatively good but Sangams give preference to less costly boats with more employment possibilities.

iii) *24 ft Dori boats*- Made of marine plywood sheeted with fibreglass. This combination makes the boat cheaper. To reduce the cost of engine, one model has been introduced without gear box. The reverse gear normally used as brake is substituted by a mechanised brake placed in the propeller well. This is good enough while fishing and for keeping boats in open sea but may not be satisfactory for movement within harbours or for access to harbour. Being an open boat, the Dori is affected by heavy rains and tidal waves.

3. *Pilot experiments*

Besides the "regular" production of fishing vessels, the BBTC has also been engaged in various experiments.

A 28' FRP boat imported from Sri Lanka in 1975 has been modified to accomodate 39 HP Ruston engine unit with 3:1 gearbox. This boat, orginally a gillnetter, has also been used as seasonal trawler. Its adaptability was good but it proved costly during lean seasons.

Fishing has been conducted with 28' and 32' trawlers in Kerala and Tamil Nadu waters. This helped to study the social conditions of fishermen engaged in this kind of fishing. Experiments are conducted now to use trawlers as long liners.

Against the need of safe anchorage, a simple model of mooring buoy has been built for three 32 footers, or five 21 footers and 20 catamarans. It has to be moored in sea in Januvary 1979.

The design of a small surf-landing craft of 18' length made of fibreglass which was very successful in Sri Lanka is being developed for out-boerd motor or small diesel inboard engine with retractable propeller. A power pole based on the new model of Lombordini is also on the drawing board.

Other problems proposed for experiments are: launching device for catamarans and small boats through surf; safety lights for boats and gillnetters on ship route; simple rain coats for fishermen; substitute for alpine wood for catamarans; mechanical dryer for surplus catch of fish or prawns; hygienic solar drying methods; simple device for salvage of sunken boats; and simple radio eommunication and fish finding device for fishing on Wadge Bank.

OPERATIONAL RESEARCH PROJECT - A CASE STUDY OF INTEGRATED CAPTURE AND CULTURE FISHERIES

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INTRODUCTION

The concept of Operational Research Project initiated by the Indian Council of Agricultural Research for transfer of agricultural and related technologies to the rural areas has led to the adoption of new or improved techniques for obtaining increased production by the rural farmers. An Operational Research Project on 'blending sea farming with traditional capture fisheries' was started in April 1978, at Kovalam, a fishing village 35 km south of Madras. This is the first of its kind in the marine fisheries sector, having as its objectives:

1. Establishing the possibilities of supplementing traditional fishing with sea farming (mariculture) in order to increase production and improve the socio-economic conditions of the fisherfolk.
2. Demonstrating the feasibility of culture of mussel and other cultivable organisms such as prawns, fish, sea-weeds etc. in large scale and its economic viability by transferring the technology available with Central Marine Fisheries Research Institute.
3. Creating a sense of involvement and participation among local fishermen in this project by associating them from the initial demonstration stage itself, so that this venture becomes self generating, equipping them to take to sea farming along with their traditional fishing.
4. Demonstrating the scope for overall improvement of the socio-economic conditions of the rural area where this project becomes operative through development of infrastructure for processing, marketing and better methods of utilization.
5. Assessing the direct and indirect impact of this project in the area where it is operative in comparison to the socio-economic conditions of the project area prior to the introduction of the project.

SOCIO-ECONOMIC SURVEY

The preliminary benchmark survey conducted at Kovalam fishing village in July 1977 revealed the existence of 175 fishermen families, with a total population of 975 individuals. Out of this 75% are Hindus. and the rest Muslims The average number of persons per household is 5.5, In the population 32% are adult males who are involved in fishing activity. Womenfolk belonging to 12% of the families are engaged in avocations such as basket weaving, teaching and marketing of fish. Among the 175 families, 66.3% own boats and nets while the rest are engaged as fishing labour. Catamarans (105) and masula boats (10) are the crafts, from which hooks and lines and nets of various types are operated.

Ninety-seven per cent of the fisherfolk have their own houses. Thatched houses account for 74%, tiled houses 21% and terraced houses 2%. The remaining 3% of the fishermen families dwell in rented premises. The Government of Tamil Nadu has recently distributed 168 independent houses, each costing about Rs.4500 to those fisherfolk who lived in thatched houses and for those who did not own a house.

A wide range of annual family income from 600 to Rs.8000 has been recorded. Sixty-one percent of the families are in the annual income group of below Rs. 2000. The average annual income per house is about Rs.2055 and per capita income Rs.369.

The literates form about 21.4% of the population. Two persons had college education while the rest had studied up to elementary school level.

The fishermen belong to two communities. Pattinava chettiars are Hindus who form the main and influential group of fishermen owning large catamarans, Masula boats and nets of various types The other smaller group are Muslims who own smaller catamarans and specialise in line fishing.

All the fish caught is disposed off in the fresh condition to local merchants who include 8 Hindu women and one Muslim business man, who buy the morning and evening landings.

Hawkers who come on cycles from other places buy the fish that is landed sometime in the noon. All the Muslim fishermen give their catch to the Muslim merchant who sustains them during the off season. The Hindu fisherwomen merchants, on the other hand give an advance of Rs. 50-100 to a few catamaran owners each, as a guarantee money and all the fish brought by these catamarans are given to these women on an agreed price. If the price is not agreeable, which is a rare case, the catamaran owner has a right to sell his fish to any other person who offers a better price. There is a fish transport van which makes normally one trip to the city of Madras in the morning and returns in the evening. The women merchants with their baskets of fish use this van paying Rs. 6 per basket of 100 kg and Rs. 4 as return fare per person. The van brings ice from the city on its return journey which is used by the fish merchants. At noon when the van is not available, cycle hawkers coming from places about 30 km away buy the available fish in auction. A very small quantity is sold by the fishermen themselves in the local market. Prawns and lobsters are sold to agents of freezing and processing plants who collect them regularly.

A study of the division of sale proceeds of the fish reveals that the line fishermen and boat seine fishermen divide the entire amount equally among themselves and the boat owner. That is each worker and the owner gets one share each. In the shore seine operation 1/3 share is given to the net owner and the balance 2/3 is divided among all the participants who helped in laying and hauling the net. The gill net catch is divided into two equal shares, one share for the owner and the other divided among the workers.

This village has a Panchayat with a headman and a group of elected representatives. All problems pertaining to the village are examined by this body in detail and decisions are given. The decision of the Panchayat is binding and the fisherfolk meticulously obey it. For maintaining the activities of this group, a fee of 25 paise per bssket of fish purchased by the merchants is collected. Small amounts are also collected at weddings and social functions and fines imposed on persons who break Panchayat rulings.

Fishermen of this village get loans only when large sums of money are needed for marriage or other functions, for construction of houses and for purchase and repair of craft and gear. While a few persons take loans from money lenders at exhorbitant interest rates, these expenses are usually met from loans taken from relatives on promissory notes and also by resources mobilised through chit funds and martgaging of jewels.

TRANSFER OF TECHNOLOGY

With these basic data, and the willingness of the fishermen to participate in this programme, one hundred youths of the village, chiefly in the age group of 15 to 25, have been enrolled and grouped in batches of ten with an elected leader for each group. Two of these leaders will hold office in the managing committee of the Operational Research Project as members by turn. A managing committee consisting of scientists, administrators and village elders including a lady member was formed. Meetings, group discussions and individual contacts have been maintained continuously.

The Institute's field laboratory established at Kovalam, two years ago has developed methods for culturing mussel, lobster and prawns. The scientists of this laboratory actively take part in the transfer of technology to the fishermen in the project.

In Phase- of the programme, it was decided to introduce mussel culture to the selected fisher youth. Steps were taken to select a farm area in the depth range of 4-6 metres in the Kovalam by north of the village and just outside the present fishing zone and also off the usual navigational route. The techniques of raft culture and pole culture of mussels will be adopted for the programme.

Experiments on rope culture at Vizhinjam (Kerala) for brown mussel, and at Culicut (Kerala) and Kovalam (Madras) for green mussel, have shown that the mussel grows to the marketable size of 70 to 80 mm within six months from spat size of 15 to 20 mm, with an average weight increase of 10 kg per metre length of rope. Pole culture is being started at Kovalam for the first time.

The training of young fishermen of Kovalam in pole culture of mussels is the beginning of a series of such trainings in other fields of mariculture. A batch of 10 fishermen of Kovalam and Karikkadu Kuppam were imparted training in the identification, collection and transport (by air and rail) of fish and prawn seeds. This sort of training will pave the way for taking up fish, prawn and molluscan seed collection and distribution as a village based industry. The fishermen are also to be trained in the cage culture of fish and lobsters. The project has made a good beginning and the support and participation of the village folk has been very impressive.

RURAL AQUACULTURE PROJECT AND ITS IMPACT ON THE DEVELOPMENT OF RURAL AREAS

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INTRODUCTION

The importance of fish in the daily diet of the people coupled with an abundance of unutilised or underutilised fish ponds in West Bengal and Orissa is too well known and needs no emphasis. It was, therefore, obvious that any significant improvement in their utilisation and increased per-unit yields from these ponds would not only meet the requirements of this much needed protein food for the people but would also play a pivotal role in the development of rural economy. Equipped with the new technologies of seed production, rearing and raising of table-fish, the Central Inland Fisheries Research Institute, in collaboration with the IDRC (Canada), launched a programme aimed primarily at bringing about a transformation in the rural scene through transfer of newly developed aquaculture technologies.

The programme titled "The Rural Aquaculture Project" was initiated in 1975 in West Bengal and Orissa where the newly developed technologies were transferred by selecting two centres in each State, each centre covering an approximate water area of about 6 ha. The criteria for the selection of the centres were (i) the availability of a large number of suitable ponds in a cluster, (ii) farmers' interest in the new technologies of fish culture and (iii) possibilities of extending the impact of these demonstrations in the neighbouring villages. The location of various centres in West Bengal and Orissa are given in Table 1.

PROJECT PROGRAMMES AND ACHIEVEMENTS

Carp culture

Fish breeding and seed production : The importance of quality fish seed and its requirement in adequate quantities for prope stocking of village ponds was unknown to the fish farmers. Moreover, its nonavailability for timely stocking also posed a serious problem to many a farmer. Hence the techniques of induced breeding of Indian and Chinese major carps and controlled breeding of common carp were demonstrated to the farmers to enable them to produce the seed either individually or collectively for meeting their own requirements These demonstrations resulted in a production of 10.58 million spawn, of which 8.48 million were distributed to the farmers for rearing in their ponds under the supervision of the project staff and the remaining reared through the various stages in farmers' ponds associated with the Project.

Use of available ponds in the villages as nurseries or rearing ponds, and techniques for their preparation and maintenance were also demonstrated. A total of 0.78 million fry and 0.38 million fingerlings were produced during the course of these demonstrations, of which 0.20 and 0.04 million fry and fingerlings respectively were again distributed to the farmers for raising table fish in the project villages and their vicinity.

Production of table fish: most farmers produced fish averaging 200-300 g; fish weighing 500 g were rare in the harvests. The average annual production of these juveniles reportedly ranged from 200-600 kg/ha/yr. The farmers did not know as to how to increase the production from their ponds and, in about 99% cases, were not even aware of the new technology of composite fish culture for obtaining increased yields. The main thrust of the project was therefore on the damonstration of the technology of composite fish culture to maximise fish yields from village ponds. The importance of pond preparation, adequate stocking with fingerlings of 4-6 carp species—depending on their local availability—in definite proportions, periodic pond fertilisation and supplementary feeding were demonstrated and emphasised. The problem of fish diseases in the project area and its vicinity was considered to be of sufficient importance and given adequate attention. The farmers were acquainted with

TABLE 1. *Location of Rural Aquaculture Project Centres in West Bengal and Orissa*

Name of the State	Years		
	1975-76	1976-77	1977-78
West Bengal	1. Hanspukur (Dist. 24-Parganas)	1. Hanspukur (Dist. 24-Parganas)	1. Burdwan (Dist. Burdwan)
	2. Harishchandrapur (Dist. Malde)	2. Gaur, English Bazar, (Dist.Malda)	2. Jalpaiguri (Dist. Jalpaiguri)
Orissa	1. Bira-Hare-krishnapur (Dist.Puri)	1. Bira-Harekri-shnapur (Dist.Puri)	1. Ayatpur (Dist. Cuttack)
	2. Aska (Dist. Ganjam)	2. Aska (Dist. Ganjam)	2. Pubasan

TABLE 2. *Yearwise fish production (in tonnes) from ponds under the Rural Aquaculture Project*

Year	Names of the States		
	West Bengal	Orissa	Total
1975-76	29.23	30.70	59.93
1976-77	59.41	36.64	96.05
1977-78	40.40	1.85	42.25
Total	129.04	69.19	198.23

common disease problem and trained in methods of controlling them. Average productions ranging form 1. 2 t/ha/7 months to over 6.0 t/ha/ 10 months were damonstrated at various centres in West Bengal and 3-4 t/ha/yr in Orissa.

At Harishchandrapur and Jalpaiguri in West Bengal and Bira-Harekrishnapur in Orissa, ponds with acid soils were utilised for composite fish culture and high productions ranging from 1.2 t/ha/9 months to 3.2 t/ha/yr were demonstrated. Fish culture was introduced in Jalpaiguri for the first time under the auspices of the Project.

A total of about 200 t of table carps (Table 2) were produced involving a sale proceeds of about Rs. 1.48 million, accruing considerable benefits to the farmers, institutions and panchayats.

Monoculture of air breathing catfishes

The air breathing catfishes being of universal occurrence in ponds everywhere in West Bengal and having a high market value, it was sought to propagate their culture in small, shallow village ponds which were ideally suited for this type of culture system. Multiuse and multicropping systems were also introduced by utilising the small ponds first as carp nurseries and rearing ponds during monsoon and post-monsoon months and later from October to

December / January for rearing juveniles for domestic consumption. The same ponds were again utilisd either for production of the seed of common carp or for rearing magur *(Clarias batrachus)* or singhi *(Heteropneustes fossilis)* from December/January to May/June.

A production of about 7.3 t/ha/6 months and 4 t/ha/6 months of magur with and without water replenishment was demonstrated from ponds already utilised for carp seed production. Similarly, a production of 4.8 t/ha/6 months of singhi was also demonstrated. These high productions were demonstrated for the first time in the country under this project in West Bengal. A total of 1.5 t of magur and 0.2 t of singhi valued at Rs. 0.02 million were produced as a result of these demonstrations.

Magur as a component in carp culture

As common carp, which forms about 20% of the stock by numbers in composite fish culture and contributes about 15% to the total production by weight, is the least acceptable fish in West Bengal, except in certain areas, it was replaced by magur which is universally acceptable and has a high market value. Magur at 20,000 fingerlings/ ha gave a production of 1200 kg/ha in 4½ months whereas the carps stocked earlier in the same pond and reared for 8½ months gave a production of 1975 kg/ha. Thus it was demonstrated that magur can be introduced as a welcome component in all small, shallow village ponds with advantage both to augment production and increase income.

Training and extension programmes

While the pond-owners and other farmers in the village witnessed and participated in the field programmes, special training programmes were also arranged, one at each centre in West Bengal, for the benefit of the farmers, educated unemployed youth, school teachers and others. Two such programmes were arranged exclusively for particular groups, one for the students of the Indian Institute of Mangement, Calcutta, and the other for the Social Workers of the Socio-Economic Development Programme, Keorapukur. Advisory services wore made available to all the farmers in the Project areas and their vicinity. A total of 187 persons were trained in fish breeding and fish culture. A number of persons were initiated to participate in fish farming industry creating a class of neo-fish farmers.

IMPACT OF THE PROJECT

Seed production and increased yields from village ponds

As a result of the training and demonstration programmes, some young boys have found an avocation in collection of pituitary glands from fish markets. while only a few progressive farmers and certain organisations have been able to take up induced breeding programmes as it requires a number of ponds and properly maintained brood fish, it is interesting to note that one farmer each at Malde and Burdwan Centres has been able to breed and produce a total of 0.1 million silver carp spawn. This augurs well for the Project as about a dozen farmers are maintaining brood exotic carps and are keen to breed them.

Most farmers, as mentioned earlier, produced small fish averagnig 200-300 g ; and rarely got fish weighing 500 g in an year's time. These farmers also did not believe that the fish could attain a weight of more than 1 kg in one year and that the production could be as high as 3-4 t/ha/year. It was for the first time that fish ranging from 1 to even 4 kg in weight were obtained from the same ponds by the farmers in less than one year. In general, a ten-fold increase in the production potential of these ponds was realised by the farmers as the yields which ranged from 200-600 kg/ha/yr under traditional farming increased to 2-6 t/ha/yr under the project programme. The greatest impact of these demonstrations was that the farmers were fully convinced both regarding the fast growth of fish and possibilities of increasing the yields from their own ponds. The importance of pond preparation, proper and adequate stocking, fertilisation and feeding has been well understood by the farmers who now prepare their ponds and effect a considerable saving of the stocking material. Fertilisation of ponds and supplementary feeding, though supplied in inadequate proportions, have become a common practice. This is no mean achievement and is bound to augment the yields from other village ponds in near future.

Creation of seed demand and its trade

For the first time, a great demand for the quality seed of Indian major carps and exotic carps has been generated in the rural sector. Not

only that, demonstrations on singhi and magur culture have also resulted in the demand of their seed for the first time and a lucrative trade has already been initiated. Certain individual farmers and social organisations such as the Bratachari Society and Socio Economic Development Programme, whose workers have been trained under the Project, are helping in the spread of the technology by supplying stocking material to the farmers. These organisations purchase the fry from the Government Seed Farms and rear it up to fingerling stage in their own ponds and then sell the fingerlings to the farmers of the area for direct stocking in the ponds at no-profit-no-loss basis.

Increased earnings by farmers and panchayats

It is obvious that production of about 200 t of table-sized carps, 1.5 t of magur and 0.2 t of singhi from the project ponds valued at Rs. 1.5 million benefited the farmers and panchayats and others directly associated with it. Considering the rate of survival from spawn to fry and fry to fingerling it has been estimated that the seed distributed to the farmers also brought another 250 ha under fish culture. These fingerlings, when reared even without feed and fertiliser to attain an average weight of 200 g resulted in an estimated production of about 200 t valued at Rs. 1 million. The impact of a turn-over of Rs. 2.5 million in such a small area and in such a short time must have been great. While it has not been possible to measure it in case of individual farmers, such effect in case of panchayats in Orissa is highly noticeable. Schools, roads, hospitals have been repaired and/or built, new ponds have been dug and Harijan villages electrified.

The way has been shown and both the farmers and panchayats are now aware that increased and additional earnings could be obtained from their ponds which remained either unutilised or were always underutilised so far.

Employment potential

The Project gave employment to 32 fishermen and educated unemployed youth, especially from the backward classes, whose average income worked out between Rs. 150 to Rs. 250/head/month. The Project has also openep up new vistas of employment for the rural people who can now take to fish-seed or table-fish production and its trade. While a 'Fishermen Cooperative Society' was organised and registered at Bira-Harekrishnapur (Puri District), an 'Unemployed Young Men Pisciculture Cooperative Society Limited' was organised and registered to take up pisciculture in Jalpaiguri District. A 'Fishermen Cooperative Society' at Ayatpur and a 'Harijan Cooperative Society' at Pubasan in Orissa have been directly benefited by the Project and have become sound technically and financially. Cooperative Societies are also coming up at Aska (Dist. Ganjam) and Sanko and Nabastha (Dist. Burdwan). If organised properly these societies can easily absorb about 10 families at each centre in this trade. With an investment of Rs. 20,000 per hectare, each society with 5 hectares of water area will, even on a conservative estimate, have an yearly income of Rs. 40,000 which works out to Rs. 4,000 per family.

The income received by farmers as a result of the sale of fish produced under the project programme enabled them to repay the debts/loans, organise social functions like marriages etc. and in reorganising or expanding the pisciculture programme in ponds their own or taken on lease. The panchayats repaired/constructed roads, schools and hospitals and electrified villages. An interesting feature of the programme is that the farmers now utilise rice bran and cowdung available with them for raising fish, bringing about an integration of agriculture and livestock with fish culture. Cabbage and cauliflower leaves, which were mere wastes so far, are utilised for feeding grass carp.

The generation of self-employment by initiating educated and uneducated unemployed youth to aquaculture industry has created a class of neo-fish farmers and ancillary traders. The generation of income through aquaculture will naturally result in raising the standard of living of the otherwise backward people in these rural areas and offers them new avenues of production and trade.

MIXED PLANTING OF COCONUT, CASUARINA AND CASHEW ALONG THE COAST LINE OF INDIA

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Coastal agriculture should form an important component in the integrated rural development of the coastal villages. All along the 6100 km long coast of India nearly 3 million fisherfolk reside in about 1800 fishing villages. These fishermen live in temporary houses constructed right on the coast of the sea. These areas are generally subjected to a great deal of tidal wave action and wind erosion causing total damage to their shelter and the crop lands respectively. Many of the fisherfolk with their meagre income live below the poverty line under conditions of malnutrition and under-nutrition. Unless his source of income is improved to a reasonable extent, the fisherman is not going to improve his living standards. As a part of the programme for integrated rural development, it would be highly beneficial and would form a source of steady income if we could bring the coastal lands under plantation crops. In this massive community development programme the scope for agricultural employment to the rural fisher womenfolk is much stressed.

Climate and soils of the coastal lands

The coastal lands receive an annual rainfall ranging from 4000 mm on the west coast to 1500 mm on the east-coast. The temperature of these areas rises up to 40°C during summer months. The east-coast is characterised by gales carrying sand particles to the productive lands. The water table all along the coast is generally high. The coast is predominently of laterite and sandy soils.

The coastal laterite and sandy soils are cropped with casuarina, cashew and coconut. Though much literature is not available on the allelopathic interaction of these mixed stands, it could be concluded from the natural mixtures of these crops that the crop stands could be maximum exploited by employing some advanced techniques for controlling the sea/wind erosion and to put the existing land under cultivation

Principle of composite cropping

Casuarina, a coastal woody plant is recognised and is put under defence on all peripheral areas to control the speeding winds and sand drifting. Cashewnut, a soil binder and deep rooted plant, and coconut, a shallow rooted crop are identified to be a suitable mixture for the protected soils.

Besides, the coastal sands of east-coast and the laterite barren hill slopes of west-coast which are being washed during the monsoon causing heavy losses of soil and land slips can be protected by employing the composite culture of casuarina, coconut, and cashewnut. With this basic information, the Department of Soil Conservation, Orissa, has brought about 1681 ha of the coastal sand dunes under this system of cropping to study the allelopathic interactions of these three crops, and to generate employment to the fishermen.

Technique of plantation

As the sterile sands are inhospitable for plan growth, special techniques of planting are adopted (Brick method). Before planting of these seedlings, tank silt and red soil are applied to each pit. About 20 rows of casuarina are planted along the sea coast as the first line of defence. To ensure optimum growth of the above vegetative screen, it is necessary to erect a 2 meter high barricade of coconut leaves tied with bamboo and anchored with casuarina poles.

The area thus protected is divided into 5 ha compartments by raising internal wind breakers of six rows of casuarina planted at 1m x 1m spacing perpendicular to the main barricade at

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regular intervals to prevent wind erosion and sand drifting. These compartments are then planted with cashew adopting a spacing of 8m x 8m. Individual cashew plant is protected from sand casting by providing a small vegetative screen made of coconut and casuarina leaves. The interspace in cashew is planted with coconut seedling at 8m x 8m spacing. Each coconut seedling is protected by a bamboo mat of 1.5 m x 2m size on the south western side to prevent the young plam from sand casting, brackish wind and south western sun.

Economic returns

The costs of cultivation of casuarina, coconut, and cashewnut are worked out to be Rs. 718 Rs.2705 and Rs.1200 per year per hectare respectively. Casuarina is estimated to yield 40-50 tonnes of log per hectare which can be disposed at the rate of Rs.120 per tonne. The fishermen require a number of logs to fabricate structures in the sea for culturing mussels and oysters. The casuarina logs can be put to use in the sea farm besides for the construction of their houses. The roots of casuarina can also be converted to charcoal which fetches a good income. Coconut a regular bearer is estimated to yield 30-40 nuts per palm per year under reasonably good management and fetch an income of Rs. 4800 per ha. Cashew is estimated to yield 1-2 kg of nuts per tree per year which will fetch an income of Rs. 1200 per ha. As these crops require nearly 300 man days of employment, the fisherwomen can be effectively employed for these agricultural operations.

SESSION V

POST - HARVEST TECHNOLOGY

Keynote Address

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India ranks seventh amongst the fish producing nations of the world, although the country's fishing activities are still confined to the narrow coastal belt; the off-shore and deep-sea waters remaining under-exploited. Declaration of the 320 km (200 miles) exclusive economic zone has thrown open a vast and virtually virgin area for exploration and exploitation. Further, the introduction of coastal aquaculture for different varieties of fish and sellfish has added a new dimension to the already available fish production. All these clearly indicate the tremendous potential for increased fish landings in the coming years.

Evolving the necessary post-harvest technology and provision of the required infrastructure for application of that technology in handling, preservation, processing, storage and distribution with the aim of minimising the postharvest losses and reaching the landed wealth to the consumer throughout the country in fresh condition or in a processed form he likes and at a price he can afford are the most important pre-requisites for any development programme aimed at increased fish catch. Technological developments in processing should also be directed towards the challenging demands for diversified products—diverse in contents and containers—for both internal markets and those overseas. This should be supplemented with ways and means to convert the low priced species and processing wastes into products for human consumption or animal nutrition on the one hand or industrially useful products on the other.

Till the late fifties the relative shares of the disposal of the catches in different forms were: fresh around 50%, sun-drying about 25%, salting about 20% and the balance converted as manure. Consumption of fish in the fresh form being limited to areas adjoining the coastal belt and with little knowledge on the methods of preservation, there always accrued a high incidence of post-harvest losses. The only technology known at that time was salting/curing and sun-drying of certain varieties of fish and prawn practised in a rather primitive way. It is, however, worth mentioning that even this primitive knowledge provided the technological base to support a none too small industry in the coastal villages, particularly on the south-west coast, from where there took place a sizeable export of its produce to some of the neighbouring countries like Sri Lanka and Burma. Prawn drying was most significant, one which suffered its worst setback consequent to the breakdown of traditional markets by the end of World War II. This, perhaps, was a blessing in disguise, since it paved the way for sustained efforts in the country for developing the required know-how in modern methods of preservation and processing of fish, ultimately resulting in the birth and subsequent growth of the modern fish processing industry in the country.

Fish is a highly perishable commodity in which the spoilage sets in almost from the time it is taken out of water. Therefore, the application of post-harvest technology in handling preservation and processing right from the moment the catches are landed needs no over emphasis. In the pre-Independent era there was no organised effort in the country on research and deve-

lopment on processing and storage of fish. The few Institutions established subsequently were attending to some of the local problems connected with traditional methods of fish preservation. A national character was given to research and development efforts in fish preservation and processing with the establishment of the Central Institute of Fisheries Technology with its Research Centres at representative locations, Studies conducted at the Institute on different aspects of handling, transport, preservation, processing, quality-control measures etc. supported by studies in the fundamental aspects of biochemistry and bacteriology have helped the Indian fish processor in meeting the challenging demands of the different fish markets. The Institute also functions as the co-ordinating centre for the ICAR All-India Co-ordinated project on "Transportation of fresh fish and utilisation of 'trash' fish".

HANDLING, PRESERVATION AND TRANSPORTATION

Proper washing in potable water and immediate use of ice in handling and preservation of fish right from the moment of catch are the basic requirements suited to Indian conditions to minimise the post-harvest losses. Studies on the use of ice, quality of water and ice, fish to ice ratio, the correct method of icing, storage on board the fishing craft and cleaning schedules for maintenance of proper hygiene have all contributed in improving the quality of fish arriving at the retail outlet or at the processing factory.

Bamboo baskets were the most common types of containers used for transportation of fish. They were useful only for short distance transport. With increased use of ice an extension of area covered by fish vendors became possible. Improved types of containers became necessary and resulted in modifying the baskets by providing them with gunny or kraft paper lining, which could keep the fish in ice nearly 3 times longer than in simple bamboo baskets. A new type of container developed for transport of fish namely plywood boxes lined on all sides with expanded polythyerene enables the preservation of fish, in ice for 72 hours. The impact of these tochnological developments is evident in the general improvement in quality of fish now available. This has been possible largely due to the provision of a network of motorable roads connecting the landing centres with the hinterlands. establishment of ice plants at or near these centres, timely transfer of technology and its adoption by the trade etc.

DRYING/CURING

By far the most important low cost technique for preservation of fish, inasmuch as the product being perhaps the only type of processed fish available to the consumers particularly in rural and tribal arears, involvement of minimum expertise, easy adaptability to application in rural fishing villages, volume of trade invofved etc. is drying/curing.

Fish cured by the traditional methods are not wholesome and suffers from several defects like susceptibility to microbial spoilage, attacks by moulds and insects, rancidity, discolouration and relatively poor storage life. Different methods of curing—dry curing, wet curing, Colombo-curing, pickling, smoke curing and drying In sun or artificial dryers with salt—have been subjects of detailed study with the aim of turning out finished products having good physical and organoleptic characteristics and extended storage life. The prevalance of most of the defects met with in dry cured products could be arrested by giving the fish a dip in an aqueous soluttion of 3% sodium propionate in which 0.05% BHA is dispensed followed by curing and drying. Quality as well as storage life of pickled fish can be considerably improved by incorporating minor percentage of propionic acid. Improvement in the quality of Colombo-cured fish by incorporation of sodium benzoate or pepper spikes, garlic, turmeric etc. are some noteworthy achievements in the field of pickle curing. Besides perfecting the technique of preparing attractive smoke- cured sardine fillets with good consumer appeal, research and development are directed towards evolving suitable methods of smoke curing of light salted fish, notable among them being the mussel meat.

Design and development of commercial models of artificial dryers, some of which are already in use in the country, solar dryers making use of solar radiation heat for drying, improvements in the techniques of curing evolved as a result of extensive research carried out in the field, suggestions to improve the overall hygienic aspects of processing and storage etc. are some of the steps taken in the dirsction of improving the status of fish curing in the country.

The importance of packaging in deciding the storage property of the cured product and more so in its consumer appeal need no over emphasis. However, it appears to be a topic which has not received proper attention so far. Appropriate thought has to be given to the problems of packaging of cured fish.

FREEZING

Being a technology practically unknown in the country as far as its application to fish preservation is concerned, the problems faced during the initial stages of its adoption were numerous. Necessary technological base for its application to fish, particularly crustaceans, was evolved by extensive research on such problems on the best applicable temperatures of freezing and storage, merits and demerits of quick freezing *vs.* slow freezing fluctuations in the temperature of storage and their effect on product quality, the cumulative, effect of all these variables on the thawed weight of the product, prevention or minimisation of thaw drip by chemical treatments, glazing and provision of suitable packaging etc· the overall quality maintenance, control and plants sanitation ete.

Irrespective of the phenomenal increase in the export of marine products, which couched an all time high of 48,000 tonnes in the year 1976, one peculiar condition seen in the freezing industry of India is a vast surplus of its installed capacity. Rencent developments like freezing fish fillets. diversified products like frozen minced meat and other fish products are designed towards making use of at least a portion of this idle capacity. Such products can have besides export potentlal, good reception from the urban population within the country. This would, in turn, have an overall impact in influencing the socio-ecnomic status of the fishermen and others engaged in the fishing profession in the rural areas.

CANNING

Like freezing canning also is a new adoption in India in the processing of fish. Our research and development efforts in the canning front have beee able to provide complete answers to almost all the problems faced by the canners in the country. However, the exports, after reaching a peak figure of 2197 tonnes in 1973, registered a steep decline from 1974 onwards due to economic reasons. Today more than 91% of the installed capacity is remaining idle. Research and development activities are now fully geared towards development of appropriate technology applicable to different types of fish and shell fish other than prawns.

Because of the advantages involved in their handling and distribution of the products, canning, though a process involving high cost technology, can play a significant role in the disposal of fish for human consumption within the country. It is possible to organize canning on a cottage industry level involving minimum essential equipment and machinery at or near the landing sites so that any surplus fish available, if suitable for the purpose, can be processed into canned fish.

WASTE UTILIZATION

Processing invariably turns out wastes. An integrated development programme on fish processing should take into consideration full utilisation of waste by way of dovelopment of useful products out of them. In addition to processing the waste, there is the problem of utilisation of the small uneconomic varieties of fish which form a sizeable proportion of particularly the coastal trawler catches. Simple methods worked out for preparation of chitosan and shrimp extract from prawn head and shell waste, chitosan and protein isolates from squilla, edible fish powder, bacteriological peptone, ensilage etc. from low prtced varieties of fish. extraction of better quality of oil from sardine, preparation of industrially useful products out of it etc. are some of the highlights of research and development activities in the field of waste utilisation.

We had a glorious past as regards the development of the appropriate technological base support our fish processing industry is concerned. A great deal still remains to be achieved to equip our technology to meet the future demands. The modern technology developed particularly to suit export of prawns is high cost technology involving sophisticated processes, equipment, machinery and skilled labour. The benefit of this technological expertise accrued is in the hands of economically higher class of people, who could make the necessary big investments. However, there should be a balan-

ced outlook in the technological developmental needs of the future so that the domestic demands are met side by side meeting the requirements of the export oriented industry.

In the domestic front industrialisation is fast giving an urban touch to many parts of the country with the consequential demand for urbanised goods; food being no exception. Unlike as in other countries, we have several landing centres from where there is no organised system of pooling the catch and distribution.

The consumers situated thousands of kilometres away from the landing centres do not get fresh fish. For the equitable distribution of fish among the population it has to be converated into processed products with good storage life. Satisfaction of the quest and urge for fish, processed or otherwise, from all sections of population, urban or rural can be attained only if low cost formulae and product approach are made in the handling, preservation and processing of fish. A research and development programme blending the traditional methods with the modern but low cost technology in utilisation of the fish should be an integral part of such a strategy. Any such approach and development should ensure the uplift of socio-economic condition of the primary producer, the fishermen. Only then an integrated rural development programme based on fish would have any meaning and purpose.

CERTAIN ASPECTS OF PRESERVATION OF THE FISH SUITABLE FOR SMALL-SCALE FISHERIES

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INTRODUCTION

Tamil Nadu has about 46,750 hectares of estuaries and backwaters and at present very little of mariculture to increase production of fish has been attempted. Besides backwaters, aquaculture in protected and shallower areas of the sea can also be carried out, on which the Central and State research organisations have conducted research work and the results can now be carried to the field. Aquaculture techniques involve location of seed, collection, acclimatization, culture and finally harvest. Induced breeding techniques hold out promise in this field as in inland fish farming. Culture of prawns, mullets, chanos, eels, oysters, mussels and lobsters has been attempted in Tamil Nadu and significant production of these varieties is expected in the near future. Aquaculture also includes culture of sea weeds which are of commercial importance and the technique of growing *Gracilaria* and *Sargassum*, the two important weeds for the production of agar has been standardised by the Central research organisations.

As increase in production of fish through the development schemes including coastal aquaculture must necessarily be linked to proper preservation techniques and a sound marketing starategy, this paper deals with some aspects of fish preservation which could be applied with advantage in the coastal area.

DISPOSITION OF CATCH

The pattern of utilisation of the marine fish currently is: fresh—64.8%, frozen—2.9%, cured—24.6%, canned—0.5%, reduction and others—7.2%.

These figures are significant in that the fishing trade in the country is still geared only to conventional use of fish namely fresh and cured. However, over the years a change in the consumption pattern even in these two major usages has taken place resulting in increasing use of fresh fish and a corresponding decline in the use of fish in the dried and cured form. In terms of quantities turned out the dried and salted fish still appear to be popular and will continue to be so.

OBJECTIVES OF PRESERVATION OF FISH

The main objective of technological research in the field of fish preservation and processing is to work out methods and methodology to maintain the freshness of fish during handling and storage for extended periods. Fish is a highly perishable food. Depending on the variety of fish, marketability, consumer preference and economics of production, methods like simple sun drying, salting and curing, chilling, freezing, pickling etc., are adopted.

In general, preservation of fish has some or all of the following objectives: 1) Preservation from spoilage, 2) Supply of fish over the lean season, 3) Stabilising price level, 4) Production of a variety of fish products as desired by the consuming public, and 5) meeting the needs of the export market. Fish processing in our country has to meet all these objectives to a greater or lesser extent.

Fish is basically distributed and marketed in the following forms : 1) fresh fish (including chilled fish), 2) preserved fish, 3) frozen fish and fish products, 4) industrial fish products consisting of fish meal, fish oil and fish manure and 5) by-products of fish as fish maws, fish fins etc.

The different processing methods for fish are chilling, freezing, canning and reduction into powder for human consumption or animal feed which are modern or non-traditional; and drying with or without salt, pickling and smoking which are traditional ones. The different methods of utilization of fish are as round fish, gutted fish, fish fillets, slices or steaks, minced meat, fish powder, fish paste and several derivatives of each of these as consumer items, ready to cook or ready to eat.

BRIEF DESCRIPTION OF THE METHODS

Chilling of fish

Of the methods mentioned, this is essentially the easiest and most popular. But it has limitations of time and area of distribution. The increased marketing of fish in the fresh or chilled condition is due to the greater availability of ice and better transport facilities including approach roads to fishing villages.

Freezing of fish

The high cost of freezing, storage and distribution makes the product out of reach of the average local consumer. The freezing industry caters essentially to the needs of the export market in prawns, lobsters and cuttle fish in view of the lucrative prices at the foreign markets.

Peeled and deveined or boiled, deshelled, and then frozen' or individually quick frozen prawns and lobsters or frozen fish meat mince free from bones are all variations that are adopted to meet the consumer preferences of the importing countries; but basically the technology adopted is the same.

The freezing of fish other than prawns and lobsters for internal marketing depends on development of cold chain from the production centre to the markets or retail shops. While marketing of frozen fish for direct use by the consumer may take some time, the bulk freezing of surplus fish during glut seasons and marketing the same as fresh fish after thawing in lean seasons hold out promising prospects.

Canning of fish

This method of preservation of fish facilitates its wider distribution over larger areas but has the disadvantage of high cost of the final product, the container being costlier than the contents in some cases. However. we can can fish in typical Indian style like curried fish or spiced fish and make it popular both in the internal as well as in the export market, employing cheaper containers like aluminium cans.

Dried and salt cured fish

This method of preservation of fish which includes plain sun-drying, dry-curing, mena-curing, wet-curing, pit-curing and Colombo-curing will continue to be popular in this country and the products will always find ready market, being cheap. It can be easily adopted in remote fishing villages and compared to fresh or chilled fish the products have longer shelf life and can be distributed over wider areas. Dried fish has also a limited outlet to our neighbouring countries like Sri Lanka.

Salt curing with additives like propionic acid to retard spoilage of the salted fish due to moulds and bacteria has been advocated as it enhances the storage life. Quick salting of picked meat of fish by mincing with salt and moulding the pressed material into thin cubes or circles before drying to yield dry fish cakes has been investigated at the Tamil Nadu State Laboratory and the product has been found to have a long storage life with the usual characteristics of salted fish.

Attention must however be paid to improving the quality of fish preserved by this method. Procedures employed for processing of fish by this method at present leaves much to be desired. The fish is not washed properly after gutting. Salting is not done as per the accepted standards; drying is done under unhygienic conditions and that too insufficiently and the product is packaged and stored in not so ideal conditions.

In the coastal areas model fish curing and drying yards with better facilities like raised drying platforms of racks, gutting and salting sheds, storage sheds for the dried fish, fencing to protect the drying yards, water and electricity supply and toilets for workers with sewage system should be established.

Also, facilities for drying fish by artificial methods may have to be provided for obtaining an improved quality product.

Smoking of fish

This method is not popular in Tamil Nadu, as also generally in the rest of the country. This is a cheaper method than chilling or freezing and in foreign countries smoked fish is considered a breakfast delicacy. The product has an attractive smoky flavour which has yet to be popularised among our people.

Reduction of fish into powder

The cost of the product depends on the method of preparation, like (i) solvent extraction (ii) simple cooking, pressing, drying and powdering and (iii) extracting the proteins and spray drying. Such a product can be used as a protein additive in our other food preparations.

PROCESSING TECHNOLOGY FOR COASTAL AQUACULTURE

Through coastal aquaculture, prawns, lobsters, chanos, eels, mullets, oysters mussels etc., can be produced. One or the other of the foregoing methods can be adopted for preserving the harvest. Location of the processing and preservation facilities close to coastal aquaculture centres will play an important role in product development and utilisation.

Prawns and lobsters that are harvested have to be first transported to the freezing plant for processing and freezing before export. For this purpose the prawns after washing have to be chilled in ice (1 part of prawn to 1 part of ice) and packed in thermocole lined tea chests or light wooden boxes. At the factory, the heads of the prawns are removed, peeled and deveined, packed in cartons, frozen in plate freezers at - 40°C and stored at - 25°C to - 30°C till exported.

Canning of prawns in brine is also another modern method of preservation for export purposes; but in view of the preference for frozen prawns and the high cost of the canned products export of prawns is predominently in the frozen form.

Chanos and mullets can be chilled and marketed as fresh fish or frozen and sent to the internal markets as and when required and sold as fresh fish after thawing. Also salting and drying can be applied to these two varieties.

Eels can be frozen in the round form and exported to Japan where it commands an attractive market. Possibilities of sending them alive in oxygenated plastic containers by air to Japan can also be explored. For internal markets, the most suitable method will be to send them in live or chilled condition.

Mussels and oysters stand transport to the interior markets in wet gunny bags. Otherwise the meat of these bivalves may have to be shucked, washed well and transported in chilled form. Also the meat of these shell fishes can be boiled and dried for later use. Canning of the meat of these bivalves and freezing also have been reported.

RECYCLING AND UTILIZATION OF FISH WASTE

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During the past twenty-five years, due to various fisheries developmental activities undertaken in coastal area, the fish catch has more than doubled. Increase in fish production has resulted in many uneconomic varieties of fish. Modernising the traditional processing industries also creates a substantial amount of waste products which at present are either unutilized or underutilized. This is mainly because, from the business point of view, the high value products themselves fetch substantial income, while the by-products and wastes, when processed, do not command attractive prices. Many of these products could be semi-processed in rural areas using simple techniques, to be taken care of further at urban centres equipped with modernized plants for turning out finished products. The article lists some such products.

Chitin from Squilla and prawn waste

Squilla (Order Stomatopoda) is of considerable importance because of its high chitin content. Large quantities of *Squilla* or "Puchee" are caught along with prawns by the trawlers. Its disposal poses a big problem. Most of it is thrown away overboard immediately after catching and only the rest, that is a close admixture of fish and prawns, is brought ashore to be sorted out and thrown away in the landing places. This indiscriminate throwing away of *Squilla* at the landing sites causes offensive smell due to its rotting. It is estimated that the total annual catch of *Squilla* in India is of the order of 50,000 tonnes. with the increased fishing efforts envisaged, there are distinct possibilities of better catches of this species.

A quantity of 47,952 tonnes of frozen shrimp were exported during 1976. Nearly 45-50% weight of the starting material is constituted by wastes in the form of heads and peels. *Squilla* and the prawn waste provide an excellent material for processing of chitosan (2 amino-2 deoxy-d-glucose), a deacetylated product of chitin which finds extensive uses in a number of industries (Moorjani *et al.*, 1977).

As a first step, the shrimp waste and *Squilla* could be squeezed to remove adhering proteineous material, deproteined with alkali and demineralized with HCl. The chitin so obtained could be dried, which forms the intermediate compound for subsequent processing into chitosan.

Small varieties of fish

Surveys conducted by the "Pelagic Fisheries Project" have indicated the potential of very large and hitherto untapped resources of fish. Introduction of purse seines in the west coast has indicated large sardine and mackerel resources away from the traditional fishing grounds. The pelagic fishes, oil sardine and mackerel, are the two important commercial varieties. During the glut season lasting for 3-4 months, huge quantities of oil-sardine are converted into fish meal, fertilizer etc. due to inadequate facilities for refrigeration. The Central Food Technological Research Institute has developed a process for preparing fish meal and designed a plant based on indigenous equipment.

It is estimated that more than one lakh tonnes of by-catches of fish are caught along with shrimp. These are mostly small varieties of fish with lot of bones and are not so tasty. They are either thrown away or converted into fish meal. Such a nutritious food like fish has to be effectively preserved and processed to bring better returns to fishermen and the fish processing industry.

To make best possible use of pelagic fish such as oil sardine and mackerel and the by-catches of shrimp from trawlers (Table 1) improved method of handling such large amount of catches have to be introduced to avoid spoilage and wastage. Also improvements could be effected in traditional processing methods and novel products developed to suit the demands of new markets (Moorjani *et al.*, 1978 *a,b.*) The Institute has developed a process utilizing high temperature processing to use some varieties of pelagic fish which can be further developed into ready-to-cook type products (Moorjani *et. al.*, 1978 c).

TABLE 1. Some of the inexpensive varieties of fish landed in India.

Name of fish	Landings (in tonnes)
Elasmobranchs	57,449
Cat-fishes	44,355
Oil sardine	1,68 940
Other sardines	1,06,711
Harpodon nehereus	87,075
Sciaenids	89,564
Ribbon-fish	68,353
Leiognathus	46,996
Non-penaeid prawns	76,812

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SOME OPTIONS FOR IMPROVEMENTS IN TRADITIONAL HANDLING AND PROCESSING OF FISH

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Rural technology in the main connotes, low capital investment, low running costs on services like fuel and electricity and low managerial or overhead costs but satisfactory product quality. The object of this paper is to examine the above concept in relation to post-harvest fish handling and processing technology in the Indian context. Some points relevant to the coastal rural setting have been spelt out in the hope of providing a basis for further thinking on the subject.

THE SETTING

The landing of most marine fish in India takes place in the coastal villages. Where landing facilities for mechanised trawlers in the form of fishing harbours are provided, the situation tends to be urban rather than rural or at least the immediate contiguity of an urban centre will be obtaining. In the typical rural setting, only a small portion of the fishes caught is used for food at the village level itself, the preferred mode of disposal being sale for transportation to interior and urban markets. Seasonal and unmarketable surpluses of fish have been traditionally cured by salting and/or by sundrying for off-season marketing and also converted into manure for use locally and elsewhere.

HANDLING CATCHES ABOARD

Technological innovations are needed to protect catches from severel ambient conditions of direct sunshine, higher temperatures and wind aboard the small country crafts which are so typical of the artisanal fisheries. The limited space on board such a vessel does not permit

use of ice or fish boxes and proper handling and preservation of catch. On the other hand, the boats being slow, the time lag between hauling the catch and landing may often make it imperative to look for some means of keeping the catch fresh till landing. Perhaps in very small vessels the catch may be of the order of 5-20 kg and in medium vessels, of the order of 50-100 kg. With the catches being uncertain and varying, even when it is technically feasible to ice the fish aboard and keep it chilled in ice till brought ashore, in all likelihood, it may turn out to be economically unatractive to do so. Can sanitary boxes to hold the catches in shallow layers instead of in piles, be designed to be fitted into the vessels? Can these boxes be covered with jute cloth which is kept wet and exposed to ambient air, so as not only to protect the catch from direct sunshine and wind but provide some evaporative cooling as well? These are points that need some attention for improving the functional set up of the limited space available aboard small vessels.

FRESH-FISH HANDLING ASHORE

The disposal of catches at the local village level for marketing in interior and urban areas as fresh fish involves the operations of handling, washing, icing and loading into transport vehicles. Improvements needed by way of better sanitation call for creation of some infrastructural facilities. A point for consideration here is whether the fish could be eviscerated, knobbed or suitably dressed before transportation for marketing. This would entail certain advantages like retaining the inedible parts for local conversion to fish meal or manure, besides reducing the bulk of the fish to be transported. This system also needs provision of necessary infrastructual facilities at the village level. However, consumer education to appreciate the convenience of such ready-to-use dressed fish vis-a-vis round fish will be a necessary prerequisite.

The redesigning of the traditional bamboo baskets (Anandaswamy *etal.*, 1971) for transportation of iced fish is of specific relevance in the rural context in that the containers can be locally improvised and would ensure better keeping quality of the fish during transportation.

CURING OF FISH

Sundrying with or without an initial brining or salting is the most important way of preservation of marine fish in India for human consumption. It is well known that the traditional products have limited storage life, being prone to mould growth, attack by red halophiles and development of yellow or brown discolouration and rancid and off-odours. All these defects have been overcome in an improved method-Sen and Sripathy, 1967 evolved for salt-curing and sundrying of mackerel. The method is equally applicable to other marine fishes with due modification. A model layout for a fish curing yard (Sripathy, 1967) with a factory-line organisation would ensure production of cured products of good quality even at the village level itself.

Sundrying of brined or salted fish under open atmospheric conditions is quite a satisfactory procedure, provided hygiene and sanitation are not neglected. Moreover, if weather conditions do not permit sundrying for some days, the fish can be conveniently held temporarily salted or steeped in brine. Mechanical drying of cured fish has no doubt been proposed, but capital costs on the drying system tend to be high if electrical energy is needed. Design of driers based on local combustible materials like paddy husk, hay or other agricultural wastes might make artificial drying more suited to a rural setting. A polythene tent drier (Doe *et al.*, 1977) of simple design and easy construction with no mechanical components has been found useful in improving drying rate and controlling larval infestation during sundrying of fish.

Procedures which can be followed at the rural level are available for preparing new marine fish products which would find acceptance with our traditional consumers of cured fish. These include a quick-salting procedure (Mendelsohn, 1974) evolved and found useful in Mexico, and preparation of cooked, dehydrated fish minces with or without spicing developed at the central Food Technological Research Institute. However, introduction of such new products in the market requires considerable market promotion efforts.

RELEVANCE OF POST-HARVEST TECHNOLOGY TO SMALL-SCALE FISHERIES

Insofar as the availability of raw material dictates the establishment of fish industries for canning, freezing and fish meal in the coastal village itself, these are economically important in the rural sector. However, these technologies cannot be scaled down sufficiently to make

them less capital intensive. Also, canned or frozen products have too restricted a market to be extensively produced in numerous rural centres. In the case of fish meal and oil units, however, a phased mechanisation of wet-rendering techniques, practised for decades on the West Coast would be practicable (Sen and Sripathy, 1968).

It is well recognised that the adoption of newer techniques of post-harvest technology has relevance to the small-scale fisheries sector only when the price realised per unit of catch improves as a consequence. In the case of a raw material like prawn or shrimp, there is a degree of competition among the processors for the catches and this is beneficial to the primary producer. In the case of the other fishes, apart from fishes like pomfret, seer or mackerel which are valued as table fishes, the factors that tend to inhibit price realisation are: (i) localised and seasonal abundance of some varieties and (ii) catches of low consumer preference. The question that arises is whether improved technological practices like carrying ice aboard the craft, icing and boxing at sea, would pay for itself by way of better returns on landing in a fresher or well-cared-for condition. The investment on technological infrastructure needed to even out the effect of seasonal and localised abundance, by short term holding in ice or long duration holding by freezing or by canning, curing, reduction or producing newer types of consumer products, can no doubt, in the long run, benefit the primary fishermen by way of adding value to his catches. Such a technological infrastructure cannot be obviously built however at the level of the individual fisherman. It calls for organised efforts in all related aspects of economics of handling, distribution and marketing.

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AQUACULTURE AND POLLUTION

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The relation between aquaculture and pollution is a complex one. Animals living in a water body are affected by changes in the chemical and physical quality of that water. An increase in water temperature can be beneficial up to certain point, above which it becomes detrimental and ultimately lethal; but a change involving an increase in level of a chemical which is not normally present can very often cause deleterious effects.

The animals are sensitive to the physical and chemical changes to which many of them have a low tolerance range. Even changes within their tolerance range can affect the physiology of the animals so as to influence their growth rate, fecundity and mortality. The tolerance of the animals also varies with their stage of development. Thus a very young animal may be more sensitive to a pollutant than an adult. This account is intended to

bring together the information available on the common pollutants and their tolerance levels in the cultivable fishes, crustaceans and molluscs that are important in aquaculture.

Nature of the culture systems and their relation to problem of pollution

Fishes living in a culture system are subjected to changes in water to a greater extent than those in the natural surroundings as they cannot select the environments in which they live. The fishes and prawns living in an estuary or lagoon can often escape from a local pollutant by moving to other areas. Obviously this is not possible for fish confined in a pond or cage.

Based on the mode of feeding of the culture animals, two types of aquaculture systems can be distinguished. In the first one, fishes depend for food on the plants and animals produced in the farm area in which they live as againt the second one in which the fishes are confined in dense populations in small areas such as cages and small ponds and wholly depend on artificial feeds. In both these systems the sensitivity to changes in water quality differs. In the first system pollution affects not only the culture animals but also the animals and plants on which they feed. This system, therefore, is likely to be more easily damaged by pollutants than the second one where the damage inflicted is directly on the culture animals. In India, we have both types of systems; but standards and criteria for varying acceptable limits of pollutants have not been evolved. It is imperative that our fisheries and allied institutions engaged in pollution investigations jointly formulate acceptable limits for both types of aquaculture systems so that suitable control measures could be evolved in order to maintain the quality of the products.

Biological effects of pollutants

Of the many different toxic substances that find their way into the estuaries and coastal waters and affect the physiology of the animals inhabiting them, pesticides occupy the top most place. The agricultural sector has using different types of organochlorine and organophosphate compounds for the eradication of pests. Recent studies on the effects of insecticides on marine organisms demonstrate that concentrations which are not sufficient to control many species of insects, nevertheless, can inhibit, the productivity of phytoplankton (Butler and Springer, 1963); kill or immobilise crustaceans, fishes and molluscs (Eisler, 1970); kill eggs and larvae of bivalve molluscs (Davis, 1961); induce deleterious changes in tissue composition of molluscs and teleosts (Eisler,1967; Eisler and Edmud, 1966; Eisler and Weinstein, 1967); affect distribution of schooling and feeding behaviour of fishes (Hiatt *et al.*; 1953); and interfere with ovary developments in molluscs and teleosts Boyd, 1964 Eisler, 1970. It has been observed that clams and oysters can concentrate pesticides from the medium by factors of 70,000 and more (Butler, 1966). Fishes also can concentrate appreciable quantities of insecticides directly from the medium and retain them for at least 4 months (Croaker and Wilson, 1965). Marine species are unable to acquire resistance to pesticides and suffer heavy mortality when exposed to relatively low pesticide levels. In general organochlorine insecticides are more toxic to marine fishes and crustaceans than organic phosphate insecticides and detergents. Table 1 gives the toxicity levels of some organochlorine and phosphorus insecticides under controlled environmental conditions to marine teleosts, crustaceans and molluscs.

Criteria for water quality in fish culture

Domestic garbage and industrial effluents containing materials that precipitate in seawater, settle on the bottom or float, can cause trouble to aquaculture. Shellfish may be killed if the beds of the farms are covered with settling substances. Materials from mining operations also can cause the same deleterious effects to shellfish by causing disturbance to their feeding mechanisms. Industrial effluents, depending upon their intensity and nature, can cause havoc to both culture animals as well as the plankton forms on which they feed. Measurements conducted with C^{14} have indicated that the effluents discharged into Chaliar river (near Calicut, Kerala) affect photosynthesis right up to the Beypore estuary, 16 km downstream from the point of impact.

The Indian Standards Institution has prescribed certain limits for water quality after receiving discharges (ISI, 1976a) and for industrial effluents (ISI,1976b) especially in selfish and commercial fish culture (Tables 2 and 3).

The use of garbage, dairy waste and sewage as organic fertiliser to increase productivity of fish ponds has been practised for a long time. Organic wastes such as cow-dung and manure from poultry and piggery can be directly used for fertilising fish ponds; but in the case of sewage, it is to be subjected to primary and secondary treatments with high rate trickling filter or by activated sledge process. In India, there are 132 sewage fed farms covering an area of 12,000 hectares (Dehadrai and Ghosh 1978). These authors have cited many instances of successful culture of fishes in sewage-fed farms in different parts of the country.

Before recycling domestic waste water through fish pond, it is desirable to treat it so that the organic load is reduced considerably. The organic load of waste waters is generally expressed in terms of its Biochemical Oxygen Demand (BOD) which in the case of raw sewage generally lies between 150-600 mg/1. Primary treated sewage effluent contains less organic matter than raw sewage and more nutrients than secondarily treated one and is preferred for fish culture in ponds where no supplementary fertilisers of foods are used (Dehadrai and Ghosh, 1978).

Beneficial effects in water quality from domestic and animal wastes, industrial organic wastes and heated effluents require careful study by aquaculturists so that a pollutant which in effect is a "displaced resource" can be profitably exploited for producing much required protein for filling up the nutrition gap. Coupled with this, bio-assay studies are also required to monitor the uptake of unwanted or toxic substances in the lipid pool by bio-accumulation in order to maintain the quality and safety of products of aquaculture.

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Table 1. *Toxicity levels of some organochlorine and phosphorus insecticides: 96 hour LC-50: µl active ingredients*

	Teleosts	Crustaceans	Molluscs
Organochlorines			
Endrin	0.05 - 3.1	1.7 - 12	> 10,000
P,p-DDT	0.4 - 89	0.6 - 6	> 10,000
Heptachlor	0.8 - 188	8.0 - 440	> 10,000
Direldrin	0.9 - 34	7.0 - 50	> 10,000
Aldrin	5.0 100	8.0 - 33	> 10,000
Lindane	9 0 - 66	5.0 - 10	> 10,000
Methoxychlor	12.0–150	4.0 - 12	> 10,000
Organophosphates			
Dioxathion	6 - 75	38 - 285	> 25,000
Malathion	27 - 3,250	33 - 83	> 25,000
Phosdrin (R)	65 - 800	11 - 69	> 25,000
DDVP	200 - 2,330	4 - 45	> 25,000
Methyl parathion	5,200 - 75,00	2 - 7	> 25,000

From Eisler, 1972.

Table 2. *Tolerance limits for water quality after receiving discharges.*

Sl. No.	Characteristic	Tolerance limits for shellfish and commercial fish culture
1.	Colour and odour	No noticeable colour or offensive odour
2.	Floating material	No visible floating matter of sewage or industrial waste origin
3.	Suspended solids	No visible suspended sdoils of sewage or industrial waste origin
4.	pH value	8.5 to 8.5
5.	Free Ammonia (as N), mg/ l max	1.2
6.	Phenolic compounds (as C_6H_6OH), mg/1, Max	0.1
7.	Dissolved oxygen, Min.	40% saturation value or 3mg/1 whichever is higher
8.	Pesticides (chlorinated hydrocarbons) (as Cl), mg/1 ,Max	0.002
9.	Arsenic (as As), mg/1, Max	0.2
10.	Mercury (as Hg). ,, ,,	0.0003
11.	Oil and greasy substances (sampled in 30 cm surface layer) mg/1, Max	0.1
12.	Biochemical Oxygen Demand (5 days at 20° C), mg/1, Max	5
13.	Coliform bacteria, MPN index per 100ml, Max	1000
14.	Bio-assay test	Not less than 90% of test animals shall survive in 96 hour test

Table 3 *Tolerance limits for industrial effluents*

Sl. No. (1)	Characteristics (2)	Tolerance limit (3)
1.	Copper (as Cu), mg/1, Max	3.0
2.	Lead (as Pb), ,, ,,	1.0
3.	Chromium (as Cr), , ,,	1.0
4.	Cadmium (as Cd) ,, ,,	2.0
5.	Mercury (as Hg) ,, ,,	0.01
6.	Nickel (as Ni) ,, ,,	5.0
7.	Zinc (as Zn) ,, ,,	5.0
8.	Total suspended solids, mg/1, Max	
	a) for process waste waters	100
	b) for cooling water effluent	Total suspended matter content of influent cooling water plus 10%
9.	Particle size of :	
	a) floatable solids, Max	3mm
	b) settleable solids, Max	850 microns
10.	pH value	5.5 to 9.0
11.	Temperature, Max	45°C at the point of discharge
12.	Biochemical Oxygen Demand (5 days at 20°C), mg/1, Max	100
13.	Oils and grease, mg/1, Max	20
14.	Phenolic compounds (as C_6H_5OH) mg/1, Max	5.0
15.	Cyanides (as CN), mg/1, Max	0.2
16.	Sulphides (as S) mg/1, Max	5.
17.	Alpha emitters, uc/m1, Max	10-8
18.	Beta emitters ,, ,,	10-7
19.	Residual chlorine mg/1, Max	1
20.	Arsenic (as As) ,, ,,	.02
21.	Celenium (as Se) ,, ,,	0.05
22.	Ammoniacal nitrogen (as N), ,, ,,	50
23.	Chemical oxygen demand ,, ,,	250
24.	Pesticides :	
	a) Organo-phosphorous compounds (as P) ,, ,,	1
2	b) Chlorinated hydrocarbons (as Cl), ,, ,,	0.02
25.	Fluorides (as F), ,, ,,	15

UTILISATION OF CONVENTIONAL AND NON-CONVENTIONAL MARINE PRODUCTS AND SCOPE FOR EXPANDING THE CONSUMER SECTOR

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INTRODUCTION

India has recorded enviable progress in her fishing and fish processing industries in the past two and a half decades, her annual fish landings reaching 2.3 million metric tonnes in 1975 and export earnings from marine products touching an all time high of Rs. 180 crores in 1977, with 13,000 mechanised boats and over two lakhs of indigenous non-mechanised crafts operating in her waters and providing gainful employment for millions of her population either directly or indirectly. Our country now ranks sixth among the fish producing countries of the world, surpassed only by Japan, Peru, China, U. S. A. and Norway in the order and fish products rank eighth among our foreign exchange earners. These achievements can almost entirely be attributed to a transition from the conventional products like cured fish, dry prawn pulp, shark fins and fish maws to the unconventional export commodities like frozen and canned prawns.

UTILISATION OF FISH IN FRESH CONDITION

Details of total fish landings in the country and their disposition in the six-year period 1957-62 are given in Table-1 (FAO, 1963). Similar figures for the six-year period 1970-75 are shown in Table-2 (FAO, 1975).

A comparison of the figures in the two tables reveals some striking changes that have taken place in the methods of utilisation of fishes in our country during a short interval of less than a decade. In the first place, an almost doubling of the total catches has occurred during the period. Secondly, a spurt has been recorded in the utilisation of fish in the fresh/unprocessed condition from 45.3% of the total catches to 66.7%. This is a very healthy trend which deserves all encouragement as none of the nutrients in the protein rich food material is lost in this mode of utilisation. These changes have been made possible by several developmental activities like introduction of more and more mechanised boats, laying of approach roads to fishing villages, making available large quantities of ice for preservation of the catch, pressing in the services of quick means of transportation like trucks, vans, etc. (insulated, refrigerated and plain), facilitating movement of fish over long distances by employing refrigerated rail wagons (though to a limited extent on selected routes) and, above all, by applying modern norms of scientific and hygienic handling of the fresh fish as recommended by recent researches carried out on post-harvest technology at our research institutions. There is vast scope for further improving and popularising consumption of fish in the fresh condition by an intensive programme of educating the fishermen and fresh fish dealers in the fundamentals of post-harvest technology, which will go a long way in expanding the consumer sector. in this commodity.

As soon as the fish catch is unloaded on the deck of the fishing boat, it has to be washed free of dirt and debris. Sea-water from the distant open sea is quite safe for this purpose, while that near the shore has been observed to be highly contaminated by even faecal organisms and hence should be avoided. The fish are to be sorted out next, larger ones to be eviscerated and degilled and prawns to be beheaded, cleaned and iced. The latter have to be preferably given a dip treatment in a 0.1% solution of sodium metabisulphite for a few minutes and subjected to ice storage without contact with atmospheric air to prevent black spot formation. Exposure of the catch on the deck to the vagaries of atmospheric conditions affects the quality adversely, which can be avoided by stacking the iced fish in proper containers inside fish holds in such a way that the fish do not get bruised or crushed and the ice melt

water from containers at the upper layers do not contaminate the contents of those at the lower layers.

Proper sanitation of the boat decks, fish holds and containers has to be ensured, as they have been found to harbour heavy bacterial loads with even pathogenic and faecal organisms when improperly maintained. After each fishing trip, these surfaces have to be scrubbed free of slime, dirt, blood and any debris and fish fragments with the help of a detergent like teepol or washing soda and disinfected with a germicide like chlorine. Dilute bleach liquor containing 100 and 1000 ppm of available chlorine serves the purpose in the cases of metallic and wooden surfaces respectively. After this step, the excess disinfectant is flushed out with fresh potable water. From this point of view wooden containers are not advisable for storing fresh fish either on board or in processing establishments as their surfaces are difficult to be disinfected properly.

The Indian Council of Agricultural Research has launched an All-India Co-ordinated Research Project by the close of the Fourth Five-Year Plan for investigating into the technological problems associated with long distance transportation of fresh and frozen fish in our country, which has evolved a cheap and efficient container for the purpose (Venkataraman *et al.*, 1976). It consists of a second hand tea-chest insulated inside with expanded polystyrene slabs sealed in polythene sheet to prevent ice melt water from soaking the insulant. Different sizes of the box as available in the market can be used and thickness of the insulation board altered according to weather conditions and distances/durations of the journeys involved. Frozen marine fishes have been successfully transported in similar containers in ordinary, unisulated rail wagons over a long distance of the order of 2360 km from Cochin to Calcutta involving a journey of 70 hours at ambient temperatures and one transhipment at Madras (Govindan *et al*, 1977).

Oil sardine, mackerel, threadfin bream catfish and ribbon fish, frozen in blocks along with glazing water, packed in such containers with 2.5 cm thick expanded polystyrene slabs sealed in 200 gauge polythene sheets and transported by ordinary parcel vans of express trains reached Calcutta still in frozen condition without any icing or other care en route, except ensuring prompt transhipment at Madras. The fish could either be disposed off immediately or preserved in crushed ice for a further period of 3 to 5 days.

While packing fresh fish in such containers for transportation, care has to be taken to maintain the required ice-to-fish ratio and to have ice at the bottom and top layers with alternate layers of ice and fish in between so as to have intimate contact of the fish with the ice. As far as possible, comparatively more ice has to be concentrated at the sides, bottom and top, through which transfer of heat takes place.

By proper application of the available technical know-how, fresh fish can penetrate deeper into the hinterland and be made easily available to the rural and tribal population who are by far the most mal-nourished as far as protein intake is concerned, vastly expanding the consumer sector and ensuring better financial returns to the fishermen community.

DRY PRAWN PULP

Another stricking change that has taken place during the above period in the mode of utilisation of fish in our country as revealed by the two tables is a steep fall in the amount of fish used for preservation by curing from 47.2%. of the total landings of 19.8%. Cured fish (including dry prawn pulp) was the most important of our conventional marine products, which along with some sharkfins and fish maws constituted our entire export trade in marine products in the prewar period, figures for which are given in Table- 3 (Government of India, 1951).

The escalation in export values in the years later of the second world war has been caused by the world wide inflation and greater demand for food materials, the main markets for these commodities being our neighbouring countries like Sri Lanka, Burma, Malaysia, Singapore, Hongkong etc. The post-war recession inflicted a crippling blow to our marine products industry, all the above markets imposing a blanket ban on imports of these commodities, which might have contributed considerably to the triggering of the above mentioned revolution in the utilisation of fish catches in the country. Still curing remains to be an important avenue for utilisation, consuming one-fifth of the total catch.

Even though dry prawn pulp occupied the pride of place among our export commodities in the pre-war period, it has receded into obscurity of late marking an all time low export figure of 36 tonnes worth a mere Rs. 3.85 lakhs in 1976, caused by a diversion of raw prawns for freezing in which form they command an extremely dear market at present. Compared to the freezing and canning industries, the dry prawn pulp industry is less organised and is still carried out as a cottage industry. There is plenty of scope for organising this into a modern industry like freezing or canning. Some of the important defects observed in our commercial dry prawn pulp samples are high moisture content (14 to 35%), high shell contents (2 to 40%) high percentage of broken pieces (0 to 47%) and low shelf life contributed by one or more of these defects. These can be overcome by adopting the following precautions. Fresh raw material alone must be used. In case the raw material has to be stored for longer periods (more than 8-10 hours after catch) it has to be held in ice. Clean vessels alone must be used for cooking. Rusted galvanised iron and untinned copper vessels must be avoided as they contaminate the product with heavy metals which cause discolouration of the product. Prawns must preferably be introduced into sufficient quantities of boiling brine and boiling continued till sufficient degree of uniform cooking of the material is achieved. Drying must be done hygienically on mats without contact with sand etc. to a moisture level of 15 to 20%. Deshelling must be done more carefully. If the traditional method of heating in gunny bags is followed it must be supplemented by hand cleaning. If the best product is desired, the prawns must be peeled, deveined, cooked and then dried or cooked whole hand-peeled and dried. The godowns where the product is stored must be clean and well ventilated with good cemented floors and plastered walls, preferably with a ceiling and rodent proof. The corners of walls should be rounded off so that they can be cleaned easily. Wooden platforms at least 10 cm high must be used for stacking the product and a clearance of 20-30 cm should be left between the walls and the containers. Godowns must be disinfected periodically. Better methods of production of dry prawn pulp have recently been worked out using a steam heated drum and hot air tunnel dryer.

SARDINE OIL

Sardine oil is yet another conventional product, for which the only use in olden days was for smearing on country crafts as a preservative. Recently methods have been reported for scientific extraction of the oil and turning out several valuable industrial products out of it such as factice (artificial rubber filling compound), paint and printing ink bases, lubricating oil etc. (Madhavan *et al*, 1974). Factice is prepared by treating the preheated oil with sulphur at higher temperatures, when a spongy mass resembling rubber is obtained. The unsaturated portion of the sardine oil, when heated for a specific time and treated with rosin gives a resinous product well suited for a paint vehicle. If air is blown through the unsaturated fraction of sardine oil, untill it attains the required viscosity, it can be used as a lubricating oil either alone or in combination with other standard mineral lubricating oils. When the strearin separated fraction is treated with small quantities of rosin and sulphur at high temperatures and thoroughly mixed with lamp black, a good printing ink is obtained.

UTILISATION BY NON—CONVENTIONAL METHODS

The export figures of marine products from the country during the period 1965-77 presented in Table-4 give us some idea of thetre mendous progress that we have achieved in this industry in recent years (Anon, 1977 *a*).

An analysis of the figures for 1976 shows that 97.07% of the export value was contributed by frozen products which included prawns, frog-legs, lobster tails, fish and cuttle fish frozen prawns alone accounting for 89.34%. The fact that prawns form barely 10-12% of the total marine fish landings of the country reveals the pivotal role that they play in our marine products industry. In short, freezing industry, particularly of prawns, virtually represents our fish processingt industry as it is known today and its entire production caters to the sophisticated foreign markets. Frozen prawn was the first ever non-conventional marine product to be turned out in our country and from the modest beginning made in 1953, it has achieved the present magnitude in a short span of just over two decades. We have built up freezing capacities far in excess of the available exportable raw materials and fishes other

than prawns which constitute about 90% of our total fish landings have practically been left untouched by this industry. There is no reason why we cannot make use of the existing idle capacity for preserving our good table fishes so that with some additional frozen storage facilities we can ensure better utilisation of our fishery resources and their more even distribution season-wise and area-wise, which besides bringing better returns to the fishermen, will help immensely in making this valuable source of cheap protein available to our rural and tribal population who require them most. That is to say, we should make the industry more broad-based and service-oriented and divert its attention from the present sole objective of earning foreign exchange to the broader perspective of meeting the needs of the poorer sector of our population. Probably the maritime state governments can contribute a lot in this direction by drawing up programmes for encouraging such endeavours by financial subsidies and technical assistance by way of providing such infrastructural facilities like refrigerated vehicles for transportation, ice plants and frozen/cold storages at all potential consuming centres on similar lines on which technical assistance/incentives are at present given liberally to certain export items. Such activities will considerably expand the consumer sector in this commodity. Technical know-how for preservation by freezing of almost all our important marine food fishes like sardine as glazed blocks, pomfrets as individually frozen and glazed, tilapia in glazed, blocksand individually, seer and tuna in round chunks and fillets, crabs, mussels and clams as raw and precooked, cat fish, hilsa, threadfin bream, black pomfret, ghol and squid has been worked out and is now readily available for commercial exploitation.

UTILISATION BY CANNING

Second in importance among the-non conventional products is canned fish.

This has also been almost entirely export-oriented and centred around prawns. Initiated in the year 1959 with a modest export of 373 tonnes worth Rs. 23 millions, the industry quickly picked up momentum until the record quantity of 2199 tonnes worth Rs. 5.24 crores was exported in the year 1973 and thereafter suffered a steep fall to a mere 102 tonnes worth Rs. 39 lakhs in 1976. As the demand for this commodity has gone down considerably in the world market and as more and more prawns of all sizes are consumed by the freezing industry and becauso of the high cost of the imported tin container, the prospects of canned prawn industry reviving to the old level are rather remote. However, we have now readily at hand the technical know-how for canning preservation of sardine, mackerel, tuna, seer, silver pomfret, black pomfret, hilsa, lactarius, tilapia, polynemus sp. and smoked eel in oil. The method in general consists in dressing and cleaning the fish, a dip treatment in brine, pre-cooking in steam under pressure, filling in cans followed by hot refined oil, exhausring. seaming and sterilising. The sterilised cans are cooled by dipping in ice water, dried, labelled and packed. Processing details so far worked out are presented in Table-6.

Investigations are in progress for standardisation of the methods of canning of our important shell fishes like clams, mussels, crabs and shell fishes like clams, mussels, crabs and squid. There is good scope for expanding the consumer sector in these products both in foreign countries and inside the country, provided the cost of the container and filling medium could be brought down to suit the pockets of the poorer sector of our population as well as to enable them to compete in the highly competitive world market. As these products do not require any cold chain for transportation and distribution like frozen/iced fish, costs on this head could be avoided.

Potential Utilisation by other Non-conventional Methods F. P. C and Bacteriological Peptone

Not all the fishes caught in the trawl nets are equally popular or readily disposable in the fresh state. An All India Co-ordinated Research Project is already in operation for finding out ways and means of utilisation of these less popular/under utilised varieties of fishes with the dual purposes of rendering the fishing industry economically more viable as well as meeting the requirements of a colourless and odourless fish protein concentrate in dry powder form suitable for human consumption from some varieties of these fishes, which can be incorporated with wheat flour in chappathies, bread, biscuit and a host of other similar preparations.

The method consists in dressing and cleaning the fish, cooking in water, pressing, extracting the press cake with an azeotropic mixture of hexane and alcohol to remove the fat and odoriferous compounds, drying under vacuum and pulverising. As this process involves solvent extraction, last traces of which are difficult to be got rid of, a method has recently been reported for preparatiou of the product without solvent extraction by picking the meat from dressed and cleaned fish, woshing, boiling for 5 to 6 minutes, again washing, filtering, partially hydrolysing overnight with 1:1 HCl, neutralising with normal NaOH, filtering, washing, pressing, drying at 70°C to a moisture level of 5-6% and pulverisIng (Setty *et al.*, 1977). A bacteriological peptone suitable for microbiological culture studies and even superior in performance to the best imported brand of the material in promoting growth of marine organisms and terrestrial pathogens has been developed from some of these varieties of fishes (Anon, 1977 b). Threadfin bream was utilised for the purpose. The meat was cooked with equal quantity of water at 0.7 kg/sq. cm steam pressure for one hour, filtered, pressed, press cake suspended in water and hydrolysed at 50-55°C for 8 hours with papain with an enzyme nitrogen to protein nitrogen ratio of 1:20 or 1:30. The hydrolysate was filtered and dried in vacuum.

Shark Liver Oil

Livers of sharks are at present put to maximum use in our country for extracting oil (a rich source of vitamins A and D) for pharmaceutical purpose. All the important maritime states have put up factories for this purpose and the residue left after extracting the oil is used for poultry and live stock feed compounding.

Miscellaneous Non-Conventional Speciality Products

Edible meat picked from the mixed varieties of cheap fishes, free of skin and bones, with the help of a machine and frozen in blocks as fish 'Kheema' has been incorporated in several products like fish soup powder, fish wafers, fish spirals, fish jams, fish, sausages, pet foods etc. either as such or after partial hydrolysis and deodourisation. Beverages incorporating hydrolysates from the meat of these fishes have been developed on the lines on which vegetable proteins are being utilised for the purpose (Prabhu and James, 1975). The fish meat is hydrolysed first with enzymes and to the concentrated hydrolysate, malt, cocoa and sugar are incorporated and vacuum dried. Technical know-how has been worked out for converting such varieties of fishes as well as offal from fish processing industry into fish meal for poultry and cattle feed; by boiling, pressing, drying and pulverising, as also an ensiled product employing lactic acid fermentation which can either be fed to cattle etc. as such after neutralisation or incorporated into materials like rice bran to prepare a dry feed mix (Anon, 1977 c).

CONCLUSION

The foregoing account points to the vast scope for expanding the consumer sector in both our conventional and non-conventional marine products and enumerates the various steps that have to be adopted for the same. The need for diversification in our fishing and fish processing industries from the present export oriented prawns/shrimps so as to make maximum utilisation of our other varieties of fishes by an expansion of the fishing and fish processing activities is indicated. It is high time that we reorient our goals/targets and bestow better attention to our vast rural and tribal population living far below the poverty line with impaired health and severe protein malnutrition. Applications of the findings of modern research in our country in the matters of harvesting, handling, processing, preservation and distribution of our highly perishable fishery resources by hygienic and sophisticated methods will go a long way in expanding the consumer sector both inside the country and outside, besides improving the lot of the lakhs of poor fishermen engaged in the industry. Hence the role of fishing and fish processing industries in any programme of integrated rural development in our country is really crucial.

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TABLE 1. *Disposition of fish catches in India during 1957-62.*

Year	1957	1958	1959	1960	1961	1962	Average
Total landings (000 tonnes)	1233.0	1064.4	822.8	1159.9	961.0	973.9	1035.8
Marketing fresh (%)	42.7	42.7	42.7	47.9	47.9	47.9	45.3
Curing (%)	50.7	50.7	50.7	43.7	43.7	43.7	47.2
Reduction (%)	6.6	6.6	6.6	8.4	8.4	8.4	7.5

TABLE 2. *Disposition of fish catches in India during 1970-75.*

Year	1970	1971	1972	1973	1974	1975	Average
Total landings (000 tonnes)	1745.9	1845.0	1640.2	1958.0	2255.3	2328.0	1962.1
Marketing fresh (%)	67.03	66.01	68.75	65.30	63.72	69.43	66.70
Curing (%)	20.29	19.37	17.49	19.39	23.23	19.00	19.80
Reduction (%)	5.49	5.72	4.98	5.33	4.95	6.00	5.41
Freezing (%)	4.60	5.28	5.01	5.38	4.48	2.80	4.59
Canning (%)	0.70	0.71	0.58	0.81	0.43	0.20	0.17
Miscellaneous (%)	1.89	2.91	3.19	3.79	3.19	2.57	2.93

TABLE 3.

Export of marine products from India in the pre-Independence period

Year	Quantity (Tonnes)	Value (lakh ruppes)
1936—37	20,080	79.62
1937—38	17,200	69.05
1938—39	17,060	69.28
1939—40	18,170	69.71
1940—41	17,560	63.14
1941—42	18,690	60.19
1942—43	19,580	78.30
1943—44	22,130	155.50
1944—45	22,200	225.90
1945—46	28,880	266.30
1946—47	28,720	323.82

TABLE 4.

Export of marine products from India since 1965

Year	Quantity (tonnes)	Value (Crore rupees)
1965	15,457	6.9237
1966	19,153	13.5246
1967	21,764	19.9286
1968	24,810	20.0846
1969	30,584	33.0731
1970	37,176	35.5359
1971	34,032	39.1725
1972	38,271	58.1317
1973	48,785	79.5763
1974	46,629	76.3127
1975	53,412	104.9063
1976	62,151	179.8620
1977	64,957	179.7374

TABLE 5

Itemwise export of marine products from India : 1965-77
(Quantity in tonnes V:Value in Rs. 000)

Item		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Frozen	Q:	7028	8784	11773	14397	21441	22134	23181	30550	35895	34361	46831	47952	47239
Shrimp	V:	41422	88792	129808	156340	262945	242515	313363	508843	658122	637326	943386	1606499	1562206
Frozen	Q:	443	557	786	452	854	2545	1451	1823	2698	1454	1317	3170	2834
froglegs	V:	2624	5576	8817	4891	11890	32899	13774	21709	44979	28652	27983	77970	65967
Frozen	Q:	112	81	128	297	529	382	326	369	380	456	402	513	596
lob. tails	V:	1474	1274	2357	6684	11224	6021	10942	12794	10663	12573	15760	31802	38804
Frozen	Q:	8	2	2	5	16	6	24	21	146	66	134	1583	3765
fish	V:	30	25	12	50	119	42	131	123	731	767	2884	16383	38566
Frozen	Q:	—	—	—	—	—	—	—	—	14	141	1017	648	1088
cuttle fish	V:	—	—	—	—	—	—	—	—	190	1979	29071	1333	17314
Canned	Q:	1148	1523	2200	2238	1661	2578	1864	1058	2199	1516	261	102	128
shrimp	V:	9506	18656	31243	26156	22104	39541	29757	21026	52369	47842	5999	3935	5221
Dried	Q:	1702	1163	1540	1411	835	1486	'684	139	284	116	99	36	235
shrimp	V:	5457	5271	8961	7259	4840	8361	3742	1380	3230	1426	1132	385	1711
Dried	Q:	4431	6551	5147	5388	4329	7269	5941	3478	3388	1748	2295	4668	4220
fish	V:	6522	13246	13238	14045	11658	18368	1382$_0$	7971	10955	6658	9061	17341	22730
Sharkfins & fish	Q:	244	139	296	331	214	282	295	294	254	259	307	268	287
maws	V:	2032	1340	3709	4690	4551	5998	5189	6027	6569	8464	9822	15294	22496
Other	Q:	341	139	492	291	705	491	266	539	3530	6512	749	3211	4572
items	V:	310	866	1141	731	1400	1614	1007	1444	7955	17440	4965	15677	22386

TABLE 6. *Processing details for canning of our common marine food fishes*

Name of fishes	*Brining*		*Pre-cooking*		*Processing*		References
	% of brine	Time:mts	Press-ure :Kg/ Sq. Cm	Time: mts	Press-ure:Kg/ Sq. Cm.	Time mts	
Mackerel	15	26	0.35	45—50	0.91	60	Anon, 1964b
Oil Sardine	15	15	0.35	35—40	0.84	70—75	Anon; 1964a
Lesser (lean) Sardine	26	15—20	Flowing steam	25—30	0.70 to 0.84	80—90	Srinivasan *et al.*, 1966
Tuna	15+0.75% $NaHCO_3$	22	0.84	90—120	0.84	60	Madhavan & Balachandran 1971
Silver/black pomfret and hilsa	20	30	0.49	15	1.05	45	Venkataramna *et al.*, 1970
Seer	15+0.05% $NaHCO_3$	24	0.70	60	0.91	75	Anon, 1965
Lactarius	26+1%HAe	15	0.35	20	0.84	90	Balachandran & Madhavan, 1976
Tilapia	26+03% to 5% HAe	15	0.35	40	1.05	60	Anon, 1968a
Dara	20	30	0.70	15	1.05	45	Anon,1968 b
Smoked eel	10	15	0 49	15	1.05	45	Kandoran *etal.*, 1971

$NaHCO_3$ — Sodium bicarbonate. HAe — Acetic acid.
Exhausting in flowing steam for 8—10 mts. Filling medium:hot refined groundnut oil at 90—95 °C. Can size: 301 x 206.

DEVELOPMENT OF LOW COST PROCESSING TECHNOLOGY FOR FISHES AND SHELLFISHES

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India is the seventh largest fish producing country in the world with a landing of 2.3 million tonnes. She is also one of the leading exporters of processed fishery products earning foreign exchange worth Rs. 1797. 4 million in 1977. While export of frozen prawns registered a steady increase over the past years that of canned prawns declined steeply from 1974 onwards. Irrespective of the spectacular achievements of the modern fish processing industry in the country, the fact that more than 75% of the installed capacity for freezing and more than 90% of that for canning are remaining idle is indeed staggering. The industry having specialised in the processing of prawns, has not ventured into processing of other fish or shellfish.

India has a very long coastline with thousands of landing sites scattered all along. The processing factories are situated in urban and semi-urban centres which offer the necessary infrastructural facilities for handling and processing, because the landing centres situated mostly in rural areas cannot offer any of these. In the absence of an organised and centralised landing system, pooling of the catch and its movement to the actual processing sites pose immense problems. Both freezing and canning involve high monetary investment and several infrastructural facilities including skilled personnel and plentiful supply of raw material for economic operation and hence are not adoptable in the fishing villages in the country.

The under-exploited pelagic resources are sure to add to our fish catch in coming years. Introduction of aquaculture for different varieties of fish and shellfish has great promise. All these are sure to contribute towards sustained increased production of fish in the future which brings in its trail the problem of their proper disposal without wastage. Though scientific transportation of fish has helped in wider distribution of fresh fish, it cannot provide a complete answer. The solution largely lies in processing and preservation of fish and shellfish other than the low-volume high-cost varieties like prawns and lobsters, in the fishing villages themselves which can later be distributed throughout the country, ensuring proper disposal of the fish catch and thereby increasing its per capita consumption. The processing methods to be employed in rural areas should be based on low cost technology, which should cover the requirements for long/short term preservation, utilization of very small and uneconomic varieties of fish and for waste utilization.

Curing

Sun-drying and salt-curing are the oldest known techniques of fish preservation. Though there has been a sizeable decrease in the percentage of fish preserved by this method in India which is attributable to the increase in marketing in fresh form, curing is bound to retain its significant position in processing fish because, this is an easy method of preservation of fish employing a low cost technology.

Cured fish processed by the traditional methods possess several defects such as easy spoilage, attack by moulds and insects, rancidity, discoloration etc. Being a method practised exclusively in fishing villages, any attempt to improve its efficiency will have a direct impact on the betterment of rural economy since an improved product can command a better reception from the consumer and consequently better fiscal returns.

Adequate attention has been paid to problems in the research and development activities pertaining to fish curing. It has been reported that fungus growth and incidence of reddening could be effectively controlled by a simple treatment with propionic acid at 0.5% level (Valsan *et. al*, 1961; Rao and Valsan, 1962 *a*). Similarly propionic acid at small levels has been found to be a very effective preservative for pickled fish (Rao and Valsan, 1962 *b*, 1962 *c*;

Valsan, 1963 *a*, 1963 *b*). A modification has been worked out in the process of Colombo-curing by incorporating a small amount of sodium benzoate along with correct proportion of salt and Malabar tamarind which yields an attractive product with prolonged storage life. (Balachandran and Muraleedharan, 1975). Another modification worked out in the field of pickle curing is to use tartaric acid and garlic at 2% levels each along with saturated brine (Devadasan *et. al*, 1975).

Smoking

Though very popular in many countries, smoked fish is yet to make its appearance in the Indian market. Smoked fish classed among 'delicatessen' products, is succulent and readily acceptable and as such has great demand in the sophisticated markets of the west. Smoking is also employed as an intermediate step in the manufacture of canned products. Smoking has the unique advantage of being a low cost technology easily adaptable to the fishing villages for producing a sophisticated item.

There are two methods of smoking applicable for the rural conditions - hot smoking and cold smoking. In hot smoking process, the fish, after dressing and salting is preliminarily held at about 85 - 90°C for about 20 minutes, the temperature raised to 145-150°C for nearly 25 minutes and then smoked at 95-100°C for about 20 minutes, all the processes taking place in the kiln itself. In the cold smoking process, which yields a more stable product the salted fish, after preliminary drying, is smoked at a temperature not exceeding 40°C. The smoking time varies with the type of fish from 36 to 72 hours. Exact details of the processes depend upon the type of fish and the properties desired in the end product.

Smoking is applicable to several varieties of fish. Attractive and delicious smoked fillets with good storage life have been prepared out of oil sardine employing a process of salting followed by smoking at 70-80°C for 6 hours; splitting, deboning, heat-treatment of the fillets to prevent attack by mites and insects and finally wrapping in cellophane sheets. (Muraleedharan and Valsan, 1976). Mildly smoked and dried mussel meat processed by a simple method has been shown to be on par with similar products popular in overseas markets. Export possibilities of the product are also being explored.

Drying and dehydration

Drying in sun, with or without salting, has been practised all over the world since time immemorial. Since there is absolutely no control over any of the parameters for drying the products always used to be substandard, often contaminated by bacteria, admixed by sand and having high moisture content resulting in early spoilage. The extremely slow rate of drying causes some spoilage even duriug the drying process. However, dried fish has several advantages over other types of processed fish. It is more concentrated, requires minimum equipment and can be stored and distributed comparatively more easily. By bestowing a little more care in the application of the process and providing certain essential facilities like raised cement platforms for drying, protection from animals and birds and by employing hygienic practices in the operation, good quality products can be prepared by sun-drying. Use of tiltable wooden frames with wire mesh support for holding fish which can be directed towards sun will be of great advantage for drying fish. In the case of larger fishes the Norwegian method of drying stock fish *viz.*, split open fish tied in pairs by the tail hung over poles or lines can be advantageously employed. A method of sun-drying Bombay-duck by hanging them on scaffoldings permitting adequate interspace between individual pieces to facilitite circulation of air and escape of moisture (Prabhu, 1972) has been found to be very effective in yielding an excellent quality dry fish.

Development of solar dryers suitable for dehydration of fish will be of great help for application in rural areas. An attempt in this direction has been made by designing and fabricating a pilot model of such a dryer at the Central Institute of Fisheries Technology which can handle 50 kg fish per batch. Split open and salted fish can be dried in this dryer, which develops a temperature of 40°C, in 13-15 day light hours to 20-25% moisture level (Chakraborty, 1976).

Utilization of uneconomical varieties of fish

Development of low cost technology for processing fish should envisage utilization of

uneconomic varieties of fish as also processing waste. One method adoptable is conversion of such material into fish meal. A small scale fish meal dryer which can handle half a ton of raw material per batch has been designed fabricated and trial runs conducted (Chakraborty *et al.*, 1970). Some of the other processes which can be advantageously employed in the fishing villages are mentioned below.

Fish ensilage

Fish offals and uneconomical varieties of small fishes which do not find a ready market can be converted into ensiled products intended for animal nutrition. Minced fish mixed with 10% of weight of molasses to which is introduced an active fermenter will yield an ensile product in 10 days which can be incorporated at 10% and 2% levels into other feeds for poultry and cattle respectively. Alternatively minced fish with 6% (by volume) of 90% formic acid also gives a similar product. Both the products keep well for over an year. The processes are simple, do not involve any sophisticated equipment and no expertise is required in the processing (James, 1966; James *et al.*, 1976). Compounding of a dry feed mix from ensilage using rice bran and other vegetable byproducts also has been successfully done (Anon, 1975).

Fish wafers and fish soup powder

In the matter of utilization of inexpensive varieties of fish, the preparation of wafers and soup powder offers promising prospects. The ingredients for these are given in Table 1. The ingredients for wafers are ground together into a slurry, spread in trays to a thickness of 3-4 mm, cooked by steaming, cut to desired shapes and dried to a moisture level below 6%. The product on frying in oil swells to several times its size and yields crisp wafers. Preparation of soup powder involves cooking the fish meat, mixing with other ingredients, grinding to paste, drying and powdering. (Gopakumar *et al.*, 1975).

Salted fish cakes

Several methods of rapid salting applicable to different species of fish have been reported (Mendelsohn, 1974). An extension of the process to certain varieties of Indian fishes in the preparation of edible fish cakes has been successfully carried out. The method consists in mincing the fish with 20% of its weight of common salt, setting aside for 2 hours with proper mixing for uniform salting, in a screw press and drying in sun (Anon, 1976).

Edible fish powder

Palatable and protein-rich fish powder from low fat fishes like 'kilimeen' *Nemipterus japonicus*) or jew-fish (Sciaenids) has been prepared by employing a process of cooking the picked meat in an equal quantity of water containing 0.5% acetic acid, decanting off the supernatant layer along with any separated fat, filtering, washing the residue, drying pulverising and seiving. The product fed to children in the age group of 1-5 years along with bread, cassava or in a chutney from showed significant improvement in them, particulariy with respect to gain in weight and increase in mid-arm circumference (Anon, 1978).

Chitosan

An estimated 40,000 tonnes of prawn waste comprising head and shell is annually turned out by the prawn processing factories. This can be made use of for the recovery of protein and for production of chitosan, an industrial chemical with wide and varied potential applications, employing a simple technology. Squilla (*Oratosquilla nepa*) which is caught along with prawns while trawling and thrown back into sea at present can also be made use of for production of chitosan, process for which are readily available (Madhavan and Nair, 1974, 1975).

Shark fin rays

Shark fin is already an item of export from our country. The importers process it for the 'rays' used in the preparation of soup. If, in place of fin, the rays are extracted and exported it can fetch better returns as also create local employment potential. Rays are also in demand from high class hotels within the country which is at present met by imports. A very simple and effective method of extracting rays from shark fins making use of acetic acid and involving no equipment other than enamelled bowls and trays has been worked out (Nair and Madhavan, 1974) and field units, working on a cottage scale, have been established making use of this technology.

TABLE 1. *Ingredients For The Preparation Of Wafers And Powder.*

Wafers

Dressed fish meat	2 kg
Tapioca starch	2 kg
Corn starch	1 kg
Refined common salt	50 g
Water	1 litre

Soup powder

Dressed fish meat	1 kg
Refined commn salt	170 g
Hydrogenated vegetable fat	125 g
Onion (chopped)	750 g
Coriander	12 g
Tapioca starch	250 g
Milk powder	100 g
Canesugar glucose	30 g
Pepper powder	15 g
Garlic	5 g
Ascorbic acid	1.5 g

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SESSION VI

MANPOWER REQUIREMENTS AND TRAINING

Keynote Address

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The term "Fisheries" ordinarily connotes hunting the wild stocks of an aquatic animal resource. The present day scientific approach in the field of capture fisheries is mainly employed towards more efficient exploitation and expedient utilisation of these dynamic renewable resources, the objective being to secure maximum sustained yield with minimum effort. Husbandry of aquatic organisms, though an age-old practice in certain parts of the world, notably China and India, had remained unrecognised till recently. The prospects and promise of aquaculture as an industry to contribute towards (i) meeting the world's increasing demand of fish and fishery products; (ii) rural development of large parts of Asia, Africa and Latin Ameirca; and (iii) employment generation, for providing protein rich food have come to forefront only in the last one decade or so. Today the whole world, especially the developing world, is looking forward to aquatic farming as a solution to human problems of nutrition and employment.

The contribution of aquaculture to the total world fish production of 70 million tons is estimated to be only about 6.2 million tons comprising *ca.* 4 million tons of fin fish, 0.6 million tons of oysters, 0.33 million tons of mussels and about 1.05 million tons of sea weeds. Other products, which include, prawns, account for only about 130,000 tons.

Asia is the cradle of aquaculture and we can raise our head high as one of the originators of the art of aquaculture in the historical past. Aquaculture in Asia is estimated to contribute *ca.* 5.2 million tons to the total world aquaculture production of 6.2 million tons. In India the production through aquaculture is still very low.

A tremendous opportunity awaits us to utilise our immense under or unutilised aquatic resources with various simple technologies of aquaculture suited to different ecosystems.

Resources and their utilisation

India has vast and varied aquatic resources. It has *ca.* 6,530 km long coast line covering coastal waters where mariculture awaits development. We have 2.00 million hectares of brackishwater areas for utilisation under brackishwater aquaculture. On the freshwater side we have about 0.6 million ha of ponds and tanks utilised under traditional carp culture, about 0.4 million hectares of readily available ponds and tanks awaiting utilisation for fish culture and 0.6 million hectares of derelict waters, presently practically unutilised, where air-breathing fish culture can be practised Reservoirs alone account for about 2 million ha of water area where the present yield is low, being of the order of less than 10 kg/ha. In addition, the large fluviatile systems of rivers running over 29,000 km furnish a very sizeable capture fishery. The hill streams and coldwater impoundments also offer appreciable scope for development of coldwater fisheries especially of trout, snow trout, Indian trout, mahseers, common carp, etc.

The coast line fisheries basically constitute a small scale industry. Out of a total of 3 million fisherfolk estimated to be living in the coastal area, 1 million are actively engaged in

marine fishery operations employing about 0.22 million indigenous non-mechanised craft using 2.5 million different types of gears. They take *ca* 65% of total marine fish catch and account for *ca*. 60% of foreign exchange earnings from export of marine products.

The brackishwater areas suitable for aquaculture presently remain unutilised except for some parts of Kerala and West Bengal. The cases of utilisation under reference are the traditional "Pokkali" fields for prawn filtration in Kerala and the "Bhasa Bada" fisheries of West Bengal.

A proper utilisation of these resources in a phased manner involving the adoption of high yielding technologies of different aquaculture systems would not only provide higher food production but also gainful employment, especially in the rural sector, to unemployed or under employed labour force who need gainful remunerative employment. Most of the technologies involve low input, low level of sophisticated instruments and are very suitable for adoption by the uneducated rural poor with rudimentary training.

Aquaculture is commonly recognised as labour intensive but high-risk bio-industry. The constructions and operations are largely manual, providing a high rate of employment.

While aquaculture techniques are elastic enough to suit both large scale enterprise as well as small scale operation, in India' with its huge population, prospects are brighter for small scale enterprises. It lends itself to easy integration with other disciplines, especially animal husbandry, duckery, poultry horticulture, sericulture, etc.

Manpower needs

Manpower requirement for forging development of aquaculture on a sound footing has to be assessed in its proper prospective. While the number of aquaculture scientists and researchers are increasing in the country, a new class of aquaculturists, who possess training, experience and a sound knowledge of various facets of aquaculture, has to be created to plan and manage aquaculture enterprises. Our fishermen know how to catch fish but do not know how to culture them.

While it is recognised that various categories of workers would be necessary to implement any developmental plan for aquaculture, the core personnel would have to be aquaculturists, field technicians and extension workers.

The aquaculture scientist will have to have a fairly high level of educational background and orientation training. He has also to possess multidisciplinary theoretical and practical knowledge to meet situations requiring innovations of viable solutions to field problems encountered while implementing programmes of aquaculture.

The field technicians have to be well versed with the techniques appropriate to selected aquaculture systems. They need a thorough practical training and may be specialised only in one aquaculture system like the foreman in a factory representing a particular trade. The extension workers have to be field technicians possessing added qualities of identifying themselves with the actual user of technologies, the farming community. This would call for specialised training in extension techniques.

It is difficult to assess the requirement of trained manpower without identifying the developmental plan and the relative weightages of different aquaculture systems and technologies A few norms have been suggested. One is 3 men per year for 1000 tons increase in production from base level. The proportions of different categories have been put as : "Among every 100 trained manpower, 1 be an aquaculturist. 10 field technicians and 89 extension workers".

A different training requirement would be for the farmers who adopt new technologies. This training would of an ordinary order of theoretical knowledge and would be primarily meant for exposing the farmers to the technology and providing practical training by adopting the technique of 'learning by doing', the same as is currently followed in our Krishi Vigyan Kendras.

Projection of fish demand

Different estimates of fish demand have been projected by different workers. Basing on nutritional needs, it is estimated that the country needs *ca*. 8 5 million tons of fish, as against

about 2.0 million tons produced in India presently, for providing every fish-eating individual 3 oz of fish per day. This computation assumes half the Indian population as fish eating. The National Commission on Agriculture has estimated a total demand of fish by 1985 as 5 58 million tons computed on 11 kg per capita per annum. The Planning Commission in its guidelines for VI Plan has put the demand by 1985 as between 2.8 and 3.4 million tons *i. e.* an increase of 43% to 74% over 1973 production level. In order to meet this demand it is necessary to step up fish production through employment of developed technologies of aquaculture such as composite fish culture, air-breathing fish culture, brackishwater fish culture, mariculture techniques of mussel culture, oyster culture, sea weed culture, etc. These techniques have undergone different stages of viability tesing under different field situations. The composite fish culture technique, developed at Central Inland Fisheries Research Institute, has made an impact and is being adopted widely.

Employment potential

Employment potential depends on the aquaculture techniques adopted. Unit economics and employment potentials are well understood in scientific freshwater and brackishwater aquaculture techniques developed at the Central Inland Fisheries Research Institute.

According to National Commission on Agriculture the employment potential in fisheries may be taken as 2.5 persons per 1 ton of fish produced from aquaculture. Based on this principle, the estimated employment potential for utilisation of inland water reeources is 13.125 million as per tabla below:

The above represents the total employment potential in aquaculture.

In order to train this manpower in fisheries, it would be neceesary to develop phased training programmes at district levels matching it with the actual growth of aquaculture in the country. The Government of India is seized of the problem and has provided, in the VI Plan, more Fish Farmers' Development Agencies (FFDA) in freshwater aquaculture, new FFDAs in brackiswater aquaculture, training centres for brackishwater aquaculture, etc. The target of training is about 250 farmers per year by each FFDA.

Role of I C A R Institutions and Agricultural Universities

The three fisheries Institutes of ICAR *viz.* Central Inland Fisheries Research Institute, Central Marine Fisheries Research Institute, and Central Institute of Fisheries Technology have already geared up their activities to provide extension literature through their information services. Training programmes are specially conducted to create a new class of fish farmers trained in field techniques of aquaculture which can be practised as whole-time occupation or as part-time vocation integrating rural aquaculture activities with other rural occupations.

The Krishi Vigyan Kendras of ICAR are primarily aimed at developing training centres for farmers in modern techniques of agriculture, animal husbandry and aquaculture etc. by bringing the farmers in close touch with scientific institutions which develop and formulate technologies. At the Krishi Vigyan Kendras farmers learn by doing. Two such Krishi Vigyan Kendras have already been set up, one for freshwater aquaculture at Dhauli, Orissa, under the Central Inland Fisheries Research Institute and the other for mariculture of Narakkal, Kerala, under the Central Marine Fisheries Research

System of culture	Resource available (million ha)	Production target (ton/ha)	Total production (million ton)	Employment potential (million men)
Carp culture	1.0	2	2	5
Air-breathing fish culture	0.6	2	1.2	3
Brackishwater aquaculture	2.0	1	2	5
Reservoir fisheries	2.0	25 kg/ha	.05	.125
		Total :	5.25	13.125

Institute. More and more Krishi Vigyan Kendras are being opened. The VI Plan of the ICAR envisages opening of 200 Krishi Vigyan Kendras in the country. Eventually there will be Krishi Vigyan Kendras in each district of India. These KVKs would have competence to teach techniques of aquaculture wherever it holds promise.

To meet the need for trainers in techniques of aquatic farming, the ICAR has another scheme of Trainers' Training Centre. Two such centres, one on freshwater aquaculture at Dhauli under CIFRI and the other on mariculture under CMFRI at Narakkal have been set up. These centres would go a long way in providing trainad manpower for running of training centres by State Governments and other agencies.

Apart from the above, the Central Institute of Fisheries Education, is devoted to provide formal and informal education in fisheries.

Selected Agricultural Universities also provide training in fisheries science and would produce trained manpower for management technicians and research scientists in increasing numbers apart from those coming from traditional Universities.

We thus find that large scale infrastructural facilities are being established to provide the trained manpower for bringing about a revolution in the field of aquaculture in India. However, it is yet to be identified as to whether the training syllabii and intake capacity for different courses would meet the need and be commensurate with the demand of different aquaculture systems and resources planned for development.

Scope for growing horizon of Indian mariculture

Marine fishery resources of India are the coastal and offshore waters along the *ca* 6530 km long coast line of the country. Present capture fishery exploitation is still largely restricted to 20 m depth zone, although with mechanisation 20-50 m depth zone is getting increasingly covered. The entire continental shelf, continental edge and upper continental slope of India fall within our 320 km exclusive economic zone.

We are blessed with *ca* 60.5 m ha of continental shelf, 40.1 m ha lying along the West Coast, 18.4 m ha along the East Coast and 2.0 m ha surrounding Andaman group of islands and Lakshadweep. Of the 40.1 m ha of continental shelf along the West Coast of India, 11.8 m ha is in 50 m depth zone and 28.3 m ha in 50-200 m depth zone Of the 18.4 m ha continental shelf on our East Coast, 6.3 m ha lies in 50 m depth zone and 12.1 m ha in 50-200 m depth zone On both our coasts put together 18.1 m ha lies in 50 m depth zone 11.8 m ha in West Coast and 6.3 m ha in East Coast and 40.4 m ha in 50-200 m depth zone (28.3 m ha in West Coast and 12.1 m ha in East Coast).

We could consider attempting to farm a portion of 18.1 m ha of continental shelf falling in 50 m depth zone in contrast to only 5.6 m ha of total inland aquaculture area of India.

Going by mariculture elsewhere in the world, a number of candidate species suggest themselves for mariculture. Japan cultivates 18 marine species although the cultivated yellow tail *Seriola quinqueradiata* furnishes bulk of the catches. In recent years, the culture of sea bream *Chrysophrys major* has made great strides.

In USA success in developing the technique of mass rearing has resulted in culturing many thousands of Pacific mackerel *Pneumatophorus diego*, Sardine *Sardinops caerulea*, and the anchovy, *Engraulis mordax*. The red snapper *Lutjanus aya* or *L. blackfordi*, the grey snapper, *Lutjanus griseus*, and the summer flounder, *Paralichthys dentatus* are also considered cultivable in mariculture operations.

We in India have several species allied to each of those cultivated in Japan and USA, and elsewhere in the Indo Pacific region. For example, some of our sea breams, snappers, groupers, sciacnids, polynemids, some of our sardines, and even our mackerel are good candidate species for mariculture. Even if we farm 1/10 of our continental shelf lying within 50 m depth zone by sea ranching, we get an additional 1.8 m ha of cultivable area for mariculture which is more than what is available for carp culture in India (viz. 1.6 m ha). Such a development of mariculture will provide avenues for additional employment in our country.

EVALUATION OF PRESENT TECHNICAL TRAINING SYSTEMS IN FISHERIES AND SUGGESTIONS FOR MODERNISATION

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INTRODUCTION

India is presently one of the major fish producing countries in the world. The country has declared an Exclusive Economic Zone of 200 miles. Because of the proposed accent on promoting off-shore and deep-sea fishing, the likely adoption of coatal aquaculture on commercial scale and possible "aquaplosion" in the freshwater aquaculture, our fish production is likely to go up further to an appreciable extent in the near furture. While planning for enlarging the production area and enhancing per-hectare production based on our recent research results is a praiseworthy effort in the right direction, it is equally important to plan for making available suitably trained managerial, technical and operative personnel for effective implementation of the development plans.

The fishery industry is of highly complex multidisciplinary nature, wherein a number of basic disciplines are integrated. But unfortunately, till recently there was complete absence of academic or professional fisheries education in the country, with the result the fisheries establishments had perforce to recruit only graduates in one of the basic sciences, mainly Zoology, for the middle level and higher cadres and matriculates and intermediates for the lower cadres. This naturally necessitated the organisation of a series of in-service training programmes at various levels, both by the Central and State Governments, to enable the recruits to deliver the goods. It was only recently that some serious thought was given to the organisation of regular fisheries education on the lines of the facilities existing in the field of agricultural sciences. It stands to the credit of the University of Agricultural Sciences of Karnataka to start the country's first ever regular professional fisheries degree course at the University level in 1969.

It has been said that "a coherent demand for technical education facilities will not arise from an assortment of industries, but the existence of technically trained people will facilitate the growth of new industries". The industry's requirements are of two types, *viz.* the establishment of a regular fisheries educational system for creating a cadre of professionally trained technical personnel and effective in-service training facilities for the existing untrained staff. As mentioned earlier, while the latter aspect has received considerable attention from the Central and State Governments, the country has only made a beginning in the former.

GROWTH OF FISHERIES EDUCATION AND TRAINING IN INDIA

As per the concept of agricultural universities in India, education in all agricultural sciences, including fisheries, is the responsibility of these universities in their respective States. Prior to the establishment of these Universities, starting in the early sixties, there was no educational institution at University level imparting fisheries education in any State. There were only a few in-service training centres for imparting training in certain specific fields, mostly at lower levels, and a number of fishermen training centres in maritime states for training operatives required for manning the smaller mechanised fishing vessels. The Government of India started in 1945 two all-India fisheries training courses, one at Barrackpore and the other at Madras. While the latter, dealing mainly with marine fisheries, has since been discontinued, the former dealing with inland fisheries is still continuing under a different set up. The Polytechnics in Tamilnadu, Kerala and Andhra Pradesh were also conducting a diploma level training course in fishery technology and navigation, but this is surviving at present only in Tamilnadu. As per the recommendations of the Fisheries Education Committee set up in 1959, the Government of India established two national level institutes, *viz.* the Central Institute of Fisheries Education (CIFE) at Bombay in 1961 and the Central Institute of Fisheries Nautical and Engineering Training (CIFNET) at Cochin in 1963. At about the same time, the erstwhile Government of

Mysore started, with Japanese collaboration, a Marine Products Processing Training Centre (MPPTC) at Mangalore in 1963. The Fisheries Training Institute at Kakinada in Andhra Pradesh was also conducting a two year course in fisheries, but reportedly this has since been discontinued. Except those of CIFNET, MPPTC the Polytechnics and the Fishermen Training Centres, other courses were of in-service character. The University of Agricultural Sciences of Karnataka for the first time started professional fisheries education at University level, through the establishment of the College of Fisheries in Mangalore in July 1969. The B. Tech. (Fisheries) course was started by Calicut University a little later, but it was discontinued after taking in only one batch. The Tamilnadu Agricultural University started the country,s second College of Fisheries at Tuticorin in 1977. A few other agricultural universities are also planning to start similar colleges in the near future, the more serious ones among them being the Kerala Agricultural University, the Konkan Krishi Vidyapeeth and the Orissa University of Agriculture and Technology.

PRESENT STATUS

Details of the various training facilities available in India today in the existing training establishments are briefly described below.

Training courses for fisheries operatives, technicians, junior professional staff and extension workers

Fishermen Training Centres

Starting in 1954, a number of Fishermen Training Centres were established in most of the maritime States, for training operatives required for manning small mechanised vessels, which do not come under the Merchant Shipping Act. The candidates are trained over a period of 6 months to a year in the techniques of fishing in coastal waters with mechanised boats, fabrication and repair of nets and boats, etc. The admission requirement is a pass in V Standard with at least 5 years of fishing experience.

Central Institute of Fisheries Nautical and Engineering Training

This institute, with headquarters at Cochin and a Unit at Madras, prepares the operatives required for the medium and large fishing vessels, which come under the manning regulations of Merchant Shipping Act. The courses offered range from 6 to 15 months in duration, the categories of operatives trained being Skippers, Fishing Secondhands, Engine Drivers, Engineers, Shore Mechanics, Radio Telephone Operators, Gear Technicians, Boat Building Foremen, Fishery Electronic Technicians, and Teachers for Fishermen Training Centres. After the institutional training, some categories of trainees have to put in requisite sea workshop service to qualify for certificate of competency examinations. The minimum entry qualification for these courses is a pass in matriculation or equivalent examination.

State Fisheries Staff Training Centres

These are in-service training centres operating in several of the maritime and inland States for imparting initial fisheries training to junior technical personnel, like Sub-Inspectors, Inspectors, Research Assistants, etc., whose qualifications may range from matriculation to degree. The courses vary from one to twelve months in duration, depending on the level of training.

Central Polytechnic, Madras

A 3-year professional diploma course in Fisheries Technology and Navigation is offered at this institute.

Integrated Fisheries Project, Cochin

This Government of India institute offers short-term training courses in refrigeration (freezing plant operation), fish processing, purse-seining, fishing boat designing and servicing of electronic equipments and engines. It also provides "sea-time" to candidates for Fishing Secondhands' examination and Engine Driver's ticket.

Central Food Technological Research Institute, Mysore

This C.S.I.R. institute conducts a short-term course in refrigeration techntiques involved in food preservation, including fish and meat.

College of Fisheries, Mangalore

For the benefit of junior technical personnel of Karnataka State, the College of Fisheries periodically conducts short-term orientation

courses and refresher training courses on different aspects of fisheries.

A Fish Processing Technicians' course of 3 months duration is also periodically conducted by this College for the benefit of processing technicians employed in governmental and private sector fish processing establishments.

Inland Fisheries Training Unit, Barrackpore

This Unit, which is under the administrative control of the CIFE, offers a one year certificate course in Inland Fisheries Development and Administration to junior fishery officers deputed by the various State Governments, the qualification required being degree or intermediate in science.

Regional Training Centre for Inland Fisheries Operatives, Agra

A 9-month certificate course in fish breeding and culture techniques is offered to matriculate deputees from various States at this Centre which is also functioing under the CIFE.

Central Fisheries Extension Training Centre, Hyderabad

Another Unit functioning under the CIFE, this centre conducts a 10-month course in extension techniques relating to fish culture at post-graduate level mainly for in-service personnel.

Undergraduate degree courses

College of Fisheries, University of Agricultural Sciences, Mangalore

This College conducts a comprehensive 4-year professional degree course in Fishery Science (B.F.Sc), the admission qualification for which is 2-year Pre-University Course or its equivalent. The annual intake of Indian students is 40, with 33 1/3% of the seats reserved for candidates from States other than Karnataka. Upto ten candidates from other countries are also admitted every year. The erstwhile MPPTC was merged with this College on its establishment in 1969.

Fisheries College, Tamilnadu Agricultural University, Tuticorin

Established in 1977, this College offers B.F.Sc. degree programme, more or less on the same pattern as the one at Mangalore, with an annual intake of 20 students.

Post-graduate degree/diploma courses

College of Fisheries, University of Agricultural Sciences, Mangalore

This College offers professional Master's degree programmes (M.F.Sc) in "Industrial Fishery Technology" and "Fish Production and Management", each of two years' duration. Each student has to carry out a programme of research and submit a thesis thereon to qualify for the degree. Only holders of B.F.Sc degree are eligible for admission to these courses, which were started in 1974. Upto ten students are admitted to each programme.

The University has already approved the starting of Ph. D. programme in the College and the same is proposed to be initiated shortly.

Cochin University

Starting in 1976, this University is conducting a M. Sc. degree course in "Industrial Fisheries" over five semesters, each of about 6 month's duration. The course is open to science graduates, the yearly intake being 15 students.

Central Institute of Fisheries Education, Bombay

This well-equipped major in-service educational institution offers a 2-year post-graduate diploma course in Fishery Science D. F. Sc.,) mainly to district level officers deputed by various States, including a few private candidates. Up to 60 candidates are admitted every year. This institute has recently been transferred from the Government of India to the Indian Council of Agricultural Research and is expected to be reorganised into a major fisheries educational centre.

Traditional Universities and Central Research Institutes

Several traditional universities are offering "fisheries" as a special subject in their M. Sc. programmes in Zoology or Marine Biology. But these are far too generalised to be of any real help. However, these universities, the central fisheries research institutes and the National

Institute of Oceanography offer facilities for doctoral research on certain aspects of fishery science.

EVALUATION OF PRESENT SYSTEMS AND SUGGESTIONS FOR THEIR MODERNISATION

Most of the existing in-service training facilities are tuned to the requirements of the present level of the fishery industry and to that extent they may be termed as satisfactory. But in the context of the developing industry's future needs, some of them are rather ill-equipped and require to be modernised suitably.

Fishermen Training

The training imparted in Fishermen Training Centres mainly relates to bottom trawling for prawns in the sea, and the candidates are neither trained nor motivated for other methods of fishing that are possible with the same craft. Techniques of fishing in inland waters and mariculture are left untouched. A "Diversification Seminar" jointly organised in 1976 at Mangalore by the College of Fisheries, Mangalore, the Karnataka Department of Fisheries and the Pelagic Fisheries Project, Cochin, in which three different methods of mechanised fishing were demonstrated, succeeded admirably in inducing the fishermen operating shrimp trawlers in Karnataka to take to purse-seining in a big way, resulting in substantially increased pelagic fish catches in the State. This is a pointer to the possibility of persuading our fishermen to adopt other diversified methods of fishing, if only they are given the required know-how in a telling way.

Now that the technology of coastal aquaculture is fast developing in the country, it would be worthwhile to expand the scope of the Fishermen Training Centres to include training of coastal fishermen in coastal aquaculture techniques (both brackishwater culture and mariculture).

At present, centres for training fishermen in inland fishing techniques seem to be present only in Karnataka and Tamilnadu. Such centres should be established in other States also and their scope enlarged to include training in freshwater fish culture techniques and their integration with agriculture and livestock practices, in the interest of integrated rural development. This is an urgent need in view of the changing socio-economic pattern of rural areas on account of migration, marginalisation and reduced employment opportunities due to progressively advancing mechanisation and automation of agricultural, animal husbandry and fisheries industries. Coastal and inland aquaculture could provide good scope for productive employment of the rural fishermen, combined with artisanal fisheries, agriculture and livestock practices. Techniques for such integrated practices are being developed in different parts of the country and should become available for transfer to fishermen in the very near future.

Training of operatives

The establishment of CIFNET in 1963 was very timely, since commercial mechanised fishing started in India in the late fifties and there was urgent need for qualified operatives for manning the vessels. In the present context there is a need for introducing more of sophisticated modern offshore and deep-sea fishing techniques. A serious lacuna is the lack of adequate facilities for giving "sea time" to the trainees after their institutional training to enable them to qualify for the Certificate of Competency Examinations. The present facilities available at CIFNET, the Integrated Fisheries Project and a few others are thoroughly inadequate even for meeting the existing demands, let alone the high demands of the immediate future. This aspect would, therefore, require urgent attention by the concerned authorities.

Training of lower and middle level technicians

The training of processing technicians as imparted at the College of Fisheries, Mangalore and the Integrated Fisheries Project, Cochin is quite comprehensive and adequate.

The State Fisheries Staff Training Centres are generally run on satisfactory lines. But a proper grounding in the fundamentals of fishery science is often found lacking. Another disquieting feature is the posting of incompetent and untrained or under-trained staff as trainers. If these centres are to continue in the future set-up also, more care is required to be bestowed on the posting of training staff and the course curricula. Aspects of integrated rural development and extension techniques should be adequately covered.

The training imparted at the Inland Fisheries Training Unit, Barrackpore and at the Regional Training Centre for Inland Fishery Operatives, Agra are quite adequate for the respective levels for which they are intended. The extension education imparted at the Central Fisheries Extension Training Centre, Hyderabad relates mainly to inland aquaculture. This should be enlarged to include not only mariculture, but also all other facets of the fishery industry. While a composite course can be offered to managerial personnel, courses in specific areas only need be given to the lower and middle level extension workers, who are to be entrusted with work relating to one or the other specific area only. Special attention must be given to the organisation of extension education in relation to integrated rural development programmes.

Training of higher level technicians, managerial personnel and research scientists

The CIFE has a good programme of training for managerial personnel deputed by State Governments and this has certainly helped in accelerating the pace of fishery development in the country. Now that it has been transferred to the ICAR, it is to be seen whether this essentially in-service training centre is going to be reorganised into an academic professional education centre for imparting fisheries education at undergraduate and post-graduate levels.

Candidates obtaining doctorate degree in fish or fisheries from traditional universities will certainly be useful in research establishments' but may not readily fit in for jobs in the development, teaching and industrial sectors, other than in narrow specialised areas.

The M. Sc. course in "Industrial Fisheries" conducted at Cochin University is not based on related undergraduate programme and thus lacks a sound foundation. Further, the University does not have its own facilities and has to depend largely on the central fisheries research institutes and the industry for giving practical training to the students.

The only well-planned fisheries educational institute offering professional undergraduate and post-graduate degree programmes is the College of Fisheries of the University of Agricultural Sciences at Mangalore. The practical oriented undergraduate degree programme is quite comprehensive and covers all essential aspects of fishery science. These graduates have been found to be highly competent and useful both by government development departments and the industry. The post-graduates (M.F.Sc's) of the College have already made a mark in the Agricultural Research Service examinations by securing top ranks. It is, however, felt that introduction of some general management courses should be/of great help, particularly to those entering the industry. A further need is the building up of adequate training facilities in coastal aquaculture.

The Tamilnadu Agricultural University has organised its undergraduate programme in fisheries on the same lines as at Mangalore. This augurs well for the parity of standards and uniformity in fisheries education in the country.

Holders of the post-graduate Diploma in Fish Processing Technology (D.F.P.T.), produced by the erstwhile MPPTC from 1963 to 1969 and later on by the College of Fisheries upto 1973, are essentially manning the fish processing establishments in the country as Processing Technologists. Since the suspension of this course in 1973, these positions are being taken up by B.F.Sc's.

General recommendations

Number of Fisheries Colleges in relation to manpower

So far no reliable manpower assessment has been made for the fisheries sector. According to one estimate, the country presently requires about 125 fisheries graduates and post-graduates every year for the government sector alone. The needs of the fast expanding private sector are yet to be assessed. At present the private sector is engaged only in fishing and processing, but it is likely to venture into aquaculture in the near future. Against all the above demands, the present turn out of graduates and post-graduates may be put at approximately 100 only. There is, therefore, scope for establishing two more Fisheries Colleges in the country, provided immediate steps are taken to prescribe fisheries degrees for fisheries jobs all over the country, as a preferential qualification for the time being and later on as the only qualification. This will be in the best interest of the country. Otherwise, mere mushrooming of Fisheries Colleges in

different States, without reference to actual needs and without establishing definite employment avenues, would only result in adding to the already taxing unemployment problem. For the present, the existing Colleges and those that may be established in the near future should set a part a sizeable number of seats for other States. as is done by the College at Mangalore.

Reorganisation of fisheries education programmes

It is high time that the country thinks of evolving a regular national policy on fisheries education. As mentioned earlier, education in agricultural sciences, including fisheries is the responsibility of agricultural universities. Therefore, it is suggested that fishery education at all levels may be entrusted to the agricultural universities. All higher education for training research scientists, teachers, managerial and higher level technical personnel may be imparted in these universities proper. The present training arrangements for middle and lower level technicians are mostly of an *ad hoc* nature. Therefore, it may be worthwhile to establish separate Fishery Polytechnics under the agricultural universities to cater to all such short-term and long-term training requirements. The Fishermen Ttaining Centres, which are now being run by State Governments, could then be merged with the polytechnics. Likewise, there will be no need for the central or State governments to maintain any staff training establishments dealing with development, extension, etc. What is now being carried out by such training centres, including orientation and refresher courses, may be wholly entrusted to the agricultural universities All specialist personnel, such as farm engineers, extension personnel, marketing personnel, etc. are also to be prepared by these universities.

The only effective alternative to the above is to think in terms of the system prevailing in Japan and U. S. S R., where fisheries education starts at high school level and culminates in exclusive fisheries universities.

Parity of standards

The country already has a few institutions dealing with higher education in fisheries, which mostly differ from one another in their standards. Coupled with this, a few more fisheries colleges are bound to be set up in the near future. It is, therefore, urgently necessary to take suitable steps to ensure uniformity of educational pattern and parity of standards throughout the country.

Internship

In order to further improve the perfessional competence of fisheries graduates, it may be worth while to introduce compulsary internship for a period of 3 or 6 months before they are conferred the degree. During this period, the students may be made to work in some other institute or industry, depending on the area of their specialisation.

MANPOWER REQUIREMENTS FOR COASTAL AQUACULTURE AND TRAINING NEEDS

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INTRODUCTION

Aquaculture in our coastal waters is still in its infancy, eventhough some of our brackish waters have been used for traditional fish culture (Bhasa-badha fishing of Bengal and paddy-cum-prawn culture in Kerala) for centuries. Indeed several new innovations in aquaculture have been made in some of our fisheries research institutes which can now be developed further and extended to intensive culture of fishes and shellfishes in coastal waters including our large brackishwater areas. The latter alone is estimated to be about 2 million hectares. The long stretch of our coastline (6100 km), dotted with fishing villages, provides vast facilities for culture of several marine organisms of economic value. It is realised now that in this extension each fishing vil age can be taken as a nucleus and aquaculture programmes

developed to integrate these with the already existing capture fisheries activities. Certainly such developments in each fishing village cannot be achieved in a short time, but they can be initiated at certain selected centres (villages) and then extended stepwise further to cover the entire coastline and thus can make use of the idle' manpower available in the villages.

Estimation of manpower requirements for coastal aquaculture at the national level must be based on plans for development proposed for a specified period. As yet, there is no national plan for development of coastal aquaculture in the country. Therefore, for the present paper, certain probable lines of development, in the context of current thinking on the subject, have been assumed and the manpower requirements at different levels of exploitation (intensive or extensive) have been estimated.

The present level of technical manpower employment on coastal aquaculture is mainly at Governmental level, concentrating in research. In the course of the next decade, as assessed now, the 2 million hectares of our almost unused brackish waters and also other potential mariculture areas in the coast will be progressively exploited commercially, with an increasing share of the artisanal fisherman in these developments. How exactly these are to be achieved will be subject of discussion in other papers in this seminar.

Lastly, the training needs for this integrated coastal aquaculture programme by way of establishment of training centres and other educational institutions and their own specialized manpower needs are discussed.

PRESENT AVAILABILITY OF TECHNICAL AND MANAGERIAL MANPOWER

All the maritime states have their own departments of fisheries, a small group in each being engaged in brackishwater fish culture. Besides these the fisheries development corporations of Bengal, Orissa and Andhra Pradesh are taking up brackishwater fish culture at commercial level.

The Central Marine Fisheries Research Institute and the Central Inland Fisheries Research Institute are having several projects on coastal aquaculture and a good portion of their staff are engaged in various research and extension activities connected with coastal aquaculture; of these one important project is the All-India Coordinated Project on brackishwater fish culture which has centres spread over the coastline engaging over 50 persons as technical manpower. The CMFRI has its various projects on aquaculture of prawns, lobster, crabs, molluscs (edible oyster, pearl oyster, mussel, clams); fin fishes (milkfish, mullets, sand whiting etc). and sea weeds.

Besides these, coastal aquaculture programmes, again mainly at an investigational level, are operated in the National Institute of Oceanography, the Central Institute of Fisheries Education and the Agricultural Universities in their Fisheries Colleges (at Mangalore and Tuticorin) and departments and also in certain other Universities.

Recently the marine Products Export Development Authority, Cochin has formulated certain programmes for assisting the development of culture of prawns. Thus the total technical manpower engaged in coastal aquaculture research and development in the country is mainly concerned with research and investigational aspects of coastal aquculture. This number would not exceed 1000 even if all the skilled workhrs are included. Since the accent in the work of most institutions, as it is, is on research, a large group of this consists of highly qualfied manpower.

Some larger industrial concerns such as the M/s. Shaw Wallace and Hindustan Lever and some smaller commercial interests including small farmers have begun exploring the possibilities of coastal aquaculture of prawns. This is a welcome trend and 1st let it be hoped that these ventures will be successful so as to attract more non-Governmental agencies in the field of coastal aquaculture.

Existing facilities for education and training

Manpower requirements for the coastal aquaculture development, as in other fisheries programme, will be of three categories, as recognized by the National Commission on Aquaculture (1976), namely:

i. Those of primary sector consisting of operatives in Fish farms, and other culture set-up and hatcheries, including skilled workers

(trained fishermen), field and technical assistants, qualified with a certificate or diploma.

ii. Those in managerial positions in fish farms and hatcheries, including fish culturists and farm managers-qualified with a degree or post-graduate degree in fisheries/aquaculture/ allied subjects.

iii. Those for research and education, including *research scientists in aquaculture and* teachers in Universities and other aquaculture education and training centres-qualified with a *post-graduate degree and experience*.

Except for the training programme given by the Krishi Vigyan Kendra (Farm Science Centre) attached to the CMFRI at Narakkal and that offered in brackis water fish culture by CIFRI, *virtually there is no other specific training programme* on coastal aquaculture. However I shall list here the present training and educational *programmes in fisheries in general. There is* always the possibility that the existing centres can be modified, if necessary, to add coastal *aquaculture programmes in their activities.* Training in fisheries at primary level has been given in the Fishermen Training Centres of various states (Table 1).

The Krishi Vigyan Kendra (CMFRI), Narakkal, gives training (short-duration courses) specific to coastal aquaculture to several batches of fishermen/farmers. A series of non-formal courses on marine prawns, fish, mussel, seaweed and edible oyster culture are being organized/in this Kendra. (Krishi Vigyan Kendra for Mariculture, Krishi Vigyan Patrika:Mariculture Series No. 1, CMFRI, 1977.)

Short training courses in fish culture for fishermen has also been given at the Krishi Vigyan Kendra, at Pondicherry attached to the Tamil Nadu Agricultural University and also in main campus of TNAU.

Fisheries operatives training available at the Central Institute of Fisheries Nautical and Engineering Training (CIFNET) may not be directly applicable to coastal aquaculture, but some ancillary level assistance of these trainees will also be needed for coastal aquacultural development.

The Central Institute of Fisheries Education at Bombay and its subcentres have different training programmes like Post-graduate diploma (DFSc) at Bombay (40 students/year) and Certificate courses in inland fisheries development and administration at Barrackpore (40 students/year), Fisheries extension at Hyderabad (25 students/year) and Inland fisheries operatives, at Agra. While inland fisheries training programmes are the concern of CIFE centres at Barrackpore, Hyderabad and Agra, Coastal aquaculture programmes can be emphasized in its programmes at Bombay.

Degree programmes in Fisheries are now offered in the Fisheries Colleges of the University of Agricultural Sciences (Bangalore) at Mangalore and the Tamil Nadu Agricultural University at Tuticorin. The Fisheries College, Mangalore has an annual intake of 40 students for B. F. Sc. and 6 students for M F. Sc. The Fisheries College, Tuticorin admits 20 students (likely to be increased to 40) in B. F. Sc. degree annually and M. F. Sc. programmes are also envisaged. Besides, Kerala Agricultural University and the University of Agricultural sciences in Orissa are also actively contemplating starting degree programmes in fisheries. The Cochin University is offering Master's programme in Industrial Fisheries (15 students). Allied programmes in fisheries especially in advanced biological studies are being conducted in several of our general Universities namely Madras, Madurai, Annamala, Kerala, Cochin, Andhra, Bombay and Calcutta.

As training programmes for advanced level workers, both the CMFRI and CIFRI conduct Summer Institutes and short-term and long-term training courses. The CMFRI has offered several such courses on coastal aquaculture. Of specific reference to coastal aquaculture is the CIFRI-MPEDA programme on Fishery Operatives Training on brackish water fish culture (1976).

Assessment of manpower requirements of future programmes

A projection of our technical and managerial manpower requirements for a period of 10 years from 1979 to 1988 is attempted herein. The main base of this projection is the progressive utilization of hitherto unused brackish water area for fish culture and the establishment of other coastal aquaculture centres and its con-

stituent village based units, along the coastline of the country. These two aspects are dealt with separately hereunder and subsequently brought together to assess the total technical manpower requirement and training needs.

Brackishwater fish culture during the next decade

As already indicated we have presently about 2 million hectares of brackishwater area, of which a very meagre portion only is utilized now. A projection of the area which would progressively come under culture in the next decade is indicated in Appendix. 1. It is seen that by 1988 about 0.77 million hectares of brackishwater area would come under culture.

The estimation of manpower requirement for the brackishwater fish culture, is based on the assumption that 50% or 25% of the area utilized would be under intensive culture and the rest under extensive culture (Fig.1). The manpower would be for managing the brackish water farms (fish culturists/farm managers, field/ technical assistants and skilled workers (trained fishermen) and also for collection, production and distribution of fish seeds to the farm. Manpower requirements of these categories have also been estimated yearwise based on the area which would come under intensive and extensive culture, under different stocking conditions Appendices 2-6). While a single stocking density (50,000/ha) has been taken for intensive culture (prawns, fishes), calculations have been made for stocking fishes and prawns by tidal flow only (no stocking of collected/produced seeds), stocking at 10,000/ha and at 20,000/ha. Manpower changes caused by these changes in stocking densities are relatively small, comparing the gross year-by-year changes in area under intensive fish culture (Fig1). From the estimates presented it appears that by 1988 more than 25% of the area under culture would not be under intensive culture.

Other coastal aquaculture systems

Besides the brackishwater fish culture described, coastal aquaculture systems of various organisms of commercial importance can be developed, generating employment potential and additional income in the rural sector. The scope for this development appears vast and it would be left as a challenge to the scientific community in fisheries to develop suitable adaptations and innovations in the culture systems to make them acceptable in the fishing villages. A list of such culture systems which can be developed for adoption in the fishing villages are indicated below:

1. Edible oyster culture
2. Mussel culture
3. Clam culture
4. Pearl Oyster culture
5. Lobster culture
6. Crab Culture
7. Pen/cage culture of fin fishes
8. Sea-weed culture

None of these exist presently as a sizeable commercial culture eventhough the technology for culture of most of these culture systems has been developed to an extent by the efforts mainly of the CMFRI (CMFRI Special Publ. 1 & 2, 1978). It also appears that most, if not all, of these systems can be extended throughout the coast of India at suitable areas utilizing existing technology or after developing improved technology.

The technical manpower requirement was estimated on the basis that by 1988, 36 nucleus culture and hatchery centres would be developed for the various culture systems at different locations scattered along the coastline (See Appendix 5 A). It was further postulated that each of these centres will have 50 subcentres for culture i, e. about 1800 subcentres located in selected fishing villages. The nucleus centres will have highly qualified personnel for research and innovation in culture and hatchery practices and these centres would be responsible for the running of the subcentres/supply of fish seeds etc. to fishermen groups. These advanced centres can also interact with the brackishwater fish culture programmes, already explained- and also the training centres for technical manpower (see following section). The nucleus centres suggested could be within the purview of any existing institutions and perhaps already some such activities are being organized. The exact number and types of cultures will be subject to review after seeing the progress of the developmental activities. The technical manpower requirements for this development is indicated in Appendix 5 B.

The combined manpower requirement for the two phases, namely brackish water fish culture and the other coastal aquaculture systems are indicated in Fig. 1, (See also Appendix. 6). The breakup of the technical manpower (university graduates, non-graduates, skilled workers) is indicated in Fig. 2 and in Appendix. 6. It is obvious that the bulk of the requirement is for skilled workers; fishermen can be trained and recruited for this rural development in both phases as indicated, linking them perhaps to the Fish Farmers Development Agencies programme existing now for freshwater fish culture.

Educational and Training needs

According to the projection shown in Fig. 2 the total manpower requirement for the coastal aquaculture development during the period 1979-88 will be about 62,600 including 4500 University graduates and postgraduates trained in fisheries, 9100 non-graduates and 5000 skilled workers (vide Appendix 7). Facilities required

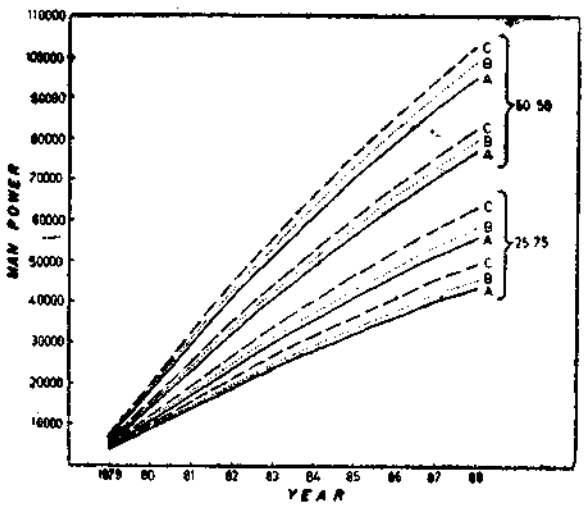

Fig. 1 Projection of technical manpower required for coastal aquaculture development for the period 1979-88. An annual increase of 5% in the area under culture appendix 1 assumed. Estimates have been made for two separate conditions, namely, i) utilization of 25% of of the brackishwater area for intensive culture and the rest under extensive culture (25 : 75), and ii) utilization of 50% of the area for intensive culture (50 : 50). The lower panels of curves under each group denote total skilled manpower (trained fishermen) i. e. excluding graduates and non-graduates. A, B, C, indicate different conditions of stocking in the areas under extensive brackishwater culture - stocking by tidal flow only B - stocking at 10,000/Aa -C- stocking at 20, 000/ha

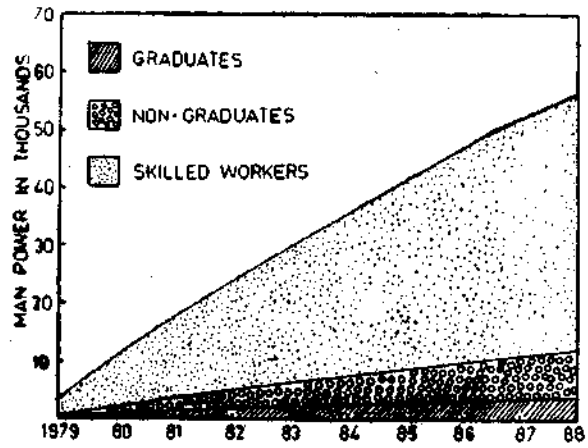

Fig 2. Projection of technical manpower requirements for coastal aquaculture developments for the period 1979-88. Figures estimated assuming a 5% annual increase in the area under brackishwater culture appendix. and that 25% of this area will be under intensive culture and the [rest under extensive culture.

for training the above mentioned personnel will be: (1) 15 univetsity Centres (Fisheries Colleges and others) for production of graduates at the rate of 30 students at each centre annually; some of these centres will have also facilities for post graduate specialisations; (2) 10 centres for training (4-6 months) non-graduates at the rate of 90 students (in two batches) per year; and 3) 20 centres (FTCs and KVKS) for training skilled workers (fishermen) at the rate of 250 fishermen per year (10 batches-4 weeks duration of 25 trainees each) (Table 2). These estimates for training needs are based on an average annual increase estimated over the 10 year period and thus would not correspond entirely to the projection indicated in Fig. 2, but difference may not significantly affect the total picture. There is a good discussion of the facilities required for fisheries education and training in the technical paper prepared by the FAO (Cole and Hall, 1973).

Teaching and Research Personnel

Including the teaching staff in the Universities and the nucleus centres for coastal aquaculture, the total requirement of higly qualified personnel for teaching and research will be about 222 (Appendix 8). Teachers are required further for the training centres, polytechnics etc., most of whom also will be trained in the Universities and also the Centrai Institutes (Appendix 7 III B). Some of the personnel required for training is already available, but

much of the manpower for training facilities will have to be developed, again over the years in the advanced level training programmes (post-graduate level) in our agricultural and general universities and also in some cases by suitable training outside the country i. e. in cases where facilities are not available in India.

INTEGRATED DEVELOPMENT

The requirement of technical manpower for our coastal aquaculture programme of the future has been emphasized at some length. As it appears intensive fish culture in our brackish waters will be restricted to about 25% of the area which would be available. It is possible that the extensive culture as indicated is less practical. Also it is likely that the availability of technical manpower as also the lack of improved technology, for example in fish seed production, and/or its application will restrict the area to be utilised and also the intensity of utilization of the area brought under culture. The latter may be the restricting factor in the expansion of the various other aquaculture systems referred to as well. Both these developments will offer some risk as well as challenge to those taking up coastal aquaculture research and development programmes.

Lead for these activities can be expected to come from the Central Institutions and the agricultural and other universities presently engaged in fisheries research and teaching. As an extension of these activities the proposed coastal aquaculture nucleus centres, as well as the Fisheries teaching institutions with their highly qualified staff, can be expected to take up the new challenge of research and innovation required for future development of coastal aquaculture. There should also be an integration of the activities of the coastal aquaculture centres, university centres and the other institutions engaged in fisheries research and education.

It is indicated that the major portion of the technical manpower requirement for the coastal aquaculture development is constituted by skilled workers, to be recruited among fishermen. This step will generate employment to a good number of rural population, as is indeed attempted now in some fish culture extension programmes. It is hoped that the resultant increase in fish production based on the coastal aquaculture systems would help improve the economy of the rural sector as well.

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TABLE 1. *Existing training facilities for artisanal fishermen at the Fishermen Training Centres of various states in India.*

Name of State	No. of Centres	Maximum intake capacity
Kerala	6	210
Tamil Nadu	7	380
Karnataka	6	160
Maharashtra	4	88
Andhra Pradesh	1	20
Madhya Pradesh	1	50
Gujarat	2	—
Orissa	1	—
Goa	1	—
Lakshadweep	1	—
West Bengal	1	—

TABLE 2. *Requirement of educational and training facilities for coastal aquaculture development*

	Training/ course offered	No. of centres	Duration of the training	No. of students per year/ pere centre	Total No. of students per year	Total man power by 1988
University Centres (Fisheries Colleges and others)	Graduation and post graduation	15	4 years	30	450	4500
Training centres (Krishi Vigyan Kendras and central Institutes)	Certificate and diploma courses	10	4-6 months	45 x 2 = 90	900	9000
Training centres (Fishermen trainiog Centres and Krishi Vigyan Kendra)	Fishermen training	20	4 weeks	25 x = 250	5000	50000

APPENDIX 1

Projection of development of brackishwater fish culture in India for the next decade (1979-88)

Total extent : 2 million hectares

Phase of development year	Area remaining unutilized (in million ha)	Area under culture (in million ha)
1979	1.95	0.05 (2)
1980	1.85	0.15
1981	1.76	0.24
1982	1.67	0.33
1983	1.59	0.41
1984	1.51	0.49 (3)
1985	1.43	0.57
1986	1.36	0.64
1987	1.29	0.71
1988	1.23	0.77 (3)

(1) Assuming a 5% increase in cultured area annually from 1979

(2) Approximate area under utilization including conventional brackishwater culture of Bengal (Bhasa-badha) and Kerala (Pokkali)

(3) George and Sinha (1975) project a value of 0.45 million ha for 1984 and extrapolation of their estimate to 1988 indicates an area of 0.74 million ha.

APPENDIX 2

Projection of technical man power requirement for management of brackish water fish culture in 1988

	50% of cultured area under intensive culture and 50% under extensivec ulture	25% of cultured area under intensive culture and 75% under extensive culture
For intensive culture:		
Area	0 385 million ha	0.1925 million ha
No. of fish culturists managers @ one for every 100 ha of water area	3850	1925
No. of field assistants @ two for every 100 ha of water area	7700	3850
No. of skilled workers (trained fishermen) @ ten for every 100 ha. of water area	38500	19250
For extensive culture.		
Area	0.385 million ha	0.5775 million ha
No. of fish culturists/managers @ one for every 1000 ha of area	385	578
No of field assistants @ two for every 1000 ha of water area	770	1155
No. of skilled workers (trained fishermen @ ten for every 1000 ha of water area	3850	5775

APPENDIX 3

*Projection of technical man power requirement for fish seed collection/production for stocking brackishwater farms in 1988**

Fish Seed Requirement: Total brackish water area under culture : 0.77 million ha.

A. *For intensive fish culture in 50% of the total area*

(Values for 25% intensive utilization are indicated in parenthesis)

Stocking rate : 50,000/ha in the ratio of 7:3:Prawn:Fish

Fish seed required for 0.385 (0.1925) million ha: = 19250 (9625) million

Prawn = 13475 (6737.5) million/crop

Fish = 5775 (2887.5) million/crop

Total seed required for 1 year =

Prawn 3 crops — 13475 (6737.5) x 3

Fish = 1 crop — 5775 (2887.5) x 1

= 40425 (20212.5) million prawn

= 5775 (2887.5) million fish

Assuming 60% survival, the total seed requ irement for intensive culture will be

Prawn seed = 67375 (33687.5) million

Fish seed = 9622 (4812.5) million

(*Based on Ghosh (1976)

B) *For extensivefish culture for 50% of total area*
(75% utilization values indicated in parenthesis)

i) Stocking by tidal flow—no seed to be collected or produced for stocking

ii) Stocking rate:10000/ha in the ratio of 1:1; prawn; fish one crop each per year.

Fish seed required for 0.385 (0.5775) million ha = 3850 (5775) million

Prawn = 1925 (2887.5) million
Fish = 1925 (2887.5) million

Assuming 60% survival, the total seed requirement for extensive culture will be:

Prawn seed = 3285 (4812.5) million
Fish seed = 3285 (4812.5) million

iii) Stocking rate : 20000/ha in the ratio of 1:1: prawn : fish, one crop each per year.

Fish seed required for 0.385 (0.5775) million ha = 7700 (11550) million

Prawn = 3850 (5775) million
Fish = 3850 (5775) million

Assuming 60% survival, the total seed requirement for extensive culture will be:

Prawn seed = 6420 (9625) million
Fish seed = 6420 (9625) million

C) *Total seed required for both intensive (Stocking density- 50,000/ha) and extensive fish culture| Stocking density-10000 ha|.*

i) *Intensive : extensive : 50 : 50*

Prawn seed = 70660 million
Fish seed = 12910 million

ii) *Intensive: extensive: 25:75*

Prawn seed = 38500 million
Fish seed = 9627 million

Note: Similar estimates of seed requirement have been made for different stocking conditions or extensive culture, i. e. stocking by tidal flow only and at 20000/ha

3 D. It is further assumed that 50% of the total requirement will be collected from natural sources and 50% will be produced at the hatcheries.

i) *Seed production in hatcherles*	50% intensive (vide Appendix 3 C (i))	25% intensive (vide Appx. 3C (ii)
Seed to be produced :	41785 million	24062.5 million
No. of fish breeders @ one for production of 15 million seeds :	2786	1605
No. of technical assistants @ two for production of 15 million seeds :	5571	3210

Appendix 3 continued

ii) *Natural spawn collection:*

Seed to be collected :	41785 million	24062.5 million
No. of fishermen (skilled operators) @ one lakh seed/ fishermen/month*	417850 fishermen/ month or 34821 fishermen/ year	240625 fishermen/ month or 20053 fishermen/ year

* Ghosh (1976) gives a value of 60,000/fisherman.

Note: This operation will not be continuous, but will be restricted to the peak availability periods of the year.

APPENDIX 4

Projection of total manpower required for brackish water farming in 1988 (based on Appendices 2 & 3)

		50% of area under intensive culture	25% of areaunder intensive culture
Fish culturists/breeders/managers	=	7025	4110
Technical Field Assistants	=	14050	8220
Skilled workers (Trained Fishermen	=	77200	45100

Note: The estimates are made for a stocking density of 50000/ha in intensive culture and 10000 ha in extensive culture.

Similar estimates have been made assuming a stocking density of 50000/ha for intensive culture and extensive culture under no stocking (i. e. by tidal flow) and stocking at 20000/ha (vide Appendix 6).

APPENDIX 5

A) *Projection of other Coastal Aquaculture facilities in 1988*

Mollusc culture and hatchery centres (Pearl oyster culture hatchery at 4 centres only, namely, Tuticorin, Krusadai, Vizhinjam and Sikka)	— 12 centres
Lobster and Crab culture and hatchery and seaweed culture centres	— 12 centres
Cage/pen culture centres and hatchery for carnivorous/seawater fishes	— 12 centres
	36 centres

Each centre in turn would be responsible for distribution of seeds and creating subcentres at 50 fishing villages nearby.

Hence, total number of subcentres for ancillary culture — 36x50 = 1800 subcentres

APPENDIX 5 continued

B. *Projection of technical manpower requirement at each main centre for other coastal aquaculture systems (besides brackishwater fish farming)*

Fishery biologists	2
Fish culturists/managers	2
Technical assistants	4
Distribution assistants	2
Skilled workers (Trained fishermen)	16

At Subcentres (selected fishing village)

Field assistant	1
Skilled workers (trained fishermen)	2

Total for 36 main centres of other coastal aquaculture systems their sub-eenrtes

Fishery biologists	72
Fish culturists/managers	72
Technical assistants	144
Distribution assistants	72
Field assistants	1800
Skilled workers (trained fishermen)	4176

APPENDIX -6

Projection of technical manpower requirement for coastal aquaculture in 1988. Estimates based on Appendices 1 to 5, for utilizing brackish water area at two different levels of intensity and a stocking density of 50000/ha under intensive culture and 3 different stocking densities under extensive culture are indicated.

Categories of manpower	50% of area(0.385 million ha) under intensive culture			25% of area under intensive culture		
	A	B	C	A	B	C
Fishery biologists/fish culturists/ Fish breeders/farm managers	6882	7096	7309	4081	4188	4508
Field/Technical Assistants	13806	14234	14660	8203	8417	9057
Skilled workers (trained fishermen)	74852	77525	80198	44158	45496	49506
Total	95540	98855	102167	56442	58101	63071

Note: Estimates given are for utilizing brackishwater area at two different intensities, namely, intensive; extensive culture: :50:50 and 25:75, and at a single level of stocking 50, 000/ha for intensive culture and extensive culture at 3 stocking densities: A: Stocking by tidal flow only (none from produced/collected seeds : B: 10000/ha and C: 20000/ha

Similar estimates have been made for the different years according to the brackish water area under utilization (vide appendix 1) and have been used for plots in figs. 2 & 3.

APPENDIX 7

Projection of Training Needs of Technical and managerial manpower for coastal aquaculture in the 10 year period, 1979-1988.

I. A. Total No. of University Graduates and postgraduates trained in Fisheries for coastal aquaculture work: — 4508 or 4500

(to function as Fishery biologists, fish culturists, Fishbreeders, and farm managers

B. 4500 Training facilities required for University graduates and post graduates

Assuming an annual/average increase of trained personnel 450 University graduates will be required, and 15 centres (colleges) will have to train 30 students each. The training will be common for the personnel for other fisheries technical functions. Thus there is need for 10-15 University Centres (Fisheries Colleges and others) for training the graduates.

Each centre/college can be expected to have about 40 highly qualified teachers/ research workers (post graduates), of whom about 10 will be specialists in aquaculture and will also be doing advanced level investigations on problems of aquaculture. Training will be given here in fish farm engineering to enable the graduates, at least at an elective level, to construct brackishwater ponds, dykes, channels, appropriate inlets, outlets etc.

It is realized that the annual requirement of graduates through 1979 to 1988 will not be same. Initially the professional graduates will be available in lesser numbers only and these may have to be supplemented with other graduates with some level of training in fish culture.

II. A. Total No. of non-graduates (certificates, diploma holders) from Krishi Vigyan Kendras (Farm Science Centres), — 9057

Vocational (Fisheries) system of Highery Secondary school and Central Institutes (to function as Field/Technical Assistants) — or 9100

B. Training facilities for non graduates Average annual requirement (See 1 B) : — 910 or 900
4-6 months training at KVKs/Central Institutes for matriculates—shorter course for vocational stream (fisheries from higher secondary schools. 10 centres, each centre training 45 students per batch will train two batches or 90 student/year.

III. A. Total No. skilled workers (trained fishermen) from State Fishermen Training Centres, KVKs/central Institutes. — 49,506 or 50,000

B. *Training facilities for skilled workers (trained fishermen) :*

Average annual requirement — 5000

4 weeks training in fishermen Training Centres, KVKs/Central Institutes : 20 centres, each centre training 25 fishermen per batch will train 10 batches or 250 fishermen/year.

The present programme of FTCs etc. can be reoriented to meet this need, with some additional staff as trained graduates from the University.

APPENDIX 8

Research/Teaching Personnel

No. of Highly qualified personnel (Fishery Biologists) heading coastal aquaculture centres (vide Appendix 5B)	:	72
No. of Highly qualified personnel engaging in teaching and research on coastal aquaculture at University Centres training graduates and post graduates students (vide Appendix 7 — 18)	:	150
Total	:	222

About a third of the number of Research, teaching personnel may be now available the rest will have to be made available in the course of the 10 year period,

TRAINING OF FISHERIES OPERATIVE PERSONNEL

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Fisheries development in India has become multi-faceted, although only about three decades back fishing was of an entirely artisanal character. The programme of fishing vessel mechanisation, use of modern gear materials, development of processing facilities, introduction of offshore and deep-sea fishing and the export trade for the marine products have been mainly responsible for the changes in the marine fisheries sector.

Among the programmes which have led to the present state of development, training has been one of the important links between the resource availability and technology utilisation. Training of operative personnel has been as vital as the training of managerial personnel for the growth of the industry.

On the inland fisheries side, training of operatives has been mostly confined to inland aquaculture and very little has been done on the training of operatives for the capture fisheries as the technlogy for this has not advanced much. The Regional Training Centre for Inland Fisheries Operatives at Agra under the Central Institute of Fisheries Education fulfils the requirements of operatives training. On the marine fisheries side the training is imparted at different levels based on the levels of competency required. The Fishermen Training Centres in different states and the Central Institute of Fisheries Nautical and Engineering Training (CIFNET) are engaged in the training of operatives for the marine fisheries sector.

Fishermen Training Centres

With the introduction of the programme for fishing vessel mechanisation in all the maritime states starting from the early fifties, there was an urgent need for training fishermen for handling the small mechanised boats, use of new gear and for carrying out the fishing operations. The State Governments established Fishermen Training Centres in different regions. These centres have curriculum of training ranging from 6 to 10 months duration. Table 1 provides information on the location of the Fishermen Training Centres, the intake capacity and duration of course. These centres train the local fisher youths for equipping them to use small mechanised crafts capable of exploiting the inshore fishery resources. The fishermen training has played a significant role towards the success of mechanisation programme.

CIFNET

With the planning for the introduction of medium and large fishing vessels for offshore and deep-sea fishing, a need arose for training personnel to man these vessels. The Panikkar Committee on Fisheries Education appointed

by the Government of India in 1958 took note of the requirements for a modern fishing industry and recommended setting up of an operatives training institute. Based on these recommendations, the Central Institute of Fisheries Nautical and Engineering Training, formerly called as Central Institute of Fisheries Operative. was established at Cochin in 1963. Subsequently a Unit of the Institute was established at Madras in 1968 to meet the training needs of operatives for the expanding fishing industry. The CIFNET is primarily engaged in giving institutional and on-board training for candidates who would man the fishing vessels and shore establishments. It offers the following courses of training:

1. Fishing Secondhands Course

The course aims at preparing candidates for the appropriate competency certificate examinations conducted by the Mercantile Marine Department under the Merchant Shipping Act, initially as Fishing Secondhands. The institutional training is of 15 months duration and is followed by 27 months of sea service. Subsequently the candidates can qualify as Skippers of fishing vessels after putting in further necessary sea service.

2. Engine Drivers of Fishing Vessels Course

This course aims at preparing candidates to qualify as engine drivers of fishing vessels for obtaining appropriate certificate of competency issued by the Mercantile Marine Department. It consists of 15 months of institutional training and 6 months at the workshop and 9 months in engine room service. The candidates could eventually qualify as Engineers of fishing vessels after acquiring required further engine room service.

3. Boat Building Foremen Course

It aims at imparting theoretical knowledge and practical training to the candidates to become competent hands in doing and supervising the work in the boat building yards. The candidates are trained in the construction of wooden boats up to 50 feet in length. The duration is 15 months.

4. Fishing Gear Technicians Course

It aims at preparing technicians for the fishing industry who will become competent to design and construct different types of modern fishing gears for operation from the fishing vessels. It is of 9 months duration.

5. Shore Mechanics Course

It aims at preparing technical personnel for manning the shore installations, workshops and slipways catering to the needs of the fishing vsesels for repairs and other connected maintenance work. The course duration is 12 months.

6. Radio Telephone Operators Course

It aims at preparing Radio Telephone Operators who will be in charge of the electronic installations in the fishing vessels such as radio telephone, fish finder, echo sounder, radar, sonat etc. and also in the shore stations. It is of 9 months duration.

7. Teachers Training Course

The course aims at preparing a cadre of trained technical teachers for the Fishermen Training Centres.

Since the establishment of the CIFNET at Cochin and its unit at Madras several batches of trainees have gone out of the Institute and are serving the moden fishing industry in their respective fields. Table 2 gives the number of candidates trained so far in different courses.

Besides the training courses mentioned above, the Institute also conducts *ad hoc* programmes of training for skippers of fishing vessels and fishing vessel engineers. Candidates appearing for the competency certificate examinations are helped to up-date their knowledge in required fields.

Training in other organisations

Besides at CIFNET, operatives training programmes are conducted in a few other organisations in specific fields. The Integrated Fisheries Project at Cochin offers a six-months training course for fish processing technicians, a six-months course for refrigeration technicians and a eight-month course for purse seine master fishermen. The Fisheries College of the University of Agricultural Sciences of Karnataka at Mangalore conducts fish processing technicians course or 12 months duration.

Training needs of small-scale fisheries sector

At present the Fishermen Training Centree provide a generalised course in small mechanises vessel fishing. At a stage when the maritimd states were keenly involved in the introduction of mechanised fishing, the supply of boats from the

government sector was linked up with the training programmes in such a manner that groups of fishermen who have received training will become eligible for the small mechanised vessels with the benefits of subsidy and loan. Therefore, the curriculum was oriented essentially towards the operation and maintenance of these boats. However, today, the picture has totally changed with the private sector coming in a large way to enlarge the fishing activities by introduction of more and more mechanised vessels. Already an estimated 16,000 boats have been introduced in the country.

There is a general feeling that the mechanisation programme has not helped the actual fishermen much who still ply the same traditional crafts and use the same type of gear and continue to remain economically brackward.

It is time that the programmes of the Fishermen Training Centres are critically reviewed and are made to meet the requirements of artisanal fishermen Since these centres are scattered all over the coastline they can rightly serve the technical needs of the fishermen. Diversification must form the theme of training. They must also serve as an integrated training centre dealing with capture and post-harvest technologies, use of infrastructural facilities, non-formal education, health, hygiene etc.

Operatives training in coastal aquaculture

Coastal aquaculture is emerging as a new field with great potential for development both for production of fish and for providing employment opportunities to the fishermen community. The need for training of operatives for coastal aquaculture has already been felt. The Research Institutes which have been responsible for developing the technologies are giving *ad hoc* training in coastal aquaculture to some fishermen and private entrepreneurs. A Krishi Vigyan Kendra on Mariculture has already been set up at the Central Marine Fisheries Research Institute. A Training Centre is shortly to be added to this facility. There would soon be a need to asses the requirements of training of operatives and managerial personnel for coastal aquaculture programme in the country and create appropriate facilities.

We find that although the traditional small-scale fisheries sector contributes to about 60% of the country's marine fish production, it has received very littly attention for improving its operational efficiency and mitigating the hard labour. This sector has not been helped wtih subsidiary vocations to strengthen the economic base. Training is one of the cheapest means of investment for the development and growth of any industry Attention has to be paid to identify the requirements for integrated development of the small scale fisheries sector and to evolve and implement plans for its development supported by suitable training programmes.

TABLE 1. Statement giving details of Fishermen Training Centres in India.

Name of the State	Location of the Training Centre	Maximum intake capacity	Duration (Months)
Kerala	Vizhinjam	40	9
	Neendakara	40	9
	Ernakulam	40	9
	Beypore	40	9
	Cannanore	40	9
	Ernakulam	10	10
Tamilnadu	Mettur Dam	20	10
	Mandapam	60	10
	Colachel	50	10
	Tuticorin	70	10
	Nagapattinam	50	10
	Cuddalore	53	10
	Madras	50	10
Karnataka	Manalore	30	10
	Gangolli	30	10
	Karwar	30	10
	Honnavar	30	10
	K. R. Sagar	20	3
	Bethamangala	20	3
Maharsahtra	Alibag	22	6
	Versova	22	6
	Ratnagiri	22	6
	Bassein	22	6
Andhra Pradesh	Kakinada	20	10
Orissa	Paradeep	—	10
west Bengal	Calcutta	—	10
Goa	Panagi	—	10
Lakshadweep	Kavaratti	—	10
Gujarat	Veraval	—	10
,,	Satpati	—	10
Madhya Pradesh	Nowgog	50	10

TABLE 2. *Number of marine fisheries operarives trained at the Central Institute of Fisheries Nautical & Engineering Training*

Category of personnel trained	Total No. trained		Under training	
	Cochin (1963-77)	Madras (1969-77)	Cochin (1977-78)	Madras
Fishing secondhands	331	206	40	40
Engine Drivers	306	192	40	40
Boat Building Foremen	78	Not offered	6	Not offered
Shore Mechanics	80	6	5	7
Fishing Gear Technicians	91	11	4	4
Fishery Electronic Technicians	76	51	14	9
Trained teachers for fishermen Training Centres	21	Not offered	...	Not offered
Total numbers trained/under training	983	466	109	100

ROLE OF KRISHI VIGYAN KENDRA AND TRAINERS' TRAINING CENTRE IN THE TRAINING OF OPERATIVES FOR COASTAL AQUACULTURE

V. BALAKRISHNAN
Krishi Vigyan Kendra, CMFRI, Narakkal

INTRODUCTION

Agricultural research, development and education have considerably advanced in cur country. However, a big gap exists in transfer of the technologies to the farmers. Unless this gap is filled, the scientific technology developed in agriculture and allied fields cannot be properly harnessed to accelerate production.

Appropriate training of practising farmers, in-service extension staff, and trainers is very essential and crucial in increassing agricultural production. This aspect has received the attention of different educational institutions in varying degrees, but it seems to have suffered in terms of weak subject matter support, introduction of programmes unrelated to the needs of the country, academic approach in methods of training and lack of facilities for practical work. To overcome these serious barriers the scheme on Krishi Vigyan Kendra (KVK) was initiated by the Indian Council of Agricultural Research.

The Krishi Vigyan Kendra concept differs from agricultural polytechnics in that it does not intend to bring out white-collared certificate and diploma holders. The Krishi Vigyan Kendra is designed to provide skill-orientated vocational training to the practising farmers, in-service field-level extension workers and to those who intend to go for self-employment.

The KVK imparts training through the principle of "learning by doing" and is concerned with "techniracy", the aquisition of which does not necessarily require ability to read and write.

KVK ON MARICULTURE

The Central Marine Fisheries Research Institute (CMFRI) has developed several indigenous techniques for the culture of marine and backishwater organisms in the recent past. It has perfected techniques for the successful spawning and rearing of most of the commercially important penaeid prawns. It has also been demonstrated to the farmers that intensive culture of some of the selected species of prawns on scientific lines could be undertaken by them for increasing production.

Aimed at disseminating the technical know-how developed by the Institute to the farm men and farm women on the culture of suitable species of prawns, fishes, shellfishes and seaweeds in the vast water area of the coastal zone

which is now lying unutilised or underutilised, the Krishi Vigyan Kendra on Mariculture was established at Narakkal near Cochin in December 1976.

Training course

While selecting trainees, preference is given to those who own fish/prawn farms and are working in them. But this condition is waived in the case of candidates belonging to scheduled castes and tribes.

At present training courses are offered only in scientific prawn farming and it will be extended to allied fields such as finfish culture, oyster, mussel and seaweed culture shortly. Trainees are given adequate training in the identification of prawns, aspect of their life history, breeding seasons, collection of spawners, breeding and rearing techniques, collection of prawn seeds from nature, improvement in tradltional prawn culture, selection of farm site, construction of farms, preparation of fields for stocking, removal of predators, scientfic methods of stocking selected varieties, culturing and harvesting them, economics of prawn culture, details of agencies financing prawn culture, preparatian of feasibility report for availing loan facilities etc.

The courses are of varying durations designed after taking the convenience of the farmers into consideration. No certificate or diploma is offered to the trainees. During the three years 1977, '78 and '79,* 7 courses of 5 days duration, 14 courses of 10 days duration, 4 courses of 15 days duration and 11 course of 1 month duration have been organised equipping a total of 643 farmers including 186 farm women with the technology of scientific prawn farming. A total of 214 farmers belonged to scheduled castes.

The training courses involve 90% off-campus and 10% on-campus programmes.

Role of women in prawn farming

The Kendra offers training of farm women in the collection, transportation, counting and stocking of prawn seed. Many of the women trainees are utilising their spare time in this work profitably thereby increasing their earning capacity.

Follow-up programme

In order to assess the impact of training in improving the culture practices for increased production and consequent socio-economic changes of the individual farmer as well as the fishing community, follow-up programmes form an important activity of the Kendra. This is being carried out by the staff of KVK through frequent visits to the sites of operation for assessing utilisation of the technology acquired and adopted by the trained hands in their farms.

Soon after completing the trainnig course in the Kendra, one of the trainees realised that the canals amidst coconut groves which had been left un-exploited till then could be used for prawn culture. He possesses about 3 acres of coconut plantation with seven inter cannected canals of 0.4 ha surface area. These canals are connected to a main outer canal, which in turn is connected to the Cochin backwaters. The trainee eradicated all fishes and other predatory organisms from the canals to make them ready for the exclusive stocking of the fast-growing commercially important prawn, *Penaeus indicus*

A total of 18000 numbers of *P. indicus* seed were stocked in the canals. Harvesting was done after a period of 85 days. He got a net profit of Rs. 2215 This has evoked considerable interest not only among other trainees but also among the farmers of such small holdings.

Socio-economic survey

Since the Kendra aims at functioning as an instrument of change for the uplift of the socio-economic conditions of the small farming sector, it is necessary to make a survey to identify the specific needs and problems of such communities. A thorough evaluation of the constraints would enable us to properly orient the training activities and seek solution to some of the problems. With this in view, a preliminary survey of the socio-economic conditions of six villages in Vypeen Island in Ernakulam District, where the Krishi Vigyan Kendra is situated, was conducted.

It has also been proposed to develop the Kendra as a centre for integrated rural development by including activities of other disciplines

* Figures updated at publication

such as agriculture and livestock production in due course.

TRAINERS' TRAINING CENTRE

A scheme for a Trainer's Training Centre for giving training in mariculture to in-service personnel and private entrepreneurs coming from various maritime states of India has also been drawn up by the Central Marine Fisheries Research Institute. The candidates trained at TTC can go back to their areas of operation and transfer the specific skills to the endusers. Such trainers should have an aptitude for rural life besides vast field experience and interest in teaching and extension programmes. Taking into consideration the vast potential of brackishwater and inshore resources of the country suitable for culture of prawns, fin-fishes, oyster, mussel and sea-weeds, the Trainer's Training Centre can play a significant role in providing competent trained expertise to look after the development of coastal aquaculture in different maritime states.

SESSION VII

FINANCING OF INTEGRATED PROJECTS

Keynote Address

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Integrated rural development is a concept under which the beneficiaries are helped to put their resources to the most intensive and comprehensive use so that their returns are maximised. Small-scale fisheries and coastal aquaculture are vocations where this strategy of development could be successfully practised by establishment of integrated farms. To quote an example: A farm model comprising of aquaculture, coconut plantation on the bunds of the culture-pond and annual cropping of cow-peas in the vacant spaces in between the coconuts is a real life situation in a State like Kerala.

It has been estimated that in India there are about two million hectares of lands suitable for aquaculture. The scope for integrated rural development in such a vast area is very vast and the financial requirements very huge.

Even at present integrated projects of the type mentioned above are being implemented. But this is being done in a sporadic and fragmented way. Finances are made available to the small farmers through Land Development Banks/Co-operative Banks/Commercial Banks.

While these efforts could be encouraged, what is really required is a National Scheme covering all the States. The preparation and implementation of this Scheme could be co-ordinated by a centralized agency. This would facilitate implementation of specific projects with a national perspective and mobilization of finance in a very big way. Economically viable projects could be presented to international financing agencies like the World Bank. This would result in ear-marking of funds, as part of the country's planning process, in a much bigger way than would otherwise be possible for specific time-bound projects in different States.

Any project on aquaculture covering different States should necessarily contain the following components:

(a) Investment on scientific surveys of fish seed resources.

(b) Investment on scientific surveys of areas suitable for development.

(c) Investment on development of artificial food for the species cultured.

(d) Investment on simultaneous research efforts to perfect hatchery techniques.

(e) Investment on actual assistance to farmers.

As far as possible, it is desirable tha investments on the various components of the projects are handled through the already established institutions. Creation of new institutions resulting in huge commitments of administr. ation expenditure should be scrupulously avoided. For example, research agencies under the Indian Council of Agricultural Research and Agricultural Universities could handle investments on research. Likewise, the State Directorates of FisheriesL/and Development Banks/Commercial Banks could handle investments in private farmers' fields.

Financing institutions require feasibility studies before they advance finances. In order to enable individual feasibility studiee in respect of separate farmers or groups of farmers, it is desirable that specialised cells are created with the available staff as part of the Directorates of Fisheries.

Small-scale fisheries and aquaculture are fields where a series of cost studies will have to be undertaken so as to facilitate easy preparation of feasibility studies. Capital and working expenses may vary from place to place depending upon the type of land, the type of water-spread and the type of tidal amplitude. There could also be different combinations of technically feasible activities under an integrated programme of aquaculture. Standardised costs in typical real life situations will have to be worked out after actual field work so that this serves as a basis for preparation of feasibility reports.

Under the programme of integrated aquaculture, financial assistance should be given so as to meet the *total requirement* of the farmer, Going back to the farm model of aquaculture, coconut plantation and cow-pea cultivation, the farmer will require capital assistance for preparation of the culture pond and planting coconut and working capital finance for the actual aquaculture, application of fertilisers to coconuts and annual cropping of cow-peas. Any programme of financial assistance in the case of this farmer should meet all these requirements. The feasibility studies also should spell out in clear terms for the assistance of the financing institutions, the periods and the manner in which the assistance given for various long-term and short-term activities would be refunded by the farmer.

Integrated farm units for aquaculture require initial capital investments of a high order. If fresh bunds have to be constructed in one acre of culture pond, the capital expenditure would be of the order of Rs. 11,000 Even if existing bunds of a one-acre land is to be made suitable for culture activities, the expense would be of the order of Rs. 2,000 If one acre of land were to be excavated to a depth of 2½ feet, the expenditure would be about Rs. 40,000 The rate of interest at which such capital could be secured by the farmers, even if assistances comes through co-operative agencies, is of the order of 11 per cent. This is a high rate. Atleast to begin with, the State Government agencies should come forward to provide interest subsidies on capital investments. In the past, subsidies have been given by Directorates of Fisheries for efforts such as acquiring mechanised vessels. In the larger economic interests of the State and of small farmers, such subsidies are worth being given.

Working capital is another major problem. The recurring expenses on prawn culture, for example, would come to about Rs. 4,500/- per acre, rental for land included. Even interest on short-term loan given through co-operative agencies would amount to 9 per cent. This again is a burden which a small farmer cannot afford. The Central Government gives allocations to State Governments from year to year for providing short-term loans to farmers engaged in paddy cultivation. The rate of interest for-short-term loans is usually of the order of 3½ to 4 per cent. Small-scale fisheries and aquaculture also should qualify for financial assistance on short-term basis at the same low rate of interest.

The input requirements of the farmers—fish seed, fertilisers etc.—will have to be met on a no-loss-no-profit basis. Only Governmental agencies can undertake this responsibility.

To conclude: small-scale fisheries and coastal aquaculture is a field where there is vast scope for integrated development; the land resources being vast, financial requirements are huge; that huge finances could be mobilised under a National Scheme covering all States; investments should be handled economically making best use of the existing institutions; the total financial requirement of the farmers should be provided with subsidies for capital work and interest concession for working funds; input requirements should be met on no-loss-no-profit basis; and technical expertise for making feasibility studies should be developed; standard cost-studies should be undertaken to support feasibility studies.

INDUSTRIAL DEVELOPMENT BANK OF INDIA AND ITS ROLE IN FINANCING FISHERIES PROJECTS

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INTRODUCTION

The Indian Ocean covers an expanse of 74.917 million sq. km, with a potential annual sustainable yield of 14.39 million tonnes of fish. However, at present as little as 2.88 million tonnes, i.e., only 20% is being exploited.

On the basis of the 1975 catch, the Indian Ocean yields only 50 kg per sq. km. Even this yield was achieved by the operation of a large number of indigenous non-mechanised crafts (about 0.22 m. of them) and supplemented by a small fleet of mechanised boats. The boats are manned by traditional fishermen; the figures therefore speak well for the effectiveness with which they have exploited the resources. They certainly have served the needs of the country well on several counts - supplying cheap protein, valuable foreign exchange, and relevant employment opportunities. These traditional fishermen of our country, residing on the fringes of the 6000 km of our coastline, belong to communities which have for centuries been involved in this activity. Over the centuries they have evolved their own craft, gear and fishing techniques which are best suited to the local conditions. Their greatest asset, however, is the accumulated knowledge about fish, fish habits, waves, currents and stars in the sky, handed down from generation to generation.

In spite of the significant role played by the small scale fisheries sector, a majority of the fishermen get a very low income and are economically backward. Though in recent years new technologies in fisheries have been developed in India for increasing the production and in turn the income of the fishermen, these could be blended with the agricultural and live stock practices of the area with great advantage. The small-scale fisheries sector will then become more economically viable.

In the context of what the organisers of the Seminar are aiming to achieve, it may be relevant to mention about the concept that is being fruitfully developed presently in some countries, viz., the Integrated Farming System (IFS). This system was originally evolved with the onset of energy crisis and the popularisation of bio-gas technology. It was felt by some that bio-gas plants alone would not be of sufficient economic benefit to the farmer unless they were coupled with the agricultural farming and pisciculture systems. Bio-gas generation is done in the conventional manner by anaerobic digestion of farm vegetable and poultry wastes and adding algae to it. After the generation of the gas, the fermented slury is taken to a pond for growing plankton and the sludge settling down, is used as manure for agriculture. This system, wherever practised as in some underdeveloped region of the South Pacific, has been highly profitable. IFS, therefore, commends itself for consideration in such seninars.

In this paper, an effort is made to delineate the broad range of activities of IDBI relevant to the small scale fishing industry, the type of projects assisted so far and future scope.

ROLE OF INDUSTRIAL DEVELOPMENT BANK OF INDIA (IDBI)

(i) General

Established on 1st July 1964, IDBI is the apex financial institution in India, co-ordinating the term lending operations of other financial institutions like IFCI, ICICI, etc. The IDBI Act of 1964 has been amended from time to time to bring under the fold of its operations several types of activities. In terms of the provisions of Section 2(c) of the Act, IDBI is empowered to finance all types of industrial concerns engaged or to be engaged in the manufacture, processing, preservation or transportation of goods, generation of power, maintenance of machinery, development of land as an industrial estate, fishing or providing shore facilities for fishing or maintenance thereof and so on. As the apex financial institution, IDBI extends assistance in two ways. Direct assistance is given by way of term loans, subscription to underwriting of issues of shares, issue of guarantees, etc. Such

assistance is normally confined to projects involving large capital outlay or sophisticated technology / exploring new technology - which might not find ready support from other institutions.

In the case of smaller units such as cottage and village industries, units in the small scale sector and the medium sized units, IDBI generally extends financial assistance indirectly. One way of availing such assistance for these units to approach the State-level agencies such as State Financial Corporations, (SFC) State Industrial Development Corporations, (SIDC) commercial banks, State Co-operative banks and Regional Rural banks for their term loan requirements. The term loans of these institutions are in turn refinanced by IDBI under its Refinance of Industrial Loans Scheme. Under, this Scheme. the eligible credit institutions such as SFC, SIDC etc, approach IDBI within a specified period after sanction/disbursement of term loans to industrial units to replenish their funds by way of refinance. IDBI provides refinance to the institutions, after satisfying itself about the norms for eligibility generally made applicable to appraisal of industrial projects. Refinance is provided at concessional rates of interest for loans to small scale units under CGS, single truck operators and units in specified backward areas. To ensure that the industrial concerns get the benefit of lower rate of interest, IDBI imposes a ceiling to the rate of interest to be charged by the primary lender. Similar refinancing facility is also offered by the Reserve Bank of India (RBI) through the Agriculture Refinance Development corporation (ARDC) for certain types of activities, but care is taken to see that there is no over lapping of efforts by any institution.

IDBI's assistance to small-scale sector also flows through its scheme of Rediscounting of Bills/promissory notes, arising out of sales of indigenous machinery on deferred payment basis. The Scheme, with its simple mechanism, can be easily availed of by small scale units as purchaser/users of indigenous mechinery.

Till July 1978, IDBI was operating two different types of refinance schemes, viz., Liberalised Refinance Scheme (LRS) and Normal Refinance Scheme (NRS). LRS applied to loans upto Rs. 5 lakhs and covered under CGS of Government of India and loans to SRTOs. The eligible institutions were allowed to club a number of proposals under one application giving essential particulars of the proposals IDBI sanctioned refinance in lump sum for several proposals and only one agreement with the institution was executed.

Under the Normal Refinance Scheme, loans beyond Rs. 5 lakhs to SSI units and SRTOs and loans beyond Rs. 2 lakhs to other industrial units, are considered for refinance. Eligible credit institutions are required to apply separately for each case, enclosing a copy of their memorandum/note for sanction of term loan. If the loan assistance exceeds Rs. 10 lakhs, they are required to furnish detailed information including cost benefit analysis, internal rate of return, domestic resources costs, etc. (these norms are used for judging economic and social cost/benefit for setting up the project from the point of view of the gains to the national economy).

With the introduction of Automatic Refinance Scheme with effect from 1st July 1978, IDBI has replaced the Liberalised Refinance Scheme and put it on an automatic basis, whereunder the sanctions/disbursements of refinance are made fully automatic. This has been done with a view to enable the borrowing industrial units to get the benefits of concessional interest available under. refinance, with minimum time lag between sanction of loan by the eligible credit institution and extension of concession in interest rate to the industrial unit on avai.lment of refinance from IDBI.

(ii) *Role of IDBI in fishing industry*

IDBI Act, 1964, till its amendment in 1972, did not regard the fishing activity as eligible for assistance. The 1972 Amendment to the Act brought under its fold concerns engaged in fishing or providing shore facilities for fishing or maintenance thereof. Though the statute now empowers IDBI to extend direct as well as refinance assistance to concerns engaged in fishing or providing shore facilities for fishing or maintenance thereof, IDBI has so far extended mainly refinance assistance to such units.

Generally loans to industrial units in the small scale sector are eligible for cover under the Credit Guarantee Scheme operated by RBI In that case, they enjoy some advantage by way of lower interest rates. However, the loans to

fishing units without provision of mechanisation are outside the purview of the said scheme. Therefore, loans to such small scale units are not considered under refinance at lower interest. However, the minimum amount of loan eligible for refinance in respect of fishing units has been kept at Rs. 10,000 as in the case of SSI units. Since November 1973, IDBI has been extending refinance to fishing units in respect of loans granted by the State Financial Corporations thus clearly demarcating its area of operations while the commercial banks' advances to fishing units are being refinanced by the ARDC.

(iii) *Operational details of IDBI's Refinancing Scheme*

All types of industrial concerns in the small scale and medium scale sectors such as sole proprietorship, partnership, Joint Hindu Family concern, co-operative society and private and public limited companies are eligible for assistance under the Scheme. However, IDBI's financial assistance has mostly been availed of by the small fishing units.

For the purpose of concessional finance from IDBI, a small scale unit is considered to be one where the original investment in plant and machinery does not exceed Rs. 10 lakhs. A unit is considered as medium scale if the project cost does not exceed Rs. 150 lakhs and the net-worth of the concern setting up the project does not exceed Rs. 250 lakhs (the net worth is taken to be the sum total of paid-up capital and reserves of the concern as on the date of sanction of financial assistance).

The eligibility criteria for IDBI's assistance is that the project should be technically feasible, economically viable and managed by competent people. While applying for refinance the institutions are required to indicate whether the proposal satisfies the requirements of the refinance scheme as well as the guidelines issued by IDBI which are in line with Government policies for financial assistance to industry. The salient items which the eligible credit institutions are required to examine at the time of appraising the project are given in Annexure I.

(iv) Various norms prescribed by IDBI for assistance

a) PROMOTERS' CONTRIBUTION

In order to ensure sustained and continued stake and interest by the promoters in the project, the norms regarding the minimum contribution by the promoters for various projects to be assisted under the Refinance Scheme range from 0 to 20%. Where an institution has prescribed higher contribution or where promoters are in a position to bring in higher share, it is not the intention that the minimum contribution prescribed by the institution should be reduced.

b) DEBT-EQUITY RATIO

The debt-equity ratio for various types of projects has been kept flexible. It may be as low as 85:15 for technician-oriented projects and 100:Nil for road transport operators holding national permits.

The 'Seed Capital' loan received from a State-level agency under the scheme formulated by Government of India for assistance to educated unemployed under the half-a-million job programme is generally treated as equity. Central subsidy to industrial units located in specified backward districts is also regarded as equity for the purpose of calculation of debt-equity ratio, provided it is made available to the unit promptly. It is not, however, treated as part of the promoters' contribution.

Certain agencies of the State Governments have formulated special schemes for assistance to units in specified backward districts/areas. These schemes, interalia, include unsecured loans linked to sales-tax on soft terms which are in the nature of quasi-equity. IDBI has decided to treat such loans as equity for debt-equity ratio, provided (i) those loans are granted on unsecured basis, (ii) the relative funds are available for financing the project and (iii) the repayment of such loans normally starts after payment of institutional loans.

c) DEBT-SERVICE COVERAGE RATIO

The repayment period of the loan is required to be fixed by the primary lending institution with due regard to the cash generation of the project. For this purpose, an average DSCR of 2:1 has been accepted as the reasonable norm. The DSCR is to be worked out in the following manner:

$$\frac{\textit{Net profit} + \textit{Depreciation} + \textit{Interest on long term borrowings}}{\text{Repayment of term borrowings} + \text{Interest on term borrowings}}$$

The important benefit to the ultimate borrower under IDBI's refinance scheme, as mentioned earlier, is the levy of a lower rate of interest on the term loan. As the fishermen operating the mechanised fishing trawlers/boats belong to the weaker sections of the Indian economy, the benefit of concessional finance should be made available to them. It will be seen from below that, if an industrial unit has been sanctioned a term loan of Rs. 1 lakh for mechanised trawlers costing Rs. 1.50 lakhs, it will be benefitted to the extent of about Rs. 21,000 by way of reduction in the interest payable to the eligible credit institution over a period of the loan (say, 7 years) as the normal rate charged by SFC is about 14-14½% and the ceiling rate under IDBI refinance for specified backward area is 9.5%. The interest rate structure under IDBI refinance applicable to fishing units is given below :

Interest rate structure under
IDBI's Refinance Scheme
(Since 1-12-1975)

	IDBI's rate	Ceiling on primary lenders' rate
	(per cent p. a.)	
i) Normal rate	9.00	12.50
ii) Concessional rate in respect of loans upto Rs. 5.00 lakhs	7.50	11.00
iii) Special rate for units in the specified backward districts/areas	6.00	9.50

CONCLUSION

As assistance by IDBI has generally been provided by way of refinance to the State Financial Corporations only and that also mainly to concerns operating in the coastal States. total assistance to these units including fish catching and processing has so far been limited. In 1976-77 and 1977-78, IDBI sanctioned assistance to 315 and 352 units amounting to Rs. 5.73 crores and Rs. 3.53 crores respectively. The loan refinanced by IDBI in individual cases ranged between Rs. 50,000 to Rs. 1,50,000. As mentioned earlier, IDBI's assistance to fishing units has mostly gone to the small scale sector and for purchase of or building up of mechanised vessels, trawlers, etc.

A party from the coastal area of Bombay by initially investing Rs. 55,000 was able to implement a Rs. 2 lakh project for purchase of mechanised vessel.

Similarly, another party from Ratnagiri district initially investing Rs. 68,500 was able to implement his project of catching fish and transporting it to other places.

Similarly, as on 1st July 1978, under the Bills Rediscounting Scheme out of the face value of bills of machinery for fishing units of Rs. 69.97 lakhs, Rs. 50.40 lakhs was discounted.

IDBI has made its refinance scheme fully automatic in respect of loans upto Rs. 5 lakhs and also dispensed with the minimum limit of loans eligible for refinance. Similarly, separate limits have been provided under Bills Rediscounting Scheme of IDBI. for exclusive use by the manufacturers/sellers or purchasers in the small scale sector. It is hoped that these facilities to the small fishermen for purchase of fishing boats would hereafter be availed of by those concerned in a greater measure.

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* Source for introductory chapter - Article of Mr. John Kurien in the Economic & Political Weekly, September 9, 1978.

ANNEXURE I

Items to be covered by Appraisal Reports

I. THE COMPANY

A. *Description of the company and promoters*

a) Name, nature and evolution, date and place of incorporation of company; address and place of business;

b) information on ownership, promoters and actual control of the company: mainshare holders and their holdings; foreign particpiation and control:

c) information on other companies with substantial involvement by sponsors and main shareholders;

d) subsidiaries and. their relationship to company;

B. *Operational and Financial Record*

1. *Operational Record* (where appropriate, also of subsidiaries)

a) description of existing facilities;

b) recent expansions, diversifications, acquisitions and consolidations of production;

c) annual volume of production and sales; also broken down by principal product lines—for at least three years;

d) trends in sales and prices;

e) utilisation of productive capacity;

2. *Financial Record*

a) audited annual accounts for past three years;

b) comments on profitability and financial strength of company; financial ratios;

c) inter-corporate investments made during past three years, with reasons therefor;

d) qualifications in previous audit reports;

e) value and behaviour of market price of company's shares.

C. *Management and Organisation*

1 *Board of Directors and Management*

a) names and relevant qualifications, experience;

b) major past and proposed changes;

c) list of other concerns in which each of the directors is interested as director/partner/proprietor;

d) degree of dependence on key management personnel.

2. *Organisation*

a) organisation chart; functional definitions; staffing;

b) communication channels within and between departments, delegation of responsibility;

c) internal control system (personnel, productivity inventory, costs etc.);

d) decision instruments (reports, emetings, etc.);

e) planning, scheduling and budgeting.

3. *Labour relations*

a) effects of labour legislation, union, practices;

b) labour participation in management; wage scales, social security, other fringe benefits, incentive systems.

II. THE PROJECT

A. *Description and Facilities*

1. *Project purpose and design*

a) description of project and its purpose;

b) review of alternative production processes and their relative efficiency;

c) justification for selected processes.

2. *Machinery*

a) list of principal machinery required;

b) availability (local, imports) manufacturers' delivery times, services and provision of spare parts;

c) basis for selection (Prices, quality, plant scale, compatibility of new equipment with existing facilities and future expansions, etc.);

d) specifications of selected mechinery-capacity (broken by main products), number of shifts, days of operation/year;

e) equipment for pollution control.

3. *Location*

a) address of chosen location; acquisition or rental;

b) availability of land, allowance for future expansions;

c) alternative plant locations;

d) suitability of chosen location; access to labour, market;

e) site development requirements;

f) access to rail, roads or other means of transportation.

4. *Utilities* (fuel, water and sewage, power; steam, telephones etc.).

a) sources, contracts, costs or prices;
b) adequacy, reliability, stand-by facilities, other special arrangements.

5. *Legal Aspects* - operating licences, construction permits, approval by regulatory agencies, insurance regulations and coverage, etc.

B. *Raw materials and products*

1. *Main raw materials*

a) sources, supplies, availability (present, future) and seasonal variations;

b) quality;

c) prices, price trends, import duties dependency on imports, foreign exchange requirements and availability;

d) concessions, contracts, trade credits;

e) stock required.

2. *Products*

a) specifiations (quality, size, packaging, etc.), suitability or applicability to market conditions;

b) product mix;

c) output volume and value, seasonal factors affecting output;

d) inventory levels;

3. *Quality control*

a) facilities;

b) testing standards (wastage factors, assumed rejection rate); research.

4. *By products* - sale or disposal.

C. *Labour*

1. *Requirements and availability*

a) sources and quality of manpower by categories of skills;

b) training requirements programme and facilities (local, abroad);

c) need for foreign expertise or instruction (temporary or permanent);

d) project's attractiveness to labour; estimated labour turnover; problems with relocation.

2. *Labour relations*

a) supervision of labour;

b) impact of (additional) labour on unionization, wage scales, fringe benefits, labour participation in management, etc.

D. *Engineering and Construction*

1. *Bidding and Construction*

a) conditions, fees;

b) contractors' and sub-contractors, names, experience and technical competence;

2. *Project Execution Responsibilities* - names, definition and division of responsibilities.

3. *Implementation Programme*

a) construction and start-up timetable; delays;

b) capacity utilization time-profile; output flexibility (volume, quality, product mix).

4. *Maintenance*

a) estimated down-time;

b) spare parts.

5. *Technical Assistance*

a) advisors and consultancy arrangements (names, experience, description of services, duration of contract, guarantee and penalty provisions, etc.).

b) access to know-how and research, technical innovations, patents, licences, copyrights;

c) trade-marks, fees and royalties, other expenses; infringement claims known or anticipated.

E. *Cost and Financing*

1. *Total cost and breakdown by local and foreign currency*

a) fixed investments (land, site development, roads, housing, plant construction, machinery and equipment, pre-operational expenses, contingencies)-dates of acquisition, estimated life to machinery c. i. f. prices, handling charges, duties and exchange rates, installation costs;

b) working capital requirements, seasonal or cyclic variations;

c) tax liabilities of project;

d) investment schedule over time;

e) costs incurred to date;

f) reasonableness of cost estimates including contingencies.

2. *SFC/Bank financing*

a) purpose, currency and form (loan, equity participation, guarantee)

b) terms of financing; schedule of disbursements and repayments; security;

c) conditions and covenants of financing (restrictions for issuance of new debt or securities, distribution of dividends, stock options, etc.).

3. *Other sources of financing*-(Sources, terms, conditions, security, etc., where appropriate)

a) internally generated funds;

b) sponsors' contribution;

c) deferred payments (trade credits);

d) equity participation and loans by third parties.

4. *Credit by local or national banking system*-availability and types of short-term credit, letters of credit, overdraft and other privileges.

III THE MARKET ENVIRONMENT

A. *The Industrial Sector of the Proposed Project*

1. *Evolution*

a) time-series of industry's output:

b) present position and importance in the country's manufacturing sector;

c) world market situation and prices.

2. *Linakages with other sectors of the economy*

B. *The Government* (local, state and central)

1. *The government as a regulator*

a) strategic importance of the project to the country; relationship to the government's development plan.

b) licences to operate, permits to import, to deal in foreign currency to contract abroad to establish foreign operations or receive international participation; authorization; to issue stock, grant of franchises, monopoly privileges;

c) direct or indirect participation in project, role as client, supplier, competitor or owner; political influence or control over sponsors.

d) profit remittances and capital repatriation;

e) price and profit controls.

2. *The government as a fiscal authority*

a) fiscal incentives applicable to the project (tax holidays, exemptions from duties, protective triffs import or export quotas or subsidies, tax-refunds, accelerated depreciation, exemption from taxes on asset revaluation, etc.);

b) value of government receipts from and subsidies to the project.

C. *The Market*

1. *Actual Consumption* (historic)

a) consumption of domestic goods and imports; total and per capita consumption;

b) classes of buyers, product end-uses and consumption patterns; sectoral, regional, seasonal;

2. *Supply Situation*

a) imports and local production;

b) names of existing competitors, trade names, reputation and public image; their capacity and its utilization;

c) market shares;

d) nature and degree of competition (cost structure, price, quality, products or services); merger possibilities.

3. *Prices*

a) domestic ex-factory; imports; wholesale and retail;

b) seasonal and regional variations; trends, factors affecting price determination;

c) estimates of future prices.

4. *Potential Supply and Demand*

a) market studies or surveys (name and competence of research team);

b) demand estimates for domestic and export markets (at least 5 year forecast);

c) estimates of domestic production, imports, and market shares for at least 5 years;

d) start-up dates and capacities of other new projects;

e) regional supply and demand situation.

D. *Commercial Aspects of Project*

1. *Sales Forecast*

a) product prices (domestic and export), company's price policy;

b) forecast profitability range of sales volume and value.

2. *Marketing plan*

a) contracts for sales (domestic and exports),

b) promotion, advertising (publicity agencies) media, budget;

c) credit policy towards customers.

3. *Distribution*

a) sales and distribution organization (names, quota, margins and geographical distribution);

b) retailers' marketing expertise.

IV. FINANCIAL EVALUATION (for expansion projects evaluation of incremental as well as over-all costs and benefits).

A. *Operational performance*

1. *Operating costs and profits*

a) cost structure, fixed and variable costs,

b) unit costs by products;

c) break-even-point as percent of capacity utilization;

d) operating profits and profitability by product line.

2. *Financial statements* (forecast for the ten operating years)

   a) income statements

   b) cash flow statement

   c) projected balance sheets.

3. *Financial indices* (forecast and evaluation of company's future financial situation)

   a) Liquidity ratios -

      — current ratio

      — acid ratio

      — debt service coverage;

   b) Solvency ratio (long-term debt/ equity);

   c) Profitability ratios

      — profit margin (gross profits/ sales);

      — net profit/turnover ratio;

      — profitability ratio (net profit/ equity);

   d) Other ratios

      — receivable turnover;

      — average turnover (sales cost/ inventory), etc.

B. *Financial Return*

1. Internal (financial) Rate of Return.
2. Sensitivity analyses, risks and uncertainty, influence of key variables on return.
3. Return to investors

   a) past dividend distributions and future policies;

   b) earnings per share, etc.

V ECONOMIC AND SOCIAL EVALUATION

A. *Economic Effects*

1. Benefit-Cost Analysis

   a) economic rate of return;

   b) sensitivity analyses.

2. Riskiness and impact of changes in relative prices and devaluation on the economic return.
3. Impact on return of alternate mix of productive factors and of alternate timing for project implementation.
4. Rate of return on national capital (where appropriate).
5. Other effects

   a) on growth and country's development programme (balance of payments import substitution, etc);

   b) economies of scale;

   c) externalities-utilization of idle productive capacity, creation of new markets, transfer of technology, stimulation of new industries interdependencies with other projects, etc.

B. *Social Effects*

1. Employment (local, national): direct and indirect effects

   a) rates;

   b) new job opportunities.

2. Income Distribution, standard of living; modification of consumption habits;
3. Other social effects

   a) training of local labour and management;

   b) improvement of literacy level of local population; improvement in health, nutrition and housing conditions.

C. *Ecological Effects*

1. *Hazards to man and environment*

   a) safety – accident prevention; fire, explosion, earthquake, noise, radiation, etc.

   b) effluents and wastes-solids, liquids vapours and gases, by-products' disposal or recycling, problems and recommended investigations, local regulations; claims or suits of vested interest groups.

FINANCING SMALL FISHERMEN — A CHALLENGING TASK

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In an agrarian country like India emphasis on land has been given for agricultural purposes and there has been a tendency to regard water masses as lost surface, unless they form a part of irrigation system. Therefore the potential for such waters for fishery has been neglected till recently. It has now been recognised that fishing industry has a vital role to play in our economy and community life particularly in the coastal regions Taking into consideration the anticipated increase in population we have no other way than to look to the sea which still remains unconquered The aquatic animals have been a substantial source of the world supply of protein, Fishery products are not just another from of food; nutritively, they rank high because they contain lot of minerals and vitamins. In addition to the more important benefits like providing nutrient food and contributing to national income, the fishing industry promotes employment opportunities. Importance of fishery development programmes needs no emphasis in a country like India where an average diet is deficient in protein and vitamin contents.

Inland Fisheries

Under Inland Fisheries, fish production is taken up in tanks, ponds, lakes, beels and swamps all of which constitute a very large part of available water resources in inland. Their potential for intensive production is the highest. Three species of carps, i.e. Catla, Rohu, Mrigal are widely used in fish cultural practices all over India. Despite recent development in the technique of fish breeding, the major source of fish seed supply on commercial scale still continues to be the rivers. For co-ordinating and promoting fish farming activities Fish Farmers Development Agencies have been organised in various states at the district level. The Agency receives active help from the concerned fisheries department. Since the development of tanks, ponds, beels etc. undertaken by the Fish Farmers Development Agencies, forms integrated inland fishery schemes the same is capable of yielding sizeable returns and commercial Banks are extending financial assistance for this purpose.

Normally, while formulating the schemes for development of inland fisheries, the following important technical aspects are considered:

a) Size of ponds or tanks, whether seasonal or perennial.

b) Ownership of the tank — whether by individuals or owned by Government or Local Bodies

c) Source of water supply

d) Expenditure on de-silting, de-weeding, de-watering etc.

e) Supply of fish seed — source of supply and rate.

f) Operational cost — cost of fish, cost of feed, cost of manures, etc.

g) Arrangement for marketing and technical supervision.

Marine Fisheries

Under Marine Fisheries inshore fishing, offshore fishing and deep-sea fishing could be discussed.

Inshore Fishing: It indicates fishing in inshore waters upto 10 fathoms (1 fathom = 6 ft) depth from the coast. Fishing operations in these areas are mainly conducted by employing small fishing boats which are not mechanised.

Offshore Fishing: It indicates fishing in the area between 10 and 40 fathoms depth, which is done mainly by mechanized fishing boats, which are made of wood and vary from 25' to 50' in overall length. The boats are equipped with oil engines.

Deep-sea Fishing: Refers to exploitation of fishery sources beyond 40 fathoms. For this purpose the boats have to be larger in size, because they are required to undertake fishing voyages of 7 to 10 days duration. The vessels are made of steel and normally exceed 50' in

overall length, and are equipped with engines of 200 BHP and above.

The intensity of fishing is at present limited to a coastal belt of approximately 5 miles in width. The bulk of the catches is landed by non-mechanised boats, and 0.05 million tons by methods that do not require boats (e.g.) Beach-seine, stake-nets, etc. The mechanised boats account for 0.35 million tons and catch from deep-sea fishing vessels is almost negligible.

The inshore fishing, where the operations are carried out by employing small fishing boats is otherwise known as traditional fishing. About 60% of marine fish production is by traditional fishing, a sector which has so far received relatively less attention. This sector requires increased attention both from the point view of achieving additional fish production as well as from that of improvement of the socioeconomic conditions of fishermen. As per the available statistics the number of fishermen in marine sector is nearly 10 lakhs. Kerala alone accounts-ed for 1/3rd of the above fishermen population followed by Tamil Nadu, Andhra Pradesh and Maharashtra, each having marine fishermen population of over one lakh. These small fishermen follow traditional methods of fishing with shore-seines, catamarans, dugout canoes and plank-built boats. Introduction of synthetic twines has significantly increased catches from the traditional fishing in recent years. In view of the larger number of fishermen, fishing craft and gear employed in this sector, any plan of fisheries development, should take into consideration the potential for increased fish production in this sector.

In view of the poor socio-economic conditions of fishermen and in particular their chronic indebtedness to middlemen who advance loans and control marketing of fish, Government encourages the establishment of fisheries co-operative societies, particularly with a view to undertaking marketing. These societies have been functioning by and large as credit societies. With the advent of social control and Bank Nationalisation, banks also stepped into the development programmes initiated by the Government for the benefit of fishermen community. The programmes need not only an integrated approach, but also active participations of fishermen, scientists, social and financial agencies. The ultimate beneficiaries of the programmes belong to the low income group and economically backward segment of the society who are in dire need of being educated, organised and helped.

Taking into consideration, possible areas of operation, investments needed and above all the social and economic benefits that would accrue to the communities, schemes for purchase of fishing nets and catamarans, dug-out canoes, nylon nets, have been drawn. In most of the cases, financial assistance was given for replacement of old catamarans and fishing nets. The areas of operation, not only included in-shore areas, but also backwaters, wherever they exist. While drawing up schemes, the infra-structural facilities available - like road, marketing, cold storage, etc. will be taken into consideration. The estimated daily catch, average income per day, capital expenses for the boat with nylon nets, will all be considered while finding out the economic feasibility of the scheme. It is also ensured that marketing is done in an organised manner, either through the fishermen's co-operative societies or through reputed exporters. To facilitate and transport either by road or water, assistance is also extended to marketing agencies. In Kerala, Social Service Organisations where the fishermen enroll themselves as members, assist the financing Banks in supervising the lending operations. In other areas, community development block officials help the Banks. Loans are granted to the experienced group of fishermen and payments towards purchase of boats, catamanans, canoes, nylon-nets, etc. are made direct to the suppliers after obtaining a consent letter from the borrowers. A very nominal rate of 11% p. a. of interest is charged and in eligible cases who come under the purview of differential interest rate scheme, an interest at 4% p. a. is charged. In those areas, where the Small Farmers' Development Agencies are functioning, the fishermen are eligible for a subsidy of not less than 25% on the cost of the item to be purchased. The repayment programme of the loan will be so fixed that the period of repayment extends over 20 months. Instalments are payable on monthly basis.

Due to lack of organised marketing and in view of the indebtedness to the middlemen who control the marketing of fish, the repayment becomes irregular and in some cases it is totally

absent. The Fish Farmers Development Agencies organised in inland areas are doing useful work, not only in assisting the Bank in supervising the operation of the scheme, but also in recoveries. The services of such agencies have to be extended to the coastal regions also. Like in a few states, fisheries development corporations may be constituted in all the maritime states and union territories. These corporations may open procurement depots in coastal areas where the fishermen can market their daily catch.

To sum up, immediate steps are to be taken for revitalising the existing marketing arrangements and also for organising an effective marketing system for the benefit of fishermen. Our suggestion in this regard is as follows:-

1. Establishing Fish Farmers Development Agencies in all the coastal regions, which will provide training to selected persons in fish culture, facilitate grant of loans by Banks, arrange necessary technical support and organise marketing of catches through co-operatives.

2. Fisheries Development Corporation to be established in all the maritime States and Union Territories and they should open procurement depots in the coastal areas.

New technologies in fisheries, particularly in the field of coastal aquaculture are being developed in India. The findings are now being disseminated to the identified areas which are ready for immediate implmentation. To cite an example, the prawn culture technique is gaining momentum in Kerala backwater areas.

The Central Marine Fisheries Research Institute, Cochin, has made a break-through in prawn culture, and now the technique has largely been welcomed by the fish farmers belonging to the coastal districts of Tamil Nadu, especially Thanjavur. Similarly the composite fish culture technique developed by the Central Inland Fisheries Research Institute, Barrackpore, is adopted in many of the inland fishery areas.

Integrated approach

The present seminar sponsored by the Central Marine Fisheries Research Institute, Cochin, aims at an integrated approach to ameliorating the present status of the fishermen. An integrated action plan is to be drawn for the development of coastal/rural sector. In this context, the scientists, administratives and bankers have to paly a vital role to achieve an overall development of the fishermen community. It is emphasised that there is vast scope for prawn culture activities in the east coasts, especially in river-sea confluence areas. It is to be ensured that proper training is given to the interested fish farmers and adequate technical staff are to be posted in the project areas for technical supervision. The need for supply of seeds and marketing can hardly be over emphasised if the industry is to be developed by taking advantage of the modern technology. In addition, supply of the inorganic and organic manures and artificial feed so as to increase the productivity of ponds and tanks is to be ensured in the project areas. Above all, a lot of extension work is necessary, before new techniques—whether it is composite fish culture technique or prawn culture—are adopted by the fish farmers. When the above schemes are taken up in the nature of of integrated fishery schemes which should be capable of yielding sizeable returns to the small fishermen, the Commercial Banks will come forward without any reservations to extend funds for the successful implementation of the schemes.

SESSION VIII

PLANNING STRATEGY FOR INTERGRATED DEVELOPMENT OF THE COASTAL ZONE

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INTRODUCTION

We may describe planning as a science which logically deduces from observed facts and demonstrates the consequences arising out of them. The facts embrace a wide field of observations, very often dependent on controversial conclusions.

Systematic development planning in India, starting about three decades back, has been maintaining as its objectives the utilization of resources to increase production, providing a stable economic base for growth, and improvement of average living standards in the country, keeping in mind the need for removal of regional disparities as well as socio-economic differences among the people. Periodic evaluation of results has led to a gradual de-centralization of the planning process in vertical integration. It has, however, yet to reach the grass-root level.

The strategy adopted was to have investments in selected projects which would serve as growth centres, which in course of implementation would send out growth impulses, resulting in development of surrounding areas fulfilling the outlined plan objectives. It is now seen that the growth impulses have only a limited range and a new look at the 'Growth Centre Model theory' has been necessary.

This paper reviews the situation and suggests an approach in planning and execution to benefit the lowest level.

REVIEW

The coastal strip, by and large a backward rural area, is covered mostly by small fishing villages along India's 6100 km of coast line. Marine fish production, using traditional methods, by about 3 million fishermen is currently estimated at about 1.4 million tonnes. This works out to a per capita production of less than half a ton of fish per annum. The marine fishermen are almost completely landless and have no real root in their villages. Sometimes they shift enmass to a different site. There are no subsidiary industries like mariculture, agriculture, cottage industries etc. to enable them to have a stable economic base. As a result, they are the poorest community in India.

Identification of problems of coastal fisheries development after detailed study both by national and international experts had been made in early stages of planning. Focus had been made on introduction of mechanized fishing as a measure to increase per capita production, with ancillary arrangements for training, processing, storage, transport and marketing. It had been expected that the traditional fishermen will be indirectly benefited. Socio-economic development of the fishermen as a whole was relegated a minor priority.

Economic considerations channelised the industry to shrimp trawling, processing and export being done by merchants. The benefit went to a few thousand traditional fishermen who took to mechanised fishing and had increa-

sed production and income. Traditional fishing, which produces practically all the fish protein for consumption in the country apart from substantial contribution of shrimp for export was left to the fishermen themselves. This is seen in the relatively small investments made by the state in developing the indigenous fishing industry. A major malady which continued to affect the economic condition of the traditional fishermen was the exhorbitant demand made by private financiers for return on the ' risk ' capital supplied by them. This was sought to be mitigated by planning fishermen cooperatives initially supported by the state and later by providing institutional finance. This did not produce appreciable results. Issue of large number of mechanised boats on very liberal terms, without corresponding reduction or diversion of traditional fishermen to other sectors, lack of regulatory measures in some areas on fish resources or fishing grounds are factors which are likely to have reduced the per capita production of indigenous fishermen. This is leading to increasing number of clashes between traditional sector and the mechanised operations. Investments in housing, education, communications, health and other civic amenities for the coastal fishermen have also been small. Most of the special fishery roads constructed for approach to fishing villages have gone out of use for want of repairs. Where harbours for commercial purpose have been built, priority has gone to more organised sectors of industry.

CURRENT DEVELOPMENTS IN TECHNOLOGY AND APPROACH TO PLANNING

The various researches on marine fisheries being conducted in India have, at least in some fields, reached a stage when the fishermen can supplement their income by taking up subsidiary industries, provided necessary assistance on a liberal scale in the beginning is available for the fishermen. As examples may be stated certain items of mariculture, mussel and oyster production. The main facility required, apart from technical assistance, is land or water area to be given to the fishermen on a long-term basis. There is considerable conflict in this matter. The same land and water resource is often claimed by various industries and actually included under each as its potential. Thus industries like salt production, plantations of cashew and coconuts, saline resistant agriculture, discharge of factory effluents and construction projects like harbours with their labour colonies and townships clash among themselves when allotment of land is required.

The present practice of allotment of land individually to each industry without a comprehensive study of the environment or the suitability of other industries has not led to optimum use of the land and water area with preservation of environmental conditions. However, the problem has not assumed serious proportions as the fishing industry on the marine coast occupies only the sand belt required for the fishing villages and other industries are not many and they are scattered.

NEW APPROACH TO PLANNING

New thinking of planning from grass-root level for the benefit of the poorer section and the importance given to coastal plantations now make it imperative that the fishing industry and fisher folk should claim its due place in the plan. The integrated rural development plan is an attempt to reach the agriculturist at the lowest level.

Recently, in November 1978, the Agricultural University of Orissa organised a workshop in a group of six undeveloped villages to discuss planning at grass-root level, failure of the present efforts to reach the poorest section and formulate guide lines for future planning. (Approach paper to village planning:¡Kalinga Prize Silver Jubilee Celebration Workshop) The seminer was attended by top-level administrators and technicians who went into the villages and studied the broblems at site. The discussions culminated in an action plan. The main theme was to have detailed area planning of all resources to ensure their optimum utilization combining growth and need based models. The action plan was to demonstrate improved techniques, decentralise administration and have liberal inputs. The most important consideration was to have small parcels of land given to landless farmers on a long-term basis out of a large area with a preplanned cropping pattern enabling them to secure inputs from Banks, improved technology being provided by service departments. This line of approach has considerable importance for the development of coastal villages, introduction of mariculture and ensuring a stable economic base for the actual fishermen.

APPROACH TO PLANNING

Referring back to the definition of planning the observed facts are enumerated below:

1. In spite of three decades of plan implementation, the coastal fishing villages remain economically at a very low level.

2. The growth centres of mechanised fishing have not appreciably stimulated growth in the remote areas, comprising of the poorest section of people.

3. An economic base has not developed for the traditional fisherman.

4. New techniques to utilise various other marine and coastal resources are available for introduction among the fishermen and other coastal population.

5. Vast tracts of the coastal belt remain undeveloped due to lack of communications, apathy, organised planning and execution in spite of these areas being covered by Community Development Blocks.

6. There is unhealthy competition among various industries in some places and general lack of consciousness regarding the environment.

7. The poorer sections are unable to get institutional finance, not being in long-term possession of land or water area.

A proper approach to planning will be to plan on the basis of areas stratified according to resource potantials and environmental conditions. Plans should cover both economic and civic service items—in fact a total plan, on short-term and long-term priorities. It can start in a selected number of blocks through out the maritime areas in the country.

PLAN POLICY

In anv particular field of economic development, the policy will be to attract participation by actual workers in the field and encourage them to develop an economic base, managing his unit, marketing being assisted centrally as a service. It is not desirable to insist on co-operatives till a common interest has evolved. Taking an example, a large area suitable for shrimp farming can be designed and alloted in parts to individual landless fishermen on long-term basis to enable him to secure finance. Technical services, fry supplies and marketing may be arranged centrally. It is time that insistence on cooperatives be given a plan holiday. If the situation permits, there should be no objection to accommodate private enterprises with special skills and capital. This will lead to more rapid pace of development.

ADMINISTRATION OF THE PLAN

Total planning in integrated areas will need an authority which can take quick decisions in implementation; in other words, decentralised powers to the extent possible. Technical section of the authority will be the most essential part as planning has to be done using techniques of many disciplines and success of the scheme will depend on the excellence of planning and technical guidance during execution. If the level of know-how is low it will be economical in the long run to employ experts on short-term basis. Suitable arrangements have to be made for demonstration and training.

STRATEGIES OF FISHERIES DEVELOPMENT IN KARNATAKA

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Development of small-scale fisheries in the two coastal districts of Karnataka, *viz.*, South Kanara and North Kanara is by far a success story. In the modernisation of marine fishing industry of Karnataka, almost all under the small-scale sector, an investment of about Rs. 22 crores has been made in the last two decades. The whole fleet of coastal fishing industry today consists of about 1,500 mechanised boats trawling for prawns in inshore waters, about 100 seiners purse capturing pelagic fisheries of mostly mackerl and sardine and a very few mechanised gill net boats. Besides, there are about 8,000 indigenous dugout and plank-built boats partly engaged in traditional coastal fishing and partly in fishing in rivers and backwaters. On the fish preservation and processing side, 58 ice plants, 32 cold storages, 25 freezing plants and 4 mod-

ern fish meal plants, 12 canning plants and about 25 boat building yards and several fish transport trucks used for marketing form the infrastructure. In short, today the economy of these two coastal districts of Karnataka depends on the fishing industry and therefore it can be said that the small-scale coastal fisheries development has played a successful role in rural development of the coast of Karnataka. The average annual marine fish production of Karnataka is about 80,000 tons valued at about Rs. 12 to 13 crores at landing centres.

Fisheries schools

Planning of coastal fisheries development started with long-term planning of primary education to fisher children in a number of fisheries schools started and managed by the fisheries department for the last three decades which has laid a strong foundation for development of the coastal fishing industry. Side by side, development of infrastructural facilities, specially of providing fisheries roads to about 77 fishing villages (total length about 104 km) connecting them to the highway during the last two decades, has had a tremendous impact on the improvement of the fishermen since their catch could be preserved with ice and moved fast on these roads to reach the markets in a prime condition and fetch better returns. The part played by these fishery roads in the total development of small-scale coastal fishing industry is very big indeed.

Mechanisation programme

The modernisation of fishing craft was introduced in Karnataka only since 1957 and, initially, fully constructed boats were given to groups of trained fishermen on a loan-cum-subsidy basis by the fisheries department. The groups of fishermen did not have any investment of their own in these boats in the initial stage since they were too poor for this. Side by side, training centres were established to train fisher youths in the operation of mechanised boats and groups of five from among these were selected for distribution of boats constructed departmentally. These mechanised boats were engaged in trawling for prawns in coastal waters since prawns were an export commodity and could get them good value.

Simultaneously with this development, the department had to transfer the technology of building mechanised boats and for the purpose the state started two boat building yards at Mangalore and Karwar where improved and specially designed boats were constructed. The boats that were distributed to groups of fishermen were first constructed in these Government boat building yards. Later, this technology was adopted quickly by local boat builders who put up their own yards to cater to the needs of private fishermen who wanted to go into mechanised fishing for self employment.

As the tempo picked up and the economic conditions of fishermen started improving, instead of supplying fully constructed mechanised boats, department started distributing marine diesel engines to groups of fishermen on loan-cum-subsidy basis whereas they had to finance the building of hulls by other means. Later on, the department started giving subsidies for procurement of mechanised boats through institutional finance to enterprising individuals and groups of fishermen. This scheme helped to extend the scope of mechanisation and the limited budget grants could be used for introduction of larger number of boats. Along with this, the Cooperative Sector was also encouraged for the procurement and distribution of boats under the Agriculture Refinance and Development Corporation Scheme and about 340 small mechnised trawlers were supplied through the Cooperative Federation to groups of trained fishermen supported by subsidy from the Department. Experience had shown that for successful redeeming of the loan, the group of fishermen had to be homogeneous and that an initial investment by the groups themselves, however small, was necessary.

Infrastructure facilities

With the progress of mechanised fishing, infrastructure facilities like ice plants, cold storages and freezing plants were initially provided in the Government Sector in selected fishing centres and later, private agencies were given incentives to start ice plants by offering subsidies to these units. Cooperatives as well as the State Fisheries Corporation were also eligible for such subsidy. With finance from commercial banks, necessary infrastructure concerning preservation and processing came up quickly in Karnataka and by 1977-78 a stage has reached when such assistance was not felt necessary. Mention must be made of the part played by the

nationalised banks, two of them established in the Karnataka State itself, *viz.* the Syndicate Bank and Canara Bank. Other banks which had their Head Offices in the coastal districts of Karnataka, *viz.* the Karnataka Bank, the Corporation Bank and the Vijaya Bank also took special interest to the fisheries development and these banks were also responsible for the quick all-round growth of the marine fishing industry of Karnataka, including the export industry, since they were convinced that fishing industry was the backbone of economy of the two coastal districts.

Parallel to the development of modernised fishing industry, landing and berthing facilities were provided at important fish landing centres through the assistance of Government of India under the Centrally Sponsored Scheme. Karnataka has about 19 river-mouth ports from where these small mechanised boats could operate and, in most of these, basic facilities like jetties and auction halls were provided.

Fisheries Corporation

A State Fisheries Development Corporation was set up to ptovide additional infrastructure facilities which the private entrepreneurs could utilise for both processing and export with the result that quite a number of entrepreneurs from the fishermen community itself have availed of these facilities. The State is at present exporting marine products worth about Rs. 11 crores every year. In such areas where it is difficult for the small scale enterpreneurs to venture, like deep sea fishing, the Fisheries, Corporation is taking the lead. The latter is now operating two 57' trawlers and is contemplating on procuring a few more trawlers for offshore fishing.

Purse-Seine revolution

In order to stabilise the marine fish production and to bring in additional fishery resources under mechanisation, the department has encouraged purse-seining by groups of fishermen with the help of institutional finance and support of subsidy given by the department. In the last two years, the purse-seine "revolution" is going on in Karnataka and at present there are about 100 purse seiners already operating and another 80 are being constructed in Karnataka. There has been a spectacular investment of about Rs. 8 crores by commercial banks and financing institutions in the last two years in purse-seining since the operation was highly successful commercially. The boat building programme to meet the demand for this fleet has led to many ancillary economic developments in the coast giving further boost to the rural economy.

The introductian of purse-seining has had a definite impact on the pattern of marine fish production in Karnataka. While the 1 500 small mechanised trawlers introduced during the last twenty years have been able to contribute only about 30,000 to 35,000 tonnes of fish, which was about 25% of the average annual catch of the State, the advent of purse-seines has remarkably improved the situation. In 1977-78, fish production from the three sectors was as follows: traditional gears—62,321 tonnes; 1,500 small mechanised trawlers—33,500 toonnes; and the 52 purse—seines—30,800 tonnes. For the first time fish production from the mechanised sector had a predominant share (51%) in the total production in Karnataka. This trend is likely to grow further with the additional number of purse-seines being added rapidly.

In order to avoid possible clash of interest between the traditional Rampany units of Karnataka coast and the modern purse-seiners, the Government has launched a special schome to assist Rampany operators to go in for purse-seining with financial assistance from commercial banks suitably supported by soft loan and subsidy from Government. Twenty such units were sanctioned last year and 20 more are being sanctioned this year. Each unit of purse seine costs about Rs. 4.00 lakhs and the assistance consists of a subsidy of Rs. 20,000 for the net and Rs. 20,000 seed money as soft loan advanced by the State Fisheries Corporation. The Rampany unit, consistihg of about 80 to 100 fishermen, which is more or less operated like a cooperative unit, will have to invest Rs. 20,000 and the remaining amount of Rs. 3,20,000 is is advanced from commercial bank. Ultimately as many Rampany units that are interested to go in for purse-seine will be assisted with special incentive by the department. This is in line with the policy of "growth with equality and social justic" of the National Plan.

Diversification to gill net fishing

To encourage futher diversification, the department has proposed to offer subsidies for gill

net fishing, for dug-out canoes or for fibreglass boats fitted with in-board or out-board engines along with a set of gill net. While a unit of gill net with craft costs about Rs. 50,000 to Rs. 60,000 a subsidy of Rs. 12,500 is proposed in the VIth Plan. This however is yet to be approved by Government. The target group for this encouragement are the small fishermen who are yet to come under the orbit of mechanisation.

Disposition of active fishermen

Among the 23,000 active fishermen of the Karnataka coast, already 8,000 are engaged in mechanised trawling. Another 4000 will be engaged in purse-seining very shortly with 200 purse seines which are expected within the close of the present season. This means that 12,000 of the 23,006 active fishermen will be covered by mechanisation which is more than 50% of the total number of active fishermen. In order to help the remaining fishermen to modernise their fishing as much as possible, out-board engines are being procured to motorise dug-out canoes. More Rampanies will be assisted for purse seine units, in addition to encouragement to gill net fishing. However, it is anticipated that 25% of the active fishermen numbering about 6000 will ultimately continue to do traditional fishing and the proposed delimitation law will give them adequate protection against competition from the mechanised sector.

Coastal aquaculture

Brackishwater fish farming is of late gaining much importance in fisheries development in India and attempts are being made in almost all the maritime states to take up this new venture in order to augment fish production. In Karnataka it is estimated that there is a potential area of about 4000 hectares where brackishwater farming could be taken up with advantage. In Utter Kannada (North Kanara) District, private pisciculturists have already taken up the culture of marine prawns in the brackishwaters of Kali and Aghanashini rivers. In about 1100 hectares of total area consisting of about 30 gazani lands, a total production of about 390 tons of prawns valued at approximately Rs. 60.00 lakhs have been harvested in 1977-78 by filtration method. This system is proposed to be put on a scientific basis by optimum stocking with the supply of additional seed to the farmers. The department has established a brackishwater culture unit at Karwar and has proposed one at Kanasgiri near Karwar, of about 60 hectares in extent for taking up commercial production. A systematic survey of the potential areas in both the coastal districts is being taken up shortly by the Marine Products Export Development Authority in collaboration with the State Fisheries Department and the Central Marine Fisheries Research Institute.

Key factors to success

The main theme of small-scale fisheries development in Karnataka has been the simultaneous encouragement of Cooperative Sector, Private Sector through individuals and groups of fishermen, and the Public Sector Corporation. Subsidy given by the department for viable projects in small-scale fisheries, with financial assistance from commercial banks, has been the catalyst for rapid Development. An effective coordination between the commercial banks and the department for promoting a healthy growth of the industry has been a special feature of this development. There is also coordination between the Cooperative Sector and the department and the subsidy for engine is released in two instalments after ensuring that the unit is marketing the catches through the cooperatives. This arrangement strengthens the cooperatives in their marketing activities and promotes their growth. Such combinations of coordination among cooperative, private and public sectors and the financing agencies have been the keyfactors of the dynamic coastal fisheries development of Karnataka.

PUBLIC POLICIES AND PLANNING OF RURAL FISHERIES IN KERALA

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The aim of this paper is to focus attention on the problems faced by the Department of Fisheries in the planning of rural fisheries in Kerala, restricting the term rural fisheries to cover only the fishing activities of artisanal fishermen both marine and inland, thus excluding any direct discussion of mechanised fishing and deepsea fishing.

The traditional fishermen of Kerala in the marine sector have been socially and economically backward. Though they have evolved several techniques of fishing over the years, their methods by their very nature have been low in productivity. Until about 30 years ago the entire fish sold in Kerala was the aggregate result of the efforts of about a lakh of artisanal fishermen spatially dispersed over the 590 km long coast line of Kerala. The fact remains that these primary producers even today form the basis of the fish economy of the State.

Ethos of modernisation

The first policy for the modernisation the marine fishing industry in the early 1950's was the introduction of mechanised boats. The initiative to introduce mechanised boats came from the Indo-Norwegian Project started in Neendakara which first introduced 25' mechanised boats with 16-24 HP diesel engines in 1954-55. The Project also set up a boat building yard to build mechanised boats for distribution among fishermen. The rationale for mechanisation was that fishermen would be able to go deeper into the sea, reach the fishing grounds faster, hence fish for a longer time, and thus raise their levels of productivity. In must be noted that none of the three traditional crafts, namely catamarans, plank-built boats and the dug-out canoes, were modified in this process, the reasons advanced by the experts being purely technical.

The traditional non mechanised sector was thus left generally to its own devices without any technical guidance, finance and organisational support from the State. Even the limited supply of nylon nets was as part of a relief and welfare programme. Because of these, there has been no major change in the technology of the non-mechanised sector either in craft or gear. Only the introduction of nylon nets and aluminimum hooks in the early 1960s, can be stated as some innovations. Under these conditions there was little scope for increases in productivity in the non-mecanised sector.

Fisheries Cooperatives

For the distribution of mechanised boats to the traditional fishermen, the Government also encouraged the formation of co-operatives. A Resuscitative Committee set up by Government has gone deeply into the working of these co-operative societies and in its report submitted in 1975 has stated as follows: " These societies were registered with the main objective of providing them with mechanised boats so as to enable them to provide employment to members and also to increase production. These mechanised boats were given on hire purchase basis extending over a period of eight years. While providing them with mechanised boats, it was not carefully planned to provide them with sufficient working capital to meet the operational expenses of these boats. These societies being composed of poor fishermen could not raise sufficient funds to meet these working capital requirements and naturally they were forced to approach middlemen for the required funds. They borrowed funds at exhorbitant rates of interest and some of them even pledged or sold the boats to these moneylenders. When money is borrowed from the moneylender, one of the conditions stipulated by him is that the entire catches should be surrendered to him at a price fixed by him. Surprisingly enough, these transactions or agreements are mostly oral and never find a place in the books of accounts of the societies. It is also observed that some of the societies situated in places where the mechanised boats cannot land, take with them only hired labourers recruited from the local place, with the result that the members of these societies are deprived of the benefit. There are even cases in

which most of the members are not even aware of the working of these boats."

Merits of mechanised sector

The policy of mechnisation has in fact failed from the point of view of the Government and the traditional fishermen. However, the two counts on which the mechanised sector excels the traditional sector are gross out-put and foreign exchange earnings. It has been estimated that the foreign exchange contribution of the mechanised sector is over twice that of the non-mechanised sector. It has also been estimated that the gross returns from mechanised boats is about six times the return of the non-traditional crafts. It must not, however, be forgotten that the activities in the traditional sector are more decentralised and labour intensive, resulting in much less economic concentration and basically serving the rural community better. In spite of the best efforts of the State the activities of the mechanised sector are concentrated only at a few centres in the State. The economic control of the operations is in the hands of a few rich men and often they are not fishermen. The output from the mechanised sector is mostly meant for export. The excessive preoccupation of the mechanised sector with shrimp is again another aspect of the problem calling for diversification of fishing efforts.

Ownership of fishing crafts

The ownership pattern in the traditional sector has been mostly in the form of individual ownership or owner-worker pattern. This is especially true in the case of catamarans and some canoes. In the case of big canoes collective ownership. prevails. Apart from these, there are labourers working in these crafts but do not own them. Since the mechanisation programme was started by the Government, right from the beginning the ownership pattern to be evolved has been much debated. State ownership was found impracticable. In fact even under the State-owned corporation, ownership and management of small boats proved to be a miserable failure. Encouragement of individual owners was also not advocated. As a compromise the Government encouraged the formation of co-operatives with collective ownership or on the basis of owner-worker pattern. All those who worked were also owners, sharing the profits. Theoretically the policy appeared to be ideal but in practice this has failed as indicated earlier.

Failure of cooperatives

The basic need today is the evolution of proper management structure at the micro-level, dealing with the fishermen directly. One of the main reasons for failure of the co-operatives is that proper leadership was not available at that level. Local politicians and other persons of questionable motives became presidents and members of the Board of directors of these co-operative societies. The fishermen actively engaged in fishing were at the mercy of these leaders and experience in the past 30 years has convinced that, this method is not feasible for productive and good results.

Conflicts of interest

The traditional sector has been facing some other problems due to the policy of mechanisation. The mechanised boats have been shrimping in inshore waters, and recently they have also taken to mid-water trawling near the shore line. These activities have been protested by the traditional fishermen on the plea that these fishing grounds are their sole means of livelihood. As this problem is confronted at a national level, a committee on the delimitation of fishing zones was constituted by the Government of India to evolve a suitable policy in the matter. The committee has already submitted its report and, pending final approval on the recommendations, the Government of India have advised the states to take executive measures to have the law and order situation under control. Accordingly, Government of Kerala have restricted the operational limits of mechanised boats to outside 5 kilometres from the shore line.

Such conflicting interests have come up because of the different ownership patterns existing. If a genuine fishermen's organisation operates canoes, catamarans and mechanised boats they can be used to evolve their most optimal functions without any conflicts. Essentially the prime need appears to be evolution of a proper collective ownership pattern with adequate managerial expertise at the rural level.

Fishermen welfare

In planning of rural fisheries in the marine sector, given the existing conditions, it must be

remembered that it is impossible for the traditional fishermen to take care of themselves financially for their primary needs Recognising their plight the Government of Kerala have recently formed a Kerala Fishermen Welfare Corporation Ltd., with headquarters in Trivandrum. The Corporation aims at helping the fishermen in the matter of housing, by way of subsidy loan programme. The Corporation also has a programme of involving the traditional fishermen individually with a bank to get loan for their crafts and gear. The Corporation's policy is to encourage full individual ownership of craft and gear and for this purpose the Government is also giving subsidy to the fishermen. The policy here is to eliminate any complicated intermediary organisation and directly get to the level of traditional fishermen through the staff of the Corporation. The results of this experiment have to be watched for evolving further policy in this sector.

Infrastructure facilities

With the development of mechanised fishing and deepsea fishing, emphasis in the past has been on construction of big fishing harbours and other infrastructure facilities connected with such harbours. But to develop rural fisheries we have to decentralise our efforts and develop infrastructure facilities at the village level. This has been recognised by the Government of India and they have already sanctioned two such schemes for Kerala now under implementation at Ambalapuzha and Cheruvathur. The policy here must be not to go in for complicated technology but to help the traditional fishermen dispose of their catches in a hygienic manner. Basic needs such as potable water, ice, hygienic auction sheds and curing sheds etc. form the main components of this programme. Another aspect which deserves top priority is proper communication between the landing centres and the main markets. Development of link roads is also one of the basic necessities which is also being taken care of in the Plan schemes of the State Government.

In order to improve the socio-economic conditions of traditional fishermen, it has been the avowed policy of the Government to start special schools and training centres for children of fishermen. Three residential schools now run by the Department have become very successful and popular. The policy should be to continue to introduce more number of such schools all along the coast. There are five training centres in the State giving training in modern methods of fishing. Here again the emphasis in the past has been on training the fishermen in the use of mechanised boats for trawling. The future policies should be to have a comprehensive curriculum in which diversified fishing also is taught. Simple methods of financial management should also be introduced, to make the fishermen conscious of the financial aspects of their trade. Extension education again is another aspect which has been ignored in the past Non-formal education, extension service for starting secondary occupations and programmes aimed at eliminating illiteracy among the adult group of the fishermen population are some of the areas where further policies and programmes will have to be evolved.

Fishwater fisheries

A review of the present status of the fresh and brackishwater fisheries, both capture and culture, vis-a-vis the opportunities available in respect of water and fishery resources indicate that the capture fishery in the rivers and reservoirs is in an unorganised state Similarly, the culture fisheries in the reservoirs, tanks and ponds have not been developed to the desired extent. By the application of the available technology, it is envisaged that the present production rate of 5 kg of fish ha/yr, in the reservoirs 399 and 500 kg of fish/ha/yr in the ponds and tanks could be increased to 20-39 kg/hr/yr/ and 3000 kg of fish/ha/yr respectively. By producing adequate spawn, fry and/fingerlings, increasing the nursery areas, bringing in additional water areas under fish culture and adopting the modern technology of culture operation, a large quantity of freshwater fish could be raised from this sector.

Brackishwater fisheries

As compared to the freshwater fisheries, the brackishwater fisheries is relatively better organised. However, there is no proper management of the fisheries of this region. The brackish waters, besides supporting a lucrative fishery from ideal nursery grounds for several marine fishes and crustacens. In recent years because of increasing demand for fishes, particularly for prawns from the-export trade, there has been considerable increase in fishing effort

in the capture fisheries of this region. Large-scale exploitation of juvenile prawns and fishes is being carried out by several gears operating in this region.

Such unrestricted exploitation of juvenile stocks adversely affects the fisheries of the area, as well as of the adjacent sea, as recruitments to these regions are interdependent. This is particularly so in the case of the prawn fishery, which forms one of the important fisheries of the State and one of the main sources of its economy. Efforts made by the Department of Fisheries to introduce mesh regulation of nets used in backwaters has not succeeded due to pressure from vested groups, who have not understood the significance of such conservation measures. High level 'conferences held recently to bring about some sort of order in this area have also not been very successful due to conflicting opinions expressed by the traditional fishermen, exporters and scientists. Besides this, reclamation of the brackishwater areas for agro-industrial and urbanisation programmes is also adversely affecting the fishery. In view of this, apropriate conservation and management measures have become an imperative need for the rational exploitation of the resources of this region, rather than the expansion of the fishery.

Coastal aquaculture

Culture fisheries in the brackish water is being carried out at present only in Central Kerala and that too in limited arears. The yield of prawns and fishes from these fields is relatively low due to indiscriminate and uncontrolled stocking and frequent harvesting within a short time. By adopting improved techniques of eradication of predatory and harmful organisms before stocking, selective stocking of fast growing spacies of prawns and fishes such as *Penaeus indicus, P. mondon, Chanos chanos* and mullets and culturing them for 3 to 4 months when they attain marketable size, it has been shown that a production rate of 1500-2000 kg/ha/yr could be obtained and higher unit price realised.

It is estimated that an area of 1,20,000 ha could be reclaimed and used for brackishwater fish/prawn culture. It is envisaged that a minimum of about 500 hectares of water area could be converted into farm every year. Suitable sites could be identified and selected after detailed survey. The success of the culture operation largely depends on the availability of adequate prawn/fish seed as and when required by the fish farmers. It is estimated that about 60% of the total prawn seed requirement could be met from those available in nature. To meet the balance requirement, it is essential to set up seed production centres. Considering the capital investment and the technical nature of the operation, it has been suggested that these hatcheries may be set up at selected centres. For the production of about 1200 million seed of stocking size, it is necessary to establish 20 hatcheries.

Besides the brackishwater culture fisheries, there is vast scope to utilise suitable areas of the inshore sea for the culture of marine organisms such as mussels, oysters, prawns and seaweeds. At present, the inshore sea is exploited by the fishermen by employing traditional gears and crafts. Several factors such as unsophisticated production means, low production rate and unorganised marketing system contribute to the poor socio-economic condition of small-scale fishermen. Indigenous techniques have been evolved to culture mussels suspended from ropes and seaweeds in coir mats. In the case of mussel culture a production rate of 60-100 tonnes/ha/yr has been obtained in field experiments. The production rate of seaweeds through culture is found to be 3.5 kg per m^2 of rope. Simple techniques have also been evolved for the culture of pearl oyster and pearls. A pilot project on pearl culture is being carried out at present at Vizhinjam to demonstrate its commercial viability. By blending sea farming with the traditional capture fisheries, it would be possible to increase fish production as well as income of the fishermen and thereby improving the rural economy.

Conservation and management of resources

Indiscriminate exploitation of brood fishes and juveniles, pollution of the habitat by industrial and domestic waste, leaching out of poisonous material, pesticides and insecticides and reclamation of water areas, adversely affect the fishery resources. Such hazardous activities if left unchecked at the appropriate time and beyond a reasonable limit would result in the total desrruction of the resource. In the inland and brackish waters of Kerala, certain species and *Macrobachium rosenbergii, Etroplus suratensis,* and

the juveniles of *Penaeus indicus, Metapenaeus dobsoni M. monoceros* and *M. affinis* require immediate protection and conservation measures of their resources. Indiscriminate fishing of undersized immature specimens has caused apprehensions on the deleterious effect on these resources. With the increasing development of industries on the banks of the estuaries and backwaters and large-scale application of pesticides for paddy cultivation in the fields adjoining the backwaters pollution problems affecting the resources are ever increasing. It is therefore, essential to protect the resource through effective legislative and conservative measures under the Travancore-Cochin Fishery Act XXXIV of 1950. However, these measures should also consider the socio-economic conditions of the fishermen who subsist on fishing in this region. Additional provisions will have to be made in the Act for:

a) protection and preservation of nursery grounds from reclamation and pollution;

b) control of fishing strictly by licenced gears (limited to a maximum number to be specified for the area) having a mesh size of 20mm and above in brackish and freshwater and,

c) prohibition of fishing in brackish water area during high tide.

NOTES PRESENTED BY FISHERMEN REPRESENTATIVES AND LEADERS

SHRI BHAI BANDARKAR, General Secretary, Maharashtra Machichimar Kriti Samiti, Bombay, made the following points in a note presented at the Seminar:

In spite of mechanisation, artisanal fisheries will continue to contribute a substantial production of fish near the coast. There have been conflicts between the traditional fishermen plyings small boats and big trawlers. These conflicts have been witnessed in Maharashtra, Tamil Nadu and Goa. The traditional fishermen need protection in carrying out their operations by delimitation of fishing zones. This delimitation may be finalised after a careful study of the need of each state, types of fishing activities etc.

Innumerable pharmaceutical industries, fertiliser projects etc. have been discharging huge quantities of effluents in the rivers and the sea which would affect the fishery resource in the coastal zone. It is absolutely necessary that all the new industries as well as the old ones may be compelled by law to adopt antipollution measures.

The Government have been contributing to the development of fishing industry by providing financial assistance, technical help, training etc. But the assistance has been extended only to such persons who are credit worthy. This has lead to an increase in the number of mechanised boats and has contributed towards socially undesirable consequence to the fishermen. It is suggested that the Government may grant loans to real fishermen on the security of the boat/ engine only.

In 1967, the Government have enacted a new law making it obligatory on the boat owners to obtain passes from the customs department to carry on fishing operations. This has created serious difficulties to the fishermen. It is suggested that this act may be repealed.

In case of accidents on land, while travelling by plane, train or bus, heavy compensation is offered to the survivors of the deceased. Likewise adequate compensation may be paid in the event of accidents and loss of life involving fishermen at sea.

SHRI N. K. BHAGAT, Chairman, Kulaba Jilla Machimar Madhyawarti Sahakari Sangh Ltd., Alibag, Kulaba District presented a note containing the undermentioned points.

The State of Maharashtra has a coastal strip of about 350 km. Nearly 11,000 boats carrying on fishing along this coastline. Of these, 800 are trawlers, 2,000 are other mechanised boats and 8,200 are the traditional crafts. While the non-mechanised boats can do fishing only within 10 fathoms crafts operate from 3-40 fathoms according to the availability of fish. This affects the fishing by traditional crats. The Government may bring in necessary legislation against indiscriminate fishing by the mechanised boats. Restrictions on size of fish to be caught and area of operation will help the small fishermen to get their livelihood.

Water pollution is affecting the breeding of important fishes like the Bhing, Pala, Khanjoori, Ghol and Dada It is imperative to move the Central and the State Governments to impose stringent restric tions on the industries to get their waste purified before it is discharged.

The Khajan lands on the sides of the backwaters are not useful for cultivation. These lands could be usefully utilised for fish farming. The State Government or any other development corporation may come forward to provide assistance to the small fishermen for utilising these lands for fish culture.

The mangroves should be preserved as they form suitable grounds for the growth of crabs.

SHRI MALLADI SWAMY, Chairman, APBC Cooperative Finance Corporation and President, AP Fisheries Federation, Hyderabad, in a note sent to the Seminar suggested the following measures for improving the lot of the rural fishermen:

Supply of fishing implements at subsidised rates; Marketing facilities to have reasonable returns on their catch; Credit facilities to equip themselves with suitable gear and tackle; To include them in scheduled tribes list to let them develop with other communities in political social and other aspects; To start residential, schools in every fishing village to educate their children; to give them training in their professional skills; To connect their villages with main roads and bus routes; To give basic amenities like medical aid, drinking water etc; To give proper housing facilities and construction of permanent shelter to get protection from cyclone etc.: To start a social security found to arrange immediate relief to those families whose members lost their lives in the sea because of natural calamities; To get them organised into sound Cooperative Organisations; To arrange proper facilities and rescue operations in the event of dangers at high seas; To arrange to give immediate relief on loss of craft and tackle. Fishermen who soletly depend on fishing in the backwaters may be rehabilitated by selecting them for coastal aquaculture enterpriies.

DISCUSSIONS

I SESSION

L. C. Perera : Do you consider cooperatives as a panacea for the evils of the fishing industry? Are not cooperatives a transferred technology in appropriate to our circumstances?

S. V. Bapat: Cooparatives are a useful means of collective effort for development and they are suitable for the coastal fishermen.

K. V. N. Rao: Has any study been made to identify the primary causes for the failure of the cooperative societies?

S. V. Bapat: Some of the reasons for the failure of the fishermen cooperative societies are the disinterest of the members, lack of motivation, lack of genuine leadership among the real fishermen, lack of comprehensive planned programmes and lack of managerial expertise.

S. K. Amin: It has been made out that the leadership of fisheries cooperatives was generally in the hands of the affluent section of the society. Is not the failure due mainly to official intervention in the working of the societies and their indifference?

H.P C. Shetty: There appears to be some confusion regarding the definition of small scale fisheries. Dr. Bapat has considered only the non-mechanised boats under the definition. But others have included mechanised boats also in this category.

S.V. Bapat: Mechanised boats using 'dol' nets for the Bombay-duck fishery have been considered under the small-scale sector. However, mechanised boats operating trawl nets and purse-seines cannot be included under the sector.

U. W. Schmidt: The suggestion was to try to define small-scale fisheries not from the operational point of view which mainly considers the technology involved, but from the aspect of income which the small scale fisherman derives from his activities.

A. G. Kalawar: Considering the high capital investment of about Rs. 2 lakhs and also the high operational cost of mechanised boats they may not to be classified as small-scale fisheries. As the Convenor has clarified, fishing by non-mechanised boats alone may be considered as small-scale fisheries.

W. Sebastian: It will be good if agriculture, horticulture, poultry etc. are introduced in the coastal area to be practised by the fishermen. The fishermen must be registered so that the benefits will go to them.

P V. Prabhu: Shri Tandel has mentioned that not much work has been done on the improvement of traditional gear. He may throw light on the improvements needed.

P. M. Tandel: The characteristics of the traditional fishing gear must be studied in detail and improvements effected. The research institutes should demonstrate and convince the fishermen of the efficiency of the improved gears.

II SESSION

W. Sebastian: The immediate need of the fishermen is to have necessary technology to harvest the vast unexploited resources of the sea. The beneficiary-oriented integrated programmes could probably wait.

A. G. Kalawar: For the speedy development of the coastal area, necessary infrastructure facilities such as transport, communications, water and power supply, fish processing and storage facility etc. will have to be provided on a regional basis. These programmes will have to be beneficiary-oriented so that the advantages would reach the targetted sections.

W. Sebastian: Is there a possibility of reserving the land on the sea shore mainly for the use of fishermen?

A. G. Kalawar: The Govt. of Maharashtra have decided not to allot any land on the sea shore to private parties without ascertaining the requirements of the fishing industry.

S. K. Amin: Shri John Kurien has given a detailed picture of the socio-economic conditions of the fishermen. What would be his suggestions to improve their conditions?

J. Kurien: The foremost need is to create an awareness among the fishermen so that they relise their deplorable living conditions because of exploitation. If this is achieved they could organise themselves to face the challenges.

K. V. Navathe: Shri Fernado has pointed out the need for risk-bearing social schemes. A decade back a report of Bhargav Committee suggested that working capital be made available to fishermen without sureties and securities. But this has not materialised. The bankers are now coming forward to take slight risks.

S. Srinivasan: Shri Frenando has given a list of needs of the fishermen. As I have been asked to comment upon the points mentioned in his paper. I would like to inform the seminar of some of the actions taken by the Govt. of Tamilnadu. The Forest Department of the Govt. is already seized of the requirements of suitable timber material for catamarans. Steps are being taken to grow *Albezia* to provide timber for catamarans. The Wood Preservation Centre of the Forest Research Institute at Madras has recommended about 20 other species of timber which would be suitable for catamarans. The Govt. have schemes for the supply of insulated boxes to the fishermen at subsidised rates to bring the catches without much spoilage. The fish curing yards of the department of fisheries had to be closed at a particular time because their transactions dwindled consequent upon the removal of subsidy element on the price of good quality salt. The Govt. in collaboration with the Marine Products Export Development Authority have evolved an improved technology for production of quality dry fish through better packing and storage methods. In the Sixth Five Year Plan it is proposed to set up some model fish curing yards at important fishing centres.

III SESSION

P. Gopalakrishnan: We do not have sufficient reliable information on the availability of seed resources of cultivable species. As this aspect is very vital for any aquaculture programme there is a need for a coordinated project for production of fish and prawn seed on mass scale for distribution to the fish farmers. Coastal aquaculture programmes could be integrated with salt works which will have a great potential for increasing production and also rural employment. I would like to know if the ICAR has any programmes under consideration on these.

R. R. Prasad: The CMFRI and the CIFRI have conducted seed resource surveys and the information are available with them The suggestion for a coordinated project should be welcomed.

W. Sebastian: Dory-type of fishing will be very helpful for the traditional fishermen as they can spend more time on fishing. I would also suggest introducing "moving warehouses" or "fish banks" in the sea which could collect the catches by the traditional bosts. The mechanised vessels can be used for the purpose.

P.S.B.R. James: The traditional crafts operate within a close range from the shore and there is no great need for the "warehouses"., However, through cooperative efforts the catches can be collected by larger boats which can function as the mother boat.

C. V. Kulkarni: The mother-ship operations will be very useful for taking the catamarans to the fishing areas and back. Such experiments were tried in Kerala quite some time back. But this never came to commercial practice.

S K. Amin: In his paper, Dr. Alagarswamj has dealt with the prospects of coastal aquaculture. Will it be economically feasible for a common fishermen to take bank loans and start aquaculture.

K. Alagarswami: Commercial succes of coastal aquaculture would depend on the identification of talents among the fishermen, giving them training in the procedures and providing proper aquaculture extension service as in the case of agricultural sector. At least to begin with liberal subsidy and soft loans should be provided.

IV SESSION

K. V. Navathe: Dr Silas has touched upon the highlights of the recent impressive developments in coastal aquaculture in the country. I feel that there should be coordination and collaboration among the maritime states and the research organisations for the proper development of coastal aquaculture.

E. G. Silas: We already have some collaboration programmes with the Governments of Tamilnadu and kerala and the MPEDA. Extension of such collaboration with other states should be welcomed.

L. C. Perera: Mr. Gillet has mentioned that a project on mechanisation of catamarans at Muttom has failed. Is the failure due to the fact that the fishermen were not motivated and there was no beneficiary participation in the programme? The failure may be due to the fact that the project imposed an idealistic plan on a non-participating group of fishermen.

F. P. Gillet: The project had failed to a certain extent for the above reason. As the project was taken up only at Muttom its performance could not be compared with a situation that might occur at other centres under similar project conditions.

A. Sreenivasan: Under the rural aquaculture project the production achieved is 6,000 kg/ha/ 10 months in West Bengal but only 3200 kg/ha/ year in Orissa. What are the reasons for such differences? what are the size of ponds and are they of drainable type?

S. D. Tripathy: The size of the ponds varied from 0.1 to 1.2 ha at different centres and are not drainable The production of 6 tonnes was achieved at Gaur (Malda) when both soil and water phosphates were very high and the plankton content was also the highest.

G. Bharathan: Are our technologies size-neutral? Given the kind of structure prevalent in our fishing villages, what long-term impact would coastal aquaculture have?

S. D Tripathy: We have the technology for different scales of operations. We cannot bring about equality in the present set up unless the water and land areas are acquired by the Government and distributed to the cooperative societies for aquaculture purposes. We have already demonstrated the potential for increasing production, income and employment by adoption of the technologies.

V SESSION

W. Sebastian: Except chilling and curing have we got any technology for the preservation of fish which would benefit the ordinary fisherman?

M. R. Nair: These are the two cheap methods available for the preservation of fish. The scientific methods of preservation of dried products should be popularised in fishing villages. For a long time to come fish curing will continue to be one of the cheapest methods of preservation.

S Jones: Side by side with post-harvest technology, there is need for institution of marketing cooperatives to eliminate the adverse role played by the middlemen. This is for the disposal of fresh fish to the consumers within the country.

Jaya Arunachalam: Dr. Nirmala was mentioning about vegetable gardens in the coastal areas to meet the nutritional requirements. It will be a costly experience. It would be better if the nutritional requirements are met from the coastal products.

P. Gopalakrishnan: What are the products developed from cheap trash fish best suited for rural development programmes?

M R. Nair: Fish powder, smoked fish and dry fish can be made use of in the feeding programmes. This has already been attempted by the coordinated research project for trash fish utilisation at Cochin and Okha.

Jaya Arunachalam: Post-harvest technology should have methods which are labour intensive so that a lot of fishermen who are unemployed could be benefitted.

A. B. Roy: More than 50% of the catch by the traditional fishermen consists of cheap varieties of fish. If there is an organisation sponsored by Government in each state to purchase this and convert into processed food it will give better prices for the catch and provide nutritious food to the common man at a reasonable price.

B. K. Soni: The cooperative marketing societies will be the proper agencies to do this work rather than the government agencies.

VI SESSION

S. Jones: What language should be the medium of instruction in the fisheries colleges?

A. Venkataraman: The medium of instruction at the higher level should be English and at the lower level the mother tongue.

M.R. Nair Apart from *ad-hoc* training courses conducted in the research organisations and fisheries colleges, there is no organised training course for processing technicians and quality supervisors. Is this because there is no demand for such personnel?

H.P.C. Shetty: This is due to the indifference of the industry in the absence of

any regulations from the Government. This attitude is slowly changing since quality control is being tightened by the Govt. of India.

Milton: The Krishi Vigyan Kendra at Narakkal gives training in mariculture only to people of that region. Gannot such training facilities be made available to other centres and states?

V. Balakrishnan: The I.C.A.R. proposes starting additional K. V. Ks. in the VI Plan. The policy is that each district should have a K. V. K.

VII SESSION

R. S. Lal Mohan: Under the existing provisions is it possible for a fish farmer to get a soft loan from financia institutions for developing a fish farm?

S. Gopalan: The fish farmer may approach the Land Mortgage Bank or Fish Farmers Development Agency. Getting financial assistance should not be a problem.

W. Sebastian: No method has been suggested to enable an ordinary fisherman to get finance without much security and delay.

R. Sundaresan: I would like to add something on financial assistance to the fish farmers. There should be a two-way traffic. The banks do reach out to the villages. A great responsibility also rests on the extension workers to educate the fishermen and guide them for getting assistance. To my knowledge, one of the banks could not utilise the funds under the Small Farmers Development Agency for want of proper schemes.

N. M. A. Marikar: I want to develop a prawn farm in about 20 ha of my land in Thanjavur district. What kind of assistance I can expect from the Government agencies?

S. Gopalan: Both the Govt. of Tamil Nadu and the Marine Products Export Development Authority could help if a viable scheme is prepared for the proposed prawn farm.

S. Ramamurthy: What are the prospects of introducing fish-crop insurance scheme?

S. Gopalan: The Insurance Agencies have not accepted land-crop insurance scheme all over India. I am afraid in the present state of aquaculture, there is no prospect for fish-crop insurance scheme. It may became possible after the industry has developed well.

VIII SESSION

A. Sreenivasan: The recent workshops and seminars held on prawn culture have indicated the high profitability of prawn culture. Most of the land and water areas in the coastal zone are with the Government. We must evolve a clear policy on the allotment of these areas for coastal aquaculture. Naturally the benefit should go to the poorer sections of the society through agencies such as F.F.D.A. or Cooperatives. On the other hand there could be a view that private entrepreneurship is more efficient and therefore water areas should be allotted to them. Policy on this must be evolved soon.

S.N. Rao: The question of fixing the size of water area to be allotted to each fisherman and the question of restricting the allotment to bona-fide fishermen are vital issues to be considered. We should definitely evolve policies on these. We should also create a proper management structure and not repeat the mistakes made in the fisheries cooperative sector.

A. Sreenivasan: Similarly we have to evolve a policy on delimitation of fishing zones. The states today adopt some *ad hoc* measures such as the 5-km zone for the traditional crafts and a 3-days-a-week fishing for the mechanised boats. We may soon have a third dimension with the motorisation of catamarans and fibreglass boats of 18' length. All these call for a clear policy to avoid the conflicts.

S. N. Rao: The Govt. of India have already constituted a committee to go into this problem.

K. V. Navathe: Shri Rao has suggested that fisheries departments should be organised properly. What are his views on this question?

S. N. Rao: The fisheries departments may be reorganised on a functional basis. Projects should be identified and put under proper officers with accountability. Non-technical subjects such as housing, health and hygiene, roads etc. should be dealt with by separate organisations. Fundamental research should be given to Agricultural Universities and only pilot projects and develpment works should be done by the fisheries departments.

RESUME OF THE PROCEEDINGS

The Seminar on the "Role of Small-scale Fisheries and Coastal Aquaculture in Integrated Rural Development" was inaugurated by Thiru. G. R. Edmund, Hon'ble Minister for Food and Fisheries, Government of Tamil Nadu at Kalaivaner Arangam on the forenoon of 6th December 1978. Dr. E. G. Silas, Convener of the seminar welcomed the Hon'ble Minister, delegates and participants. Dr. R. Raghu Prasad, Assistant Director General, Indian Council of Agricultural Research, New Delhi presided over the function. Thiru. G. Thirumal, Secretary to the Govt. of Tamil Nadu, Forests and Fisheries Department gave the felicitation address. Shri T. Tholasilingam proposed a vote of thanks. The Inaugural Address by Thiru G. R. Edmund, Presidential Address by Dr. R. Raghu Prasad, and Welcome Address by Dr. E. G. Silas have been reproduced in this volume.

The eight Technical Sessions and the Plenary Session were were conducted in Rajaji Hall from the afternoon of 6th December to the forenoon of 9th December 1978.

Opening the first Technical Session on "Present status of small-scal fisheries and coastal aquaculture", the Chairman Shri K. H. Alikunhi, Fisheries Development Advisor, Govt. of Kerala, stated that in spite of the rapid progress in the mechanisation programme, the traditional fisheries have continued to contribute substantially to the fish production. With continuing increase in fishing efforts, views have been expressed on the decreasing trends in the size of fish, catch and profits. Indiscriminate fishing of juveniles in the backwaters and the coastal zone which are nursery grounds for commercial fish stocks has been reported to lead to adverse results on coastal fishing. Clashes between the traditional and mechanised sectors have often been reported. These are some of the major problems needing attention and solutions to strengthen the small-scale fisheries sector.

Although a traditional system of prawn filtration has been in vogue in India, particularly in the States of Kerala and West Bengal scientifc brackishwater farming has made only a beginning. Commercial production of seed of cultivated species of fishes and shellfishes is yet to be achieved. Shri Alikunhi briefly indicated the prospects for coastal aquaculture in India. After the Chairman's introductory remarks, Dr. T. A. Mammen, Director, Marine Products Export Development Authority, delivered the keynote address which was followed by the presentation of five working papers. Dr. P. S. B. R. James

and Shri A. Noble assisted the chairman as rapporteurs of the session.

After the session came to a close, Shri K. H. Alikunhi delivered a special lecture on "Coastal Aquaculture and Rural development" profusely illustrating the talk with slides. In his lecture, he touched upon the recent developments in coastal aquaculture in the South-East Asian countries.

The Session II on "Socio-economic conditions of the coastal rural sector" was chaired by Dr. S. Jones, retired Director of CMFRI, who was assisted by Dr. S. V. Bapat and Dr. S. Ramamurthy as rapporteurs. The Chairman highlighted the overall deplorable conditions of living of the fishermen community. He stressed that the discussion under the session should also deal with the remedial measures necessary for the uplift of the fishermen. The keynote address was delivered by Shri A. G. Kalawar, Director of Fisheries, Maharashtra. Four working papers were presented and discussed at the session. Shri Kasam Usman Malam, Member of Gujarat State Fisheries Advisory Board, in his talk, called for the utilisation of the vast brackishwater lands of Gujarat coast for coastal aquaculture.

The Session III on "Resource potential for capture and culture fisheries in the coastal region" was chaired by Shri C. V. Kulkarni, retired Director of Fisheries, Maharashtra, who was assisted by Dr.M.J. George and Shri K. A Narasimham as rapporteurs. The Chairman pointed out the importance of having a correct appraisal of the resource potential as the basic requirement for developing the capture and culture fisheries. He said that in the marine capture fisheries there is scope for increasing production as the estimates of potential stocks would indicate. On the culture side we have a number of economically important species of fishes and shellfishes suitable for aquaculture. Our scientists have developed the technologies for the culture of various organisms and have demonstrated that the growth of all these species is very fast and quick harvests can be taken. The production figures are also encouraging. Dr.R. Raghu Prasad, Assistant Director General, ICAR, New Delhi delivered the keynote address. Three discussion papers were presented, and discussed at the session.

The Session IV on "Technological base for integrated rural development" was chaired by Dr. P. N. Ganapati, Emeritus Professor of Andhra University, Shri K. Nagappan Nayar and Shri K. Dorairaj assisted as rapporteurs. The Chairman, in his introductory remarks mentioned that in the earlier stages of fisheries development in the marine sector emphasis was given on the capture fisheries. In the recent years there has been a recorientation in our thinking and approach and coastal aquaculture is being given top priority. In a developing country like ours we cannot afford to go all out for capital intensive sophisticated fishing vessels and gears although it could be done in a phased manner over a period of time. Therefore, mariculture is very important to India. The Research Institutes under the ICAR are giving the right type of lead and we are greatly impressed by the progress made at the CMFRI in coastal aquaculture. We have talented scientists who can deliver the goods. They must endeavour to develop low-cost technologies for commercial operations. Dr. E. G. Silas, Director, CMFRI delivered the keynote address. Five working papers were presented at the session and discussed.

The Session V on "Post-harvest technology" was presided over by Dr. B. K. Soni, Deputy Director General, Indian Council of Agricultural Research. He was assisted by Dr. P. V. R. Nair and Dr. K. S. Rao as rapporteurs. The Chairman, stressed that this session is of vital importance as it deals with the technologies for handling, preservation, processing, storage, transportation and marketing. All our efforts to increase fish production through employment of new and improved technologies would be of value only if the post-harvest technology for proper and profitable utilisation of the products is available. Shri G. K. Kuriyan, Director, Central Institute of Fisheries Technology, Cochin delivered the keynote address. Six working papers were presented and dicussed at the session.

Chairing Session VI on "Manpower requirements and training", Shri A. Venkataraman, Vice Chancellor, Tamilnadu Agricultural University, Coimbatore pointed out that there is a tremendous difference between macro and micro-level planning. Integrated rural development emphasises planning at micro-level with available resources. The socio-economic background of the people living in the rural sector should be taken into account while planning programmes for development. He also stated that a distinction has to be made between edu-

cation and training. Education is a process which involves study, analysis, evaluation and transfer of ideas according to the circumstances and requirements, whereas training is to make people do something, such as learning skills, without involvement of much thinking. The training at the lower levels should be in the regional languages. There is need to set apart funds for operational research at the village level. The rural development programmes must be co-ordinated by an agency effectively and also evaluated by appropriate methods. Dr. V. G. Jhingram, Director, Central Inland Fisheries Research Institute, Barrackpore delivered the keynote address. Four papers were presented and discussed at the session. Shri K.V.N. Rao and Shri M. H. Dhulkhed assisted the Chairman as rapporteurs of the session.

The Session VII on "Financing of integrated projects" was chaired by Shri S. Gopalan, Chairman, Marine Products Export Development Authority, Cochin who also delivered the keynote address of the session. Dr. B. Krishnamurthy and Dr. M. D. K. Kuthalingam assisted as rapporteurs. The Chairman remarked that integrated rural development is a concept under which the beneficiaries are helped to put their resources to the most intensive and comprehensive use so that the returns are maximised. Following his keynote address, two working papers were presented and discussed.

On the closing of this session on the afternoon of 8 December, the participants were taken for a Field Visit to the Operational Research Project of the Central Marine Fisheries Research Institute at Kevalam, a fishing village near Madras. The project is one of the Transfer of Technology programmes where the technical staff work with the fishermen assisting them in adoption of coastal aquaculture technology and blending of farming with the artisanal fisheries. In the evening the participants were entertained to a cultural programme staged by the children of the fishermen of the village.

Chairing the last Technical Session on "Public policies and planning of rural fisheries" on the forenoon of 9 December, Prof. A. Abraham, Member, State Planning Board, Kerala, drew the attention of the Seminar to the fact that fisheries development has so far helped mostly other than those who are actually engaged in fishing and cautioned against the adverse role played by middlemen affecting the economy of the fishermen. So far we have been only harvesting the sea without sowing. Now we have improved our competency for a process of sowing and reaping. This necessitates the identification of suitable areas in public waters for coastal aquaculture and allotting them to the fishermen. The fisheries cooperatives should be organised more effectively with proper coordination among officials, techanicians and fishermen. Social justice should be done to the fishermen by providing them the production means such as craft, gear, finance etc. which will in turn increase the production and bring in greater foreign exchange earnings. The extension services in the fisheries sectore are grossly inadequate and strengthening in this direction is required. Among the employed sectors, the fishermen are the only ones who do not have any social security schemes such as retirement benefits, provident fund etc. He should be encouraged to join the insurance schemes so that when he is old enough to retire from fishing, he can invest on some other less arduous occupations. There is also need to consider granting of old age pension, accident compensation etc. The Chairman concluded his address by stating that our research policies should be intimately related to the needs of the fishermen. Shri G. Venkataraman and Dr. G. Luther assisted the Chairman as rapporteurs of the session.

The fishermen representatives and leaders took the floor of this session to express their views. Some of the points made out by them. have been given in this volume. Shri Kasam Osman Kakal (Malam) from Gujarat pleaded for starting Krishi Vigyan Kendras in Gujarat, establishment of Fisheries Banks and strengthening of extension services. Shri S. K. Amin from Karnataka suggested that an All-India Fisheries Cooperatives Act should be enacted by the Government of India so that uniform rules could be applied in the functioning of all fisheries cooperatives in the counlry. Shri Wilfred Sebastian from Kerala suggested establishment of Fishermen Welfare Boards. Shari Bhai R. S. Bandarkar and Shri S. S. Kinny from Maharashtra and Shri Bhagawandas Modashia from Gujarat also spoke on the needs of the fishermen. The speches of some of these representatives which were in the their regional language were translated into English by the Director of Fisheries of the respective States.

The Plenary Session, held on the forenoon of 9 December 1978 was chaired by Dr. E. G. Silas, who was assisted by Dr. P. Vedavyasa Rao and Shri S. Mahadevan as rapporteurs. The Chairman summed up the discussions of the seminar. Farlier, suggestions for developing a plan of action had been invited from the participants. A large number of suggestions had been received and these had been classified and prepared in the form of draft recommendations. The Chairman read out these recommendations and the plenary Session approved them with very few amendments which were taken note of.

Dr. M. S. Swaminathan, Director General, Indian Council of Agricultural Research, who was the President of the Seminar addressed the Plenary Session and his speech has been reproduced in this volume.

Marking the close of a successful seminar, Dr. K. Alagarswami, Central Marine Fisheries Research Institute Cochin proposed a vote of thanks to all those who have helped in the organisation and conduct of the seminar and its assaciated activities and functions.

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RECOMMENDATIONS

1. SMALL-SCALE FISHERIES

1. 1. *DIVERSIFICATION OF COASTAL FISHERIES*

The Seminar,

noting that the resources available to the small-scale fisheries consist of multiple species that co-exist in the same fishing grounds and that certain fish stocks which are in high demand are heavily fished while the others are under-exploited, and

realising the urgent need for the development of small-scale fisheries both for enhancing production and for improving the economy of the small fishermen,

recommends that more attention be paid to the development of small-scale fisheries by diversification of fishing effort through evolving appropriate technologies and that a critical evaluation of the impact of the recent introduction of new gears such as purse seine, midwater trawl and pelagic trawl on the resources exploited by traditional crafts and gears be made for formulating regulatory measures, if necessary, to ensure rational fisheries development through diversification.

1. 2. *FISHERY RESOURCES*

The Seminar,

realising that continuous assessment and monitoring of resources are essential to evolve viable management measures for the proper development of small-scale fisheries and to avoid over investment in developing any fisheries,

recommends that the resources assessment and monitoring systems may be strengthened so as to provide the data required for the regulation conservation of the fisheries.

1. 3. *CRAFT AND GEAR*

The Seminar,

noting that the fish stocks available to the small-scale fisheries could be harvested by simple crafts and gears and that the greater part of the investment in this sector is on these production means, and

realising the need for improvements in the existing designs of craft and gear for more efficient harvest,

recommends that improvements be effected, keeping operational efficiency and cost in view, to the existing craft types and gears using local material, expertise and skills with the full involvement of all concerned including the fishermen, and that, besides the conventional timber used at present, suitable alternate material for the construction of traditional fishing crafts may be identified, tested and made available.

1. 4. *TRANSMISSION OF FISHERIES INFORMATION*

The Seminar,

realising the need for quickly transmitting all fisheries information relating to developments in the field, prospects for fisheries in different regions, environment etc. to the fishermen for their use,

recommends that proper systems be developed on a regional basis for the quick collection and dissemination of fisheries information including forecasts, through All India Radio, Doordarshan, and other media.

2. COASTAL AQUACULTURE

2. 1. *WATER AND SPECIES RESOURCES*

The Seminar,

noting that our country is endowed with immense water and species resources suitable for large-scale coastal aquaculture ventures, but

realising that specific data on the extent and ecological parameters of the different water areas with reference to their suitability for aquaculture are lacking,

recommends that a survey of the coastal and contiguous water areas be carried out in all maritime States and Union Territories to locate and map out suitable areas and to evaluate the cultivable species resources for coastal aquaculture.

2. 2. *TECHNOLOGICAL BASE*

The Seminar,

noting the recent technological advances in coastal aquaculture made in our country,

considering the need for strengthening the technological base, and

realising that the availability and timely supply of fish and shellfish seed are the most important prerequisites without which further development towards establishing commercial culture fisheries would not be possible,

recommends that intensive research be taken up to develop economically viable low-cost technologies for the farming of all cultivable species of economic importance in the coastal and contiguous waters and that emphasis be given to adopt the technology of hatchery production of seed leading to establishment of commercial seed-production centres for supply of quality seed to the farmers.

2. 3. *ECONOMICS OF CULTURE*

The Seminar,

noting that the small-scale entrepreneurs are hesitant to take up coastal aquaculture on commercial scale due to lack of adequate and proven data on the economics of culture operations,

recommends that efforts be made to collect reliable data on the economics of operations of different culture systems in different areas and, after proper evaluation, these data be made available to the aquaculturists and others interested in their use.

3. INTEGRATED RURAL DEVELOPMENT

3. 1. *INTEGRATED DEVELOPMENT OF COASTAL ZONE*

The Seminar,

noting with great interest the concepts of blending traditional capture fisheries and coastal aquaculture, and integrated farming of crop-livestock-fish|prawns towards proper utilisation of the synergy of the coastal ecosystem and increasing production, and

pointing out that adoption of such integrated operational practices would not only accelerate the harmonised development of the coastal sector but also would bring in a new economic order,

recommends that priority should be given to formulate and implement integrated systems of fisheries utilising the available technology, skills and materials throughout the coast and programmes for productive utilisation of coastal land area with suitable plantation crops and livestock.

3. 2. *DEVELOPMENT OF FISHERMEN COMMUNITY*

The Seminar,

noting that, in spite of the significant development of fisheries during the last three decades, the majority of fishermen still live below the poverty line, and

realising that the uplift of the fishermen community, socially and economically, is an urgent need so that they are not left out of the main stream of National development,

recommends that the State Governments accelerate their fishermen-welfare programmes to provide adequate facilities, aid and concessions to the fishermen community for simultaneous development of the community along with others, and encourage and provide necessary technical and infrastructure facilities for taking up employment-and-income generating additional avocations in the coastal areas.

4. INFRASTRUCTURE FACILITIES

4. 1. *LANDING FACILITIES*

The Seminar,

noting that at present landing facilities for the crafts engaged in small-scale fisheries are meagre and that during adverse weather conditions and monsoon beach landing of the crafts is extremely difficult, and

realising that high investments would be required to provide modern fishing harbour facilities,

recommends that effective beach landing facilities be established at all important landing centres and approach roads and other infrastructure facilities be provided.

4. 2. *FISH PRESERVATION AND PROCESSING*

The Seminar,

noting that the present conditions of handling of fish catches at sea and on landing leave much to be desired, and

realising that proper preservation and processing are essential for producing quality products and realising better prices and that sophisticated techniques are beyond the reach of artisanal fishermen,

recommends that simple but effective preservation and processing techniques within the technical ability and economic capacity of fishermen should be evolved; particular attention be paid to the use of solar energy; fish curing yards with required facilities be established|re-established; canning of fish in suitable cheap containers be evolved; and steps be undertaken to minimise the loss of protein quality and vitamin contents during processing of fish products.

4. 3. *MARKETING*

The Seminar,

recognising that the marketing and distribution of fish catches are beset with many problems due to small landings, middleman problem, inadequate infrastructure facilities and marketing opportunities, and

realising that one of the means for the uplift of the economic conditions of the fishermen is to ensure him a fair price for his produce,

recommends that effective systems be established in all maritime States and Union Territories to take up distribution and marketing of fish catches landed by small-scale fisheries and that immediate steps be taken to carry out indicative surveys to collect market intelligence and to promote internal marketing.

5. EDUCATION, TRAINING AND EXTENSION

5. 1. *ASSESSMENT OF NEEDS AND TRAINING FACILITIES*

The Seminar,

realising the vital need for expertise and manpower for the development of coastal aquaculture and small-scale fisheries, and the importance of creating the manpower through phased-out training programmes, and

noting that no reliable estimates are available on the requirements of different categories of personnel and training needs,

recommends that an assessment of requirements of technical, managerial and operative personnel for a phased development of small-scale fisheries and coastal aquaculture for the next 25 years be made and, on this basis, adequate training facilities at different levels be established; that need-based training be imparted to fishermen and fish farmers through Fishermen Training Centres and Krishi Vigyan Kendras; and that, besides these training facilities, the fishermen be educated through other means of non-formal education on the self-efforts needed for improving their saving habits, nutritional and hygienic standards and socio-economic conditions, and the fishermen leaders themselves should endeavour to give the necessary guidance and assistance in this.

5. 2. *EXTENSION*

The Seminar,

realising that extension service has a pivotal role to play in the development and advancement of small-scale fisheries as well as coastal aquaculture as an agency between the R & D programmes and end-users, and

noting that the extension facilities available at present are totally inadequate for playing a meaningful role,

recommends that the existing extension activities may be strengthened to meet the growing demands of technology transfer and developmental programmes and new extension facilities be created wherever they are not available at present so that each State and Union Territory will have full-fledged fisheries extension service.

6. FISHERMEN COOPERATIVES

The Seminar,

realising that quick progress of the small-scale fisheries depends to a great extent on the credit facilities and other services available to fishermen on favourable terms and conditions and that the Cooperative System is the best means for providing such services, and

noting with concern that at present the fishermen cooperatives are generally ineffective due to an interplay of many factors,

recommends that functional cooperatives to serve all the activities and needs of the fishermen be established.

7. FISHERIES FINANCING

The Seminar,

considering the immense potential for the development of coastal aquaculture and small-scale fisheries in the country and the large investments needed for the purpose, and

noting that the fishing industry has certain unique characteristics different from other land-based industries and that any financing agency will have to take these conditions and the general illiteracy of fishermen into consideration,

recommends that separate provisions and guidelines be made by the commercial banks for providing financial assistance and loans through simplified procedural formalities and with minimum delay to help the quick development of the fisheries sector, eventually leading to the establishment of Fisheries Banks.

8. PUBLIC POLICIES AND PLANNING

8. 1. *GENERAL POLICY AND PRIORITIES*

The Seminar,

drawing attention to the need for sustained Government support and interest which are essential for the development of both the small-scale fisheries and coastal aquaculture, and

suggesting that the Government may announce well-defined policies, strategies and guidelines for the development of these fisheries, in the making of which the fishermen/fish farmers themselves may be fully involved,

recommends that high priority be assigned for the development of these fisheries and that coastal aquaculture be recognised as an industry to facilitate its quicker growth.

8. 2. *DISTRIBUTION OF WATER AREAS FOR FARMING*

The Seminar,

noting the availability of water spreads suitable for coastal aquaculture under the control of the State Governments and the possibility of utilising the same by the small, marginal and landless fishermen and fish farmers for the purpose,

recommends that a viable policy for the distribution of such water areas to the coastal fishermen and fish farmers for aquaculture purposes be formulated and implemented.

8. 3. *SUBSIDY AND INCENTIVE SCHEMES*

The Seminar,

noting that coastal aquaculture is a rapidly developing field in the country and for its proper development and growth liberal Governmental aid and incentives are necessary in the initial stages, as was the case with the introduction of mechanised boats,

recommends that suitable subsidy and incentive schemes be instituted for the quicker establishment and proper growth of the coastal aquaculture industry and constraints in respect of taxes, high cost of material etc. may be removed.

8. 4. *ACCIDENT AND NATURAL CALAMITY BENEFITS*

The Seminar,

realising the hazardous and risky nature of the fishing profession, frequent occurrences of natural calamities such as cyclones and tidal waves hitting the fishermen out at sea and at their abodes, and the disabilities and loss of life and property caused while engaged in fishing,

recommends that they be provided adequate compensation promptly under all the above circumstances and appropriate accident reliefs be instituted, and that the function of compensation in cases of injuries, loss of life, and equipments be taken over by the Government of India as a package measure.

9. PROTECTION AGAINST DAMAGES TO ENVIRONMENT

The Seminar,

noting that human interference is upsetting the natural balance of the ecosystem through indiscriminate denudation of mangroves and quarrying of corals leading to extensive coastal erosion, and through uncontrolled discharge of domestic, agro and industrial wastes leading to pollution of the environment, and

stressing the need for maintenance of natural balance of the ecosystem for the protection of all the living resources therein,

recommends that the State Governments take immediate steps to develop necessary action plan for the protection of the coastal zone against such damages and that effective steps be undertaken to protect the living resources therein from destructive human interference and pollution based on criteria and guidelines that may be framed by expert committees constituted in all the maritime States and Union Territories.