Proceedings of
THE NATIONAL WORKSHOP ON TRANSFER OF TECHNOLOGY FOR SUSTAINABLE SHRIMP FARMING

held at Madras, India
9-10 January 1995

Organised by

Central Institute of Brackishwater Aquaculture (ICAR), Madras

in collaboration with

Ministry of Agriculture, Government of India, New Delhi

Marine Products Export Development Authority, Kochi

and

M.S. Swaminathan Research Foundation, Madras

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Edited by

K. ALAGARSWAMI

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FOREWORD

The National Workshop on Transfer of Technology for Sustainable Shrimp Farming was organised jointly by the Central Institute of Brackishwater Aquaculture, Madras, Ministry of Agriculture, Government of India, the Marine Products Export Development Authority, Cochin and Dr. M.S. Swaminathan Research Foundation, Madras during 9-10 January, 1995 at Madras. The Workshop was a timely exercise to discuss particularly the debatable issues of sustainable shrimp farming in relation to environmental and socio-economic aspects.

During the last five years, the growth of the shrimp farming sector in the country has been smooth and rising, with considerable expectations generated in the Industry. However, during 1993-94 certain isolated instances of over crowding of shrimp farms in Andhra Pradesh and Tamil Nadu resulting in outbreaks of diseases in shrimp farms caused serious economic losses to the farmers. The problem was compounded all the more by the resulting social conflicts as reported by the media.

Our farmers and entrepreneurs in their enthusiasm to take up shrimp farming happen to ignore planned development of the farming sites. Over crowding of farms and their intensive activities at places exceeded the carrying capacity of the aquatic environment. Water sources such as brackishwater creeks and canals through excessive use became polluted and in turn affected the farm eco-systems. However, the setbacks experienced by the shrimp industry due to their over indulgence in unplanned growth as well as the absence of regulations caused serious concern. It is satisfying that the entrepreneurs and farmers have come to appreciate the scientific opinion on technical aspects of the shrimp industry and would not repeat the mistakes committed earlier. Under Agenda 21 of UNCED Conference held in Rio in 1992, "Code of Conduct for Responsible Fishing" has been formulated and aquaculture would have to be practised in a responsible manner for its long term sustainability and environmental security.

The National Workshop had the benefit of advice and guidance of eminent aquaculturists, besides the active participation of several eminent scientists, industrialists, farmers and administrators in addition to the benefit of the wisdom of Dr. M.S. Swaminathan. The National Workshop examined the twin themes of sustainable shrimp farming and the transfer of technology to achieve the goals of sustainability.

The Proceedings of the National Workshop contained in this publication along with important recommendations made by the Workshop form a valuable document as a reference work for policy makers, administrators, farmers and students to appreciate the requirements of sustainable development of shrimp farming industry.

(P.V. Dehadrai)
Dy. Director General, ICAR
Ministry of Agriculture
Government of India, New Delhi.

25th March, 1996
New Delhi.

ACKNOWLEDGEMENTS

The National Workshop on Transfer of Technology for Sustainable Shrimp Farming was a collaborative effort of the Central Institute of Brackishwater Aquaculture, the Department of Agriculture and Cooperation (DAC) of the Ministry of Agriculture, Government of India, the Marine Products Export Development Authority (MPEDA) of the Ministry of Commerce and Dr. M. S. Swaminathan Research Foundation (MSSRF). DAC and MPEDA extended financial support and MSSRF provided facilities of the Foundation premises for the Workshop. Several discussions were held with Dr. M. S. Swaminathan in planning the details of the Workshop.

The Indian Council of Agricultural Research, New Delhi kindly approved the holding of the Workshop.

Dr. P. V. Dehadrai, Dr. Y. S. Yadava, Dr. T. V. R. Pillay, Dr. S. D. Tripathi, Dr. P. U. Verghese and Dr. M. Y. Kamal chaired the different sessions of the Workshop. Dr. R. Paulraj Dr. Mathew Abraham, Shri M. Kathirvel, Dr. P. Ravichandran, Dr. S. A. Ali, Dr. A. R. Thirunavukkarasu and Dr. Vineeta Hoon acted as Rapporteurs of the sessions.

In organising and conducting the Workshop, several committees were constituted (listed in Annexure -II) and they did an excellent job. Besides, the officers and staff of CIBA extended all assistance. Shri N. Raghavan provided the secretarial assistance.

Dr. A. R. Thirunavukkarasu, CIBA extended very valuable help right from planning to the conclusion of the Workshop. He along with Dr. P. Ravichandran, Dr. (Smt) Munawar Sultana and Shri M. Kathirvel gave excellent assistance in bringing out this publication.

It gives me great pleasure to record my most grateful thanks to all the above organisations and officers for their unstinted cooperation, support and assistance. Our thanks are due to all the participants whose contributions made the Workshop successful.

K. Alagarswami
Director
Central Institute of
Brackishwater Aquaculture

Madras,
23rd March 1996.

PROCEEDINGS OF
INAUGURAL SESSION

WELCOME ADDRESS

Dr. K. Alagarswami
Director
Central Institute of Brackishwater Aquaculture (ICAR), Madras

Respected Dr. Swaminathan, Shri K.B. Pillai, Dr. Dehadrai, Thiru Bhujanga Rao, Dr. T.V.R. Pillay, distinguished delegates to the Workshop, invitees, members of the Press, Doordarshan and All India Radio, Ladies and Gentlemen,

It gives me great pleasure to welcome you all to the inaugural function of the National Workshop on Transfer of Technology for Sustainable Shrimp Farming. This Workshop has the unique distinction of having Prof. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation and one of the most eminent agricultural scientists of the world for all times, and one with great vision and equal concern for environment and development, for its inauguration and to guide its deliberations in the most fruitful manner. It is he who made 'fisheries' a respectable profession with great potential for increasing food production in our country. It is our great fortune that he has kindly found time to be with us today as well as tomorrow. Sir, I thank you very much for the honour you have done to this National Workshop and I extend a very warm welcome to you.

Shri K.B. Pillai, Chairman, Marine Products Export Development Authority, Kochi, is presiding over one of the most significant segments of economic activity of the country at a crucial time, with pressure on the one hand to increase marine products exports for earning more foreign exchange and pressure imposed by the field problems on the shrimp production sector on the other. I am happy that he has kindly agreed to preside over the function. I extend a very warm welcome to Shri K.B. Pillai.

Dr. P.V. Dehadrai, Deputy Director General (Fisheries), Indian Council of Agricultural Research, New Delhi, who is in charge of fisheries research at the national level is the guiding force and a friend and philosopher of all those who are engaged in R&D programmes in fisheries and aquaculture, and also of the farmer and industry. He has taken upon himself the responsibility for setting the theme on the right track for discussion at this Workshop through his Keynote Address. I extend a very warm welcome to Dr. Dehadrai.

Thiru Bhujanga Rao, Secretary to Government of Tamil Nadu, Animal Husbandry & Fisheries Department, is shouldering a very heavy responsiblity in the State at this juncture. Tamil Nadu is one of the two States which is going through a major revolutionary phase of shrimp culture with great challenges and opportunities. I am very grateful to him for kindly accepting our invitation to be with us this morning to release the special publications brought out by the Central Institute of Brackishwater Aquaculture and to address the Inaugural Session. I extend a very warm welcome to Thiru Bhujanga Rao.

Dr. T.V.R. Pillay is an aquaculture scientist of international repute and has served at the Food and Agriculture Organization of the United Nations at Rome for over three decades. He has been instrumental in putting aquaculture as a food production activity of great importance at the global level and has very wide experience of the problems and prospects of shrimp culture all over the world. He has kindly agreed to give us the benefit of his experience and guide us in planning for sustainable shrimp farming through his special address. I extend a very warm welcome to Dr. Ramu Pillay.

I welcome Dr. Y.S. Yadava, Fisheries Development Commissioner, Government of India who would give this Workshop the policies of the Government on sustainable shrimp farming.

It gives me great pleasure to welcome all the eminent personalities, scientists, experts, industry, farmers and officers from national and state organizations, who have kindly responded to our invitation, and the enlightened media, including the Press, Doordarshan and All India Radio, for kindly covering this programme and for their continued support both to the cause of development and security of the environment.

Kindly permit me to say a few important points on the background and objectives of this National Workshop on Transfer of Technology for Sustainable Shrimp Farming. All of us are aware of the present status of shrimp culture industry in the country and the issues that have been raised against it by the environmentalists and social organizations. We all do recognize the need to expand shrimp culture as a very important production and economic activity, but it has to be done in a responsible manner for its long-term sustainability. This responsibility squarely lies with us and aquaculturists to ensure that the activity meets the requirements of the parameters

of sustainable development, namely, social acceptability, equitability, economic viability, technical appropriateness, environmental soundness and conservation of resources. This is an intrinsic matrix of principles, easy at the concept level, but difficult to implement at the ground level to the satisfaction of all concerned, given the diversity of interests involved. This Workshop aims at deliberating these issues to evolve a working policy framework, with guidelines and some concrete action plans for sustainable shrimp farming for implementation.

Yet another objective of the Workshop, which appears to me more urgent in this context, is the issues relating to the transfer of technology. This is a mechanism which involves technology generation, dissemination and utilization. In fact, originally when the idea for holding this Workshop was considered sometime back, this was the focal theme to be centred around the Transfer of Technology structure and mechanism in the country, more particularly with the Brackishwater Fish Farmers Development Agencies operating at the district level in the States. This, you would have noticed in the original announcement issued for the Workshop. However, due to subsequent developments, we took up the twin-themes of Transfer of Technology and Sustainable Shrimp Farming, to broaden the scope of consideration and to derive the maximum benefit from our two-day deliberations. We all know now the famous phrase "Extension is the weakest link in fisheries development". We will be failing in our responsibility if we do not give adequate attention to this vital aspect required for providing the knowledge base, skills and technologies and for the necessary feedback from the system.

Having set the background and objectives of the Workshop, I, on behalf of the organizers of the Workshop and on my personal behalf, have great pleasure in thanking you for your participation and in extending a very warm welcome to all of you, the dignitaries on the dais, distinguished participants, invitees, members of the Press, Doordarshan and All India Radio.

KEY-NOTE ADDRESS

Dr. P.V. Dehadrai
Deputy Director General (Fisheries)
Indian Council of Agricultural Research, New Delhi

Respected Dr. Swaminathan; Shri Pillai, Chairman of MPEDA; Dr. Pillay, who has been a guiding force for global aquaculture development for a very long time; Shri Bhujanga Rao and very dear friends:

This Workshop is very significant not only because we would discuss in this forum some very critical issues about shrimp farming industry, but also because of the seriousness which has been imparted to it by the august association of MPEDA, M.S. Swaminathan Research Foundation, Department of Agriculture and Cooperation and, of course, ICAR, in organising this Workshop.

We know the significance of aquaculture in the world and we do not have to re-emphasize it. With all the developments taking place now, we have a very flourishing shrimp farming industry in India and we have got to deal with it. Basically, it is true that in any sector which grows, particularly the agriculture sector, the entire credit for its growth should go to the farmers and the entrepreneurs and we should salute them. However, the time has come now for a fast growing sector like shrimp aquaculture to have some introspection. It is posing several problems - social, ecological and economic and we have got to manage it properly. When we embark upon the management of aquaculture sector, if the government wants to intervene with controls, with Do's and Don'ts and guidelines, these should be of promotive or parental or corrective in nature rather than punitive.

We know that shrimp aquaculture in the country has tremendous potential. There is entrepreneurial enthusiasm. A lot of technology is available in the country. There is a political and administrative will. There is very great potential for export earnings from this sector. Therefore, development of shrimp farming industry should be considered as a challenging task.

Shrimp farming should be related basically to the coastal zone management plans. Coastal aquaculture development, I would call it CAD, is very diverse in relation to geography, agro-climatic situations, people involved, the resources used and the methods and practices followed. It should be integrated with various economic and conservational activities such as forestry, agriculture, estuarine and lagoon fisheries, industry, habitation, tourism, fish landing centres and mariculture as a multi-sectoral programme. However, most of the present day development of coastal aquaculture has occurred in an isolated and uncoordinated manner largely by the entrepreneurial enthusiasm. The growth of aquaculture in India, thus, needs to be guided by the relevant national plans for economic and overall social development. The industry needs to be managed pragmatically right from the beginning. Unfortunately, too much concentration is often given to short-term gains and insufficient attention to long range planning. It is essential to formulate some ecological and economic models before we think about further growth of the

shrimp farming sector.

The ecological planning should consider the potential of each coastal zone, identify appropriate and compatible uses of resources of land and water, and allot the resources on environmental considerations as per Master Plans for the areas.

Land is a very scarce resource and the judicious use of only few places for shrimp farming would be possible. CAD will be useful, not only for identifying where it should be developed, but also for how it should be developed. It will also help in regulating such activities with better chances of success and minimal environmental conflicts. This may pave the way for obtaining the much desired community involvement in defining and developing best practices of aquaculture in relation to ecology within a specific policy framework.

The caution should be that one should not become preoccupied with the biophysical process at the expense of social processes. Man should remain at the centre stage of any development programme, as Dr. Swaminathan always used to say. We should follow the old dictum that too much of anything is bad. In fact, even over-playing the environmental card as well as the reckless development of shrimp farming would be extremes, which would be disadvantageous to the country. The coastal aquaculture development, at least in India, has not caused any measurable damage as yet.

Dr. T.V.R. Pillay, in his early works on aquaculture had mentioned that most of our concerns regarding potential adverse impact of aquaculture are still of speculative nature. But in recent years, we have some glaring examples of what could go wrong in a fast developing aquaculture sector. We have the very sad experiences of Taiwan in 1989, China in 1993 and in several provinces of Thailand. In India also in some places we did get little worried, although we have had a very clean growth curve since 1990. This needs to be sustained.

However, recent trend in shrimp farming in the country is alarming indeed. We find an urge among the entrepreneurs to go for spectacular productivity by adopting intensive aquaculture practices thereby endangering the proverbial goose which lays the golden eggs. Then there is an increasing concentration of aqua farms in close proximity to human habitation and in areas with access and infrastructure facilities. This has the danger of over-crowding and is subjecting the environment to stress beyond its carrying capacity.

The drainage problem in brackishwater aquaculture is very critical. In freshwater aquaculture, water in the pond could be very advantageously used in irrigation as fertilised and nutrient loaded water. But in brackishwater this is not possible. Conversion of functional agricultural paddy lands into fish farms in coastal areas would affect the eco-system and cause displacement of people leading to social problems and conflicts. This is true and nobody can deny this. In fact, even in freshwater aquaculture the same thing has happened. The problem came up in East Godavari district in Andhra Pradesh and in Punjab about two years back. When the labour force from Bihar and U.P. was not able to go to Punjab, a large number of paddy fields were converted to fish ponds. In Haryana some of the army officers when they return home after retirement, are digging up their backyards into fish ponds. You cannot blame the farmers who would like to practise something from which he gets more money. But the food

basket would be affected. The rice acreage may shrink. There are whole lot of problems. Therefore, some kind of rational approach towards all these developments is required. You would agree with me that because salt water is available, it does not mean that the entire coastal belt should be devoted to shrimp farming. Some kind of rational integration would be the answer.

In 1983 we initiated shrimp farming in the country through a Centrally Sponsored Scheme of the Agriculture Ministry. But there has been a long gestation period. We should salute the private enterprise and the farmers for the recent spurt in growth and development. But then how to avoid this rush or over-crowding in easily accessible areas? It may be desirable to provide infrastructure on identified difficult areas by some national agencies to absorb the cost of basic facilities such as embankments, sluice gates, feeder canals, roads, electricity etc. These areas could be designated as Aquaculture Estates in line with industrial estates. This would help the small farmers sector. The Ministry of Agriculture has enunciated the policy of equitable distribution of coastal resources for shrimp farming for the small farmers sector as well as for large houses. On the one hand, we could help the poor farmers by extending the technology to bring in the desirable change in their social and economic status. On the other part, the resource should be developed through hightech aquaculture so that the much required quantum jump in shrimp production could be achieved.

This kind of capital infrastructure was created in Orissa near the Chilka Lake. A complex of 178 ponds of 0.2 ha each was constructed for the economic rehabilitation of rural poor. I would like to share with you my personal experience. I went to a house of an old man who was one of the beneficiaries of the scheme. I asked him how much money did he get? He said he got Rs. 3000/- and his son took it as he was studying in ITI in Bhubaneshwar and needed the money. It was very exhilarating to know from him that with a 0.2 ha pond a small family could earn Rs. 3000/-. The example shows that shrimp aquaculture can make a tremendous impact on the socio-economic structure. Therefore, to vindicate our stand that science of aquaculture should also benefit the rural poor, that kind of common infrastructure in the difficult areas should be created.

This Workshop should address on the issues of land lease and utilisation policy of the States and over-dependence on imported shrimp feed. There was a move to import shrimp seed from outside which was not desirable. We have to define and develop parameters for environmental impact assessment. There should be a centralised mechanism to monitor aquaculture farms for environmental quality. Some national agency should guide the entrepreneurs and farmers with Do's and Don'ts.

Manpower development for aquaculture is important. Like the hotel industry has taken steps on its own to develop the manpower required, the aquaculture industry also should take steps to create a cadre of managers, technicians etc. Government institutions like the CIFE and CIBA could take up short-term training programmes.

The whole world is talking about sustainable aquaculture. In fact, internationally a "code of conduct for responsible fisheries" is being formulated under Agenda 21 of UNCED. We should bring in an awareness and response from the entrepreneurs and farmers on a rational approach to aquaculture and environment. I am sure that they would respond once they are

aware of the problems.

This National Workshop which has the benefit of participation of eminent scientists like Dr. M.S. Swaminathan, Dr. T.V.R. Pillay and administrators like Shri K.B. Pillai and Shri Bhujanga Rao, would, I am sure, will make some crisp and practical recommendations to enable shrimp aquaculture to develop and move forward in the sustainable direction.

Thank you very much.

SPECIAL ADDRESS

SUSTAINABILITY OF SHRIMP FARMING - AN OVERVIEW

Dr. T.V.R. Pillay

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INTRODUCTION

Sustainability of development is now a widely accepted concept, though it is often interpreted and understood differently by both specialists and the general public. Economists tend to focus on economic sustainabilty, ecologists insist on environmental sustainability, and the sociologists dwell on social equity and its effect on overall human development. The common man appears somewhat confused by it all, but tends to equate it with ecological sustainability. To an aquaculturist, it should mean a harmonious combination of these basic elements of sustainability in order to adopt systems that improve in an enduring way the use of natural resources and their productivity to meet increasing levels of demand caused by population and economic growth.

Our task at this Workshop is to define ways in which shrimp farming can be developed on a sustainable basis.

Modern shrimp farming is not more than a decade old, and during this period producers, scientists and development agencies have concentrated on increasing yields and production, rather than making it a sustainable activity. It is only the disastrous consequences of this narrow obsession, and public resistance to some aspects of development that have persuaded aquaculturists in recent years to start examining the impacts of the procedures adopted in shrimp farming.

Not much progress has been made in evaluating the real and suspected impacts of the industry and determining appropriate mitigatory measures, as well as acceptable trade-offs. But one cannot afford to wait till all the necessary scientific information have been obtained, when the industry is forging ahead in an unregulated manner. Under the circumstances the only solution is to make the best use of available information, both locally and from experience elsewhere. This, I believe, is the rationale for this Workshop.

This approach should not be taken as a plea for neglecting essential research for the development of scientifically verified procedures for sustainable farming. Pragmatic solutions often lose their validity very rapidly, and have to be strengthened or replaced by scientific

enquiry. I would therefore like to make use of this opportunity to impress on my colleagues in the scientific institutions to give the highest priority to this type of research.

I shall now try to summarize some of the more important observations that have a bearing on the development of sustainable shrimp farming.

DEVELOPMENT PLANNING

Even countries that are averse to central planning have implicitly accepted the need for coastal zone management plans to avoid the deterioration of coastal resources and conflicts in their use. It is indeed a major requirement in our country, and I understand there is a policy-level acceptance of its priority. If this type of planning is done, based on the proper balance of environmental, economic and social priorities, the conflicts that have arisen in the use of coastal resources can be minimized.

The national priority presently accorded to shrimp farming is largely based on export requirements and to make up for the reduction of landings from natural stocks. This focus on exports, with no regard for domestic markets, though nationally important and justifiable, conflicts with the aim of economic sustainability. Export markets have often proved volatile and if an enterprise does not have appopriate technology for producing shrimps at affordable cost for the domestic market, or is unable to switch production to some other suitable species, the enterprise is likely to meet major financial problems when the export markets become unattractive or inaccessible.

Another interesting observation, though not well documented is that in many Asian countries, investors have been able to recover their investments with only one or two crops after the farms became operational. This high profitability has a negative aspect, and a short-sighted investor may not have the necessary incentive to make his operation sustainable, especially when the growth phase is over and the profits have declined.

In planning of shrimp farming development, efforts are needed to harmonise it with capture fisheries management, in order to avoid inter-sectoral conflicts. Sustainable shrimp farming contributes to the reduction of fishing pressure on the natural stocks. Additionally, the large quantities of by-catch landed with shrimps have ready use as ingredients in the manufacture of shrimp feed.

FARM SITES

In the context of shrimp farming in India, site selection and farm design appear to have special significance.

The most desirable sites for shrimp farms are fertile coastal agricultural land. Therefore, when available, low-yielding agricultural or similar lands have been converted into pond farms. Because of the high prices offered by investors, even fertile high-yielding lands are reported to

have been sold for shrimp farming. The conversion of agricultural lands has created controversies. Besides the reduction of cereal production locally, there is the risk of seepage of salt water into neighbouring agricultural lands and drinking water sources, if adequate precautionary measures are not taken. This risk has to be taken into account at the site selection and farm design stages to avoid future problems and unnecessary additional expenses. Neglect of this has created considerable local resistance or even violent opposition to commercial shrimp farming.

If the farm has to use large quantities of fresh water for long periods from underground sources for regulating salinity levels, there can be conflicts with other users of the same water resources. This also is not an unavoidable problem, if it is taken into account in the design of water supply to the farm, and species that can tolerate the prevailing salinity range are selected for farming.

There is also the possibility of alternating the rearing of low salinity species during periods of greater freshwater inflow, with high salinity-tolerant species during other periods. The requirement of fresh water, if any, will generally be seasonal and species-specific.

Farms should be located in sites away from major freshwater aquifers when possible and suitable means of preventing saline seepage should be incorporated in engineering designs. It is indeed very unlikely and unwise for any large commercial shrimp farm to depend entirely on groundwater for its water supply.

Experience so far suggests that shrimp farming in close proximity with wild life, particularly bird sanctuaries are not viable, because of exposure of farmed shrimps to large-scale predation by wildlife and the predator control measures that the farmers may have to adopt to protect their stocks.

Very great concern has been created by the use of mangrove swamps for the construction of shrimp farms. Though there are no quantified information available on the impact of shrimp farming on the productivity of the mangrove environment and related coastal fisheries, it would appear logical to believe that it would result in reducing the nursery grounds of larvae and juveniles of commercial species and thereby productivity in the adjacent seas and estuaries. The nutrient loading from the swamps is likely to be reduced and subsistence fishing in the mangroves may be affected.

These are certainly possible impacts, and deserve to be investigated and quantified to assess the magnitude of trade-offs that are acceptable. It has, however, to be remembered that mangroves are not the preferred sites for shrimp farms, and when used because of the absence of better sites, generally only the back mangroves that contribute little to productivity are chosen. The soil quality and construction costs, and management problems, make them very poor sites. However, many of the earlier brackishwater pond farms were constructed on mangrove areas as in Southeast Asia and Ecuador.

Mangroves have many uses and the traditional forms of aquaculture, including shrimp farming is only one of them, and that too of much lower magnitude than other destructive uses like clearfelling and diversion of fresh water, as shown by world surveys of mangrove areas.

The extent of mangroves in India is estimated to be around 700,000 ha. The total extent of shrimp farms at present all over the country, including all types of sites is probably around 82,500 ha. This may give some idea of the magnitude of the impacts, if any, of shrimp farming on mangrove resources in the country as a whole, though not on a local basis.

As mentioned above, the back mangroves, characterised by stunted growth are inundated by tides only for short periods, such as only during spring tides, and therefore contribute relatively little to the productivity of the systems. If the topographic conditions are suitable, conversion into farms may even increase productivity of these areas due to more frequent tidal inundation and easy drainage made possible by the farms' canal systems. The planting of mangroves on the farm embankments would also add to the productivity of the back mangroves.

FARMING TECHNOLOGIES

As pointed out earlier, the root cause of present-day concern about the environmental consequences of aquaculture is the rather blind pursuit of increased yields through constant intensification of farming operations. The traditional small-scale production systems were considered eco-friendly; not only because they gave rise to very little wastes of their own, but also because they formed effective recycling systems for other farm wastes.

The scenario has changed with the evolution of farming systems from what are loosely termed 'extensive' to 'semi-intensive' and to 'intensive' and even 'super-intensive' systems. Questions are raised about the environmental sustainability of the procedures involved.

The intensive systems of production involves: (1) rearing of higher densities of stocks in limited space; (2) use of larger quantities of feeds, giving rise to increased accumulation of faeces and spilled feeds: (3) higher loading of dissolved nutrients in pond water; (4) frequent water exchange and consequent lower rates of water retention time in rearing ponds that do not allow adequate time for the decomposition of particulate wastes and utilization of dissolved nutrients for organic production. Such environmental conditions are very conducive to the occurrence of diseases and mortality of stocks.

Attempts to control diseases generally involve the use of chemicals and therapeutants, the remains of which can impair the quality of farmed products, and cause public health hazards if appropriate withdrawal periods are not observed. If the diseases are incurable and infectious, the entire stock may have to be destroyed to prevent them from spreading to other farms and water bodies. This would naturally cause considerable loss to farming enterprises.

Because of all these risks, questions have been asked why intensive and super-intensive systems of farming should not be discouraged. In fact, based on field experience many farms have already turned to what they consider semi-intensive production. But one cannot conclude that intensive systems do not have a role and cannot be sustainable. It will depend on the local conditions, farm design, state of technology and farm management methods. Intensive systems would use less space or land, even though they would consume greater amounts of energy. Farm wastes can more easily be treated and disposed off, or recycled. Higher costs of production may

be compensated by increased revenue. So under certain circumstances intensive farming can be justified.

Extensive small-scale farming has several ecological and social advantages, but economic considerations and land use problems make it much more difficult to be adopted for commercial purposes. This accounts for the preference for semi-intensive systems.

Extensive systems of production involving lower stock densities, may become economically attractive, if lower stock levels are grown to larger individual sizes through feeding with natural foods and supplementary feeds, for marketing in the live or farm-fresh state, in specialty markets. This would, of course, involve accepting the goal of quality, instead of quantity.

WASTE PRODUCTION AND DISPOSAL

The main wastes from shrimp farms consist of particulate matter (sediments and free-floating) and dissolved nutrients derived from the disintegration of feed spills, faeces, and pond biota, as also metabolic by-products. The quality and quantity of the waste products naturally depend on the culture operations, magnitude of production, farm design and management.

For example, the wastes from a farm producing less than 50 tons annually are considered too small to require any environmental impact assessment. Of course, a large number of such small farms concentrated in a small area, discharging their wastes into the same waters, would require special consideration. Similarly wastes arising from cage farming in open waters have to be considered differently from still-water pond farms.

Observations have shown in many pond farms with adequate water retention times, that the quality of waste water is well within acceptable limits. Organic matter disintegrates under aerobic conditions and contribute to the productivity of the ponds. The load of particulate as well as dissolved wastes are eliminated or greatly reduced. When discharged into a fast-flowing waterway, the remaining wastes, if any, are dissipated and easily get mineralized and utilized for organic production.

Conditions in farms adopting intensive and super-intensive farming procedures may be different. Maintenance of dense stocks with intensive feeding and frequent water exchange (and consequently low water retention time) would lead to higher waste loads in the effluents. This can affect the water quality of the receiving waters and affect their flora and fauna, particularly when the flushing rate of the water body is low.

Remedial measures required are suitable waste treatment before the discharge of effluents, and the use of anti-pollution feeds, especially feeds with adequate water stability.

Indiscriminate use of chemicals and therapeutants to control diseases, predators and weeds in farms have created considerable environmental concern. When easily degradable chemicals are used, the toxicity disappears in a matter of hours, with very little risk of retention

of toxins in the stock.

Intensive farming is associated with more frequent disease outbreaks, and consequent use of these substances, particularly the increasing use of antibiotics as curatives or as prophylactics. Chemotherapeutic products used in the control of many diseases are known to remain in aquatic organisms and can become public health hazards.

It has been shown that antibiotics are not effective in controlling disease in aquafarms and much of what is administered finds their way into the environment. Pathogenic bacteria will develop resistance to most, if not all antibiotics. There is a real risk of transference of antibiotic resistance to normal bacteria within the human gut, if large numbers are ingested. Because of the danger to human health, the use of antibiotics has to be discouraged in shrimp farms.

In order to develop sustainability, the overall attitude to waste disposal has to change. It should cease to be that one's responsibility ceases when it is out of one's door. This is more so in farms located in tidal areas. There is always the chance of the discharged wastes finding their way back to the same farm or your neighbours' farms!

SOCIO-CULTURAL IMPACTS

Historically aquaculture has been a part of rural development, with very little conflict with other activities. Homestead farming, and subsistence-level or small-scale farming, formed an integral part of rural farm life. But the advent of large-scale commercial aquaculture, especially highly profitable farming of shrimps for export, financed by companies and corporations, have resulted in a polarity of interests and social tensions.

Notwithstanding the fact that some of these tensions may be caused by small-town politics and 'not in my back-yard' posturing by local leaders, they have the potential to make the enterprises unsustainable.

Reactions to the acquisition of agricultural land and wetlands have been referred to earlier. What is often described as 'land grab' by rich entrepreneurs and large companies appears to have created considerable resentment in certain areas. To some extent, this may be due to the perception that aquaculture, which was traditionally a subsistence-level rural activity of local communities, is being transformed into a vertically integrated industry by non-local entities, with very little benefits accruing to local populations.

Though lands have been sold for farm construction to avail of the high prices offered by entrepreneurs, there appears to be very few cases of dispossession of land caused by aquaculture development, unlike some of the other developmental projects, as for example dam construction. On the other hand, it has helped to open up isolated areas for human habitation, providing people with a remunerative occupation. There are reports of depressed villages transforming into prosperous townships, as a result of shrimp farm development, even though the benefits may not always be equally distributed. Some countries have actively promoted aquaculture in support of trans-migration policies or for national security reasons. On the other hand, there

are disturbing instances of villages becoming uninhabitable because of salination of drinking water sources or getting encircled by extensive shrimp farms.

As mentioned earlier, conflicts have arisen as a result of competition in the use of water resources - ground water as well as surface water - and the salination of drinking water and agricultural soils. Though there is a perception that these consequences have been blown out of proportion, there is little doubt that these possible effects should be prevented by suitable measures, both in the design and construction stages of the farm, as well as during farm operation. In an economically attractive venture like shrimp farming, there should not be any valid reason for entrepreneurs to shy away from the extra investment that may become necessary for this.

Partial or complete dependence on wild brood stocks and wild larvae and juveniles in shrimp culture has given rise to the belief that their capture affects the wild stocks, and consequently the capture fisheries. Though there is as yet no convincing evidence to this effect, it is advisable to phase out this practice as early as possible in the interests of aquaculture, as well as capture fisheries.

CONCLUSION

I have tried here to summarize the major concerns that relate to the sustainability of aquaculture development, with particular reference to shrimp farming. As mentioned earlier, proven and quantitative information on many of the adverse as well as beneficial impacts of aquafarming are presently lacking.

Though it may be justifiable to conclude, on the basis of available knowledge, that the adverse effects are not so serious as anticipated, the need to reorient research to obtain basic data for the adoption of sustainable production technologies, and for the judicious planning and regulation of development, is worth emphasizing here once again.

All the types of research required cannot be done in laboratories or research stations only. On-farm research with the cooperation of farmers and the industry is most essential. Aquaculture scientists generally have not been used to this type of research, and may find farm operators not sufficiently cooperative, if they are unable to convince the owners of the direct benefits of such research for ensuring the sustainability of their farms.

Much of the opposition of local communities to aquafarming can be traced to the lack of information or mis-information. This needs to be addressed through measures suited to local situations, and the real root cause of their opposition. Ways of involving the local communities in the planning and operation of enterprises, such as personal contacts, community discussions or contract farming, have to be considered.

Though one may sound a little out of tune with modern trends to recommend government regulations, these can be avoided only at peril to this emerging industry and the environment. But, when arbitrary regulations have to be adopted, simultaneous action has to be initiated to obtain factual information through appropriate research and field enquiries, to enable their revision, if required.

SPECIAL ADDRESS

Thiru G. Bhujanga Rao, I.A.S.
Secretary to Government of Tamil Nadu
Animal Husbandry & Fisheries Department

Shri Pillai, Chairman, MPEDA; Dr. M.S. Swaminathan; Dr. Pillay; Dr. Alagarswami and dear friends,

I have great pleasure in releasing the publications by CIBA. Eminent scientists and others spoke about aquaculture. I am new to this field and only six months back I joined the Animal Husbandry and Fisheries Department. I want to start with a note of caution about this new aquaculture development. It is generally felt that when new industries are started, they interfere with nature. In the cement industry, excavations have been done in many hill areas causing denudation and degradation of the forests. The fertilizer industry is causing damage to the neighbourhood. In cultivation in hill areas, like in Kodai and Ooty, we see denudation of forests. While travelling to Ooty you don't see greenery. You only see brown patches all the way. While promoting tea cultivation, coffee cultivation and other such activities, a lot of forest coverage was removed, though regulations were there. The regulations were of not much use because of the greediness of man. All the regulations are not really enforceable. There are a lot of constraints while enforcing the regulations.

Coastal aquaculture is now considered as 'Mackenna's Gold'. There is a great rush for converting the lands into aquaculture ponds. The Government either at the Centre or in the State have not brought out the master plans till now. It is only being discussed. If such plans had been drawn, and accordingly aquaculture is developed with proper layouts, water drawal systems, and drainage systems, perhaps it would have been wonderful. But now the lands are being purchased helter skelter in a great hurry. When the Government is thinking of formulating guidelines and regulations, there is general unhappiness in the industry. Some of the companies have already started culturing shrimp.

We have a project to formulate the Integrated Coastal Area Development Plan which is under way and which may be finalised in a couple of months. When we think about integrated coastal area development plan, a lot of things are discussed and planned for afforestation in the coastal area, tourism development, agricultural development, horticulture etc. At the same time, when we think about the aquaculture development, it is yet to be seen whether it is complementary or contradictory. Definitely the Integrated Coastal Area Development Plan is going to be affected. The agricultural lands are being converted. It is said that the industry is giving lot of employment to the local public, but definitely the employment potential is not appreciable. Many agriculturists are going to be labourers too. The cry from the local public about the environmental disasters cannot be simply ignored. You have to give a proper weightage for their outcry. It cannot be simply dismissed, because, for ages the coastal area people are enjoying the coastal lands and suddenly they are encircled by the aquaculture ponds. Their social and cultural habits are affected. They may undergo a very great change. I do not think their

economic conditions will improve, but the country may gain by way of exports. Definitely the coastal area public may not be able to gain much though the lands are offered a good price at present. But in no time they will spend it off. They will have to become dependents on the larger industries. Therefore, the Government is thinking of imposing some regulations. They may not be very harsh, but I am not sure how far they can be implemented. The companies which have already bought large extents like 500 ha and 400 ha and started culture may not be able to satisfy the regulations, I am afraid. Anyway, the responsibility on the part of the industry has to be stressed. I mean the industry has to feel responsible for the local public and for the restoration of ecology. They have to follow the regulations and they have to cooperate with the Government and other non-governmental agencies in following the rules and regulations. In that case, I think the much expected disaster can be avoided. But I can think of a situation where coastal area will be only a waterspread, with less of forests, less of tree growth, and less of greenery. There will be seepage of salt water whatever protective measures you take. These may not be visible within 10 years or 15 years, but think of about 50 years. Definitely miles and miles of useful agricultural lands will get salinized and I have no doubt in that. So the scientists have to recommend taking into account the large gestation period. You have to think about the situation after 50 years. When I talk to some of the shrimp farmers, they say that the agricultural farmers are getting good price for the land and that they should not have any grudge; hitherto these were fallow lands; there is no proper yield from the land and now they are getting good money and employment. I do not think these things are going to help them.

My humble request to the industry and to the scientists is to cooperate with the Government and non-governmental agencies in fulfilling the guidelines and regulations. I am not against aquaculture, but you have to go about with a note of caution in this. I am sure the Institutes like CIBA, Dr. M.S. Swaminathan Research Foundation and organisations like MPEDA, will take care of the future of the coastal area development. With these few words I thank the organisers for having invited me for this National Workshop on Transfer of Technology for Sustainable Shrimp Farming.

Thank you very much.

PRESIDENTIAL ADDRESS

Shri K.B. Pillai, I.A.S.
Chairman
Marine Products Export Development Authority, Kochi

Aquaculture has a major role to meet the world requirement for fishery products in the coming years as harvest from the nature is expected to plateau around 100 million tonnes by 2000 AD. Accordingly, it is estimated that the contribution from aquaculture sector should be 20 million tonnes, 38 million tonnes and 62 million tonnes respectively by 2000, 2010 and 2025 AD to meet the per capita availability of 19.1 kg/Caput/yr as estimated in 1989. A number of factors such as effective utilization of potential sites, better farm management practices, adequate supply of basic inputs, identification of new species, development of better strains, environmental safety, marketing opportunities etc., have to act in tandem to achieve these projections.

In our country too, the trend is similar, as production from caputre fisheries in the marine sector is fast nearing the potential yield of 3.9 million tonnes with the reported production of 2.57 million tonnes in 1992. The expectation to augment production from the deep sea may not materialize as a number of social and political constraints are emerging. Inland capture fishery production is showing a declining trend with the production of only 0.42 million tonnes in 1992 from 0.64 million tonnes in 1990. This underlines the fact that aquaculture is the only alternative to sustain the present percapita availability of fish (3.7 kg) for the ever increasing population (expected to reach 1039 million by 2000 AD) as well as to achieve the national goal of earning more foreign exchange through export of fisheries products. Bulk of the current aquaculture production of the country i.e. around 1.35 million tonnes is coming from inland fish culture, whereas shrimp farming produces over 63,000 tonnes. The former mainly caters to domestic consumption demand, whereas the latter is totally export oriented.

Shrimp is the dominant item among the exported marine products from the country and its share is around 36% by quantity and 70% by value, out of the total export of 2,43,960 tonnes in 1993-94, fetching Rs. 2504 crores in foreign exchange. Since capture fishery production is reportedly stagnating around 2 lakh tonnes for quite sometime, the increase in shrimp export is evidently contributed by shrimp farming. Marine Products Export Development Authority has taken several bold steps and shrimp farming has witnessed tremendous development especially in the last couple of years. Around 82,500 ha. is under farming producing more than 63,000 tonnes of cultured shrimp. Considering the fact that only a fraction of the potential area has been converted as shrimp farms, much more scope exists for further development. However, bringing these potential areas under culture depends mainly upon the speedy land allotment by the concerned state government, especially Govt. of Gujarat, Maharashtra and West Bengal.

Considering the quick turn over, high profitability and absence of any gestation period, there has been practically a mad rush for establishing shrimp farms and this has really led to disease and production problems mainly due to environmental degradation. In fact, the experiences of countries like Taiwan, Ecuador, China etc., have not prevented the occurrence

of such a situation in the country. MPEDA had taken steps much earlier to study the possible environmental effects and to recommend precautionary measures in shrimp farming in association with NEERI, Nagpur and is in the process of bringing out guidelines for avoiding environmental problems. However, the recent occurrence of diseases is the result of the negligence on the part of some of the entrepreneurs who wanted to generate as much profit as possible without giving much thought for environmental aspects and the sustenance of their ventures.

Considering the national interest in generating more foreign exchange, employment opportunities etc., it is essential to sustain the current productivity level in the existing farms apart from bringing more area under culture with sustained production. This requires adoption of a number of steps such as:

1. Selection of site and proper designing of the farm considering the carrying capacity of the natural water bodies.
2. Making available essential inputs such as seed, feed etc. in required quantity.
3. Effective farm managerial measures and restricting production to sustainable levels in semi-intensive farms and discouraging intensive farming methods.
4. Availability of trained manpower.
5. Avoiding conflicts in multiple-usage of land and social problems.
6. Maintenance of a clean and pollution free environment to prevent any major outbreak of diseases or other pollution problems.
7. Discouraging use of any antibiotics and harmful chemicals which may create marketing problems etc.

Some important issues

1. Actual land availability

The potential land availability of brackishwater area has been indicated at various places from 0.9 million ha. to 1.2 million ha. It is reported that these estimates invariably include some of the open water bodies such as lakes, backwaters, estuaries, bays, lagoons etc. unsuitable for conversion on account of exorbitant cost/undesirable depth range.

Lack of accessibility and basic infrastructure facilities/conflict with traditional fishermen/navigational and other land use etc. would restrict land availability further.

2. Haphazard development

Often the demand for the areas close to water sources and having required basic facilities is the maximum and farms are developed in such places without looking into the carrying capacity of the natural water bodies. This results in pollution and environmental degradation with consequent disease and mortality problems. To avoid these, area-wise master plans should

be prepared, possibly by pooling the resources from various promotional agencies. Land allotment and farm development can be based on them. Over-crowding should be discouraged and provision of sufficient buffer zone may be suggested considering the nature of farming, quantum of water intake and discharge, organic load, tidal amplitude and volume of exchange, carrying capacity of the water body etc.

3. Tiger shrimp broodstock requirement

As more and more hatcheries are coming up on both the coasts, the demand for broodstock is bound to increase. However, the availability of broodstock in the nature is bound to come down due to over-exploitation of shrimp in the natural fishing grounds and of seed resources in the estuaries and brackishwater bodies. One alternative is captive development of tiger shrimp broodstock. However, this has not attained commercial technology development stage for tiger shrimp. Another possibility is sea ranching of tiger shrimp seed in some selected areas in the sea coast, especially in the west coast where natural tiger shrimp population is very less compared to east coast. The argument that when there is not sufficient seed to stock the farms, how to source seeds for ranching does not appear logical as progressive reduction of natural tiger shrimp broodstock will equally bring down shrimp farming.

4. Over dependence on tiger shrimp

Majority of the farmers are preferring tiger shrimp for farming considering its fast growth rate, hardy nature, high price realization obtained right from the earlier farming days. However, white shrimp is not inferior especially where full strength sea water is being used, and the survival is very good. In the price front also, things have changed much especially because of the white shrimp production problem in China. The demand and price for white shrimp is very bright. Therefore, more farmers should take up white shrimp for culture which could also ease the enormous demand for tiger shrimp seed.

5. Shrimp feed

Corresponding to growth in farming, the feed manufacturing industry especially for semi-intensive farming has not grown and as a result, considerable quantity of feed is still imported. Technology for semi-intensive shrimp feed manufacture is still available only with some leading overseas feed manufacturers and their collaborators in the country. No commercial indigenous technology is available.

As regards feed ingredients, fish meal is an important component and the diminishing availability of fish meal for non-food use with increase in world population, may also push up price of shrimp feed. Therefore, suitable measures have to be taken to keep the production cost at affordable level.

6. Environmental issues

Shrimp farming should be eco-friendly for its sustenance. The probable causes of threat to environment could be higher organic and nutrient load as well as discharge of other biodegradable effluents. Most of the environmental problems could be positively prevented by establishing proper effluent treatment systems. The effluent treatment ponds have to be put up in medium and large shrimp farms having above 10 ha of water spread area. The farms having less than this area can think of putting up effluent ponds jointly with neighbouring ponds. Setting up of the effluent treatment ponds/system should be made mandatory in the coming years for all the farms that are to be established in future and also to the farms that already exist within a reasonable period of six months to one year.

The treatment ponds will be highly helpful for minimizing the biological load within the prescribed standards before releasing into the main water body. It also helps the entrepreneurs for secondary aquaculture and to create additional income. Establishment of reservoirs is also a concept which is very widely accepted in countries like Thailand and, therefore, it is high time that our entrepreneurs also positively orient their planning in this aspect for sustainable growth in shrimp farming.

There are also other indicative measures for sustainable growth which are as listed below:

(i) Not to aim at intensive shrimp farming at all.

(ii) Semi-intensive farming limited to 3 to 4 tonnes per ha/crop could be aimed in prime areas where the cultivable land is adjacent to the sea or nearer to the sea mouth in the creeks where water of the required quality can be made available in sufficient quantities for required water exchange.

(iii) The farms located in the interior of the creek should plan the production level according to the tidal influence. Farms having tidal influence between 1.5 to 2 meters may plan for 2 MT/ha/crop. Where the tidal level is limited to 1 to 1.5 meters, restricting to extensive farming is most desirable.

7. Creation of buffer zones

Salination of agricultural land and drinking water sources is a major social problem that has been reported. This could be avoided by keeping sufficient buffer zone between agricultural land and shrimp farms. There should also be sympathetic considerations from the part of shrimp farmers to compensate or provide drinking water supply to villagers, if establishment of farms in the vicinity has resulted in salination of drinking water.

8. Manpower development

Trained manpower for shrimp farming sector is in short supply. Therefore, all steps should be taken to develop sufficient manpower for the industry. Suitable aquaculture courses can be introduced through the industrial training institutes. Suitable short-term courses and programmes can also be started through Fisheries Colleges/Agriculture Universities, Voluntary Agencies

etc., apart from strengthening the training wings of Fisheries Departments. KVK's of ICAR Fisheries Institutes are known to conduct short - term training courses on shrimp seed collection, transport etc. This may be broadened.

9. Rural economic uplift

It is evidently seen that wherever prawn farms have been established economic uplift is experienced. In the earlier instances, the villagers whose daily wages were limited to 15 to 20 rupees a day and hardly getting any employment opportunities for more than 120 days a year now could get more than 60 to 70 rupees and up to 250 days in a year. In order to feel the real economic uplift, it is also advisable to employ more women folk in the projects and ensure that the income earned by them is effectively utilized for the uplift of the rural farmers.

INAUGURAL ADDRESS

Dr. M.S. Swaminathan
Chairman
M.S. Swaminathan Research Foundation, Madras

Shri K.B. Pillai, Dr. T.V.R. Pillay, Shri Bhujanga Rao, Dr. Dehadrai, Dr. Alagarswami and friends:

When Dr. Alagarswami told me about this particular workshop on sustainable shrimp farming a few months ago, I was very happy because from whatever has been said so far, it is clear that it is a timely one and a very essential one.

Crop farming is about 12,000 years old and it was mentioned by earlier speakers that shrimp farming is 20 to 30 years old. Therefore, there is so much to be learnt here from the experience gained in land based agriculture.

My own introduction to aquaculture took place when I became the Director General of ICAR in 1972. Coming from the crop side, I thought I must educate myself on the fisheries and animal husbandry side. Otherwise, how do I head an organisation which deals with all these areas - crops, animals and fisheries?

The first three months of my career in ICAR was devoted to visiting the Fisheries Institutes and the Animal Husbandry Institutes and spending as much time as possible to learn. One of the early ones I visited was the CMFRI, Cochin where Dr. Qasim was Director. Dr. Qasim is presently a member of the Planning Commission. Then I met Dr. Alagarswami. He had returned from Japan with knowledge on pearl culture. My discussion with both of them led to our starting a pearl culture farm in Tuticorin. Then Dr. Dehadrai showed me the wonderful murrels and so on. He was the project coordinator for culture of airbreathing fishes. I was tremendously impressed with whatever I saw. The late Dr. Jhingran briefed me on "Aquaplosion" or what we call "Blue Revolution" as a complement to the Green Revolution. So it appeared to me in the early seventies that here is a sort of goldmine on which we were sitting which provided enormous opportunities for this country, because of its large inland waters and the seas around. The U.N. Convention on the Law of the Sea gives us over two million sq. km of sea area as Exclusive Economic Zone.

I still recall, it is not hindsight wisdom, when I requested all the Directors of Fisheries Research Institutes under ICAR to prepare some programmes in the Fourth Five Year Plan on various culture fisheries. One of the projects I received was from Dr. V.G. Jhingran, who was then the Director, CIFRI. He made a fine proposal on composite fish culture, but I did not find any provision for any disease expert in the project. When I asked him on this he said that we do not have any problem of diseases in fish culture. I told him of our past experience in crops. When the ecology of the rice field was changed as a result of Green Revolution technology, altogether new pests and diseases appeared which were not there before; like the brown plant hopper and green leaf hopper and so on which we did not study before. The point I made to

Dr. Jhingran was that the ecology of the pond is going to be changed and the micro environment is going to be changed. As a result of your enormous inputs of intensive feeds and high yielding varieties of seed I expect diseases to occur.

In Dr. Ramu Pillay's outstanding, very knowledgeable and authoritative talk today, he mentioned about the need to reorient research. In many cases aspects of anticipatory research are not included. When we provoke change, the change happens not only in some directions which we want, but also in other directions which we would not have anticipated. For example, in January 1968, in my Science Congress address, I listed a number of secondary problems which are going to crop up with the Green Revolution. I think any good scientist should not overlook, however inconvenient it might be, certain difficulties which will come up. We always try to exaggerate the potential and underestimate the problems. In the research institutions it is important to look at the problems in totality both in their short-term and long-term perspectives.

Dr. Ramu Pillay also mentioned that in the early years we were concerned on productivity and not on sustainability. That is true. Retrospective analysis is easy but proactive analysis and predictions are necessary. It does not, however, receive the kind of financial support required. When you formulate a project in which you provide for a lot of things which do not occur today, the finance man will cut these out because money is short.

One of the first steps I took when I became Secretary of Agriculture was to get the Central Institute of Fisheries Education linked to ICAR. One of my dreams was to set up a Fisheries University for the country and fortunately CIFE became a deemed university.

We set up this Centre for Research on Sustainable Agricultural and Rural Development, and this April 1995 it will complete 5 years. There are hundreds of research centres here, and there is no need for one more research centre. But we wanted it to identify some major gaps in the ongoing programmes which we should fill and add something useful. The first programme of the centre is called the Coastal Systems Research (CSR). Essentially, our idea was how to adapt the Farming Systems Research (FSR) methodology to the coastal systems. As I said earlier, agricultural farming is 12,000 years old, but aquafarming of fish, prawns, mussels, crabs etc. is hardly 25 years old in our country. What do we learn from FSR methodology and how to apply that knowledge to the coastal systems? That is the reason we started CSR.

I happen to be a Member of the Planning Commission of Tamil Nadu as well as Kerala. I was able to persuade both these governments and the Chief Ministers to accept the fact that an integrated conservation and development strategy for coastal areas is exceedingly important. Kerala has its own problems which, in my view, require urgent attention, particularly sea erosion. Kerala has a higher population density. Integrated conservation and development of coastal areas requires attention to capture and culture fisheries and coastal forestry, industries and tourism and the scientific area should be the first one.

When we want to go in for sustainable shrimp farming as in sustainable agriculture, whole new areas of research have to be opened up, starting from seed. In the case of agriculture, we have adopted integrated nutrient supply in which mineral fertilizers form one small part. We have gone in for biofertilisers, organic manures, green manures and so on. Likewise, in terms

of disease and pest management our strategy is integrated pest management. Similarly, you will have to think of new approaches and adapt them to the conditions of water body. In aquaculture we are dealing with cubic volume of water, while in agriculture we are dealing with cubic volumes of soil and air. It is important to look at a new ecological technology in which every step of the production technology is examined carefully for its implications in terms of technology development. We should learn lessons from the methods used in Low Input Sustainable Agriculture (LISA) and develop an integrated technological package for Low Input Sustainable Aquaculture (LISAq). Inputs and outputs are related; hence low input does not mean reduction in input supply. LISAq will have to be developed on the basis of substituting chemical inputs with biological inputs and should aim at semi-intensive culture methods.

Secondly, we should look at the whole area of services. I am glad that most of the speakers today have emphasized on sustainable shrimp farming. We know that it is not only economically sustainable, but also attractive. What we want to make is that it is ecologically sustainable and socially sustainable. It might be environmentally sustainable, it might be economically sustainable, but if social sustainability is not ensured it will just not be possible to make progress due to societal objections.

The Government of India, the Government of Tamil Nadu, and all Coastal States have a policy on allocation of land for aquaculture. The policy is that 60% of the brackishwater lands of the government has to be given to the poor people, to the landless fishermen communities and so on, 20% for medium-scale operators including technocrats and 20% for the large-scale entrepreneurs and corporate sector. The entrepreneurs have already taken the land and also purchased private lands. I am requesting Mr. Bhujanga Rao to examine what has been done for the poor people for whom the 60% of the land is supposed to be assigned. Has anything been done on this? When I asked, people said where is the money for the poor people to develop aquaculture? Money is not part of the land lease policy. If the services are not going to be associated, we cannot sustain the enterprise socially. You are not really going into the problems of poverty and equity of the society. Today the Planning Commission has classified 360 million people as living below the poverty line. One-third of the country's population belong to the coastal areas. When the first Five Year Plan was started in 1950, our total population was only 360 million. Today, 360 million are below the poverty line and it is an austerely defined poverty line. Therefore, aquaculture should be a sunrise industry not only for industrialists, but a sunrise industry also for the poor fishermen and fisherwomen.

Part of our own work on aquaculture at this centre is based on this principle. We want at least to demonstrate it under the CSR programme area. I always believe that we must demonstrate the validity of what we preach. That is why we took up the National Demonstration Programme in agriculture in 1964. Farmer has to live by our recommendations but we do not have to live with them. So it is important to demonstrate. With financial support from the Department of Biotechnology, an All-women Eco-aquaculture Estate is being started at Karaikal with the help of CIBA, the Department of Fisheries and the Women's Development Corporation of Government of Pondicherry. If we really want to help the poor it can be done. Where there is a will, there is a way. The NABARD officers are here as also others who can help these people. We cannot excuse them if they find excuses for not helping to take new technologies to the

unreached.

The third area is the public policy. The policy is there in terms of land allocation. They have to be translated into a whole package of opportunity, services and producer-oriented marketing.

Fourthly, the area of post-harvest production technology becomes exceedingly important in an export industry. The World Trade Organization (WTO) has just come into existence on January 1 this year. We will not know immediately the full implications of it. There are very extensive clauses on quarantine and other regulations. It is not known what will happen in the industrialised countries when the competition is from poor countries. They will invoke arguments like social dumping, and environmental and sanitary factors to continue the discrimination. Now, unless we master all these including the Intellectual Property Rights (IPR) regime, we cannot take advantage of the new order. For 12,000 years, agricultural evolution has gone on in a non-IPR environment. From January 1, 1995 we are entering a field where agricultural research, in a generic term including fisheries, forestry, crop husbandry and animal husbandry will be under the regime of IPR. What are its implications? The ICAR and Dr. Dehadrai should examine all the sections of the GATT Agreement and its implications for research as far as agriculture is concerned, including sanitary and phyto-sanitary measures where I feel we are very weak.

I have been reading for the last few days that some diseases of shrimp have come from outside. Our Customs Department are looking for watches, gold and computers. They do not look at import of pests and diseases. If you go to Australia and U.S. they only look whether you have seed, some new plant, which you are going to introduce there. Our officers need to have training in such areas.

Finally let me conclude by saying that we should look at all these four aspects of transformation - the four T's, Technology, Training, Techno-infrastructure and Trade. All of them have implications with reference to science, in relation to services and in relation to public policy. Training at all levels, for public policy makers, scientists, extension workers, farmers and farm women is important. We have lagged behind in this. We start with a large programme without adequate preparation. In our country, unfortunately, people are only looking for failures. They would not look at successes. Even if a small problem crops up, it will immediately be blown up and then you have tremendous negative feedback.

I recall Dr. Alagarswami saying that extension is weak. An extension method called T&V system - 'Training and Visit' system, was started with great fanfare. A large amount of borrowed money under the World Bank loan was used. After five years, the T&V system was being called 'Talk and Vanish' system! Somebody said 'Touch and Vanish'. There are a number of other examples too. When the population stabilisation programme came, many took it with great fanfare. Most of them failed largely because of inadequate backstopping, inadequate preparation and inadequate analysis. In my personal view, the enthusiasm for aquaculture is not different. It was very great in the early 70's, it is even greater today. But I always feel we must make it a success and not find reasons for failure. I hope that when you develop an extension system for aquaculture, you should do it in a methodical way.

I hope this particular meeting would help us to document at least some of the things which we have to do. Being the New Year, we should strive for a new beginning for aquaculture industry. We should launch the Low Input Sustainable Aquaculture movement.

May I also request you all whenever you get time in the next two days to go around our centre. It is a small centre but committed to linking the livelihood security of the people with the ecological security of the country. In coastal areas, we define CSR as linking the livelihood security of coastal communities with the ecological security of coastal areas. In other words, it is a human centred institution. Our aim is 'Science for Society' and not science for scientist's sake. The Centre co-sponsored this workshop on an applied area of sustainable aquaculture as it is one of its programmes under CSR.

I want to thank the ICAR for giving our Centre the opportunity to be associated with this workshop.

Thank you all very much.

VOTE OF THANKS

Dr. Y.S. Yadava
Fisheries Development Commissioner
Department of Agriculture & Cooperation
Min. of Agriculture, Govt. of India
New Delhi

Ladies and Gentlemen,

I am indeed privileged to perform the duty of proposing a vote of thanks on behalf of the organisers of the workshop. At the outset, I express my indebtedness and respect to Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation, Madras for sparing his valuable time and inaugurating this workshop on Transfer of Technology for Sustainable Shrimp Farming. Sir, with your devotion and crusade for sustainable farming systems not only in this part of the world, but all over the globe, and with your kind patronage and guidance, shrimp farming in this country will receive the right impetus and the right directions for its sustainable development as so vividly illustrated by you in your thought provoking and inspiring Address.

Shri K.B. Pillai, Chairman, MPEDA in spite of his busy schedule agreed to deliver the Presidential Address and we are highly thankful to him. Propagation of sustainable farming practices is the talk of the day and we are hopeful that MPEDA with Shri Pillai at the helm of affairs shall be able to make valuable contributions to this sunrise industry.

Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR has been the guiding spirit behind this workshop right from the beginning. Sir, we are indebted to you for sparing your time and delivering the Keynote Address which has also set the tone for this workshop.

Thiru Bhujanga Rao, Secretary, Department of Animal Husbandry and Fisheries, Government of Tamil Nadu represents one of the States where the social and environmental issues concerning shrimp farming have been focussed a great deal. We are highly thankful to him for his benign presence here and for the release of the publications and for the concerns he has expressed in his Address.

Dr. T.V.R. Pillay is known all over the world for his contributions to aquaculture development and authoring several publications of immense help to the planners and development agencies alike. We are grateful to him for participating in this workshop and sharing his valuable views with all of us.

Ladies and Gentlemen, we have eminent personalities like Dr. S.N. Dwivedi, Dr. S.D. Tripathi, Dr. M.Y. Kamal, Dr. P.U. Verghese and a galaxy of others from the industry, farming community and several organizations. We are highly thankful to all of them for their participation. Their presence during the business sessions of the workshop shall be highly valuable in discussing the issues and chalking out the recommendations.

On behalf of the organisers, I place on record our gratitude to the Heads of Fisheries

Departments of different States, senior officers of ICAR, farmers and their representatives, members of the industry, officers from NABARD, NCDC, NFI, Pollution Control Board and other invitees who have kindly responded to our invitation.

I shall be failing in my duty if I do not acknowledge the contributions of my colleagues in the Ministry, officers of CIBA, MPEDA and MSSRF for their untiring efforts in the organization of this workshop.

Last, but not the least, we are highly thankful to Smt. Krishna Iyer for rendering the melodious invocation and to Ms. Sharadha for kindly compering the inaugural programme.

We extend a warm vote of thanks to the members of the Press, Doordarshan and AIR for covering this programme.

PROCEEDINGS OF
TECHNICAL SESSIONS

I. Policies and Programmes

STRATEGIES FOR SUSTAINABLE SHRIMP FARMING AND TRANSFER OF TECHNOLOGY

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1. Review of progress of shrimp farming in India

1.1 Area and production

Brackishwater shrimp farming is making rapid strides in India. The area under shrimp farming has increased from 65,100 ha in 1990 to 82,500 ha in 1993, and production from 35,500 t to 63,300 t during the same period (Table 1). The average annual growth rate of area is 8.9 per cent and that of production is 26.1 per cent. Considering that, of the total, a larger area (ca 52,000 ha) is under the traditional system, the annual growth rate of recently established farms under extensive/semi-intensive system is 44.3 per cent in area and 58.1 per cent in production for the same period. It is believed that the figures are underestimates and in reality the area

covered by shrimp farming would be larger (e.g. in Andhra Pradesh).

1.2 Shrimp seed hatcheries

Similarly, the growth of shrimp seed hatcheries has been significant and, by the recent count, the number of hatcheries established in India is 54 with a total capacity of 3076 million postlarvae (including 188 million of freshwater prawn) per annum. An equal number of hatcheries is under different stages of establishment. The individual hatchery capacity ranges from 10-200 million postlarvae per year.

1.3 The growth phase and some milestones

The nuclei for this significant growth can be traced to a few pioneering efforts made by the Government as well as the farmers (In a broader sense the term 'farmer' will include all categories from the individual small-scale operators even of 0.25 ha to the corporate sector, unless otherwise specified). Some of the important milestones are:

- Establishment of "Pilot Project Centres" of brackishwater aquaculture by the Government of India, Ministry of Agriculture, during the Fifth Plan period (1974-75 to 1978-79).

- Implementation of the All India Coordinated Research Project on Brackishwater Fish Farming by the Central Inland Fisheries Research Institute under the Indian Council of Agricultural Research (ICAR) during 1973-1985, as also the research on shrimp breeding and seed production from 1975 at Narakkal Field Centre of Central Marine Fisheries Research Institute.

- Starting of an innovative scheme of "confined pond shrimp culture" in the periphery of Chilka Lake, with 0.20 ha units, under the Economic Rehabilitation of Rural Poor programme of Government of Orissa, from 1982-83.

- Enterprising small farmers of Andhra Pradesh starting extensive shrimp culture from 1985.

- Semi-intensive shrimp culture of about 3.5 t/ha/crop with imported feed achieved by M/s. Hindustan Lever Ltd. at Sandeshkali, West Bengal in 1987.

- Establishment of Central Institute of Brackishwater Aquaculture by the ICAR during 1987.

- Construction of two large commercial shrimp hatcheries at Visakhapatnam and Gopalpur by the Marine Products Export Development Authority with imported technology during 1987.

- Intensive shrimp farming of white shrimp of 8 t/ha/crop with seawater pumping achieved by M/s. Victory Aquafarm at Tuticorin in 1989.

Table 1. State-wise details of shrimp farming in India (MPEDA- An Overview, July 1994)

State	Estimated brackish-water area for aquaculture (hectares)	Area under culture (hectares)				Estimated production (tonnes)			
		1990-91	1991-92	1992-93	1993-94	1990-91	1991-92	1992-93	1993-94
West Bengal	405,000	33,815	33,918	34,050	34,150	12,500	13,800	16,300	16,500
Orissa	31,600	7,075	7,417	7,760	8,050	4,100	3,800	4,300	5,500
Andhra Pradesh	150,000	6,000	8,100	9,500	19,500	7,350	9,700	12,800	24,800
Tamil Nadu	56,000	250	480	530	1,230	450	700	1,100	2,800
Pondicherry	800	Neg.	Neg.	Neg.	Neg.	Nil	Nil	Nil	Nil
Kerala	65,000	13,000	13,145	13,400	13,860	8,925	9,500	9,750	10,400
Karnataka	8,000	2,500	2,542	2,570	2,600	1,000	1,100	1,150	1,500
Goa	18,500	525	525	550	570	245	300	350	400
Maharashtra	80,000	1,800	1,869	1,980	2,180	800	930	1,050	1,200
Gujarat	376,000	125	231	360	360	130	170	200	200
Total	1,190,900	65,100	68,227	70,700	82,500	35,500	40,000	47,000	63,300

- Demonstration of semi-intensive shrimp farming of about 4 t/ha/crop at Nellore by the TASPARC farm of the Marine Products Export Development Authority (MPEDA) under a project of Department of Biotechnology, Government of India, in 1990.

There are several other important policies and schemes of the Government of India such as the Prawn Farming Scheme of Marine Products Export Development Authority (MPEDA), the establishment of Brackishwater Fishfarmers Development Agencies (BFDAs) in the States as a centrally sponsored scheme of the Ministry of Agriculture, guidelines for leasing of brackishwater lands belonging to State/Union Territory Government for shrimp culture, and liberal credit and import policies which have in no small measure contributed to the development of this industry to the present level. Above all, the higher profitability of shrimp farming, and export incentives and benefits have played the key role in luring the farmers to shrimp farming.

1.4 Phase of expansion and intensification

The traditional form of brackishwater aquaculture in West Bengal, Kerala, Karnataka and Goa which has been practised for over a hundred years has been in equilibrium with the

environment and much of the area had also been put to alternating cropping system of salt-resistant paddy cultivation during the monsoon season, and shrimp and fish cultivation during the rest of the year. Even when the new system of extensive culture of shrimp using brackishwater came into vogue during early eighties, there have not been any noticeable environmental problems.

Shrimp culture entered into the expansion and intensification phase after Sandeshkali, Tutitcorin and Nellore results. The simple tide-fed system changed to pump-fed system. Besides shrimp culture with brackishwater, seawater-based culture farms started appearing along the coastline of Tamil Nadu and Andhra Pradesh. Farms were constructed on predominantly sandy soil, which was till then considered unsuitable for pond culture. With liberal import policy shrimp feed was imported and, along with feed came the technicians of these feed manufacturing companies to demonstrate the efficacy of the feeds in the farms. Foreign consultants and tie-up with foreign companies became a dominant factor. Private and public limited companies entered into shrimp farming with integrated projects of farm, hatchery, feed mill and processing plants and started purchasing large areas of land along the coastal belt. For the first time in the history of India's fisheries development, some shrimp culture companies entered the share market offering equity shares to the public.

1.5 Cropping up of social and environmental issues

At that stage of development of shrimp farming, environmental issues were raised by the public. A whole year of protest against Chilka Lake shrimp culture project in 1992 led finally to the abandoning of the project. The same year witnessed the beginning of protest against shrimp farms in Tuticorin and Nellore which continued. The year 1994 went through one of the intense demonstrations against shrimp culture in Nagapattinam Quaid-e-Milleth district in Tamil Nadu. Several social issues associated with coastal farms were raised. The print and electronic media played a major role in projecting the issues. There was a stalemate when new farms were not allowed to be constructed in certain areas and a ban on shrimp farming was demanded.

The Government at the centre and in the States of Andhra Pradesh and Tamil Nadu became concerned with the environmental and social issues of shrimp aquaculture and, since 1993, a number of expert committees have been working on framing guidelines and regulations, carefully considering the experiences of other countries such as Taiwan, Thailand, the Philippines, Indonesia and China and the database available in India.

1.6 Outbreak of shrimp diseases

The highest number of disease outbreaks and shrimp production losses in the farms in Andhra Pradesh and Tamil Nadu has been reported in 1994. Some shrimp farms in West Godavari, Nellore and Sirkazhi areas suffered a serious setback during the year. The environment responded with a negative feedback to shrimp culture due to a self pollution effect leading to disease outbreaks.

2. Sustainable development

In the above background, it became imperative to consider ways and means of guiding shrimp culture in the direction of sustainable development for long-term benefits.

In 1987, the World Commission on Environment and Development defined that "Sustainable development implies the ability to meet the needs of the present without compromising the ability of the future generations to meet their own needs".

A more elaborate definition of the Food and Agriculture Organization of United Nations in 1988 is that "Sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

The cardinal principles of sustainable development can be stated as:

- social acceptability
- equitability
- economic viability
- technical appropriateness
- environmental soundness, and
- conservation of resources.

These are interlinked with one another and, a holistic and matrix approach is required to achieve sustainable development.

3. Sustainable shrimp farming - potential issues

3.1 Experiences of Asia-Pacific countries

With the lessons learnt from the negative impacts that irresponsible aquaculture practices have produced in many countries in the Asia-Pacific Region, it is well recognised that shrimp culture should be carried out on the principles of sustainable development. On the one hand, aquaculture is found to be the only way to bridge the widening gap between demand and supply of food fish for human consumption in view of contracting production from capture fisheries, and on the other, aquaculture itself faces environmental constraints. Therefore, a middle path of sustainable development has to be chosen to derive long-term benefits.

Aquaculture is part of the environment and interacts with it. It utilises resources and causes environmental changes. Most interactions have beneficial effects. There have been substantial socio-economic benefits arising from the expansion of aquaculture. These benefits

include increased income, employment, foreign exchange earnings and improved nutrition. According to Barg (Barg, U.C. 1992. Guidelines for the promotion of environmental management of coastal aquaculture, FAO Fisheries Technical Paper 328, FAO, Rome), "It should be recognised that to date the majority of aquaculture practices have had little adverse effect on ecosystems. Nevertheless, some cases of environmental degradation in coastal areas have occurred due to, for example, intensive cage culture operations in Europe and shrimp farming practices in Southeast Asia and Latin America".

It is relevant to place on record the findings of the "Regional Study and Workshop on the Enviornmental Assessment and Management of Aquaculture Development" held at Bangkok during 21-26 February 1994 (FAO/NACA 1995. Regional Study and Workshop on the Environmental Assessment and Management of Aquaculture Development (TCP/RAS/2253), NACA Environmental and Aquaculture Development Series No.1, Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand 492 p.) The Workshop had the benefit of views and experiences of 30 government officers, from 16 countries in the region, including India, and 40 representatives of national, regional and international organisations and the private sector. The conclusions of the Regional Workshop were:

"It was apparent that far less precise and quantified information was available concerning the interactions between aquaculture and the environment than had been expected at the outset of the study. While the nature of impacts is generally well known, knowledge of what caused the impact - especially that suffered by aquaculture - is often unquantified and speculative. Little is known of the environmental impacts caused by aquaculture, with most information - even if recent - anectodal in nature. The degree of responsibility of aquaculture producers in recent serious disease outbreaks (mainly affecting the shrimp farms) and their contribution to pollution of culture areas is also speculative".

The Regional Workshop further observed that the nature of impact of coastal shrimp farms on land-based activities (e.g. agriculture, use of mangroves, groundwater supplies, changes in rights of access to land and water) and on coastal waters (e.g. fishing, tourism) in the major shrimp producing countries (Thailand, China, Indonesia, India, Philippines and Vietnam) is better known than its magnitude or economic importance. Studies in the Bohai in China and the Upper Gulf of Thailand indicate that shrimp farms are a minor contributor to pollutant loads in these water bodies (FAO/NACA, 1995). Not undermining the impacts of aquaculture, the Workshop made a number of important recommendations for action by governments, the private sector and international organisations which, when taken up and implemented, would go a long way in ensuring sustainability of aquaculture.

3.2 General issues for consideration

It is in the above background of the status in the Asia-Pacific Region, the general issues raised in India in several fora and media on shrimp farming are summed up below under relevant sustainability parameters.

Social: Indiscriminate conversion of agricultural lands; dispossession of land from small

and marginal agricultural farmers; loss of employment; deprivation of women from agricultural labour opportunities; encircling of coastal villages by shrimp farms and loss of access to places of social and vocational activities, including fishing; flooding by obstruction of natural drains; salinization of drinking water wells, dwelling units, agricultural lands and groundwater.

Equity: Impact on livelihood security; economic growth not witnessed at the local level; lack of participatory approach; export-oriented production does not help nutritional security requirements.

Economic viability: Fluctuations in external market demand and price; absence of strategy to promote domestic market; single species preference in spite of environmental constraints; post-GATT scenario and possible discriminatory factors.

Technical: Problems of wrong sites and designs of farms; lack of scientific knowledge and information of farmers; over-concentration beyond carrying capacity; self-pollution effects of aquaculture; imported technology and short-term contracts without long-term sustainability; wild seed destruction; absence of diversification and alternate crop system; use of substandard seed due to inadequate seed supplies; high stocking densities; unscientific use of fertilisers, chemicals and drugs; irrational use of feeds; absence of coordinated action in use of common property water resource; absence of waste water treatment facility; weak extension system.

Environmental: Destruction of mangroves; siting of farms in ecologically sensitive areas; cutting of beach for laying pipelines and open drains; absence of buffer zones and separation distances; pollution effect of farm waste; absence of monitoring and regulatory mechanisms; salinization problems; groundwater extraction.

Conservation: Mangrove destruction; wild seed exploitation; effect on biodiversity; threat to native species and ecosystem by introduction of exotic species.

3.3 Manage and develop

The issues requiring consideration to ensure sustainability of shrimp farming have been outlined above. All the negative aspects are not directly applicable in the present context of development of shrimp farming in India. It may be that in some areas with over-concentration of shrimp farms, some of the impacts have been felt. But the compendium should help in taking a pro-active approach to the issues raised in order to ensure that shrimp farming is directed, guided and regulated towards sustainable development for long-term benefits.

There has been a great deal of national debate on these issues, and guidelines, regulations and legislations on aquaculture are under finalization, keeping in view the provisions under the Water (Pollution Control and Prevention) Act, 1974 as amended and the Enviornment (Protection) Act, 1986, and the Coastal Regulation Zone (CRZ) Notification, 1991 under the latter.

The needs and aspirations for economic development of the developing countries are qualitatively and quantitatively different from those of the developed world as judged from the parameters of population size and quality of life. India as a country committed to the recent Rio

Declaration, Biodiversity Convention and the post-GATT World Trade Orgnization, and as a developing country with aspirations of economic development, has to strike the 'middle' path or the 'right' path with regard to the development of aquaculture in general, and shrimp farming in particular, so that environment protection and development programmes are made mutually complementary and not exclusive, in the spirit of Agenda 21 of Rio Declaration.

4. Strategies for sustainable shrimp farming

i) Enlightened public policies to promote and support sustainable shrimp farming to achieve the positive advantages of economic growth and to remove or minimise negative aspects of social and environmental consequences, and to develop a harmonized farming system.

ii) Proper land use planning for aquaculture on a careful consideration of land use pattern, ecologically sensitive areas, livelihood security needs of people who would be affected, and environmental soundness, with the help of remote sensing and ground truth data and microlevel surveys.

iii) Land lease policies to promote aquaculture to be comprehensive with enabling provisions and institutional arrangements for the resource-poor families for whom the benefits are meant to accrue.

iv) Zonation of aquaculture and provision of types of buffer zones required, with master plans for each aquaculture zone.

v) Environmental Impact Assessment (EIA) and Environment Management Plan (EMP) for all large projects.

vi) Small Farmers Aquaculture Estates (SFAE) to be encouraged on a collective responsibility basis and for proper input supplies and output management, to serve as people-oriented development programme.

vii) Use of appropriate technologies according to the carrying capacities of the environment and rational use of inputs such as fertilisers, seed, feed, water quality and farm management practices; use of chemicals and drugs to be regulated.

viii) Effluent treatment facilities with settling ponds and biological treatment of waste, and eco-restoration programmes.

ix) Interfacing aquaculture with the socio-economic and cultural milieu of coastal communities and ensuring participatory approach.

x) Human resource development programmes for various levels, including imparting of new skills.

xi) Generation of a sound and scientific technology and information base and dissemination of knowledge.

xii) Enforcement of regulations with incentives and disincentives.

India has a vast potential for shrimp farming. Outside the traditional system, only about

30,000 ha have been brought under shrimp culture. People's response has been given due consideration in framing regulations. Disease problems have come up and these too have been analysed. Environmental issues have cropped up at a few centres and have been taken note of.

Aquaculture as a development activity with larger benefits to farmers, to food production and to the national economy should be viewed positively. The negative aspects should be managed with understanding and regulations. Aquaculture science is very young and only for a few of the issues solutions are becoming apparent. Much remains to be done and intensive collaboration among all parties concerned is necessary to achieve success.

5. Transfer of Technology

Having discussed the parameters of sustainable development of shrimp farming, an essential linkage is sought to be established with the Transfer of Technology (TOT) mechanism for achieving the goals set. The phrase Transfer of Technology has a multidimensional connotation, including in its scope research, extension, clients, inputs, economic, psycho-socio-cultural and administrative-organizational systems. These elements can be combined to fall under three sub-systems, namely the Research System, Dissemination System and Utilization System. These have feedback at all levels in order to make TOT effective.

5.1 Research System

In India, agricultural research mandate is vested in the Indian Council of Agricultural Research (ICAR) which, besides the Research Institutes dealing with commodities and disciplines, has a large number of other projects, programmes and schemes on agriculture, animal sciences, social sciences and fisheries. Among the eight research institutions under the Fisheries Division of ICAR, the Central Institute of Brackishwater Aquaculture (CIBA) is mandated -

i) to conduct research for development of techno-economically viable and sustainable culture system for finfish and shellfish in brackishwater,

ii) to act as a repository of information on brackishwater fishery resources with a systematic database,

iii) to undertake transfer of technology through training, education and extension education programmes, and

iv) to provide consultancy service.

The seven other institutions have similar research functions in different specialisations.

The ICAR has functions similar to the University Grants Commission, in respect of the State Agricultural Universities (SAUs), which are responsible for agricultural education and research. Under the SAU system, a number of College of Fisheries have been established, which carry out educational and research functions in the field of fisheries, including aquaculture.

The Department of Biotechnology, Government of India supports research on

biotechnological aspects of shrimp culture. Related research programmes are also carried out in some of the academic Universities with support given by many departments/organizations.

5.2 Dissemination system

It basically consists of the Extension System which uses several extension mechanisms to absorb technologies from the Research System and effectively transfer the same to the Utilisation System which is comprised of the clients or the target groups. A National Seminar on Fisheries Extension organised in 1980 identified extension as one of the weakest links in fisheries development and quoted the observations of the National Commission on Agriculture thus: "Absence of adequate work in fisheries extension has been one of the principal reasons for the slow pace of inland fisheries development".

FFDAs : There has been a little improvement since then with reference to aquaculture with the establishment of Fish Farmers Development Agencies (FFDAs) by the Government of India as a centrally sponsored scheme in the States/Union Territories by the end of the Fifth Five Year Plan. This was the first targetted extension service created at the District level to look after freshwater aquaculture.

The main objectives of FFDAs are:

i) to promote scientific integrated fish culture, linking modern techniques of fish culture with training, production, marketing, credit etc.,

ii) to create a class of Fish Farmers from the existing pond owners,

iii) to create viable employment in the rural sector and to increase rural income,

iv) to reclaim and renovate ponds in the villages for fish production,

v) to provide job for rural youth,

vi) to make arrangements for post-harvest activities like fishing, marketing etc., and

vii) to transfer latest technologies in fish seed production.

As on date, 414 FFDAs have been sanctioned by the Department of Agriculture and Cooperation of the Union Ministry of Agriculture. Due to the efforts of the FFDAs, productivity in freshwater tanks and ponds has increased to 2105 kg/ha/year during 1993-94 against 900 kg in 1984-85. About 4.30 lakh fish farmers have been given the benefit of training in modern fish culture.

BFDAs: With the felt needs for providing similar service to brackishwater aquaculture sector, the Department of Agriculture and Cooperation introduced the centrally sponsored scheme, during the Seventh Five Year Plan, for the establishment of the Brackishwater Fish Farmers' Development Agencies (BFDAs), with similar objectives as FFDAs. So far 38 BFDAs have been sanctioned in all the maritime States and Union Territory of Andaman and Nicobar Islands and about 14,600 ha of brackishwater area have been developed for shrimp farming. About 4000 shrimp farmers have been trained upto 1993-94, benefitting 8,500 families.

MPEDA: The Marine Products Export Development Authority (MPEDA) under the Union Ministry of Commerce established a Prawn Farming Section in 1979, with field offices in different maritime States. There are six regional and 4 sub-regional centres engaged in extending technical assistance in shrimp farming. The Authority undertakes training of farmers and entrepreneurs in shrimp farming and also arranges visit of farmers from one state to another for learning different aspects of shrimp farming. Primarily, it extends subsidy assistance along with technical assistance.

MoA: The Union Ministry of Agriculture (MoA), with the Department of Agriculture and Cooperation (DAC) under it, is the nodal Ministry responsible for fisheries policies and planning and supporting fisheries development programmes in the country. It initiated the Pilot Project Centres Scheme for brackishwater aquaculture during the V Plan and has consistently sanctioned several schemes to promote aquaculture since then. Besides the Centrally Sponsored Schemes already referred to and several others, the DAC has established the Central Institute of Coastal Engineering for Fishery (CICEF) which looks after the survey and engineering aspects of shrimp farming. The DAC has recently taken up the World Bank assisted Shrimp Culture projects in West Bengal, Orissa and Andhra Pradesh. This has a sizeable component of training of BFDA extension officers and other project personnel. The Government of India has recently approved the implementation of the Central Sector Scheme called "Fisheries Training and Extension", with a view to augmenting the availability of qualified manpower for fisheries and to broadbase the extension system.

ICAR and its Institutes: The mandate of the ICAR, *inter alia,* includes "To act as a clearing-house of research and general information relating to agriculture, animal husbandry, home science and allied sciences, and fisheries matters through its Publications and Information system, and instituting and promoting transfer-of-technology programmes". The Research Institutes have their mandate on transfer of technology. The Krishi Vigyan Kendras (KVKs) with their Trainers' Training Centres (TTCs) play a major role in training and human resource development programmes like the Operational Research Projects (ORPs), Lab-to-Land Programmes (LLPs) etc. have a large resource-base coverage in the country.

Specifically, CIBA has conducted a large number of training programmes, including the Training Course in Semi-intensive Shrimp Farming under the World Bank-assisted Project. The Institute is extending technical assistance to a large number of farmers and industry on shrimp farming, environment management and hatchery operations. It has assisted DAC, and Governments of Tamil Nadu and Andhra Pradesh in evolving policies and guidelines for sustainable shrimp farming.

SAUs: The College of Fisheries under the SAUs are State-centred institutions to provide extension support to the development programmes.

States: Fisheries is a State subject under the Indian Constitution and, therefore, the State/Union Territory (UT) Governments are responsible for the development programmes including extension. The Fisheries Departments in the States / Union Territories have Fisheries Extension wings with officers at the Headquarters, at the Regional and District levels and also at the fishing village level. They are concerned with fisheries development, extension and

coordination programmes. Thus, the State Fisheries Departments have a reasonable network for Transfer of Technology. Fish Farmer Development Agencies (FFDAs) and Brackishwater Fishfarmers Development Agencies (BFDAs) have district level coverage of aquaculture activities.

CRSARD: The Centre for Research on Sustainable Agricultural and Rural Development (CRSARD) of the M.S. Swaminathan Research Foundation (MSSRF) has a major programme on Coastal Systems Research with aquaculture as one of its components. Under a project of Department of Biotechnology, Government of India on Prawn Aquaculture, the Centre has planned a major technology demonstration and training programme at Karaikal.

Private sector: Private sector companies such as MAC Industries and Waterbase have started training courses in shrimp farming. Some private schools are also coming up.

5.3 Utilization System

The Utilization System in shrimp culture is very broadbased. The clients for transfer of technology include resource-poor sub-marginal farmers operating ponds of 0.20 ha each as in the Economic Rehabilitation of Rural Poor (ERRP) Scheme of Government of Orissa on the fringe of Chilka Lake, small and marginal farmers with 1-5 ha, medium-scale farmers with 5-20 ha and resource-rich large farmers and corporate sector with 100 ha or more. The system also includes the traditional farms which have waterspread area of even more than 200 ha each as in the case of bheries in West Bengal.

The types of farming practices vary widely encompassing extensive, improved extensive, semi-intensive and intensive culture systems, depending on the capacities of the owners for investment, own technical skills, access to technology and manpower, sourcing of inputs and business targets. The large private and public limited companies have easy access to import of technologies, inputs such as feed and chemicals and consultants and technicians from abroad.

Use of inputs varies in quality and quantity. For instance, shrimp seed used are from the wild and from hatcheries; feed used ranges from snails to nutritionally balanced and high energy pellet feeds; water quality management ranges from stagnant water to 40% exchange of water per day. Disease outbreaks are more common in semi-intensive and intensive systems than in traditional and extensive systems.

Production performance of shrimp culture varies from about 400 kg/ha/year to more than 10 t/ha/year. The national average production rate (1993-94) is 764 kg/ha/year, with the traditional system performing at 562 kg/ha/year and the new system at 1143 kg/ha/year.

5.4 Evaluation

India has put in place an institutional network at the Central and State levels for dealing with research on fisheries (including shrimp culture) and transfer of technology. However, it is not fully equipped to meet the demands of shrimp culture. Infrastructure and programme strengthening is required. Given the spread of the farms along the entire coastline of India, there

are limitations of coverage and outreach activities by the existing institutions, centres and laboratories. It is also important to improve competence and skills of S&T manpower both in research and in extension.

The extension programmes and personnel are largely oriented to executive/generalist type of extension work than on technical aspects. The BFDA mechanism lacks the scientific knowledge base and field skills. Its access to subject matter specialists is very limited. Basic infrastructure for problem solving at local level is wanting. The administrative and organizational system for extension at the State/District/field levels needs strengthening for playing an effective role. Like the Training and Visit System which has been successful in agriculture, there is no proven extension model for aquaculture. The available media for group or mass communication has hardly been used.

The client system is very diffuse and its transfer of technology requirements cannot be easily assessed. Since transfer of technology can be made effective only when the package of technologies is appropriately targetted, it is necessary to have some categorisation of the client system and the needs of each category are addressed to.

6. Strategies for transfer of technology

i) Fisheries is a State subject and the State has to develop its strategies, plans and programmes with a clear policy to promote sustainable shrimp farming under a National Policy framework.

ii) SAU College/Faculty of Fisheries should closely work with the Department of Fisheries and its extension programmes in each State.

iii) ICAR institutes engaged in strategic research and extension education at the national level may take up TOT programmes such as National Demonstration Programme (NDP), Operational Research Project (ORP), Krishi Vigyan Kendra (KVK) and Trainers' Training Centres (TTC) for outreach research, demonstrations and training in sustainable aquaculture of shrimp and related aspects. The institutes may be strengthened with infrastructure and manpower. In all such programmes support of State is essential.

iv) Consideration may be given to develop a 'Cooperative Extension Programme' linking Fisheries Department - SAU - ICAR Institute - Farmers to maximise benefits.

v) Suitable extension models for shrimp culture may be developed considering the status and scope of the three major TOT components (technology development, extension and utilization).

vi) For the present Extension Wing of the Department and BFDA are the major players at the field level. These are not well equipped in terms of manpower, infrastructure and skills required to address the sustainable shrimp farming development problems. The objectives of the BFDAs are low keyed and hence under-staffed with inadequate skills requirements. These problems have to be looked into and remedied.

vii) Access to technologies and problem-solving approaches and methods should be improved for the field level workers. Similarly, reference to specialists should be speeded up.

viii) Training of extension personnel is of primary importance. Equally important is the continuity of such trained personnel in positions for which they have been trained, with avenues for career advancement.

ix) Feedback is a reciprocal part of transfer of technology and a suitable mechanism for speedy action in this two-way process is necessary.

x) TOT should aim at promoting group action and cooperative management which is highly essential in aquaculture using common property resource (water).

xi) District level "Aquaculture Technology Centres" with essential laboratory infrastructure and technical manpower should be established for performing specific functions which need to be attended to on a day-to-day basis.

xii) Specific vocational training programmes and skill improvement programmes for men and women may be planned and organised at institutions where facilities are available. Such programmes may be supported with additional infrastructure and funding. Off-campus and farm-site training programmes are as important as institutional programmes and are more relevant at the village level.

xiii) TOT programmes should be socially, ecologically and economically appropriate, particularly in the case of resource-poor farmers and rural women.

xiv) The available print and electronic media may be used purposefully for group or mass communication.

POLICY AND PROGRAMMES OF MINISTRY OF AGRICULTURE ON SHRIMP FARMING

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1. Introduction

Traditionally, fishing in open waters has been the principal vocation of a segment of the population living on the banks of rivers, lakes, reservoirs and backwaters. Therefore, till recently the fisheries development in India was oriented towards the traditional fish trapping and harvesting by fishermen. The traditional practices being largely governed by the local conditions and needs, those who are involved in capture fisheries never felt the need to intensify the fishery operations, particularly in the form of culture fisheries. However, the pioneering work undertaken by the fisheries research institutes in the country has been instrumental in creating an awareness among the fishermen and others to shift the pattern from the traditional capture fisheries to culture fisheries in the traditional systems, which was followed by scientific fish farming in confined water bodies particularly tanks and ponds.

1.2. Scientific aquaculture, therefore, is of recent origin in so far as India is concerned. The main objectives of aquaculture are (a) to increase the production of a desirable species under controlled conditions in the environment, (b) to improve the dietary standards and (c) the socio-economic status of a section of the rural population. Aquaculture is also considered as a viable means of diversification of fisheries. Considering the importance of aquaculture in rural upliftment and increasing the fish production, both for domestic and export markets, the Government has launched a number of programmes for popularising the aquaculture technology for the common man as a viable alternative to capture fisheries.

1.3. Out of the total inland fish production of about 18 lakh tonnes/annum, fish production through aquaculture presently is estimated to be a little over 13 lakh tonnes. A decade ago aquaculture production was contributing hardly 2 lakh tonnes to the total inland fish production. Thanks to the introduction and popularisation of the concept of scientific composite fish farming technology developed by the Indian Council of Agricultural Research and adopted by a network of Fish Farmers' Development Agencies and development of viable technologies for controlled breeding and rearing of commercially important fish species such as Indian major carps and the Chinese carp, substantial increase in aquaculture production has been achieved.

1.4. It is estimated that aquaculture could be undertaken in about 22 lakh ha of tanks and ponds, over 19 lakh ha of lakes and reservoirs, 13 lakh ha of derelict water bodies and about 12 lakh ha of brackishwater land. These resources could be harnessed through aquaculture yielding more than 2-3 times the present level of aquaculture production. As compared to the total estimated potential fish production of about 45 lakh tonnes from the freshwater and brackishwater

aquaculture resources, the present level of production is hardly 40% of the potential, thus giving ample scope for future expansion of aquaculture activity in the country. Hardly 7.4 lakh ha of tanks and ponds is reported to be under scientific aquaculture with an average yield of about 1.83 tonnes of fish per ha per annum. In the case of brackishwater aquaculture, hardly 7% (80,000 ha) of the available resources is utilised for traditional/extensive and semi-intensive farming.

1.5. Considering the potential available for aquaculture and the gross under-utilisation of these resources, the Government have recognised aquaculture as a high priority area for development, both in the freshwater and brackishwater area. In this background, this paper outlines the policies and programmes initiated by the Ministry of Agriculture, particularly for dissemination/transfer of technology for shrimp farming over the last few years.

2. Policies and programmes for shrimp farming till the end of 6th Five Year Plan period.

2.1. The All India Coordinated Research Project on Brackishwater Aquaculture undertaken by the Indian Council of Agricultural Research through the Central Inland Fisheries Research Institute, Barrackpore during the 5th Five Year Plan period and the results obtained therefrom prompted the Ministry of Agriculture (Deptt. of Agriculture & Cooperation) to formulate a pilot project for brackishwater aquaculture in all the coastal States with a view to demonstrating the viability of shrimp farming. A one time central grant amounting to over Rs. 125 lakhs was also made available to all the maritime States for construction and operation of a 50 ha Pilot shrimp farm in each State.

2.2. During the 6th Five Year Plan period new beneficiary oriented brackishwater aquaculture programmes were introduced under the Centrally Sponsored Sector. These programmes envisaged development of about 1500 ha. brackishwater area for aquaculture and establishment of shrimp hatcheries for production of over 160 million shrimp seed/annum. Due to a number of factors/constraints including the non-availability of appropriate culture technologies and expertise, most of the projects sanctioned during the 5th Plan and 6th Plan periods had either to be curtailed or dropped and hence these programmes could not yield the desired results.

3. Policies and programmes adopted during the 7th Plan period

3.1. During the 7th Five Year Plan period upgradation of technology for shrimp farming was given priority. Since the indigenous technology for shrimp farming starting from site selection and related support activities, seed production, culture management and feed production to processing was inadequate, the Department of Agriculture & Cooperation obtained technical assistance through UNDP for upgradation of shrimp culture technology in the country. The UNDP Coastal Aquaculture Project taken up from 1986 onwards with a total UNDP assistance of US $ 965,975 developed four pilot shrimp farms and one pilot shrimp seed hatchery. The technical expertise for this project was provided by M/s. France Aquaculture.

3.2. The other components introduced by the Govt. during the 7th Five Year Plan period

included establishment of Brackishwater Fish Farmers' Development Agencies (BFDA) in some of the potential coastal districts for providing a package of technical, financial and extension support to the shrimp aquaculturists; strengthening of the technical wing in the State Fisheries Directorate for upgrading the manpower available for implementation of aquaculture development programmes; human resource development through training of shrimp farmers by establishing demonstration-cum-training centres; and establishment of brackishwater shrimp farms and hatcheries in the Govt. sector.

3.3. The major objectives of the programmes initiated during the 7th Plan period for development of shrimp farming were (a) to increase production of shrimp/fish as a means of foreign exchange earnings and to meet the domestic demand by tapping the hitherto underutilised brackishwater aquaculture resources; (b) to make available the requisite quantity of the inputs such as seed and feed for various systems of shrimp farming through establishment of support facilities; (c) to generate adequate employment opportunities for the small-scale fisherfolk in the coastal areas by diversifying their involvement in aquaculture; and (d) to develop a new cadre of trained manpower for aquaculture development by imparting training to shrimp/fish farmers.

3.4. Till the end of the 7th Five Year Plan period as many as 27 projects covering 2000 ha area, 7 shrimp seed hatcheries and 25 Brackishwater Fish Farmers' Development Agencies were sanctioned for establishment.

4. Major steps for promotion of shrimp culture

4.1. The micro-level surveys conducted so far notably by the Central Institute of Coastal Engineering for Fishery, Bangalore, have revealed that at least 2.25 lakh ha brackishwater area out of the total estimated 12 lakh ha could be brought under shrimp farming in the next few years. The available potential area has also been mapped through satellite imagery in all the coastal States for identifying the most suitable areas for shrimp farming.

4.2. Since most of the brackishwater land belongs to the State Government and the technology for shrimp culture needed to be gradually upgraded the Government took the following policy initiatives for promotion of brackishwater aquaculture during the 7th Five Year Plan period:

(i) Appropriate guidelines for classification, use and lease of brackishwater land by the State Governments were formulated and circulated to all the coastal States during December 1987. These guidelines *inter-alia,* outlined the following criteria for allotment of brackishwater land:

(a) 50% of brackishwater area requiring low levels of investment for pond development may be reserved to individual/group of fishermen or economically weaker sections/fishermen's cooperative societies.

(b) the remaining 50% of the brackishwater area requiring relatively high investment may be allocated to public sector and private entrepreneur.

(ii) Macro and micro-level survey of fallow brackishwater areas by the Central and State government for identification of the most suitable areas /location.

(iii) Encouraging construction of shrimp farms and hatcheries in the State sector for demonstrating the techno-economic viability of shrimp farming to the small-scale sector/weaker sections of the society.

(iv) Encouraging establishment of shrimp farms, hatcheries, feed mills, etc.in the State/ public/private sectors with foreign technology inputs.

(v) Providing a package of technical, financial and extension support to small-scale shrimp farmers by establishment of district level organisations namely, Brackishwater Fish Farmers' Development Agencies (BFDAs) on the pattern of FFDAs.

4.3. In spite of a number of policy initiatives, and the efforts taken by the Government, development of shrimp culture is still facing a number of challenges, namely:

Delay in allotment of land by the state governments, which acts as a disincentive for beneficiaries.

Non-acceptance of leased land as mortgage and insistence of collateral security from the small and marginal farmers by the commercial banks and the consequent delay in sanctioning of the loan.

Increase in the demand for quality shrimp seed and consequent pressure on the natural seed resources. This will necessitate the establishment of a large number of shrimp seed hatcheries.

Non-availability of adequate quantity of high energy and quality shrimp feed within the country.

Inadequacy of trained man power for shrimp culture and related activities.

5. Programmes of DAC for shrimp culture

5.1. Brackishwater Fish farmers' Development Agencies (BFDAs)

5.1.1. With the main objective of popularising shrimp farming as an avocation of the rural population, the concept of establishment of Brackishwater Fish Farmers' Development Agencies (BFDAs) was introduced during the 7th Five Year Plan period. These agencies are district-level organisations, which provide a package of technical, financial and extension support to shrimp farmers.The Goverenment of India have so far sanctioned the establishment of 38 such agencies in the country. These agencies have brought under shrimp culture, over 11,700 ha area. A list of BFDAs and the area brought under shrimp culture, State-wise, is given in Table 1&2.

5.1.2. Under the BFDA programme, the Govt. of India/State Govt. provide financial support to shrimp farmers in the form of subsidy to the extent of 25% of the capital cost on pond development and the total cost of first crop inputs, subject to a maximum land holding of 10 ha per beneficiary.

5.1.3. Assistance in the form of subsidy for construction of semi-intensive shrimp farms limited to a maximum of Rs. 30,000 per ha is given to all categories of shrimp farmers including private entrepreneurs, subject to a maximum land holding of 10 ha per beneficiary.

5.1.4. With a view to encouraging construcrtion of small-scale/backyard type of shrimp hatcheries with a designed capacity for producing 2-5 million shrimp seed per annum, a maximum subsidy of Rs. 1 lakh per benficiary is also available under the Centrally Sponsored Scheme of Intergated Brackishwater Fish Farm development.

5.1.5. With a view to developing a cadre of trained fish farmers, extension workers, farm managers, farm engineers, etc., establishment of demonstration-cum-training centres in each coastal State, have been sanctioned during 1992-93. These training centres will be located in the pilot shrimp farms, which have already been constructed under the Centrally Sponsored Scheme. A stipend of Rs.25 per trainee per day and a lumpsum of Rs.140 per trainee for travel expenses for field trips, is given to the shrimp farmer trainees for two months training.

Table 1. Details of Brackishwater Fish Farmers' Development Agencies

	State	BFDA's sanctioned	Area covered (in ha)	Farmers trained (No.)
1.	Andhra Pradesh	6	260	--
2.	Gujarat	3	304	158
3.	Karnataka	2	33	488
4.	Kerala	6	442	674
5.	Maharashtra	4	107	--
6.	Orissa	7	9652	4538
7.	West Bengal	3	728	1000
8.	Tamil Nadu	5	109	100
9.	Goa	1	44	--
10	A & N Islands	1	--	--
	Total	38	11679	6958

Table 2. Brackishwater Fish Farmers' Development Agencies sanctioned so far

S.No.	State	Name of districts
1.	Andhra Pradesh (6)	Krishna Nellore Srikakulam East Godavari Prakasam West Godavari
2.	Gujarat (3)	Valsad Surat Bharuch
3.	Karnataka(2)	Uttara Kannada Dakshina Kannada
4.	Kerala (6)	Ernakulam Kollam Cannanore Alappuzha Kozhikodu Thrissur
5.	Maharashtra (4)	Thane Ratnagiri Raigad Sindhudurg
6.	Orissa (7)	Kendrapada Ganjam Bhadrak Puri Jagatsinghpur Balasore Khurda
7.	West Bengal (3)	North 24-Parganas South 24-Parganas Midnapore
8.	Tamil Nadu (5)	South Arcot Chengalpattu Thanjavur Ramnathapuram Chidambaranar
9.	Goa (1)	South and North Goa
10.	A & N Islands (1)	Port Blair

5.2. World Bank assisted shrimp culture project

5.2.1. A World Bank assisted Shrimp and Fish Culture Project has been taken up for implementation from 1992-93 onwards for a duration of 7 years in 5 selected States, *viz.* Andhra Pradesh, Bihar, Orissa, Uttar Pradesh and West Bengal.

5.2.2. The shrimp culture component of the project envisages development of new water area of 3829 ha in 10 sites in the three coastal States, *viz.* Andhra Pradesh, Orissa and West Bengal, at an estimated cost of Rs. 239.87 crores. This component of the project has been designed to introduce suitable advanced technology for semi-intensive shrimp farming, which would provide a model for future development of shrimp farming in the country.

5.2.3. The shrimp culture sub-project would benefit nearly 9000 households, mainly from the poorest sections of the society. It would help in increasing the productivity level of shrimp from the present level of 200 - 300 kg per ha to 2000 kg per ha at full development levels. The household income through shrimp culture is likely to increase to Rs. 25,000 annually and it would generate adequate employment opportunities for large sections of the rural population including women. The export value would also increase by US $ 70 million per annum, when the project reaches full production levels.

5.2.4. The designs and estimates in respect of 10 sites identified, have been finalised. Construction in 3 sites is expected to start by December, 1994 and in the other 7 sites by January, 1995. Training/study tour both abroad and within the country, has been arranged for about 49 fisheries personnel from the project States and Govt. of India. Action has also been initiated for implementation of Environmental Action Plan, establishment of a training centre for shrimp seed hatchery operators, preparation of feasibility report on *Artemia* pilot project, etc.

6. Kuwait assisted Shrimp Culture Project in Kerala

6.1 This project envisages development of shrimp farming in about 1500 ha area in Kerala at a total estimated cost of Rs. 75 crores. The loan assistance available from Kuwait Fund for this project will be about Rs. 35 crores.

6.2. The project includes construction of shrimp farms, 4 hatcheries each with a capacity for producing 60 million shrimp larvae per annum and a prawn feed production unit with an annual capacity of about 9000 tonnes of feed, with technical assistance and provision of extension support. The project, on full development level, is designed to produce about 3400 tonnes of shrimp per annum benefitting about 1500 families. The Govt. of Kerala has set up an Agency for Development of Aquaculture for executing this project and initiating work on survey of potential areas for shrimp farming, etc. The project got delayed because of the Gulf War since mid 1990-91, but presently it is in progress, with the appointment of consultants.

7. Role of other Ministries/Departments in Aquaculture

7.1. Even though DAC is the nodal agency for development of fisheries including aquaculture, a number of other Ministries/Departments are also involved in promotion of

aquaculture, for increasing the export of marine products, development of technology packages, man power development, etc.

7.2. The Ministry of Commerce through Marine Products Export Development Authority (MPEDA) is implementing a number of programmes for development of shrimp farming as an export promotion activity. The MPEDA provides subsidy to the small-scale sector for development of new shrimp farms, supply of inputs such as shrimp seed and feed for encouraging traditional farming and establishment of shrimp hatcheries of different capacities, besides participating in the equity upto a maximum of 11 per cent of the total paid up capital in economically viable shrimp aquaculture projects.

7.3. The Department of Ocean Development has been funding ICAR Fishery Research Institutes and Agricultural Universities for undertaking R&D programmes for upgradation of technology in this field. The Department of Biotechnology has funded MPEDA to develop model farms for semi-intensive shrimp farming in Nellore district of Andhra Pradesh and in A&N Islands. The Central Institute of Brackishwater Aquaculture under the ICAR functions as a nodal institute for undertaking R&D activities in brackishwater aquaculture including development of culture technologies for different species of finfish and shellfish.

8. Socio-economic and environmental aspects

8.1. While expanding coastal aquaculture activity, even though adequate measures are taken to see that it is developed as an eco-friendly activity, its rapid expansion is also likely to lead to a number of social and environmental side effects.

8.2. Some of the potential positive impacts of brackishwater aquaculture in India include

- Use of coastal land/area free from forest or mangrove cover.
- Offering an alternative economic activity to the weaker sections of the coastal population, particularly fishermen, which is compatible with their social and cultural milieu.
- Reducing the pressure on the coastal fisheries harvests.
- Creation of additional employment opportunities to local population in farm construction and operation activities.
- Expansion of ancillary activities such as food production, processing and marketing, etc.

8.3. There are also a number of potential negative impacts, putting pressure on the socio-economic aspects of the coastal population and environment. These factors, *inter-alia,* include:

- Social displacement by commercial ventures.
- Conversion of agricultural land into aquaculture system.
- Competition for suitable land for aquaculture, leading to escalation in cost of land

along the coastal belt.

- Salination of agricultural land and groundwater.
- Prolonged water logging in shrimp farms will lead to adverse ecological conditions, aiding in lowering the productivity levels and the spread of disease epizootics.
- Restriction of aquaculture to only a few commercial species of shrimp might result in over-exploitation of the natural seed resources and the spawners, for artificial propagation.

It is, therefore, imperative that aquaculture of a broad spectrum of commercial species of finfish and shellfish is encouraged.

8.4. Clustering of a large number of shrimp farms and other related support facilities in a particular area might cause environmental degradation in the long run, if adequate steps are not taken by such units for treatment of the pond effluents before the wastes are discharged into the open waters. A number of South-east Asian countries such as Taiwan, Thailand, Philippines and of late, Indonesia and China have already witnessed such adverse impacts of concentration of shrimp farms leading to environmental degradation and consequent slump in shrimp production. It is feared that such a situation may occur in India also, particularly along Andhra Pradesh and South Tamil Nadu coast, where there is a very high concentration of shrimp farms.

8.5. To keep our coastal zone free from pollution and for making aquaculture an environment-friendly activity, the State Governments have been requested to ensure that the integrated brackishwater shrimp farming units coming up under joint sector/100% EOUs may obtain the clearance from the State Pollution Control Boards and also incorporate adequate environmental safeguards, particularly environmental management plan, environmental monitoring plan and waste water treatment systems, as suggested by the State Pollution Control Boards, so as to mitigate adverse impact, if any, of shrimp aquaculture on the environment and vice-versa. The State Governments have also been advised to make an assessment of the criteria adopted by Pollution Control Boards for clearance of aquaculture projects, the expertise available with them for this purpose, etc. The Governments are also encouraging expansion of aquaculture under scientific extensive and semi-intensive systems only, in the light of the adverse impacts of intensification and super-intensification of aquaculture faced by many South-east Asian countries.

8.6.The Government have also taken steps for identification of most suitable brackishwater areas in the country through the use of remote sensing data, particularly with a view to eliminating the ecologically sensitive areas such as reserved forests, mangroves, etc. These maps are being put into use for preparation of master plans for aquaculture development in the country.

9. Future Strategy

9.1. In the light of the experience so far gained in implementation of various programmes for shrimp culture, it is considered essential to follow a planned and coordinated approach for

sustainable development of the coastal areas identified for brackishwater farming in the country.

10. Policy initiatives proposed

10.1. Development of aquaculture has been identified as one of the major thrust areas by the Government during the 8th Five Year Plan period, not only as a means of expansion of aquaculture activity, but also for increasing the employment opportunities of the rural population and consequent increase in their income and for augmentation of fish/shrimp production for domestic and export markets.

10.2. The Government would continue to accord top priority for involving small-scale sector/rural poor in development of aquaculture by reserving 50-70 per cent of the brackishwater land to the weaker sections. An appropriate package of technology and inputs would continue to be provided for scientific extensive shrimp/fish farming by this sector. Since the realisation from aquaculture largely depends on the development of requisite basic infrastructural facilities for production of inputs such as seed and feed, adequate emphasis would be given for creation of such facilities wherever needed, particularly with the increased involvement of private sector. Adequate importance would also be given for aquaculture of a broad spectrum of finfish and shellfish species. For this purpose, multi-disciplinary R&D efforts and bio-technological inputs would be stepped up.

10.3. For the purpose of concession in water and electricity supply, payment of Income Tax, credit flow, etc., aquaculture would be treated at par with agriculture.

10.4.Human resource development at all levels, dissemination of information and extension of technology to the end users would be accorded adequate priority. Aquaculture would be developed as eco-friendly activity by introducing necessary environmental safeguards wherever appropriate.

POLICY AND PROGRAMMES OF MPEDA ON TRANSFER OF TECHNOLOGY FOR SHRIMP FARMING

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1. Shrimp as an item of export

The world trade in marine products as a whole and shrimp in particular is growing steadily over the years. Marine products exports from India during 1993-94 earned foreign exchange valued at Rs. 2503.62 crores for a volume of 2,43,360 tonnes. This represents 3.31% of the country's total exports and 1.3% of global seafood trade. Shrimp is a dominant item in the export from India, accounting for 36.38% by volume and 70.24% by value during the year 1993-94. The Indian marine product export industry has been depending mainly upon the catch from the sea. However, over the last few years the marine shrimp landings are showing signs of stagnation and are not sufficient to meet the increasing demand. This phenomenon is not peculiar to India alone. The production from the sea is at a plateau and beyond certain levels a phase of decline is expected to set in. Already some of the countries are experiencing depleted catch and several countries including India have started tapping alternate production sources through culture of shrimps. World production of shrimp from capture and culture sources is estimated to be 3.5 million tonnes, of which about 30% is obtained from culture fisheries. Asia contributed about 65% of the world shrimp production with China as the leading producer, followed by Indonesia and India.

2. Development of shrimp aquaculture

A traditional system of shrimp farming exists in the Pokkali fields of Kerala and extensive basa bada fisheries (Bheries) of West Bengal. This remains at subsistence level with very low rate of production. Considering the potential for production of shrimp through culture, the ICAR Institutes, namely the Central Inland Fisheries Research Institute (CIFRI), Barrackpore and the Central Marine Fisheries Research Institute (CMFRI), Cochin, had reoriented their research programmes to develop a viable shrimp culture technology in early 1970s. The CIFRI set up a brackishwater fish farm at Kakdwip, 24 Parganas, West Bengal and the CMFRI centred its programmes in the Narakkal fish farm near Cochin in Kerala. However, the country had to wait for long years to come up with commercial production. It is now estimated that out of a potential area of 1.2 million ha, around 82,500 ha are under shrimp production with a total harvest of about 63,300 mt. Out of this, nearly 50,000 ha are under traditional extensive culture system, producing 17,500 tonnes with an average production of 300 kg/ha/year and about 32,500 ha are under modified extensive and semi-intensive systems producing about 45,800 tonnes with productions ranging 1-2 tonnes/ha/year. It is projected that by the turn of the century nearly

100,000 tonnes of shrimp will be produced from an area of 100,000 ha, of which nearly 10,000 ha will be under semi-intensive system with average annual production of above 4 tonnes/ha/year.

3. Role of MPEDA in export oriented shrimp production

In 1978 the Marine Products Export Development Authority stepped into the field of promoting shrimp culture to augment the raw material availability for the seafood export trade. Initially the Authority conducted field trials and culture demonstrations in the farmer's field providing technical and financial support and was able to get a maximum production of around I tonne/ha/crop of 4-5 months with the available technology. Encouraged by the results obtained from these field trials, the Authority included brackishwater prawn farm production in its regular work programme and formed a division in the Head Quarters at Cochin. Two Regional Centres, one in Cochin to cover the states of Kerala and Karnataka and another at Bhubaneswar to provide extension service in the states of Orissa and West Bengal were also established.

4. Extension service through Regional Centres

In view of the necessity for increasing production for export, the Ministry of Commerce advised the MPEDA to set up additional centres in the maritime states exclusively for the promotion of shrimp farm production. Field offices were opened in a phased manner in all maritime states and Union Territories to extend the activities, *viz.*, micro - and macro - level survey to identify suitable sites for shrimp farming; preparation of site specific project reports; technical advice to entrepreneurs on various aspects of shrimp farming; training of farmers/ entrepreneurs in shrimp farm technology; arrange interstate study tours for shrimp farmers; conduct workshops/seminars/symposia/farmers meets for the benefit of entrepreneurs as well as other agencies connected with shrimp farm development such as Bankers/Crop Insurance Companies/State Department of Fisheries/Scientists and Research workers in Universities and Institutes; and extend financial assistance as subsidy incentives.

The Authority also established a prawn farm project complex at Vallarpadom near Cochin with a model hatchery, farm and training centre. This training centre was the first of its kind exclusively for imparting field oriented training in management of shrimp hatchery and farm. At this centre, regular training programmes are offered in shrimp culture, hatchery operation, design and construction of hatchery to entrepreneurs, Govt. officials and personnel of financial institutions interested in supporting shrimp aquaculture.

In the absence of its own research facility, the Authority draws technology from the research institutes of ICAR and agriculture universities.

5. Establishment of shrimp hatcheries

In the initial stages stocking material for the grow-out farms in the form of post-larvae was collected from the natural sources. This, however, could not be encouraged for long. The technology for seed production through hatcheries on a commercial scale was not available in

the country, even though research laboratories were reporting successful breeding and larval rearing of different shrimp species. In this context the Authority had to draw technical know-how through overseas consultancy to establish two commercial hatcheries. The first one was in Orissa under a registered society called Orissa Shrimp Seed Production and Research Centre (OSSPARC) and the second in Andhra Pradesh under another society, the Andhra Pradesh Shrimp Seed Production and Research Centre (TASPARC) with annual production capacity of 25 million and 40 million post-larvae respectively. Subsequently, the capacity has been enhanced to 65 million and 80 million.

These hatcheries became the fore-runners for the establishment of several other commercial hatcheries in the private sector. Presently, over 50 hatcheries have been set up in different states with a total production capacity of about 3100 million seed per annum. Of these, 18 are in Andhra Pradesh and 16 in Tamil Nadu. The present production is reported to be around 1000 million. It is further estimated that by 1996-97 the seed requirement would be around 7000 million and that will necessitate the establishment of nearly 100 hatcheries in another two years. Considering the huge demand for shrimp seed to meet the requirement of increased farm area, there are requests to import seed from abroad. In the absence of proper quarantine procedures and regulations it is felt that it is improper to bring shrimp post-larvae into the country from outside.

6. Schemes for financial assistance

The Authority has instituted financial assistance schemes with the main objective of attracting entrepreneurs into the field of shrimp aquaculture by adopting innovative technology. The financial assistance is disbursed as subsidies as follows.

(a) Subsidy for new farm development

Financial assistance is rendered at the rate of 25% of the capital cost or Rs. 30,000 per ha of water spread area, whichever is less. A farmer/entrepreneur can avail upto a maximum of Rs 1.5 lakhs for developing upto to 10 ha of water spread area.

(b) Subsidy for establishment of hatchery

Assistance is provided at the rate of 25% of the capital cost or a maximum of Rs 5 lakhs for establishing hatcheries with a minimum capacity of 30 million seed per annum.

(c) Subsidy for seed and feed to step up production from traditional prawn farms

Subsidy is given at the rate of 25% on the cost of seed and feed subject to a maximum of Rs 450 and Rs 3000 per ha respectively for additional stocking of quality seed and supplementary feeding in the traditional farms. At a time subsidy for a maximum of 50 ha only can be availed by one beneficiary.

(d) Subsidy for establishment of broodstock/spawner bank/ nauplii rearing centre

Under this scheme, subsidy is extended on capital investment at the rate of 25% subject to a maximum of Rs 1.5 lakhs per unit.

(e) Equity participation in aquaculture projects

To encourage the development of integrated aquaculture and export facility in private sector through public limited companies the Authority extends equity support at 11% of the paid up capital. So far, 12 projects have been supported and ten more projects are under consideration. Presently, the equity is limited to a maximum of Rs 5 lakhs with the objective of supporting more companies with the available fund. The Authority also undertakes the work of techno-economic appraisal of aquaculture projects for various agencies.

7. Demonstration of semi-intensive shrimp culture

Shrimp culture largely remains at extensive level with minimum inputs on seed, feed and water management. With the development of high-tech shrimp aquaculture with productions above 10 tonnes/ha/year from other countries of South East Asia, MPEDA set up demonstration of the technology under Indian conditions to prove its viability. One such demonstration was conducted at Nellore in Andhra Pradesh with the assistance of the Department of Biotechnology. The average production from this demonstration was well over 4 tonnes/ha/crop.

Encouraged by the results, the Regional Centres are helping the entrepreneurs under a productivity campaign to optimise production through semi-intensive system. The Authority provides technical guidance on all aspects of farm management and also gives the services of mechanical aerators, water pumps and electricity generators for one production cycle during the first crop.

This demonstration was further extended to the unexplored area of Andaman and Nicobar islands, by the establishment of a pilot project with grant-in-aid from the Department of Ocean Development. A production of two tonnes per crop has been achieved from this demonstration.

8. Need for policy support

With the introduction of the New Economic Policy from July 1991, growth of exports is a major requirement for the success of the structural reform programmes. Simultaneous with the announcement of the long term and liberalised trade policy, the Ministry of Commerce also announced a package of measures for special thrust in the export of high potential items. Marine products export falls in this category. The Ministry of Commerce has identified shrimp aquaculture as an item of "Extreme Focus" where a 30% growth rate can be achieved. The Extreme Focus Group on aquaculture set up by the Ministry has suggested a crash programme to develop exports by over Rs. 1500 crores in a 3-5 year time frame through aquaculture. MPEDA was also given a target of one billion US dollars in marine products export to be achieved by the end of the 8th Five Year Plan.

National policy guidelines drawn up for the development of export oriented aquaculture have identified priority areas for action such as land allotment by the state government, land utilization, environmental issues, problems of finance, problems of small and marginal farmers, manpower development, etc.

9. Strategy for development of aquaculture

The shrimp oriented aquaculture development in the country is now taking place in a haphazard manner and is mainly concentrated on the east coast. Investment climate in different areas is extremely varied and both infrastructure development as well as extension services are inadequate. Productivity and production patterns vary from small marginal holdings to large integrated farms that are coming up. It is necessary to extend benefits of technology to the rural poor and marginal farmers by promotion of low cost extensive aquaculture linked with rural employment and in the organised sector high production facilities with semi-intensive culture technology on a factory-farm basis. It is planned that the MPEDA should concentrate on strategies for export oriented aquaculture industry assisting small entrepreneurs with extensive farming technologies and simultaneously promoting aquaculture estates through the concept of satellite farming for larger entrepreneurs.

10. Action plan

The action plan to translate the policies and strategies is to be started in right earnest so that ultimate objective of export promotion has to catch up with the highly competitive world market. Immediate attention is called for in the following areas:

i) Popularising the concept of satellite farming where large units shall assist the small farmers with technology and finance for higher productivity in return for the buy-back arrangement of their produce at remunerative prices

ii) Trained manpower development to keep pace with the development of aquaculture

iii) Effective extension support capable of providing guidance to both small farmers and big entrepreneurs

iv) Efficient research and development programmes to improve the management practices especially in the maintenance of good farm hygiene, shrimp health management, disease control, effluent treatment systems, and post-harvest handling

v) Preparation of master plan keeping in view the competition in the use of land and environmental degradation.

There is need for co-ordinating the activities of various agencies and ministries engaged in the development of aquaculture to avoid conflicts and duplications. To this end, the Ministry of Commerce has plans to set up a Development Council for Export Oriented Aquaculture comprising representatives of various ministries and organisations as well as representatives of the Trade.

Table 1. NABARD refinance disbursement in fisheries sector and brackishwater aquaculture during 1989-90 to 1993-94

Year	Total Refinance disbursed in fisheries sector Rs. (in million)	Refinance provided to brackishwater aquaculture sector Rs. (in million)	%
1989-90	205.7	18.57	9.03
1990-91	211.8	42.49	20.06
1991-92	306.7	62.86	20.50
1992-93	304.7	105.00	34.46
1993-94	552.0	214.00	38.70
Total	1580.90	442.92	27.13

These figures of disbursement, however, do not reflect the true picture of NABARD's contribution for the development of brackishwater aquaculture. In fact, the bank has supported projects worth total financial outlay of Rs. 240 crores involving refinance commitment of Rs. 132 crores in the last three years (1991-94). The total physical area being developed is over 600 ha (Table 2).

Table 2. Total area coverage and NABARD's refinance support to brackishwater aquaculture (1991-92 to 1993-94)

Year	Area (in ha.)	Total financial outlay (Rs. in million)	NABARD's Refinance (Rs in million)
1991-92	198.69	195.02	107.44
1992-93	188.58	657.00	342.22
1993-94	207.60	1552.60	872.25

The statewise position of brackishwater prawn farming reveals that the states enjoying considerable resources are West Bengal, Gujarat, Andhra Pradesh and Orissa in decreasing order. While in West Bengal and Kerala, the development is on traditional lines, in the states of Andhra Pradesh and Tamil Nadu the growth is on scientific lines. Analysis of available data reveals that the total water area covered in Andhra Pradesh, Orissa and Tamil Nadu under scientific farming is much more than in other states. From the financial outlay point of view, the leading states are Andhra Pradesh, Tamil Nadu and Orissa in that order. Use of more commercial and scientific technologies in these states could be the reasons for availing more

refinance. In Gujarat and Maharashtra the extent of brackishwater aquaculture is very poor and therefore there is scope for greater utilisation.

Items eligible for credit under institutional finance

Eventhough NABARD provides credit support to all types of fisheries and aquacultural activities the following items are covered under investment credit:

1. Pond construction and other supporting infrastructures
2. Equipments, machines, pumps, etc.
3. First year crop input costs
4. Harvesting expenses, lease fee, insurance premium, marketing charges, security and staff wages for first year
5. Establishment of hatcheries
6. Establishment of prawn seed bank
7. Small scale feed plant
8. Freezing plant, ice plant, transport vehicles (as an a integral component).

Interest rate on bank loan

In the liberalised economy the interest rate on bank loan, availed by beneficiary, keeps on changing. The present rate of interest charged from beneficiaries varies upon the size of credit limit. It is 12% upto Rs. 25,000, 13.5% from Rs 25,000 to Rs 2.00 lakhs and as per bank's discretion for credit over Rs 2.00 lakhs.

Margin money

In shrimp farming project, a borrower is required to contribute atleast 25% of the total cost and the balance is provided as bank loan. If the entrepreneur procures some subsidy from any other agency, NABARD considers it as part of borrower's contribution in case of small farmers, while in the case of corporate sector schemes, such subsidy is deducted from the outlay for arriving at the bank loan. NABARD normally gives refinance to the extent of 70% of the bank loan but in those cases where projects are certified to be 100% Export Oriented Unit (EOU) status, the refinance is provided at 90% of bank loan. Certification of EOU status has to be issued from Ministry of Commerce.

Support to EOU projects

Besides the above thrust in routine types of schemes, NABARD since last year has allocated additional credit for EOU, hi-tech, value addition and innovative projects of agriculture and allied activities. While this allocation was Rs. 2000 million in 1993-94, it was further enhanced to Rs. 3500 million in 1994-95. Aquaculture has been the major beneficiary of this

allotment, as it could utilise 66% of the total achieved target of Rs. 3500 million.

Repayment period

Loan repayment period for the project depends on cash flow, profit earned and economic life of the project. First year of the project is considered as moratorium period when interest alone is collected and repayment of principal amount and interest is stipulated from second year. Average DSCR of 1.6 to 1.8 is generally adopted.

NABARD supports only traditional, extensive and semi-intensive shrimp farming projects and intensive aquaculture is not encouraged. Such policy decision has been taken taking into consideration the sustainability of the project and also long-term interest of environmental security. Besides, any additional step taken by entrepreneur to safeguard the surrounding eco-system in greatly encouraged. Beneficiaries are directed to monitor technical data like growth, production, physico-chemical and biological parameters and insisted to keep the bank informed about the adverse impact. Beneficiary is also advised to keep the crop free from antibiotics and steroid contamination. In hatchery project, thorough disinfection during operational intervals is insisted by the bank for success of the project.

Table 3. Projections of credit requirements in fisheries sectors

Sl. No.	Type of Investment	Addl. Prodn. (lakh tons)	Total outlay (Rs. crores)	Invest-ment Credit 75%	FFO for bank Loan	Bank Loan ground-level disburse-ment 75%	Bank Loan for whichRF may be sought 40%	NB Refinance 70%
1.	Marine Fisheries	9	5570	4178	1110 (20%)	833	333	233
2.	Inland Fisheries	19	6019	4514	3010 (50%)	2257	903	632
3.	Brackishwater Fisheries	5	5270	3953	2583	1937	775	542
	Total	33	16859	12644	6703	5027	2011	1408

Future strategies

NABARD has identified fisheries in general and aquaculture in particular as focus area

for the next decade and assumed that Rs. 14080 million would be the likely refinance requirement between 1994-95 and 2003-04 AD for developing different fisheries sectors of the country. Assuming that only 75% cases would come to NABARD for refinance, we expect that approximately Rs. 50270 million would be required as total bank credit for total ground level fund requirement of Rs. 168590 million total fisheries outlay. The projections are indicated in Table 3.

Besides NABARD and other sister scheduled banks, several other financing institutions like UTI, SCICI, IDBI and ICICI are also financing various components of fisheries sector. Investment of this magnitude for fisheries development would set an era of blue revolution and increase fish production from existing level of 4.6 million tons to 8.5 million tons.

WOMEN'S ROLE IN SHRIMP FARMING, TECHNOLOGY NEEDS AND MECHANISMS FOR TRANSFER OF TECHNOLOGY

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Abstract

The role of women in planning for rural development is marginal. This is despite the increasing evidence of the vital role played by women in food related activities, throughout the world. According to a United Nations estimate, women account for over half the food produced in developing countries. Women are proving to be admirably suited to all new activities related to fisheries, beyond their well-established and traditional roles in fisheries marketing and administration. This paper examines emerging trends and prospects of women in aquaculture. It describes the women's role in shrimp farming along coastal districts of Tamilnadu and Pondicherry. It discusses technology needs to develop appropriate skill and attitude towards sustainable shrimp farming. To achieve the desired goal, a well geared machinery is needed for regular transfer of technology to set up effective linkages between planning, research, extension and women. One possibility is encouraging the establishment of "All women's aquaculture estates".

Introduction

Women have played a silent, yet a central role in the sustainable use of natural resources. Although, they are not as visible in the formal industrial sector, a large number of poor women are engaged in traditional aquaculture practices and make an important contribution to the economic output of our country. There is a growing recognition that conservation and sustainable development of any economic activity will not be possible unless women are involved in planning and decision making process and are equal partners in managing and controlling resources. Shrimp farming requires minimal skill levels and creates value added employment opportunity.

Aquaculture is a growing sector in the food industry. The projection for global production by ADCP is some 22 million tonnes by the year 2000. (Armin Lindquist, 1987, Welcoming address, Proceedings of the Aquaculture Development and Coordination Programme / NORAD Workshop on Women in Aquaculture, Rome, FAO, 13-16 April 1987). Technically this is feasible, but it will require much investment in capital and in training human resources. If this total is to be reached, innumerable opportunities have to be provided for coastal women to demonstrate their skills and find employment.

Women's role in shrimp farming

To study the involvement of women in scientific shrimp farming, we conducted a survey of shrimp culture ponds in various stages of operations along the coastal districts of Tamil Nadu (Thanjavur, Pattukottai, Nagai Quaid-E-Milleth) and Pondicherry (Karaikal).

Table 1. Degree of gender participation in shrimp farming in Karaikal

Activity	Men %	Women %	Training thrust for women
Pond construction	74	26	Techniques of manual pond construction & its economic cost.
Pond preparation	75	25	Pond weeding, drying or draining.
Collection of wild seed	18	82	Hand picking, netting, identification of species, survival, packing for transportation and tidal seasons.
Stocking	100	nil	Timing and season of stocking, acclimatisation of the fry or fingerlings to the pond temperature, maintenance and grading fingerlings and taking stocking count.
Feeding	100	nil	Formulation and preparation of supplementary feeds, monitor the feed conversion ratio and feed distribution techniques
Monitoring	82	18	Regular sampling of the culture water & analysis of physico-chemical parameters, daily record maintenance and nitrification load testing.
Managing water quality in ponds	100	nil	Water exchange practices, pump operation and sluice gate maintenance.
Harvesting	87	13	Methods of harvesting, techniques of harvesting, maintenance of record over the date and time of harvest and the count/kg.
Post harvest handling	86	14	Knowledge about washing, sorting, icing, methods of packing and preservation methods.
Managerial aspects	100	nil	Scientists or research associates, overall technical knowledge and managerial skills.
Source: Field survey of 8 private farms in Karaikal - August, 1994			

Table 1 shows that while women play an important role in wild seed collection, their involvement in scientific shrimp farming is marginal. This is mainly due to social constraints, lack of technical knowledge and organisation and credit availability.

Social constraints

It is rare to find a woman manager or technician at the shrimp grow-out pond sites. One usually finds a domination of male workers, employed at the site. This is not surprising considering that aquaculture management staff are exceedingly well paid. One of the serious problems cited in obtaining jobs for women in Tamil Nadu is that technical experts (women graduates) have not been actively sought by the private sector. Their expertise is frequently viewed as inferior to the hands on practical knowledge of farm operators. There is also a conscious and unconscious bias towards employing women for the following reasons.

1. Grow-out ponds and hatcheries are located in isolated areas.
   a) Men are easier to manage since they can fend for themselves
   b) Special attention will be needed for women's needs.
   c) Women may be frightened to work in isolated areas.
   d) Women need the company of more women, since they will be lonely and they will be cut off from their families.
   e) Men can live at the site but women cannot and therefore, daily commuting from nearby towns to the shrimp culture fields creates a problem for women.
   f) Fear of sexual harassment.
2. Brackishwater shrimp farming involves dedicated and concentrated work. A tough person is needed at the site to battle with construction workers, possible theft and night management of shrimp ponds.

This bias is a pity, since at the degree level, there is equal participation of male and female students. For example in the batch of 1994, there were 5 female and 4 male students who graduated in fisheries science course of Madurai Kamaraj University. The current batch consists of 15 students, out of which 8 are female candidates. Women students perform better at their studies at the degree level. This recognition has encouraged some shrimp farm owners to employ women technicians in their hatcheries. Over here again, the reason is that women have small and delicate hands and are therefore more skilful and dextrous at induced breeding techniques.

Technology needs

Collection of wild seeds

Women are involved in the collection of juveniles by the simple hand-picking technique in estuaries and backwaters during high tide. This work is seasonal and is traditionally carried out by women who can identify different species of shrimps *Penaeus monodon* (black tiger prawn) and *Penaeus indicus* (Indian white prawn) by their morphology. They transport the collected juveniles from the natural water bodies to the nearby private farms in polythene bags. The women engaged in the collection of juveniles are often illiterate. However, they know how to pack and transport live seed and report that the smaller sized juveniles have a better survival rate than the bigger ones. With a little on the spot training, we can help improve their efficiency

and increase their income. They need information on techniques of hand-picking and various ways of netting on tidal conditions, morphology of different species, their survival rate and mechanism of transportation.

Pond construction

Women are employed in carrying out manual work of raising the bunds for ponds. It is sad to note that women are paid less for their labour and are exploited. Women should be exposed to the techniques of manual and mechanical pond construction and its economic cost. For example, women in coastal Tamil Nadu are often exploited and under-paid since they have no idea what their work is worth. Manual excavation of one cubic foot costs Rs. 0.60. One woman can easily excavate 100 cubic feet per day, which should fetch them an earning of Rs. 60.00 per day. However, due to their ignorance, they are often exploited and paid Rs. 20/day.

Feeding

Women are employed in the preparation of feed and also in the dispensing of the feed in the ponds at regular intervals. They could additionally be trained in feed formulation and preparation. They need to have practical knowledge to monitor the feed conversion ratio and be aware of the various feed distribution techniques.

Marketing

Women traditionally predominate in local marketing. At the local scene, however, they are shy at negotiating with big business houses. Their training should extend to building confidence in carrying out negotiations at any level.

Hatchery

There is a preference for women workers in hatcheries for broodstock management. Women have dextrous fingers and become skilful in eye stalk ablation techniques in a few months.

Management

Women graduates can become efficient managers and technicians. They are capable of pond preparation, regular monitoring, harvesting and post-harvest treatment. Training thrust should be on the following:

Pond preparation: Weeding, drying and draining of ponds.

Stocking: Timing, season, candidate species, seed count, growth rate of juveniles, acclimatisation period (water quality - temperature, salinity, pH).

Monitoring: Women should be trained in regular sampling of the culture water in order to analyse the physico-chemical parameters and feed monitoring. Daily record maintenance of important parameters is essential. Training should include water exchange practices, pump operation, and sluice gate maintenance.

Harvesting: The women should be trained in the various methods and techniques of harvesting. maintenance records for the date, time of harvest and the count per kilogram.

Women are proving to be suited for the post-harvest technologies which include washing, sorting, icing, packing and preservation. However, adequate analysis should be done in the consumer taste, availability and costs of the processing material, price of the final product, storage facilities, quality control and marketability. Keeping in view the multi-dimensional roles of women and full utilisation of the women's potentiality in the developing process, it is necessary to develop their capacities, which will contribute to efficient human resource management.

All Women Aquaculture Estates

Aquaculture ponds in coastal areas often replace paddy fields, or other marginal agricultural activities. While this is an economically sound practice, it often takes place at the cost of environment and social equity. There is a built in gender bias towards employing men in aquaculture. The group who is most marginalised are coastal women, because they are deprived of their jobs as agricultural labour, when shrimp ponds flourish. Due importance needs to be given to their plight, and job creation must replace job destruction. The question that comes to mind is how do we do this. One solution is given below.

Promoting large Corporations to purchase coastal lands for conversion to shrimp ponds reduces the small farmers and land owners to landless labourers. This creates a social problem since the local people see an influx of outsiders, profitably utilising their former land. Institutional devices are necessary to enable resource poor families to take advantage of Government's land allocation priorities in favour of the poor. Mechanisms are needed to organise a large number of small farmers including women.

For this purpose, it is suggested that a compact All Women's Aquaculture Estate (AWAE) is to be formed of about 40 ha each. The concept was first suggested by Dr. M.S. Swaminathan in 1994. This will allow the allotment of one acre of pond space for 100 women belonging to fisher and landless labour families in each Aquaculture Estate. The size of each estate could vary according to location.

The interested resource poor women and men will need training, credit and infrastructure to carry out shrimp farming. To minimise the ecological impact, the government can help by making an overarching ground site plan of the aquaculture estate, including location of the feeder and waste water discharge canal. The Estate should provide common services, such as purchase of inputs, maintenance of water quality and shrimp health, processing, marketing and training. It should confer on small producers the advantages of scale. The Estate will provide centralised services and the farm women will take care of decentralised production in their leased ponds. They in turn will pay for all the services from the profits earned. AWAE can be organised by the State Women's Development and Scheduled Caste Development Corporations.

By linking land allotment with credit, technology, techno-infrastructure, training and trade, AWAE could become powerful instruments in improving the livelihood security of the rural poor living in coastal areas.

An All Women's Aquaculture Estate is currently under consideration by the Government of Pondicherry. They have identified thirty hectares of land at the Keelaoduthurai Village at Karaikal. This is expected to serve as a model unit for the other shrimp culture farms as well as the women managed farms. The objective of this pilot project is to extend the economic benefits of aquaculture to a socially disadvantaged group of people.

Mobilizing funds for the AWAE

Infrastructure: The capital development costs (construction) which is non-recurring could be mobilised from various IRDP schemes such as Jawahar Rojgar Yojana, NREP, Prime Minister's Rojgar Yojana, etc.,

Operational costs: Once the Government agrees in principle to lease the land to the AWAE, MPEDA could help the AWAE members work out the project plan and budget as a bankable proposition and the lead bank could then finance the AWAE project.

Aquaculture Estate Managers and Technicians: Competent technical staff will be needed to professionally run the AWAE and provide training to the women stakeholders. These people can be paid from the profits earned.

Conclusion

Need for Women Extension workers

Women are noticeably absent in the extension concern and the need of the hour is to create a linkage between planning, research, extension and women. Women should be encouraged to carry out extension services. Women extension agents respond to the needs of women producers and also create awareness about possibilities for women.

The taditional top-down approach to extension should be reversed to a bottom-up approach starting from women - extension - research and ending with planning.

Learning by doing: Though rural women have knowledge of shrimp culture, adequate training programmes, and appropriate techno-infrastructure development will revive and strengthen their role in the conservation and sustainable shrimp farming. Rural women though often illiterate are by no means stupid. They have very keen power of observation and can learn sophisticated techniques when it is transmitted visually and they are allowed to practice. On the spot training programmes should be designed innovatively to maximise rural women's skills.

A project should be prepared and implemented as a training programme for women fisheries extension workers. The extension workers' specific functions should be a) to mobilise fisherwomen for constructive group action, b) to improve their social and economic conditions, c) to create an understanding for the need for change in socio-cultural attitudes among men and women, d) to encourage women to utilise the services of the Governments and other institutions and e) to stimulate government institutions to respond to the objectives and felt needs of the stake-holders.

GENERAL REMARKS *

A. Sankaram

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I regard it a privilege to address this distinguished gathering of aquaculture specialists. I express my gratitude to Dr. M.S. Swaminathan for the confidence reposed in me, for addressing you. My continued interest in acquisition of knowledge on the subject over the past decades enables me to present the vicissitudes of different sectors of fisheries in general and aquaculture in particular. I share your concern of the current problems in shrimp culture. This is a temporary phase and it is within your potential outfit to meet the challenge to land on sunny shores, very soon. About two thirds of aquaculture production comes from inland rivers, lakes, ponds and artificial tanks. The rest is from coastal mariculture practised in bays or in the open ocean. Aquaculture has an advantage over pork, chicken and beef producing industry with highest feed efficiency of 2 kg of feed for one kg fish. It is 4 for pork, 2.2 for chicken and 7 for beef. For aquaculture the land is expensive using coastal, lakefront or riverfront areas.

The global fishing industry has become enmeshed in a cycle that is now undermining the health of the very resource on which it depends. The oceans have nearly been fished to the limits. The marine catch is unlikely to maintain the 100 million ton mark unless fish stocks are better managed under restraint and discipline. The fundamental problems that fishers face are their own ability to catch fish and counter-productive policies that have led more people and boats into the business with subsidies lavished even after the point of diminishing returns. For example between 1970-90 FAO recorded a doubling in the world fishing fleet from 585,000 to 1.2 million large boats and from 13.5 million to 25.5 million gross registered tons. As observed by Chris Newton, an FAO analyst, we could go back to the 1970 fleet size and we would be no worse off. We'd catch the same number of fish.

In India shrimp aquaculture appears to have ignored the law of nature that dictates the delicate relationship between capacity factor (of the oceans and waters as an ecosystem) and intensity factor (the technology of fishing with new tools and machinery). The pattern of food production, 97% from land, 2% from aquaculture and 1% from pastures, would remain undisturbed in the future provided greed is substituted by need and excessive instant profit by sustained pay off for the farmers and entrepreneurs. There is room for optimism for Indian aquaculture if management is scientific and the farmers are aware of natural laws governing the biosystem. If the model of aquaculture is intensive then failure is a real possibility since, at that level, the industry is self polluting in environmental terms. Given a semi-intensive approach and onfarm feed production at the small scale level it should be possible to increase supply for national consumption. But both the approaches are delicately balanced for success between capacity and intensity factors of the ecosystem. Of the large, medium and small sectors, it is the small sector that carries many advantages such as it employs more people, produces less waste, requires less capital and supports a great diversity of coastal communities. I am aware

* Excerpts from Address at the Concluding Session

of the policy framework of Taiwan, Malaysia etc. that encourages large scale mechanised operations. But this pattern cannot prevail in India, except to a limited extent under disciplined management, for sustainale production levels. The validity of the endeavour shall be tested on its social relevance and distributive justice to those who are below the poverty line. This is the challenge of now and the future for all governments.

I cannot suggest legislative measures to regulate your industry. They were tried in some countries but with partial or no success. We have more laws than ever before and they are doing more harm than good. Perhaps more appropriate is to quote Abraham Lincoln - "Discourage litigation, persuade your neighbours to compromise wherever you can, point out to them how the nominal winner is often the real loser in fees expenses and waste of time". I wish you all well.

II. Status Reports

Status Report - ANDHRA PRADESH

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1. Resources

A macrolevel survey with tide-fed concept of culture was conducted during 1980's. It revealed that there is an area of 63,961 hectares of brackishwater lands all along the coastline of 974 km in Andhra Pradesh.

As per the recent surveys, the potential land resources suitable for shrimp farming in Government and private land is as given below:

	Name of the District	Govt. land (ha)	Private land (ha)	Total (ha)
1.	Srikakulam	2429.78	1502.64	3932.42
2.	Vizianagaram	2.53	9.47	12.00
3.	Visakhapatnam	801.04	490.66	1291.70
4.	East Godavari	23902.30	935.10	24837.40
5.	West Godavari	1583.00	1884.50	3467.50
6.	Krishna	24418.57	243.42	24661.99
7.	Guntur	1564.16	30.64	1594.80
8.	Prakasam	1300.53	110.00	1410.53
9.	Nellore	2716.20	36.80	2753.00
	Total	58,718.11	5,243.23	63,961.34

2. Land lease policy

The overall programme for brackishwater farming in the State and the policy for allotment of Government-owned brackishwater land for aquaculture has been decided by the Government in the following pattern of allotment amongst the three categories, namely, Fishermen Cooperative Society/fishermen, technocrats (including eductated unemployed) and entrepreneurs:

Category	Allotment of land	Ceiling	Annual lease amount per ha
Fishermen Cooperative Society / Fishermen	60%	1 ha per fishermen family	Rs. 500/-
Technocrats (including educated unemployed)	20%	Upto 10 ha	Rs. 5,000/-
Entrepreneurs	20%	Upto 100 ha	Minimum Rs. 5,000/-

3. Progress made in allotment of lands as on 1.11.94

S.No.	Name of the District	Area of land allotted to different sectors (in hectares)		
		Fishermen/ Fishermen Coop. Society	Technocrats	Entrepreneur
1.	Srikakulam	--	--	--
2.	Vizianagaram	--	--	--
3.	Visakhapatnam	--	--	--
4.	East Godavari	40	152	320
5.	West Godavari	--	--	--
6.	Krishna	--	192	440
7.	Guntur	--	--	--
8.	Prakasam	--	--	--
9.	Nellore	153.50	172	640

4. Actual area under farming

S.No.	Name of the District	Area under shrimp farming as on 30.9.94 in the private sector (ha)			
		Traditional	Extensive	Semi-intensive	Total
1.	Srikakulam	142.45	33.87	7.00	183.32
2.	Vizianagaram	--	4.66	56.00	60.66
3.	Visakhapatnam	19.06	144.93	173.20	337.19
4.	East Godavari	3181.72	1400.77	64.60	4647.09
5.	West Godavari	12593.57	141.66	--	12735.23
6.	Krishna	29476.15	5.20	120.40	29601.75
7.	Guntur	8769.31	38.94	--	8808.25
8.	Prakasam	976.59	2318.52	836.28	4131.39
9.	Nellore	338.00	3619.00	--	3957.00
	Total	55496.85	7707.55	1257.48	64461.88

5. Organisational structure for fisheries extension

The extension programmes in shrimp farming are looked after under the overall control of Commissioner of Fisheries who is assisted by the Joint Director of Fisheries (Brackishwater) at the Headquarters. There are three Regional Deputy Directors, one each at Visakhapatnam, Kakinada and Guntur. The Visakhapatnam region is served by four Assistant Directors (Visakhapatnam, Vizianagaram and Srikakulam); Kakinada region by Five Assistant Directors (Kakinada, Khammam, Rajahmundry, Eluru and Machilipatnam); and Guntur region by four Assistant Directors (Guntur, Prakasam and Nellore). Besides, there is a post of Deputy Director (Brackishwater) at Kakinada, under whom three Assistant Directors are working. Inspector of Fisheries and Fisheries Extension Officers are in charge of brackishwater extension activity, each covering 3 - 5 coastal mandals at the field level. The extension work carried out by the above officers is in addition to the work of BFDAs in the State.

6. Structure of BFDAs

There are five Brackishwater Fish Farmers Development Agencies in the State in Srikakulam (1990), East Godavari (1991), Nellore (1990), Krishna (1988) and Prakasam (1991) Districts. Each BFDA is headed by the District Collector as chairman of the Managing Committee, with an Assistant Director of Fisheries as Chief Executive Officer. Fisheries Extension Officers (two) function at the field level, supported by fishermen (two) and administrative staff (three).

BFDA is managed by a Governing Body, consisting of District Collector as chairman, Project Director DRDA as Vice-chairman, and members with the Chief Executive Officer as Member - Convenor.

Financial assistance is to be shared between the state and centre on 50:50 basis. It includes:

1. Subsidy towards cost either for renovation or for construction of brackishwater prawn farm (maximum 10 hectares) with provision of inlet and out let gates for prawn culture; Subsidy payable only once to the prawn farmers:

   25% of the total cost (Maximum of Rs. 20,000/- all category of prawn farmers)

2. Subsidy towards the cost of inputs (seed, feed, manures, etc.) payable only once for prawn farmer:

   Rs. 10,000/- per ha water spread area for all category of prawn farmers.

3. Cost of stipend for training of prawn farmers for a period of 15 days duration:

   Rs. 25/- per day for trainee, Rs. 40/- as lumpsum for to and fro Bus/Train fares.

4. Administrative cost:

   Shared between the State and Central Government on 50:50 basis.

5. 50% of the vehicle cost payable once for each Brackishwater Fish Farmers Development Agency.

7. Aims and objectives of BFDAs

Brackishwater Fish Farmers Development Agency is a production oriented programme. The main objective of the project is to develop suitable brackishwater areas in the district for prawn culture by adopting improved culture practices and making available seed-feed linkage to progressive farmers. The aim of the Agency is to develop 50 hectares of brackishwater every year through coastal aquaculture by way of construction of new tank or by renovating existing tanks in order to yield an additional prawn production of 25 tonnes per year.

To attain the above major objectives, the Agency will take the following steps:

1. Identify brackishwater aquaculturists and entrepreneurs in the district
2. Survey brackishwater areas to be brought under effective prawn farming
3. Identify 50 hectares of brackishwater area for new construction/reclamation of tanks every year
4. Prepare bankable project reports on behalf of the beneficiaries to arrange bank loan
5. Act as an agent to financial institutions and beneficiaries for providing loan and also helping in recovery of the loan instalments due to the bank
6. Provide training to farmers in brackishwater aquaculture and its management
7. Monitor the prawn culture tanks subsidised by the Agency

8. Provide technical assistance to farmers right from the selection of site to marketing of the prawn
9. Arrange supply of inputs such as seed, feed, manure, etc.
10. Release 25% subsidy on reclamation/construction of selected ponds and on total cost of inputs for the first crop
11. Provide market information and assist in the marketing of prawn
12. Arrange and organise supply of prawn/fish culture machinery and implements for the brackishwater fish farmers.

8. Achievements of BFDAs as on 31.03.1994

BFDA District	Area developed (ha)	No. of farmers trained
Krishna	63.10	50
Srikakulam	9.00	23
Nellore	32.76	83
West Godavari	49.76	82
Prakasam	40.13	58
Total	194.75	296

About 50,000 small and marginal farmers have taken up shrimp culture. They have to be covered under training programme.

9. Technology and Training

The BFDA officers are being sent for training on shrimp farming, hatchery operations, pen/cage culture, both in india and abroad under World Bank assisted shrimp culture project. There is a need to continue the training programmes for fisheries technical officers. Technology and training sources are Central Institute of Brackishwater Aquaculture, Central Institute of Fisheries Education and Marine Products Export Development Authority and its hatchery at Visakhapatnam.

It is proposed that CIBA may establish its Research centre at a centralised location in Andhra Pradesh with facilities of monitoring, diagnosis and control of shrimp and fish diseases. A Krishi Vigyan Kendra of ICAR may also be established.

The Fishery Extension Officers and inspectors of Fisheries are in regular contact with shrimp farmers and provide the feedback to the research stations.

10. Constraints of BFDAs

The constraints are problems related to credit flow to small and marginal farmers,

periodical re-orientation training to technical officers on latest technology with financial allocation and provision of adequate manpower at the field level to monitor culture operations.

11. Suggestions for improvement of functioning of BFDAs

(a) Establishment of Brackishwater Fish Farmers Development Agencies in all coastal districts.

(b) Though the Government need not invest for ice plants and cold storages, support to set up such infrastructure by cooperatives and entrepreneurs in the shape of Government share in investment/subsidies etc., may be required.

(c) New trades like grading and storage will create greater employment, especially for women agricultural labour. Training has to be organised.

(d) The aquaculture activities may be treated on par with agriculture activity.

(e) With technical officers, farmers should also be exposed periodically to the latest technical know-how available not only in the country, but also outside the country. Required funds are to be earmarked for such exposure activity.

(f) Diversification to different culturable species like crabs, fish etc., as shrimps are more susceptible to diseases and economy of export markets is now based on shrimp mostly.

(g) Financial Institutions should finance farms, which are permitted as per the guidelines.

(h) Frequent workshops and Kisan Melas should be organised for interaction with farmers.

Status Report : GOA

V.G. Gopinathan
Chief Executive Officer
Brackishwater Fish Farmers Development Agency
Goa

The State of Goa has approximately 104 km long coast line and about 250 km long water ways formed by the major river, namely, Terekhol, Chapora, Mandovi, Zuari, Sal, Talpona and Galgibag. All the above rivers are opening to the Arabian Sea. The total brackishwater area available in all the above tidal rivers is estimated to be about 520 km^2. The estaurine resources are exploited by means of stake net fishing, gill net fishing, sluice gate operations, barrier net fishing etc.

Resources for Brackishwater Aquaculture

The State has about 18,000 hectares of low lying paddy fields which are located all along the sides of tidal rivers. These paddy fields are locally known as 'Khazan' lands. Of the above area, about 200 ha are used for 2 crops of paddy, 12,500 ha for a single crop of paddy and about 3500 ha are lying fallow without much productive use. All the above areas are brackish in nature, since they are located adjacent to the tidal rivers.

The single crop paddy cultivation is carried out in 12,500 ha from June-July to October-November, and during the remaining period these fields are lying idle. If such fields are inundated with tidal waters after the harvest of paddy in December availing the natural ingress of white prawn seed, a fairly good harvest of prawn is possible around April. However, the existing rules do not permit the inundation of paddy fields by saline water for fish culture. Yet, a small portion of such land is flooded every year with due government approval.

About 3,500 hectares of fallow and marshy lands are available for conversion to brackish water prawn farming.

Out of 246 ha of Government land located at Chorao in Tiswadi taluka and Durga in Salcete taluka, about 55 ha are mangrove free and permitted to develop for prawn farming. Since the Government land available is very negligible, no leasing policy has been formulated for the allotment on lease.

About 7 ha of water area consisting of individual ponds of 1 ha each with all the water management facilities, has been developed under the Centrally Sponsored Scheme. Such developed ponds have been allotted on long lease basis to the individual farmers at the rate of 1.0 ha per individual.

Present status of Brackishwater Aquaculture

Brackiswater fish farming by traditional means has been practised in Goa from time

immemorial. It is estimated that around 500 ha of brackishwater area is used under traditional farming, with maximum concentration in the talukas of Bardez, Tiswadi, Salcete and Ponda. The methods of farming involves composite rearing of wild stock of fish and prawn which enter the fields along with tidal waters. The following systems are generally in vogue.

Distribution of fallow and marshy lands suitable for aquaculture

Area in hectares				
Taluka	Govt. Land	Private	Communidade	Total
North Goa District				
Pernem	--	124	--	124
Bicholim	--	127	--	127
Bardez	--	193	195	388
Tiswadi	220	50	275	545
South Goa District	--	400	--	400
Marmagoa	26	489	560	1075
Salcete	--	580	330	910
Ponda				
State Total	246	1963	1360	3569

Permanent Fish Farms (Traditional)

These farms are situated very close to estuaries or its tributaries. Wild stocking with all varieties of fish and prawn is carried on with the help of tidal waters. Harvesting for the marketable size is a continuous process.

Prawn filteration in Khazan Lands

A khazan farm consists of a narrow or wide strip of land alongside the river of creek, protected from the tidal inundation by construction of embankment or bundhs. Sluice gates are provided on these bundhs to control the inflow and outflow of water. The sluice gate consists of single or multiple collapsible doors which get automatically closed when there is a rise in the level of water outside the farm and get opened when there is a rise inside. Thus, the undersireble flow of water into the farm during high tides is prevented, while allowing drained water to flow into the river during low tides. There are numerous drains inside the farm, but the main drain usually lies parallel to the main bundh and the other drains discharge the water into the main drain. The main drain discharges the water to the river through the sluice gate. These drains are used for raising fish and prawn. Fishing is mostly carried out by operating sluice gate net during the spring tide periods. In certain khazan lands after the paddy is harvested during November-December, the entire field is flooded for raising a crop of fish and prawn,

and the harvesting takes place around April.

Salt-cum-fish production

Salt curing is carried out generally in the salt pans during summer months, mainly from February to May. During the remaining period a crop of fish and prawn is raised in such salt pans, partly by natural stocking and partly by supplementary stocking.

Modern farms

After the setting up of the Brackishwater Fish Farmers Development Agency (BFDA) to cover both the districts of south and North Goa during 1990-91, about 92.0 ha of water area has been brought under scientific prawn farming.

The following table indicates the total area under shrimp farming:

Name of District	Area under shrimp farming (in ha)			
	Traditional	Extensive	Semi-intensive	Total
South Goa	175.00	12.86	--	187.86
North Goa	325.00	43.33	36.80	405.13

Organisatinal structure of fisheries extension under the Department of Fisheries

The Directorate of fisheries, Government of Goa is headed by the Director of Fisheries in charge of both marine and inland fisheries development. The categories of technical staff include the Deputy Director of Fisheries, fishery Scientists, Superintendent of Fisheries, Extension Officers and Gram sevaks. The extension service is carried out by the Gram Sevaks at village level, Extension Officers at taluka level, superintendent of Fisheries and Deputy Director at H.Q. level.

The Department of Fisheries has set up a brackishwater fish farm, covering an area of 5.0 ha at Ela Dhauji during 1974 to undertake and demonstrate scientific prawn and fish farming. The training programme is organised at this farm to transfer the technology to the farmers and entrepreneurs.

BFDA in the state

One Brackishwater Fish Farmers Development Agency for covering both North and South Goa Districts has been set up under the Centrally Sponsored Scheme during 1990-91. Though the sanction for the BFDA has been accorded from 1990-91, the actual activities commenced

from 1991-92. The Governing Body of BFDA, Goa is headed by the Minister for Fisheries.

Since the scheme of BFDA is not permanent, the appointment of staff is made on deputation basis. Since the personnel are changed very often , the activities of BFDA also get affected at times, resulting in shortfalls. It would be desirable to specify the role of BFDA in transfer of technology, indicating the personnel required for carrying out the activities envisaged. The budget provision towards administrative cost may also be enhanced, depending on the requirement of personnel for carrying out the specific work of BFDA.

It would be appropriate to have a uniform staff pattern for all the BFDA's and the personnel are properly trained in specific aspects by a Central Agency. The BFDA schemes are to be made permanent so that the staff can be appointed on a regular basis.

In addition to the normal functions, the BFDA, Goa has been entrusted with the management of the Pilot Prawn Hatchery, at Benaulim set up by the Government of Goa under UNDP assisted Centrally Sponsored Scheme. The hatchery is in operation since April 1992 and produces *P. monodon* seed. The seed is supplied to the farmers from Karnataka, Kerala, Maharashtra, Gujarat and Andhra Pradesh besides Goa.

The Government of Goa has enacted the Act known as (Brackishwater) Fish Farming Regulation Act, 1991, and by a notification made it effective from 1-08-1993. Under the Act, the entire brackishwater fish farming shall be regulated by issue of licence.

Status Report : GUJARAT

Commissioner of Fisheries
Govt. of Gujarat, Gandhinagar

1. Potential land resources found suitable for shrimp farming

(Position as in September '94)

District	Areas surveyed (preliminary)		Suitable Areas	
	No. of sites	Area (ha)	No. of sites	Area (ha)
Valsad	35	6721	10	5120
Bhavnagar	28	2494	6	1131
Junagadh	10	1317	4	490
Surat	35	8965	8	2075
Kutch	35	8506	9	4496
Amreli	11	3024	7	2432
Rajkot	3	2900	2	2500
Kheda	13	15916	1	3019
Bharuch	31	15265	20	11971
Jamnagar	12	5318	7	4104
Surendranagar	9	*	--	--
Ahmedabad	14	6350	--	--
Total	236	76776	74	37338

* Vast area of Rann of Kutch

2. Salient features of land lease policy

A brackishwater land lease policy was adopted by government in April 1987. As per this government resolution, an individual entrepreneur is eligible for obtaining 5 ha of land, a cooperative society for 50 ha and corporate body/private companies upto 100 ha of land or even more depending on their expertise in the field. The lease period is 15 years, extendable for another 15 years. 50% of the land is reserved for the Scheduled Caste, Scheduled Tribe and other weaker sections.

3. Progress made in allotment of lands under the above policy (Position as on 31-8-1994)

Name of the District	Area of land allotted to different sectors (area in ha)				
	Corporate/ business houses	Coops.	Individual entrepre-neurs	Others like BFDA/ Govt.	Total
Valsad	317	203	606.5	60	1186.5
Bharuch	100	40	585	--	725
Surat	5	--	88.5	--	93.5
Jamnagar	--	35	30	--	65
Bhavnagar	--	--	46	--	46
Junagadh	60	--	2	--	62
Amreli	--	--	33	--	33
Kutch	--	--	125	--	125
Rajkot	--	--	5	--	5
Total	482	278	1521	60	2341

4. Actual area under shrimp farming (Position as on 31-8-1994)

Name of the district	Area under shrimp farming (in ha)
Valsad	127.90
Bharuch	19.20
Surat	4.50
Junagadh	1.00
Jamnagar	6.00
Total	158.60

5. Organisational structure of BFDA with number of posts

Sr. No.	Name of Posts	No. of Posts BFDA		
		Valsad	Bharuch	Surat
1	Supdt. of Fisheries	1	1	1
2	Asstt. Supdt of Fisheries	3	3	3
3	Farm Supervisor	1	-	-
4	Engg. Supervisor	1	-	1
5	Head Clerk	1	-	-
6	Accountant	1	-	-
7	Clerk-cum-Typist	1	1	1
8	Jr. Clerk	1	-	-
9	Fieldman	4	2	2
10	Watchman	1	-	-
11	Peon-cum-Driver	1	1	1
12	Peon	1	-	-
	Total	17	8	9

6. Objectives set for BFDAs

The objective of the BFDA is to effectively introduce and impart technologies of brackishwater prawn/fish culture among the coastal communities so as to give them a gainful vocation and productively utilise the coastal fallow lands.

7. Training

Some of the officers of BFDAs have received training in shrimp farming/hatchery at Marine Products Export Development Authority and Central Marine Fisheries Research Institute, Cochin.

Training given by BFDAs to farmers is as follows:

Year	No. of farmers
1990-91	15
1991-92	83
1992-93	41
1993-94	42
1994-95	20 (upto 7/94)

A number of farmers have been trained in shrimp farming at the Kakdwip Research Centre of Central Institute of Brackishwater Aquaculture. A three months training course has been started especially on brackishwater farming to the prospective farmers at the departmental training complex at Umbergaon. The course started on 1-8-1994. A batch of 23 farmers are at present undergoing training in this training complex. The second batch of training will be commencing from 1-12-1994.

8. Achievement of BFDAs

District	Activity	1990-91	1991-92	1992-93	1993-94	1994-95
Valsad	BW land allotment (ha)	85.50	397.50	416.00	275.50	2.00
	Area brought under BW aquaculture (ha)	2.00	7.50	21.50	60.90	36.00
	Training given (No. of farmers)	15	41	12	18	--
Bharuch	BW land allotment (ha)	--	100.00	370.00	120.00	135.00
	Area brought under BW aquaculture (ha)	--	--	5.20	4.00	10.00
	Training given (No. of farmers)	--	22	14	17	--
Surat	BW land allotment (ha)	--	--	9.50	--	84.00
	Area brought under BW aquaculture (ha)	--	--	1.20	3.30	--
	Training given (No. of farmers)	--	20	15	7	20

Status Report : KARNATAKA

M.L. Doddamani
Brackishwater Fish Farmers' Development Agency
Karwar, Karnataka

Karnataka with its two maritime districts of Dakshina Kannada and Uttara Kannada has a coastline of 300 km. Dakshina Kannada District has 273 ha of suitable brackishwater lands of which 213 ha is Government land. Uttara Kannada District has 3868 ha of brackishwater land area out of which 67.6 ha belongs to Government.

Traditional shrimp farming has been carried out in Uttara Kannada District in 2500 ha area, after a crop of "Kagga" a salt resistant variety of paddy, in gazani or kharlands. This brackishwater environment has a rich and varied natural distribution of many important species of molluscan, crustacean and fish fauna. The river banks are also rich in mangroves and lime shell beds. The kharland area on account of high salinity remains unfit to grow high yielding agricultural crops, but provides good scope for aquaculture. From traditional shrimp farming the production of prawns is very meagre and the present production is about 50-70 kg/ha/year which can be easily increased to 500 kg/ha with the adoption of improved technique or management. In Dakshina Kannada District traditional shrimp farming is not in vogue.

The Government of Karnataka established a Brackishwater Fish Farmers Development Agency at Karwar in 1987. The scheme envisages development of brackishwater farms in about 250 ha in Karnataka and construction of one prawn hatchery with production capacity of 10 million *Peneaus indicus* seed per annum at Kumta. The hatchery was commissioned during 1993 and produced 1.7 million seed. The Agency is also maintaining one experimental brackishwater shrimp farm at Kanasagiri, Karwar.

The Government of Karnataka has formulated leasing policy for allotting available Government land on the following basis.

Category - I	Individuals & Fishermen Co-operative Societies	50%	1 ha per member (18% of this to SC/ST)
Category - II	Small entrepreneurs	30%	1 - 4 ha
Category - III	Small entrepreneurs	20%	4 - 10 ha

Out of 280 hectares of Government land available 165 hectares of land has been leased to 108 individuals and entrepreneurs. Construction of ponds will be taken up by the lessees soon.

About 600 hectares of brackishwater land has been converted into ponds for semi-intensive prawn culture. The production of prawn from culture is about 1250 t.

The Government has established a prawn hatchery and private firms have established two hatcheries. The annual production capacity of these hatcheries is 100 million PL-20. The present demand of prawn seed in the state is around 500 million.

There are no shrimp feed manufacturing units in the State. Most farmers use feed supplied from outside or prepare local feeds.

Status Report : KERALA

D. Ravi
Director of Fisheries
Vikas Bhavan, Thiruvananthapuram-33

1. Introduction

The State of Kerala has a coastline of 590 km and a sprawling brackishwater area of nearly 65,000 hectares inclusive of backwaters and canals, suitable for brackishwater shrimp farming. Being a maritime state, the fishery development plans in the state concentrated more in the marine sector. During the past two decades there has been a sharp decline in the shrimp catch from the marine sector, presumably due to overfishing. The shrimp catch is now showing signs of revival (Table 1). In the past two Five-year plans, considerable attention has been given to the development of brackishwater fish/shrimp culture in the state and this has made signficant contributions in this sector. The establishment of Brackishwater Fish Farmers Development Agencies (BFDAs) hatcheries and implementation of a Rs. 74 crore Kuwait Fund aided shrimp culture development programme through the Agency for Development of Aquaculture, Kerala (ADAK) are offshoots of such a strategy. India is one of the largest exporters of shrimp in the world. The growing international demand for value added seafood items such as IQF Shrimp, will boost growth in this area. During 1993-94 India exported 86,500 tonnes of shrimps valued at Rs. 1770 crores and Kerala's share in this was 31,600 tonnes valued at Rs. 405 crores.

Table 1. The position of Kerala in all India shrimp production (in tonnes)

Year	All India production	The share of Kerala	
	(in tonnes)	Actual (tonnes)	(%)
1984	2,03,186	31139	15.32
1985	2,32,489	35882	15.43
1986	2,12,118	29817	14.06
1987	1,92,177	25443	13.24
1988	2,24,744	67661	30.11
1989	2,22,990	53335	23.92
1990	2,44,353	45483	18.62
1991	3,00,474	60594	20.17
1992	2,80,139	51131	18.25

2. Potential

Kerala has a tremendous potential for scientific aquaculture in the areas of estuaries and the lower reaches of rivers within the tidal influx, mangrove swamps and marshes.

The details of brackishwaters in Kerala (including backwaters and canals) are shown in Table 2. In Kerala, at present nearly 13,145 hectares are under shrimp culture and the production during 1992-93 is estimated at 9750 tonnes. Extensive type of culture method is usually undertaken and recently semi-intensive culture is also being taken up in few places.

Table 2. District-wise and taluk-wise details of brackishwater area in Kerala (Including brackishwater and canals)

District	Taluk	Brackishwater area (ha)	
Thiruvananthapuram	Chirayinkeezhu	831.15	
	Thiruvananthapuram	493.55	
	Neyyattinkara	99.28	1423.98
Kollam	Karunagappally	2716.49	
	Kunnathur	484.75	
	Kollam	5402.38	8603.62
Alappuzha	Sherthala	7463.82	
	Ambalapuzha	4515.19	
	Kuttanadu	1192.26	
	Karthikappally	2051.65	15222.92
Kottayam	Vaikom	3635.20	
	Kottayam	691.54	
			4326.74
Ernakulam	Parur	2602.63	
	Kanayannur	6707.88	
	Kunnathunadu	25.92	
	Kochi	6876.68	16212.71
Thrissur	Chavakkadu	1325.83	
	Trissur	186.50	
	Kodungallur	1485.16	
	Mukundapuram	1274.45	
			4271.94
Malappuram	Tirur	1240.24	
	Ponnani	556.02	1796.26
Kozhikode	Vadakara	864.54	
	Quilandy	1802.25	
	Kozhikode	1495.65	4162.44
Kannur	Taliparambu	1902.54	
	Kannur	3304.21	
	Thalassery	737.35	5944.10
Kasargode	Kasargode	1159.41	
	Hosdurg	2088.84	3248.25
		Grand Total	65212.96

3. Brackishwater Shrimp farming in Kerala

3.1. Traditional-Shrimp farming

Table 3. District-wise details of traditional shrimp filtration fields and brackishwater fish/shrimp culture farms in Kerala

District	Traditional prawn filtration fields (ha)	Culture farms in public & private sector (ha)	Total (ha)
Thriuvananthapuram	Nil	2.22	2.22
Kollam	24.00	74.50	98.50
Alappuzha	475.35	9.24	484.59
Kottayam	15.38	48.61	63.99
Ernakulam	10597.01	131.46	10728.47
Thrissur	898.21	58.66	956.87
Malappuram	--	--	--
Kozhikode	--	--	--
Kannur	501.51	20.56	522.07
Kasargode	--	8.91	8.91
Total	12511.46	354.16	12865.62

Traditional farms are natural impoundments found adjoining estuaries. The low lying paddy fields adjoining the backwaters support a lucrative shrimp fishery based on the techniques of 'trapping and holding'. Tidal water carrying juveniles of shrimp and fishes are periodically let into impoundments during high tide and allowed to grow for short durations, feeding on the naturally available food in the water. This culture operation is an age old avocation practised seasonally in most fields and perennially in a few. Traditional shrimp culture is practised in about 12,511 hectares in Kerala (Table 3). This type of impounding of shrimp from the "Pokkali" paddy fields is locally known as 'Chemmeenkettu' and the type of capturing is called 'Chemmeen Vattu'. In these fields, shrimp culture and paddy cultivation are practised in rotation, shrimp from mid-Novermber to mid-April (the brackishwater period) and paddy, from June to September/October (the freshwater period). After the harvest of paddy the fields are prepared for shrimp culture by strengthening the bunds and fixing sluice gates. During the spring tide the sluice gates are kept open to let in shrimp seeds coming from the sea along with the heterogenous collections of other marine organisms including fish. During the neap tide a screen is placed at the sluice gate to prevent the escape of shrimp. The shrimp and fish fry thus trapped are allowed to grow before the harvesting is started. Harvesting of the shrimp starts by the middle of December and it is a continuous process during full moon and new moon in succession throughout the remaining culture period. The gear used for fishing is locally known as "Thoombuvala" or sluice net, which is attached to a rectangular wooden frame, and the material used for making the net is cotton thread. Mesh size of the net is decreased gradually towards the cod end of the net floating freely in favour of water current. While the net is in operation,

a hurricane lamp is hung at the inner mouth of the sluice gate to attract shrimps. A float is attached to the cod end which forms a bag, in which the shrimps are collected during filtration. When float appears to sink due to the weight of catch, the net is lifted and emptied to a dugout canoe. The size of the seasonal fields in which shrimp culture is practiced ranges from about one half to forty hectares.

3.2. Catch composition and yield from traditional method

Since selective stocking is not practised in the traditional Pokkali fields, the yield is a mixture of important as well as less important species of shrimp. The shrimp catch from traditional fields is chiefly of the small sized shrimp mainly, *Metapenaeus dobsoni*, followed by *Peanaeus indicus*. The percentage of shrimp of different species in the catch would be roughly as follows:

Penaeus indicus	36-43%
Penaeus monodon	0.7-1%
Metapenaeus dobsoni	53-57%
Metapenaeus monoceros	3.5-6%

Some of the important disadvantages of the traditional systems are:

i) Environmental factors are not controlled.

ii) It involves no selective stocking; desirable and undesirable species enter into the field which will inhibit the growth of shrimps to marketable size, reducing price.

iii) No manuring and no feeding.

iv) At no time can the quality and quantity of shrimp crop are predicted.

During culture, capital cost in respect of Pokkali fields are generally incurred by the owners of the field. Majority of these fields are owned by a group of people/societies or trust. For the purpose of shrimp filtration, these fields are leased out to contractors for a period of minimum five months. In Kerala the lease period starts in November and ends by 15th April. The average shrimp catches from Pokkali fields is reported to be 100-600 kg/ha.

3.3. Extensive system of culture

In this culture practice the earthern ponds are filled with tidal water and wild seeds are stocked. Fertilization, supplementary feeding and water exchange are not usually done.

The constraints in this system are:

i) The species stocked and quantity are not definite.

ii) The duration of crop normally will be about 5 months or below.

iii) Absence of any water management results in low yield of less than 500 kg/ha/year.

The Strategies for high productivity in the system would be as follows.

i) Stocking should be standardised at the rate of 40-50 thousand PL 20 and above per ha.

ii) The intake of species should be monitored and if required, seed may be procured from hatcheries.

iii) Cheaper feed should be provided to increase the productivity.

3.4. Semi-intensive culture

Along with the extensive system of shrimp farming in the State, the semi-intensive system has also been tried in a few hectares.

4. Brackishwater farms owned by the Department of Fisheries

Table 4. Details of Brackishwater Fish/Shrimp Culture Farms owned by the Department of Fisheries, Kerala

District	Taluk	Name of Farm	Area (ha)
Kollam	Karunagappally	Ayiramthengu Estuarine Fish Farm	38.89
Kottayam	Vaikom	Palaikari Fish Farm	48.00
Ernakulam	Kochi	Edakochi Fish Farm	10.93
Ernakulam	Kochi	Malippuram Fish Farm	21.14
Ernakulam	Kochi	Njarakkal Fish Farm	22.40
Trissur	Kodungallur	Poyya Brackishwater Fish Farm	49.09
Trissur	Chavakkad	Kadappuram Fish Farm	6.33
Kannur	Thalassery	Eranholi Estuarine Fish Farm	10.96
		Total	207.74

Source : Kerala Fisheries Brackishwater Resources Survey 1991 - At a glance.

There are eight brackishwater shrimp culture farms in the State having a total area of 207.74 ha. All these farms are tide fed and are suitable for either extensive or semi-intensive shrimp culture. The model brackishwater farm at Poyya having an area of 49.09 ha is one of the pilot projects of ADAK in the State. The Central Institute of Coastal Engineering for Fishery has designed the farm with technical assistance of UNDP consultants. The farm is designed for higher production of quality shrimp through semi-intensive culture. Out of the total 49.09 ha, 36 ha has been designed as 21 grow-out ponds of one hectare each and three bigger ponds of 5 ha each. As this is a pump-fed farm, necessary feeder and drainage canals are also provided.

Agency for Development of Aquaculture, Kerala has started semi-intensive shrimp farming in 20 ha and has harvested 43 tonnes during April-May 1994. The departmental farms are proposed to be developed as model farms or as joint venture farms, where shrimp farmers could be trained.

5. Departmental Agencies

5.1 Brackishwater Fish Farmers Development Agencies

Table 5. Achievements of BFDAs from inception to 1993-94

District & Name of BFDA	Date of registration	Farmers registered	Farmers trained	Area developed (ha)
Kollam	21.11.90	284	329	77.38
Alappuzha	2.12.92	101	35	6.23
Ernakulam	3.12.87	363	552	409.54
Thrissur	13.1.93	21	--	20.59
Kozhikode	10.3.93	26	16	12.70
Kannur	3.10.90	170	105	55.85

Six Brackishwater Fish Farmers Development Agencies (BFDA) were established in districts of Kollam, Alappuzha, Ernakulam, Thrissur, Kozhikode and Kannur. The first BFDA was started in the Ernakulam District during the 1987-88. The area of operation of BFDA was extended to the adjoining districts to promote shrimp farming in those areas where BFDA was absent. The BFDA gives subsidy to shrimp farmers upto a maximum of Rs. 30,000/- per ha. Through the six BFDAs, 1037 farmers have so far been trained in shrimp farming and 582 ha of farm have been developed (Table 5).

5.2. Agency for Development of Aquaculture, Kerala (ADAK)

Agency for Development of Aquaculture, Kerala was registered in the State for the development of brackishwater semi-intensive shrimp farming in 1,500 ha owned by public, private and co-operative sectors. Finance for the agency was granted by the Kuwait Government as loan from the Kuwait Fund for Economic Development.

The scheme will be implemented in a phased manner. In the first phase 1,500 ha of brackishwater area will be developed as shrimp farms. The project envisaged for the scheme includes construction of shrimp culture ponds, a pilot demonstration farm, hatcheries, an applied research laboratory for product quality control and development of appropriate technology, training and extension and technical assistance. ADAK has made an agreement with Aquatic Farms Ltd., USA for consultancy which includes project planning and evaluation, site selection, pond and hatchery design, operational guidance and training. The consultants recommended three models of shrimp culture depending upon the situations of the land. Based on these suggestions, ADAK completed engineering survey for 200 ha. The Government land at Poyya has been selected for the development of Pilot Training Farm. In addition to this, 36 hectares

of ponds in Palayad, Manayad and Pinarayi near Thalassery in Kannur Districts were identified for initial stocking of fry. ADAK selected two groups of farms, namely, Roshni Aqua Farms having an area of 29.3 ha in Kannur district and the Consolidated Aqua Farms having an area of 10.36 hectares in Trissur District for semi-intensive culture of shrimp. ADAK have inspected 15 sites in the southern and northern side of Kerala for the construction of shrimp hatcheries. Survey work is progressing in six sites. The achievement of ADAK is shown in Table 6.

Table 6. Summary of shrimp farms developed/being developed under the Project (ADAK)

Name of Farm, Village District	Gross area (ha)	Net pond area proposed to be cultured(ha)	No. of farmers	Type of culture done/ proposed	Remarks
Kurichipadam Elamkunnappuzha Ernakulam	24.84	3.3	80	Trial Culture Extensive	Trial culture undertaken in 1992. Further modification will be taken up.
Kuttachal Elamkunnappuzha Ernakulam	16.70	1.2	67	Trial culture Extensive	
Poyya Pallippuram Trichur	49.09	20	--	10 ha Semi-intensive	43 Tonnes
Dharmadam Dharmadam Kannur	36	20	--	Extensive	On going
Roshni Aqua Farm Kunji Mangalam Kannur	29.3	22.25	20	Semi-intensive	"
Consolidated Aqua Farm Pallippuram Trichur	10.36	9.00	7	Semi-intensive	"

6. New scheme envisaged for the year 1994-95

Reviewing the status of shrimp culture in Pokkali fields, Mammen (1984) pointed out that the average shrimp production from Pokkali fields has come down from 1069/kg/ha in 1965-70 to 735 kg/ha in 1977-78. It is estimated that about 4000 tonnes of shrimps are annually

Table 7. Name and address of shrimp/prawn hatcheries in Kerala

Sl. No.	Name & address	Production Capacity (million)	Species of seed produced	Source of water
1.	Regional Shrimp hatchery, Azhikode, Azhikode Jetty P.O. Thrissur.	5	Penaeid & fresh water prawn	Brackishwater
2.	Shrimp Hatchery, Mopla Bay, Kannur.	10	Penaeid	Sea Water
3.	Prawn Hatchery, Neendakara, Quilon.	5	Penaeid & Fresh water prawn	Brackishwater
4.	MPEDA Hatchery, Vallarpadam, Ernakulam.	(used for training)	Penaeid	Brackishwater
5.	CIBA Prawn Hatchery, Narakkal, Ernakulam.	-Do-	Penaeid	Brackishwater
6.	Golden Freshwater Prawn Hatchery, AISWARYA, Asoka Road, Kaloor, Cochin.	2	Fresh water prawn	Artifical sea water
7.	Royal Shrimp Hatchery, Perumanoor, Thevara, Cochin.	2	Fresh water prawn	Artifical sea water
8.	Aqua plaza Hatcheries Pvt. Ltd., Beach Road, Cherai (PO), Ernakulam District.	2	Fresh water prawn	Sea water
9.	Kuttanad Hatchery, VII/319A, Kottappuram Mill Road, Kundannur, Maradu P.O.	2	Fresh water prawn	Brackishwater

8. Feed production

At present, there is only one feed mill in the State, namely, Higashimaru Feeds (India) Limited, producing quality shrimp feed. Usually most shrimp farmers are using trash fish, clam meat, tapioca powder and rice bran for shrimp rearing. However, the progressive farmers import

feed from Taiwan, Singapore or Thailand.

9. Conclusion

Shrimp dominates the export front of marine products in Kerala. The declining trend and stagnation in catches from marine sector has raised awareness to include more shrimp farming schemes during the last two Plan periods. Raising shrimp through brackishwater farming has been recognised as a viable proposition to augment the production for export.

Status Report - MAHARASHTRA

Commissioner of Fisheries
Government of Maharashtra, Bombay-400 002.

1. Land resources

Maharashtra State, along the 720 km long coastline, is estimated to have about 80,000 ha of marshy land. However, in the macrolevel survey undertaken during the period of 1979-1982, an area of only 14,455 ha was found to be apparently suitable for shrimp farming. Of this 10,095 ha of Government level is available for leasing out to the entrepreneurs. The district-wise availability of the Government land in Thane, Raigad, Ratnagiri and Sindhudurg is 3490, 3655, 1682 and 1268 hectares respectively. A total area of 6618 ha of private lands in different districts found suitable for shrimp farming has also been identified.

2. Salient features of land lease policy for brackishwater aquaculture

In order to promote coastal shrimp farming, the State Government has framed the land lease policy and passed the resolution on 24-6-1985 for allotment of brackishwater land. As per Government Resolutions dated 24.6.85 and 29-8-1990, the allotment of land and lease amount being charged is as given below:

Sr. No.	Category	Land admissible (ha)	Lease amount (Rs.)
1.	Individual from fishermen community/weaker section	5	10
2.	Cooperative societies of fishermen	25 (100) *	10
3.	Small entrepreneure	5	20
4.	Big entrepreneurs	50 (100)*	50

* Revised

Lease rent - In May 1992, the lease amount was steeply raised as given below:

Period	Rate per ha.
1 to 5 years	Rs. 1000
6 to 10 years	Rs. 2000
11 to 15 years	Rs. 3000
16 to 20 years	Rs. 4000
21 to 25 years	Rs. 5000
26 to 30 years	Rs. 6000

In addition to this, Rs. 15,000 per ha in the form of premium is also being charged.

As per the present land lease policy, the small entrepreneurs has to invest 5%, and the big entrepreneur 20% from their own resources, of the total estimated expenditure of the project.

The land is being given on lease broadly on the following terms and conditions.

a) The lease period shall be 30 years.

b) Three months notice to terminate the lease shall be given by either side.

c) Big entrepreneurs will have to encourage local employment by training and absorbing local candidates especially those belonging to fisherman community and weaker section.

d) Big entrepreneurs will not be allowed to collect seed from natural sources as far as possible.

e) Government reserves the right to withdraw the land by giving three months notice if it is observed that -

   (i) No sincere and tangible efforts have been and/or are being made by the lessee to put the land to the contemplated use.

   (ii) The lessee fails to develop atleast one third of the area leased within a period of two years and the entire area within a period of five years from the date of taking over the possession of land on its allotment.

In addition to this following conditions are also imposed:

1. The lessee is not entitled to sublease or transfer the land without the prior permission of the Government.

2. The lessee is not entitled for any construction viz. sheds, chowkidar hut on the land without prior permission of the District Collector.

3. Progress made in allotment of land

So far 847 ha Government land has already been allotted to 38 small and big entrepreneurs, as shown in the statement below:

Name of District	Area of land allotted to different sectors (in ha)				Total
	Corporate Sector/Business houses	Co-operatives	Technocrat	Weaker section	
Thane	487.50	10	--	87.94	585.44
Raigad	231.00	--	--	16.00	247.00
Ratnagiri	--	--	5	--	5.00
Sindhudurg	--	--	10.40	--	10.40
Total	718.50	10	15.40	103.94	847.84

The entrepreneurs have started prawn farming in Government land and also in private land with the technical assistance of the field officers of Fisheries Department in the State.

4. Actual area under shrimp farming

Name of District	Area under shrimp farming (in ha)		Total
	Extensive	Semi-intensive	
Thane	132.42	45	177.42
Raigad	29.90	8	37.90
Ratnagiri	12.74	--	12.74
Sindhudurg	26.47	6.30	32.77
Total	201.53	59.30	260.83

5. Organisational structure for fisheries extension under the Department of Fisheries

There is no separate organisational structure for fisheries extension under the Department of Fisheries. At present the extension activities are carried out by the BFDAs in the district.

6. BFDA in the State

6.1. As per the directives of Government of India, Brackishwater Fish Farmers Development Agency (BFDA) has been established in the coastal district of Thane, Raigad, Ratnagiri and Sindhudurg by the end of financial year 1990-91.

6.2. The BFDA has been registered under the Societies Registration Act 1860 (21 of 1860). The main objectives for which the society is established are:

(a) To promote and develop the brackishwater farming in the district.

(b) To propagate amongst the public through various media like newspapers, radio, television, posters, meetings, seminars, visuals etc. for undertaking brackishwater shrimp and fish farming activities.

(c) To select the persons undertaking or desirous to undertake brackishwater fish and shrimp farming in the district and assist them in making available the appropriate land to the fish farmers for the same.

(d) To provide technical guidance and financial assistance to the fish farmers for operating such projects.

(e) To create a cadre of trained fish farmers by providing them training in modern technology of fish farming.

(f) To arrange the collection of fish seed and feed locally or procure from outside and also to arrange the marketing of fish and shrimp traders.

6.3. Infrastructure facilities are not provided for the BFDA but support facilities, such as vehicle, technical equipments and library facilities are available. It is proposed (1) to establish Demonstration Farm and shrimp hatchery unit in future and (2) to purchase aquaculture Audiovideo aids for effective transfer of advanced techniques during training programme and farmers meets.

7. Targets and achievements of BFDA

As per directives of Government of India, the BFDA has to develop 50 ha brackishwater land for shrimp farming in each district. The achievement made for the last two years is shown in the statements below:

Sr. No.	District	Area covered/developed (ha)		Beneficiaries (No.)	
		1992-93	1993-94	1992-93	1993-94
1.	Thane	16.20	14.00	5	4
2.	Raigad	6.50	3.81	1	9
3.	Ratnagiri	12.23	0.53	2	1
4.	Sindhudurg	48.32	7.37	1	2
	Total	83.25	25.71	9	16

So far 254.89 ha land is developed including 191.53 ha land under extensive culture and 59.36 ha under semi intensive culture in the State. An area of 113 ha has been developed with the financial and technical assistance of BFDA. Initially, the farmers have taken the extensive type of culture and then they are shifting to improved extensive and semi-intensive type of culture. About 26 farmers have been assisted with subsidy, amounting to Rs. 10 lakhs. Further, 122 farmers have been trained with the assistance of BFDA. Moreover, 371 farmers have taken the benefit of farmers' meet and seminars arranged by the BFDA.

8. Constraints

It is seen from the above that the achievement of the BFDA is not encouraging. This is due to lack of proper stocking of seed, proper feeding and proper management. The BFDA has been facing following difficulties for achieving the prescribed target of area development and shrimp production.

1. Non availability of quality seed and cheap shrimp feed locally.
2. Delay in allotment of Government land.
3. Restriction to mortgage the land allotted to the lessee with the financial institution.
4. Banks are reluctant to finance.
5. Subsidy amount is comparatively less for prawn farming.

Considering the delay in allotment of Government land, revised land lease policy has been proposed, particularly to cover the small farmers and weaker section, as suggested below:

1. Reduction in premium amount and lease amount.
2. Permission to mortgage the land with the bank for financial assistance.
3. Decentralisation of power of land allotment.
4. Simplification of existing land allotment procedure.

Shrimp farming is capital intensive avocation, which requires sizeable capital investment for construction of ponds and operation of the project. It is experienced that the farmer has to invest for development of one ha land about Rs. 2 lakh on capital cost (i.e. about 70%). Moreover, the development cost is 30% of the total project cost and it is beyond the reach of the small farmers and weaker section without enough financial assistance from the Government. The farmer has to invest more amount on seed, feed, fertilizer etc. in the first year by availing the credit facility from the Financial Institutions, but the profit of the first year is marginal. At present, the subsidy on capital cost and first crop is 25% limited to Rs. 30,000 per ha. There is no financial assistance on the cost of seed and feed.

9. Suggestions for improvement

For effective implementation of the BFDA Scheme following suggestions are proposed for consideration:

1. Establishment of Demonstration farm and hatchery in each district.
2. Increase of subsidy from Rs. 30,000 to Rs. 1,00,000 to individual from fishermen community and weaker section and also fish farmer's cooperatives.
3. Subsidy on seed and feed to the tune of 50% of the cost to the extent of Rs. 30,000 per ha per year for the second and third year.
4. Increase in subsidy amount for establishment of shrimp hatchery by the individual.
5. Uniformity in pollution control in aquaculture regulations.

In prevalant condition and considering the delay in allotment of Government land, it is proposed to develop the land owned by the private farmers also. As such, it is planned to develop 200 ha land under improved extensive type of shrimp farming initially.

The BFDA will arrange for the institutional finance and also arrange to provide the required quantity of quality seed and feed. At present the demand of seed and feed cannot be met locally due to want of productive shrimp hatchery and feed mill plant. Efforts will be made to meet the demand by getting shrimp seed and quality feed from outside the State. For imparting technical knowledge in the field, it is proposed to establish a Training Centre with the assistance of Government of India.

In Maharashtra, large number of private shrimp hatcheries and processing plants are

coming up. At present there is no serious problem of water pollution but, in future, due to fast development in brackishwater farming preventive measures need to be taken from the very beginning. Certain parameters are already laid down for maintaining the water quality in shrimp farming but there should be uniformity in pollution control regulation in aquaculture.

Status Report : ORISSA
WITH SPECIAL REFERENCE TO GANJAM DISTRICT

S.N. Misra

Brackishwater Fisheries Development Agency
Ganjam District, Berhampur, Orissa

1. Resources

The inventory survey report of Department of Fisheries, Orissa indicates, 38,111.49 ha of brackishwater fisheries resources, of which, 85% (32,394.30 ha) have been identified for aquaculture. Till end of 1993-94, 32.02% of the area (10,373.08 ha) was under brackishwater shrimp culture in the State. This includes extensive pond culture in 3126.94 ha (30.14%), semi-intensive culture in 113.59 ha (1.09%) and traditional "ghery" culture in 7,132.55 ha (68.76%).

Shrimp production of 4344.32 t during 1993-94 comes from extensive pond culture, 254.23 t from semi-intensive and 2211.29 t from traditional culture.

Traditional "ghery" culture yields only one crop with an average shrimp production of 313.07 kg/ha whereas extensive pond culture produces 559.57 kg/ha in the first crop and 452.95 kg/ha in second crop. Semi-intensive culture yields average production of 2858.60 kg/ha during the first crop and 1603.65 kg/ha in the second. The growth of shrimp farming is in a take-off stage with enarmous scope for development in the State.

2. Brackishwater Fisheries Development Agencies, Orissa

Origin

The first BFDA in India was established at Puri and Balasore coastal districts of Orissa during 1983-84 as State Plan Scheme with assistance from Government of India. Centrally sponsored Plan schemes were thereafter established during 1988-89 in Cuttack District and during 1989-90 in Ganjam District. Presently, all the seven maritime Districts have BFDA in the State.

Objectives

To utilise fallow, marshy, waste lands not suitable for agriculture in coastal Districts and to develop brackishwater fisheries on scientific methods to produce protein food, provide employment, earn foreign exchange, and for allround development to raise socio-economic conditions of poorest of the poor families.

Functions

The Agency is involved in survey, identification of feasible areas, making recommendation of Government lands for sanction of lease, formulation of suitable projects,

sponsoring to financial institutions, providing subsidies, imparting technical knowhow and helping farmers from farming to marketing of shrimps.

Seed production

The 480 km length of Orissa coast is bestowed with natural shrimp seed resources in the estuaries and 80% to 85% of shrimp seed demand is met from natural resources only. Ten main seed centres have been identified by the Department. The hatchery established at Gopalpur (OSSPARC, 80 million) by the Marine Products Export Development Authority supplies only 20-25% of seed requirements. State Government hatchery in Puri (25 million) and TATA's hatchery (200 million) have started functioning during 1994-95. Ten more new hatcheries are under construction in the state.

Credit

Commercial Banks, Rural Banks, and Agriculture Banks provide credit for shrimp farming. The Agency also formulates projects of shrimp culture with own finance of farmers or private source.

3. Land lease policy

State Government formulated land lease policy and earmarked 75% of Government lands to landless low-income group people on priority. As per recommendations of BFDAs, 1.00 ha/2.5ha area is sanctioned on 15 year lease at Rs. 335/year acre at the District level. The balance 25% of Government lands are earmarked for entrepreneurs up to 100.00 ha each at lease premium of Rs. 15,000/acre and 1% ground rent on the recommendation of District level Committee.

4. BFDA, Ganjam - Performance

The BFDA, Ganjam was established in 1989. Prior to that, the Agency at Puri was looking after the brackishwater aquaculture development in Ganjam District also.

Feasible brackishwater land resources identified by the Agency are as follows:

Name of Block	Govt. Land (ha)	Private Land (ha)	Total Land (ha)
1. Khalikote	184.11	53.23	237.34
2. Ganjam	745.04	232.18	977.22
3. Chatrapur	20.00	8.86	28.86
4. Rangailunda	114.57	20.62	135.19
5. Chikiti	1330.63	136.01	1466.64
Total	2394.35	450.90	2845.25

The targets and achievements in project development are as follows:

Item	Target (ha)	Project developed through Bank finance No./Area (ha)	Project developed through own source No./Area (ha)	Total No./Area (ha)	Total No. of beneficiries
1. Pre-agency period		130/43.07	420/239.70	550/282.77	460
2. Agency period					
Sept. 89 to Mar. 90	100	35/24.97	37/87.23	72/112.20	224
1990-91	310	58/30.05	87/287.35	145/317.40	271
1991-92	300	49/36.69	95/264.87	144/301.56	382
1992-93	143.5	65/31.06	26/129.84	91/160.90	164
1993-94	100	87/32.15	37/77.19	124/109.34	171
Total		424/197.99	702/1086.18	1126/1284.17	1672

Some of the areas in which the BFDA, Ganjam has brought in improvement in shrimp farming are:

Pond preparation, soil and water quality managment, quality seed collection from the wild, introduction of pumping of water in confined ponds around Chilka for the second crop, better flow of credit from financing institutions, extension literature, cluster development approach, introduction of pen-culture technology in the gheries, organisation of input supplies, and arrangement of training programmes.

Status Report : PONDICHERRY

V. Arunachalam
Director of Fisheries
Govt of Pondicherry, Pondicherry

1. Land Resources

1. Land resources found suitable for shrimp farming in the Union Territory of Pondicherry as per latest survey are given below:

Name of District	Govt. land (ha)	Private land (ha)
Pondicherry	125	--
Karaikal	154	591
Yanam	722	--
Total	1,001	591

2. Land lease policy for brackishwater aquaculture

A land leasing policy for brackishwater aquaculture is in vogue in the Union Territory, wherein 50% of available brackishwater areas involving low capital investment are to be given on lease to fishermen, small and marginal farmers for taking up extensive or semi-intensive farming. The remaining 50% of brackishwater areas are to be leased out to progressive entrepreneurs for taking up semi-intensive or intensive farming. A Standing Committee has been constituted by Government of Pondicherry for the allotment of lands on the above lines. However, as on 31 August 1994, no allotment of land has been made.

3. Area under shrimp farming

Name of District	Area under shrimp farming (ha)		
	Traditional	Extensive	Total
Pondicherry	2.74	--	2.74
Karaikal	--	11.0	11.00
Total	2.74	11.0	13.74

4. Suggestions

The Government of Pondicherry has not established any Brackishwater Fish Farmers

Development Agency in the Union Territory. Action is being taken to undertake activities of brackishwater aquaculture by the existing Fish Farmers Development Agency. Latest farming technologies should be disseminated by the Research Institute to the programme implementing agencies at the earliest. For recording feedback information, a standard proforma may be developed. Guidelines on scientific prawn farming may be issued to all maritime states. These should include aspects of environmental pollution. At present, the Department of Fisheries forwards all applications for licence for shrimp farms to the Department of Science, Technology and Environment, which, in turn, prefers to transmit the same to the Government of India for clearance. This acts as a constraint in promoting brackishwater aquaculture.

Extension literature may be produced for different systems of shrimp farming. The Research Institutes may give prompt advice on remedial measures to overcome stress situations and disease problems in the shrimp farms. The farmer generally feel happy when resource persons attend to their needs in person.

Status Report - TAMILNADU

G. Bhujanga Rao
Commissioner of Fisheries (In charge)
Govt. of Tamil Nadu
Madras.

1. Potential land resources found suitable for shrimp farming (as per reports of the District Collectors)

S. No.	Name of the district	Government land (in ha)
1.	Chengai-MGR	1108.40.5
2.	South Arcot	187.17.0
3.	Thanjavur	48.33.0
4.	Nagai Quaid-e-Milleth	2186.44.5
5.	Ramnad	242.08.0
6.	V.O. Chidambaranar	243.00.0
	Total	4015.43.0

2. Salient features of land lease policy for brackishwater aquaculture

The Government of Tamil Nadu have issued orders in G.O.Ms. No. 121, Animal Husbandry and Fisheries Department, dated 2.4.92 and the guidelines given in Annexure-I are to be followed while allotting Government lands in brackishwater areas for prawn farming to private entrepreneurs.

The Government has also constituted a High Level Committee under the Chairmanship of the Minister for Fisheries with Agriculture Production Commissioner, Secretary to Government, Animal Husbandry and Fisheries Department, Secretary to Government, Revenue Department, Secretary to Government, Environment and Forest Department as Members and Commissioner of Fisheries as Member-Secretary. Leasing of Government lands for aquaculture *per se* has proved to be a very difficult exercise for the following reasons:-

i) Some public lands falling under prohibited categories cannot be assigned, or leased to anybody, unless a specific relaxation from the prohibition order is issued by the Government themselves. River course porombokes, burial ground porombokes, pathways to burial grounds and grazing ground porombokes fall in these categories.

ii) Other public lands which do not fall in the prohibited categories are badly needed for people at large i.e. local village communities for a variety of uses including putting up new huts as population increases.

iii) Leasing of Government land to private parties has evoked very hostile reaction among local people.

iv) As per Government policy, 60% of the Government land is to be reserved for small scale sector aquaculture industry including priority category. Therein lies a paradoxical situation i.e. those entitled for leasing of land will not be able to raise bank loan to carry out capital works and for working capital even for scientific extensive culture.

For these complex socio-economic reasons, progress in leasing of Government lands has been slow. Most of the shrimp farms, therefore, are on private lands or on encroached (not leased) Government lands or on a combination of the two.

3. Actual area under shrimp farming

S. No.	Name of the district	Area under shrimp farming (in ha)		
		Extensive	Semi-intensive	Total
1.	Chengai-MGR	44.31	10.00	54.31
2.	South Arcot	76.26	10.00	86.26
3.	Nagai Quaid-e-Milleth	422.45	124.36	546.81
4.	Thanjavur	46.79	--	46.79
5.	Pudukottai	21.90	6.00	27.90
6.	Ramnad	35.33	--	35.33
7.	Nellai Kattabomman	2.20	--	2.20
8.	Kanyakumari	7.10	--	7.10
9.	V.O. Chidambaranar	42.51	135.00	177.51
	Total	698.85	285.36	984.21

4. Organisational structure for fisheries extension

Assistant Director of Fisheries (Information and Extension) at Madras is in-charge of Extension and Propaganda for 6 districts. Tuticorin, Nagai Quaid-e-Milleth and Coimbatore

Districts have separate Assistant Directors of Fisheries for the purpose of Extension. Deputy Director of Fisheries (Extension) at Head Quarters is the overall supervisory official for the above said 4 units. Deputy Director of Fisheries (Regional), Nagai Quaid-e-Milleth, Deputy Director of Fisheries (Regional), Coimbatore and Joint Director of Fisheries (Regional), Tuticorin will be supervising the activities of Asst. Director of Fisheries (Extension) of the concerned Districts.

Each extension unit is controlled by one Assistant Director of Fisheries with one Inspector of Fisheries, 1-2 Film Operators and 2-3 Sub-Assistant Inspector of Fisheries for assistance. Extension wing is incharge of:

- conducting exhibition relating to fisheries
- conducting film shows
- arranging participation of Departmental staff in T.V./AIR.
- conducting mass contact programme, seminars and meeting in villages to create awareness about benefits of fisheries activities.
- preparing and distributing pamphlets and brochures on new schemes and Departmental activities.

5. Brackishwater Fish Farmers Development Agencies (BFDAs)

S. No.	Name of District	Date established	Address
1.	South Arcot	1.1.91	Fishing Harbour Complex, Cuddalore O.T., South Arcot District.
2.	Thanjavur, Nagai Quaid-e-Milleth, Pudukottai	1.1.91	114, Nadimuthu Nagar, Pattukottai, Thanjavur District.
3.	V.O. Chidambaranar, Nellai Kattabomman, Kanyakumari	6.2.91	Fishing Harbour Complex, Tuticorin, V.O.Chidambaranar District.
4.	Chengai - MGR	28.8.92	Vanianchavadi, Padur (Post) -603 103 Chengai - MGR District.
5.	Ramnad	14.9.93	Manthoppu, Sivagnanapuram, Ramnad, Ramnad District.

6. Organisational structure of BFDAs

6.1. Administration of BFDA

All the BFDAs have been registered under Tamil Nadu Societies Registration Act 1975. The agencies are individually governed by the Managerial Committee with the District Collector as Chairman and the following as members:

i)	District Collector	Chairman
ii)	Chief Executive Officer	Member - Secretary
iii)	District Revenue Officer/ Additional Collector	Member
iv)	Joint Registrar of Cooperative Societies	Member
v)	Joint Director of Fisheries (Regional)/ Deputy Director of Fisheries (Regional)	Member
vi)	Asst. Director of Fisheries (Regional)	Member
vii)	Executive Engineer (Fishing Harbour Circle)	Member
viii)	Personal Assistant to District Collector	Member
ix)	Manager of Lead Banks	Member
x)	One BFDA farmer	Member

The Management Committee will hold at least two meetings in an year. As the supreme body, it approves the expenditure and audits accounts of the agency, besides taking policy decisions on day-today administration.

6.2. Staff pattern

No separate staff is sanctioned for this centrally sponsored scheme. Staff sanctioned for the on-going brackishwater model prawn farms are used for the BFDA scheme also on internal diversion.

7. Objectives set for BFDAs

The main objective of BFDA is to make use of the available brackishwater areas along the coastline of the State for brackishwater aquaculture, in order to augment the foreign exchange reserve, to generate rural employment avenues, and for better utilisation of fallow and salt affected lands which have no other use.

Each BFDA is responsible for identification of brackishwater areas, identification of beneficiary farmers, preparation of bankable projects on behalf of beneficiaries, training the farmers in technology, arrangement for government subsidy, providing market information and marketing of the produce.

8. Subsidy assistance provided through BFDAs

8.1. Present

i) Subsidy assistance provided to the farmers is to the tune of Rs. 30,000/ha for developing 50 ha per annum (Rs. 15,00,000) and a consolidated amount of Rs. 26,000/- to meet the contingencies.

ii) Subsidy of Rs. 1 lakh to a hatchery of 2-5 million capacity.

iii) Rs. 25/day per trainee plus Rs. 140/trainee as lumpsum payment for field trips as stipend for training of prawn farmers (2 months duration) (all the three to be equally shared between Government of India and State Government).

8.2 Proposed

Subsidy needs to be increased to meet 25% of capital cost as it varies for extensive and semi-intensive farming. Identical subsidy for both extensive and semi-intensive will not serve the purpose as actual fund needs are very different. Also, subsidy needs to be revised every year in relation to inflation.

For extensive farming, the fund requirement, per ha is Rs. 1.50 lakhs for capital expenditure and Rs 1.00 lakh as working capital, totalling to Rs 2.50 lakhs/ha. The subsidy of Rs 30,000 covers only 12% of the requirement. In the case of semi-intensive farming, the capital cost is Rs 6.00 lakhs and working capital requirement is Rs 5.20 lakhs, totalling to Rs 11.20 lakhs/ha. The subsidy covers only 2.7% of the fund requirement.

The capital cost of a hatchery of 2-5 million seed/annum capacity is Rs 10.00 lakhs and working capital requirement is Rs 2.00 lakhs. The subsidy of Rs 1.00 lakh covers only 8.3% of fund needs.

9. Physical performance of BFDAs upto June, 94.

	Pattukottai	Tuticorin	Cuddalore	VOC	Ramnad	Total
Target (ha)	200.00	200.00	200.00	150.00	100.00	850.00
Achieved (ha)	82.65	9.78	63.58	9.40	28.00	193.41

10. Training

Other than the Departmental training at Staff Training Institute on brackishwater farming, no other/special training is being given for BFDA officials alone.

Central Insitute of Brackishwater Aquaculture can train the department officials dealing with brackishwater aquaculture who in turn can train the farmers on the recent developments in brackishwater aquaculture.

Farmers registered under each BFDA as members are to be trained by MPEDA depending on the facilities available with them.

A separate demonstration-cum-training centre has been set up at Karangadu for training of BFDA farmers by Tamilnadu Fisheries Development Corporation and Government of India has released Rs.5 lakhs towards Central assistance during 93-94. Trinees will be given practical training for 2 months duration.

11. Technology sources for BFDAs

CIBA is the immediate source available for consultation. CICEF is also being contacted for rendering assistance while taking up survey activities in coastal/brackishwater zones of the State.

At department level, Deputy Director (Mariculture) is the controlling officer and incharge of all BFDAs, reviewing the activities, rendering necessary assistance on subjects relating to farming, hatchery and feed mills.

12. BFDA interaction with research system

Research institutes may take up field related research activities and assist BFDAs in achieving better production in harmony with environment. More of interaction between BFDAs and Central Institutions will be of help. Utilisation of the results of research in the field in a significant way and taking up field oriented research in collaboration with local agencies, people and entrepreneurs is the need of the hour.

13. Constraints of BFDAs and suggestions for improvement

13.1. Flow of credit

Prime reason for BFDAs tardy progress is the inordinate delay in sanction of loans by banks. As per MPEDA's hand book on shrimp farming (1994) a prawn farmer must invest Rs 2.2 lakhs for 1 ha even for doing extensive farming (capital cost Rs 1.5 lakhs + working capital Rs 1 lakh less subsidy of Rs. 30,000). Value of the land may not be more than a fraction of this amount. Under the said circumstances, farmers are compelled to provide additional security to cover the loan risk.

Insistence of 1:2 collateral security by banks is far too heavy for marginal and small farmers to bear. Recently the Chairman, NABARD has agreed to relax the norms of offering security provided that there should be tie-up arrangements between large houses and small farmers for seed, feed and marketing. When 14 large houses were contacted to ascertain their willingness to enter into a tie-up arrangement with small satellite farmers around by way of providing them with inputs, undertake marketing of shrimp and be responsible for repayment of loans from sale proceeds, response from them was not encouraging. Three of them had agreed to only supply of inputs. Two more firms had agreed in principle to marketing and loan repayment in addition to input supply.

13.2. Inadequate subsidy assistance

The norms need to be revised as already stated.

13.3. Staff

Separate staff need to be provided for looking after the BFDA activities, instead of redeployment or internal diversion. Training of staff by CIBA will help in adopting better technology.

13.4. Reluctance of coastal patta land owners to dispose of their lands

Since most of the development in shrimp farming has taken place in patta lands in coastal areas, the land price has gone up steeply. Small farmers are affected by this sharp hike in land prices. On account of the awareness created in shrimp farming and rush witnessed in acquiring suitable lands, patta land owners are reluctant to dispose of lands, bidding time for escalation in land costs.

13.5. Satellite shrimp farming

It is not possible for the Government to provide inputs required by small farmers, to market their produce and to provide technical guidance. The principle of satellite farming is already in vogue in the sugarcane industry. Satellite shrimp farming principle has not taken deep roots in aquaculture. Adoption of this principle shrimp farming will mutually benefit the small and large farmers.

13.6. Registration of farmers

Registration of farmers under BFDA/MPEDA should be made compulsory. This will help in transfer of technology and feed back information from farms.

14. Coastal zone management plan

With a view to make aquaculture industry (AC-I) as an eco-friendly activity, it has been recommended to Government by Commissioner of Fisheries to incorporate the following points "under Control of Pollution generated by AC-I".

i) Approval of Ministry of Environment and Forests (Government of India) may be obtained at an early date for the Coastal Zone Management Plan (CZMP) prepared by Government of Tamil Nadu.

Thereafter Government of Tamil Nadu may issue clear and detailed guidelines, within the framework of the approved plan, classifying CRZ areas in categories I (ecologically sensitive and important), II (areas already developed upto or close to the shore line) and III (areas not falling in I and II).

ii) A single window (it could be District Collector) may give all clearances through the District Level Committee to intending AC-Industrialists to help set up AC-Is in approved areas.

iii) Central Pollution Control Board may be requested (through Ministry of Environment and Forests) to evolve treated effluent standards.

iv) Enforcement may be done by Tamil Nadu Pollution Control Board.

v) Industry sponsored adaptive research may be undertaken for developing a package of practices for secondary aquaculture. State Government may bear 50% of the cost.

15. Policy guidelines

Government of Tamil Nadu, in their G.O.Ms. No. 205, Animal Husbandry and Fisheries Department dated 23.8.94, have decided to constitute an Expert Committee to suggest the norms taken for prevention of salination of ground water and agricultural lands under the Chairmanship of Commissioner of Fisheries, Tamilnadu and members from various Central and State Organisations including Fisheries College.

Based on the recommendations of the Expert Committee, the Government will announce its aquaculture policy. It is expected that this policy will harmonize interests of AC-Is on one hand and of local people on the other.

ANNEXURE

Guidelines of Govt. of Tamil Nadu for allotment of lands in Brackishwater area for Prawn Culture

(Vide Animal Husbandry and Fisheries (FS. IV) Department G.O.Ms. No. 121 dated 02.04.1992)

1. a). Application for allotment of Government lands in Brackishwater areas for Prawn/Fish farming in Tamil Nadu should be in a prescribed form and should be called for based on the following guidelines fixing a last date for receipt. The proforma for the application should be prescribed in such a manner as to bring all the relevant particulars for taking the decision.

   b). Application will be called for periodically through advertisement in the leading dailies depending on the availability of lands for allotment.

2. 20% of the total brackishwater lands available will be allotted to large scale entrepreneurs and another 20% will be allotted to medium scale entrepreneurs. Small scale entrepreneurs will be allotted lands from out of the remaining 60%. The question of reserving lands exclusively for fishermen and other priority categories will be decided after watching the situation for sometime. However, this does not preclude the allotment of lands to fishermen and other priority sectors based on the applications received.

i) **The priority/target sectors will be as follows:**

   a. Marine:

      1. Fisherwomen widows, 2. Fisherwomen, 3. Active Fishermen

   b. Inland:

      1. Fisherwomen widows, 2. Fisherwomen, 3. Active Fishermen

   c. Schedule Caste/Schedule Tribe

   d. Ex-Servicemen

   e. Landless Agricultural labourer living below poverty line as eligible under District Rural Development Agency

   f. Fishermen/Fisherwomen Cooperative Societies

   g. Small and marginal farmers.

ii) **Small Scale entrepreneurs**

A person or a firm with capital investment upto Rs. 45.00 lakhs with technically and financially sound schemes who will be able to establish their capacity to take up brackishwater farming will be considered as small scale entrepreneurs.

iii) **Medium entrepreneurs**

A registered company with a capital investment about Rs. 45.00 lakhs and upto Rs.

5.00 crores will be considered as Medium entrepreneurs. Eligibility for allotment of land will be on the basis of evidence of sound technical and financial viability for establishment brackishwater farms.

iv) **Large Scale entrepreneurs**

Big industrial establishments or institutions having a capital investment of above Rs. 5.00 crores with good bankable projects with expertise and use of international technology for setting up sucessful brackishwater units will be considered as large entrepreneurs.

Lands are to be allotted on lease basis for Prawn Culture on the following basis:

a)	Priority sector	1 hectare per benefiicary
b)	Small and Marginal Farmers/ Small Scale entrepreneurs and / Fishermen/Fisherwomen Cooperative Societies	Upto 5 hectare each
c)	Medium Scale entrepreneurs	Upto 50 hectare each
d)	Large Scale entrepreneurs	Upto 200 hectare each

and in exceptional cases of proven ability more than 200 hectare can also be allotted. If two or more applicants apply for the same piece of land, preference will be given to applicants from the priority sector. If the applicants belong to the same category, the allotment will be decided by committee on merits. Lands to the extent possible should be allotted to the fishermen and other priority sectors in one area and for the other categories in a different area.

4. **The annual lease amount will be fixed as follows:**

Rs. 100/- per hectare for priority sector beneficiaries

Rs. 500/- per hectare for small scale entrepreneurs

Rs. 750/- per hectare for medium & large scale entrepreneurs.

The above lease rates will be revised periodically by the Government as per the prevailing conditions.

5. The lease period will be 10 years. At the end of 10 years, Government will resume the land and give in auction for prawn culture purposes for specified periods. On resumption of land after 10 years, compensation will be paid for structures as depreciated value as on that date.

6. A High Level Committee under the Chairmanship of the Minister for Fisheries constituted will finalise the allotment of lands for prawn culture for all categories of applicants.

7. **Terms and Conditions of lease**

i) Lands allotted will have to be utilised within one year from the date of allotment. If no substantial work is done in the first year itself, and if the land is not brought into production before the end of the second year from the date of allotment, they will be resumed by the Government without any further notice and without any compensation and will be allotted to other applicants.

ii) The lessee shall furnish data in respect of production etc. from the lease lands to officials of the Fisheries / Revenue Departments whenever so demanded.

iii) The lessee shall afford all facilities to officials of the Department of Fisheries/ Revenue to inspect the farm and other activities on the lease lands.

iv) The lessee shall not sublet or in any other manner transfer the land to others. However, the lessee will be permitted to mortgage the land for purposes of Bank Loans.

v) The lessee shall use the land for brackishwater Prawn/Fish farming only.

vi) The lessee shall bear all expenditure in the matter of execution of lease deed.

vii) The lessee shall pay the annual lease amount without fail on the due date in the local Treasury under the head of account - "Department of Fisheries". Any failure in the payment of lease amount on the due date is liable to lead to termination of lease.

viii) In case of violation of terms and conditions of lease by the lessee, the lease is liable to be terminated without any compensation with three months notice by the Government.

ix) If the lessee desires to terminate the lease, the same can be done by giving three months notice to the Government through the Commissioner of Fisheries.

x) The Government reserve the right for termination of lease agreement, in case the lands are required for any other public purposes by payment of suitable compensation by assessing the loss involved to the entrepreneurs.

8. Only local people should be employed by the entrepreneurs both in the prawn farms established in the Government lands allotted to them and in the processing units established to process the prawn harvested from such farms.

9. An agreement incorporating necessary conditions in order to protect interest on the Government should be obtained from the applicants.

Status Report : ANDAMAN & NICOBAR ISLANDS

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Brackishwater aquaculture had been on the low key in Andaman and Nicobar Islands. These Islands have a long coastline with 37916 ha of marshy low lying area and mangrove swamps. The major constraint coming up in the way of shrimp culture is the acid sulphate content in the soil. The Department of Ocean Development in collaboration with MPEDA had been successful in culturing shrimp and achieved about 2 tons production/ha in their farm at Dollygunj near Port Blair.

The Andaman & Nicobar Administration had identified about 1000 ha, which are suitable for shrimp culture. Out of this, 800 ha belong to the private sector. About 154 ha belonging to Government have been notified for leasing out to various entrepreneurs, for which, applications were invited and the process for allotment is at the final stage.

At present, seed and feed are procured and transported from mainland. Since there is no hatchery and feed mill in these Islands, which are the basic requirements for the development of shrimp culture, the cost of production of shrimp (head on) works out to be more than Rs. 150/- per kg as evidenced in the demonstration farm of MPEDA-DOD, whereas the cost of shrimp in these Islands is very low. The head-less form of shrimp from natural resources costs Rs. 70/- per kg at Port Blair. The cost of shrimp at Middle and North Andamans is around Rs. 30/- per kg.

Transportation and marketing are other constraints coming in the way of shrimp farming. In order to overcome these problems, introduction of reefer containers in inter-island and mainland-going vessels have been suggested in the current financial year plan schemes of this department and are being procured.

Since, seed transported from mainland is involving high risks and mortality, there is need for the establishment of a shrimp hatchery in these Islands to produce seed and to meet the local requirements.

III. Technology Issues

TECHNOLOGY FOR SUSTAINABLE SHRIMP FARMING

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1. Introduction

India has great potential for developing brackishwater shrimp farming, for which, the plans are under way to convert waste lands near coastal areas into shrimp farms, by leasing out these lands to interested farmers and private entrepreneurs. Already, the State Governments of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu have partially distributed these lands and shrimp culture is progressing in a rapid manner. The preference for shrimp culture by farmers and entrepreneurs is due to its high profit and greater demand in the export market. About 1.4 million ha of brackishwater areas have been identified suitable for shrimp farming, of which, 83,000 ha are under shrimp farming with an annual production of 59,000 t. While the traditional farming is practised in 50,000 ha, scientific farming is adopted in 33,000 ha, mainly in the states of Andhra Pradesh and Tamil Nadu.

2. Systems of scientific shrimp farming

Based on management practices, systems are classified into extensive, improved extensive, semi-intensive and intensive. A comparative account of the different systems is presented in Table 1.

Among the different systems, intensive culture system is not advised, since it leads to rapid deterioration of the pond bottom and results in severe problems. Selection of suitable system for the culture depends on the site, the capital investment and the level of technological package available.

3. Techniques of shrimp culture

3.1. Optimal conditions for shrimp farming

Soil is the most important part of a culture system and its quality should be ascertained for pH, permeability, bearing capacity and heavy metal content. Generally clayey loam soils are preferred for brackishwater culture systems. High capital and operational cost would be involved for maintaining a farm constructed in sandy area. The soil characteristics that are more suitable for a prawn farm is given in Table 2.

Table 1. Comparison of different systems of shrimp farming

	Systems of culture			
	Extensive	Improved Extensive	Semi-intensive	Intensive
Capital investment	Low	Moderate	High	Very high
Pond management	Low	Moderate	High	Very high
Pond size (ha)	>2	1 - 2	0.5 - 1	0.2 - 0.5
Pond depth (m)	0.5 - 1.0	0.8 - 1.5	1.0 - 1.5	1.5
Stocking density (no/m^2)	1.5 - 2.5	5 - 10	10 - 30	50 - 70
Feed	Natural	Natural + Formulated	Formulated	Formulated
Feeding frequency per day		1 - 2 times	3 - 5 times	4 - 6 times
Water exchange per day	Only filling	0-10%	10-30%	Flow-through
Production (kg/ha/crop)	500-1000	1000-2000	2000-3000	6000-12000
FCR	--	1:2	1:1.5	1:1.5

Table 2. Optimal soil characteristics for shrimp farm

Parameters	Range
Soil pH	7.0 - 8.0
Organic carbon (%)	1.5 - 2.5
Calcium carbonate (%)	> 5.0
Available nitrogen (mg/100 g soil)	50 - 75
Available phosphorus (mg/100g soil)	4 - 6
Electrical conductivity (mmhos/cm at 25°c)	> 4

For successful operation, sufficient quality brackishwater should be available. The optimal levels of some of the parameters of water and the safe levels of some of the toxicants/pollutants are listed in Table 3.

3.2. Technologies

The eradication of pests and predators from the culture pond can be easily achieved in drainable ponds. Simple drying of the pond bottom would eliminate all the unwanted organisams. However, in ponds where complete draining is not possible, application of chemical agents are resorted to. Mahua oil cake and tea seed cake are used @ 100 - 150 ppm and 10 - 15 ppm respectively for this purpose. Since tea seed cake does not harm the shrimps, it is used regularly

during the course of the culture.

In used ponds the metabolites of the previous culture should be removed to prevent further accumulation and its harmful effect. This is achieved by the following methods

a) Removal of the bottom slurry after the harvest.
b) Drying of the pond bottom till cracks.
c) Removal of the 10-15 cm of the top black layer when present.
d) Tilling or ploughing the pond bottom.
e) Applicatiom of lime to accelerate decomposition of wastes and final flushing.

Table 3. Optimal and safe levels of water quality parameters

Water Quality Parameters	Level
Optimal :	
1. Temperature (°C)	28 - 33
2. Turbidity (cm)	25 -45
3. pH	7.5 - 8.5
4. Dissolved oxygen (ppm)	5 - 7
5. Salinity (ppt)	15 - 35
6. Total Alkalinity (ppm)	200
7. Dissolved inorganic phosphorous (ppm)	0.1 - 0.2
Safe levels :	
8. Nitrate - N (ppm)	< 0.03
9. Nitrite - N (ppm)	< 0.01
10. Ammonia - N (ppm)	< 0.01
11. Cadmium (ppm)	< 0.01
12. Chromium (ppm)	< 0.1
13. Copper (ppm)	< 0.025
14. Lead (ppm)	< 0.1
15. Mercury (ppm)	< 0.001
16. Zinc (ppm)	< 0.1

The pH of the culture medium is influenced by the soil pH and if the soil pH is less than 6.5, then it has to be corrected by the addition of lime as per the levels prescribed in Table 4

Table 4. Dosage of lime to be applied in relation to soil pH.

Soil pH	Quick lime (tonnes / ha)
4.0	8.7
4.5	7.2
5.0	5.8
5.5	4.3
6.0	2.9
6.5	1.4

The natural food in the form of algae and plankton forms a good basal food for the shrimp postlarvae and juveniles. To sustain the development of natural food, the productivity of the pond should be increased with the addition of manures and fertilizers. The dosage of organic manure required is estimated based on the level of organic carbon in the soil and presented in Table 5.

Table 5. Dosage of manures in relation to organic carbon content of soil

Organic Carbon in soil (%)	Prescribed basal dose	
	Raw cow dung (kg/ha)	Dry chicken manure (kg/ha)
1	500	175
0.5	1000	350
0.25	2000	700

Similarly, the dosage of urea and super phosphate is calculated, depending on the level of available nitrogen and available phosphorus in soil respectively and summarised in Table 6 and Table 7.

Table 6. Application of urea in relation to available nitrogen

Available nitrogen in soil (mg/100g soil)	Prescribed dose of Urea (kg/ha)
12.5	100
25.0	50
50.0	25

Table 7. Application of super phosphate in relation to available phosphorous

Available phosphorus in soil (mg/100g soil)	Prescribed dose of Super phosphate (kg/ha)
1.5	100
3.0	50
6.0	25

After fertilization, the pond is filled with water gradually over a period of 1-2 weeks, during which time, the water turns green and is ready for stocking.

Quality prawn seed of uniform size obtained either from wild or from hatcheries can be stocked after suitable acclimatization to the pond water conditions. This can be done gradually over a period of 1-2 hours. First, the water temperature is adjusted by floating the transportation bags in the pond and then the salinity is gradually brought to the pond level by mixing the pond water with the transport medium. Finally, seeds can be released uniformly on all sides of the pond.

The quality of the hatchery-reared seed is tested by exposing them to sudden change in salinity as well as dipping them in formalin (100 ppm) for 30-60 minutes.

With increased stocking densities and exchanging large quantities of water, high energy feeds containing more protein and lipids are used. In semi-intensive system of farming, pellet feed containing 38-40% protein, 8-10% lipid and 18-20% carbohydrates is necessary. minerals, vitamins and other additives are also supplemented in these feeds. The ingredients should be of good quality fish meal, squid meal, soybean meal, oil cake, rice bran, wheat flour or tapioca. Three grades of feeds are produced. These are 'starter', 'grower' and 'finisher'. The starter is used for the first 45 days after stocking, grower during the next forty five days and the finisher till the end of the culture.

In intensive culture system a balanced feed containing 45-50% protein, 8-10% fat and 15-20% carbohydrates is used. The feed also contains vitamins, minerals, feed attractants, flavours, growth promoters and digestive acids.

Feed is broadcast uniformly after assessing the daily feed requirement. For estimating biomass, cast net samples taken at random in the pond would indicate the average weight of prawns. Further, the total biomass is estimated from the average weight and estimated survival rate. The calculated feeding rate is given in Table 8. The feed to be provided is distributed 2-5 times in a day.

Table 8. Rate of feeding

Weight of prawn (in g)	Feeding rate (%)
0.1 - 1.0	8.0 - 12.0
1.0 - 5.0	5.5 - 6.5
10.0 - 15.0	5.0 - 5.5
15.0 - 20.0	4.5 - 5.0
20.0 - 25.0	4.0 - 4.5
25.0 - 30.0	3.5 - 4.0
30.0 - 35.0	2.7 - 3.0

Though various feeding methods and schedules are prescribed, the best method is to use test trays and adjust the feeding rates and schedules according to the consumption of the feed by prawns.

In the tide-fed ponds, water is exchanged 2-3 days to 7 days at spring tides, in a fortnight, depending on the elevation of the pond and the tidal amplitude. During the low tide, water is let out. In extensive system of farming, exchange of water is not required during the first months after stocking. Thereafter, water exchange is done @ 5-8% or more, depending on the condition of pond water. In semi-intensive farming, water exchange is done initially @ 5-10% of the total volume of pond water, depending on the algal bloom and later increased to 30%. In intensive system of farming, water exchange is done @ 30-50% per day, depending on the stocking density and quality of water.

For extensive system of farming, where lesser stocking densitites and lesser addition of supplementary feeds are practised pond aeration is not required. The daily water exchange is

sufficient to maintain pond hygiene.

For improved extensive, semi-intensive and intensive systems of farming, where the pond depth varies from 1.0-1.5 m, pond aeration and water circulation are necessary, particularly during night and early morning hours for maintaining adequate oxygen levels and proper mixing of pond water to help breaking up thermal and chemical stratification and removal of bottom wastes.

Various aeration equipments are used in grow-out ponds. Most commonly used are paddle wheel aerators, air-O_2, surface agitators, blowers and diffusers. Of these, paddle wheel aerators are widely used. In improved extensive system of farming, 4 units/ha and for semi-intensive farming 6-8 units/ha are recommended. In intensive farming, more than 8 aerators/ha are required.

Temperature, pH, salinity, dissolved oxygen and transparency (Secchi disc reading) are to be monitored daily. In semi-intensive ponds, where protein rich feeds are given, the parametres like ammonia and H_2S are also to be monitored daily at 7 A.M. and 2 P.M. Redox potential of pond soils is to be monitored at weekly intervals.

Periodical monitoring of the prawns is necessary to check their growth rate and to look for any visible signs of infection. The estimation of biomass is required for adjusting the feeding rate. Prawns which are inactive or sluggish are indicative of some stress. Diseases like soft-shell syndrome, black gill disease and lesions should be looked for in random sampling. Surfacing of prawns in the early morning hours is an indication of oxygen depletion.

Harvesting is generally done after 3-5 months of culture when the prawns reach harvestable size (*P. indicus* - 20 g; *P. monodon* - 30 g) by draining the pond water through bag net placed at the outlet sluice and handpicking. In ponds where the draining is not possible, the stock is harvested either by cast netting or by using net or bamboo traps.

3.3. Problems of diseases in shrimp farming

Disease is a result of interaction of health of host, virulent pathogen and environmental quality. In grow-out phase, diseases of prawns are caused by virus, bacteria and protozoans, often due to nutritional deficiencies and environmental stress. Major diseases that affect prawn production in semi-intensive and intensive shrimp farms are black gill disease, systemic vibriosis, Monodon-type baculovirus (MBV), Baculovirus penaei (BP), Type C baculovirus (TCBV), yellow head baculovirus (YBV), Infectious hypodermal haematopoetic necrosis (IHHN), baculovirus midgut gland necrosis (BMN), REO virus and microsporidiosis.

The microorganisms causing disease constitute a part of the natural microflora in the pond ecosystem. The microorganisms cause disease in prawns under stress, resulting from environmental pollution. The stress factors are stocking shrimp beyond carrying capacity of an ecosystem and associated with high feeding rates. It is reported that about 20% of the feed is converted into shrimp biomass and the remaining 80% accumulates in the pond bottom. Under these conditions, the pond bottom becomes an excellent broth culture medium favouring proliferation of a variety of heterotrophic bacteria including pathogens such as *Vibrio*,

Pseudomonas, Aeromonas, Flavobacterium etc., resulting in increase in the biological oxygen demand of the pond water. The heterotrophic bacteria also act on unutilized feed and accumulated organic matter in the ponds and convert them into toxic metabolites such as ammonia, nitrite and hydrogen sulphide. Further, the use of increased quantities of feed also causes turbidity of the pond water resulting in subsequent collapse of phytoplankton and its settlement at the pond bottom. Anaerobic activity between the water and soil further increases, resulting in highly reducing condition of the soil, a sign of pollution. Thus, the products of microbial activity such as ammonia, nitrite and hydrogen sulphide, associated with low oxygen levels of water and highly reducing conditions of the soil beyond tolerance levels are toxic and create stress to the prawns and make them susceptible to microbial infection.

Many drugs are used to control diseases in shrimp ponds, although their efficacies are yet to be proved. Use of drugs leads to development of drug resistant bacteria. The drug may accumulate in the muscle of shrimp and may adversely affect the consumer. Drugs may release toxic products, which may adversely affect the ecosystem. Use of drugs to prevent disease is not practicable i.e., to treat only the affected prawns.

Because of these problems, so far effective measures are not known for controlling diseases in shrimp ponds. Only preventive measures have been followed. These are: a) maintenance of good environment, b) optimum feeding regimes and c) quarantine measures.

IMPACT OF SHRIMP FARMING ON THE ENVIRONMENT - A CASE STUDY

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INTRODUCTION

Environmental impact of shrimp farming has become a major issue in many countries with developing shrimp culture industries (Phillips *et al.* 1993; Alagarswami, 1993, 1994).

In India there has been a rapid expansion of shrimp aquaculture activity during the last 5-6 years. However, this activity has been concentrated only in certain specific areas, particularly in the East Coast bordering Andhra Pradesh and Tamil Nadu. The concentration of activities in certain specific localities may put severe strain on the resources available in the area as well as on the environment.

The experience gained in a number of Asian countries, particularly, Taiwan, the Philippines, Indonesia, China and Thailand, has shown that high density shrimp culture in these countries has caused environmental degradation, threatening the long-term sustainability of shrimp culture itself. The main impacts are destruction of coastal mangroves, loss of land resources and deterioration of water quality (Phillips *et al.* 1993). Loading of ponds and the surrounding environment with shrimp pond effluents has also been linked to outbreak of diseases and poor pond productivity.

The present study was taken up to assess the physical, chemical and biological characteristics of shrimp farm effluents from different culture practices/systems, as environmental impact of farm effluents needs characterisation and quantification of various components of the effluents discharged into the environment.

MATERIAL AND METHODS

The number of shrimp farms studied were one extensive farm along the Kandaleru creek at Krishnapatnam, Nellore District, Andhra Pradesh; three semi-intensive farms along the Kandaleru creek at Pudiparthi and one intensive farm at Tuticorin in Tamil Nadu. Samples were collected from each farm (monthly intervals) during culture period (April to July 1993) and at the time of harvest (August 1993). Samples were also collected from Kandaleru creek and farms during 1994. Water and soil samples were analysed by following standard methods (APHA, 1980; Strickland and Parsons, 1972; Piper, 1966; Jackson, 1967). Bacterial populations in the samples were determined by serial dilution and spread-plate method. The bacterial flora were identified based on their biochemical reactions (Oliver 1982; Baumann and Schubert, 1984).

REMEDIAL MEASURES FOR CONTAINING DISEASE OUTBREAKS IN SHRIMP FARMS OF ANDHRA PRADESH AND TAMIL NADU

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Shrimp farming is a fast expanding enterprise in the coastal areas of India, resulting in increased shrimp production. The rapid growth of shrimp farming through semi-intensive culture in recent years, has also resulted in the outbreak of diseases in the culture systems, especially in areas where there are several shrimp farms together or when the farms have been in operation for longer period of time.

The mass mortality of cultured shrimps in Andhra Pradesh and Tamil Nadu coastal ponds has stopped many farmers from continuing their culture operations. The affected farms were previously yielding a good crop with a low stocking density. Many farmers became over confident, and hoped to increase the production through higher stocking density without any technical inputs such proper pond design, pond preparation, or improved water management. Stocking took place without proper pond preparation such as stocking the fry immediately after harvesting without the recommended procedures of draining and drying or removal of the sediments. The high stocking density, poor pond design i.e without proper intake and outfall structures, non-provision of aerators, inadequate water exchange, etc. have resulted in oxygen depletion, causing greater stress in the cultured shrimp and ultimately resulted in mass mortalities.

India is not the first country to experience such a disaster; the disease outbreaks have already occurred in the Phillipines, Thailand and Indonesia. The Govt. of India should take appropriate steps to overcome this crisis and to educate the farmers through their organisations such as MPEDA, ICAR and related fisheries departments.

These organisations at Central or State level should establish a system to overcome such a crisis as follows:

1) Establishment of shrimp farmers development agency at district level in Andhra Pradesh and Tamil Nadu. All the farmers in the respective districts should register as members.
2) Fisheries officials should visit all the farms to assess and advise on stocking density for each farm, based on the pond design, water source and availability of aerators, required pumping capacity and technical manpower.
3) All farmers should adhere to the stocking density recommended by the Agency strictly and violating farms should be severely fined.
4) Wherever a single canal extending several kilometers from the sea is used for both pond supply and discharge, fisheries dept. should have a monitoring station at the canal mouth to monitor water quality.
5) All the farms and the monitoring station of Fisheries Dept. should have a flag pole in front

of the farm. The pole should have two flags, one red and the other green. When the water quality in the canal is bad, the monitoring station should raise the red flag. When the farmers see the red flag, nobody should pump the water into their farms. On the other hand, if the water quality is good, the green flag should be raised and all the farmers can go ahead with pumping.

6) When the farmers want to drain effluents from the pond, they should raise the red flag to inform the neighbouring farms not to do the pumping.

INFORMATION AND TECHNOLOGY NEEDS OF SHRIMP FARMERS AND INDUSTRY

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Proper information and appropriate technology is the need of the day for shrimp farmers in particular and aquaculturists in general. The present situation in India is that the shrimp farmers and aquaculturists are confused without the knowledge of appropriate technologies. With an estimated area of 1.5 million ha suitable for shrimp farming and with a limited area developed for aquaculture operations, India has tremendous potential for further development, if proper information and appropriate technology are made available to the shrimp farmers.

With the introduction of the above, production levels can be enhanced from the present meagre 0.8 m tons per hectare to an average production of 4 m tons. The concept of sustainable aquaculture should also be taken into consideration with emphasis on environment friendly attitude among aquaculturists. The conflict between divergent interest groups can also be averted by adopting proper information systems and appropriate technologies in shrimp culture practices. The dissemination of technical information to the concerned personnel and organisations will also help minimise conflicts and this will automatically bring in an atmosphere congenial for aquaculture development in the country.

Achievement of economic viability, environmental stability and social equity in aquaculture is possible only through the development of new technologies and improvement of the existing methodologies and techniques. Indigenisation of imported technology for adoption to Indian conditions needs primary attention to avoid economic losses at a later stage.

It is imperative that right information and successful technology is disseminated to the farmers at all levels. Today the technology available to Indian farmers is mainly through MPEDA and their regional centres and also through the 34 BFDAs that are functioning in the maritime states. The quality and the credibility of the technologies extended to the prawn farmers through these agencies are also highly variable, as there is no proper database on the technologies available for aquaculture practices. The technologies presently available are dependent on the personnel imparting them. Further, these are also not specific or proven for adoption in various site/farm conditions.

Though India is known to have a long background and experience in aquaculture, many of the enterprising industrialists are looking for import of technology . This may be due to the lack of confidence in the existing technologies or due to the non-availability of required information. The various research institutes engaged in aquaculture research are also yet to

contribute to this challenging field. Many of the research findings and technologies are not properly propagated or effectively demonstrated. Very often, these findings are made known through outsiders.

The information system available today to the prawn farmers is highly limited to the magazines published by individuals interested in aquaculture and also various write-ups that appear in the dailies enlightening or/and exaggerating the problems in aquaculture. Further, the voluminous information which is available with various research institutions and governmental agencies is very often not accessible to the small prawn farmers due to various reasons like administrative constraints for approach. The farmers rely on other governmental agencies like MPEDA and BFDA for providing routine and general information and in the case of advanced technologies and techniques they always depend on industries and aquaculture consultants. The mushrooming of consulting agencies is another proof for the above blockage of information and technology to the masses. In recent times, there has been an emergence of aquaculturists and consultants and the information and technology available through them is highly questionable.

In addition to the above facts regarding the status of information and technology presently available to the farmers, the areas which need attention are:

1. The information available with various agencies should be made available to the farmers without any blockage or inhibition.
2. The organisations and agencies which have proven information on prawn culture should come forward to publish them in national magazines and dailies so that the information is available to the farmers at any time.
3. The research institutions and governmental agencies should make available their findings to the farmers in their language through the MPEDA and other aquaculture promoting agencies.
4. Modern information systems like Compact Disk, Satellite networking etc., should be developed and utilised to disseminate modern information to the farmers.
5. Get-togethers like farmers meet etc. to be frequently organised for the dissemination of information using modern audio-visual techniques.

The technology needs of the day, covering various areas and dimensions in aquaculture operations can be classified as follows:

1. Husbandry and husbandry practices
2. Feed and feed management
3. Disease control and management
4. Environment friendly aquaculture technology and practices
5. Development of probiotics and use of microbial techniques for aquaculture farming
6. Broodstock development and management
7. Hatchery technology for consistent production

With the improvement in the above information systems in the country and adoption of indigenously perfected farming and hatchery techniques, aquaculture could be developed in the proper direction. The only need of the day is that environment conscious and self-regulatory aquaculture projects should be taken up with a view to develop them on a consistent basis.

VI. Human Resource Development

EDUCATION AND TRAINING FOR STRENGTHENING THE TRANSFER OF TECHNOLOGY SYSTEMS FOR SUSTAINABLE SHRIMP FARMING

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1. Introduction

India was the largest shrimp producing country till recently when it was overtaken by Taiwan, Thailand, Indonesia and China, owing to the boom in shrimp farming in those countries. Easy availability of seed through large hatcheires and highly nutritive and balanced formulated feeds coupled with suitable sites for construction of large farms and the policies of the respective governments helped to bring about a sudden transformation in less than a decade. During the same period, the developments in India, though fast, were comparatively slow as is evident from the total shrimp production of about 63,300 t during 1993-94 when it occupied the fourth position in the world. While about 1.2 million hectares of brackishwater area is available for shrimp farming, the present produce comes from about 82,500 ha currently under culture, giving low average production of about 768 kg/ha/yr, as considerable expanses are still under traditional culture with low yield rates.

For sustainable shrimp farming, besides adequate R&D support, a strong extension link is essential for transfer of technology. This needs subject matter specialists in every aspect of shrimp farming technology. However, the shooking inadequacy of educated, trained and skilled manpower is the bane of effective transfer of technology programmes in this sector.

2. Present status of human resource development and extension programmes

2.1. Agricultural Universities and Research Institutes

About ten State Agricultural Universities (SAUs) have established Fisheries Faculty with College of Fisheries of which at least two are awarding Master's and Doctoral degrees. Seven of these Colleges are functioning in maritime States. Paucity of funds and the lack of infrastructural facilities especially proper farms have been the basic constraints in conducting meaningful research for technology generation. To this may also be added another important component which is very vital for research - the inadequacy of faculty and its quality. The SAUs which are mandated for research, training and extension could not make significant contribution so far to sustainable shrimp farming.

Similarly, the Central Institute of Fisheries Education (CIFE), Bombay, so far a training institute for in-service personnel, but conducting post-graduate programmes since 1989 with a

Deemed University Status, has also not been involved in technology development. It has, however, been conducting short-term training programmes on brackishwater fish and prawn culture and method/result demonstrations at its Fish Farm at Kakinada.

Besides the SAUs, the research in aquaculture is also conducted at ICAR institutes. Of the eight research institutes, under its Fisheries Division, the Central Institute of Brackishwater Aquaculture (CIBA), established at Madras in 1987, alone has the mandate to conduct research for technology development for fin and shell-fish culture in brackishwater. Prior to its establishment, the Central Marine Fisheries Research Institute (CMFRI), Cochin, was involved in developing seed production technologies for both fin and shell-fish. The Estuarine Division of the Central Inland Fisheries Research Institute (CIFRI), Barrackpore, established a Brackishwater Fish Farm at Kakdwip (West Bengal) and also operated an All India Coordinated Research Project on Brackishwater Fish Culture in collaboration with the State Fisheries Departments of maritime states, where mono- and poly-culture technologies for mullets, milk fish, pearlspot and penaeid prawns were developed. Though the beginings made at CMFRI and CIFRI formed the basis for technology development at CIBA, which has further advanced them despite inadequate field and farm facilities, these were not found adequate by the industry which plunged headlong in semi-intensive and intensive shrimp farming and imported the various technologies as well as seed and feed too.

Some of the SAUs and the ICAR Fisheries Research Institutes are however regularly conducting short-term training programmes on shrimp aquaculture through Krishi Vigyan Kendras (KVK) operating under their control and meeting the requirements of small farmers and entrepreneurs.

2.2. Government of India Programmes

At least two different Ministries in the Government of India are supporting shrimp farming programmes in the country.

2.2.1. Ministry of Agriculture (MOA)

The Department of Agriculture and Cooperation (DOAC) under the MOA is responsible for national planning and policies through its Fisheries Division. It has established an institute called the Central Institute of Coastal Engineering for Fishery (CICEF) for survey of suitable sites and designing, construction and other engineering aspects of shrimp farms. It is presently operating a World Bank funded project on shrimp and fish culture in three States on the east coast *viz.* West Bengal, Orissa and Andhra Pradesh and has an important built-in component of training the State extension officers. Besides, it has just launched one more scheme on 'Fisheries Training and Extension' to strengthen the extension system.

2.2.2. Ministry of Commerce (MOC)

This Ministry looks after the trade of marine products through an autonomous establishment called the Marine Products Export Development Authority which is supporting prawn farming by way of subsidy, training and technical assistance through its six regional and

four sub-regional centres.

2.2.3. State Government Department/Agency

As the establishment of Fish Farmers' Development Agency (FFDA) in each district gave a major fillip to carp polyculture, so also the establishment of Brackishwater Fish Farmers' Development Agency (BFDA) in each potential coastal district is likely to give a renewed thrust to technology adoption and expansion of area under cultivation with increased yield rates. Presently, 38 BFDAs have been sanctioned, of which, 16 are operational and the rest under various stages of establishment. This Agency, initiated as a Central sector scheme by the MOA, provides a package of technical, financial and extension support to the farmers and has by now trained 4000 shrimp farmers and developed about 15,000 ha of brackishwater area.

2.2.4. Non-Governmental Organisations (NGOs) / Corporations/and the Private sector

A couple of NGOs, State Councils and others are also organising training programmes and technology demonstrations with funding support from the Department of Biotechnology, Government of India, under a mission-mode programme. This besides, MAC Industries and Waterbase, two large industrial houses, are offering training courses but at sufficiently high cost. Training in seed production is also imparted at the two MPEDA shrimp hatcheries at Berhampore and Visakhapatnam. The fee being high, only a few can afford to go there.

3. Requirements of an effective technology transfer programme

Despite the existence of quite a few agencies working in the field of shrimp farming, the traditional practices are still in vogue covering more than twice the newly-developed area under semi-intensive and intensive systems. It is unfortunately not being realised that shrimp farming requires a group of highly technical, competent, sincere and trained/skilled/experienced workers in different disciplines at various levels from research scientists down to field/farm/hatchery workers. Besides biologists trained in husbandry, expertise in nutrition, disease, engineering, environment and socio-economics is also needed for sustainable shrimp farming, which is sadly lacking in the country to meet its massive requirements. The manpower base is not only weak at all levels but also equally inadequate.

Besides manpower, urgent attention is also required to be paid to organisation of input supplies mainly seed and feed besides fertilisers, chemicals, aeration and filtration equipment, and the like. While big industrial houses are able to arrange these supplies, the small and medium farmers have to remain contented with meagre inputs resulting in low survival and poor yields.

Another important component that is required in the transfer of technology programmes is farm literature which helps in accelerating the process of development and ensures maximum benefits to those who need to be uplifted socio-economically the most. The literature could be in any form from a newspaper, magazine, leaflet/pamphlet to a bulletin.

4. Strategy to be adopted for strengthening the TOT programme

In order to provide focussed attention to shrimp farming with a view to regaining the No.1 position as shrimp producer and exporter, generating additional employment and income, utilising the available resources currently being wasted, earning foreign exchange and providing healthy protein food, it is imperative to have a mission-mode approach. This should also encompass post-harvest handling and marketing.

4.1. Strengthening the research base

Since the research base for technology development is weak, an expert pool may be developed and the scientists stationed at three or four centres along the coasts and provided with the best of farm facilities with a time targetted programme of two and five years for maximissing production with emphasis on sustainability and environmental/ecological stability. Similarly, a group of biologists, nutritionists, pathologists and engineers should be working at designing new hatcheries, reducing the duration of larval life, controlling diseases, maximising growth, increasing survival rates and thereby post-larval production in numbers. All these scientists should be selected based on their merits and expertise in a particular discipline. Higher emoluments and awards on performance should be the main draw.

A group of young and experienced scientists at middle level may also be sent abroad, at least, three in each specialised field to take over from these senior scientists and form the second line of defence. They in turn will also be a guiding force for the new entrants. It is necessary that a sincere liaison is maintained between the research institutes/Central and State Governments/industrial units and small farmers. This would be the core group of subject matter specialists.

4.2. Developing extension specialists

Extension itself is a specialised subject and it is necessary that a few young fishery graduates who have an aptitude for becoming good extension specialists are first given an intensive training within the country to understand the effective agriculture extension system in certain areas and then sent abroad to study the system at least in three different countries. On return, they should be based in one single place for training other young workers.

It is necessary to prepare and distribute literature in different languages for different categories of farmers with different levels of understanding. Video films are a very effective method of transferring the technology but we have hardly any on modern techniques of shrimp seed production or farm practices. In fact, a series of small strips detailing the technology are needed to be really worthwile.

4.3. Training the skilled workers

A large contingent at each hatchery/farm is that of skilled workers. These should be drawn from those who have opted for vocational cources at the Higher Secondary level and are capable of doing hard work with attendant intelligence. They should also be given an intensive

3-month training in operational skills at established training centres at large farms/hatcheries. The best is to establish a pilot hatchery/farm in each state for training on an industrial level.

The above are some of the suggestions for strengtheing the TOT programmes in shrimp farming leading to its sustained growth and development.

WORKSHOP RECOMMENDATIONS

Preamble

The National Workshop on "Transfer of Technology for Sustainable Shrimp Farming" was organised by the Central Institute of Brackishwater Aquaculture (CIBA - ICAR), in collaboration with the Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Government of India, the Marine Products Export Development Authority (MPEDA) and the M.S. Swaminathan Research Foundation (MSSRF), Madras. The Workshop was held during 9-10 January 1995 in the Sambasivan Auditorium of M.S. Swaminathan Research Foundation, Madras.

The National Workshop was attended by 100 delegates from the Central and State Fisheries Organizations, ICAR, Institutes of ICAR, MPEDA, MSSRF, NABARD, NCDC, NFI, shrimp culture industry, farmers and experts. The workshop was inaugurated by Dr. M.S. Swaminathan, with Shri K.B. Pillai, Chairman, MPEDA in the Chair. Dr. K. Alagarswami, Director, CIBA welcomed the gathering and explained the background and objectives of the workshop. Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR delivered the Keynote Address. Dr. T.V.R. Pillay, former Programme Director, Aquaculture Development and Coordination Programme, FAO gave the special address on "Sustainability of Shrimp Farming - an Overview". Shri G. Bhujanga Rao, Secretary to Government of Tamil Nadu, Animal Husbandry and Fisheries Department released the Publications of CIBA on (1) Shrimp Diseases, their Prevention and Control, (2) Technology for Atremia Cyst and Biomass Production, (3) Microparticulate Feed for Postlarvae of Shrimp *Penaeus indicus,* and (4) Development of Broodstock and Maturation of Tiger Prawn *Penaeus monodon* in captivity, and also delivered a Special Address.

The Workshop was organised in six Technical Sessions, namely

I. Public policies, planning and programmes for sustainable shrimp farming

II. Review of present status of Transfer of Technology for sustainable shrimp farming - Reports from States/Union Territories

III. Technologies for sustainable shrimp farming rooted in the principles of ecology, economics and equity

IV. Strengthening of Transfer of Technology system

V. Role of industry in development of sustainable shrimp farming and transfer of technology

VI. Human Resource Development for sustainable shrimp farming.

A number of papers were presented and discussed at these Technical Sessions.

A Working Group consisting of Dr. T.V.R. Pillay, Dr. P.V. Dehadrai, Dr. S.N. Dwivedi,

Dr. Y.S. Yadava, Dr. P.U. Verghese, Shri J.P. Dange, Dr. S.D. Tripathi, Dr. M.Y. Kamal, Dr. George John, Dr. (Ms) Vineeta Hoon, Shri V. Natarajan, Shri S. Durairaj and Dr. K. Alagarswami considered and prepared draft Recommendations of the Workshop based on the important points that emerged during the deliberations of the workshop, and the Draft Recommendations were presented by Dr. K. Alagarswami at the Plenary Session, under the Chairmanship of Dr. P.V. Dehadrai and discussed. The Recommendations were unanimously approved by the Workshop. The Recommendations of the National Workshop are given below:

Recommendations

1. Database on brackishwater aquaculture

1.1 The Workshop considered the data available on brackishwater aquaculture and expressed that a more accurate database is necessary for purposes of planning and development of sustainable shrimp farming.

1.2 The workshop recommended that the States and Union Territories should arrange for the collection of real-time database on the extent of shrimp farms using remote sensing and ground data, seed and feed production, and their supplies and utilization, through an appropriate mechanism and methodology. The Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Government of India should arrange to evaluate the existing methodologies and provide an uniform procedure for acquisition, storage and retrieval of data and extend necessary support for the same.

1.3 The Workshop further recommended that the data for the country as a whole should be maintained at the Central Institute of Brackishwater Aquaculture (CIBA - ICAR), which has the mandate to serve as the national level repository for database on brackishwater aquaculture. Data centre facilities at CIBA should be strengthened for the purpose. It was also recommended that modern communication and networking facilities available in the country should be utilised for speedy flow of information. CIBA and the National Informatics Centre should enter into a collaborative arrangement for this purpose.

For Action: Fisheries Departments of States/Union Territories; DAC of Union Ministry of Agriculture; CIBA (ICAR); NICNET

2. Environmental impact assessment

2.1 The Workshop took cognizance of the perceived impact of shrimp farming with regard to the cardinal principles of sustainable development relating to social, equity, technical environmental and conservation aspects, as also of the preliminary data already collected and evaluated by CIBA (ICAR) and other agencies, and desired that more in-depth studies on the perceived impacts are required to be carried out.

2.2 The Workshop recommended that in-depth impact studies may be planned and carried out on a nation-wide basis covering different production and ecological systems of shrimp farming. CIBA could serve as the coordinating and nodal agency for such an Impact Analysis Network, with support from DAC, Marine Products Export

Development Authority (MPEDA) and State Fisheries Departments as well as the industry and farmers. Funding support for such a Network may be provided by the National Bank for Agriculture and Rural Development (NABARD); Department of Science and Technology (DST), Department of Biotechnology (DBT), Department of Environment and Forests (DEF) and Department of Ocean Development (DOD) of Government of India, and MPEDA. The required expertise for impact assessment in real terms may be created at an early date with the help and support of international organizations such as FAO and the Regional body, Network of Aquaculture Centres in Asia-Pacific (NACA). The objective of the study should be to address the growing concerns on the ecological and social sustainability of coastal aquaculture and to use the information in refining the regulatory measures in the best interests of aquaculture, and of social and environmental security requirements.

For Action: CIBA (ICAR); DAC; MPEDA; NABARD; DST; DBT; DEF; DOD

3. Integrated Coastal Area Development

3.1 The Workshop noted the efforts the country has already taken to identify and delineate coastal aquaculture zones with the help of remote sensing and ground truth data, and prepartation of master plans for these zones. The Workshop also took note of the fact that the Union Ministry of Agriculture has entrusted the work of collection of remote sensing data on the entire coastal zone of the country to the Indian Space Research Organization (ISRO) and State-wise satellite imageries of the coastal zone have already been made available to the State/Union Territory Governments. The Workshop also noted that remote sensed coastal zone maps are also available with the State Governments, institutes under ICAR such as the Central Marine Fisheries Research Institute (CMFRI), National Institute of Oceanography and Department of Ocean Development, Government of India and suggested that these should also be sourced for and utilised by the State/Union Territory Governments. Further, GIS data available with the Ministry of Agriculture may be passed on to States/Union Territories.

3.2 The Workshop reiterated the need for preparation of integrated coastal area development plans and recommended that the States/Union Territories may examine the satellite imagery maps and GIS data, identify aquaculture zones after due cross-sectoral considerations, carry out microlevel survey of the identified zones and prepare master plans for each zone. The plans could transcend State limits and may be considered eco-zone-wise, as deemed necessary. Technical support that might be coming through bilateral arrangements of Government of India for this work may also be availed of. Since Zonation and Master Plans are to be prepared for all the coastal States/Union Territories, Ministry of Agriculture may take further initiative to have the exercise completed at the earliest.

3.3 Observing that while the above exercise will be for the preparation of prospective plan, the Workshop recommended that the existing shrimp farms may be examined in the light of above zonation and master plans and wherever restructuring and restorative

work is found necessary for mitigating social and environmental impact, the same may be caused to be carried out.

3.4 The Workshop further recommended that, based on the above inputs, the States/Union Territories should prepare Integrated Coastal Area Development Plans, incorporating Aquaculture Zones.

For Action: State/Union Territory Governments; DAC: CMFRI (ICAR); NIO; DOD; ISRO

4. Integration of Gender and Equity considerations

4.1 The Workshop noted that present role of women in coastal aquaculture is very minimal and emphasized the need for sensitising policy makers, private industry etc. on gender issues and the potentiality for employment of women fisheries graduates in aquaculture projects. Women's Development Corporations could be involved in taking the benefits of aquaculture to women.

4.2 The Workshop recommended that women should be given equal opportunities through appropriate programmes for improvement of skills and establishment of Women Aquaculture Estates. The land lease policy of the Government is to lease out 50-60 per cent of Government land to the landless, small farmers, fishermen and weaker sections of the society. This policy should be backed up by an integrated programme paying concurrent attention to technology, training, techno-infrastructure and trade. The socially and economically disadvantaged sections of coastal communities should be empowered to derive economic and nutritional benefits from coastal aquaculture through the organisation of Aquaculture Estates, backed up with appropriate funding and insurance mechanisms.

For Action : Union Ministry of Agriculture; State/UT Governments; MSSRF

5. Research re-orientation

5.1 The Workshop took note of the research programmes being undertaken at the national institutes under ICAR and the state-level Colleges of Fisheries under the SAU system, and other laboratories. It also noted that the Departments like DBT, DST, DOD, MPEDA and NABARD are lending support to aquaculture R&D programmes in the country.

5.2 The Workshop further noted that shrimp culture industry and farmers tend to use technology packages passed down to them without further innovation and adaptation to meet the situational requirements. Sustainability of shrimp farming is often questioned on technical appropriateness as suited to Indian conditions.

5.3 In the context of the thrust to sustainable development of shrimp farming, the Workshop recommended that the research programmes need to be re-oriented to address specifically the technology needs and innovations of operational procedures for sustainable shrimp farming. The scope should cover all aspects of inputs and output to

support ecologically and socially sound economic models of coastal aquaculture and the continuous upgradation of this system with reference to long-term sustainability.

For Action: CIBA (ICAR); College of Fisheries, SAUs; Deparments of Fisheries, States/Union Territories.

6. Integrated coastal aquaculture system

6.1 The Workshop noted that the present thrust of production is on a single species of tiger shrimp, with marginal interest on white shrimp. There has been no commercial interest in integrating other potential species of shrimp, fish and aquatic organisms in coastal aquaculture.

6.2 The Workshop emphasized the need for diversification of species and development of integrated farming systems and recommended that CIBA, in association with industry, should consider experimentation on such systems, including waste treatment through sedimentation and biological processes and aeration (including use of ozone) in cases of high level waste outputs.

For Action: CIBA (ICAR); SAUs

7. District-level Aquaculture Service and Monitoring Centres

7.1 The Workshop observed that shrimp culture is practiced almost all along the coastline adopting different types of production such as traditional, extensive, modified extensive, semi-intensive and intensive systems. New farms are coming up very fast. The entire development is taking place in the private sector in a disorderly manner without proper information and service back up. The BFDAs which are District-level agencies themselves do not have the required backstop.

7.2 The Workshop strongly recommended that District-level Service and Monitoring Centres with infrastructure, manpower and facilities should be established to provide basic services of correct information, technology sourcing, soil and water quality analysis, basic disease investigations and also as a referral mechanism for the farmers and industry to get the services of national and state laboratories. This needs creation of an organizational structure to be linked with Brackishwater Fish Farmers Development Agencies (BFDAs). While the initial setting up of these Centres would need financial and logistic support, they could be turned into self-financing agencies as all the services could be charged for.

For Action: Union Ministry of Agriculture; Fisheries Departments, States/Union Territories; BFDAs

8. Strengthening of BFDAs

8.1 The Workshop noted that BFDA is a very important instrument for the promotion and

transfer of technology of brackishwater aquaculture at the district/regional level. However, the scope, organization, structure, manpower and skills of BFDA are not at a level to match the requirements and play an effective role.

8.2 The Workshop recommended that the BFDAs may be strengthened in all the above areas, including qualified technical and extension staff, by the States with the required support from the Ministry of Agriculture. The BFDAs will not be able to improve performance of technology transfer, monitoring and feedback without adequate support. The BFDAs should work in close cooperation with the proposed District Aquaculture Service and Monitoring Centres. Staffing of BFDAs should be done with care for motivation and length of service. All technical staff of BFDAs should be given an orientation course and training at the national institutes like CIBA. CIBA should have a strong extension and training wing for this purpose.

For Action: Fisheries Departments, States/Union Territories; BFDAs; Ministry of Agriculture; CIBA (ICAR)

9. Industry-research institute co-operation

9.1 The Workshop was pleased to find the interest evinced by the industry to have collaborative programmes with research institutions and to make available facilities required for research, which would help development of indigenous technologies and innovations required for various types and systems of shrimp farming, leading to sustainable development of the activity for long-term benefits of the industry and the country.

9.2 The Workshop recommended that industry-research institute interaction for on-farm research should be fostered for the overall benefit of the country.

9.3 The Workshop also recommended that the industry should come forward to sponsor specific research programmes which they consider important and the research institutions should be enabled to take up such industry-sponsored projects.

For Action: Shrimp culture industry through Fisheries Departments, States/Union Territories and MPEDA; CIBA (ICAR).

10. Adoption and implementation of guidelines and regulations

10.1 The Workshop noted that the unregulated development of shrimp farms that has taken place so far has been responsible for the recent unrest against the industry in certain areas. The Ministry of Agriculture and State Governments have already taken steps to discuss, debate and formulate guidelines for coastal aquaculture to ensure sustainable development. Suitable guidelines at the national and state levels should be issued soon.

10.2 The Workshop recommended that approval for commercial coastal aquaculture projects should be given only after it is ensured that the project satisfies the guidelines given by the Government.

For Action: Union Ministry of Agriculture; Governments of States/Union Territories.

11. Expanding exports

In order to ensure the sustained growth of exports, the R&D efforts in the fields of post-harvest handling and phytosanitary measures need strengthening. All links in the chain, starting from shrimp harvest to the time the produce reaches the consumers' table need concurrent and intensive attention in order to enable both producers and consumers to derive maximum benefit from enhanced production efforts.

For Action: CIFT (ICAR); MPEDA

12. Empowered Committee

Shrimp farming in India is at the crossroads. On the one hand, there are vast untapped opportunities for increasing shrimp production on an environmentally and socially sustainable basis both for home consumption and export. On the other, numerous social, environmental and production problems (particularly diseases) are growing. It is, therefore, essential that speedy action is taken on the recommendations of this National Workshop on Sustainable Shrimp Farming. It is recommended that an Empowered Committee may be set up by the Ministries of Agriculture and Commerce and ICAR for this purpose.

For Action: Union Ministry of Agriculture; Union Ministry of Commerce; ICAR.

Annexure - I

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