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SHRIMP FARMING: PROBLEMS AND PROSPECTS

K. Asokakumaran Unnithan,
Senior Scientist & Programme Coordinator, KVK of CMFRI, Narakkal

Introduction

Shrimps accounting for over 20% of the global trade in fish and fishery products and commanding a premium value have also been the mainstay of Indian marine products export trade. Frozen shrimp continued to be the largest item exported in terms of value with 59.02% of the total value of export during 2005-06. Around 60% of the volume of frozen shrimp exported was contributed by aquaculture. Shrimp farming provides direct employment to about 0.3 million people and ancillary units provide employment to 0.6-0.7 million people.

The growth and survival of the shrimp industry depend on the uninterrupted production and supply of quality shrimps. In view of this the last two decades have witnessed a multi-directional strategy towards improving the production of shrimps harnessing both capture and culture fishery potential in our country with government and non-government entrepreneurial support. Production of shrimp through capture fishery along Indian coasts has been fluctuating around 3 lakh tonnes during the past decade in spite of increased efforts at levels of exploitation of 98% upto 50m, 75% between 50 and 100 m and 25% beyond 100 m depth. Stock-assessment of important species has revealed that the coastal shrimp resources of India is fully exploited and some major species are over-fished in their respective areas of fishing, leaving no scope for further expansion of the fishery in the already exploited coastal zones. The proposition of seeking shrimps in the less exploited deeper areas of the sea is capital intensive and generally turns out to be less economical because of the dwindling resources and lack of the desirable mix of penaeid species. Considering the vital role played by the shrimp industry in the socio - economic development of our country, it becomes highly imperative to safeguard the production trend against any fluctuation or decline. A major share of world's farm-raised shrimps is produced in South-East Asia.

Traditional practices of shrimp farming in India

In India, a traditional system of shrimp farming based on the principle of 'trapping and holding' the juveniles of shrimps brought in by tidal water has been prevalent in the low-lying brackishwater impoundments/ paddy fields adjoining the Vembanad Lake in Kerala State and in the Sunderban mangrove swamps of West Bengal known as '*bheries'*, since decades. The system followed in Kerala in around 5000 hectares and popularly described as 'paddy field or *pokkali* (a variety of paddy) field prawn filtration, has been extensively studied by the CMFRI (Panikkar,1937; Menon, 1954; George *et al.*, 1968 and George, 1974) . These fields varying in area from less than 0.5 ha to more than 10 ha are confluent with the Vembanad Lake and are subjected to tidal influence. Prawn filtration is a seasonal operation carried out during the pre-monsoon period, November- April when the water is saline. The process involves, trapping and holding the juveniles of shrimps in the fields, brought in by the tidal flow during the high tide, and harvesting them by filtration during the low tide at periodical intervals coinciding with spring tides around full moon and new moon. During the ensuing south-west monsoon when the water becomes almost salt- free, these fields are used for the cultivation of the salt-resistant variety of paddy locally known as *pokkali.* In addition to the seasonal fields there are relatively deeper brackishwater impoundments which are not suitable for growing paddy. These fields ranging in size from 2 to 75 ha (George, 1983) used for shrimp filtration throughout the year are known as perennial filtration fields. The average production of shrimps has been reported to be 903 kg/ha/ season in the seasonal fields and 838.6 kg /ha/ year in the perennial fields, during the period 1969-' 72 (George,1974). The percentage composition of different species of shrimps in the yield has been estimated as, *Metapenaeus dobsoni* 53-57%, *Penaeus indicus* 36-43%. *M. monoceros* 3.5-6% and *P. monodon* 0.7-1% (George, 1978, 1980).

The *bheries* of West Bengal extend to a total area of 32, 930 ha spread over the low saline (9844 ha), medium saline (15613 ha) and high saline (7472 ha) zones in the spill areas of Bidyadhari river near Calcutta city and 24 - Parganas district and the brackishwater tidal wet lands, mud flats, swamps, marshes and paddy fields . In seasonal bheries both prawn/fish and paddy are raised in the same unit either simultaneously or sequentially and the fields are dried out during November - December. In the perennial *bheries, prawn* and fish are raised almost throughout the year. The average production rate is 775 kg/ ha/ year, with 18.75% contribution by *P. monodon*

The traditional trapping and holding practices in similar lines have been adopted in about 2500 ha of the '*Khar* lands' (*gazani* farms) in Karnataka, yielding a production of 400 kg/ha/year, 85% formed of shrimps; about 500 ha of brackishwater areas in the '*Khazan* lands' of Goa, yielding an average production of 350 kg/ha/year and nearly 900 ha of fields in Orissa forming part of Panchapara Budhabalanga estuarine zone and Jumboo- paradeep (Rajnagar) area with an average yield of 633.29 kg/ha/year of which prawns form 19.4 %

Since selective stocking is not effected in the traditional practice, the yield would be a mix of different species of shrimps, generally the commercially less important ones are occupying a major proportion and may be sometimes over-stocked or under-stocked, both being undesirable and as sufficient grow-out time is not allowed, the catch would also contain under-sized shrimps to a considerable extend. Predatory organisms entering the field along with tidal water may also cause much havoc to the shrimps. While evaluating the merits and demerits and ecological and techno-economic aspects of the traditional practices, scientists have highlighted the scope for improving the farming practices and production trend by way of propagating the selective farming of shrimps at semi-intensive and intensive levels.

Selective farming of shrimps

The wealth of scientific information gathered by the CMFRI through elaborate studies on the primary productivity, related hydrographic parameters, chemical constituents of the bottom soil of the brackish water areas, the environmental parameters conducive for the culture of shrimps, effective use of mahua oil cake and croton seed as piscicides in brackishwater shrimp culture systems, detailed estimate of the lime requirement of different seasonal and perennial shrimp culture ponds for pre-monsoon and monsoon seasons based on exchange and potential acidity of the bottom soil, disease among shrimps in hatcheries as well as in farming systems, the situations leading to pollution in aquaculture systems and the common pollutants and their tolerance level in the cultured aquatic organisms, techniques for the induced maturation and breeding and rearing the seeds of commercially important species of shrimps, nutritional requirements of different species of shrimps at different stages of their growth and necessary techniques for the formulation and manufacture of cost- effective compounded feeds with protein contents ranging from 23 to 60% have been instrumental in developing indigenous low-cost techniques for the culture of penaeid shrimps during the 5th Five Year Plan. Different agencies including the National Institute of Oceanography, Central Institute of Fisheries Education, the Konkani Krishi Vidyapeeth, and other Agricultural Universities and the All India Co-ordinated Research Project on Brackishwater prawn and fish culture have also devoted much of their attention in this line of research.

Among the different species of commercially important shrimps, *P. indicus* and *P. monodon* are the prize species because of their fast growth rate, large size and high economic value The package of practices of the improved technology tested and proved at the CMFRI, which involves the exclusive stocking of the seeds of only the commercially more important species of shrimps, proportionate to the area and productivity of the fields and growing them for definite periods to achieve good quality and maximum quantity for more profitability than the conventional shrimp filtration system, has been published for the benefit of the end users.

The introduction of the technology of selective farming has enabled even marginal farmers and landless labours to make use of even the very minimal brackishwater holdings in the form of narrow canals in coconut groves forming part of their backyard, constructively. The role of women in managing such small-scale shrimp farming operations in homestead canals in coastal areas which offers great scope for self employment and supplementary source of income for the economically weaker sections of the rural society has been successfully demonstrated under the extension programmes of CMFRI.

Simultaneous with developing suitable packages of practices for the farming of shrimps, the CMFRI has also given priority for the speedy and continuous flow of economically viable technology from the laboratory to the end users. This mission was accomplished through different means of information dissemination systems including publication of literature, organizing training courses, both at trainer (Trainers' Training Centre) and operator (Krishi Vigyan Kendra) level, undertaking Operational Research Projects, demonstration projects, implementing Lab-To-Land and Scheduled caste and Scheduled tribe programmes ,village adoption, rural empowerment and Entrepreneurship development schemes Institutional support from various research organizations, mainly under the ICAR, Agricultural Universities and central level development agencies like the MPEDA and Departments of Fisheries of the various maritime states, coupled with the liberal economic support from nationalized and scheduled banks, have enabled the rapid ramification of the improved technology of shrimp farming all along the coastlines of our country. The entrepreneurial attraction of the technology, which ensures substantially high economic returns in so short a time of less than four months, provided momentum to the process of adoption.

Since its introduction in mid-seventees, the selective farming practices of shrimps have undergone tremendous transformations over the years, based on the species preferred, quantum of input requirement, package of practices adopted and the resultant production target. From a humble beginning of extensive type of farming it has gone through semi -intensive and intensive levels, although there is no clear cut demarcation among these systems. The extensive system involves farming operations with a relatively lower stocking density of around 50,000 numbers of seeds per hectare anticipating a production of about 1000 kg/ ha/ crop without much supplementary feeding or soil and water quality management. Water quality is maintained by natural tidal flow. The semi- intensive and intensive systems aim at achieving higher production from available unit area through increased inputs and superior management procedures. Under semi- intensive system, a comparatively higher stocking density of around one lakh seed per ha is adopted expecting a production of around 2000 kg/ ha/ crop. The intensive system, involving higher stocking densities of more than 5 lakh seeds per hectare with artificial aerators and heavy feeding and water exchange schedule aimed at production above 5 t/ha/crop had also been adopted in many areas, in course of development , but discontinued in later years because of techno-ecological reasons. Another practice of farming referred to as improved traditional system, involving supplementary stocking in the traditional operation, with desired species of shrimp seed has also been evolved along with the expansion of the selective farming practice.

Out of the total potential brackish water area of 11,90,000 ha in India, about 1,41,837 ha (11.9%) have been brought under shrimp farming by the end of 2000-2001, spread over Andhra Pradesh (71,000 ha) followed by West Bengal (47,067 ha), Kerala (14,705 ha), Orissa (8,000 ha), Karnataka (3564 ha), Tamilnadu (1,087 ha), Goa (650ha), Maharashtra (426 ha) Gujarat (316 ha) and Pondicherry (22 ha). The annual trend in the adoption of the technology of shrimp farming in India showed that the increase in the area under farming and production was sharp over the period, 1990-'91 to 1994-'95 recording 54.7 % increase in area and 133.4 % increase in production. Thereafter the annual increase in area of culture maintained a low profile indicating a 40.9 % increase upto 1998-'99, which continued up to 2000-01. The production also, after reaching a peak in 1994-'95, showed a sharp decline reaching the minimum in 1997-'98 recording a decrease of 19.3 % and further, a fluctuating trend. The rate of production per unit area also followed the same trend. By 2003-04, the total area under shrimp farming has increased to approximately 152000 ha yielding a production of 1, 15,000 mt.

Problems in shrimp farming and alternative options

Shrimp farming operations involving indiscriminate and disorderly exploitation of the resources and adoption of unscientific package of practices had mushroomed in many parts of the coastal areas causing environmental problems and the resultant outbreak of various diseases in the shrimp culture system severely affecting the production and utilization of the cultured shrimp, after 1994- '95. The circumstances, which led to the situation, have been attributed to a combination of often inter-related factors including misuse and mismanagement of the culture systems causing environmental, physiological, and biochemical stress on the species under culture due to poor husbandry, vertical transmission of pathogen from brood-stock, use of aquacultural equipments infested with pathogen, use of virus latent wild seeds, repeated cropping without intervals under intensive seeding, feeding and manuring beyond the carrying

capacity of the culture system, indiscriminate use of medicines, antibiotics and other chemicals and contamination of ponds through transmission of effluents containing infected shrimp, fish and other waste Aquaculture industry has been facing a major challenge of its sustainability in view of the above circumstances coupled with socio-economic conflicts. The issue of ensuring the development and sustainability of shrimp farming industry and mariculture production in general need a two-way approach. At one side, the problem facing the prevailing practices of shrimp farming has to be addressed. At the other side, prospects of diversifying coastal aquaculture using alternative species and also extending mariculture activities to other realms like open sea areas have to be explored. Going back to the practice of selective farming of shrimps under low stocking density of quality seeds and strictly optimal feeding by nutritionally balanced feeds and regular scientific monitoring of physico-chemical aspects of farm sediment and water and evaluation of growth and survival of the shrimp only can ensure sustainability under the prevailing scenario of shrimp farming.

Proper selection of site

For sustainability, eco-friendly and techno-economically viable hatchery and farming system must be ensured, for which attempts should be initiated from the stage of selection of site by suitable macro and micro level survey. Aspects including the topography of the area, distinct land usage pattern (agriculture/aquaculture/marginal lands/ mangroves/common or public utility facilities etc), source of water, pollution, silting and physico-chemical status of the soil and water including productivity, must be evaluated effectively and above all government rules and regulations should be adhered to strictly. Proper awareness of the scientific package of practices to be followed is also one of the essential pre-requisites.

Shrimp seed

Availability of quality seed is a major issue confronting shrimp farming. Wild brood stock forms the major source of shrimp seed in the commercial sector and it has been reported that about one fourth of the wild spawners are positive for diseases like white spot. Besides, continuous exploitation of shrimp resources has brought about scarcity of breeders also. In this context domestication of shrimp brood stock will be a suitable solution for ensuring the timely availability of quality seeds.

Shrimp feed

Provision of optimum quantity of quality feed manufactured as per the nutritional requirements of the cultured organism and also free of undesirable ingredients is essentially required for maintaining healthy farming systems.

Water and soil quality management

With a view to enhance the productivity of water bodies, increase the resistance in shrimp, promote growth and providing protection against diseases, many drugs, antibiotics and other chemicals are used by farmers. Considering their harmful effects including the development of antibiotics-resistant microbial strains and their transmission, residual toxicity leading to bioaccumulation / biomagnification, the use of such materials should be stopped. The load of organic wastes including feed materials, dead plankton, manure, shrimp excreta and various other metabolites may affect water and soil quality. Nearly 78 % of the nitrogen and 51 % of the phosphorus input into a pond is observed to come from feed and most of it sinks to the pond bottom. Accumulation of organic waste on the bottom increases with culture period. This will influence the soil and water quality by decreasing the carrying capacity of the pond. In these circumstances, 'Bio-remediation', a biotechnological process of using selected micro or macro organisms to reduce harmful wastes to less hazardous levels (Thomas et al.,1992) is emerging as a new management practice to tackle the problem of waste accumulation in a more natural way (Devaraja,2001). *Bacillus* sp., *Nitrosomonas* sp., *Nitrobacter* sp., *Saccharomyces* sp. and several algae are recognized for their bioremediation abilities (Devaraja *et al*., 2004).

Certain bacteria and yeast function against harmful microbes and contribute to improving its intestinal microbial balance. These beneficial microbes are called 'probiotics'. Use of probiotics is gaining acceptance in aquaculture with many commercial preparations. Incorporation of Lactobacillus bacteria as probiotics is gaining popularity. Since leaching is a problem while feeding probiotics in water, bio-encapsulation of probiotic products is suggested as an alternative

approach (Jameson, 2003). Bio-remediation/application of probiotics may be attempted under expert advice and guidance only. If there is sufficient facility for letting out effluent water with organic load into separate effluent treatment ponds (bio-ponds), filter feeding organisms like edible oysters and mussels can be cultured there and the problem free water can be re-circulated to the shrimp culture system, ensuring a more natural way of purification.

Crop rotation and integrated farming

The method of farming shrimps alternating with other crops like finfish / scampy / crab / paddy or integration of different components including aquaculture, agriculture (coconut, vegetables etc) and livestock can also be adopted so that the production system will be easily integratable into the rural economy.

Organic farming

Organic farming is the method of sustainable aquaculture based on long term ecologically and environmentally sound practices aimed at protecting the environment, minimizing soil and water degradation, decreasing pollution and optimizing biological diversity and productivity. The main principles of organic aquaculture as per the standards outlined by the International Federation of Organic Agriculture Movements (IFOAM) are (i) Intensive monitoring of environmental impact, (ii) Integration of natural plant communities in farm management, (iii) Processing according to organic principles, (iv) Natural breeding procedures, without use of hormone and antibiotics, (v) Absence of Genetically modified organisms in stocks and feed, (vi) Limitation of stocking density, (vii) Feed and fertilizer from certified organic agriculture, (viii) Criteria for fish meal sources, (ix) No use of synthetic pesticides and herbicides,(x) Restriction of energy consumption (eg. Aeration) and (xi) Preference for natural medicines.

Diversification in coastal aquaculture

Diversification of coastal aquaculture has been suggested as an alternative option for the problems faced in depending on a single commodity, the shrimp, for culture and export. Prospects of culture of several species of shrimps, crabs, finfishes and sea weeds in brackishwater areas for ecofriendly production have also been recommended.

Extending culture operations to new areas

Extending the area of culture operations to open sea, utilizing the vast areas of lagoons and bays available in different agro climatic zones and different candidate species including finfish and shell fish species, sea weeds, sea cucumbers etc and developing suitable package of practices for sustainable eco-friendly hatchery and grow out systems has also been suggested as a means of enhancing and sustaining aquaculture production.

Standards for aquaculture inputs

In order to help the farmers to ensure the quality of inputs the MPEDA has constituted a Ten Member Expert Committee which has set standards for the major aquaculture inputs. The Committee involves organizations such as, CIBA, CMFRI, CIFT, CFTRI, EIA, Bureau of Indian Standards and Universities in the country. The standards will help the farmers to select quality inputs for carrying out responsible aquaculture. Different institutes have been identified to undertake testing of inputs like seed, feed quality, soil and water quality refiners, antibiotics, disinfectants, vitamins and minerals, algicides, eradicators, etc.

Regulation of aquaculture activities

The Honorable Supreme Court in its Orders on the Writ Petition (Civil) No.561 of 1994-dated 11-12-1996 held that “The shrimp culture industry/the shrimp ponds are covered by the prohibition contained in para 2(1) of the CRZ Notification. No shrimp culture pond can be constructed or set up within the coastal regulation zone as defined in the CRZ Notification. This shall be applicable to all the seas, bays, estuaries, creeks, rivers and backwaters. This direction shall not apply to traditional and improved traditional types of technologies as defined in Alagarswamy’s Report which are practiced in the coastal, low-lying areas”.

The Court in its Orders also permitted the farmers operating traditional and improved traditional systems of shrimp aquaculture to "adopt improved technology of increased production, productivity and return with prior approval of the Aquaculture Authority". In pursuance of the directives of the Supreme Court the Aquaculture Authority has been set up through a notification dated 6th February, 1997 under the provisions of the Environment (Protection) Act 1986. The Coastal Aquaculture Authority Bill, 2005, enacted by the Parliament, provides for the establishment of a Coastal Aquaculture Authority for regulating activities connected with coastal aquaculture in the coastal areas and for matters connected therewith or incidental thereto. The Act encompasses shrimp, prawn, fish or any other aquatic life in saline or brackishwater. The enactment of this legislation would enable the Government to take all such measures deemed necessary to regulate coastal aquaculture by prescribing guidelines, rules and regulations to ensure that the coastal aquaculture does not cause any detriment to the coastal environment and that the concepts of responsible aquaculture shall be followed to protect the livelihood of various sections of the people living in the coastal areas' (- *from the inaugural address by Justice G. Raman jam, Chairman Aquaculture Authority, at the one day National Consultation on Shrimp Farming, Chennai, 25 May,2005*). Earnest efforts put in by various agencies including government and non-government organizations have been yielding positive results in creating increased awareness among the entrepreneurs, on the environmental impacts of aquaculture.

The Krishi Vigyan Kendra concept

The Krishi Vigyan Kendra works as Resource and Knowledge Centre in the areas of Agricultural Sciences and Technology. The activities include On Farm Testing to identify the location specificity of agricultural technologies under various farming systems, Front Line Demonstrations to establish its production potentials on the farmers' fields, training of farmers to update their knowledge and skills in modern agricultural technologies, and training of extension personnel to orient them in the frontier areas of technology development. In order to speed up the process of dissemination of technology, various other extension activities and production and distribution of quality seeds and other planting materials are also undertaken. The KVK of CMFRI functioning at Narakkal, since its inception in 1976 has been concentrating on testing, demonstrating and popularizing locally adoptable technology packages in the fields of Fisheries, Agriculture, Animal Science and Home Science, mainly focusing on brackish water aquaculture, the mainstay of the economy of coastal Ernakulam.

Technology packages concerned with farming of shrimps (*P.indicus* and *P.monodon*), crabs (the mud crabs, *Scylla serrata* and *S.tranquebarica*), finfishes (the Pearl spot, *Etroplus suratensis*, different species of mullets, the Milkfish, *Chanos chanos* and the Sea Bass, *Lates calcarifer*) and molluscan shell fishes including mussels (the green mussel,*Perna viridis*) and oyster (the edible backwater oyster, *Crassostrea madrasensis*) have been tested, assessed and demonstrated paving way for widespread adoption.

Till the inception of the KVK, only the traditional practice of shrimp farming popularly known as Prawn filtration, was prevalent in the district in around 4,500 ha of low-lying fields. During 1977-78, for the first time the technology of selective farming of the Indian White Shrimp, *Penaeus indicus,* a commercially important species of shrimp was successfully demonstrated in a farmer's field. This followed lot of developments in the area as well as technology packages in the field of shrimp farming. Presently, there are more than 10,000 ha. of shrimp fields under different levels of adoption of the package of practices such as improved traditional, extensive and semi-intensive systems aimed at different levels of production ranging from 1000 to 2000 kg./ha /crop when compared to the production of only 700-800 kg./ha. from the conventional system.

The newly generated or enhanced employment opportunities in shrimp farming is more diverse in nature from preparation of the field for stocking, monitoring of the stock, exchange of water to maintain water quality,. Feeding , watch and ward , harvesting , marketing, transportation to peeling sheds, ice plants for producing ice blocks to keep the shrimp fresh from spoilage, peeling sheds for providing employment to men and women, employment in processing plants and finally transportation to export markets.

The impact of KVK intervention on shrimp farming is evident from the spread of the practice to areas beyond Ernakulam, and neighbouring districts to other maritime districts of Kerala in later years. Being the pioneering agency responsible for propagating the technology of scientific shrimp farming, Narakkal KVK has been directly instrumental in creating a general awareness on the potentiality of shrimp farming in Kerala. Whereas the total area under traditional shrimp filtration practice in Kerala was only around 4500 ha confined to Ernakulam and neighbouring areas during nineteen seventies, in later years the practice has been extended to more districts including Kasaragod (29.17 ha) , Kannur (761.18 ha), Kozhikode (53.42 ha), Malapuram (5.20 ha) Trichur (1149.19 ha), Ernakulam (11016.63 ha) Kottayam (26.59 ha), Allepuzha (1319.47 ha), Kollam (258.89 ha) and Trivandrum (2.50 ha), recording a State wide coverage of 14621.74 ha, of which 9509.58 hectare under traditional shrimp farming, 1087.43 hectares under improved traditional shrimp farming and 419.62 hectares under semi intensive shrimp farming system. Along with the development of farming of shrimps, diversification of the species cultured has also been popularized by involving mud crab, scampi, oysters and mussels among shellfish, and mullets, milk fish sea bass and pearl spot among fin fishes and also sea weeds, either simultaneously or in rotation.

Success story

1.	Name of the Farmer	Mr.A.M.Nizar	
2.	Address :		
	i) Village ii) Post iii) Tehsil iv) District v) State	Edavanakkadu Edavanakkadu:PIN 682502 Kochi Ernakulam Kerala	
3.	Contact details	Name of father:Makkar Name of House:Azhivelikkakathu Phone:0484-2505193 Cell Phone: 09895670672	
4.	Details of the farm	Area: 4 ha, in Pallipuram Village of Kochi Tehsil, brackishwater, tide-fed from Cochin backwater forming part of the Vembanad backwater system, traditionally under shrimp filtration	
5.	Membership of Self Help Group, Producers' Cooperative/Company /Cooperative Society etc	Member of (i) 'One Lakh Young Farmers' Samithi General', a State sponsored Society and (ii) Village level Service Cooperative Society	
6.	Names of the Central Sector/State Schemes utilized by the farmer and the period	Undergone 10 days training on 'Coastal Aquaculture' at the Krishi Vigyan Kendra of Central Marine Fisheries Research Institute (ICAR) funded by the National Fisheries Development Board during 2007-08, followed by very frequent interaction with the KVK	
7.	Technologies/Good agricultural practices/ Facilities/Benefits obtained with details	Technology of polyculture of brackishwater finfishes and shell fishes, blending with traditional practice of shrimp filtration gained during training at the KVK	
8.	Details of results obtained due to the adoption of technologies (season wise crops grown, techniques adopted, results achieved etc)	Improved/present production technologies Supplementing the shrimp/fish seeds entering the farm through tidal water, with selected seeds of high quality shrimp/fish and feeding (all are perennial components)	Traditional/past production practices Letting in and trapping shrimp/fish seeds coming along with tidal water and filtering them at fortnightly intervals (no feeding)
i.	Productivity per ha	(i) Shrimps - 750 kg (ii)Finfishes - 750 kg	(i) Shrimps - 250 kg (ii)Finfishes- 60 kg

ii.	Cost of production per ha	Rs.75,000-00	Rs. 25,000-00
iii.	Net income per ha	Shrimps- Rs. 75,000-00 Finfishes- Rs.1,50,000-00 Total Rs. 2,25,000-00 Net income:Rs.1,50,000/ha/year	i)Shrimps - Rs. 18,750-00 ii)Finfishes -Rs.4,500-00 Total Rs.23,250-00 Net income: Minus (Loss Rs.1750/-
iv)	Price realized (Rs./ton)	Shrimps: Rs.1,00,000/ t Finfishes: Rs.2,00,000/ t	Shrimps: Rs.75,000 / t Finfishes: Rs.75,000 / t
v)	Natural resources saved/conserved like soil/water etc	Disturbance to natural topography avoided while developing the farm; used only tidal water (no artificial means like pumping),use of chemicals avoided (resorted to organic farming)	
vi)	Product quality improvement	Improved the farm scientifically by deepening, shaping the bund; supplemented the stock of shrimps and fishes entering the farm through the traditional way, with selected varieties of commercially more important species of shrimps and fishes thereby enhancing the percentage of quality species in the yield. Provided quality feed	Depended only on the species of shrimps /fishes, majority being commercially less important ,fetching only lower price
9.	Marketing strategy	Shrimps are cleaned, peeled (removal of head &intestine) under his own facility (peeling shed) and sold to private exporters. Finfishes are taken to the market directly and sold: all private arrangements	
10.	Factors contributing to success	Interested in learning scientific practices; developed the farm scientifically; supplemented the stock of shrimps and fishes entering the farm through the traditional way, with selected varieties of commercially more important species of shrimps and fishes thereby enhancing the percentage of quality species in the yield. Provided quality feed; establishes and maintains good linkage with developmental agencies; adopts the practice of intermittent stocking and harvesting of fishes. Aquaculture is also integrated with plantation crop(coconut- on the bunds)	
11.	Any other relevant information	Maintains very good relationship with the people of the neighbourhood of his farm. For example he was there in the fore-front during the recent Tsunami along coastal Kerala and earth quake in Gujarat His farm is like a Farmers' Field School, readily welcoming any body seeking knowledge and guidance from his experience. The Krishi Vigyan Kendra makes use of the farm for instructional purposes and takes visitors including trainees, students of aquaculture stream, in-service personnel, and dignitaries to his farm for providing exposure to his success story.	

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