Diversification of Aquaculture for Empowerment to Fisheries Through Institution Village Linkage Programme (IVLP) in Kerala, India

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Abstract

Technology Assessment and Refinement through the Institution Village Linkage Programme (IVLP) is the latest participatory extension model successfully undertaken by the Indian Council of Agricultural Research in India. The Central Marine Fisheries Research Institute has been implementing IVLP since 2001 to assess and refine the technologies of the coastal agro ecosystems at Elamkunnapuzha village (Vypeen Island) in the Ernakulam District of Kerala. A series of need based location specific technology intervention plans have been introduced to overcome the social and biological constraints on farming practices in fisheries, livestock and agriculture, and implemented with the active participation of the stakeholders. The inferences drawn from IVLP ultimately form a package suitable for enhanced production in the costal agro ecosystem for replication to other areas with similar characteristics. This paper gives a brief account of the treatment packages applied in fisheries through various technological interventions and discusses the consequent yield and benefits obtained. The 'integrated whole village development' through the involvement of multi institutional teams and a participatory approach was accorded prime importance in the IVLP of Elamkunnapuzha, with a greater emphasis on marginal and small farmers and specifically focusing on women for poverty alleviation and equity under the coastal agro ecosystem.

Introduction

Community participation plays a key role in Common Property Resource Management (CPRM) for sustainable development that has significant impacts on the quality of the environment. Integrated natural resource management (CGIAR 2002) focuses on improving livelihoods, agro ecosystem resilience, agricultural productivity and promoting environmental services. Its efficiency in dealing with complex problems comes from its ability to empower relevant stakeholders, resolve conflicting interests, foster adaptive management capacity, integrate levels of analysis, merge disciplinary perspectives, make use of a wide range of available technologies, guide research on component technologies and generate policy for technological and institutional alternatives. It is well known that natural resource systems such as open water fisheries, forests, water, air, minerals, etc., are exploited or utilized beyond their sustainable levels.

In fisheries, the backwaters and many water bodies in the coastal agro system that are common in nature require effective management. Most of the policies and regulations of Nations' with a democratic nature could not work to the desirable extent for effective implementation. Failure to manage these resources sustainably and equitably has lead to conflict and disaster in many cases. The Rio Declaration on Environment and Development correctly proclaimed *inter alia* that "Human beings are at the centre of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature". In this context, the Institutional Village Linkage Programme (IVLP) of the Central Marine Fisheries Research Institute (CMFRI), implemented at Elamkunnapuzha village in Kerala (India), serves as a model for community participation for sustainable production from various types of aquaculture systems. IVLP was successful in making significant positive and cumulative changes in the production patterns in various micro-farming situations. Vypeen Island in the Ernakulam district of Kerala covers an area of 87.12 sq km. Elamkunnapuzha village has a total population of 51 197 and an area of 11.52 sq km. It has a distinct ecosystem that includes capture and culture fisheries, a variety of agricultural crops, and animal husbandry.

IVLP for technology assessment and refinement aimed at diagnostic studies of production systems to suggest alternative means for enhanced productivity. It introduced improvements in the existing production systems without endangering the stability and sustainability of the environment through scientific management practices. IVLP suggested innovative farm production systems with multiple options for implementation with the genuine participation of the farm community. Rural farmers followed the scientific inputs only if they had an assurance of more employment and income generating opportunities. All the interventions were functionally linked with the stakeholders through key informants, frequent visits by the scientific personnel and a group of progressive farmers. The key informants were from the same village and were knowledgeable about villagers as well as the economic and social fabric of the stakeholders. Frequent visits by scientific personnel were seen as an impetus to the farming attitude of the farmers. The recording of data on various parameters of farm inputs and outputs not only stimulated the farmers towards a result oriented approach, but also gave feedback information for further refinement. Visits to the farm sites of progressive farmers or a common place to share their experiences created a catalytic effect among the identified stakeholders. Another set of factor that functioned as the link between the institute and the primary stakeholders was the scientific information and advice imparted through a number of training programs and leaflets. The linkages developed in this program have enabled the stakeholders to continue the efforts towards achieving better output. The results of IVLP clearly demonstrated its utility for preparing a comprehensive plan for the entire coastal agro ecosystem (Sathiadhas et al. 2004).

During February to April 2001, 32 techno-interventions covering 687 farm families were implemented at Elamkunnpuzha in the fisheries, animal husbandry, agriculture and horticulture sectors (Sathiadhas et al. 2004). Between 10 and 50 farmers were selected in each sector on the basis of their indigenous knowledge, aptitude for adoption of scientific practices, suitability of the location and involvement in participatory exercises. Farmers were selected for introduction of scientific practices in culture. The most important impact was the adoption of diversified aquaculture practices by the farmers. The lowest cost combination of factors of production coupled with the high suitability of ponds for monoculture of crabs, *Mugil cephalus* and *Chanos chanos,* and polyculture of different types of finfish resulted in profitability ranging from Rs0.2 million/ha for monoculture of milkfish to Rs0.7 million/ha for monoculture and fattening of juvenile crabs at the optimum levels of productivity (US$1 = approx Rs 46.79).

Participatory Rural Appraisal (PRA) Techniques: Extension Strategy Used in IVLP

Most of the development programs attempted in the past focused on technology transfer without considering the needs of the end users (i.e., farmers). The communication gap between the researchers and farmers has led to many disappointing experiences. Because of the flaws in the conventional approach, there has recently been a rapid expansion in participatory methods and approaches. The new methods are being used not just for local people to inform outsiders, but also for people to analyze their own conditions (Chambers 1992; Pretty and Chambers 1993; Pretty 1995).

The extension strategy adopted in IVLP is very much participatory in nature with a vision of an integrated whole village development ensuring greater scientist-farmer linkage and accessibility for farmers to the technologies generated by CMFRI

Group of stakeholders with experts.

and the entire National Agricultural Research System (NARS) of the country. This requires a multi-institutional team and an array of stakeholders with knowledge of the local systems and traditions. An micro-level farming approach using participatory Rural Appraisal (PRA) techniques (Sathiadhas et al. 2003) was used to earmark problems and formulate participatory programs to enhance the productivity of current farming practices.

As a result of employing various PRA techniques, the following observations were made. Transect walks and direct observation gave the IVLP team members an insight into the topography, natural resources, cropping patterns, soil types, natural vegetation and local practices, and also provided a graphic representation of places where unexploited or underexploited potential existed. Wealth ranking was used to classify households according to relative wealth or well-being. This provided a baseline against which future intervention impact could be measured; a sample frame to cross-check the relative wealth of informants who were interviewed; and local indicators of welfare. Through an analysis of their livelihood activities it was noted that fishing and related activities provide the major source of income, accounting for about 55 per cent, followed by coconut (20 per cent), paddy and vegetables (10 per cent), milk and meat (10 per cent) and others (5 per cent). Participatory mapping and modeling involved constructing maps, like resource maps of catchments, villages, forests, fields, farms, home gardens; social maps of residential areas of a village; wealth rankings and household asset surveys; health maps, indicating the health status of each family; and impact monitoring maps where villagers recorded pest incidence, input usage, weed distribution, soil quality, etc. Seasonal constraints and opportunities, like patterns of rainfall, soil moisture, crops, labour, food consumption, illnesses, prices, animal fodder, fuel, migration, pests, income, expenditure, etc., were entered into the seasonal calendars and activity profiles. Historical analyses included technology histories and review, crop histories and biographies, livestock breed histories and labour availability. Through matrix scoring it was found that fish farming was preferred because it was locally feasible, profitable and had a marketable product. Even though crab farming is profitable, it was not as popular because of a lack of seed availability.

The existence of five typical micro-farming situations such as tide-fed brackish water systems, open sea-based coastal agro-ecosystem, homestead animal husbandry and poultry farming system, rain-fed agro-horticulture systems and low-lying seasonal paddy (*pokkali*) lands were identified. Various technological interventions were sketched out to suit these micro-farming systems, on the one side, and to achieve the broader objective of technology assessment and refinement, on the other side. Based on this, an action plan was outlined under three broad categories - fisheries, livestock and agriculture. The major problems identified in the fisheries sector were unscientific farming practices, improper selection and overstocking of species, and uneconomic utilisation of farmlands. Assessment experiments in fisheries included polyculture/monoculture of finfish as well as shrimp, integrated farming of poultry and fish, and monoculture of uniform sized juvenile crabs. Linkages were developed between institutions like the Central Institute of Fisheries Technology (CIFT) and fisheries Research Station of Kerala Agricultural University (KAU), and input suppliers like shrimp hatcheries, fish/crab collectors, auctioneers and net makers.


Scientist-farmer interaction – location specific problem identification.

Interventions in Aquaculture

More recent research has shown that improved management practices can ensure pollution free and disease free aquaculture systems. In addition to technological, environmental and socioeconomic considerations, the plans and polices should be finalized after discussion and dialogue with all stakeholders of the aquaculture ventures. This will ensure that any change in the management is part of an integrated plan for fisheries development.

The fisheries based intervention undertaken under Natural Resource Management (NRM) were monoculture of crabs, milkfish and *Mugil cephaus,* polyculture of finfish, biculture of crab and *Mugil cephalus*, polyculture of *penaeus indicus* with finfish in tide fed ponds, mud crab fattening, and integrated farming of fish and poultry. The location specific advantages of diversified aquaculture practices and the possibility of hitherto unutilized water resources for finfish culture were pointed out to the stakeholders.

Monoculture Practices

Crab culture. Traditionally, crab culture was followed on a limited scale along with fish culture in the micro-farming situation of tide-fed brackish water system. Prawn culture was predominantly practiced and widely accepted as more profitable than any other venture in the village. Crab culture was given the least importance. Lack of fabricated sluices, absence of proper maintenance, lack of good quality seed and cannibalism were the major constraints on production. Boiled slaughter wastes and kitchen wastes were usually used as feed and the feeding rate were very uneven.

Mud Crab Culture – A remunerative venture.

Technology for the monoculture of uniform sized juvenile crabs (*Scylla tranquebarica*) was recommended. The major elements of the technology were: proper water exchange through fabricated sluices (size of sluice 60 cm width and 135 cm height); stocking of uniform sized juvenile crabs (stocking rate 4800/ha, size 150-200 g); feeding rate of 8-10 per cent of body weight with feeds such as trash fish and slaughter waste in the ratio of 2:1; and fencing of ponds (45° angle) using nylon nets to prevent crabs escaping (Sathiadhas et al, 2003). With this treatment, the crabs attained a maximum weight of 1.46 kg and the yield increased by 48.48 per cent (Table 1).

The net earning was Rs0.743 million/ha/annum with the recommended technology as compared to Rs0.404 million/ha with the existing practices of the farmers. The benefit/cost ratio for the treatment was estimated to be 2.10 as against 1.36 for the existing practices.

Aquaculture of milkfish in tide fed ponds.

Uneven and simultaneous stocking of various species normally resulted in lower productivity. Farmers were not very aware of the location specific potential of monoculture practices of milkfish in tide fed ponds

Scientific monoculture of milkfish in tide fed ponds gave a gross yield of 5500 kg/ha, which was much higher than the yield of 3750 kg/ha under traditional practices. Predators in

Table 1. Performance indicators for different monoculture practices.

	Crab culture (1 ha)		Milkfish culture (1 ha)		Grey mullet culture (1 ha)		Mud crab fattening (1 ha)	
	FP	SC	FP	SC	FP	SC	FP	SC
Survival rate (%)	60	85	70	80	50	60	65	75
Period of culture/ Maturity	5-6 months	4-5 months	Irregular	11 months	Irregular	10 months	Irregular	35-45 days
Weight at harvest time (kg)	0.6 - 1.2	0.95 - 1.46	0.250	0.360	0.350	0.450	0.6000 - 1.200	0.7000 - 1.300
Size at time of harvest (cm)	13.5 - 16	21.25 - 25.75	23	27.5	28.8	35.7 cm	13.5 – 16.0	20.0 - 24.0
Operating cost (Rs/ha)	296 200	354 312	160 000	180 000	184 000	190 000	284 000	240 000
Yield (kg/ha)	2500	3712	3500	5760	2625	4050	2275	3000
Gross returns (Rs/ha)	700 000	1097 880	245 000	403 200	301 875	465 750	637 000	840 000
Net returns (Rs/ha)	403 800	743 568	85 000	223 200	117 875	275 750	353 000	600 000
B-C Ratio	1.36:1	2.10:1	0.53:1	1.24:1	0.64:1	1.45:1	1.24:1	2.50:1

FP: Farmer's practices; SC Scientific culture the culture pond were eradicated by using *mahua* oil cake. The recommended stocking density of *Chanos chanos* was 15 000/ha. The fish attained an average weight of 360g and an average length of 27.5 cm in a culture period of 11 months. The net earnings were estimated at Rs0.223 million/ha per annum with the recommended technology as against Rs0.085 million/ha with existing practices. The benefit/cost ratio for the treatment was 1.24 as against 0.53 for farmer's practices (Table 1).

Monoculture of *Mugil cephalus*

Unscientific stocking patterns, especially overstocking of all available fish, were the major problem under traditional farming practices. Non-eradication of predators before stocking and limited availability of quality seeds were other constraints faced by farmers under the traditional farming system. Poor water exchange also resulted in lower production than the actual potential.

This intervention included eradication of predators using *mahua* oil cake prior to stocking and stocking of seeds at the rate of 15 000/ha. Water exchange was regulated through fabricated sluices and fish feed included wheat bran, rice bran and oil cake. The intervention increased the yield by 55 per cent.

The net returns was Rs0.276 million/ha with the treatment as against 0.118 million/ha with traditional practices with a benefit/cost ratio of 1.45 and 0.64, respectively.

Mud crab fattening

Hard-shelled crabs fetched about twice the price of water crabs. The average farm gate price of hard-shelled crab was Rs325 kg as against Rs110 kg for water crabs during the period of the experiment (2001-2002). Hardening of crabs under controlled conditions was totally absent in the area.

Water crabs of *Scylla tranquebarica* variety was stocked at the rate of 5000/ha and hardened by following the recommended feeding and management practices. An additional weight gain of 85-90 g in the fattening period of 35-45 days was observed. The increase in yield was 3000kg/ha/year under the regime as compared to the yield of 2500kg/ha under traditional culture practices. The net earnings were Rs0.6 million/ha per annum for the recommended technology and Rs0.353 million/ha with the traditional system. The benefit/cost ratio for the treatment was 2.50 and 1.24, respectively.

Farmer harvesting *Chanos chanos* – usually at night or early morning.

Polyculture Practices

In order to utilize available space in the culture medium to the maximum, aquaculture of more than one specie is advisable. In biculture practices, only two compatible species are grown concurrently in the pond and in polyculture practices more than two species are grown in the same system for improving yield and profits.

Polyculture of finfish in tide fed ponds

In the traditional system of fish farming, fabricated sluices were not properly maintained and in some cases sluices were not used at all. In such cases, pieces of worn out wood were used as temporary sluices. Predators in the ponds were rarely eradicated. Uneven stocking of various species of fish resulted in low productivity. Natural entry of fish was also allowed, resulting in overstocking and a low growth rate.

Polyculture of finfish was the recommended technology. Predators were eradicated using *mahua* oil cake. Water exchange was maintained through fabricated sluices and natural entry of fish was regulated. Combination of *Chanos chanos* and *Mugil cephalus* were stocked at the rate of 20 000/ha. *Mugil cephalus* at the harvesting stage attained a mean weight of 440 g and mean length of 35 cm, where the mean weight and length of *Chanos chanos* were 200 g and 26.5 cm, respectively. The period of culture was 11 months.


Harvesting of Chanos chanos.

The net return was Rs0.443 million/ha under the regime as against 0.254 million/ha with farmer's practices. The benefit/cost ratio was 1.64 and 0.96, respectively (Table 2).

Polyculture of *Penaeus indicus* with finfish in tide fed ponds

A substantial reduction in operating costs was the special feature of polyculture of *penaeus indicus* with finfish. The additional advantages were a high survival rate and smaller period of culture. The net return was Rs0.182 million/ha for the treatment regime as against Rs0.125 million/ha under farmer's practices. The benefit/cost ratio was 0.73 and 0.51, respectively.

Integrated Farming of Fish and Poultry

Uneconomic utilization of land was identified as one of the problems in the coastal agro ecosystem. The lack of an integrated approach to farming was found to be the major constraint on optimizing income from farming. Fish farming in homestead ponds could generate a higher income with the integration of poultry farming.

Though both fish farming and poultry farming were being practiced, the lack of its integration between the two was an obstacle to attaining the maximum output. The suggested method for integration was to place poultry cages atop the fishpond.

Poultry droppings fertilize the fishponds, thereby enhancing the production of both fish and plankton through direct and indirect utilization of nutrients. Chicken manure is one of the best organic fertilizers for growing natural food in brackish water ponds. It can convert crude, inedible nutrient materials into high quality fish food. Fresh chicken manure contains 1.6 per cent nitrogen, 1.5 per cent phosphorous and 0.9 per cent potassium. The protein content ranges between 20-30 per cent. About 80 per cent of the manure is undigested feed with a 25 per cent dry matter. This is because chickens have a very short digestive tract and most of their food intake is only partly digested.

The operational expense of fish culture was reduced by 8-12 per cent through this form of fertilization (Krishnan et al. 2002). Supplemental feeding and inorganic fertilization were not required during the culture period. Apart from the output from fish culture, the farmers earned a reasonable additional income from poultry farming utilizing the same land and manpower. An improved variety of poultry birds (Gramasree) was introduced. The egg yield of country birds was 120/birds/year as against the yield of 200/birds/year for the Gramasree variety.

The adoption of integrating farming of fish and poultry resulted in higher earnings. The net return almost doubled from Rs0.265 million/ha with the traditional farmers practices to Rs0.552 million/ha with the suggested methods. The benefit/cost ratio was 0.93 and 1.85, respectively (Table 3).

Biculture of Crabs and *Mugil Cephalus*

In the past, the farmers were engaged in either monoculture of crabs or the monoculture of *Mugil cephalus*. When both crab and *mugil cephalus* were cultured together, the biculture

Table 2. Returns from polyculture practices.

Farmers	Fin fishes (*Mugil cephalus* and *Chanos chanos*)		*Penaeus Indicus* with fin fishes	
	FP	SC	FP	SC
Operating cost (Rs/ha)	264 000	270 000	245 000	250 000
Yield (kg/ha)	5705	7195	924	1080
Gross return(Rs/ha)	517 763	713 352	369 600	432 000
Net return(Rs/ha)	253 763	443 352	124 600	182 000
Benefit/cost ratio	0.96:1	1.64:1	0.51:1	0.73:1

FP: Farmer's practices. SC: Scientific culture.

resulted in a significant reduction of operating costs. Increased survival rate, low period of culture and higher earnings were the specific advantages.

The adoption of recommended practices in the biculture of crabs and *Mugil cephalus* resulted in higher earnings, with net returns of Rs0.404 million/ha for farmer's practices and Rs0.607 million/ha for the suggested method. The benefit/cost ratio was 1.36 for the former and 1.71 for the latter (Table 3).

Comparative Analysis of Yield, Earnings and Profitability

The most important impact of IVLP was the adoption of diversified aquaculture practices by the farmers. The comparative yield levels of different fish culture (Krishnan et al. 2002) under recommended practices showed a marked increase (Fig. 1). Hitherto, the farmers in the region were concentrating mainly on shrimp oriented aquaculture. The high price of shrimp coupled with the export potential attracted them to shrimp culture without an analysis of its suitability and cost of

Table 3. Comparative economics of integrated farming and biculture practices.

Parameters	Integrated farming of fish and poultry		Biculture of crab and *Mugil cephalus*	
	FP	SC	FP	SC
Operating cost (Rs/ha)	285 750	297 600	296 200	354 312
Yield (kg/ha) *Eggs/annum	5705 14 400 *	8172 27 800	2500 -	3240 -
Gross returns (Rs/ha)	551 063	849 340	700 000	961 100
Net returns (Rs/ha)	265 313	551 740	403 800	606 788
Benefit/cost ratio	0.93:1	1.85:1	1.36:1	1.71:1

FP: Farmers practice. SC: Scientific culture.

production. Shrimp culture was not the ideal choice and was also less profitable than other fish/crab culture practices. The least cost combination of factors of production coupled with the high suitability of ponds for the monoculture of crabs (*Mugil cephalus, Chanos chanos*) and polyculture of different types of fin fish resulted in profits ranging from Rs0.2/ha for monoculture of milk fish to Rs0.7 million/ha for monoculture of juvenile crabs. The only constraint n the spread effect of crab culture was the non-availability of hatchery-produced seeds.

There were a number of observations that indicated the positive impact of the resource-specific techno-interventions of IVLP in the project

Integrated farming of fish and poultry.

village. Farmers showed a lot of enthusiasm in continuing their efforts to commercialize their ventures. About 30 per cent of the farmers engaged in fisheries were using leased farms. The price of leasing the farms increased from Rs8500/ha in 2000-2001 to Rs10 000/ha during 2003-2004 because the increase in

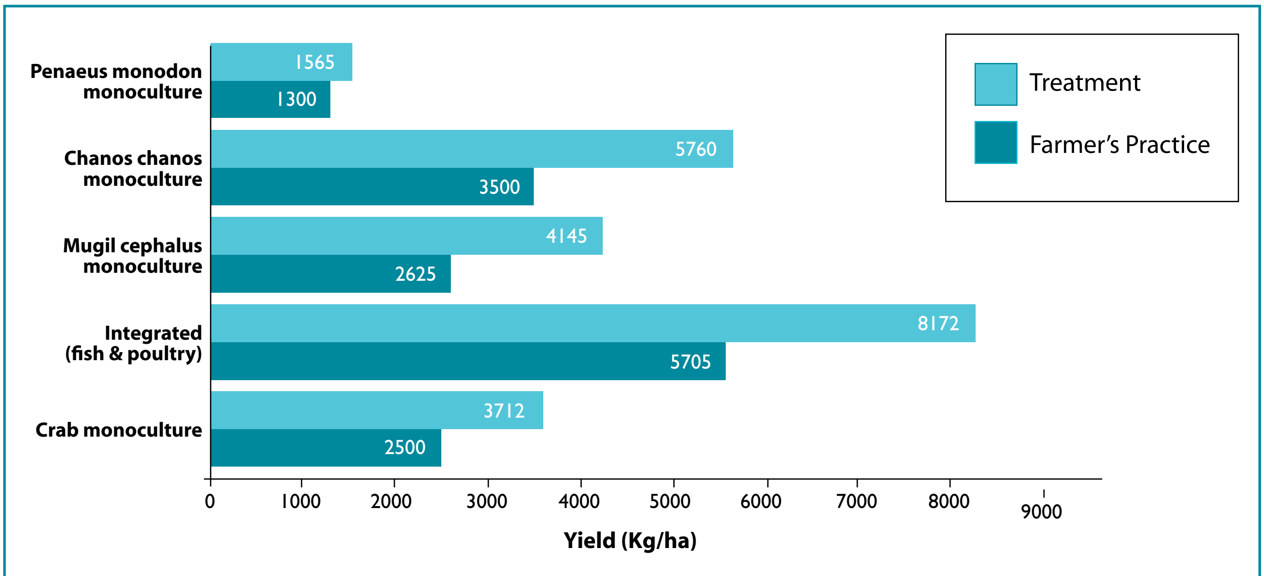

Figure 1. Comparative yields of different culture systems.

profitability with the diversification of farming practices resulted in an increase in the demand for farms. The fish/crab collectors, who were marginal fishermen, saw an increase in demand for their labor from about 80 to 120 labor days per annum (seasonal) and became conscious of the need for uniformity in the size of fingerlings for stocking. Farmers became aware of the components of culture practices like monoculture, biculture and polyculture. In the project village, an underutilized area of 22.3 ha was brought under the newly introduced fish culture practices. This created a demonstration effect on farmers from neighboring villages who visited the more progressive farms in the project village and also adopted the modified interventions. The increased level of awareness escalated the demand for unutilized ponds and embankments. Social participation and interaction among villages increased. This was more obvious in the case of women farmers. Inter and intra functional linkages between farmers, research stations, state departments and other organizations were evolved. Some farmers functioned as consultants and this gained them social recognition. Collective action among farmers

Biculture of crab and *Mugil cephalus*.

improved as a result of the group approach followed in the project.

Kerala has a potential area of 65 000 ha for aquaculture, of which hardly 23 per cent is currently utilized. Most of the unutilized water bodies cannot be utilized for shrimp culture because of technological and socioeconomic constraints, but they are highly suitable for fin fish culture. The IVLP experiments at Elamkunnapuzha have proved that *Mugil cephalus* and *Chanos chanos* can be cultured successfully, with the former yielding 4050 kg/ha and the latter 5500 kg/ha. The average farm-gate price was Rs115/kg for the former and Rs70/kg for the latter. If 20 000 ha of the unused area is brought under monoculture and polyculture of fin fishes in 10 years, an additional production of 60 000 t (assuming a conservative 3 t/ha output) can be envisaged. This amounts to a value of Rs4200 million at a price of Rs70/kg.

Impact of IVLP on Attitudes of Farmers and Adoption Level

A total of 300 farmers in the village were surveyed (150 IVLP and 150 others) to assess the socioeconomic profiles and impact on attitudes and adoption levels. Eight socioeconomic indicators were selected to compare the profile of IVLP farmers with other farmers. The respondents were categorized into 'high' and 'low' taking mean scores into consideration. More than 80 per cent of the IVLP farmers had a high scientific and risk orientation, an annual employment of more than 120 labor days, and savings of more than Rs7500/annum (Fig. 2)

Among IVLP farmers, 80 per cent preferred scientific fish/crab culture practices, whereas among 'others' 64 per cent of the farmers favored the scientific farming practices. It could be inferred that training and other extension activities succeeded in

Harvesting of *Mugil cephalus*

spreading the technology and bringing positive changes in the attitude of farmers.

Conclusion

The introduction of technological interventions in Elamkunnapuzha village ensured the committed involvement of stakeholders, which resulted in improvements in production. The recommendations of the project are:

- A facilitative mechanism with an entrepreneurship, technology, finance, marketing, and promotion center should be established at the village *panchayat* level. It should comprise of members like the extension officer of the concerned *panchayat*, block extension officer, experts from the nearby technical institutes, the resource persons of the *panchayat* as well as representatives of stakeholders of the project. This is crucial because of the fact that the survival of any enterprise, a micro enterprise in particular, can be ensured only through continued follow up and support.
- Efforts at linking the SHGs to various financial institutions like the National Bank for Agricultural and Rural Development (NABARD) and commercial banks should be the responsibility of the facilitation center.
- Linking the SHGs with technical

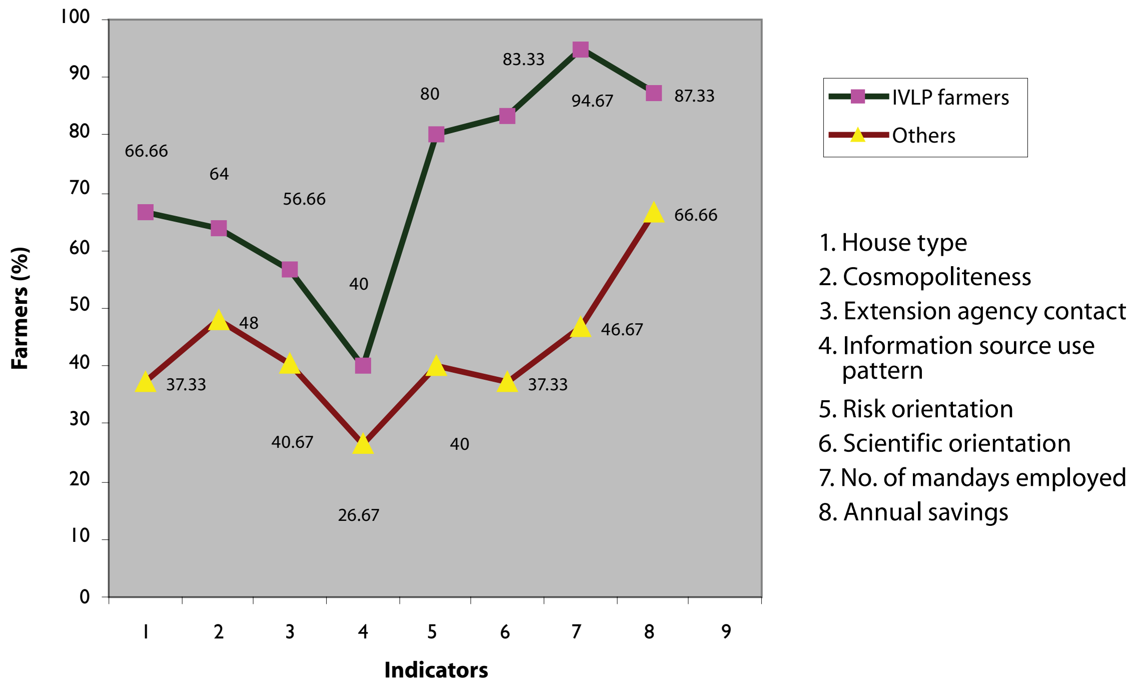

Figure 2. Comparative yield of fish/crab culture

institutions for technology transfer as well as refinement should be the responsibility of the facilitation center.

- Marketing should be organized by the concerned SHG as well as the facilitation center.
- Commercial hatchery production of the crab and fin fish seeds should be adopted.
- Optimum utilization of space in ponds should be made through biculture and polyculture practices.
- Yield and earnings should be enhanced through integrated aquaculture practices. .
- Adoption level should be enhanced and serve as a model for development in the coastal agro ecosystem.

Indeed, the Elamkunnapuzha model developed and initiated by CMFRI has put into practice the message of the Rio Convention emphasizing the role and responsibility of all sections of society, with the recurring message that **"**real change is most likely to come only with the involvement of ordinary people**".**

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