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Technology Assessment and Refinement of Farming Practices in Vypeen Island, Kerala: Implications for Designing Effective and Socially Optimal Development Strategies

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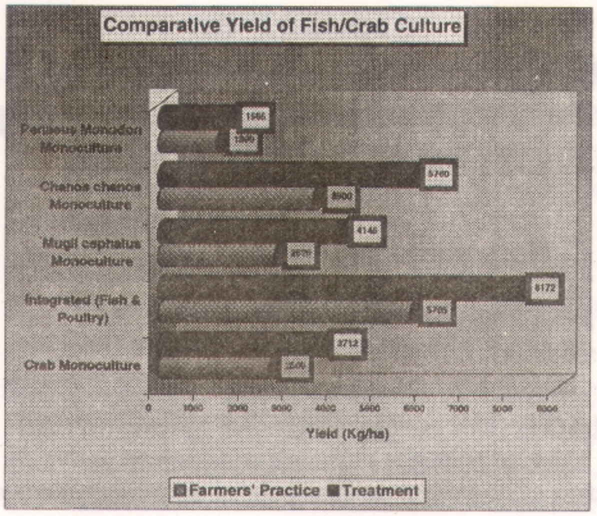
ABSTRACT

Traditional farming practices of diverse production systems in a defined coastal agro-ecosystem is assessed through participatory approaches and later refined through a planned set of techno-interventions, as part of the widely acclaimed Institution Village Linkage Programme (IVLP). The strategies adopted for the implementation and execution of IVLP by the Central Marine Fisheries Research Institute, Kochi has embedded with tools for a socially optimal development paradigm. The techno-interventions are carried out in a coastal village of Vypeen Island - Elamkunnapuzha – in Ernakulam district during first phase and later to the whole of Vypeen Island, for horizontally expanded interventions in second phase. The present paper focuses on the extension processes that contributed to the success of IVLP and also on a comparative economic assessment of the consumptive value of the various produce brewed out of planned scientific interventions in aquaculture, livestock management and agri-horti farming. The study made use of the secondary data from IVLP of CMFRI and a rapid rural appraisal on linkages and sustainability components. The IVLP has been successful in building instantaneous linkages among farmers, fisherfolk, research institutions, agricultural universities and the local extension system. The linkages established by IVLP is assessed by way of actor-linkage-matrix developed for monitoring partnership building and found that it has made significant linkages with various institutions. There is enough space for building further linkages especially with NGOs and other community based organisations for an intensive sustainability of the project benefit. On the output side, the comparative economic assessment reveals the considerable improvement in overall production and earnings compared to traditional farming practices. Aquaculture demands comparatively more investment than those of livestock management and agri-horti farming, and resulted in better economic returns.

Keywords : Refinement of farming practice, Technology Asessment

INTRODUCTION

The Institution Village Linkage Programme (IVLP) for Technology Assessment and Refinement (TAR) is one of the most important segments of National Agricultural Technology Project (NATP) for testing, improving and refining technologies prevailing at or generated for diverse production systems. Central Marine Fisheries Research Institute has implemented



the programme in a coastal village, *viz.*, Elamkunnapuzha in Ernakulam district of Kerala, since August 2000 to April 2005. Altogether 31 techno-interventions are assessed and refined in farmer's fields (13 fisheries, 5 livestock and 13 agriculture). A total number of 687 farm families have participated in these interventions and the total population covered under this programme is 3435. The programme has been successful in building instantaneous linkages among farmers, fisherfolk, research institutions, agricultural universities and the local extension system. It has imparted diverse packages of technical knowledge through 15 field level training programmes in which 576 farmers, out of which 318 females are participated. The overall impact of this intervention is highly promising and is termed as "Elamkunnapuzha Model of Development". The paper critically analyses the improvements in productivity and the social factors contributed to this achievement. Since the programme adopted a farmer participatory research, a sustainable adoption of improved technologies at the farmer level mostly deals with the development of various institutions closely linked to farmers.

Location specific resource Potentials

The village identified is typical of the coastal agro ecosystem existing in Kerala characterised by poor water and soil quality, high density of population, low income generation opportunities, vulnerability to health, social and environmental impacts. These inherent problems could be addressed only through a better planning and management of the concerned sectors. There are vast potentials of development in the resource-rich village. The livelihood betterment of the poorer segment in the village could be realised through proper utilisation of the resources.

Elamkunnapuzha village represents the typical and unique coastal topography of West Coast of India, which is congenial for the techno interventions of capture and culture fisheries, agri-horticulture and animal husbandry. It is a representative village of Ernakulam district, which is located on the North-Eastern side of Vembanad Lake - the largest lake in Kerala. The topography is without much undulations and the soil type of western parts belong to fertile clay loam while the eastern side is characterised by typical sandy soil. The village has a total population of 51,197 within a total area of 11.52 sq.km. Nature has endowed this area with larger expanse of fresh, saline and marine water resources (Sathiadhas *et al.*, 2003).

Participatory rural appraisal (PRA) techniques are applied to study and analyse the spatial and production pattern of the village. Problem-cause relationships in the socio-economic and bio-physical features of different production systems of the village are assessed. Based on this assessment, suitable techno-interventions are designed to solve the problems in the diverse micro-farming situations identified in the village. Agro-ecosystem analysis and resource inventory of the village indicated five micro-farming situations such as, 1) Tide-fed brackish water system, 2) Open sea-based coastal agro-ecosystem, 3) Home-stead animal husbandry and poultry farming system, 4) Rain-fed agri-horticulture system and 5) Low-lying seasonal paddy (*pokkali*) lands. Techno-interventions are broadly categorised as fisheries-based, livestock-based and agriculture-based. In fisheries-based interventions, the improvements suggested in the traditional farming practices include, eradication of predators in fishponds using mahua oil cake, stocking of uniform sized fish fingerlings, standard stocking density corresponding to the pond size, selection of suitable species considering water parameters and other pond characteristics and also post farming information, polyculture, biculture and monoculture practices, integrating aquaculture with poultry farming, scientific feeding schedule and respective culture periods and duration. In the case of livestock based interventions, de-worming, micro-nutrient supplementation, prophylactic immunization and other disease control measures for cows and goats, introduction of breeds with high genetic potential in poultry, duck and rabbit are some of the major elements of respective techno-interventions. Agriculture-based interventions included elements such as introduction of improved varieties of vegetable seeds, banana suckers for cultivation, intercropping of banana and amaranthus, nutrient management in coconut plantations, use of bio-fertilizer in paddy farming, vegetable farming on embankments of paddy fields following standard seed rates and spacing pattern. The consumptive value of yields obtained under various categories of techno-interventions give a comparative analysis of the farmers' practice and techno-interventions.

Given these significant implications, why has the development potentials not been explored to its maximum in the pre-intervention scenario? The earlier interventions enunciated by various agencies such as Marine Products Export Development Authority, Agriculture Office, NGOs and also CMFRI had focused more on the output rather than on the process through which a development should be taken up. Irrespective of the organisation involved, a skewed focus could be seen in imparting shrimp farming techniques to various farms. Moreover, they had not taken any special interest in integrating diverse farming potentials of the village rather it concentrated on single-entity farming methods. In some other cases, for instance, CMFRI's planned interventions targeted a recommended set of vulnerable population among scheduled castes and tribes. This has naturally provided a *closed perspective* (may this be a reflecting factor of the targeted communities' behavioural features), of the innovative farming methods introduced and hence a wider reach of the interventions to adjacent farms or villages is seen absent. Another element, which is observed to hinder the maximisation of resource-utility, is the inadequacy in farm related investments. The present programmes (IVLP) subsidised intervention components contributed much to its wider spread as it provided first-hand benefits to a total of 687 farm families.

Development mutations

As part of IVLP, an integrated approach to fine tune the existing aquaculture / fish farming technologies along with animal husbandry and agricultural practices already in vogue for improving productivity was undertaken. IVLP broadly aimed at joint diagnostic studies of production systems for assessment and refinement of technologies. Location specific assessment and refinement of technologies is done in a holistic, inter-disciplinary and interactive manner. The programme introduced improvements in the existing production systems through better scientific management practices without endangering the stability and sustainability of environment. It suggests possible and potential ways of innovative farm production systems with multiple options for implementation with genuine participation of the farmer community. The rural farmers have adopted the scientific know-how that is transferred to them as the same holds up the potentials of wider employment generation or income-enhancing ventures.

IVLP implemented in the coastal village features a participatory development plan. The concept participation has attained importance as it is considered as a pre-requisite for sustaining the project benefits and applying various tools that could attain this. Venkattakumar *et al.,* (2000) envisioned people's participation as a development strategy, in which the associated communities are motivated to function and contribute as a group to perform a pre-determined task. Tamilmani (2002) advocates for people-centered development projects and justifies, as it ensures need assessment by the people themselves which would be more accurate and reliable than that done by outsiders, transparency in every stage of the project cycle, greater chances of mobilising local community resources (labour, capital and common property resources etc), serves as a training ground for empowering people through knowledge gathering, experience sharing, decision making, confidence building and in other facets of development discourse, as people are involved in every stage of the project cycle from formulation to evaluation, people develop concern and tend to put towards success. Dhillon and Hansara (1995) describes the major objectives of people's participation as 1) better planning and implementation of rural development programmes, 2) mobilisation of additional resources required for rural development programmes and 3) empowering people particularly the poor to play an effective role in rural development.

Biggs (1987) distinguishes four different modes of farmer involvement in agricultural research, determined by researchers' and farmers' relative degree of control over the research agenda, a) Contract—researchers set the agenda, farmers' only involvement is that researchers carry out trials on their land; b) Consultative—researchers consult farmers in order to diagnose problems and modify research plans, but retain control over decision-making; c) Collaborative—researchers and farmers work as equal partners and decisions over what research should be done, and how, are made jointly; d) Collegiate—the research agenda is farmer-driven, with farmers having the final say in all decisions. All except the first are participatory, in the sense that the research process takes some account of farmers' opinions and priorities. The implementation of IVLP has followed a collaborative process and during the follow-up stage, the programme has taken up a collegiate recipe. This is evident from their frequent and intensive communication with the scientific institutions in search of solutions to several of their farming constraints, further refinements in farming practices and new experiments in unutilized farm locations.

Comparative assessment of techno-interventions and traditional farming practices

The improvements in the existing production systems by way of introducing scientific management practices is visible in various techno-interventions carried out under the three broad categories such as fisheries, livestock and agriculture. It could be observed **(Table 1)** that crab fattening in tide-fed ponds recorded the highest returns per rupee invested (BC ratio – 2.50). The optimum combinations of water parameters suiting to crab fattening usually occur once for two months in a year in this ecosystem. Aquaculture practices such as biculture of crabs with *Mugil cephalus* and also monoculture of uniform sized juvenile crabs have high investment potentials as is evident from a comparatively higher BC ratio. The difference in returns between traditional and techno-intervened farming practices is more prominent for the intervention of integrated farming of fish and poultry. A better opportunity is open to them with respect to the economic use of their resources through the integration of livestock management and aquaculture practices. Farmers prior to the intervention do not practice pearl spot seed production, in tied-fed ponds. Hence a comparative data on the value and B C ratio is not available.

Another intervention, which is widely acclaimed, is the rack drying of dip-treated fish. This intervention is managed by two self-help groups of women in the village. The major components of the technology include dip-

Table 1: Consumptive use value of fish/crab yield under farmer's practice and techno-intervened aquaculture practices

Sl. No	Aquaculture practice*	Value (Rs.'000 ha^{-1})**		Benefit – Cost Ratio	
		Farmers' practice	Techno-intervention	Farmers' practice	Techno-intervention
1	Monoculture of uniform sized juvenile crabs	403.8	743.6	1.36	2.10
2	Polyculture of finfish in tide-fed ponds	253.8	443.4	0.96	1.64
3	Integrated farming of fish and poultry	265.3	551.7	0.93	1.85
4	Monoculture of *P.monodon* under modified extensive method of farming	275.0	376.0	1.21	1.50
5	Monoculture of *Mugil cephalus* in tide-fed ponds	117.9	275.8	0.64	1.45
6	Monoculture of milkfish in tide-fed ponds	85.0	223.2	0.53	1.24
7	Crab fattening in tide-fed ponds**	353.0	600.0	1.24	2.50
8	Biculture of crab and *Mugil cephalus*	361.8	610.7	1.61	2.37
9	Polyculture of finfish with *P.indicus*	277.5	458.6	0.74	1.20
10	Pearl spot seed production in tide-fed ponds	—	221.6	—	1.03

**This refers to the pattern of techno-intervention followed and for a comparative assessment; the value of consumptive use value of the yield from ponds following farmer's traditional practice is estimated. Farmers' practice is an unrefined version of the current modified techno-intervention*

*** Adjusted for 11-month duration of culture period (for crab fattening the suitable period in this ecosystem is mostly not more than two months, considering the water parameters, and hence only one culture is possible in a year)*

Table 2: Consumptive use value of yields under farmer's practiced and techno-intervened livestock management practices

Sl. No	Livestock management practice	Value (Rs.'000 year⁻¹)**		Benefit – Cost Ratio	
		Farmers' practice	Techno-intervention	Farmers' practice	Techno-intervention
1	Deworming, micronutrient supplementation and prophylactic immunization for dairy cows (for 10 cows)	101.6	135.1	1.12	1.42
2	Deworming, micronutrient supplementation and disease control for goats (for 10 goats)	6.1	10.0	1.00	1.39
3	Farming of *Gramalakshmi* breed of poultry (for 10 birds)	7.3	17.9	0.61	1.12
4	Farming of *Kuttanadan* ducks (for 10 birds)	15.4	24.0	1.05	1.33
5	Farming of *Grey giant* variety of rabbit (for 5 rabbits and offsprings)	5.5	10.7	1.10	1.46

**Adjusted for one year*

treatment of fish in saturated brine solution with 5 per cent calcium propionate. The treated fish is then dried in sunlight in the specially designed racks. The dried fish is then packed in polyester polyethylene for sale. The treated fish resisted microbial attack and consequently increased the shelf life to an average of 125 days. The B C ratio worked out during the intervention period was 1.98:1 which is well above the mark of 1.37 in the traditionally practiced drying of fish.

Under livestock based interventions, the problems such as intensive parasitic infestations due to the peculiar geographic features, lack of nutritious feeds and inadequate supply of breeds with high genetic potential are rectified through proper interventions. The consumptive use value of the yields from various livestock management practices, increased by 33 per cent for cows and 64 per cent for goats. The introduction of breeds with high genetic potential has also proved to be suiting to the typical agro-ecosystem as the yield from respective breeds of poultry, duck and rabbit out-performed traditionally reared country varieties **(Table 2)**.

Most of the agriculture-based interventions (8 out of 11) have suggested improvements in the farming of vegetable. Vegetable farms made use of the nutrient rich pond-bed soil. Recommended spacing pattern and seed rate have resulted in better yield for the improved varieties of seeds introduced. The highest B-C ratio is worked out for the cultivation of *Preethi* variety of bittergourd (6.8:1) followed by *Indam-1222* variety of ridgegourd (3.94:1).

It should also be noted that the increase in consumptive use value with respect to yields from traditional farming practices to techno-interventions is more intense for the cultivation of *Dwarf Cavendish* variety of banana and also for nutrient management practices in coconut plantations **(Table 3)**.

An index-based estimate is used for a comparative assessment of the average investment and returns on various techno-

Table 3: Consumptive use value of yields under farmer's practice and techno-intervened agriculture farming practices

Sl. No	Agriculture practice	Value (Rs.'000 year^{-1})**		Benefit – Cost Ratio	
		Farmers' Practice	Techno-intervention	Farmers' Practice	Techno-intervention
1	Cultivation of improved variety of amaranthus (*Kannara local*)	40.5	54.3	2.61	3.37
2	Cultivation of improved variety of bittergourd (*Preethi*)	60.6	128.3	3.50	6.80
3	Cultivation of improved variety of okra (*Arka anamika*)	98.6	69.1	5.68	3.66
4	Cultivation of improved variety of snakegourd (*Kaumudi*)	38.6	55.3	2.22	2.93
5	Cultivation of *Dwarf Cavendish* variety of banana	48.8	200	0.32	1.27
6	Nutrient management practices in coconut plantations based on soil test data	15.0	50.0	0.75	2.00
7	Cultivation of improved variety of cowpea (*Arka garima*)	25.6	41.4	1.40	2.16
8	Cultivation of improved variety of salad cucumber (*Pointsetae*)	44.2	62.72	2.55	3.32
9	Cultivation of improved variety of ridgegourd (*Indam-1222*)	63.8	83.4	3.28	3.94
10	Rice cultivation using biofertilizer (*Azolla*) under group farming system	0.8	1.6	0.10	0.22
11	Integrated farming of improved variety of vegetable on embankments along with paddy farming	39.3	52.5	2.03	2.70

**Adjusted for one year*

interventions carried out in the typical coastal agro-ecosystem. Accordingly fisheries required a comparatively higher investment over livestock and agriculture based interventions. With respect to investment, the index value remained same in case of livestock and agriculture interventions, whereas that of returns was in favour of agriculture. It is also obvious that while the index value of returns from fisheries-based interventions is 100, the same for livestock and agriculture are 9 and 16, respectively **(Table 4)**. The disadvantageous position of fisheries in investment requirements is compensated with a comparatively better return.

Table 4: Comparative index of investment and Returns from techno-Interventions under IVLP

Category	Investment	Returns
Fisheries	100	100
Livestock	11	9
Agriculture	11	16

Partnership Building in IVLP: A critical appraisal

The environment within which the programme is implemented should be supportive for a productive functioning of the techno-interventions. This has been identified by way of an actor-linkage matrix developed for monitoring partnership building. On the basis of the *Actor-Linkage Matrix for Monitoring Partnership Building*, the *intra* and *inter* linkages that are created between various actors in IVLP has been recognised.

A total of 18 actors, including the project team have been identified. Monitoring and evaluation mechanism based on *ex-post facto* research design could easily identify the "strong" as well as "weaker" linkage in the matrix, on the basis of which appropriate actions could be planned in the future to explore the potentials of strong linkages and also search for measures to strengthen those "weaker" or "destructive" linkages. The dark shades in the matrix suggest the linkages to be established in the forthcoming phase so as to strengthen the partnership among various actors. A need-based and also analysis-based linkage building would certainly help in sustaining the project initiatives in the embedded social fabric. Out of the other 17 actors identified, the project team has established linkages with 11 actors. The omitted linkages include that of NABARD, political parties/leaders, and local middlemen. It should be noted that local middlemen are counted as those entrusted with catalytic roles since they have developed themselves as an inevitable institutions in the primary sector activities of the village, especially in fishery related activities. Linkages that are established during intervention period with banks/other financial institutions, NGOs and researchers are performing weak. From the actors' point of view, final consumers, local middlemen, and NABARD are not at all linked to the project particulars. Though actors like agriculture office, Panchayat functionaries, academic institutions (agriculture related) political parties/leaders have made linkages but observes to be bleak in maintaining the linkages. Hence, the advantages with respect to effective dissemination, quality of farm-based research and the possible spread effect of techno-interventions that could be derived out of a strong partnership building are below the optimal. The table also tells about the linkages to be established to strengthen the village development system with respect to the refined techno-interventions.

Implications for development strategy within the village

Development based on the natural wealth of the village is rational and a major obligation for the functionaries planning for development. A successful development strategy should address three main production stay in the village, such as fisheries, agriculture and livestock. A critical analysis of the development processes and the output trends from farms have identified which farming practices should be followed in order to maximise productivity, in the most space-efficient and eco-friendly manner. Further, consideration has been given to the way in which such areas should be configured in order to minimise the direct costs of conservation in an environmentally sensitive coastal region. The interventions carried out in the village and result of such participatory research provides the first step in developing a more holistic development pattern that works in the context of existing costs and benefits of development oriented farming and maximised societal wellbeing.

Determining the optimal area for cultivation from a societal point of view is not necessarily the final solution. The optimal solution for society as a whole is likely to be quite different from that perceived from local level interventions, and if ignored, this difference has the potential to undermine development initiatives. Ideally, a whole-village-development-plan should take cognisance of local level values in order to achieve a pareto-efficient solution, whereby overall benefits to society are improved without uncompensated losses to any individual or any segment of the society. This study has come across a societal problem with respect to the collection of wild seeds for the increasing number of fish farms which follow recommended intervention strategies. A public-private partnership may be evolved out to resolve the problem of scarce natural resources. In this case, development of hatchery techniques for a generous supply of the scarce fish seeds is a solution. This study has shown that the consumptive value of yield from farms adopted technology upgradation has outperformed the local and traditional farming practices. It should be noted that a replacement of the existing farming practices is not at all attempted in any of the techno-interventions, rather it instilled on altering the composition of farm ingredients for a better output and found successful. But that the subsidised support system offered by the interventionist strategy influenced the adoption rate remains factual and this could be substituted with locally evolved strategic support in future. The actor-linkage-matrix shown to study the partnerships to be established clearly depicts the role of financial institutions, social activists, Panchayat functionaries, NGOs and media in building up such a support system. This would contribute significantly to the sustainable adoption of techno-intervention elements and subsequently an optimal village development pattern. The study however rests on the crucial assumption that a proper extension campaign would be successful in transforming all unutilised and under-utilised farm area in the village to productive use for the refined techno-interventions.

The impact projections of a wider transfer of the techno-interventions beyond village bounds to the remote coastal reaches of Kerala, for a select set of four identified interventions could bring out a surplus production of about 60,000 t fish, 52 crore coconuts, 2.7 lakh t milk and 2 crore eggs, generating consumptive value of Rs.842 crore per year (Sathiadhas *et al.*, 2005). The shift from a semi- articulated village farming system to an optimal-seeking production pattern might induce private incentives to mine the coastal resource stocks. Appropriate regulations may also be framed especially to check the tendency to reap maximum even through the muddle up of coastal ecosystem.

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