

Spatial and Temporal Integration of Component Enterprises in Smallholder Farms of India for Sustainability in Farming and Rural Livelihoods

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Abstract: Integrating component enterprises in small holder farms in agro-ecologically varying clusters of three villages each is being tried, through a participatory research, sponsored by Indian Council of Agricultural Research and World Bank. Integrating fish culture and poultry rearing in the rice fields, over 200 m² of the farm in 100 holdings and integrating goat rearing with crops in sequence, in 2000m² of 100 farm holdings are being practiced. Results during the first 18 months indicate that the livelihood enhancement is by 21-32 per cent in wetland clusters and 11 to 15 per cent in upland clusters.

Keywords: Farming Components, Spatial, Temporal, Integration, Sustainability, Livelihoods

Introduction

The three of the districts identified by planning commission of India as disadvantaged in the state of Tamilnadu are coastal and fourth one is adjoining the coast. They occupy 270 km of coastal length and these districts are disadvantaged by agro-ecological, bio-climatic and socio-economic conditions. These districts are compelled to grow rice because of monsoon dependent crop growing seasons that often result in inundation and stagnant water, that could be tolerated only by rice. Further, they lie at the tail end of cauvery river delta, with the Lake 'Veeranum' and it's 27 distributaries serving the purpose of supporting transplanted wetland rice during a pre-monsoon or post-monsoon season. However, in recent days they remain dry during most part of the year due to dispute in sharing of Cauvery river water with the adjoining state. Added to these constraints the predominant soil type in these tract is heavy clay that restricts the scope for crop diversification in the pre or post-monsoon seasons. The average annual rainfall in these districts is 1408 mm which is higher than the state average by 10 per cent. Further, as they remain along the coast they are also frequently exposed to natural disasters like cyclones, floods and tsunamis. All these force mono-cropping of rice to the majority of farm holdings and restrict crop and farm diversification resulting in dismal livelihood / income, poor nutritional status and under employment. These districts also possess interior uplands that are comparatively dry, where farmers grow rainfed crops like millets, groundnut, vegetables or flower crops during the monsoon season. These districts are selected as the target area of World Bank and Indian Council of Agricultural Research funded National Agricultural Innovation Project. Technological interventions with primary emphasis on integration of farming components are implemented in small holder farms that predominate the locality, from September 2008 onwards.

Materials and Methods

Site Selection:

Clusters of villages, each of which include 3 villages of similar administrative setup and geographical contiguity are selected in all the four districts (Figure 1) that are classified as disadvantaged by planning commission of India viz., Cuddalore, Nagapattinam and Thiruvannamalai. The other criteria for selection of the target villages are

- Larger proportion of farm lands under any one of the three identified agro-ecological groups such as irrigated/coastal wetlands, rainfed uplands and shore farming.
- Availability of considerable landless agricultural labourers
- Lower farm productivity
- Lack of infrastructure and marketing facilities

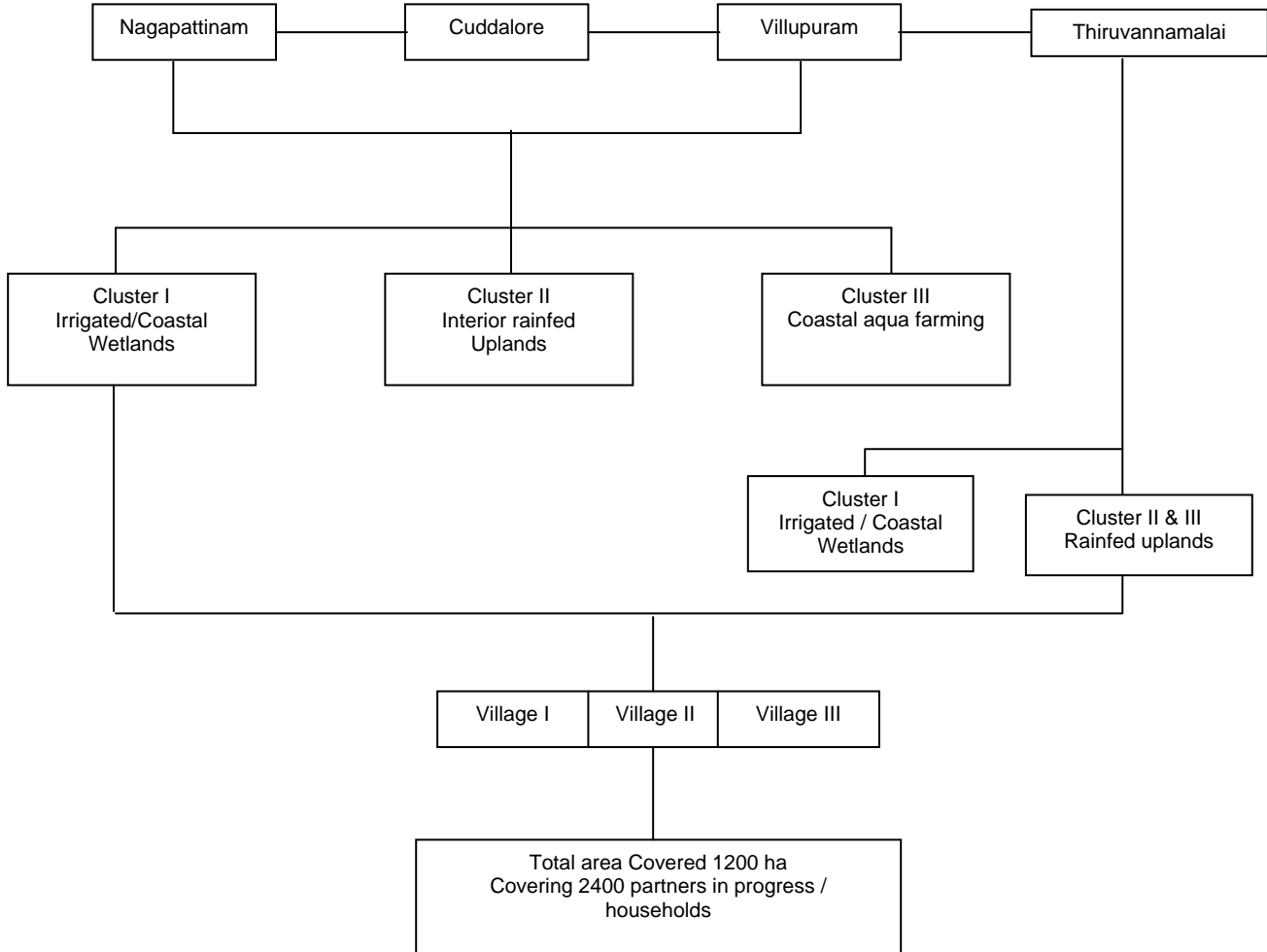


Figure 1. Flowchart for site selection.

Technological Interventions

Technological intervention for Wetland Clusters

An innovative mode of integrating fish culture and poultry rearing in rice fields is being implemented. Unlike other farming systems demonstrated elsewhere, wherein the components would remain as separate entities, in this IFS approach, fish poly culture with Catla, Roghu, Mrigal, Common Carp and Grass Carp in equal proportions of a stocking density of 2000 fingerlings ha⁻¹ are taken up in trenches running along the border of rice fields in one side, with a dimension of 1 x 0.5 m, occupying 10 per cent rice area. Broiler birds @ 1 bird / 10 m² of rice area, are housed in cages that could accommodate a maximum of 20 birds (6 x 4' of floor space and a height of 3') and are installed in the field using six concrete posts of height 8', 4' buried inside the field and 4' protruding above, lifting the cages above crop canopy. The bottom of the cages are made of wire mesh (0.5 sq. inch) so as to leave the broiler waste, straight to the rice field wherein a 5 cm water column is maintained, allowing

the poultry waste to get dissolved and to serve both as manure to the field as well as feed for the fishes. This excludes the need for collecting the poultry waste and applying it to the rice field the task of which are laborious and cumbersome, besides the scope for some wastage. The fishes swim in the rice field and feed on the pests and weeds. This technology is taken up over 5 cents area of rice in each of the 100 selected holdings with 1m deep fish trenches on one side, occupying 10 per cent of rice area and poultry cages installed as per specification, to accommodate broiler birds @ 1/10 m². Poultry cages are given free of cost initially.

Technological Intervention for Upland Clusters

This technology involve rearing goats and using them for manuring as well as plant protection in crops that would be grown during the succeeding cropping season. Under existing goat rearing mode, farmers rear goats, exclusively on herbs and vegetation available on social and ranching sites. In the intervention implemented, farmers are trained to rear the goats, allowing them to graze on the weed vegetation (mostly perennial grasses like *Cynodon dactylon* and sedges like *Cyperus rotundus*) that predominate the cropped lands during the off-season. Simultaneously, collecting the goat manure during the off-season and incorporating them for the crops (millet / vegetable / flower crop) during the rainfed seasons is practiced that greatly compliment the crop by virtue of improved organic matter, soil nutritional status, pest, disease and weed control (through depletion of soil weed seed bank and suppression of alternate weed hosts for the pest and diseases). This helps control of perennial weeds. However, these goats (reared @ 4/acre or 10/ha) are fed with tree loppings and other freely and easily available forages during the cropping season that raises a crop of the farmers choice. Early sexual maturity, low age at first kidding (10-14 months) and multiple births in well managed goats contribute for a rapid rise in goat population. Hence, farmers are trained to sell goats attaining weight between 15-20 kg, after 18 months.

Results and Discussion

The baseline survey of the project indicated that the gross household income in Wetland clusters is Rs.31,822.11 (US\$677). Increase in income for these three clusters are presented in table 1. The increase in Gross household income in Villupuram districts is Rs.10,100 (US\$214) which is accounting for 31 per cent, the highest, as the number of broiler rearing spread over three crops of rice is seven. The increase in gross household income in Cuddalore district is Rs.8,100 (US\$172), that contributes only 25 per cent increase. This is because of the fact that water availability in the Wetland cluster is not permitting more than one crop and hence, only four broiler rearings are alone possible. However, the farmers are enthusiastic about the intervention as is evident from one broiler rearing that extends outside the three that are possible during the single crop of rice. The increase in gross household income is the least of Rs.6,600 (US\$140) that makes only 21 per cent increase with in an year in Nagapattinam district. Though two crops of rice are grown and poultry rearings for five generations were taken up, the meat yield and market prices are comparatively lower than that experienced at Cuddalore. The Manurial output from broiler birds in rice are furnished in table 2. The results indicate that addition of poultry manure in five cents of rice area has added nutrients more than the quantity that could have been possible through the normally recommended dose of Farm Yard Manure. Higher nutrient addition through poultry manure compared to other organic sources in rice is already observed in institutional and on-farm experiments (Kathiresan, 2009a) Pest incidence in rice as shown in table 3, is also reduced due to integration of the fish culture and poultry components, because of the feeding habits of fishes that suppresses the egg masses, larvae and alternate weed hosts of pests. Reduced pest incidence in rice and enhanced weed control due to the feeding habits of fish integrated in rice reported earlier (Kathiresan et al., 2001; Kathiresan et al., 2005; Kathiresan 2007; Kathiresan 2009b) lend support for these observations.

In the upland clusters, integrating goats rearing with crops in sequence, enhanced the livelihood of small and marginal farmers (Table 4). The baseline survey indicated that annual income of farmers in

upland clusters is Rs.30398, in all the three district. The average livelihood enhancement is the highest in Villupuram districts, as the reproduction from three goats given to the farmers, at the commencement of the project, has resulted in five goats in total by 18 months with three of them becoming salable. In other two districts, though the reproduction rate on an average is comparable, the weight increase in kids is slow because of lesser availability of the loppable fodder during cropping season and weed vegetation available for grazing during the off-season. This is reflected on the fact that farmers of these districts viz., Cuddalore and Nagapattinam had only two additional goats that are salable by 18 months duration, that contributed for comparatively lower livelihood enhancement. However, the reduction in weed biomass in the farmers field because of grazing by goats in the off-season. (Fig 2) is higher in Cuddalore and Nagapattinam districts compared to Villupuram that could be attributed to closer grazing of goats for want of excessive or adequate flushes of weed vegetation in the off-season in these two districts compared to Villupuram.

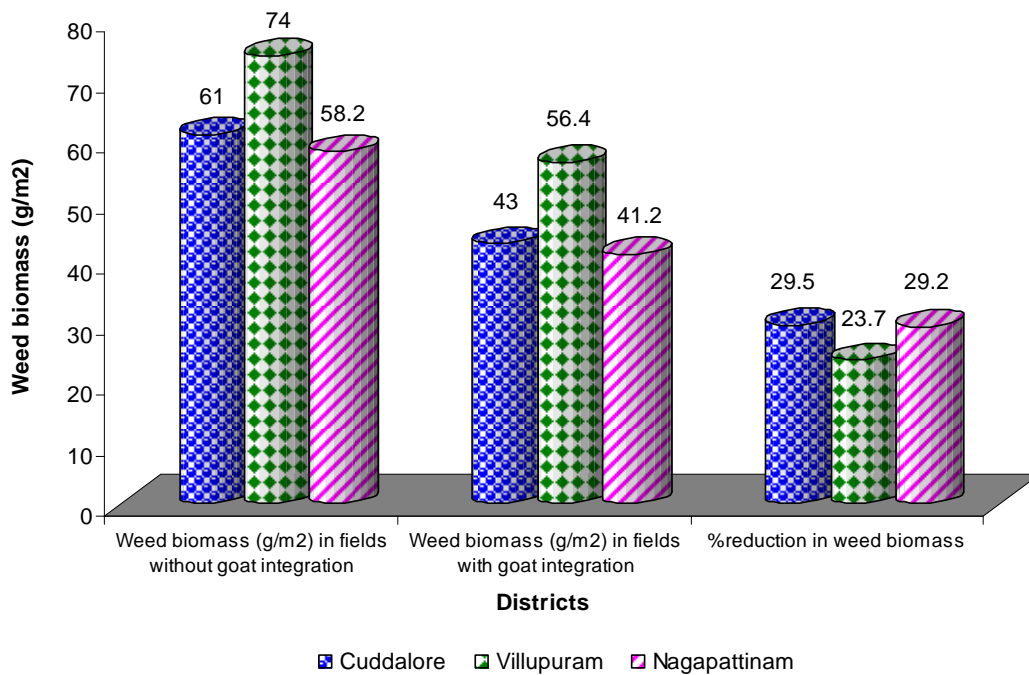


Figure 2. Weed suppression due to goat grazing in upland clusters.

Table 1. Livelihood enhancement in wetland clusters

Districts	No. of poultry bird rearing	Average meat yield/bird (Kg)	Average meat yield/household (kg)	Cost of meat Rs/Kg	Gross return from poultry (Rs)	Cost of production of poultry bird	No. of Fish rearing	Fish yield/household (Kg)	Fish cost Rs/kg	Gross return from fish	Cost of production of fish	Total net return	Livelihood enhancement (%)
Villupuram	7	2.10	294	50	14,700	9,800	2	150	40	6,000	800	10,100	32
Cuddalore	4	2.25	180	65	11,700	5,600	1	60	40	2,400	400	8,100	25
Nagapattinam	5	2.0	200	55	11,000	7,000	1	75	40	3,000	400	6,600	21

Table 2. Manurial Addition from Poultry Voidings

District	Age of birds (in days)	Voiding by a bird / day (g)	Total quantity of voiding added for 5 cents of rice/year (Kg)	Nutrients added (Kg)			Recommended quantity of FYM for 5 cents rice (Kg)	Nutrients added (Kg)		
				N	P ₂ O ₅	K ₂ O		N	P ₂ O ₅	K ₂ O
			1.73% N, 0.85% P ₂ O ₅ & 0.38% K ₂ O							
Cuddalore	15	39.2	228.00	3.94	1.93	0.86	200.00	1.00	0.50	1.00
	30	71.8								
	45	78.5								
Nagapattinam	15	37.8	279.45	4.83	2.37	1.06	400.00	2.00	1.00	2.00
	30	70.6								
	45	77.9								
Villupuram	15	38.0	392.00	6.78	3.33	1.48	600.00	3.00	1.50	3.00
	30	71.5								
	45	77.3								

Table 3. Rice+Fish+Poultry and Pest Incidence in Rice.

Districts	Leaf Damage in % on 40 DAT		N.lugens Population on 7 DAT	
	Rice Alone	Rice+Fish+Poultry	Rice Alone	Rice+Fish+Poultry
Cuddalore	23.0	18.0	11.0	8.0
Villupuram	21.0	17.0	14.0	10.0
Nagapattinam	17.0	14.0	15.0	11.0

Table 4. Livelihood enhancement in upland clusters.

Districts	Number of goats sold on reproduction	Return from sale of goats (Rs.)	Maize yield in Kg/ha	Enhancement in livelihood (%)
Cuddalore	Two	3600.00	1850	12.0
Villupuram	Three	4500.00	2175	15.0
Nagapattinam	Two	3200.00	1920	11.0

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