

16. INTEGRATED FARMING SYSTEMS RESEARCH IN TAMIL NADU

The marginal and small farmers constitute 78.2 per cent of the farming community in India. The unique Indian situation of small fragmented holdings and lack of capital investments is not suitable for single commodity farming being practiced in developed countries. So, the integrated farming system appears to be a viable solution to the Indian agriculture for increasing productivity and income of the small and marginal farmers with constrained resources. Efforts for a holistic integration of different farming enterprises with cropping were carried out for Western, Cauvery delta, Southern and North western zones out of seven agro climatic zones of Tamil Nadu with the objectives of increasing income and recycling of farm wastes and by-products to sustain the soil productivity since 1985. The approaches were to find out viable components for wetland, irrigated upland and rainfed situations existing in different ecological zones.

INTEGRATED FARMING SYSTEMS

1. WESTERN ZONE

WETLAND

Integrated farming systems experiments were conducted at wetlands from 1987-onwards at Tamil Nadu Agricultural University, Coimbatore involving different components *viz.*, poultry, pigeon, goat, fishery and mushroom.

Crop + poultry/ pigeon + fish + mushroom

In this system, the component of integrated farming system involved were crop + fish + mushroom, crop + poultry + fish + mushroom and crop + pigeon + fish + mushroom and was taken from 1993–1995. The efficiency of the component linkages was evaluated predominantly on the basis of productivity, its income and employment generation with the possibility of utilizing recycled organic wastes as nutrient to enrich the soil fertility.

To enhance and sustain the productivity, economic returns, employment generation for the family labour round the year and soil fertility with environmental protection, integration of rice-gingelly- maize and rice- soybean -sunflower cropping each in 0.45 ha with recycled poultry manure as fish pond silt to rice and 75 per cent of the recommended NPK to each crop in the system + poultry (50 layers) + fish (1000 polyculture fingerlings in 0.10 ha of ponded water) comprising catla (20 per cent), silver carp (20 per cent), rohu (20 per cent), mrigal (15 per cent), common carp (15 per cent) and grass carp (10 per cent) fed with poultry dropping + oyster mushroom (5kg/day) for the lowland farmers having one hectare farm.

Cropping + poultry / pigeon / goat + fishery

During 1998-2001, the study involved cropping, poultry, pigeon, goat and fishery enterprises in all possible combinations, with a view to recycle the residue and by-products of one component over the other. In one hectare farm, an area of 0.75 ha was assigned for crop activity, 0.10 ha for growing fodder grass to feed the

goat unit (20+1), 0.03 ha allotted to goat shed and the remaining 0.12 ha allotted to 3 fish ponds. Three integrated farming systems *viz.*, crop + fish + poultry (20 Bapkok layer birds), crop + fish + pigeon (40 pairs) and crop + fish + goat (Tellicherry breed of 20 female and 1 male maintained in 0.03 ha deep litter system) were tried for three years. Polyculture fingerlings of 400 numbers (catla, rohu, mirgal/ common carp and grass carp) in the ratio of 40:20:30:10, respectively, reared in 3 ponds of size 0.04 ha (depth of 1.5 m) each.

Integration of crop with fish, poultry, pigeon and goat resulted in higher productivity than cropping alone under lowland. Crop + fish + goat integration recorded higher rice grain equivalent yield of 39610 kg/ha. The highest net return of Rs.131118 and per day return of Rs.511 ha⁻¹ were obtained by integrating goat + fish + cropping applied with recycled fishpond silt enriched with goat droppings. Higher net return of Rs.3.36 for every rupee invested was obtained by integration of pigeon + fish + cropping applied with recycled fishpond silt enriched with pigeon droppings. The poultry, pigeon and goat droppings were utilized as feed initially and at the end of a year after the fish harvest, about 4500 kg of settled silt from each pond were collected. The pond silt was utilized as organic sources to supply sufficient quantity of nutrients to the crops.

IRRIGATED UPLAND

Crop + Dairy + Biogas + Mushroom + Fish

Integration of 0.32 ha each of sorghum + red gram - sunflower + coriander, maize + fodder cowpea - cotton + coriander and perennial fodder CO3 grass + legume fodder (Lucerne) with dairy (6 cows + 4 calves), biogas (2 m³ capacity) and mushroom (2 kg day⁻¹) + spawn production (10 bottles day⁻¹) recorded higher productivity than the cropping alone with sorghum - cotton (0.50 ha) and maize - cotton (0.50 ha) cropping systems. Cropping + dairy + biogas + fish + mushroom integration recorded the highest gross, net and per day returns. It also registered the highest benefit cost ratio of 2.41 during 2000-2001.

On farm study was conducted during 2004-2007. The crop activity in integrated farming system consisted of field crop, vegetable crop and fodder crops. The livestock kept were two cross bred milch cows + one calf, ten female tellicherry does + one buck and twenty guinea fowls. Improved farming system gave the maximum maize grain equivalent yield of 22,754 kg/ac/year which was 47.9 % higher than the traditional farming system. The improved system was able to generate employment of 235 man day's acre⁻¹ which was higher than traditional farming system (105 man day's acre⁻¹). Through recycling of crop residues and livestock manure about 3.72 tonnes of bio-compost and 1.59 tonnes of vermicompost were obtained. This could able to supply 26.0, 22.3, and 26.0 kg N P K to field and fodder crops through biocompost application and 39.4,10.5 and 18.0 kg NPK to vegetable crops as vermicompost

application in an acre land area. The returns per rupee of investment from the ratio of gross value of output to total cost (GVCR) was 3.62 and ratio of net value of the products to total cost (NVCR) was 2.80.

RAINFED LAND

Crop + Tree + Goat

Integrated farming system model involving crop + tree + goat was taken from 1999-2001. Experimental results on integrated farming system revealed that

- (i) Integration of sorghum + cowpea (grain), sorghum + cowpea (fodder) and *C. glaucus* each in 0.33 ha intercropped in *E. officinalis* with Tellichery goat component (5+1) in 0.01 ha resulted in higher productivity, economic returns and provided better employment opportunity and improved soil fertility than raising sole sorghum alone
- (ii) Coir pith mulching and pitcher irrigation increased the tree seedling growth than the control,
- (iii) Tied ridges conserved more moisture and improved the productivity of the crops,
- (iv) Application of 50 per cent N through fertilizer and 50 per cent N through goat manure increased the productivity, enhanced the soil fertility and provided better opportunity for recycling of manure to the crops. Results of on-farm field experiments conducted during 2009 - 2011, revealed that, integration of *Cenchrus setigerus* + *Stylosanthes hamata* and fodder sorghum + *Pillipesara* with sheep (5+1) and buffalo (2 No.'s) could be the best silvipastoral farming system with the application of recommended dose of 25: 45: 19 kg ha⁻¹ NPK for *Cenchrus* based system and 30: 20: 10 kg ha⁻¹ NPK for fodder sorghum based system along with FYM (10 t ha⁻¹) for dry land of Western Zone of Tamil Nadu.

2. CAUVERY DELTA ZONE

Cropping + fish + poultry/duck/goat/dairy

An experiment was conducted during 1992-1994 in rice based farming system as a demonstration trial at Aduthurai. The components were cropping, fish culture and poultry. An area of 0.40 ha was selected for the farming system study, considering the small and marginal farmers of the state. Conventional cropping as practised by farmers was taken up in an area of 0.96 hectare. In the fish pond with 400 m², fingerlings belonging to the species viz., Catla (*Catla catla*) (200) Rohu (*Labeo rohita*) (100), Mirgal (*Cirrbinus mrigala*) (100) were stocked.

The economics worked out for the system as a whole was Rs.28,983, in which cropping system contributed Rs.23,709, Poultry and Fisheries contributed additional income of Rs.5,274. Poultry droppings added to the fish pond as feed was 3 tonnes year⁻¹ (100g/birds). Mean number of egg production was 262 year⁻¹ bird⁻¹. In the case of fish pond (0.04) yield recorded was 234 kg. Of the income obtained from the integrated farming system, 78% was from cropping system and poultry cum fisheries generated additional income and employment.

Cropping + duck + fish culture

Integrated farming system with duck-cum-fish culture as a component was tried during the year 1989. Two farm holdings each with the size of one ha were selected for conducting the study. In one holding, conventional cropping as practiced by farmers was followed. In another one hectare, cropping was practiced in an area of 0.973 ha and an area of 0.027 ha was allotted for duck-cum-fish culture. Economics of IFS was compared with existing cropping systems. Net income of Rs.13790/- was obtained from existing cropping system (*Kuruvai-thaladi* rice - pulse) and a net income of Rs.22676/- was obtained from the modified cropping system (*Kuruvai - thaladi* rice - cotton and maize) with an area of 0.973 ha allotted for cropping.

The additional profit from modified cropping alone was Rs.8886/-. From duck-cum-fish culture as a component in mixed farming system, a net profit of Rs.1441/- was obtained from an area of 0.027 ha. Totally an additional income of Rs.10327/- was obtained from the mixed farming system over existing cropping system.

3. SOUTHERN ZONE

WETLANDS OF TAMBIRAPARANI COMMAND AREA

Evaluation of integrated farming system for wetland farms was conducted during 1990-92.

The components of the traditional and integrated farming systems are as follows:

Traditional system (1 ha)	: Rice – Rice – Fallow
(1 ha)	: Crop + dairy + fishery
0.4 ha	: Rice-rice + soybean (bund) – blackgram
0.2 ha	: Ragi + sunflower (border) – fodder maize + cowpea – cotton + Greengram
0.2 ha	: Bajra napier hybrid fodder grass
0.1 ha	: Desmanthus
0.04 ha	: Fish pond
0.06 ha	: Cattle shed for 3 jersey cows and 2 work bullocks

The integrated farming system provided a net income of Rs.25,215/- which was 100.7 per cent more than the income from the traditional rice farming (Rs.12,662/-)

On-farm studies were also undertaken to assess the economic benefits of integrated farming systems actually practised by wetland farmers of Tirunelveli-Kattabomman district during 1990. The study covered four farms in four villages with a farm size of 1-2 ha, raising rice, banana and pulses. The allied activities includes dairy, goat rearing, poultry and fishery. The average monthly income of the farm family practicing the integrated farming system varied from Rs.1,850 to 2,560.

WETLANDS OF PERIYAR VAIGAI COMMAND AREA

In the Periyar – Vaigai command area, nearly one lakh hectares are raised with a single crop of rice during August – January. The lands are usually left fallow after rice harvest in January. To assess the potential of IFS in such single crop wetlands, experiments were conducted at Agricultural College and Research Institute, Madurai during 1989-91. The results revealed that by crop intensification, diversified cropping and by inclusion of fishery and poultry, the farm income per acre could be increased by Rs.5435 to Rs.6235 per year.

DRY LANDS OF SOUTHERN ZONE

To identify suitable integrated farming for the dry lands, experiments were conducted at Regional Research Station, Aruppukottai and Agricultural Research Station, Kovilpatti. In the rainfed black soils, the common crops are sorghum, pulses, cotton and sunflower. Introduction of tree legumes like subabul, *Acacia senegal* and *Prosopis cineraria* and perennial fodder grass *Cenchrus ciliaris* and inclusion of goat rearing were evaluated at Regional Research Station, Aruppukottai. Five female and one male goat of Tellicherry breed were raised in deep litter system. The results revealed that the IFS yielded an additional income of Rs.2163 to Rs.2556 per year from a farm area of 1.6 ha. In another study at Aruppukottai proved the IFS system of crop + horticulture + goat proven to be successful in the black soils and increased the profit by Rs.2363 to Rs.4706 per ha over cropping alone.

At Agricultural Research Station, Kovilpatti, studies were taken in farmers' holdings in the dryland red soils. IFS with crop+goat yielded an annual income of Rs.8410 per ha compared to Rs.4654 per ha under traditional cropping alone.

4. NORTH WESTERN ZONE

The studies were made under garden land condition. The results revealed that in both Paiyur and Yercaud Centres dairy linked farming system was more remunerative, with more employment generation. The next successful farming system under rainfed condition at Paiyur was sericulture.

POTENTIAL ALTERNATIVES

Western zone

Wetlands Crop + poultry/ pigeon + fish + mushroom Crop + poultry/ pigeon + goat + fishery

Upland with supplemental irrigation

Crop + dairy + biogas + silviculture

Crop + dairy + biogas + mushroom + fish

Rainfed lands Crop + goat, Crop + goat + tree

Cauvery Delta zone

Crop + poultry + fish Crop + duck + fish Crop + milch animals Crop + goat + dairy

Southern zone

Wetlands of Tambirabarani Command: Crop + dairy + fishery Wetlands of Periyar

Vaigai Command: Crop + fish + poultry Dry lands: Crop + orchard + goat

North Western zone

- ❖ Crop + dairy + poultry
- ❖ Crop + dairy + poultry + sericulture

Adoption of improved farming system models can result in the advantages listed below.

- Higher food production to equate the demand of the exploding population of our nation
- Increased farm income through proper residue recycling and allied components
- Sustainable soil fertility and productivity through organic waste recycling
- Integration of allied activities will result in the availability of nutritious food enriched with protein, carbohydrate, fat, minerals and vitamins
- Integrated farming will help in environmental protection through effective recycling of waste from animal activities like piggery, poultry and pigeon rearing
- Reduced production cost of components through input recycling from the byproducts of allied enterprises
- Regular stable income through the products like egg, milk, mushroom, vegetables, honey and silkworm cocoons from the linked activities in integrated farming
- Inclusion of biogas & agro forestry in integrated farming system will solve the prognosticated energy crisis
- Cultivation of fodder crops as intercropping and as border cropping will result in the availability of adequate nutritious fodder for animal components like milch cow, goat / sheep, pig and rabbit
- Firewood and construction wood requirements could be met from the agroforestry system without affecting the natural forest
- Avoidance of soil loss through erosion by agro-forestry and proper cultivation of each part of land by integrated farming
- Generation of regular employment for the farm family members of small and marginal farmers