



Integrated nutrient management through residue recycling in lowland integrated farming systems

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Abstract: Integrated farming system experiments comprising enterprises like cropping, fishery, poultry, pigeon and goat were undertaken at Tamil Nadu Agricultural University, Coimbatore during 1998-2000, with a view to sustain the productivity through residue recycling and thereby enriching the soil fertility under lowlands. Among the enterprises, cropping with fish and goat integration recorded higher productivity of 39610 kg ha⁻¹ than other systems. Similarly, maximum total income (Rs. 1,38,418) with the highest level of employment (575 mandays ha⁻¹ year⁻¹) was achieved in crop + fish + goat integration. Crop applied with recycled fish pond silt fed with poultry manure resulted in higher income (Rs. 1,04,231). Integration of poultry + fish + cropping nourished with recycled poultry manure sustained the productivity of soil through the addition of residue with better NPK nutrient supply potential (88, 20 & 27 kg of NPK, respectively). To enhance the productivity, economic returns and employment generation for family labour, integration of crop with fish + goat/pigeon/poultry could be recommended than cultivating the crop alone under lowland situation.

Key Words: Lowlands, Integrated farming systems, Residues/wastes recycling, Cropping, Poultry, Fishery, Pigeon, Goat rearing, INM.

Introduction

Integrated farming system approach is not only a reliable way of obtaining fairly high productivity with substantial fertilizer economy but also a concept of ecological soundness leading to sustainable agriculture (Swaminathan, 1987) and also deriving maximum compatibility and replenishment of organic matter by way of proper recycling of organic residues/wastes obtained through integration of enterprises like fishery, poultry, goat, milch animal, mushroom and sericulture activities. The recycling process could reduce the cost of production per unit of grain, meat, milk, egg, edible mushroom, biogas etc., thereby widen the gap between the production cost and net return.

An effort has been made for a holistic integration of different farming enterprises such as linking poultry, pigeon and goat rearing with cropping with the objectives of increasing income and effective recycling of farm wastes and by-products to sustain the soil productivity and fertility.

Materials and Methods

Field experiments on integrated farming systems were conducted at the Tamil Nadu

Agricultural University, Coimbatore during 1998-2000 involving cropping, poultry, pigeon, goat and fishery enterprises in all possible combinations, with a view to identify the sustainability of integrated farming systems through recycling of organic wastes/residues of one component over the other. In one hectare farm, an area of 0.75 ha⁻¹ was assigned for crop activity, 0.10 ha⁻¹ for growing fodder grass to feed the goat unit (20+1), 0.03 ha to goat shed and the remaining 0.12 ha 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) were tried for 2 years. Polyculture fingerlings of 400 numbers catla, rohu, mrigal / 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. Fishes were fed with poultry, pigeon and goat droppings to assess the feasibility of rearing fish by using different manures as feed. In addition, the goat unit could also provide 11.0 t of valuable manure for crop component. At the end of an year after the fish harvest, about 4500 kg of settled silt from each pond were collected. The pond silt was utilized as recycled organic

Table 1. Productivity (Rice Grain Equivalent Yield kg ha⁻¹) of different cropping systems (1998-2000)

Cropping Sequence	Recycled poultry manure			Recycled pigeon manure			Recycled goat manure			Vermicompost		
	I year	II year	Mean	I year	II year	Mean	I year	II year	Mean	I year	II year	Mean
I. Sugarcane (Planted)- Sugarcane (Ratoon)- Banana* 0.25 ha	48200	32040	40120	48188	27388	37788	48095	28513	38304	48596	26157	37376
II. Banana-Turmeric- Rice-Banana*- 0.25 ha	50560	29426	39993	51422	26952	39187	51062	28276	39669	52647	26658	39652
III. Maize-Rice- Sesame-Sunhemp 0.25 ha	16552	17665	17109	16162	16374	16268	15617	17045	16331	16984	16282	16633

* 3rd 4th crop in the I & II sequences were not taken into account as they are standing crop for the III year.

sources to supply sufficient quantity of nutrient to the crops. Under Integrated Farming System cropping sequence includes (i) sugarcane (planted) - sugarcane (ratoon) - banana (3 years) (i) banana - turmeric - rice - banana (3 years) and (iii) maize - rice - sesame - sunnhemp (annual) each in 0.25 ha and (iv) bajra - napier grass + desmanthus (perennial) in 0.10 ha. In another one hectare, conventional cropping systems comprising (i) rice-rice-blackgram (ii) maize-rice-blackgram (iii) maize-rice-sunn hemp and (iv) rice-rice-sunn hemp each in 0.25 ha as practiced by the farmers were taken up.

To sustain the productivity of soil through integrated nutrient supply, a field experiment was carried out in split plot design with three replications. Recycled poultry, pigeon and goat manures and composted crop residue (banana waste and sugarcane trash) as vermicompost each @ 6.25 t ha⁻¹ were assigned to the main plots and three fertilizer levels (100%, 80% and 60% of the recommended fertilizer schedule) were tested in subplots for the first three sequences of cropping.

The efficiency of the components integrated 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. Observations were made on productivity of different cropping sequences and components under integrated farming system in terms of rice grain equivalents, income and employment. Samples of raw animal manure and settled silt collected from different fish ponds were analysed for their NPK contents.

Results and Discussion

Research results on the effect of different organic sources along with inorganics on the productivity of different cropping sequence clearly revealed that the highest yield was obtained with the recycled fish pond silt fed with poultry droppings (40120, 39993 & 17109 kg ha⁻¹ for I, II and III sequences, respectively (Table 1). The comparative rice grain equivalent yield showed that crop + fish + goat integration recorded higher rice grain equivalent yield of 39610 kg ha⁻¹ than other systems. Similar

Table 2. Productivity (rice grain equivalent yield) of components (mean over two years 1998 – 2000)

Farming systems	Component Productivity (kg)					Total system productivity (kg ha ⁻¹)
	Crop	Poultry	Pigeon	Fish	Goat	
Cropping alone	12223	-	-	-	-	12223
Crop + Fish + Poultry	29166	630	-	2063	-	31859
Crop + Fish + Pigeon	27973	-	2592	1790	-	32355
Crop + Fish + Goat	28809	-	-	1983	8818	39610

observations were made by Jayanthi (1996) indicating the advantages of component integration under lowland condition.

While considering the individual animal component, productivity of 8818 kg (of two years mean) was obtained with 20 + 1 goat unit. The goat unit could also provide 1.0 t of valuable manure apart from supplementing the feed requirement of 400 numbers of fish included in an area of 0.04 ha of ponded water (Table 2). While assessing the feasibility of rearing fish by using poultry, pigeon and goat droppings as feed, the fish fed with poultry droppings resulted in higher yield (825 kg /0.04 ha ponded water) than the other two sources of feed. A higher level of fish production through recycling of poultry manure was earlier reported by Jhingran and Ghosh (1988) and Banerjee *et al.* (1989).

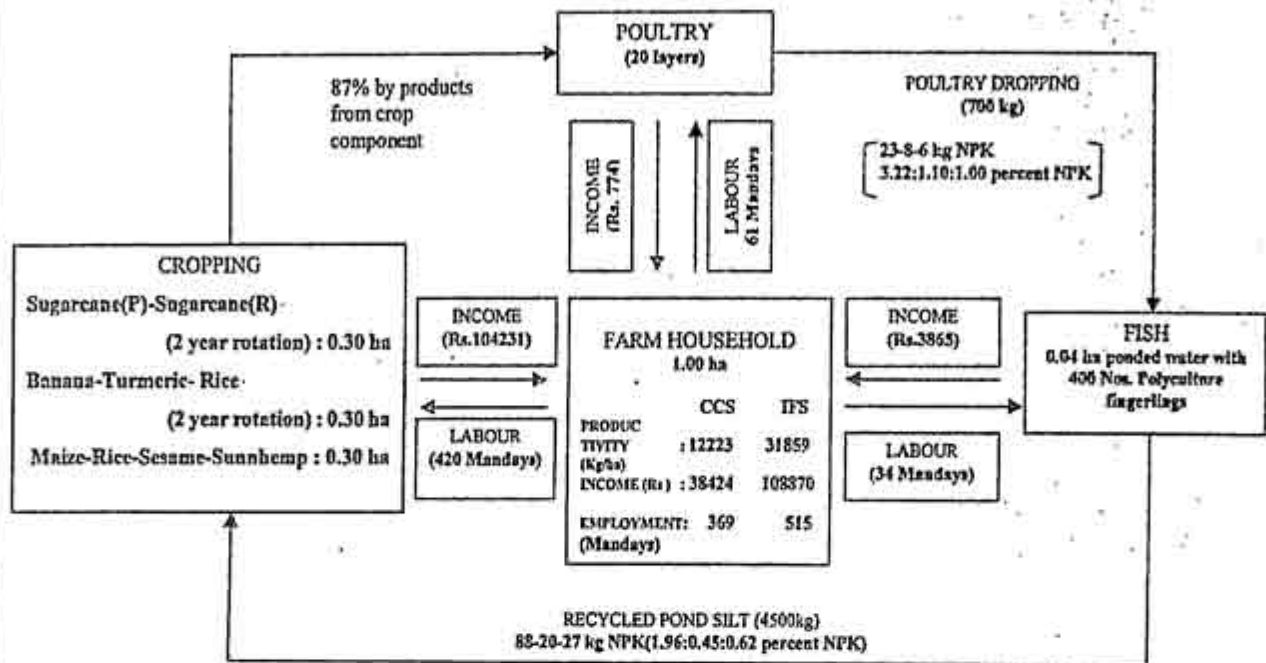
The results on residue recycling revealed that sugarcane (planted) - sugarcane (ratoon) - banana, banana - turmeric - rice - banana and maize - rice - sesame - sunnhemp cropping systems, with goat (20+1) and fish (400 polyculture fingerlings in 0.04 ha⁻¹ of ponded water) was the best in obtaining higher rice grain equivalents than the conventional cropping systems, cropping + fish + pigeon and cropping + fish + poultry systems (Model 3). Cropping + fish + goat integration earned the highest income of Rs. 1,38,418. Integration of cropping with goat + fish also generated the highest employment of 575 mandays/ha⁻¹/year⁻¹.

Integration of poultry + fish + cropping applied with recycled poultry manure sustained the productivity of soil through the addition

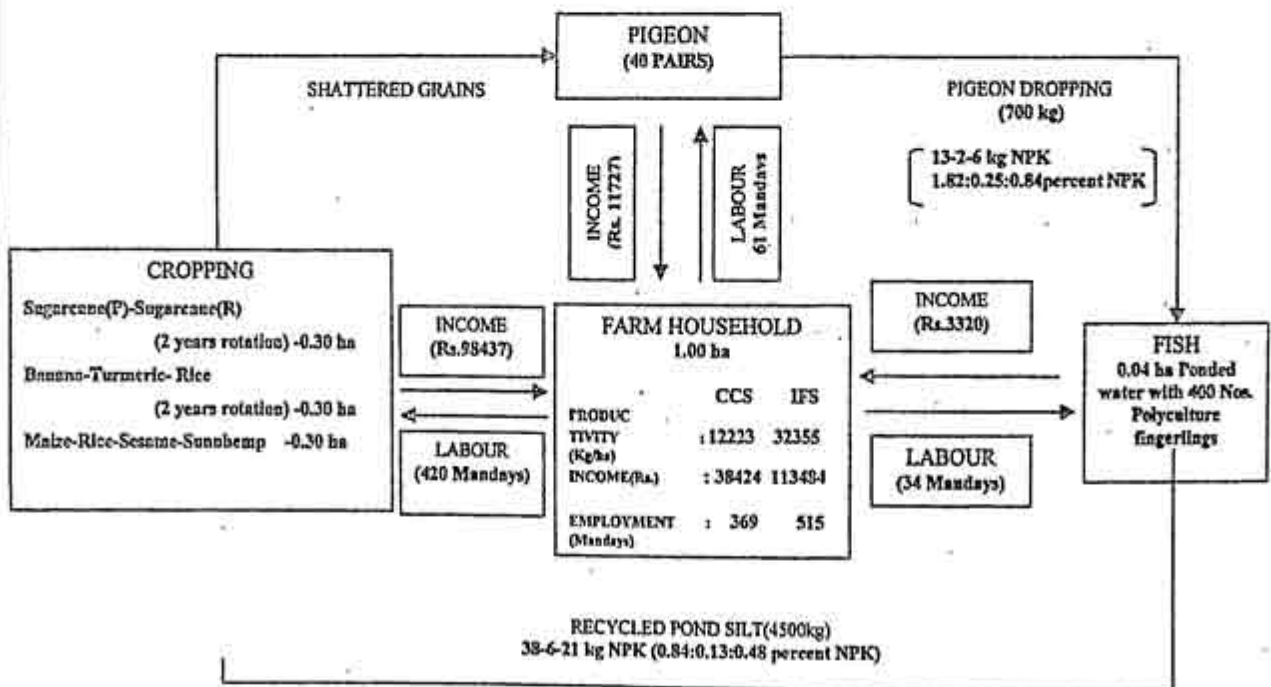
of residue with better NPK nutrient supply potential (Model 1). Twenty fowls in the poultry unit voided 700 kg of droppings with the nutrient potential of 23, 8 and 6 kg of NPK respectively, but when recycled through fish pond, nutrient contents were enhanced to 88, 20 and 27 kg of NPK respectively which in turn reflected on higher profit from crop component (Rs.1,04,231). Economic advantage of poultry and pigeon components through residue recycling in lowland integrated farming system was earlier reported by Jayanthi (1996) and Sivaraj (1989). The yield of fish cultures was also higher in the fish fed with poultry droppings followed by goat and pigeon droppings (Rangasamy and Jayanthi, 1994). Forty pairs in the pigeon unit produced 700 kg of droppings contributing 13,2 and 6 kg of NPK nutrients which were further enhanced by three folds (38,6 and 21 kg NPK) through recycling (Model 2).

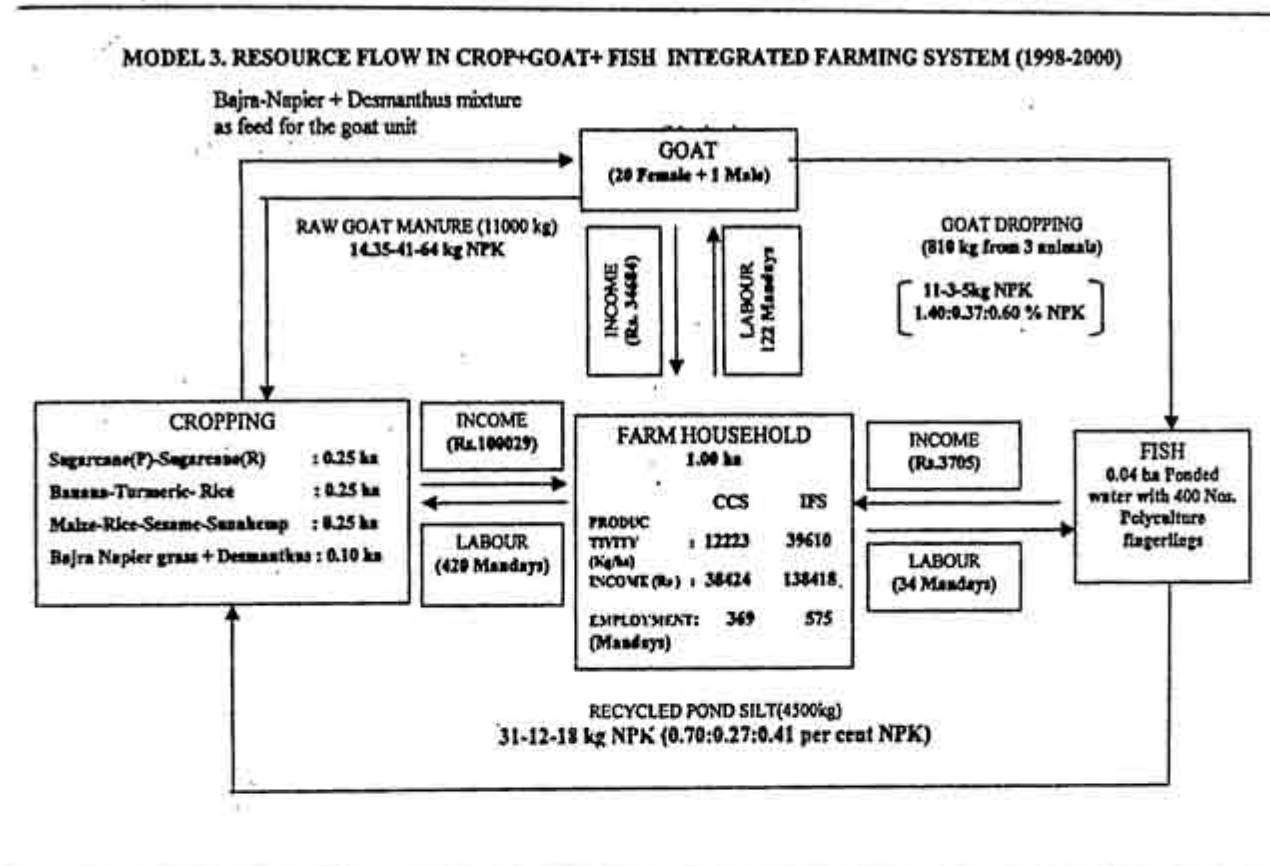
In crop + goat + fish farming system, about 29 t of bajra - napier (CO 3) grass + desmanthus mixture obtained from sequence (iv) was used as feed for the goat unit. Raw goat manure of 11 t with 14.35, 41 and 64 kg NPK nutrients was applied to the crops specified. The goat unit of 20 + 1 could give the highest income of Rs. 34,684 than the other components compared (Model 3). The finding clearly showed that the recycled organic residues of crops and allied activities could supplement the chemical fertilizers and would certainly pave way for increasing the productivity, profitability and also help in sustaining the nutrient potential of the soil under lowland farms.

MODEL 1. RESOURCE FLOW IN CROP+POULTRY+FISH INTEGRATED FARMING SYSTEM (1998-2000)



MODEL 2. RESOURCE FLOW IN CROP+PIGEON + FISH INTEGRATED FARMING SYSTEM (1998-2000)





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