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Study on integrated farming system in hilly upland areas of Bay Islands

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ABSTRACT

Integrated farming system, comprising the components like cropping, vegetables, floriculture, fishery, poultry, duckery and cattle (bullock, cow and calf) rearing was undertaken at Calicut village of South Andaman during 2004-06, to study the productivity, profitability, employment generation, energy flow and nutrient recycling for slopy upland areas of Bay Islands. Among the components evaluated, the highest net return was obtained from crop (81.09%), followed by livestock (14.3%), poultry (4.38%) and fish (0.38%). Employment generation was 346 mandays/ha/year under the integrated farming sytem. The net return obtained from all components was also higher under this system, with a benefit:cost ratio 3.30. To improve the productivity, economic returns and employment generation for family labour, integration of all these components could be adopted instead of cultivating the crop alone in the hilly upland situations of Andaman and Nicobar Group of Islands.

Key words: Integrated farming system, Productivity, Profitability, Energy flow

The supply and demand profile of food has changed due to higher economic growth, population explosion and shifts in dietary pattern. Integrated farming system seems to be the possible solution to meet the continuous increase in demand for food, stability of income and diverse requirements of food grains, vegetables, milk, egg, meat etc, thereby improving the nutrition of the small-scale farmers with limited resources. Integration of different agriculturally related enterprises with crops provides ways to recycle the products and by-products of one component as input to another linked component and reduce the cost of production and thus raise the total income of the farm. In Bay Islands the farmers are using crop (rice, vegetables, sugarcane etc.), fish and livestock without proper integration. Multiple land use through integration of crops, livestock and aquaculture can give the optimum production from unit land area. An effort was made for a holistic integration of different agricultural enterprises such as linking poultry, fish and cattle with cropping, for increasing the income and recycling of farm wastes and by products.

MATERIALS AND METHODS

A study was conducted on integrated farming system at Calicut village of South Andaman during 2004-06, involving cropping (rice, vegetables, crossandra, marigold, fruits, coconut, arecanut, ginger and black pepper), poultry, duckery, cattle (bullocks and cow) and fishery as the integrated system, and cropping alone as the control. In 1 ha area of integrated farming system, cropping was undertaken in 0.9 ha, in which cropping sequences of rice-*okra*-floriculture, rice-cowpea-floriculture, rice-sugarcane, ginger-amaranthus-ginger, *okra*-cowpea-*okra*, coconut + fodder, arecanut + black pepper, coconut + crossandra, rice-*okra*-cowpea were tried. An area of 0.064 ha was allotted for three cows (crossbred) and two bullocks (non-descript) and fodder, and 0.036 has was assigned for fish-pond. Nicobari birds (23) and Chara Chambelli ducks (10) were reared in fish-pond with 200 Indian major carp fingerlings (catla, rohu, mrigal) to assess the feasibility of rearing fish by using poultry manure as the feed.

The integrated farming system was compared with cropping alone (rice, vegetables, sugarcane, fruits, sole crop of coconut and arecanut) in the farmers' field. Andaman and Nicobar Group of Islands are blessed with true maritime climate, receiving annual rainfall of 3,000 mm, spread over 8 months. The soil is sandy loam to red laterite, medium in organic carbon, low in N, medium in P and high in K. To sustain the productivity of soil, inorganic fertilizers combined with organic waste like vermicompost, compost and farmyard manure (FYM) were applied to the crops. Recycled composted crop residues were also applied in the plots of five cropping sequences, viz. S_1, rice, vegetables and floriculture; S_2, rice and sugarcane; S_3, ginger, leafy vegetable and ginger; S_4, vegetable, vegetable and vegetable; and S_5, rice, vegetable and vegetable. All the sequences were followed for 2 years and their yields and economics were worked out. Poultry birds were reared in shed constructed above the pond; regular body weight and egg production was recorded. Cattle and poultry manure were used in the field in the form of FYM and compost. Fishes were harvested by drag net. Observations on the productivity and economics of individual components and the farming system as a whole and employment generation and nutrient recycling of different components in the farming system were recorded as per the standard procedure. Energetics of all the components was also worked out, using standard formula. For crop components, the input energy was calculated in terms of both direct and indirect energy; the output energy was based on the yield. For poultry and animals, the input energy was in terms of feed and labour and the output was the products obtained, viz. egg, meat, milk, manure or dung and draught power. Cultural energy (Mega Joules) used through various inputs in cropping, animal or fish was computed (Dazhong and Pimental, 1984) and the energy-use efficiency (energy ratio) was worked out using the formula:

$$\text{Energy ratio} = \text{Energy output (MJ/ha)/ Energy input (MJ/ha)}$$

Specific energy of the crops was calculated in terms of energy required to produce a kilogram of economic yield and was expressed in MJ/kg. The energy content of various inputs was calculated as given by Mittal *et al.* (1985).

RESULTS AND DISCUSSION

Productivity

The integration of crop with fish + poultry and cattle (bullock and çow) resulted in higher productivity than the adoption of crop alone. Jayanthi *et al.* (2003) also reported similar findings. Among the cropping sequences under integrated farming systems, ginger-amaranthus-ginger yielded the maximum rhizomes and greens for one crop (53 q ginger and 9.6 q amaranthus), followed by coconut + crossandra (Table 1). The animal component yielded 21.9 tonnes manure and each cow yielded 3,000 litres milk/lactation. Each bird laid 156 eggs/annum and produced 41.4 kg manure as fish-feed. The fish yield was 49 kg/year/0.36 ha. Jhingran and Ghosh (1998) and Banerjee *et al.* (1989) reported higher level of fish productivity through recycling of poultry manure, owing to better plankton development as well as direct feed to fishes. The total phytoplankton and zooplankton growth in the integrated farming system pond were 256/litre water and 200/ litre water respectively, which served as the primary source of feed to the fish compared with that of the control (without poultry integration) wherein the growth of phytoplankton was less than 150/ litre water and of zoo plankton (100/litre water).

Profitability

Among the cropping sequences, ginger-amaranthus – ginger (0.20 ha) yielded the maximum net income of Rs 1,56,562. Lesser cost of production with better productivity of each component integrated in the system in-

Table 1. Yield and economics of different cropping sequences under integrated farming system (pooled data of 2 years)

Cropping sequence	Area (ha)	Yield (q)			Cost of cultivation (Rs)	Net returns (Rs)	B:C ratio
		1st crop	2nd crop	3rd crop			
Rice–vegetable (okra) –floriculture	0.10	7.03	9.72	10.71	16,775	32,634	1.94
Rice–vegetable (cowpea) –floriculture	0.10	7.03	11.39	10.71	20,122	27,753	1.38
Rice–sugarcane	0.20	7.03	2,927 (no.)		14,312	20,586	1.44
Ginger–amaranthus ginger	0.12	26.27	9.6	26.27	18,526	1,56,562	8.45
Vegetable (okra) – vegetable (cowpea) – vegetable (okra)	0.07	3.40	5.81	3.98	6,105	17,506	2.87
Coconut + fodder	0.02	184 nuts	4.4		428	750	1.75
Arecanut + black pepper	0.02	0.64	0.10		248	4,310	17.41
Coconut + crossandra	0.07	646	1.77		4,172	51,604	12.37
Rice–vegetable (okra) –vegetable (cowpea)	0.20	7.03	11.39	16.59	15,365	46,061	2.99
Total	0.90				96,053	3,57,766	

creased the returns. Cropping (0.9 ha) led to the maximum net income of Rs 3,57,766, followed by livestock, poultry and fish. Contributions from cropping, livestock, poultry and fish were 81.09, 14.3, 4.38 and 0.38 per cent respectively. Net return obtained from all the components was Rs 4,41,165/ha, with a benefit:cost ratio of 3.30. Livestock and fishery contributed an additional income of Rs 83,399. Behera and Mahapatra (1998) also reported increase in net income through integrated farming system. The system as a whole provided opportunity to utilize the produce or waste material of one component as input for another at the least or no cost at farm level. Thus there is a possibility for reduction of production cost of the enterprises from one to another, increasing greatly the final return/Re invested. Jayanthi (1996) also reported economic viability of lowland integrated farming system due to lower production cost.

Employment generation

The employment generation increased to 346 mandays/ha/year by integrating fish-cum-poultry and cow and bullock rearing with cropping compared with cropping alone (225 mandays/ha/year). Additional employment of 15 mandays from poultry, 91 mandays from cattle and 15 mandays from fishery were generated under integrated farming system (Fig. 1). Integration of other components with cropping increases the labour requirement and thus provides scope to employ family labour round the year without much lean and peak demand for labour. Similar increase in employment generation was reported with integration of fish + poultry with cropping (Chinnuswami, 1994) and rice+poultry+fish+mushroom (Rangaswamy *et al.*, 1995).

Energy flow

The energy flow in the system studied by evaluating the energetics for each component, revealed that the energy ratio is more in the cropping component than with other components (Table 2). The energy ratio from coconut + crossandra was the highest (14,08.27) among different cropping sequences. It was 1.13 and 0.13 respectively from poultry and cattle. Specific energy was calculated for each sequence in the cropping component and for products from livestock and poultry. Specific energy was the least (0.51) for arecanut + black pepper integration. This indicates a very low input-energy requirement for this sequence. Specific energy was higher (4.83) for rice + sugarcane cropping.

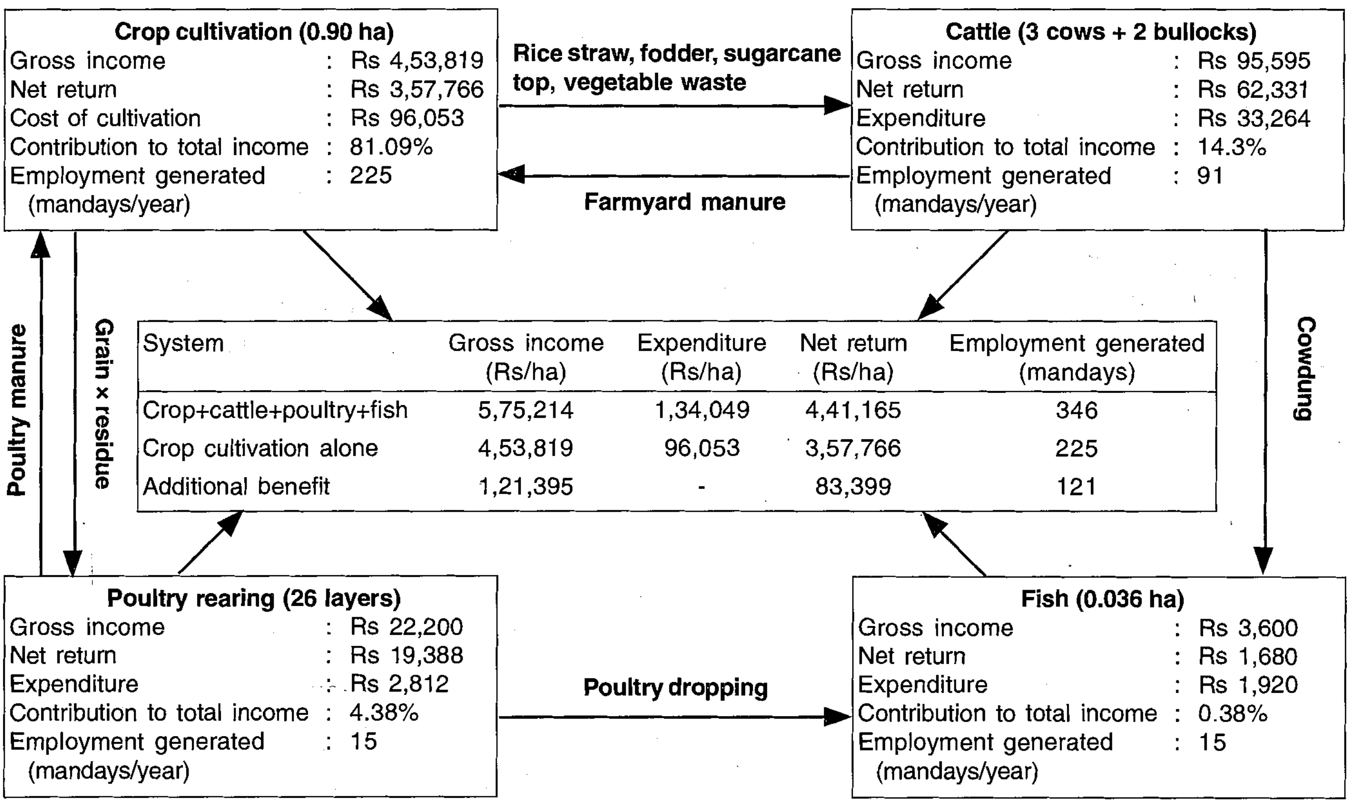

Fig. 1. Productivity, profitability and employment generation in integrated farming system

Table 2. Energy flow in integrated farming system (pooled data of 2 years)

Cropping sequence	Energy input (MJ)	Energy output (MJ)	Energy ratio	Specific energy (MJ/kg)
Rice–vegetable (okra)–floriculture	2,897	25,568	31.71	3.06
Rice–vegetable (cowpea) –floriculture	3,519	25,885	31.24	3.45
Rice–sugarcane	12,499	25,851	21.18	4.83
Ginger–amaranthus–ginger	3,059	12,768	10.92	1.53
Vegetable (okra) –vegetable (cowpea) – vegetable (okra)	1,233	2,501	5.99	2.87
Coconut + fodder	328	6,220	37.77	1.26
Arecanut + black pepper	12	1,295	172.74	0.51
Coconut + crossandra	615	18,495	1,408.27	3.42
Rice–vegetable (okra) –vegetable (cowpea)	2,995	15,638	24.12	2.53
Poultry	4,182	4,716	1.13	
Livestock	2,01,784	25,405	0.13	
Fish	645	151		

Table 3. Quantity and quality of excreta from poultry, duck, cow and bullocks reared under integrated farming system (pooled data of 2 years)

Species	Monthly yield of excreta (kg)	Carrying capacity/ha	Moisture (%)	Chemical (%) of dry matter with nutrient composition		
				N	P_2O_5	K_2O
Poultry	3.45/bird	500	18	2.89	1.80	0.5-0.9
Duck	3.92/duck	300	80	0.91	0.38	0.36
Cow/bullock	510.0/animal	275	81	3.86	0.5	1.62

Nutrient recycling

The quanity of nutrients available through poultry, duck, cow and bullock are furnished in Table 3. The nutrient content of manure increased manifolds after recycling into compost. The nutrients recycled from poultry and duckery were more in terms of plankton (256/litre) development in the ponds for fish growth. Nutrients from cowdung were utilized for composting.

Thus it can be concluded that integrated farming system with cropping sequences involving vegetables, sugarcane, rice, ginger, coconut, arecanut, black pepper, crossandra and marigold in 0.9 ha; livestock (3 cows, 2 bullocks) and fodder in 0.064 ha; and fish + poultry + duckery in 0.036 ha can be advocated for sloping hilly upland areas of Andaman and Nicobar Group of Islands for realizing higher productivity and profitability from 1 ha area.

REFERENCES

Bahera, U.K. and Mahapatra, I.C. 1998. Income and employment generation for small and marginal farmers through integrated farming system. *Indian Farming* **48**(3): 16–28.

Banerjee, R.K., Saha, S.K., Sen, P.K. and Srinivasan, K.V. 1989. Ecological studies on town refuge in the context of environment pollution abatement and fish production. *Journal of Inland Fish Society of India* **21**(2): 25–30.

Chinnuswami, K.N. 1994. Farming system research and development in Cauvery delta and north-western zone in Tamil Nadu. In: *Proceedings of Summer Institute on Integrated Farming System Research and Development for Sustainable Agriculture*, held at Tamil Nadu Agricultural University, Coimbatore during 6-15 June 1994, pp. 252–257.

Dazhong, W. and Piemental, D. 1984. Energy inputs in agricultural systems in China. *Agricultural Ecosystems Environment* **11:** 9–35.

Jayanthi, C. 1996. *Sustainable component linkage and resource recycling to lowland integrated farming system.* Ph.D. thesis, Tamil Nadu Agriculturla University, Coimbatore.

Jayanthi, C., Balusamy, M., Chinnusamy, C. and Mythily, S. 2003. Integrated nutrient supply system of linked components in lowland integrated farming system. *Indian Journal of Agronomy* **48**(4): 241–246.

Jhingran, V.G. and Ghosh, A. 1998. Aquaculture as potential system of sewage disposal: a case study. *Journal of Inland Fish Society of India* **20**(2): 1–8.

Mittal, V.K., Mittal, T.P. and Dhawan, K.C. 1985. '*Research project on energy requirements in agricultural sector.*' Co-ordinating cell, College of Agricultural Engineering, Punjab Agricultural University, Ludhiana.

Rangasamy, A., Venkittasamy, R., Premsekar, N., Jayanthi, C., Purusothaman, S. and Palaniappan, Sp. 1995. Integrated farming system for rice based ecosystem. *Madras Agricultural Journal* **82**(4): 287–290.