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Productivity, profitability and employment generation in integrated farming systems for rainfed vertisols of western zone of Tamil Nadu

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ABSTRACT

A study was conducted at Coimbatore during July 2000 to July 2002 to find out suitable farming system for small and marginal farmers of rainfed vertisols of the western zone of Tamil Nadu. All enterprise combinations tried were profitable compared with conventional practice of cropping alone. The integration of crop (0.80 ha) fertilized with buffalo manure produced on the farm, with pigeon (10 pairs on 0.01 ha), goat (5 + 1 female + male on 0.02 ha), buffalo (2 milking buffaloes + 1 calf on 0.03 ha), agroforestry (0.10 ha) and farm pond (0.04 ha) was found to be the most profitable farming system on a holistic basis. Recycling of resources and residues led to higher productivity, employment and income generation with this enterprise combination. For small and marginal farmers who are short of cash, integration of crop (0.80 ha) with pigeon (10 pairs on 0.01 ha), goat (5 + 1 female + male on 0.05 ha), agroforestry (0.10 ha) and farm pond (0.04 ha) was found to be a good alternative farming system with recycling of composted goat manure to the crop.

Key words: Diversification, Enterprise combination, Farming system, Sustainability

Farming system represents a complicated interwoven mesh of soils, plants, animals, workers, farm inputs and environmental influences. Some of these are manipulated by the farmer to produce outputs according to his preferences and aspirations. The integration of various crops and animals enables synergistic interaction, which has a greater total contribution than the sum of their individual effects (Edwards *et al.*, 1988). The Indian farming communities are predominantly small and marginal, with average land holding of < 2 ha. Hence it is essential to integrate suitable enterprises at their optimal levels to capture the maximum benefits without degrading the natural resources. Studies on combination of such enterprises are lacking and hence the present study was conducted at Coimbatore to identify and optimize the enterprise combination and to sustain the productivity, income and employment of cropping and linked components through bio-resource utilization and recycling.

MATERIALS AND METHODS

An experiment was conducted at Tamil Nadu Agricultural University, Coimbatore from July 2000 to July 2002. The location experiences a mean annual rainfall of 640 mm. The soil was vertisol, with a bulk density of 1.59 g/cm^3, low in available N, medium in P and high in K status. The enterprises were selected based on farmers' preferences, popularity and complementary nature of enterprises under dryland conditions of the western zone of Tamil Nadu. The experiment comprised three enterprise combinations of cropping, pigeon, goat, buffalo, agroforestry, farm pond and border planting of *Glyricidia sepium* in an area of 1 ha each. There were four treatments, viz. FS_1, conventional cropping system with crop (sorghum) alone; FS_2, IFS with crop (CGM) + pigeon + goat + agroforestry + farm pond; FS_3, IFS with crop (CBM) + pigeon + buffalo + agroforestry + farm pond; and FS_4, IFS with crop (CBM) + pigeon + goat + buffalo + agroforestry + farm pond. *Glyricidia sepium* was planted along field boundaries at 2 m interval. Cropping in integrated farming system was of fodder maize + fodder cowpea – chickpea + coriander in 0.25 ha each (FS_2), fodder sorghum + fodder cowpea – chickpea + coriander in 0.25 ha each (FS_3), sorghum + cowpea in 0.20 ha, and sunflower + coriander in 0.10 ha each (FS_4). The crops were fertilized with the manure generated on the farm after composting from the animal enterprises. Ten pairs of pigeon (pilot breed) were sheltered in a shed in 0.01 ha. Tellicherry goats comprising five females and one male, less than 1 year old, were maintained under deep litter system in a goat shed in 0.02

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ha. Two buffaloes of local breed and one calf formed the buffalo enterprise, which were sheltered in a cattle shed on 0.03 ha. Six year old *Acacia nilotica* trees, numbering 62, existing on 0.10 ha land area, formed the agroforestry component. Under this an area of 0.05 ha was allotted to silvipasture, where *Cenchrus ciliaris* was grown as the intercrop, whereas in another 0.05 ha area sorghum and cowpea were raised for fodder. A farm pond was dug out on 0.04 ha at one end of the farm along the slope gradient to collect the runoff water and the silt that drains away from the farm due to rain.

The fodder obtained from the cropping system and *Glyricidia* as well as the stover and haulm residues from sorghum and cowpea were used as feed for the animals, whereas grains were sold for cash generation. Additional inputs (fodder during lean season and concentrate) for livestock were purchased from the market. The shattered and ill-filled grains were used to feed the pigeons. Labour (men and women) required for different activities in each enterprise was recorded in terms of hours everyday and converted to mandays/ha/year. In the experiment the enterprises were managed individually and the results were combined for each system enterprise combination.

Various farming systems were compared based on sorghum grain-equivalent yield (SGEY), profitability and employment generation. The involvement of labour for upkeep of each enterprise in the farming systems was considered for comparison, based on employment generation. A regular inventory of the inputs (inclusive of labour) and outputs of each enterprise was maintained and converted to monetary terms at the prevailing price, taking recycling between enterprises into consideration as a measure of profitability of farming system enterprises.

RESULTS AND DISCUSSION

Productivity

Integration of crops with allied enterprises like pigeon, goat, buffalo, agroforestry and farm pond resulted in higher productivity than cropping alone during both the years of study (Table 1). In 2000-01 the highest productivity of 12.18 t sorghum grain-equivalent yield (SGEY) was obtained by the enterprise combination of cropping system supplied with composted buffalo manure at 100% production level, pigeon, goat, buffalo, agroforestry and farm pond (FS_4). In 2001-02 also the same system (FS_4) registered the highest productivity (12.59 t of SGEY). An increase in productivity was observed during 2001-02 over 2000-01 in each farming system, the results following a similar trend of productivity response. Regarding the contribution of the individual enterprises to the system total in the crop + pigeon + goat + buffalo + agroforestry + farm pond system (FS_4), the contribution of cropping to system

Table 1. System productivity (sorghum grain-equivalent yield, SGEY), employment generation, mean contribution of enterprises to SGEY and economics in integrated farming systems

Farming system		Productivity (t/ha)		Employment (mandays/ha)		Component productivity (kg)					System productivity (t/a)	Cost of production (x 10^3 Rs/ha)	Net returns (x 10^3 Rs/ha)	B : C ratio
		2000–01	2001–02	2000–01	2001–02	Crop	Pigeon	Goat	Buffalo	Agro-forestry				
FS_1	Cropping alone	0.69	1.84	28	32	1,270					1.27	5.520	1.17	1.21
FS_2	Crop (CGM) + pigeon + goat + agroforestry + farm pond	4.23	5.21	110	116	2,760	306	1,393		264	4.72	18.90	9.30	1.49
FS_3	Crop (CBM) + pigeon + buffalo + agroforestry + farm pond	11.20	10.79	140	142	3,195	306		7,229	264	10.99	43.65	22.67	1.52
FS_4	Crop (CBM) + pigeon + goat + buffalo + agroforestry + farm pond	12.18	12.59	160	166	3,195	306	1,393	7,229	264	12.39	52.85	21.82	1.41

productivity was 26%. The other enterprises, viz. pigeon (2%), goat (11%), buffalo (59%) and agroforestry (2%), also contributed positively to the system. The highest system productivity in FS_4 may be due to major contribution of buffalo with higher milk production and addition of plant nutrients in huge quantity through more dung production compared with that of goat. Recycling of this animal waste to cropping can be a vital source of plant nutrients, especially in dryland agriculture where growing of crops with low or no fertilizer application leaves a net negative balance of nutrients (Singh, 1996; Mafongoya *et al.*, 2000). Buffalo was found to be the most suitable milch animal for small and marginal farmers (Bhogal *et al.*, 1985). The productivity of the farming system where crop was supplied with composted goat manure and pigeon, goat, agroforestry and farm pond (FS_2) was also higher than of cropping alone (FS_1), indicating that goat is a profitable enterprise for integration (Devendra, 1998, 2000).

Employment

Integrated farming systems provided higher employment opportunity for family labour compared with conventional cropping alone (Table 1). The enterprise combination of crop + pigeon + goat + buffalo + agroforestry + farm pond (FS_4) generated the highest labour employment (163 man/days/year), with a contribution of 38% from cropping, 6% from pigeon, 13% from goat, 31% from buffalo and 12% from agroforestry. This system generated an additional employment of 134 mandays compared with cropping alone. Enterprise combination of crop, pigeon, buffalo, agroforestry and farm pond (FS_3) generated on an average 141 mandays/ha/year, with crop, pigeon, buffalo and agroforestry having a share of 45, 6, 35, 14% in the total employment generation. In FS_2 the employment generation was 0.27 mandays/ha throughout the year, the contribution by pigeon, buffalo and agroforestry being 0.03, 0.17 and 0.07 manday, respectively and of the crop an additional employment of 0.20 manday during the crop season. The maintenance of buffalo involved greater utilization of labour than of goats. Hence FS_3 and FS_4 which have buffalo as the component enterprise, recorded higher employment generation than the farming system with goats.

Employment generation in cropping is restricted to the important field operations only, which rendered the farmers unemployed for the rest of the year. Contrary to this, the employment generated in a farming system is spread uniformly throughout the year. Labour requirement for maintaining the livestock enterprises was high and spread throughout the year. One male labour engaged in the activities of pigeon, goat, buffalo and agroforestry can find employment for 101 days in a year. Santhi *et al.* (1996) reported an increase in employment generation with the integration of animals in the dryland integrated farming system.

Economics

The economics of component enterprises revealed that though the integration of buffalo recorded higher cost of production, it also maximized the returns (Table 2). The crop fertilized with composted buffalo manure recorded 53% higher net returns than that fertilized with composted goat manure. The net returns from the goat, pigeon and agroforestry enterprises increased in the second year compared with those in the first year. Both the years of study followed a similar trend with marked variation only in the contribution of goat enterprise, whereas the second year recorded higher output from goats, which translated into higher monetary gains. The highest gross returns of Rs 74,670 were obtained in FS_4. The highest contribution was from the buffalo unit (58%), followed by cropping (26%), goat (12%), pigeon (2%) and agroforestry (2%). The gross returns were highest from this system because of the economical benefits of the linked enterprise of goat (11%) and buffalo (58%).

Highest net returns and benefit : cost (B : C) ratio were observed in the farming system integrating pigeon + buffalo + agroforestry + farm pond with crop receiving

Table 2. Economic indicators (Rs) of individual enterprises in integrated farming systems

Component	2000 – 01		2001 - 02	
	Cost of production	Net returns	Cost of production	Net returns
Cropping alone (1.0 ha)	4,690	410	6,350	1,920
Crop with CGM (0.8 ha)	10,030	6,300	10,240	6,290
Crop with CBM (0.8 ha)	10,030	9,660	10,240	9,120
Agroforestry	1,470	110	1,320	260
Glyricidia	620		540	
Pigeon (10 pairs)	1,110	600	1,090	880
Goat (5 + 1)	5,730	180	5,660	5,140
Buffalo (2)	31,390	13,040	29,490	12,830

composted buffalo manure (FS_3). The farming system with integration of buffalo benefited from the higher monetary gains obtained from milk, which is available on daily basis, whereas in FS_2 this advantage was lost. The net returns and B : C ratio in FS_4 were slightly less because when the goat enterprise was integrated along with buffaloes, the unit had to be raised on external inputs because the resources were recycled to buffalo enterprise. This led to higher cost of production, reducing the net returns marginally. The farming system with goats as the animal enterprise recorded lower net returns. However, it was better than cropping alone. Sivakumar *et al.* (2000) and Das (2001) also reported increased net returns and higher B : C ratio with integration of goat. Cropping alone (FS_1) remained the least profitable system compared with the farming systems with integration of allied enterprise during both the years of study.

The results clearly revealed that the farming system with enterprise combination of cropping (fertilized with composted buffalo manure), pigeon (10 pairs), goat (5+1 female + male), buffaloes (2 milking buffaloes + 1 calf), agroforestry and farm pond as per the land ratio apportioned above is the best for the rainfed vertisols of the western zone of Tamil Nadu. This system resulted in increased productivity, employment opportunity for the family labour round the year and better economic gains. It also provided the best avenue for the recycling of resources and residues generated in the system, with resultant nutrient addition as witnessed from increased returns from the crops supplied with composted buffalo manure. Though FS_2 recorded lesser returns than FS_3 and FS_4, for the farmer who has limitations of capital the buffalo enterprise will cease to be an asset. Under such circumstances, the system enterprise of crop with pigeon, goat, agroforestry and farm pond (FS_2) is profitable than cropping alone.

REFERENCES

Bhogal, T.S., Sharma, J.S. and. Arora, V.P.S. 1985. Augmenting income and employment of small and marginal farmers and landless agricultural labourers through dairying in western Uttar Pradesh. *Indian Journal of Dairy Science* **41**: 101–108.

Das, S.K. 2001. Prospect and potentiality for goat farming in north eastern region of India – a review. *Agricultural Reviews* **22**: 228–233.

Devendra, C. 1998. Improvement of small ruminant production systems in rainfed agro-ecological zones of Asia. *Annals of Arid Zone* **37**: 215–232.

Devendra, C. 2000. Animal production and rainfed agriculture in Asia: potential opportunities for productivity enhancement. *Outlook on Agriculture* **29**: 161–175.

Edwards, P., Pullin, R.S.V. and. Gartner, J.A. 1988. Research and education for the development of crop- livestock- fish farming systems in the tropics. *ICLARM Studies and Reviews, No.*16.

Mafongoya, P.L., Barak, P. and Reed, J.D. 2000. Carbon, nitrogen and phosphorus mineralization of tree leaves and manure. *Biology and Fertility of Soils* **30**: 298–305.

Santhi, P., Ponnusamy, K. and Shanmugasundaram, V.S. 1996. Role of goats as a component in mixed farming system under lower Bhavani project area of Tamil Nadu. *Farming Systems* **12**: 22–25.

Singh, G.B. 1996. Integrated nutrient management: strategy for balanced usage. *Survey of Indian Agriculture, The Hindu,* pp. 151–153.

Sivakumar, K.M., Alagesan, V. and Ramachandran, K. 2000. Land use planning for the lands of north-western zone of Tamil Nadu. *LEISA* India *(supplement)* **2**: 7.