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Farming system options for small and marginal holdings in different topographies of Goa

B.L. MANJUNATH[1] AND C.J. ITNAL[2]

ICAR Research Complex for Goa, Old Goa Goa 403 402

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ABSTRACT

A field experiment was conducted during 1998–2001 at the ICAR Research Complex for Goa, Old Goa, to evaluate suitable integrated farming systems in different topographies. The results revealed that monocropping of rice (*Oryza sativa* L.) and coconut (*Cocos nucifera* L.) was not productive in comparison to improved cropping, i.e. rice–brinjal (*Solanum melongena* L.) or coconut–forage grass combinations, respectively, and their integrated farming systems (poultry along with mushroom and dairy integration, respectively). Gross returns from lowlands predominated by rice and rice-based copping systems were relatively higher (Rs 34,600/ha) than from uplands with cashew (Rs 31,420/ha) or midlands and valleys with coconut (Rs 18,370/ha). However, the net returns (Rs 25,020/ha) and benefit : cost ratio (3.91) were higher with cashew system, particularly with nut shelling. Integration of mushroom and poultry production in rice and coconut systems with dairy and value addition in cashew through farming system approach resulted in gross return of Rs 98,690/ha and net returns of Rs 48,000/ha, although the investment cost was also enhanced substantially (Rs 50,680/ha). Integration of dairy with coconut and forage intercropping through farming system enhanced the gross returns (Rs 94,870/ha) and net returns (Rs 32,335/ha) by 5 times over monocropping of coconut, indicating the superiority of the systems approach.

Key words : Intercropping, Monocropping, Nut shelling, Systems approach, Topographical situations

Although productivity of rice is good, there is a lot of scope for increasing the productivity of coconut and cashew with good management in Goa. The integration of allied enterprises such as dairy, mushroom and poultry with crop components has a bright future for increased productivity and profitability. Further, the by-products of dairy, mushroom and poultry enterprises serve as valuable manure for recycling within the system. These integrated systems of crop and animal components provide scope not only to augment income of the farmers but also generate additional on-farm employment. Studies under similar coastal climatic conditions of Kasaragod have indicated the advantage of farming systems approach in coconut (Reddy and Biddappa, 2000). Keeping this in view, a study was conducted to maximize the productivity and profitability from a farm with a marginal holding size in upland, midland and lowland topographical situations.

MATERIALS AND METHODS

A field experiment was conducted during 1998–2001 at the ICAR Research Complex for Goa, Old Goa. The study involved 3 aspects, viz. identification of profitable rice-based cropping system in lowlands, integration of the cropping system with allied agro-enterprises such as mushroom and poultry production in lowlands and identification of a perennial forage grass–legume combination for intercropping with coconut and its integration with dairy (2 milch cows) in midlands. In addition, yield observations were collected from an established cashew orchard to arrive at farming system options for uplands. Rice–based cropping systems studied in the trial included rice–groundnut (*Arachis hypogaea* L.), rice–cowpea [*Vigna unguiculata* (L.) Walp.], rice–brinjal, rice–sunnhemp (*Crotalaria juncea* L.) with rice–fallow as the control. Mushroom production was integrated with the crop components using the rice straw, which was available within the system. Broken rice and rice bran formed the ingredients of a formulated feed for the integrated poultry unit. Data were recorded on all the growth and yield parameters of rice, rice-based crops. A 12 years old coconut (variety 'Benaulim') garden was intercropped with perennial forage grass (Hybrid Napier) and legume (*Centrosema*) in 1:1 ratio and the grass–legume forage mixture formed the feed for the integrated dairy in the system. Performance of forage crops and the coconut was studied in detail. Apple and kernel yield in cashew was recorded periodically and

Present address : [1]Division of Agronomy, [2]University of Agricultural Sciences, Dharwad, Karnataka 580 005

the feasibility of kernel processing in cashew was assessed. The system productivity and the returns in all the situations were studied based on rice-grain-equivalent yield and economics (Jayanthi, 1995). The returns were worked out for 1 ha in all the 3 topographies and the size of integrated units of dairy (2 milch cows), poultry (720 broilers) and mushroom production (1,000 bags/year) was decided based on the resource availability and practical feasibility.

RESULTS AND DISCUSSION

Productivity of different systems

Monocropping of rice and coconut in lowlands and midland situations, respectively, and cashew cultivation in uplands without kernel processing was least productive (Table 1). Rice cropping was relatively better in the lowlands followed by cashew in the uplands, while coconut in midlands recorded the lowest productivity. Relatively, lesser productivity of coconut coupled with lower market prices for the produce during the period resulted in lower profitability from mid lands.

Table 1. Rice-grain-equivalent yield under different production systems (mean data of 1999–2000 and 2000–2001)

Production	Productivity (kg/ha)
Monocropping	
Cashew	4,489
Coconut	2,624
Rice	4,943
Total	12,056
Improved cropping system	
Cashew	4,489
Coconut + forage	7,796
Rice–brinjal (0.5 ha) + rice–cowpea (0.5 ha)	10,859
Total	23,144
Integrated farming system approach	
Cashew	7,521
Coconut + forage+dairy	13,553
Rice–brinjal (0.5) + rice–cowpea (0.5 ha)+ mushroom + poultry	21,223
Total	42,297

Intercropping with forages enhanced the productivity of coconut lands substantially (7,796 kg/ha) compared with 2,624 kg/ha in sole cropping of coconut. This may be due to the suitability of the hybrid napier and *Centrosema* forage combination grown in shallow lateritic soils having poor water-holding capacity. Similarly, improved cropping of rice with brinjal or a high-yielding cowpea resulted in a productivity of 10,859 kg/ha under lowlands. Productivity was the highest with farming system approach in lowlands with the integration of mushroom and poultry production with improved rice-based cropping system (21,223 kg/ha). Cashew with kernel processing enhanced the productivity by 67% compared with no kernel processing. Similarly, dairy integration with coconut and forage intercropping enhanced the productivity up to 13,553 kg/ha compared to 2,624 kg/ha productivity with monocropping of coconut. The overall productvity from a unit land holding of 1 ha in all the 3 topographical situations enhanced nearly 3.5 times through farming system approach in relation to monocropping. Reddy and Biddappa (2000) also reported the increased productivity of the system with farming systems approach.

Economics of different systems

High-yielding grafted progeny of cashew yielded raw nut production of 6.90 q/ha, with an apple yield of 2.73 tonnes/ha. Processing of raw nuts could resulted in kernel yield of 170 kg/ha, fetching net returns of Rs 36,330/ha (Table 2).

Table 2. Economic analysis of different farming systems (mean data of 1999–2000 and 2000–2001)

Production system	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Benefit : cost ratio
Monocropping				
Cashew	31,420	6,400	25,020	3.91
Coconut	18,370	12,150	6,225	0.51
Rice	34,600	15,230	19,370	1.27
Total	84,390	33,780	50,610	1.50
Improved cropping system				
Cashew	31,420	6,400	25,020	3.91
Coconut + forage	54,570	28,995	25,575	0.88
Rice–brinjal (0.5 ha) + rice–cowpea (0.5 ha)	76,015	31,500	44,500	1.41
Total	162,005	66,895	95,095	1.42
Integrated farming system approach				
Cashew	52,645	16,315	36,330	2.23
Coconut + forage + dairy	94,870	62,535	32,335	0.52
Rice–brinjal (0.5 ha) + rice–cowpea (0.5 ha) + mushroom+poultry	148,560	73,200	75,360	1.03
Total	296,075	152,050	144,025	0.95

A coconut-based integrated system involving intercropping of forage grasses and maintenance of 2 milch cows resulted in a production of 4,700 coconuts/ha, 1,648 litres of milk and 60.7 tonnes/ha of surplus green forage, besides 4.70 tonnes of FYM. This resulted in gross returns of Rs 76,500/ha compared to Rs 18,370/ha in a monocropped situation. The perennial multicut forage grasses,

incurred lower cost of cultivation for seeds or planting, including land preparation and pest and diseases control. Although the cost of production for the coconut + forage with dairy intercropping system was enhanced by Rs 50,385/ha over monocropping of coconut, it resulted in additional net returns to the tune of Rs 26,110/ha.

Rice-based integrated system with only 50% of land under protective irrigation yielded 4.4 tonnes/ha of rice, 5.24 tonnes/ha of straw, 7.5 tonnes/ha of brinjal and 5.84/ q/ha of cowpea under improved package. Further, from the integrated mushroom enterprise, 493 kg of edible oyster mushroom could be obtained. The integrated broiler poultry added 864 kg live weight of chicken in addition to 9.0 tonnes of recyclable manurial resources from a unit of 720 broiler birds. The overall productivity from the integrated rice system was thus enhanced from a mere 4943 kg/ha to 21,223 kg/ha. The allied enterprises, viz poultry and mushroom, when maintained with recycled by-products of rice production system such as rice straw (2 tonnes/ha), rice bran (130 kg/ha) and broken rice (257 kg/ha), the dependence and cost incurred on externally purchased inputs was greatly reduced. Further, a better market in Goa, being a tourist destination, for their products, viz rice, pulse, vegetable, mushroom, poultry meat etc. resulted in substantial benefits to the system.

It was observed that monocropping in all the 3 situations was not remunerative due to lower productivity per unit area and time in comparison to improved cropping or integrated farming systems. The productivity from a unit land holding of 1 ha in all the 3 topographical situations with integrated farming systems was 42,297 kg/ha as against 12,056 kg/ha under monocropped situations. The benefit of integrated farming systems was also reflected both the terms of gross returns (Rs 28,130/ha) and net returns (Rs 16,870/ha). Among the topographical situations, the gross returns were relatively higher (Rs 34,600/ha) from lowlands in comparison to cashew (Rs 31,420/ha) in uplands or coconut in midlands and valleys (Rs 18,370/ ha). However, the cost of production of rice under lowlands was higher (Rs 15,230/ha), leading to lower net returns (Rs 19,370/ha). On the contrary, the maintenance cost of cashew was least (Rs 6,400/ha), which resulted in better net returns (Rs 25,020/ha) and benefit : cost ratio (3.91). The coconut monocropping in midlands and valleys was least remunerative both in terms of gross returns (Rs 18,370/ha) as well as net returns (Rs 6,220).

Integration of different enterprises with cropping systems and value addition to cashew resulted in gross returns (Rs 98,690/ha) and net returns (Rs 48,010/ha), although the investment cost was also enhanced substantially (Rs

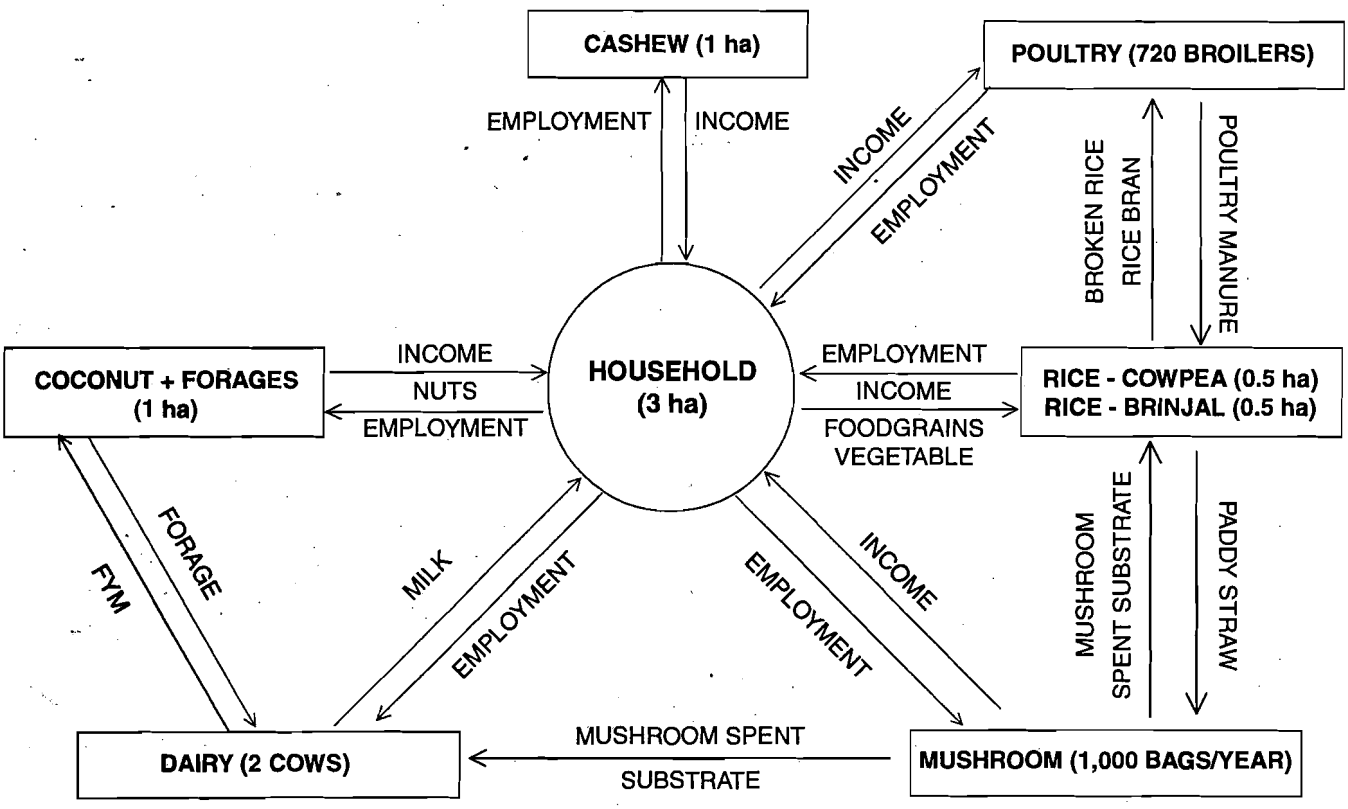

Fig. 1. A sustainable schematic model showing synergistic relationships among different components of an integrated farming system

50,680/ha). Integration of dairy with coconut through forage intercropping enhanced the net returns nearly 5 times (Rs 32,335/ha) in comparison to monocropped situation (Rs 6,225/ha), although the cost of maintenance was enhanced by 5 times. Similarly, when rice-based cropping system was integrated with poultry and mushroom the gross and net returns improved by 4 times (Rs 148,560/ha and Rs 75,360/ha respectively) over monocropping, while the cost of production was enhanced by 5 times (Rs 73,200/ha), leading to a reduction in benefit : cost ratio (from 1.27 to 1.03). The higher returns with the farming system were not only due to the higher productivity of the system but also due to lower cost of production and recyling of by-products from crop components (Fig. 1).

Thus, the net returns could be increased by 3 times by following farming systems approach in all the topographical situations.

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