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Improving the Productivity of Rainfed Farming Systems of Small and Marginal Farmers in Adilabad District, Telangana

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ABSTRACT: On-farm trials were conducted during 2010 and 2011 to evaluate the effect of different interventions on productivity and profitability of rainfed farming systems of small and marginal farmers in Seethagondhi cluster, Adilabad district. Averaged across six farmers' fields, the cotton equivalent yield (CEY) of cotton + pigeonpea intercropping was 7.99 q/ha with farmers' practice. The CEY increased by 17.5% due to herbicide use for weed control, 28.3% with application of recommended NPK, and 35.8% with use of both herbicide and recommended NPK compared to farmers' practice. Use of herbicide for weed control coupled with application of recommended NPK gave higher net return (₹ 10,300/ha) compared to other management practices. Among the farming systems of marginal farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (4 bullocks, 3 *desi* cows and 1 buffalo) gave higher net return (₹ 40,180/year) compared to other farming systems. Similarly, among the three farming systems of small farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (2 bullocks, 1 *desi* cow and 40 goats) performed better with a net return of ₹ 89,937/year compared to other farming systems.

Key words: Farming systems, intercropping, productivity, economics

Despite receiving higher annual rainfall (1103 mm), Adilabad has suffered from major agricultural droughts during the past two decades (Kareemulla *et al*., 2007). Sorghum has been continuously losing area to cotton, maize and black gram. Presently, cotton represents maximum share (40.4%) followed by rice and sorghum. But the productivity of cotton is low (375 kg/ha during 2008-09 against the state average of 434 kg/ha). Traditionally, farmers in rainfed regions practice crop-livestock mixed farming systems, which provide stability during drought years, minimize their risk and help them to cope with weather aberrations. However, these traditional systems are low productive and cannot ensure livelihood security now. Several researchers have recommended a farming systems approach (Gurbachan Singh, 2012; Venkateswarlu *et al*., 2012) to meet the multiple objectives of poverty reduction, food security, competitiveness and sustainability. However, small and marginal farmers with capital scarcity, risk avoidance objectives, and a cautious learning process rarely make drastic changes in their farming system. Rather, they proceed in a step-wise manner to adopt one and sometimes two new inputs or practices at a time (Byerlee *et al.,* 1982). Hence, an efficient research strategy should focus on a very few-perhaps two to four-research opportunities that offer potential to increase resource productivity in a way acceptable to farmers. Keeping this in view, on-farm studies were conducted during 2009-12 to improve the existing farming systems of small and marginal farmers in Adilabad district of Andhra Pradesh.

Materials and Methods

On-farm research with a farming systems perspective (OFR/FSP) was adopted for the present study. A cluster of eight villages/hamlets were selected for the survey. The cluster is located at 13 km from the district headquarters and 7 km from mandal (Gudihatnoor) headquarters. About 50% of the households were selected for the survey. The selection of sample households was done by adopting random sampling technique. A detailed analysis of the existing situation with respect to farm and non-farm activities, constraints and opportunities for enhancing household income and livelihood security was made in the selected villages. The pre-designed questionnaire that consisted of data requirement both from primary and secondary sources was administered simultaneously in all the villages. Cross verification was carried out with available secondary data wherever required.

After the benchmark survey, a total of six farmers were selected in three villages (Seethagondhi, Chinna Malkapur and Pedda Malkapur) based on the following criteria: a) farm size: (small and marginal), and b) type of farming system: [crops alone, crops + livestock (crop production is a major enterprise), and crops + livestock (size of livestock component is relatively more)]. Diagnosis of existing farming systems of these farmers was done for identification of major constraints and suitable interventions were identified in consultation with the farmers. Most of the farmers were of the opinion that weed management is labour-intensive and is not done at the right time due to shortage of labour. They were willing to use suitable herbicides for weed control. Similarly, imbalanced fertilizer use was another major constraint limiting crop productivity. Hence, the following interventions were identified for addressing the diagnosed constraints, T_1: Farmers' practice; T_2: Herbicide use (pendimethalin) for weed control; T_3: Use of recommended NPK (120:26:33 kg NPK/ha) for cotton + pigeonpea intercropping system; and T_4: Use of both herbicide and recommended NPK. On-farm trials were conducted during 2010 and 2011 to evaluate these interventions at selected six farmers' fields. Pendimethalin was applied @ 1.0 kg/ha on the same day of sowing using a knapsack sprayer fitted with flat-fan nozzle. The trials were conducted on 0.4 ha area (0.1 ha under each treatment) and each location/farmer was considered as one replication.

Regarding the livestock component, chopping of sorghum stover, which is available in large quantity in selected villages, was promoted to reduce wastage (by at least 50%) and improve its digestibility. Further, animal health camps were conducted to raise awareness among the farmers about the incidence of various diseases in livestock. In addition, all the selected farmers were encouraged to adopt improved composting techniques for efficient recycling of on-farm resources. The impact of the technologies/ interventions on overall performance of farming systems was assessed in terms of productivity and profitability of each enterprise at the household level.

Results and Discussion

Benchmark survey of selected villages

A cluster of eight villages/hamlets (Seethagondhi, Chinna Malkapur, Pedda Malkapur, Garkampet, Old Somwarpet, New Somwarpet, Arkapalli and Kotwalguda) was selected for the survey. Majority of the soils of the cluster are black soils while red soils are found in isolated patches. The cluster received a rainfall of about 1100 mm during 2006 and 2007. The average land holding per household was 2.58 ha in the cluster. More cultivated area (52%) was possessed by large farmers followed by medium farmers (37%). Small and marginal farmers cultivated about 11% area in the cluster. The average livestock ownership of the households ranged from 2 to 7 in the selected cluster villages. The population of draught animals was more in the cluster followed by goats. The cluster was predominantly a sole crop belt with *kharif* as the major cropping season. Cotton + pigeonpea intercropping occupied about 70% of the cultivated area during 2009-10. The next major crop was sorghum that occupied one-sixth of the gross cropped area in the cluster. The productivity of cotton intercropped with pigeonpea varied between 11-18 q/ha across the farmer categories. Similarly, the intercropped pigeonpea yielded about 1.9 q/ha. The sorghum yield was in the range of 7.4-11.8 q/ha in the cluster. The cost of cultivation for cotton + pigeonpea intercropping was ₹ 14770/ ha. Labour accounted for the largest cost component (61%) followed by fertilizers (17%) and seed (13%).

Diagnosis of existing farming systems of selected farmers

A total of six farmers were selected from three villages (Seethagondhi, Chinna Malkapur and Pedda Malkapur). The selected farmers in different villages follow cotton + pigeonpea intercropping. Among the livestock, farmers usually rear cows, bullocks and goats. Regarding the analysis of crop production component, all the six selected farmers followed a row-ratio of 8:1 for the cotton + pigeonpea intercropping. All the farmers had adopted Bt-cotton hybrids ('Brahma', 'Mallika' etc). The predominant pigeonpea varieties were 'Asha' and 'Nirmal durga'. A spacing of 90 cm x 90 cm was mostly followed for cotton + pigeonpea intercropping. However, with the adoption of Bt-cotton hybrids, the farmers have reduced the spacing to 75 cm x 75 cm. Regarding nutrient management, one farmer was using only chemical fertilizers for crop production but other five farmers were using both organic manures and chemical fertilizers. However, no farmer was applying fertilizers as per the recommendation. All the six farmers followed manual and mechanical methods (harrowing) for weed management. The farmers were using various pesticides including imidacloprid, monocrotophos, endosulfon etc for pest management. The yield levels ranged from 8.75-20 q/ha for cotton and 1-2.5 q/ha for pigeonpea in different farmers' fields. Regarding the analysis of livestock component, all the farmers use sorghum and pigeonpea residues for feeding the livestock. In addition, green fodder from field bunds and crop fields was also used. The purchased feeding material included paddy straw and groundnut cake. While there was no healthcare for cows and buffaloes, deworming was done once in 3 months for goats.

Performance of different interventions

The cotton equivalent yield (CEY) ranged from 7.9-10.1 q/ha under different treatments. Averaged across six farmers' fields, the CEY of cotton + pigeonpea intercropping was 7.99 q/ha with farmers' practice (Figure 1). All the management practices gave higher CEY compared to farmers' practice. The CEY increased by 17.5% due to herbicide use for weed control, 28.3% with application of recommended NPK, and 35.8% with use of both herbicide and recommended NPK compared to farmers' practice.

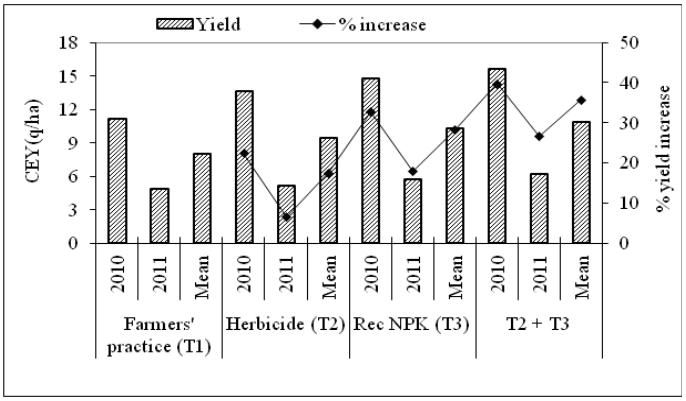


Fig. 1 : Effect of different management practices on cotton equivalent yield (CEY) in farmers' fields of Seethagondhi cluster, Adilabad district

The cost of cultivation under farmers' practice was ₹ 21,200/ ha. It was lowest (₹ 19,500/ha) under the treatment involving use of pendimethalin for weed control. Similarly, the cost of cultivation was less (₹ 19,900/ha) with use of both herbicide and recommended NPK. However, use of recommended NPK alone resulted in higher cost of cultivation (₹ 21,700/ha) compared to farmers' practice (Figure 2). Both gross and net return from cotton + pigeonpea intercropping were less (₹ 23,800 and ₹ 2,600/ha, respectively) under farmers' practice compared to improved management practices. Use of herbicide for weed control coupled with application of recommended NPK gave higher gross return (₹ 30,300/ha) and net return (₹ 10,300/ha) compared to other management practices.

Resource flow between different components of farming systems

The cotton equivalent yield was 9.2 to 11.2 q/ha and contributed 35 to 47.3% to total net income of marginal farmers. In addition, about 1.5 to 1.7 tons of livestock feed (pigeonpea stalks and

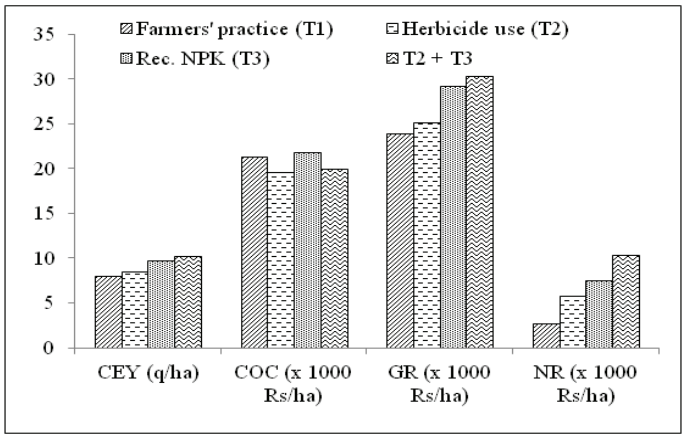
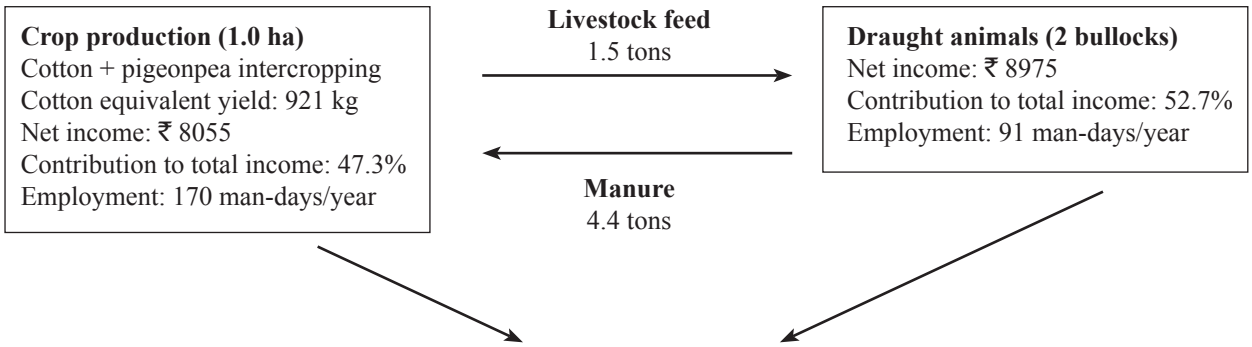


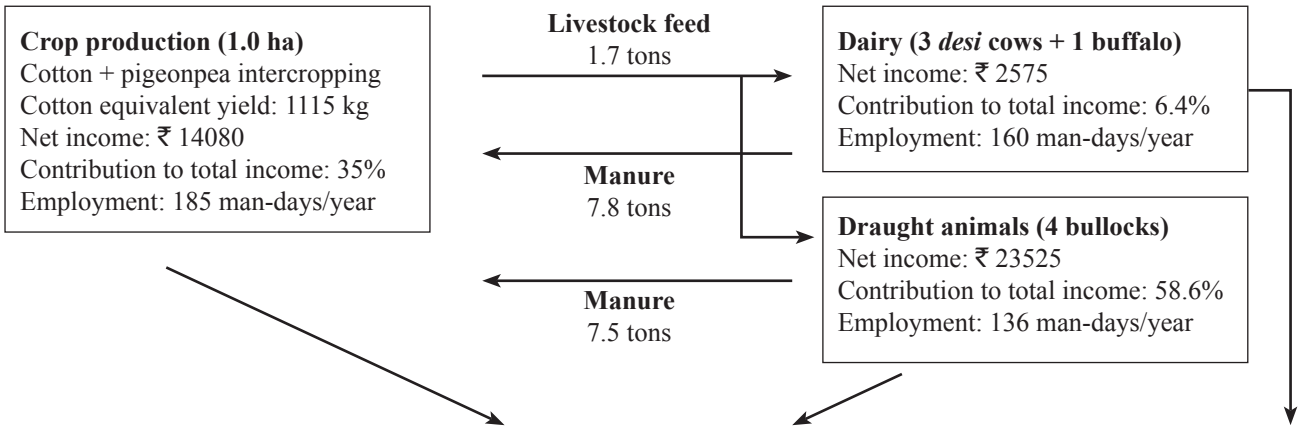
Fig. 2 : Economics of cotton + pigeonpea intercropping in Seethagondhi cluster, Adilabad district (mean of 2010 and 2011); CEY: cotton equivalent yield; COC: cost of cultivation; GR: gross returns; NR: net returns

green fodder from crop field and bunds) was harvested from crop component in farming systems of marginal farmers (Figures 3 & 4). The major share of net income (52.7 to 58.6%) was from livestock component in addition to generation of about 4.4 to 7.5 tons of manure. Among the farming systems of marginal farmers, the employment generation was highest (482 man-days/year) with integrated farming system involving crop + dairy + draught animals. Among the farming systems of small farmers, the crop component produced cotton equivalent yield of 1882 to 2390 kg, and contributed 2.6 to 2.8 tons of livestock feed and 32.7 to 56% to total net income (Figures 5 & 6). The livestock component generated about 4.4 to 10.4 tons of manure which was used for manuring crop fields. Integrated farming system involving crop (2 ha) + draught animals (2 bullocks) + dairy (1 cow) + small ruminants (40 goats) generated the highest employment (672 man-days/year) compared to other farming systems. Radha *et al.* (2000) also reported that integrated



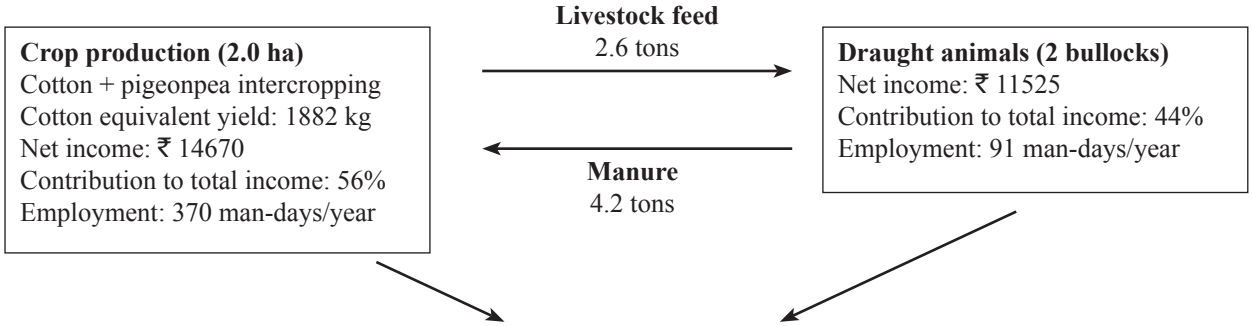
System	Net income (₹/year)	Employment (man-days/year)
Integrated farming system	17030	261

Fig. 3 : Resource flow in integrated farming system (crop + draught animals) of a marginal farmer (N. Rajanna) in Seethagondhi, Adilabad



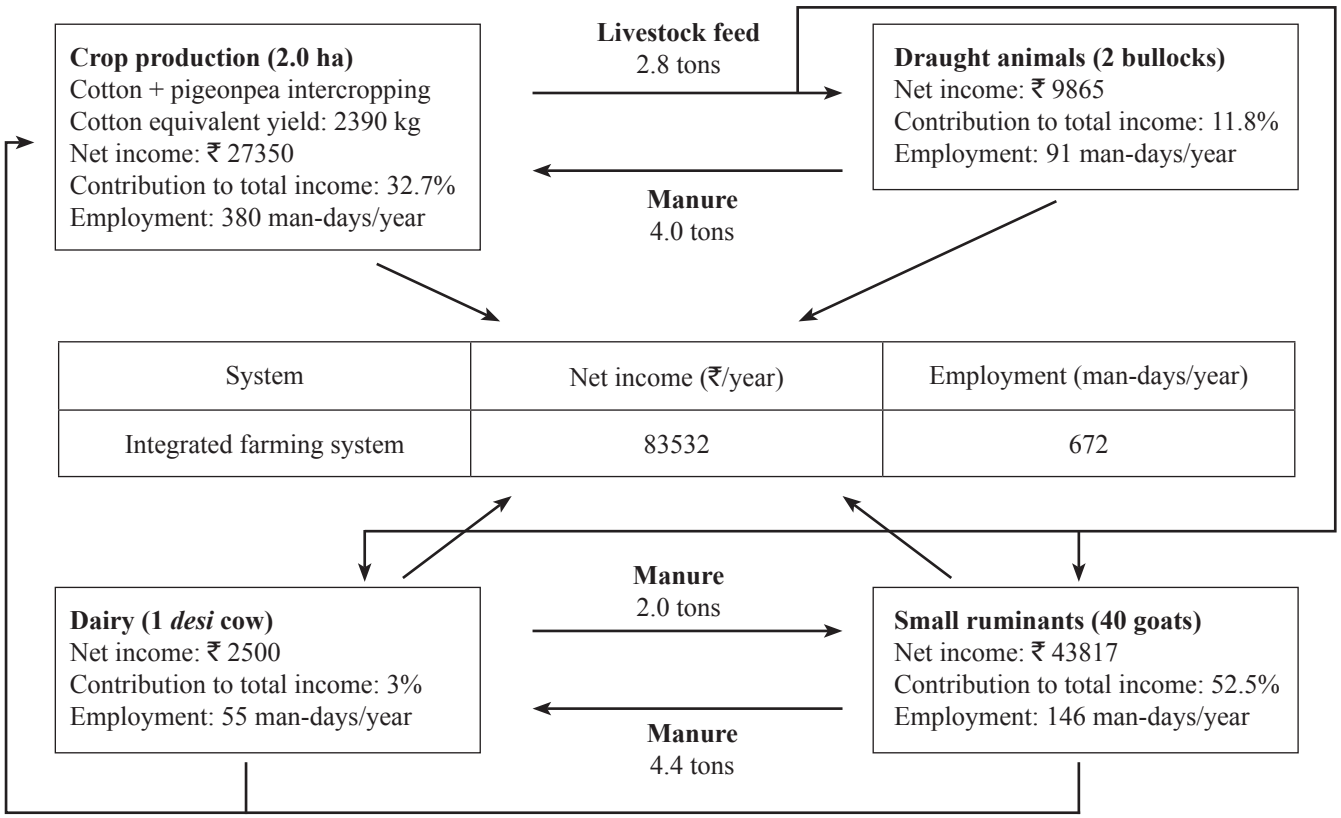
System	Net income (₹/year)	Employment (man-days/year)
Integrated farming system	40180	482

Fig. 4 : Resource flow in integrated farming system (crop + dairy + draught animals) of a marginal farmer (B. Kistu) in Seethagondhi, Adilabad



System	Net income (₹/year)	Employment (man-days/year)
Integrated farming system	26195	461

Fig. 5 : Resource flow in integrated farming system (crop + draught animals) of a small farmer (S. Manku) in P. Malkapur, Adilabad



System	Net income (₹/year)	Employment (man-days/year)
Integrated farming system	83532	672

Fig. 6 : Resource flow in integrated farming system (crop + draught animals + dairy + small ruminants) of a small farmer (K. Manthu) in Seethagondhi, Adilabad

farming systems involving crop production, dairy, poultry and sheep rearing generated more than three times additional employment over arable farming in Telangana region.

Economics of different farming systems

The economics of different farming system models were worked out for marginal and small holdings in Seethgondhi cluster of Adilabad. Improved farming systems gave higher net returns/ year compared to existing farming systems involving farmers' practice for both marginal and small farmers. Further, farmers having crop production alone realized less income/year than those having integrated farming systems (Table 1). Among the farming systems of marginal farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (4 bullocks, 3 *desi* cows and 1 buffalo) performed better with a net return of ₹ 40,180/year compared to other farming systems. Similarly, among the three farming systems of small farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (2 bullocks, 1 *desi* cow and 40 goats) gave higher net

Table 1 : Economics of different farming system modules in Seethagondhi cluster, Adilabad District

Farmer	Area (ha)	Cropping system	Livestock	Net income (₹/year)	
				Farmers' practice	Improved FS
Marginal farmers					
N. Dharmaji	1	Cotton + Pigeonpea	-	1,100	10,125
N. Rajanna	1	Cotton + Pigeonpea	Bullocks- 2	10,750	17,080
B. Kistu	1	Cotton + Pigeonpea	Bullocks- 4 *Desi* cows-3 Buffaloe-1	30,580	40,180
Small farmers					
M. Mothiram	2	Cotton + Pigeonpea	-	9,186	17,460
S. Manku	2	Cotton + Pigeonpea	Bullocks- 2	10,755	26,195
K. Manthu	2	Cotton + Pigeonpea	Bullocks- 2 *Desi* cow-1 Goats-40	70,907	89,937

return (₹ 89,937/year) compared to other farming systems. Sahadeva Reddy *et al.* (2010) and Gopinath *et al.* (2012) also reported that farming systems involving crop production and livestock component were profitable in rainfed areas of Andhra Pradesh.

Conclusion

Integration of livestock rearing with crop production gave higher economic returns compared to crop production alone for both marginal and small farmers. Further, improved farming systems gave higher net returns/year compared to existing farming systems involving farmers' practice. Hence, integrated farming systems assume greater importance in rainfed areas for sustaining the productivity and profitability of small and marginal farms.

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