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Enhancement of Productivity and Profitability through Integrated Farming Systems in Rajasthan

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ABSTRACT

The present study was conducted to enhancing the productivity and profitability of tribal farmers through various intervention of farming systems in Udaipur district of Rajasthan state. The study was based on primary data which were collected through pre-structure schedule for the year 2015-16 as benchmark survey, 2016-17 and 2017-18 from the selected households. The result of the study shows that prior to start the RKVY project during benchmark year 2015-16, three farming systems were existed in study area viz. FS-I: (C+D), FS-II: (C+D+G) and FS-III: (C+G). In the year 2017-18, there are five farming systems were observed viz. FS-I: (C+D+V), FS-II: (C+D+V+O), FS-III: (C+G+V), FS-IV: (C+D+G+V) and FS-V: (C+D+G+V+O) in the study area. The total cost was observed lowest in FS-III (`77105.19) and it was found highest in FS-II (`195324.56). The most profitable farming system based on of net return per farm was FS-II `101910.59. The return per rupee investment was found maximum in FS-IV (`1.71) which was observed the most profitable farming systems. Employment generated per farm was found maximum in FS-V (385.75 man-days). The change in net income per farm was increased by 187.08 per cent and employment generation per farm was also increased by 69.56 per cent over existing to improved farming systems. Thus, the well organized and integrated with crops and other labour intensive enterprises like dairy, poultry, vegetable, fruits, etc. can significantly increase the employment of farm families particularly small and marginal farmers having surplus family labour.

Keywords: Farming systems, Productivity, Profitability and Udaipur district

Indian agriculture is at cross road and passing through transition between traditional subsistence and modern and market oriented one. It followed the process of intensification, diversification and commercialization during different phases of agricultural history in India since independence. Intensification of cropping equipped modern agro-based technologies undoubtedly boosted up agricultural production and productivity especially of food grains. Indian agriculture has responsibility of providing national as well as household food and nutritional security to its spilling over millions. The declining trend in size of land holding poses a serious challenge to the sustainability and profitability of farming. The average size of the landholding has declined to 1.16 ha during 2010-11 from 2.28 ha in 1970-71. If this trend continues, the average size of holding in India would be mere 0.68 ha in 2020 and would be further reduced to 0.32 ha in 2030 (Agriculture Census, 2010-11). This situation in India calls for an integrated effort to address the emerging livelihood issues. It is imperative to develop strategies and agricultural technologies that enable adequate income and employment generation, especially for small and marginal farmers who constitute more than 85 per cent of the farming community. Farmers under these categories are economically poor working in diverse, risk prone environments and with hardly sufficient to sustain their family.

Rajasthan is the largest state of India constituting 10.4 per cent of total geographical area and 5.67 per cent of total population of India (GOI, 2011). About 65 per cent population (56.5 million) of the state are dependent on agriculture and allied activities for their livelihood.

Agriculture in Rajasthan is primarily based on rainfed covering country's 13.27 per cent of available land. The agriculture in most part of the state is rainfed and is prone to high production risk. Accordingly, every region of the state has evaluated crop and livestock species suitable for the region. Out of 10 agro-climatic zones of the state, two zone *i.e.* Sub-Humid Southern Plain and Aravali Hills Zone (IVA) and Humid Southern Plains Zone (IVB) falls in Southern Rajasthan and is relatively more diversified for crop and livestock production. In these zones, crops like maize, sorghum, cotton, black gram, soybean, groundnut, cluster bean *etc.* are grown in *kharif* season and crops like wheat, barley, rapeseed and mustard, gram, isabgol, *etc.* are grown in *rabi season*. Food security always remains an uncompromising goal of farm level agriculture for rural masses in most part of the state. Rural tribal farmers are facing the malnutrition problems due to less diversified food habit and low intake of vegetables in their diet. Farmers generally grow maize round the year so they eat maize with locally available vegetable i.e. *Kahlo* (butter milk + green sag), okra etc. They rarely purchase fresh vegetables due to poor economy. Backyard gardening consisting of seasonal vegetable crop's seeds were established nearby their houses for their own consumption to improve their nutrition. In order to meet the farm and family requirement, the farmers in the state have adopted different farm enterprise combinations of crop, dairy, goatry, vegetables, fruit orchards, poultry etc. Among livestock, cattle, buffalo and goat are the most dominating animals. The farming system models practiced by the farmers include various combinations of field crops, horticulture crops and livestock in southern Rajasthan. The different farming system models yield different level of incomes and employment at farm household levels. Integrated farming system approach provide a better solution to meet the increasing demand for food, diversification in food habits and stabilizing the income thus improving the nutrition level of the small-scale households with available limited resources. This paper deals with livestock based enterprise combinations for their contribution to sustainable livelihood of farm families with income enhancement as a major plank.

MATERIALS AND METHODS

Southern Rajasthan comprises of seven districts viz., Udaipur, Chittorgarh, Bhilwara, Rajsamand, Dungarpur, Banswara and Pratapgarh. These districts fall in agro-climatic region IVA (Sub-Humid Southern Plain and Aravali Hills) and IVB (Humid Southern Plain). Out of two agro-climatic regions, one region *i.e.* IVA (Sub-Humid Southern Plain and Aravali Hills) was taken under study. Among these districts, Udaipur district was selected purposively and Vallabhnagar tehsil from Udaipur district was selected in such a way that each having highest proportion of irrigated area to total net sown area of the district. Three villages from tehsil were selected based on the more the 50 per cent tribal population existed.

Thus, a total sample of 30 households was selected from Vallabhnagar tehsil of Udaipur district. The benchmark survey was conducted of the selected farmers for the year 2015-16. The present study was based on primary data which were collected from selected farmers through the pre-structured schedule for the year 2015-16, 2016-17 and 2017-18.The collected data were tabulated and analyzed by using different analytical tools.

Variable costs

The actual costs incurred by the farmer along with incidental charges incurred towards labour and material costs. The various items of operational costs were seed, farmyard manure, fertilizers, plant protection chemicals, feeds and concentrates, fodder and straw, labour (hired labour and family human labour) etc. Labour in all enterprises was converted into man-days by multiplying female and child labour by 0.70 and 0.50, respectively. Bullock labour, both owned and hired were accounted at the prevailing hire rates.

The operational costs in terms of labour (human, bullock and machine) and other outputs (main and by-products) of one activity utilized as an input in the other activity within the integrated farming system were worked out to assess the cost effectiveness of different integrated farming system.

Fixed costs

The various items of fixed costs were land revenue, land rent, interest on fixed capital and depreciation. The depreciation rates, life span and junk value for various agricultural implements and machinery were decided in consultation with the respondents. Consequently, the

depreciation was calculated using the straight line method as shown below:

$$\text{Depreciation (₹)} = \frac{\text{Purchase Value (₹)} - \text{Junk Value (₹)}}{\text{Life Span (Years)}}$$

Interest on fixed capital was calculated at the prevailing bank rate (10 %) on the value of the farm and livestock assets.

The returns from crops, dairy, horticultural crops and goat rearing were estimated by multiplying the actual price realized to quantity sold by them and the quantities that was retained for seed or consumption was evaluated at the rates prevailing at the time of harvest. The same method was also followed for the valuation of by-products of various enterprises.

(A) Gross Return from Integrated Farming System (GIIFS) was worked out as:

$$GIFS = \sum_{i=1}^{n} Q_i \times P_i$$

Where,

Q_i is the Physical output (main and by product) of i^{th} component of IFS and

P_i is the price of i^{th} output.

(B) Paid Out Cost of Integrated Farming Systems (PCIFS) was work out as:

$$PCIFS = \sum_{i=1}^{n} x_i \times p_i$$

Where,

x_i = the i^{th} external input in quantity term

p_i = the price of i^{th} external input

(C) Net Income from Integrated Farming System (NIIFS) was worked out as:

$$\text{NIIFS} = \text{GIIFS} - \text{PCIFS}$$

(D) Cost of Internally Adjusted Input (CIAI)

$$\text{TC} - \text{PCIFS}$$

Where,

TC = Total Cost (Fixed Cost + Variable Cost).

PCIFS = Paid out cost of integrated farming system.

Human labour employment in farming systems were calculated by taking time spent in performing various operations. Male, female and child labour engaged in farming systems were computed separately. All types of labour (male, female and child labour) used in different livestock and crop production operations were converted into man equivalent days.

RESULTS AND DISCUSSION

Existing farming systems

Integrated farming system is a combination of different enterprises like crops, vegetables, fruit orchards, dairy enterprise, goatry and poultry to enhance the farm income and employment. In Udaipur district, three farming systems were prominently observed during the year 2016-17 of the benchmark survey for the year 2015-16 (Table 1). They were FS–I: Crops + Dairy (C+D), FS–II: Crops + Dairy + Goat (C+D+G) and FS–III: Crops + Goat (C+G).

Table 1: Existing farming systems

Sl. No.		Farming Systems
1	FS-I	Crop + Dairy (C+D)
2	FS-II	Crop + Dairy + Goat (C+D+G)
3	FS-III	Crop +Goat (C+G)

Comparison of cost and return of existing farming systems.

Cost and return in existing farming systems prevalent in the study area are presented in Table 2, Fig. 1 and 2. Results from the table showed that among existing farming system in the Udaipur district, total cost among all three farming systems was highest in FS-II i.e. ₹ 113456.48 followed by FS-I (₹ 75113.95) and FS-III (₹ 57955.85). The total variable cost varied from 83.46 per cent in FS-II to 87.15 per cent in FS-III as percentage share of total cost whereas the total fixed cost varied from 12.85 in FS-III to 16.54 in FS-II. The net return per farm over the year was found

highest in FS-II i.e. ₹ 33908.86 and it was lowest in FS-III (₹ 18429.61) whereas the return per rupee invested was observed highest in FS-I (₹ 1.37) followed by FS-III (₹ 1.33) and FS-II (1.30).

Table 2: Comparison of cost and return in existing farming systems (₹/Farm/Year)

Sl. No.	Particulars	Existing Farming Systems			Overall
		FS-I	FS-II	FS-III	
A	Cost (₹)				
1	TVC	64410.21 (85.75)	94690.78 (83.46)	50508.52 (87.15)	69869.84 (85.02)
2	TFC	10703.74 (14.25)	18765.70 (16.54)	7447.33 (12.85)	12305.59 (14.98)
3	**TC**	**75113.95 (100.00)**	**113456.48 (100.00)**	**57955.85 (100.00)**	**82175.43 (100.00)**
B	Return (₹)				
1	GR	102851.77	147365.34	76385.46	108867.5
2	NR	27737.82	33908.86	18429.61	26692.1
3	**Returns per Rupee Investment**	**1.37**	**1.30**	**1.32**	**1.33**

Overall result had shown the total cost, net return and return per rupee investment was ₹ 82175.43, ₹ 26692.10 and ₹ 1.33, respectively among existing farming systems adopted by tribal farmers of Udaipur district. Similar finding were also observed in many studies conducted by Kumari *et al.* (2015), Singh and Burark (2016), Singh *et al.* (2017), Ponnusamy and Devi (2017) and Negi *et al.* (2019).

Income and employment generation among existing farming systems

Table 3, Fig. 3 and 4 showed the quantum of income and employment generated under different farming systems adopted by the tribal farmers in Udaipur district of Rajasthan. Results from the table showed that the net income per farm was found highest in FS-II (₹ 30908.86) and it was observed lowest in FS-III i.e. ₹ 18429.61. On the basis of per hectare, the net income was also generated maximum from FS-II of ₹ 31397.09 followed by FS-I (₹ 30149.80) and FS-III (₹ 29725.18). The employment generation on the basis of per farm and per hectare was found highest in FS-II i.e. 215.85 and 199.86 mandays per year, respectively followed by FS-I and FS-II. Overall result shows that the net income and employment generated per hectare was ₹ 30563.47 and 181.32 mandays per year, respectively. Kumar *et al.* (2012) also reported the similar findings with the net income (₹ 159485/year) and employment generation (752 mandays/year). Employment

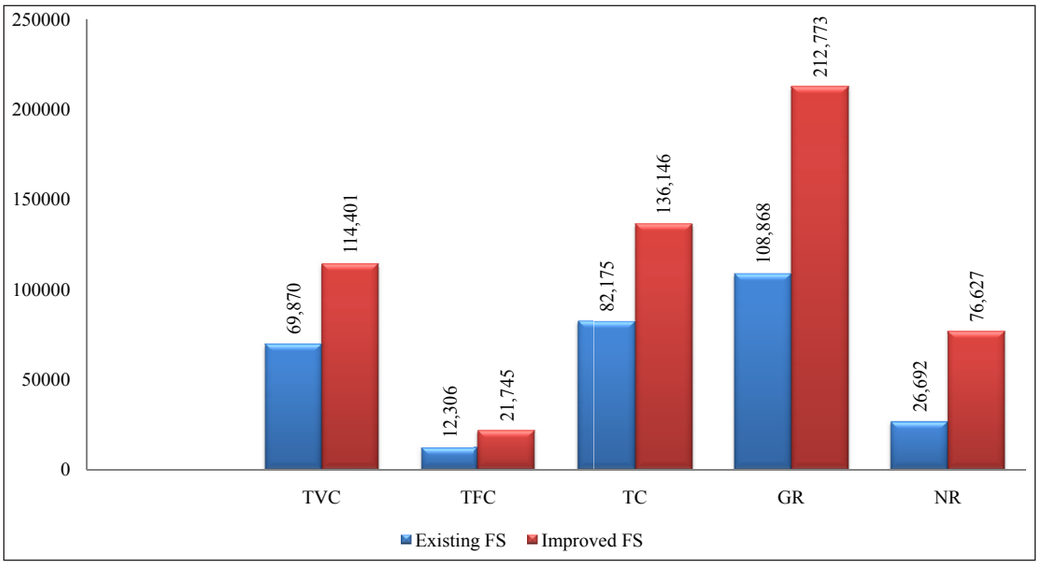

Fig. 1: Comparative analysis of existing and improved farming systems

Table 3: Farm income and employment generated in existing farming systems

Sl. No.	Particulars	Units	Existing Farming Systems			Overall
			FS-I	FS-II	FS-III	
I	**Income**					
A	Net Income/Farm	₹/Farm	27737.82	33908.86	18429.61	26692.10
B	Net Income/ha	₹/ha	30149.80	31397.09	29725.18	30563.47
C	Average Land Holding	Ha	0.92	1.08	0.62	0.87
II	**Employment**					
A	Employment/Farm	Mandays/Farm	175.55	215.85	83.65	158.35
B	Employment/ha	Mandays/ha.	190.82	199.86	134.92	181.32

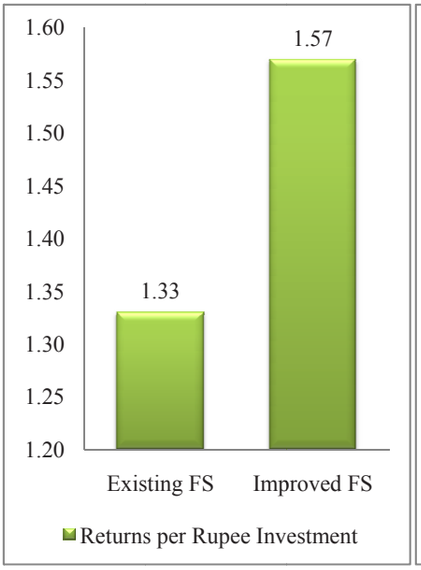

Fig. 2: Returns per rupee investment in improved over existing farming system

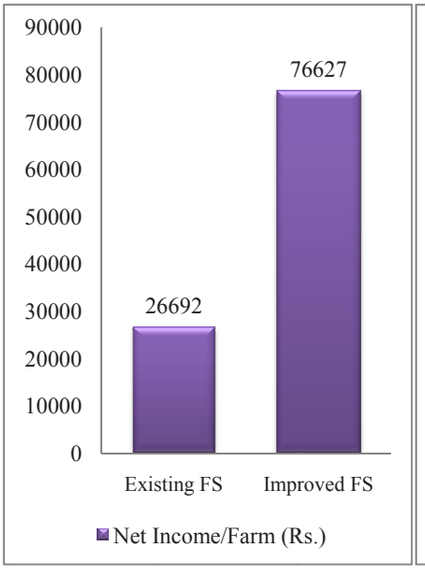

Fig. 3: Comparison of income between existing and improved farming systems

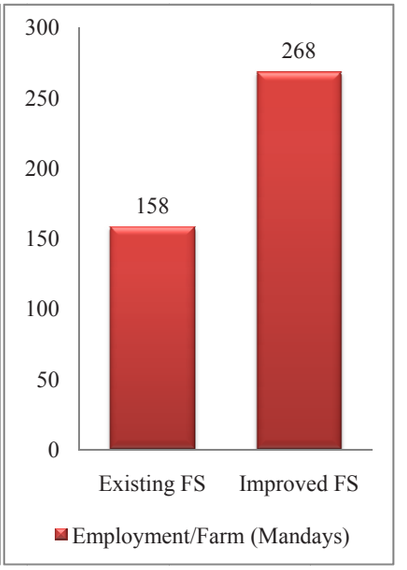

Fig. 4: Comparison of employment between existing and improved farming systems

generation and marketing behaviour were also found significantly correlated with the total income due to the proper engagement of family labour and immediate returns from sale of crop output, vegetable production and dairy products for meeting the urgent expenses. Similar studies were also conducted by Sekhar *et al.* (2014), Kumar *et al.* (2011), Ravishankar *et al.* (2007), Toor *et al.* (2009), Jayanthi *et al.* (2003) and Singh (2003).

Improved farming systems

There were only three farming systems existed during the benchmark survey for the year 2015-16. After two years of the implementation of the project from 2016-17 and 2017-18, the five improved farming systems were observed in the study area (Table 6). These improved farming systems were developed through the various interventions proposed to the tribal farmers of the selected area. The various interventions provided to the selected farmers are as follows:

- ❒ Improved seed of crops like cereals, pulses, oilseeds and cash crop like cotton and clusterbean
- ❒ Crop diversification through introduction of hybrid vegetables seeds/seedlings and fruit plants.

- ❒ Follow the proper crop rotation.
- ❒ Need of high water use efficiency by using the drip/sprinkler irrigation practices.
- ❒ Need of labour management by better farm mechanization.
- ❒ Need of better feeding management practices in livestock rearing.

All these interventions have been provided as per requirement of the farmers under the RKVY project.

Table 4: Improved farming systems

Sl. No.	Farming Systems	
1	FS-I	Crop + Dairy + Vegetable (C+D+V)
2	FS-II	Crop + Dairy + Vegetable + Orchard (C+D+V+O)
3	FS-III	Crop + Goat + Vegetable (C+G+V)
4	FS-IV	Crop + Dairy + Goat + Vegetable (C+D+G+V)
5	FS-V	Crop + Dairy + Goat + Vegetable + Orchard (C+D+G+V+O)

Comparison of cost and return of improved farming systems in study area

Data presented in Table 5, Fig. 1 and 2 indicated that the cost and return in improved farming systems in Udaipur district of Rajasthan state. Results show that the total cost was observed highest in FS-II with ₹ 195324.56 followed by FS-V (₹ 187956.63), FS-IV (₹ 115118.19) and it was found lowest in FS-FS-III (`77105.19). The total variable cost was varied from 82.82 per cent in FS-IV to 85.21 per cent in FS-III whereas the total fixed cost was varied from 14.79 per cent in FS-III to 17.18 per cent in FS-IV in the percentage share of total cost. The net return per farm over the year was found maximum in FS-II with ₹ 101910.59 followed by FS-V (₹ 99630.91), FS-IV (₹ 82017.06) and the least profitable farming system based on net return per farm was observed in FS-III (₹ 37647.96). Based on the return per rupee invested, the most profitable farming system was seen FS-IV with ₹ 1.71 followed by FS-I (₹ 1.59), FS-V (₹ 1.53) and it was found least profitable in FS-III i.e. ₹ 1.49. Overall result of the all farming systems shows the total cost, net return and return per rupee investment was ₹ 136146.15, ₹ 76627.10 and ₹ 1.57, respectively. The percentage change over existing farming systems to improved farming systems in total cost, net return and return per rupee investment was 65.68 per cent, 187.08 per cent and 18.03 per cent, respectively from the year 2015-16 to 2017-18. Based on net income, improved farming systems were found to contribute a higher net income to the farm families, since they were engaged in profit oriented farm enterprises including livestock rearing, goatry, vegetable production and fruit orchard etc. Despite their small or medium holding and small livestock holding, the farmers in study area earned a better return from such enterprises due to their intensive management including the use of family labour. Similar finding were also observed in many studies conducted by Kumari *et al.* (2015), Singh and Burark (2016), Singh *et al.* (2017), Ponnusamy and Devi (2017) and Negi *et al.* (2019).

Income and employment generated in improved farming systems in study area

Data given in the Table 6, Fig. 3 and 4 depict the income and employment generation in improved farming systems in Udaipur district of Rajasthan state. Results from the table showed that the FS-II was found the most profitable farming system with net income per farm of ₹ 101910.59 and the least profitable farming system was seen FS-III (₹ 37647.96) whereas net income per hectare basis, the FS-IV was observed the most profitable farming system with ₹ 97639.36 per hectare followed by FS-II (₹ 90991.60), FS-V (₹ 85888.72) and it was seen least profitable in FS-III (₹ 75295.92). Employment generation per farm was seen highest in FS-V (385.75 mandays /farm /year) and it was lowest 123.25 mandays per farm per year in FS-III whereas per hectare employment generation was found highest 371.96 mandays per farm per year in FS-IV followed by FS-V (332.54 mandays /farm /year), FS-I (299.12 mandays /farm /year) and lowest 246.50 mandays per farm per year also in FS-III. The overall results from the table depicted that the net income and employment generation per hectare was seen ₹ 87875.11 and 307.91 mandays per farm per year, respectively. The percentage changes over existing scenario of the farming systems to current scenario of farming systems was 188.83 per cent and 75.75 per cent, respectively in net income and employment generation per hectare. The diversified nature

Table 5: Comparison of cost and return in improved farming systems (₹/Farm/Year)

Sl. No.	Particulars	Improved Farming Systems					Overall	Percentage Change over Existing to Improved Farming System
		FS-I	FS-II	FS-III	FS-IV	FS-V		
A	**Costs (₹)**							
1	TVC	87464.01 (83.12)	164170.29 (84.05)	65701.33 (85.21)	95340.88 (82.82)	159330.84 (84.77)	114401.47 (84.03)	63.74
2	TFC	17762.18 (16.88)	31154.27 (15.95)	11403.86 (14.79)	19777.31 (17.18)	28625.79 (15.23)	21744.68 (15.97)	76.71
3	**TC**	105226.19 (100.00)	195324.56 (100.00)	77105.19 (100.00)	115118.19 (100.00)	187956.63 (100.00)	136146.15 (100.00)	65.68
B	**Returns (₹)**							
1	GR	167155.15	297235.15	114753.15	197135.25	287587.54	212773.25	95.44
2	NR	61928.96	101910.59	37647.96	82017.06	99630.91	76627.10	187.08
3	**Returns per Rupee Investment**	**1.59**	**1.52**	**1.49**	**1.71**	**1.53**	**1.57**	**18.03**

Table 6: Farm income and employment generated in improved farming systems

Sl. No.	Particulars	Units	Improved Farming Systems					Overall	Percentage Change over Existing to Improved Farming Systems
			FS-I	FS-II	FS-III	FS-IV	FS-V		
I	**Income**								
A	Net Income/Farm	₹/Farm	61928.96	101910.59	37647.96	82017.06	99630.91	76627.10	187.08
B	Net Income/ha	₹/ha	83687.78	90991.60	75295.92	97639.36	85888.72	87875.11	188.83
C	Average Land Holding	Ha	0.74	1.12	0.50	0.84	1.16	0.87	
II	**Employment**								
A	Employment/Farm	Mandays/Farm	221.35	299.68	123.25	312.45	385.75	268.50	69.56
B	Employment/ha	Mandays/ha.	299.12	267.57	246.50	371.96	332.54	307.91	75.75

of multifarious activities related to different enterprises included in integrated farming system provide a lot of opportunities of employment and keeps farmers and their family members engaged more time and help in improving the employment for rural poor. Similar results were reported by Sekhar *et al.* (2014), Kumar *et al.* (2011), Ravishankar *et al.* (2007), Toor *et al.* (2009), Jayanthi *et al.* (2003) and Singh (2003).

CONCLUSION

Thus, it can concluded there is urgent need to prepare a policy draft for the consideration of planners for promotion farming system modules at large scale with nominal financial assistance from the state government either through short/medium/long term loans and other promotional advantage like subsidies. The entire philosophy of farming system revolves around better utilization of time, money, resources and family labour. The farm family gets scope for gainful employment round the year thereby ensuring good income and higher standard of living even from small holdings. From the above study it is clear that the small size farms can earn

a living provided the farmer does all the field operations as well as marketing himself. The income can be further increased if the farming system is managed so as to harvest the crop during festivals. Early harvest can also help to get high price.

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