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Research Article

EXTENT OF DIVERSIFICATION IN SMALL HOLDER CROP AND LIVESTOCK INTEGRATED FARMING SYSTEMS UNDER MAJOR FARMING SITUATIONS IN KURNOOL DISTRICT OF ANDHRA PRADESH

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Abstract: Majority of the Indian economy is in the hands of small and marginal farmers with 80% of total land holdings having less than 1ha of cultivable land. Integration of crops and livestock is very much needed to get sustainable income for small holder farming. With an objective to identify the profitable crop and livestock integrated farming for small and marginal farmers in Kurnool district, the present study 'sustainable livelihood for small and marginal farmers through agriculture and livestock activities – a study on farming systems in Kurnool district of Andhra Pradesh was conducted. It was observed that the farming system consisting of seasonal crops along with dairy, sheep and poultry was found most profitable than cultivation of crops alone. The farming system with red gram + dairy + sheep was found profitable in rainfed black soils with BCR of 2.11. from the study it was identified that red gram + dairy (1.94) in rainfed red soils and maize + sorghum + dairy + sheep + poultry (1.87) in rainfed black soils were found most profitable farming systems The Simpson Index of Diversification was also assessed and observed more diversification in the farming systems under irrigated black soils. The results of the study useful to adopt suitable and profitable farming system for small and marginal farmers in Kurnool district.

Keywords: *Farming systems, Small Holder Crop, Livestock, Major Farming Situations*

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Introduction

Indian economy is heavily reliant on agriculture and livestock and two-thirds of rural families depend on livestock for their livelihood [1]. Majority of the Indian agriculture production is in the hands of small and marginal farmers consisting about 80% of total land holdings. Among the 115 million operational land holdings, 85 million are having below 1ha of land. The small and marginal farmers in India cultivate only 44% of the area and producing 60% of food grains includes 40% wheat, 29% of coarse cereals and 27% of pulses and over 50% of fruits and vegetable production. Kurnool district of Andhra Pradesh located in scarce rainfall zone with 630mm annual rainfall is having 10.2lakh ha of total cultivable land and 12 farming situations out of which 80% is under rainfed black soils, rainfed red soil and irrigated black soils. The soils in the district are predominantly black cotton soils (7.66lakh ha), followed by red soils (2.05lakh ha) and other soils (0.51lakh ha). Marginal holdings constitute 40% and small farmers have 28% of the total land holdings in the district.

Different studies have revealed that the integration of crop and livestock provide sustainable income and employment and to small and marginal farmers [2]. Several studies have conducted to assess the farming systems in different agroclimatic zones at different districts of Andhra Pradesh [3-6] Since data on crop and livestock farming systems is not available for Kurnool district, the present study was conducted on "Sustainable livelihoods for small and marginal farmers through agriculture and livestock activities – A study on farming systems in Kurnool district of Andhra Pradesh" with the following objectives

To assess the socio-economic characteristics of the farmers in the major farming situations of Kurnool district

To identify major agriculture and livestock farming systems in major farming situations of Kurnool district.

To analyse the extent of diversification of the farming systems in major farming situations of Kurnool district.

Materials and methods

Selection of Villages and respondents

A total of 270 respondents were selected for the study from 9 villages randomly selected from three major farming situations *viz* rainfed black soils, rainfed red soils and irrigated black soils.

Tools of data collection

A semi-structured schedule was designed to collect the required information from the sample regarding their socio-economic profile, different components and their management and the cost economics of the different crops and livestock.

Research Design and Statistical analysis

'Ex-post facto' design was used for this study. Benefit Cost Ratio was calculated for each farming system to assess the profitability. Appropriate statistical tools and techniques such as percentages and averages were used for analyzing the data. Simpson index of diversification was calculated with following formula

$D_i = 1-\sum(si/s)^2$

Where,

D_i = Simpsons diversification index

S_i = Share of net income of i^{th} enterprise in per farm net income

S = Per farm net income of whole farming system

Benefit Cost Ratio was calculated for each farming system with the following formula - *BCR= Gross Income/Cost of production*

Results and discussion

Personal and socio-economic characteristics

Personal and socio-economic characteristics of the respondents in the study area of farming situations *viz*. Rainfed Black Soils, Rainfed Red Soils and Irrigated Black Soils of Kurnool district is presented in [Table-2].

Table-1 Personal and socio-economic characteristics of farmers in the study area

Characters	Category	Irrigated Black soils N=90		Rainfed Black soils N=90		Rainfed Red Soils N=90		Pooled Data N=270	
		No	%	No	%	No	%	No	%
Age (Years)	Young Age (<35 years)	30	33.3	27	30	21	23.3	78	28.9
	Middle Age (36-60 years)	54	60	58	64.4	64	71.1	176	65.2
	Old Age (>60 years)	6	6.67	5	5.56	5	5.56	16	5.93
Education	Illiterate	2	2.2	14	15.6	9	10	25	9.3
	Primary School	12	13.3	27	30	26	28.9	65	24.1
	Middle school	11	12.2	15	16.7	19	21.1	45	16.7
	High School	29	32.2	16	17.8	19	21.1	64	23.7
	Intermediate	17	18.9	10	11.1	11	12.2	38	14.1
	Graduation & above	19	21.1	8	8.9	6	6.7	33	12.2
Family type	Nuclear	38	42.2	40	44.4	56	62.2	134	49.6
	Joint	52	57.8	50	55.6	34	37.8	136	50.4
Family size	Small (3-5 members)	57	63.3	60	66.7	44	48.9	161	59.6
	Medium (6-7 members)	22	24.4	13	14.4	34	37.8	69	25.6
	Large (>7 members)	11	12.3	17	18.9	12	13.3	40	14.8
Farming experience	1-10 years (less)	26	28.9	24	26.7	31	34.4	81	30
	11-20 years (Medium)	33	36.7	26	28.9	31	34.4	90	33.3
	21-30 years (High)	23	25.6	30	33.3	18	20	71	26.3
	>31years (Very High)	8	8.9	10	11.1	10	11.1	28	10.4

Table-2 Operational land holding particulars of the sample respondents in the study area

SN	Land Particulars	Rainfed Black soils	Rainfed Red Soils	Irrigated Black soils	Pooled Data
1	Own land (ha)	116.50	127.10	124.00	367.60
2	Average own land (ha)	1.29	1.41	1.38	1.36
3	Leased in land (ha)	66.20	48.60	88.20	203.00
4	Total operational land (ha)	182.70	175.70	212.20	570.60
5	Average operational land (ha)	2.03	1.95	2.36	2.11

Table-3 Distribution of respondents according to own land

SN	Land holding group	Rainfed Black soils	Rainfed Red Soils	Irrigated Black soils	Pooled Data
1	Marginal farmers	36 (40)	21 (23.3)	24 (26.7)	81 (30)
2	Small farmers	54 (60)	69 (76.7)	66 (73.3)	189 (70)
3	Total	90 (100)	90 (100)	90 (100)	270 (100)

Age

The data indicated that 65.2%n of the sample respondents were belongs to middle age group. It shows that middle aged people were actively involved in agriculture and allied activities. Among the sample respondents, the young people are 28.9% and old people were 5.93%. Old age people were least in all the three farming situations.

Education

It is evident from the [Table-1] indicated that most of the respondents (90.7%) were literate. 25.5%, 46.7% and 40% had their school education in Irrigated Black Soils, Rainfed Black Soils and Rainfed red soils respectively. However, 40%, 20% and 18.9% had their college (intermediate, Graduation and above) education in Irrigated Black Soils, Rainfed Black Soils and Rainfed red soils respectively.

Overall, 24.1% had up to primary education, 16.7% had middle school education, 23.7% had high school education, 14.1% had intermediate education and 12.2% had graduation and only 9.3% were illiterates. The literates were more in Irrigated Black soils (97.8%) followed by Rainfed Red Soils (90%) and Rainfed Black Soils (84.4%). It is known fact that the education plays a key role in decision making, adoption of new technologies and also changes in socio-psychological behaviour of the farmers.

Family type

Type of family plays an important role in adoption of farming system. From the [Table-1] it is clear that 50.4% were Joint families and 49.6% were nuclear families. Nuclear families were more in Rainfed Red Soils (62.2%) and Joint families were more in Irrigated Black Soils (57.8%). Joint families have an opportunity to share the various activities of different enterprises so as to minimize the cost on labour.

Family size

The data presented in [Table-1] indicated that majority (59.6%) of the sample respondents represents from small family with 3-5 members followed by medium (25.6%) and large (14.8%) families. It clearly indicates that joints families are gradually converting into small families.

In irrigated black soils, majority of the respondents were belonged to small (63.3%) followed by medium (24.4%) and large families (12.3%). Similarly, among the respondents from rainfed black soils, 66.7% belongs to small, 18.9% large and 14.4% medium families. In rainfed red soils, 48.9% were small, 37.8% were medium and 13.3% were large families.

Farming experience

The particulars of farming experience of the respondents given in [Table-1] reveals that about 70% of the farmers had experience more than 10 years. Among the respondents in Rainfed Black Soils, 33.3% had high farming experience, 28.9% had medium, 26.7% had less and 11.1% had very high level of farming experience.

Similarly, among the respondents in rainfed red soils, medium and less category of farming experience were equal (34.4%) percentage, 20% had high and 11.1% had very high level 0f farming experience.

Among the respondents in irrigated black soils, 36.7% had medium, 28.9% had less, 25.6% had high and 8.9% had very high level of farming experience. It clearly indicated that one third of the respondents in irrigated black soils had medium to low level of farming experience. In the pooled sample, 33.3% were having medium level of farming experience, 30% had less, 26.3% had high and 10.4% had very high level of farming experience.

Operational land holding

The data pertaining to operational land holding of the sample respondents is presented in [Table-2] confirmed that the average operational land holding is 2.11ha. It was observed that the operation land holding of the respondents belonged to small and marginal farmers was high in irrigated black soils (2.36ha) followed by rainfed black soils (2.03) and rainfed red soils (1.95ha). the data revealed that the leased land is highest in irrigated black soils (88.2ha) followed by rainfed black soils (66.2ha) and rainfed red soils (48.6ha).

Table-4 Farming systems practiced by the sample respondents in the study area

SN	Farming systems	Rainfed Black soils N=90	Rainfed Red Soils N=90	Irrigated Black soils N=90
1	Crops	19 (21.1)	20 (22.2)	23 (25.6)
2	Crops + Dairy	16 (17.8)	26 (28.9)	32 (35.6)
3	Crop + Dairy + Poultry	10 (11.1)	17 (18.9)	14 (15.6)
4	Crop + Dairy + Sheep & Goat	12 (13.3)	10 (11.1)	3 (3.3)
5	Crop + Dairy + S&G + Poultry	24 (26.7)	12 (13.3)	13 (14.4)
6	Crop + Poultry	4 (4.4)	1 (1.1)	3 (3.3)
7	Crop + Sheep + Poultry	5 (5.6)	2 (2.2)	2(2.2)
8	Crop + S&G	0	2 (2.2)	0
	Total	90 (100)	90 (100)	90 (100)

Table-5 Comparative economics of the major farming systems in the study area

SN	Farming system	Total cost	Gross income	Net Returns	BCR
I	Rainfed Black Soils				
1	FS-I	93569	140419	46850	1.50
2	FS-II	194864	329537	134673	1.70
3	FS-III	154085	264000	109915	1.71
4	FS-IV	237146	450495	213349	1.90
5	FS-V	209808	401518	191710	1.91
II	Rainfed Red Soils				
1	FS-I	100551	126053	25502	1.25
2	FS-II	133878	243942	110064	1.82
3	FS-III	138739	237904	99165	1.71
4	FS-IV	228190	354820	126630	1.55
5	FS-V	255779	399830	144051	1.56
III	Irrigated Black Soils				
1	FS-I	266394	322550	56156	1.21
2	FS-II	284862	488348	203486	1.71
3	FS-III	519836	654220	134384	1.26
4	FS-V	288140	531335	243195	1.84

Distribution of sample respondents according to land ownership

The data pertaining to land ownership of the sample respondents is presented in [Table-3] indicated that 70% of the respondents belongs to small farmers with 2.5 to 5 acres of land and 30% were marginal farmers with less than 2.5acres of land. Among the sample respondents in rainfed black soils 60% were small farmers and 40% were marginal farmers. Whereas in rainfed red soils, 76.7% were small and 23.3% were marginal farmers. Similarly, in irrigated black soils 66% were small and 26.7% were marginal farmers.

Identification of farming systems

Various crop and livestock integrated farming systems were identified in rainfed black soils, rainfed red soils and irrigated black soils of Kurnool district. Major farming systems in each farming situation where at least 10 or more farmers practicing were then selected for further in-depth analysis [Table-4].

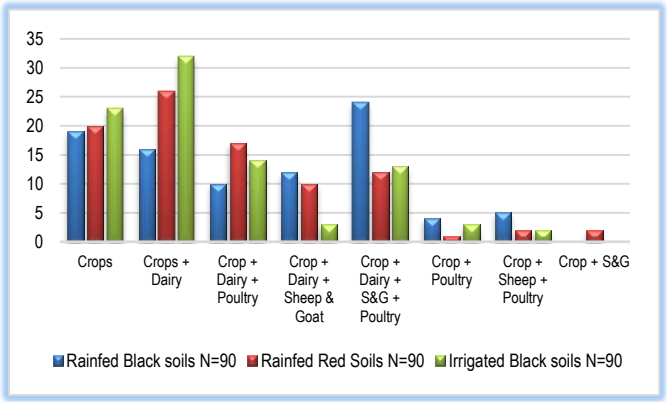

Fig-1 Graphical representation of different farming systems in major farming situations of Kurnool district

Major farming systems in rainfed black soils

A total of seven farming systems practiced by the sample respondents of rainfed black soils were identified. The major farming systems in the rainfed black soils of Kurnool district were Crops + Dairy + Sheep & Goat + Poultry (FS-IV: 24 No), followed by Crops alone (FS-I: 19 No), Crops + Dairy (FS-II: 16 No), Crops + Dairy + Sheep & Goat (FS-IV:12 No) and Crops + Dairy + Poultry (FS-III: 10 No).

Major farming systems in rainfed red soils

A total of 8 farming systems were identified in the rainfed red soils of Kurnool district out of which Crops + Dairy (FS-II: 26 No) followed by Crops alone (FS-I:20 No), Crops + Dairy + Poultry (FS-III: 17 No), Crops + Dairy + Sheep & Goat + Poultry (FS-IV: 12 No) and Crops + Dairy + Sheep & Goat (FS-IV: 10 No) were selected as major farming systems.

Major farming systems in irrigated black soils

A view from the [Table-4] confirmed a total of seven farming systems were practiced by the sample respondents of irrigated black soilsof Kurnool district out of which Crops + Dairy (FS-II: 32 No) followed by Crops alone (FS-I:23 No), Crops + Dairy + Poultry (FS-III: 14 No) and Crops + Dairy + Sheep & Goat + Poultry (FS-IV: 13 No) were selected as major farming systems.

Table-6 Extent of diversification in the major farming systems of Kurnool district

SN	Farming system	Simpson Index of Diversification (SID) value
I	Rainfed Black Soils	
	FS-I	0.41
	FS-II	0.62
	FS-III	0.73
	FS-IV	0.67
	FS-V	0.66
II	Rainfed Red Soils	
	FS-I	0.64
	FS-II	0.63
	FS-III	0.69
	FS-IV	0.75
	FS-V	0.77
III	Irrigated Black Soils	
	FS-I	0.52
	FS-II	0.82
	FS-III	0.79
	FS-V	0.81

Profitability of farming systems

The economics of major farming systems in rainfed black soils, rainfed red soils and irrigated black soils is presented in [Table-4]. Among the major farming systems in rainfed black soils, FS-V (1.91) was found profitable followed by FS-IV (1.90), FS-III (1.71), FS-II (1.70) and FS-I (1.5). The highest profitability among the farming systems in rainfed red soils was recorded in FS-II (1.82) followed by FS-III

(1.71), FS-V (1.56), FS-IV (1.55) and FS-I (1.25). Similarly, the highest profitability in irrigated black soils was recorded in FS-V (1.84) followed by FS-II (1.71), FS-III (1.26) and FS-I (1.21). The data clearly indicated that among the farming systems lowest profitability was observed in the farming system with crop component only whereas the profitability was more in the farming system with crop and livestock components.

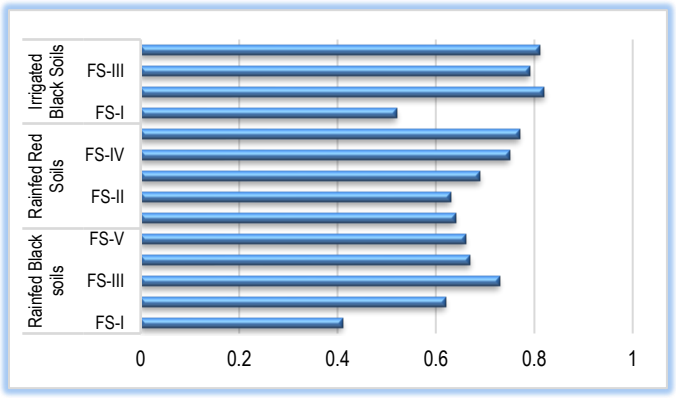

Fig-2 Graphical representation of SID values of different farming systems

Field crops + Poultry + Fishery + Horticulture system recorded profitable integrated farming system in eastern ghats of Andhra Pradesh [7] Rao *et al*., (2019) [5] have identified profitable farming systems for Vijayanagaram, Vishakhapatnam and Srikakulam district. Kumari and Chauhan (2021) [8] identified seven livestock crop and livestock integrated farming systems in Odisha out of which cattle + crop + goat + poultry system was found more operational area with 1.13ha. Reddy, *et al* 2021 [6] identified crop + dairy and crop + dairy + horticulture are sustainable integrated farming systems for Anantapuram district. Crop + fish was the most satisfied farming system in Punjab [9] Crop + Dairy + Goat farming and Crop + Goat farming were found potential farming systems in Uttar Pradesh [10].

Extent of diversification in major farming systems

Diversification of income from the different components in the existing farming systems of major farming situations in Kurnool district was assessed and presented in [Table-5].

Rainfed Black Soils

The diversification index of farming systems in rainfed black soils indicated that the higher SID value was observed in FS-III (0.73) followed by FS-IV (0.67), FS-V (0.66), FS-II (0.62) and FS-I (0.41). The highest SID value I, FS-III was highest due to a greater number of crop and animal components are equally contributed to the income while the lowest SID value in FS-I was due to more than 60% of the income from single component. The SID values of the major farming systems were ranged from 0.41 to 0.73 indicated that the farming systems are moderately specialized.

Rainfed red soils

The SID values for major farming systems of rainfed red soils ranged from 0.638 to 0.77. The higher SID value was observed in FS-V (0.77) followed by FS-IV (0.75), FS-III (0.69), FS-I (0.638 and FS-II (0.635). The lower SID value in FS-II was due to more income from dairy component and the higher SID value was in FS-V was due to all the components were equally contributed to the income. The SID values indicated that more diversification in major farming systems of rainfed red soils.

Irrigated Black soils

It is evident from the data pertaining to diversification indices of major farming systems in irrigated black soils presented in [Table-5] that the diversification index values ranged from 0.52 to 0.8. the highest SID value was observed in FS-II (0.82) followed by FS-V (0.8), FS-III (0.79) and FS-I (0.52). The lowest SID value in FS-I was due to more income from a single crop. The highest SID value in FS-II was due to equal contribution of all the components in the system. The SID values indicated that all the farming systems were diversified except FS-I.

Lowest diversification was observed in the farming system with crop component only whereas higher SID values recorded in the farming system with drops + dairy of irrigated black soils, followed by the farming system with crops + dairy + sheep + poultry of rainfed red soils and the farming system with crops + dairy + poultry of rainfed black soils. Similar study conducted by Chatterjee *et al* (2013) [11] have observed extent of diversification among marginal and small farming community were 0.33 and 0.341respectivelt in hilly tract of West Bengal.

Conclusion

The present study revealed that the majority of the respondents in the major farming situations were middle aged with high literacy rate. The half of the families were joint families with 3-5 members. 70% of the respondents were small and 30% were marginal farmers in the study area and majority farmers have medium to high level of farming experience. It was observed that dairy was the common livestock component along with seasonal crops in all farming systems. Lowest diversification was observed in the farming system with crop component only whereas higher SID values recorded in the farming system with drops + dairy of irrigated black soils. The diversification indices helped the small and marginal farmers to improve the profitability of the farming systems.

Application of research: The outcomes of research can be used for formulation of agriculture and livestock related development projects. The results are useful for the farmers to adopt suitable and profitable crops to the particular agroclimatic situation.

Research Category: Agricultural Rural Development

Abbreviations: BCR: Benefit Cost Ratio, SID: Simpson Index of Diversification

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University: Sri Krishnadevaraya University, Anantapuram, 515003, India
Research project name or number: Sustainable livelihood for small and marginal farmers through agriculture and livestock activities – A study on farming systems in Kurnool district of Andhra Pradesh

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Kurnool district of Andhra Pradesh

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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