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# Sustainable Agriculture and Livestock Integrated Farming Systems for Small and Marginal Farmers: A Case Study of Kurnool District, Andhra Pradesh, India

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

Indian economy heavily depends on agriculture and livestock. Integration of livestock with crop provide scope for effective utilization of byproducts which assures the profitability of the farming system. Integrated farming system approach is required to enhance the living standards of small and marginal farmers. A study was conducted on 'Sustainable livelihoods for small and marginal farmers through agriculture and livestock activities – A study of farming systems in Kurnool district' with an objective to identify profitable and sustainable farming systems under major farming situations of Kurnool district. The results revealed that the farming systems with one or more livestock components were found profitable. The economic sustainability of the faming systems was evolved through Sustainability Value Index (SVI). 3 out of 5 farming systems in the rainfed black soils were found sustainable. But only one farming system in rainfed red soils was found sustainable and none of the farming systems in irrigated black soils were found sustainable. The results of the study are useful for small and marginal farmers to adopt the suitable farming system.

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## 1. INTRODUCTION

Indian economy is heavily depending on agriculture and livestock. 85% of the total farming relied on small and marginal farmers having 44% of operational land. The operational farm holding in India is declining and over 85 million out of 115 million are below the size of 1 ha. The decrease in per capita availability of land in our country is due to increased population [1].

Integration of crop and livestock is very much required for small and marginal farmers to increase productivity, profitability, employment generation, food and nutritional security and agricultural sustainability [2] Integrated farming system is the tool for sustainable agriculture in which the byproducts of one system become input for other. Livestock play a key role not only as food and also useful for crops as manure and draught power [3] The living standards of the small and marginal farmers can be enhanced by efficient utilization of different enterprises like dairy, fish, poultry and others [4]

Kurnool district of Andhra Pradesh is located in scarce rainfall zone with 630mm annual rainfall. The total cultivable land is 10.2lakh ha in which majority are black soils (7.66lakh ha) and red soils (2.05lakh ha). Marginal holdings constitute 40% and small farmers have 28% of the total land holdings in the district. Kurnool district is having livestock population consisting 4.09lakh cattle (8.9%), 4.1lakh buffaloes (6.4%), 15.04lakh sheep (11.11%), 5.05lakh goats (11.13%) and 12.01lakh poultry (1.47%).

Several studies have suggested sustainable farming systems for different agroclimatic zones of Andhra Pradesh [5,6]. Since data on sustainable 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” with the following objectives

- To identify major agriculture and livestock farming systems in major farming situations of Kurnool district.
- To analyze the economics of the farming systems for profitability
- To assess the economic sustainability of the farming systems under major farming situations of Kurnool district

## 2. MATERIALS AND METHODS

### 2.1 Selection of Villages and Respondents

Three major farming situations viz. Rainfed Black Soils, Rainfed Red Soils and Irrigated Black soils were selected among the 12 farming systems for the study. Three villages from each farming situation covering 9 villages and 30 farmers from each village consisting of two or more agriculture and livestock activities were selected randomly for this study. Data was collected from a total of 270 respondents representing three major situations

### 2.2 Tools of Data Collection

A semi-structured schedule was designed to collect the required information from the sample regarding their socio-economic profile, factors involved in adoption of integrated farming systems, different components and their management, economic indicators of crops and livestock, sustainability indicators and problems involved in farming systems.

### 2.3 Research Design and Statistical Analysis

‘Ex-post facto’ design was used for this study. Benefit Cost Ratio (BCR) was calculated for each farming system to assess the profitability.

#### 2.3.1 Benefit Cost Ratio (BCR)

To know the profitability of the farming systems, Benefit Cost Ratio was calculated for each farming system with the following formula:

BCR= Gross Income/Cost of production

#### 2.3.2 Sustainability Value Index (SVI)

The sustainability Value Index was calculated to know the economic sustainability of the

prevailing farming systems with the following formula (Kiresur et al 2010)

SVI= ANI- (1.96 X SD)/ MNI

Where

SVI = Sustainability Value Index
ANI = Average Net Income
MNI = Maximum Net Income
SD = Standard Deviation
CV = Coefficient of variation

## 3. RESULTS AND DISCUSSION

### 3.1 Identification of Farming Systems

Existing farming systems with crop and livestock (dairy, sheep and poultry) combinations were identified in the study area of major farming situations of Kurnool district and selected major farming systems in which 10 or more farmers were practicing (Table 1)

#### 3.1.1 Major farming systems in rainfed black soils

The major farming systems identified 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).

#### 3.1.2 Major farming systems in rainfed red soils

The major farming systems identified in the rainfed red soils of Kurnool district were 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).

#### 3.1.3 Major farming systems in irrigated black soils

The major farming systems identified in the irrigated black soils of Kurnool district were 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).

### 3.2 Comparative Economic Analysis of Major Farming Systems

The profitability of the farming systems in rainfed black soils was observed in FS-V (1.91) followed by FS-IV (1.90), FS-III (1.71), FS-II (1.70) and FS-I (1.50). The lowest profitability was observed in the farming system involved the crops only, whereas inclusion of the livestock components greatly influenced the profitability of the farming system.

Similarly, among the major farming systems in rainfed red soils, highest profitability was observed in FS-II (1.82) followed by FS-III (1.71), FS-V (1.56), FS-IV (1.55) and FS-I (1.25). unlike in the rainfed black soils, the increase in the livestock components had no influence in the profitability of the farming system due to increase in the cost of production as the crop residues of pulses were not available in sufficient quantities to feed the livestock. Whereas the highest profitability in the farming system involved the dairy as only component is due to effective resource use efficiency through grazing.

**Table 1. Farming systems practiced by the sample respondents in the study area**

| S. No | Farming systems | Rainfed blacksoils N=90 | Rainfed red soils N=90 | Irrigated blacksoils 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 2. Comparative economics of the major farming systems in the study area**

| S.No | Farming system | Total cost (Rs.) | Gross income (Rs.) | Net income (Rs.) | BCR |
|---|---|---|---|---|---|
| **Rainfed Black Soils** | | | | | |
| 1 | FS-I | 93,569.00 | 1,40,419.00 | 46,850.00 | 1.5 |
| 2 | FS-II | 1,94,864.00 | 3,29,537.00 | 1,34,673.00 | 1.7 |
| 3 | FS-III | 1,54,085.00 | 2,64,000.00 | 1,09,915.00 | 1.71 |
| 4 | FS-IV | 2,37,146.00 | 4,50,495.00 | 2,13,349.00 | 1.9 |
| 5 | FS-V | 2,09,808.00 | 4,01,518.00 | 1,91,710.00 | 1.91 |
| **Rainfed Red Soils** | | | | | |
| 1 | FS-I | 1,00,551.00 | 1,26,053.00 | 25,502.00 | 1.25 |
| 2 | FS-II | 1,33,878.00 | 2,43,942.00 | 1,10,064.00 | 1.82 |
| 3 | FS-III | 1,38,739.00 | 2,37,904.00 | 99,165.00 | 1.71 |
| 4 | FS-IV | 2,28,190.00 | 3,54,820.00 | 1,26,630.00 | 1.55 |
| 5 | FS-V | 2,55,779.00 | 3,99,830.00 | 1,44,051.00 | 1.56 |
| **Irrigated Black Soils** | | | | | |
| 1 | FS-I | 2,66,394.00 | 3,22,550.00 | 56,156.00 | 1.21 |
| 2 | FS-II | 2,84,862.00 | 4,88,348.00 | 2,03,486.00 | 1.71 |
| 3 | FS-III | 5,19,836.00 | 6,54,220.00 | 1,34,384.00 | 1.26 |
| 4 | FS-V | 2,88,140.00 | 5,31,335.00 | 2,43,195.00 | 1.84 |

Among the four major farming systems in irrigated black soils, highest profitability was observed in FS-V (1.84) involved the livestock components viz. dairy, sheep and poultry along with crops followed by FS-II (1.71), FS-III (1.26) and FS-I (1.21). The abundant crop residues to feed the livestock in the irrigated black soils had greatly influenced the profitability.

The results are in accordance with Reddy SB et al [6] identified crop + dairy and crop + dairy + horticulture are sustainable integrated farming systems for Anantapuram district. Similarly, Rao SH et al [5] have also identified profitable farming systems for Vijayanagaram, Vishakhapatnam and Srikakulam district. Higher profitability index as well as rate of returns was high in horticulture – livestock – fish farming in Banda district of Uttar Pradesh [4]. The highest income was observed in Cattle + Crop farming systems in Odisha [7].

### 3.3 Economic sustainability of major farming systems

To measure the sustainability of the major farming systems in Kurnool district, Sustainability Value Index (SVI) was calculated and presented in Table 3.

#### 3.3.1 Rainfed Black Soils

From data given in Table 3 indicate that among the major farming systems, the highest positive SVI was observed in FS-III (0.287) followed by FS-V (0.163) and FS-IV (0.171). whereas negative SVI was observed in FS-I (-0.118) and FS-II (0.016). The data clearly indicated that FS-III (Crops + Dairy + Poultry), FS-IV (Crops + Dairy + Sheep) and FS-V (Crops + Dairy + Sheep + Poultry) were found economically sustainable whereas the FS-I (Crops only) and FS-II (Crops + Dairy) were observed negative. Increase in the number of components have contributed income for sustainability of the farming systems in the farming situation of rainfed black soils.

#### 3.3.2 Rainfed Red Soils

It is evident from the Table 3 consisting the sustainability value indices of major farming systems under rainfed red soils that the positive and highest SVI was observed only in FS-V (0.204) and negative SVI was observed in FS-I (-0.192), FS-II (-0.07), FS-III (- 0.196) and FS-IV (-0.085). The data clearly indicated that the farming system consisting of crops + Dairy + Sheep + Poultry was found economically sustainable whereas the other farming systems FS-I (Crops only), FS-II (Crops + Dairy), FS-III (Crops + Dairy + Poultry) and FS-IV (Crops + Dairy + Sheep) were found economically not sustainable. The data indicated that the vagaries in the rains, unavailability of feed and fodder to the livestock and low production in crops and livestock influenced the income stability.

#### 3.3.3 Irrigated Black Soils

The data presented in Table 3 clearly indicated that negative SVI was observed in all farming systems viz FS-I (-0.181), FS-II (-0.278), FS-III (0.088) and FS-IV (-0.051). Among the major farming systems negative and lowest SVI was observed in FS-II (Crops + Dairy) followed by

**Table 3. Economic sustainability indices of major farming systems in Kurnool district**

| Farming system | Maximum net income | Average net income | SD | CV (%) | Sustainability value index |
|---|---|---|---|---|---|
| **Rainfed black soils** | | | | | |
| FS-1 | 169000 | 71372 | 46576 | 65 | -0.118 |
| FS-II | 398000 | 201764 | 106095 | 53 | -0.016 |
| FS-III | 200600 | 142901 | 43495 | 30 | 0.287 |
| FS-IV | 368800 | 225703 | 82986 | 37 | 0.171 |
| FS-V | 384150 | 218159 | 79391 | 36 | 0.163 |
| **Rainfed red soils** | | | | | |
| FS-I | 203000 | 55409 | 48107 | 87 | -0.192 |
| FS-II | 387500 | 151800 | 91237 | 60 | -0.070 |
| FS-III | 298400 | 188467 | 65117 | 79 | -0.196 |
| FS-IV | 399700 | 168390 | 103189 | 61 | -0.085 |
| FS-V | 365700 | 132547 | 104125 | 35 | 0.204 |
| **Irrigated black soils** | | | | | |
| FS-I | 543200 | 117007 | 109856 | 94 | -0.181 |
| FS-II | 639700 | 258836 | 153916 | 59 | -0.278 |
| FS-III | 560250 | 290193 | 173308 | 60 | -0.088 |
| FS-V | 847490 | 304337 | 177403 | 58 | -0.051 |

FS-I (crops only), FS-III (Crops + Dairy + Poultry), and FS-V (Crops + Dairy + Sheep + Poultry). The high cost of inputs in crop production and livestock production and fluctuations in the yield and the sale price were the major reasons for the negative sustainability of the farming systems in the irrigated black soils. Similar to the rainfed red soils, increase in the components have influence on the economic sustainability of the farming system.

Kiresure et al [8] reported the sustainability value index was higher for the farming system with the combination of horticultural crops in Karnataka. Chouhan et al [9] reported that farmers had medium (71.6%) of livelihood security which 55.7% of the economic security to the total livelihood security if the farmers in NEH regions. Boussaada et al [10] have reported the economic sustainability of sheep farming systems in eastern steppe eco system of Algeria.

## 4. CONCLUSIONS

The major farming systems consisting of one or more livestock components found profitable than the crops alone. The sustainability of the farming systems under rainfed black were found positive, whereas only one farming system in the rainfed red soils was found positive. But all the farming systems in the irrigated black soils were found to be negative. The study results are useful for small and marginal farmers to adopt suitable farming system to get sustainable income.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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