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# Comparative performance of integrated farming system models in Gariyaband region under rainfed and irrigated conditions

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## ABSTRACT

Two farming system research models were laid out on farm at KVK Gariyaband during 2014-15 and 2015-16 with an aim to study the economic viability and employment generation of the models. Model I was laid out in 3.5 acre area under rainfed conditions and Model II was laid out in 1.5 acre area under irrigated conditions. IFS Model II under irrigated conditions proved to be more remunerative with highest average net returns of Rs.452096 indicating better economic viability and better employment generation capacity as compared to IFS Model I under rainfed conditions.

**Key words:** Employment generation, Integrated Farming System, Irrigated, Marginal, Net returns, Rainfed, Small.

## INTRODUCTION

The Indian economy is predominantly rural and agricultural. The farming community in Gariyaband district of Chhattisgarh state accounts for 71.14 % of marginal and small farmers. In addition to the economic poor condition of the farmers under these categories the declining trend in size of land holding poses a serious challenge to the sustainability and profitability of farming. In view of the decline in per capita availability of land from 0.5 ha in 1950-51 to 0.15 ha by the turn of the century and a projected further decline to less than 0.1 ha by 2020, it is imperative to develop strategies and agricultural technologies that enable adequate employment and income generation, especially for small and marginal farmers. In Gariyaband District traditionally rice is grown both in upland and lowland under irrigated and rainfed conditions. The population of Gariyaband district has increased to 5.97 lakh in 2011 over 2001 (4.91 lakhs) at a growth rate of 21.69 % and is estimated to increase further to 7.26 lakh by 2021 (Census of India, 2011).The per capita net availability of food grains is 491.2 g/day. (Agriculture Statistics, 2015). There are projections that demand for food grains would increase from 234 million tonnes in 2009-10 to 345 million tonnes in 2030 (Government of India, 2009). Hence, in the next two decades the production of food grains needs to be increased @ of 5.5 million tonnes annually. Simultaneously, the demand for high-value commodities *viz*., fruits, vegetables, livestock products, fish, poultry etc., is increasing faster than food grains, and is expected to increase by more than 100 per cent from 2000 to 2030. In view of the gradual shrinking of land holding and growing demand of food commodities it is necessary to integrate land based enterprises like dairy, fishery, poultry, duckery, field and horticultural crops, etc. within the bio-physical and socio-economic environment of the farmers to make farming more profitable and dependable (Behera *et al*., 2004). Birthal (2012) reported that the diversification especially to high value commodities provide an opportunity for the small holders to enhance income and escape poverty. No single farm enterprise is likely to be able to sustain the small and marginal farmers without resorting to integrated farming systems (IFS) for the generation of adequate income and gainful employment year round (Mahapatra,1994). Integrated farming systems are also viewed as a sustainable alternative to commercial farming systems particularly on marginal lands with the objective of reversing resource degradation and stabilizing farm income (Dadabhau and Kisan, 2013). Farming systems approach, therefore, is a valuable approach to address the problems of sustainable economic growth for farming communities in India. Though, integration of crops with cattle, goat, sheep and apiary and recycling of organic manure is being practiced since olden days, adopting non-scientific combination of enterprises resulted in lower yields. Keeping this in view, a study was undertaken to evaluate the efficiency of integrated component technologies in terms of productivity, income increase and employment generation under rainfed and irrigated conditions. This paper presents some insights on IFS of crop and allied enterprises implemented in KVK farm under both rainfed and irrigated conditions.

## MATERIALS AND METHODS

This study was carried out during 2014-15 and 2015-16 in the farm of Krishi Vigyan Kendra, Gariyaband. Two farming system research models one under rainfed condition and other under irrigated condition involving crop production, vegetables, horticulture, dairy, fishery, poultry,

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duckery, goatry, were laid out in the farm. The farm lies in the Gariyaband Block, Gariyaband District (Latitude 21º54′ North, Logitude 81º25′E, altitude 226m above MSL). This region comes under the Chhattisgarh Plains with average rainfall of 1462.72 mm, maximum temperature ranging from 23.1 to 44.1 °C and minimum temperature ranging f rom 3.8 to 32.3 °C. Model I was laid out in 3.5 acre area under rainfed conditions and Model II in 1.5 acre area under irrigated conditions. Crops and animals were raised by applying recommended package of practices utilizing the resources available within the farm to the maximum extent. In the dairy component cows belonged to the Sahiwal breed. In the poultry and duckery component birds of Kadaknath and Naghans were raised for the sale of birds. In the goatry component goats of barbari breed were bred for kids. In the fishery component fish fingerlings of Catla, Rohu and Mrigal were purchased from the Department of Fisheries, Chhattisgarh Government. The recommended package of practices were adopted for all the crops grown under crop and horticulture component. The nutrient need of the crops was fulfilled through urea, single super phosphate and muriate of potash in addition to the farm yard manure received from the dairy component. In the irrigated model the crops were irrigated by the drip irrigation system.The system was analysed by quantifying the productivity, profitability and employment generation. The productivity of the crop component integrated in the system was assessed based on the crop yield , that of dairy by sale of milk and calves, that of goat by sale of kids, that of poultry by sale of birds. A man or woman working for 8 hrs a day was considered as one man day. For relative economic analysis during different years, cost of inputs and outputs at market prices prevailing in the corresponding years were considered and net returns were worked out. The details of the area allotted to each enterprise in both the models are given in Table 1. The cropping programme followed in crop production in both the models is shown in Table 2 & 3 and the cropping programme followed in the vegetable component is shown in Table 4 & 5.

**Table 1:** Components of Integrated Farming System Models

| **Model 1** | | |
|---|---|---|
| **Component** | **Area alloted ($m^2$)** | **Area alloted (%)** |
| Crop production (Rice-fallow), (Maize – fallow) | 7800 | 55.71 |
| Vegetables | 1500 | 10.71 |
| Fodder (Jowar- single cut) | 1500 | 10.71 |
| Fruit plantations (Ber) | 750 | 5.36 |
| Floriculture | 750 | 5.36 |
| Dairy (2 cows) | 50 | 0.36 |
| Goat rearing (20+1) | 50 | 0.36 |
| Poultry (20) | 20 | 0.14 |
| Duck (20) | 20 | 0.14 |
| Fisheries | 1500 | 10.71 |
| Vermicompost | 30 | 0.21 |
| Storage | 30 | 0.21 |
| Total | 14000 | 100 |

| **Model II** | | |
|---|---|---|
| **Component** | **Area alloted (m2)** | **Area alloted (%)** |
| Crop production (Rice-Wheat-Cucurbits) (Groundnut-Linseed-Cucurbits) | 3400 | 56.67 |
| Vegetables | 1200 | 20.00 |
| Fodder (Jowar {multi cut} - Berseem) | 600 | 10.00 |
| Fruit plantations (Papaya) | 300 | 5.00 |
| Floriculture | 300 | 5.00 |
| Dairy (2 cows ) | 50 | 0.83 |
| Goat rearing (20+1‘) | 50 | 0.83 |
| Poultry (20) 4 batches | 20 | 0.33 |
| Duck (20) 2 batches | 20 | 0.33 |
| Vermicompost | 30 | 0.50 |
| Storage | 30 | 0.50 |
| Total | 6000 | 100 |

## RESULTS AND DISCUSSION

The annual yields from the different components are presented in Fig. 1& 2. The annual yield obtained from different components of livestock are depicted in Table 6. The net returns, operational cost and benefit cost ratio of both the models has been studied individually during the two years of study period and the pooled data is given in Table 7 & 8. It was observed that Model II i.e IFS model in 1.5 acre area under irrigated conditions was highly economical with higher net income of Rs. 452096. This was mainly due to more intensive cultivation of vegetables and crop production round the year under irrigated conditions along with cultivation of papaya fruit plants and integration of dairy, poultry, goat and duck unit which added profit to the system. Similar results in integrated farming systems over conventional cropping were reported by

**Table 2:** Cropping Programme followed in Model I during 2014-15 & 2015-16

| ***Kharif*** | | ***Rabi*** | | **Summer** | |
|---|---|---|---|---|---|
| **Crop** | **Area (ha)** | **Crop** | **Area (ha)** | **Crop** | **Area (ha)** |
| Rice | 0.40 | Fallow | 0.40 | Fallow | 0.40 |
| Maize | 0.15 | Fallow | 0.15 | Fallow | 0.15 |
| Blackgram | 0.12 | Fallow | 0.12 | Fallow | 0.12 |
| Groundnut | 0.11 | Fallow | 0.11 | Fallow | 0.11 |

**Table 3:** Cropping Programme followed in Model II during 2014-15 & 2015-16

| *Kharif* | | *Rabi* | | Summer | |
|---|---|---|---|---|---|
| **Crop** | **Area (ha)** | **Crop** | **Area (ha)** | **Crop** | **Area (ha)** |
| Rice | 0.22 | Wheat | 0.22 | Cucurbits | 0.22 |
| Blackgram | 0.06 | Chickpea | 0.06 | Cowpea | 0.06 |
| Groundnut | 0.06 | Linseed | 0.06 | Cucurbits | 0.06 |

**Table 4:** Cropping Programme followed in the vegetable component in Model I during 2014-15 & 2015-16

| *Kharif* | | *Rabi* | | Summer | |
|---|---|---|---|---|---|
| **Crop** | **Area (ha)** | **Crop** | **Area(ha)** | **Crop** | **Area(ha)** |
| Tomato | 0.06 | Fallow | 0.06 | Fallow | 0.06 |
| Bottlegourd | 0.06 | Fallow | 0.06 | Fallow | 0.06 |
| Brinjal | 0.03 | Fallow | 0.03 | Fallow | 0.03 |
| Chilli | 0.03 | Fallow | 0.03 | Fallow | 0.03 |

**Table 5:** Cropping programme followed in the vegetable component in Model II during 2014-15 & 2015-16

| *Kharif* | | *Rabi* | | Summer | |
|---|---|---|---|---|---|
| **Crop** | **Area (ha)** | **Crop** | **Area(ha)** | **Crop** | **Area(ha)** |
| Cowpea | 0.06 | Cauliflower | 0.06 | Cucurbits | 0.06 |
| Chilli | 0.06 | Pea | 0.06 | Cucurbits | 0.06 |

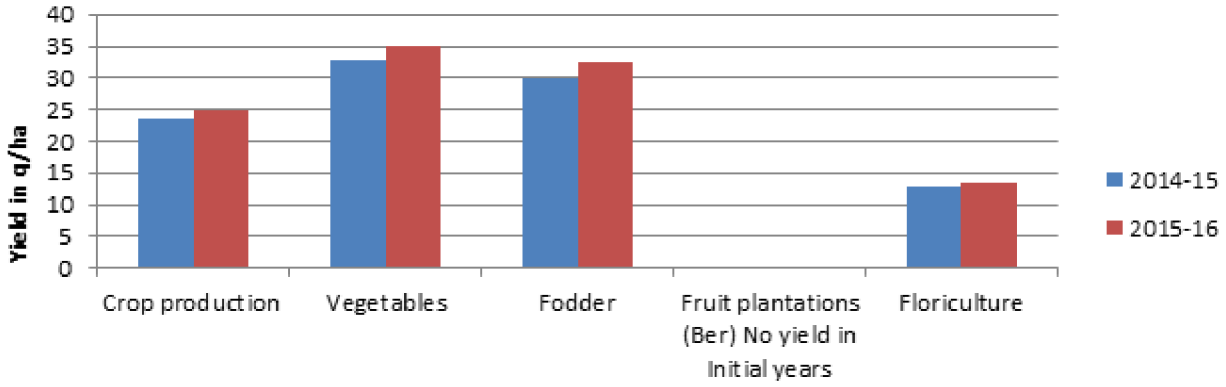


**Fig 1:** Yield (q/ha) from different components in Model I

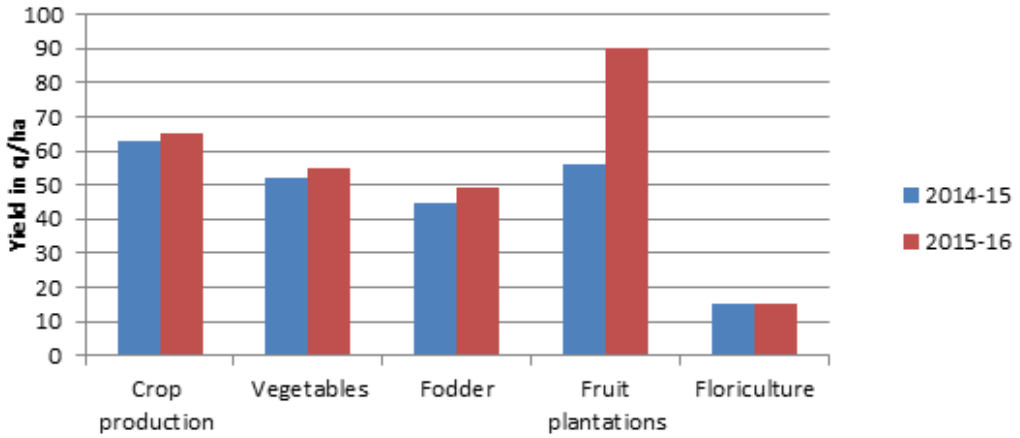


**Fig 2:** Yield (q/ha) from different components in Model II

(Korikanthimath and Manjunath, 2009; Sanjeev Kumar, 2011). In rice based farming system risk is reduced due to diversification of system with low risk enterprises and vegetable cultivation (Behera *et al.*, 2008). Better performance of all the components under irrigated conditions was observed in comparison to rainfed situations. While considering the individual enterprises IFS model of 1.5 acre area under irrigated conditions higher net returns of Rs. 120439 was obtained with vegetable cultivation with benefit cost ratio of 8.56 due to intensive cultivation in all three

**Table 6:** Yield of Different Livestock Components

| Component | Yield | | | |
|---|---|---|---|---|
| | Model I | | Model II | |
| | 2014-15 | 2015-16 | 2014-15 | 2015-16 |
| Dairy (lt. of milk) | 1830 | 2040 | 2430 | 2610 |
| Goatry (kg live weight) | - | 208 | - | 675 |
| Poultry (kg live wt) | 24 | 27 | 144 | 150 |
| Duckery (kg live weight) | 42.5 | 45 | 187.5 | 192.5 |
| Fisheries (kg) | 207.2 | 235 | - | - |

**Table 7:** Economics of farming system model for a small farmer (3.5 acre) under rainfed conditions of Gariyaband (Mean of 2 years)

| Component | Expenditure (Rs.) | Gross Returns (Rs) | Net Returns (Rs) | Return per rupee invested(Rs) | Employment generation (Man days /year) |
|---|---|---|---|---|---|
| Crop production (Rice- fallow), (Maize –Fallow) | 27977.9 | 40050.35 | 12072.45 | 1.43 | 56.50 |
| Vegetables | 11550 | 24675 | 13125 | 2.14 | 20.00 |
| Fodder | 1236 | 3785 | 2549 | 3.21 | 61.00 |
| Fruit plantations (Ber) | 912.5 | 0 | -562.5 | 0.00 | 12.00 |
| Floriculture | 675 | 3875 | 3200 | 6.21 | 10.50 |
| Dairy (2 cows) | 43747.5 | 72160 | 28412.5 | 1.65 | 229.06 |
| Goat rearing (20+1) | 18497 | 32760 | 14263 | 1.77 | 182.50 |
| Poultry (20) | 1800 | 5100 | 3300 | 2.83 | 18.00 |
| Duck (20) | 1800 | 10937.5 | 9137.5 | 6.08 | 15.00 |
| Fisheries | 5000 | 22110 | 17110 | 4.66 | 46.00 |
| Vermicompost | 6000 | 16500 | 10500 | 3.83 | 8.88 |
| **Total** | **119195.9** | **231952.9** | **113107** | **1.95** | **659.44** |

**Table 8:** Economics of farming system model for a marginal farmer (1.5 acre) under irrigated conditions of Gariyaband (Mean of 2 years)

| Component | Expenditure (Rs.) | Gross Returns (Rs) | Net Returns (Rs) | Return per rupee invested(Rs) | Employment generation (Man days /year) |
|---|---|---|---|---|---|
| Crop production(Rice-Wheat-Cucurbits) (Groundnut-Linseed-Cucurbits) | 29313.14 | 90994.7 | 61681.56 | 3.10 | 60.38 |
| Vegetables | 15926 | 136365 | 120439 | 8.56 | 73.50 |
| Fodder | 8135.5 | 13380 | 5244.5 | 1.66 | 79.75 |
| Fruit plantations (Papaya) | 9000 | 84375 | 75375 | 9.84 | 53.25 |
| Floriculture | 6000 | 11230.5 | 5230.5 | 1.87 | 45.00 |
| Dairy (2 cows ) | 70747.5 | 128120 | 57372.5 | 1.83 | 365.00 |
| Goat rearing (20+1‘) | 18497 | 60750 | 42253 | 3.28 | 228.13 |
| Poultry (20) 4 batches | 7200 | 29400 | 22200 | 4.08 | 71.75 |
| Duck (20) 4 batches | 7200 | 47500 | 40300 | 6.60 | 42.88 |
| Vermicompost | 12000 | 34000 | 22000 | 2.83 | 13.10 |
| **Total** | **184019.14** | **636115.2** | **452096.1** | **3.46** | **1032.73** |

Rice(Rs/q) - 1400 (2014-15), 1450 (2015-16),Wheat (Rs./q)-1450 (2014-15), 1525 (2015-16), Maize (Rs./q)-1310(2014-15), 1325 (2015-16), Blackgram (Rs./q)-4350 (2014-15), 4625 (2015-16) Chickpea (Rs./q)-3175 (2014-15), 3245 (2015-16), Groundnut (Rs./q)-4000 (2014-15), 4030 (2015-16), Linseed (Rs./q)- 4400 (2014-15 & 2015-16), Tomato (Rs./q) -2000 (2014-15 & 2015-16),Cucurbits(Rs./q)-2000 (2014-15), 2500 (2015-16), Brinjal(Rs./q)-2000(2014-15&2015-16),Chilli (Rs./q) -3000 (2014-15 & 2015-16),Cauliflower (Rs./q)-3000 (2014-15 & 2015-16), Pea-1800(2014-15), 2000 (2015-16) Cowpea- 2000 (2014-15), 2500 (2015-16), Jowar-5/kg, Papaya (Rs/kg)-10, Marigold- 5/kg, Milk- Rs. 36/litre, Goat (Rate/kg live weight)- 180, Broiler-200/kg, Duck (Rate/kg live weight)- 250, Fisheries (Rs./kg) -100 Vermicompost-Rs. 150/25 kg

seasons along with high market price of the vegetables. A higher B:C ratio was obtained with papaya cultivation in the allotted area and along the field bunds (9.84) followed by vegetable cultivation (8.56), Duckery (6.60) and Poultry(4.08) as less input cost was incurred towards raising/ rearing the above enterprises. In the 3.5 acre IFS model under rainfed conditions a higher B:C ratio of 6.21 was obtained in the floriculture component with marigold cultivation followed by duckery (6.08). On an average Model II under irrigated conditions recorded a higher B:C ratio of 3.46 in comparison to Model I under rainfed condition with a B:C ratio of 1.95. Similar results were also recorded by (Singh *et al.,* 1993) who conducted studies of various farming systems in Haryana on 1 ha of irrigated and 1.5 ha of unirrigated land and found that under irrigated conditions of mixed farming with crossbred cows yielded the highest net profit (Rs 20,581/-) followed by mixed farming with buffaloes (Rs 6,218/-) and lowest in arable farming (Rs 4,615/-). These results also fall in line with the findings of (Radhamani *et al*., 2003) who reviewed several studies on the financial viability of integrated farming system and concluded that they positively influenced the economic viability of these systems.

**EMPLOYMENT GENERATION**

An increase in the employment generation resulted due to integration of different components in the Integrated Farming System models. The average employment generation in 1.5 acre irrigated model increased to 1033 mandays /year in comparison to 659 man days/year in 3.5 acre rainfed model. The extra employment generated was due to adoption of intensive cultivation of crops and vegetables round the year under irrigated conditions over the traditional cropping system. The diversified nature 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 for more time and helps in improving the employment for rural poor. Similar results were reported by (Mynavathi and Jayanthi, 2015; Sanjeev Kumar *et al*., 2011; Ravishankar *et al*., 2007; Jayanthi *et al*., 2003).

**CONCLUSION**

The integrated farming system model of 1.5 acre under irrigated conditions was more remunerative in average net returns (Rs.452096) and employment generation (1032 mandays) thus proving to be profitable for the small and marginal farmers of Gariyaband region of Chhattisgarh.

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