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Enhancing income and employment opportunities

in rainfed agriculture through integrated farming systems approach

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Integrated Farming Systems (IFS) for rainfed areas are essential for enhancing productivity and resilience in Indian agriculture. Rainfed IFS effectively address climate challenges by integrating components such as poultry, livestock, and diversified crops, which improve yields, income, and employment opportunities. Models in Maharashtra, Karnataka, and Tamil Nadu show significant economic gains by efficiently utilizing resources and minimizing external inputs. This sustainable approach supports smallholder farmers, enhancing resilience against climate uncertainties and securing food and nutritional needs, ultimately reducing vulnerability to agricultural risks through diversified, stable income sources.

Keywords: Employment opportunities, Enhancing income, Integrated farming systems, Rainfed agriculture

RAINFED agriculture constitutes a major part of Indian agriculture, covering about 51% of the country's cultivated land and contributing approximately 40% of food production. This form of agriculture is complex and varies greatly due to unpredictable monsoon patterns, making it vulnerable to climate change impacts. Consequently, it experiences low productivity and requires a strategic, interdisciplinary approach to ensure food and nutritional security, alongside sustainable natural resource management. The Integrated Farming Systems (IFS) approach provides a holistic solution by combining multiple agricultural components such as crops, livestock, fisheries, and horticulture into a cohesive system. IFS aims to achieve minimal competition and optimal complementarity between components, leveraging advanced agronomic practices to sustainably increase farm income, improve family nutrition, and support ecosystem services. This system not only boosts farm productivity but also minimizes the need for external inputs through recycling within the system, which can reduce costs by up to 45%. By integrating diverse activities like field and horticultural crops, livestock, and poultry, IFS presents a resilient model for rainfed agriculture, helping farmers cope with the challenges posed by limited water resources and erratic rainfall. The IFS approach holds significant potential for increasing farmers' incomes and supporting the livelihood of small-scale and marginal farmers by building a more stable and sustainable agricultural framework.

Key features of rainfed IFS

- ***Soil and water conservation practices:*** Rainfed IFS emphasizes *in-situ* moisture conservation techniques such as contour farming, bunding, and mulching. Water harvesting structures like farm ponds and percolation tanks are also commonly used to capture and store rainwater, enabling crop growth during dry spells.
- ***Systems of diverse cropping***: Rainfed IFS encourages intercropping, crop rotations, and mixed cropping with drought-tolerant varieties suited to local climatic conditions. Common combinations include cereal-pulse or cereal-oilseed systems that make efficient use of water and nutrients.
- ***Livestock integration***: Including livestock like goats, poultry, sheep, and cattle in rainfed farming systems serves as a buffer against crop failures. Livestock provides a steady income source through the sale of milk, meat, eggs, and manure, which can also be used to enrich soil fertility.
- ***Horticulture and agroforestry***: The inclusion of fruit trees and forage crops enhances system productivity and adds a variety of produce that can be sold or consumed. Agroforestry improves soil moisture retention, reduces soil erosion, and increases biomass availability.
- ***Aquaculture in lowland areas:*** In certain low-lying rainfed areas, farmers integrate small-scale fish farming in water bodies or refuges, which improves

nutrient cycling and provides an additional source of income.

- ***Value-added activities***: Small-scale value-added enterprises, like mushroom cultivation, sericulture, and beekeeping, complement IFS by enhancing income potential and diversifying production.

IFS models for rainfed conditions

IFS model for rainfed lowland

Integrated Farming System (IFS) model for rainfed lowland conditions (1.0 ha) at Cuttack (Odisha), incorporated crop rotations (rice–green gram, rice–vegetables, and rice–rice), horticulture, fish and prawn in refuges, and fodder on bunds, covering 85% of the area and contributing 75% to the net income. Livestock, including 3 goats, 100 ducks, and 75 poultry birds, used 12% of the area and added 20% to income. Oyster mushroom farming on 3% of the area contributed an additional 5% to net income. Overall, the model provided a rice-equivalent yield of 25 tonnes/year, generating ₹1.5 lakh annually and creating 400 person-days of employment.

IFS model for rainfed conditions of Maharashtra

IFS model (1.0 ha) for rainfed areas of Akola, comprised crop systems such as cotton + pigeon pea (6:2)–sesame, soybean + pigeon pea (5:1), sorghum–wheat, soybean–chickpea, and cowpea–fenugreek, occupying 80% of the area and providing 26% of the income. Horticultural crops (custard apple and drumstick) on 10% of the land contributed 19% of the income. Livestock, comprising 12 goats, 25 poultry birds, and 5 rabbits, used another 10% and contributed 55% to income. Overall, this IFS model reached a soybean-equivalent yield of 51 tonnes annually, earning ₹0.67 lakh and creating 951 person-days of work. Similarly, at Solapur, a 0.8-ha rainfed model incorporating crops, livestock, and poultry along with improved crop varieties and nutrient management yielded 7,994 kg of sorghum equivalent, generating ₹1,37,874 in net income and 371 person-days of employment, yielding 12% higher returns than traditional farming.

Rainfed IFS models for Bundelkhand region

Two resource based and farmer specific IFS models (1.0 ha) i.e. a rainfed crop-based focusing on rainfed crops and water harvesting, and a rainfed livestock-based incorporating livestock, rainfed fodder, crops and water harvesting were developed by IGFRI, Jhansi. Among these two models, highest net return (₹37,424) and B:C ratio (2.03) was observed in rainfed crop dominated IFS as compared to rainfed forage dominated IFS. Rainfed farmers in Bundelkhand, who earn ₹25,000 to ₹30,000 annually, could increase their income to ₹40,000 with these models.

Rainfed IFS model for Gujarat

By introducing improved crop varieties, nutrient management, *in-situ* moisture conservation, livestock mineral supplementation, and napier grass cultivation on bunds in rainfed IFS model (1.76 ha) at Banaskantha (Gujarat), productivity increased by 18.8% over traditional methods. This model generated ₹92,444 year and provided 353 person-days of employment.

Rainfed IFS model for Rajasthan

At Jodhpur (Rajasthan), a 2 ha rainfed IFS model incorporated a cropping system that included pearl millet + green gram + dew gram + cluster bean in a 3:1:1:1 ratio along with horticulture (ber), covering 80% of the area and contributing 18% to income. Livestock, including 1 cow and 10 goats/sheep, utilized 20% and contributed 82% to income. Overall, this IFS model achieved a pearl millet equivalent yield of 15 tonnes/year, generating net returns of ₹1.32 lakh/year and providing employment for 350 person-days/year.

Rainfed IFS model for Jharkhand

A rice + fish (mixed carps)-wheat system increased net returns to ₹58,557/ha compared to the rice-fallow system (₹2,770/ha). Another Jharkhand model, which combined fish, pig rearing, and paddy, generated returns of ₹53,100/ha with a benefit-cost ratio of 4.12, significantly outperforming fish alone in the ponds (₹12,125/ha).

Rainfed IFS model for Chhattisgarh

A mixed farming (crop-livestock) module of 1.5 acre for marginal farmers generated 316 person-days of employment and ₹33,076 in net income annually, outperforming crop-only systems.

Rainfed IFS model for Karnataka

A model with 35.4% cereals, 25.7% pulses, 21% oilseeds, 17.3% commercial crops, and 1.2% fodder, supplemented with backyard poultry (6 birds per household), was found to be ideal for small and marginal farmers of Dharwad. In this model, poultry component played a major role in stabilizing the farmers' income during drought years. In Karnataka's eastern and central dry zones, rainfed groundnut-based systems generated ₹5,059/ha with crops alone, rising to ₹22,000/ha when combined with groundnut + dairy + sheep (8–10). With respect to small and large farmers, the crop + dairy system recorded higher net income, whereas the crop + sheep farming system was more economical for medium farmers. In Chamarajanagar, systems integrating crop + dairy + sheep + poultry + sericulture + fodder yielded net income of ₹1,15,584/ha, while crop + dairy + sheep + goat systems generated ₹1,04,078/ha compared to other farming system models under rainfed conditions.

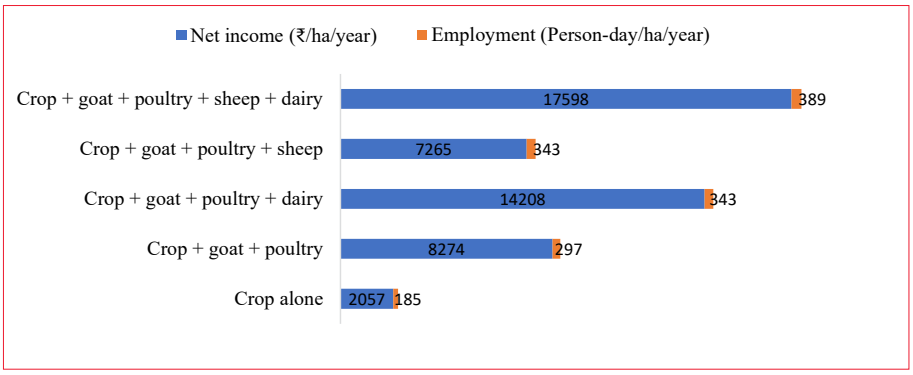
Rainfed IFS model for Telangana

A cotton + sheep model involving cotton on one ha of arable land and rearing of 10 lambs generated ₹27,500/ha, significantly higher than cotton alone (₹8,700/ha) at Warangal district of Telangana.

Rainfed IFS model for Andhra Pradesh

In Anantapur (Andhra Pradesh), the highest returns were achieved with a groundnut (2 ha) + poultry system (₹43,360), followed by groundnut + dairy (3 buffalo) (₹40,606), with sole crop of groundnut (2.6 ha) generating ₹14,872/ha.

Major components of rainfed IFS models



Income and employment generation potential of different farming system models at Tamil Nadu (*Source*: Chary *et al*. 2022)

IFS Model for rainfed conditions of Tamil Nadu

An integrated approach with crop + goat (4) + poultry (20) + sheep (6) + dairy (1) achieved the highest income of ₹17,598/ha/year, followed by a crop + goat + poultry + dairy model (₹14,208/ha/year), while the conventional system having crop cultivation alone gave a net income of only 2,057/ha/year. In this system, employment increased from 185 person-days/ha/year in conventional systems to 389 person-days/ha/year with IFS.

Benefits of rainfed IFS

Increased resilience: By diversifying income sources and reducing dependence on a single crop, rainfed IFS builds resilience against weather fluctuations, pests, and market risks. This is crucial for farming communities vulnerable to droughts and erratic rainfall.

Enhanced resource-use efficiency: The integrated nature of IFS allows for better recycling of resources, where outputs from one component (like livestock manure) become inputs for another (such as crop fertilization), minimizing waste and lowering input costs.

Economic stability: Rainfed IFS models generate multiple income streams, thereby stabilizing farmers' earnings throughout the year. Income from horticulture, livestock, and aquaculture complements seasonal crop revenues, ensuring financial security even during challenging times.

Employment generation: The integration of various activities provides year-round employment opportunities for farm families and rural labourers, reducing seasonal migration and enhancing rural livelihoods.

Environmental sustainability: Rainfed IFS promotes practices that enhance soil health, improve biodiversity, and lower environmental impacts. Techniques like crop rotation, mixed cropping, and agroforestry conserve soil and water resources and encourage sustainable land use.

Food and nutritional security: Rainfed IFS not only provides a variety of food products (cereals, pulses, fruits, vegetables, and livestock products) but also improves household nutrition, which is vital in rural areas with limited access to diversified diets.

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