

From concept to practice:

The IFS model of ICAR-IARI and its impact on smallholder farming

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Indian agriculture, largely dependent on small and marginal farmers, faces significant challenges such as limited resources, resource degradation, and declining profitability. The Integrated Farming System (IFS) offers a viable solution by integrating various agricultural components—crop production, livestock, aquaculture, and agroforestry—to create a resource-efficient, cyclical system that minimizes waste and enhances productivity. ICAR-IARI's IFS model, designed for a 1-hectare irrigated area, includes nine components: crop production, pisciculture, duckery, poultry, apiary, agroforestry, composting unit, biogas plant, and dairy. This model optimizes land use, improves soil health, and ensures continuous income. The feasibility analysis highlights the dairy module as the most profitable with the highest Net Present Worth (NPW) and a strong Benefit-Cost Ratio (B:C), while the poultry and apiary modules also show significant financial viability. The IFS model supports food security, enhances nutritional security, and creates employment opportunities. By recycling resources efficiently and managing them holistically, IFS provides a resilient and sustainable agricultural solution that addresses the needs of small and marginal farmers, promotes biodiversity, and ensures economic stability.

Keywords: Integrated Farming System (IFS), Resource efficiency, Smallholder livelihood, Sustainable agriculture.

INDIAN agriculture faces significant challenges, particularly for the small and marginal farmers who constitute over 86% of the farming community. These farmers often lack essential resources, such as quality seeds, irrigation, and credit, which hinders their ability to improve productivity and adopt sustainable practices. While the cultivation of annual crops has made India self-sufficient in food grain production, it has also led to serious issues like resource degradation, plateauing productivity, and declining profitability. To address these challenges, the Integrated Farming System (IFS) emerges as a promising solution.

IFS operates on a key principle i.e. integration of various farm components, such as crop production, livestock, aquaculture, and agroforestry, where the output from one component serves as an

input for another. This cyclical use of resources reduces waste and enhances overall farm productivity. It also follows the concept that "there is no waste," viewing waste as merely a misplaced resource

Table 1. Advantages and disadvantages of IFS model

Advantages	Disadvantages
• Diversified Income Sources: Reduces reliance on a single income source, mitigating risks from market fluctuations and crop failures. • Resource Efficiency: Optimizes the use of soil, water, labour, and inputs to ensure all farm resources are utilized effectively. • Environmental Sustainability: Lowers the need for chemical fertilizers and pesticides, improves soil health, conserves water, and boosts biodiversity. • Increased Farm Resilience: Enhances resilience to climate change and economic shocks while increasing farm income through diverse farming enterprises. • Efficient Waste Management: Converts waste into valuable resources, thereby boosting farm productivity. • Sustainable and Profitable Agriculture: Offers a pathway to sustainable and profitable farming, especially advantageous for smallholder farmers.	• Complex Management: Requires advanced knowledge and skills to manage multiple agricultural components effectively. • High Initial Costs: Involves significant initial investment in infrastructure and resources, which can be a barrier for some farmers. • Increased Labour and Time: Demands more labour and time to coordinate and maintain various farm activities. • Potential Interference: Different components may occasionally conflict, such as livestock damaging crops or aquaculture affecting soil conditions. • Resistance to Change: Traditional farming communities might be hesitant to adopt new, complex methods. • Risk of Overuse: Potential for overuse of resources like water or feed if not managed judiciously. • Disease Transmission: Risk of disease spread between livestock and other components in the system.

that can be transformed into valuable inputs, such as using crop residues as livestock feed or converting livestock manure into organic fertilizer. IFS offer a range of multifaceted benefits along with diverse challenges.

IFS models for different agro-climatic zones of India

India's agricultural landscape is segmented into 15 distinct agro-climatic zones, each presenting unique environmental conditions and challenges. In response to this diversity, the ICAR-AICRP on IFS has meticulously recommended specific IFS models to harness local resources efficiently, optimize agricultural productivity, and enhance sustainability, thereby offering holistic solutions to the multifaceted needs of Indian agriculture.

IFS model for livelihood security of small and marginal farmers by ICAR-IARI, New Delhi (1ha-Irrigated)

In light of the challenges faced by small and marginal farmers, the Indian Agricultural Research Institute (ICAR-IARI), New Delhi, has developed an innovative IFS Model specifically designed for the livelihood security of these farmers to provide a practical blueprint for optimizing income. This model is tailored for a 1-hectare area under irrigated conditions and includes nine different components: crop production, pisciculture, duckery, poultry, apiary, agroforestry, composting unit, biogas plant, and



dairy. The primary goal of the IFS model is to enhance food, fodder, cash, and livelihood security for farmers, ensure continuous income generation, reduce production costs, improve soil health, and minimize risks in farming.

Feasibility analysis, employment generation, nutrient recycling and season-wise food availability of different components of IFS model, ICAR-IARI

The IFS model developed by ICAR-IARI offers a comprehensive approach to sustainable agriculture, focusing on the synergistic integration of various components for enhanced productivity. This model not only promotes employment generation and nutrient recycling but also ensures consistent food availability across different seasons.

The feasibility analysis of various modules along with the entire IFS model of ICAR-IARI has been done



by considering a project life of 15 years with a discount rate of 10%. For computing fixed cost, variable cost of different components and gross return, main product along with by product has been measured. Notably, the dairy module exhibited the highest Net Present Worth (NPW) of rupees 8.69 lakh, followed closely by the crop unit with 8.45 lakh, and the horticulture module with 6.59 lakh. In terms of B:C ratio, horticulture module secured the top position with 2.75, followed by the apiary module with 1.49, and the crop unit with 1.47. Regarding Internal Rate of Returns (IRR), the apiary module again leads with 75%, trailed by the poultry module with 45%, and dairy module with 33%. These rankings highlight the profitability and financial viability of various modules within the integrated farming system demonstrating notable performance

Table 2. IFS models for different agro-climatic zones of India

Agro-climatic zones	IFS models
High altitude cold deserts	Pasture + Forestry + Livestock (Goats, Rabbit, Yak) + Crops (Millets, Wheat, Barley, Vegetables)
Western and Central Himalayas	Horticultural crops + Crops (Wheat, Maize, Rice, Potato) + Goat
Eastern Himalayas	Agroforestry + Crops (Rice) + Poultry + Piggery
Indo-Gangetic Plains	Crops (Rice, Wheat, Maize, Sugarcane, Pulses) + Dairy+ Poultry
Central and Southern highlands	Crops (Cotton, Sorghum, Millets, Pulses) + Goats + Poultry
Delta and coastal plains	Rice cultivation along with Fish + Goat + Poultry
Western Ghats	Plantation crops + Crops (Rice, Pulses) + Livestock (Cattle, Sheep, Goat)
Arid and desert region	Livestock (Camel, Goat) + Crops (Millets, Wheat)





Table 4. Feasibility analysis of different modules of IFS model, ICAR-IARI

(Values in lakh rupees)

Modules	Fixed Cost	Variable Cost	Total Cost	Gross Return	NPW	B:C Ratio	IRR (%)
Pisciculture	11.50	7.51	19.01	28.35	3.43	1.29	16
Duckery	2.50	6.43	8.93	11.52	0.93	1.19	21
Poultry	7.34	14.02	21.36	34.01	5.31	1.45	45
Apiary	0.64	1.83	2.47	3.97	0.66	1.49	75
Vermicompost	0.57	0.65	1.22	1.80	0.09	1.11	4
Biogas Unit	0.28	1.54	1.82	2.06	0.02	1.02	2
Crop Unit	18.00	12.41	30.41	52.43	8.45	1.47	27
Horticulture	1.60	4.90	6.50	28.39	6.59	2.75	19
Dairy	10.39	42.17	52.56	74.25	8.69	1.31	33
IFS	51.99	87.51	139.50	212.30	27.86	1.35	28

across different metrics. The IFS model as a whole exhibits NPW of ₹ 27.86 lakh, a B:C of 1.35, and an IRR of 28%, showcasing its economic robustness and lucrative potential.

The IFS model, ICAR-IARI demonstrates significant

employment generation, totalling 628 mandays where the dairy module stands out as the highest contributor, generating 365 man days, followed by crop module, which provides 150 mandays of employment. Additionally, poultry,

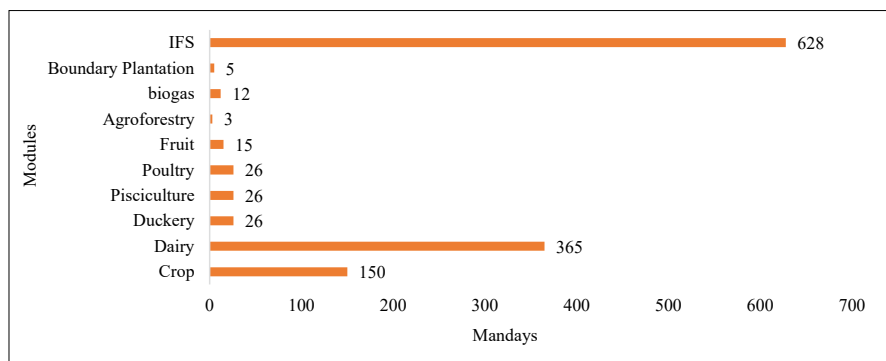
pisciculture, and duckery modules collectively contribute the third highest employment generation, providing 26 man days. This highlights the diversified nature of employment opportunities within the IFS model, emphasizing its role in promoting livelihoods and economic sustainability.

Table 3. Modules of IFS model of ICAR-Indian Agricultural Research Institute, New Delhi (1ha-Irrigated)

Modules	Area/Capacity	Description	Details
Crop Production	0.07 ha	Covers various crops with multiple cropping systems.	Components: cereals, pulses, oilseeds, vegetables, fruits, flowers. Cropping Systems: 9 different systems.
Pisciculture	0.01 ha (50 m x 20 m)	Fish pond with composite fish culture.	Stocking Density: 12,000 fingerlings/ha. Species: Catla, Rohu, Mrigal, Grass Carp. Annual fish collection: 1500 kg.
Duckery	Pond embankment	Low-cost duck shed on pond embankment with Khaki Campbell ducks.	35 ducks (32 female, 3 male). Feed: 100g/bird/day (wheat and pearl millet). Annual egg collection: 240 eggs.
Poultry	A low-cost house on the fish pond	Poultry house on fish pond with Kadaknath breed birds.	50 birds. Feed: 100g/bird/day (wheat and pearl millet). Egg collection: 160-180 eggs/year. Meat: 2-2.5 kg/bird.
Apiary	Four boxes	Bee boxes managed by ICAR-IARI for honey production.	European bee (<i>Apis mellifera</i>). Harvest: 8 kg of honey per box, half-yearly. Feed: Sugar syrup in off-season.
Agroforestry	0.012 ha	Tree planting along the boundary.	22 trees (21 moringa, 1 neem). Annual produce from moringa: 37 kg.
Composting Unit	Four pits (3m x 1m x 1m)	Composting of crop residues and cow dung with red worms.	Compost preparation time: 3-4 months. Harvest: 25 kg/month.
Biogas Plant	2m ³ volume	Biogas plant under KVIC model for energy production.	Feed: 20 kg cow dung, 20 L water. Slurry collection: 10 kg/month.
Dairy	Three crossbreed cows	Cattle shed with paddock and urine/dung tanks.	Daily milk collection: 30-35 litre. Daily cow dung collection: 50 kg.

This particular IFS model exemplifies an exemplary demonstration of nutrient recycling, showcasing the interrelation and complementarity among its various modules. The system efficiently recycles resources within its components, ensuring optimal utilization. Resources are reused across various components, such as using biomass and cow dung to produce biogas and slurry, which support fish farming and crop irrigation. This system enhances productivity, provides food, energy, and employment, and ensures sustainability, benefiting both farm families and the ecosystem.

The model for small and marginal farmers also ensures year-round, diverse food production by integrating crops, livestock, poultry, and fisheries. This model optimizes land use, resource management, and productivity, allowing farmers to continuously harvest a range of crops along with dairy products, eggs, and meat, enhancing nutritional diversity. It also supports food security, provides surplus for market sale, and offers resilience against climatic and economic challenges, promoting



Employment generation from different IFS modules of ICAR-Indian Agricultural Research Institute (1ha)

Table 5. Season-wise food availability in IFS model, ICAR-IARI

Season	Kharif	Rabi	Summer
Cereals	Maize, Sorghum, Rice	Wheat	
Pulses	Red gram, Cowpea		Green gram
Oilseeds		Mustard	Sunflower
Fodder		Berseem	
Fruits	Banana, Lemon, Guava	Kinnow, Banana, Lemon	Banana, Mango, Lemon, Guava
Vegetables	Baby corn, Bottle gourd	Vegetable pea, Potato, Broccoli, Red Cabbage, Palak, Green onion	Onion, Okra, Baby corn
Milk	Available	Available	Available
Egg	Available	Available	Available

self-sufficiency and sustainability in agriculture.

SUMMARY

Integrated Farming System (IFS) offers a transformative approach to agriculture for small and marginal farmers by integrating crops, livestock, aquaculture, and agroforestry. This model enhances resource efficiency, sustainability, and profitability while addressing issues like resource degradation and declining income. The ICAR-Indian Agricultural Research Institute developed IFS model for a 1 ha irrigated area demonstrates significant economic benefits, improving soil health, food security, and livelihood. Given its advantages, small holders should adopt this model to ensure economic stability, environmental sustainability, and self-sufficiency in food production across various agro-climatic zones.

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TECHNICAL SPECIFICATIONS

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