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Case studies on successful integrated

farming systems in West Bengal: Lessons for small farmers

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An integrated farming system (IFS) is a sustainable farming technique specifically designed for small and marginal farmers with the objective of enhancing system productivity, profitability, and employment prospects, ultimately ensuring their food and nutritional security. This approach utilizes livestock to manage pests that affect crops, cultivates fodder crops to provide food for animal sustenance, and applies animal waste to fields to acquire nutrients for crops. The article evaluates the impact of six distinct models under IFS against the traditional farming system popularly practised by small and marginal farmers in the Nadia district of West Bengal. All IFS models have exhibited superior economic performance in terms of benefit-cost ratio (B:C ratio), ranging from 1.21 to 2.72. The optimal combination has been achieved by merging horticulture (fruits and flowers) and dairy components, resulting in a gross return of ₹8.23 lakh/ha with a B:C ratio of 2.72. However, the integration of agriculture, fodder production, horticulture (fruits and flowers), and dairy in another model resulted in the highest number of job opportunities (632 mandays/ha/annum), which is 165% more than the jobs created by the traditional farming system.

Keywords: Diversification, Employment generation, Integrated farming system, Profitability, Resource recycling, Sustainability

INDIA, primarily a rural and agrarian economy, faces a significant challenge in terms of profitability and sustainability in farming due to the ongoing decline in land holding size along with demand of sustainable food production to satisfy the growing demand and to increase the marketable surplus of the farmers. Half of the population suffering from malnutrition are small-scale farmers, whereas another 20% are families without land who primarily work as agricultural labourers. At the same time, the global human population is growing at an exponential rate, with a two-fold increase from 1960 to 2010 and is expected to reach approximately 9.7 billion by 2050 and 10.4 billion during the 2080s. Achieving Sustainable Developmental Goal (SDG2: zero hunger) in the context of high global population expansion demands a continuous focus on food production. It is necessary to raise yearly meat production from 200 million tonnes to 470 million tonnes, and annual cereal production from 2.1 billion tonnes to 3 billion tonnes in order to fulfil the rising food demand.

The marginal and small farmers of Nadia district in West Bengal commonly engage in traditional farming systems. To change their conditions, farmers are willing to adapt new technologies or systems. Additionally, they lack knowledge about the substantial financial gains that can be obtained through the utilization of natural resources in conjunction with various agricultural activities to generate revenue. Under such circumstances, the concept of an integrated farming system (IFS) should be introduced as an alternative to traditional intensive agricultural practices without having adverse impacts on the environment. It manages crops and livestock on a single farm with the goal of utilizing the products of one for the growth of the other, like a range of ecosystem services that promote sustainability, climate resilience and ecological balance. Further, IFS has been demonstrated to effectively guarantee a consistent source of year-round income for farmers and create job opportunities for the rural population. This is also a dependable method for achieving increased system productivity while enhancing soil quality.

IFS initiatives among farmers in Nadia district through All India Coordinated Research Project (AICRP)

Since 2013–2014, the All India Coordinated Research Project (AICRP) has been conducting on-farm experiments on IFS in the new alluvial zone of West Bengal, namely in Chakdaha and Krishnanagar-1 block of Nadia district. A total of six distinct IFS models have been identified across three separate villages, Atilia and Kumarpur in Chakdaha block and Jalalkhali in Krishnanagar-I block. These models included components like agriculture (paddy, mustard, jute, pulses), fodder crop production (khesari), horticulture (banana in fruits and tuber rose, marigold in flower), and animal husbandry (milch cows, poultry and goat rearing). As the adoption of IFS model necessitates a transitional period of 3–10 years to get its maximum benefit, the farmers were interviewed in 2023. Additionally, a total of 12 traditional farmers who were not affiliated with this study were interviewed from the same villages to establish a comparison between traditional farming systems and several IFS models.

***IFS model 1*:** Shyamol Biswas, a diligent and passionate 44 years old farmer from Jalalkhali village in Krishna nagar-1 block in Nadia district, has implemented the combination of horticulture + dairy. His annual gross income was ₹823076.92/ha, which was 821.19% higher than the gross income of the traditional farming system. The net return and B:C ratio were ₹520639.74/ha and 2.72, respectively. The principal horticultural crops cultivated were bananas (1.56 ha) and tuber roses (0.26 ha), yielding a gross return of ₹4200,00 and ₹14,40,00, respectively. In the case of animal husbandry, there were two improved varieties of milch cows available with a yield of 1960 kg milk per annum. The integrated approach generated a total of 626.92 mandays per year, which is 162.78% higher when compared to the traditional farming system.

***IFS model 2*:** The second IFS model was carried out by Pradip Sarkar, a 40-year-old farmer from Jalalkhali village in Krishna nagar-1 block in the Nadia district of West Bengal. This model includes agriculture + fodder production+horticulture+dairy. In particular, paddy (0.52 ha) in agriculture, khesari in fodder (0.52 ha), marigold (0.52 ha) and banana (0.52 ha) in horticulture and 1 cow were present in his farm. A gross return of ₹23,196 from paddy, ₹11,600 from khesari, ₹18,00,00 from marigold, ₹84,000 from banana has been obtained from the assigned area. He did not receive any milk from the cow as the cow had not yet reached the stage of milking during the time of interview. On an average, his system gross income per hectare per annum was ₹574615.38 with a B:C ratio of 1.88. Further, this model has generated 632.69 mandays/annum, which is 165.20% greater than the traditional farming system.

***IFS model 3*:** In the third IFS model (agriculture + poultry + goat rearing), Alauddin Mondal, a 65 years old farmer from Atiliya village in Chakdaha block of Nadia district, integrated aman paddy (1.04 ha), boro paddy (0.52 ha), mustard (0.52 ha), jute (0.52 ha), 31 poultries and 20 goats. He earned a gross income of ₹69,365.40 from cultivating paddy, ₹15,599.85 from cultivating mustard, and ₹34,300 from cultivating jute, each from their respective land areas. Further, he generated ₹27,000 from selling eggs and ₹86,499.60 from selling goat meat during that particular year. The total annual gross income of his system was ₹223812.36/ha, with a system rice equivalent yield of 8453.40 kg/ha. With a B:C ratio of 1.46, the model created 342.31 mandays of employment annually, a 43.48% increase over the traditional farming system.

***IFS model 4*:** Biswajit Singha, a 35-year-old farmer from Atiliya village in Chakdaha block, is practicing the integration of agriculture + fodder + dairy. The primary agricultural crops comprise aman paddy (0.78 ha), boro paddy (0.52 ha) and jute (0.26 ha), with khesari (0.26 ha) being cultivated as a fodder crop. He received a

Table 1. Economics of various farming system models in Nadia district of West Bengal

Farmers' details	Farming Systems	Components	Ope. Hol. (ha)	SREY (kg/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio	Emp. Gen. (mandays/ha)
Average value of 12 traditional farmers	Traditional	Agriculture (paddy, mustard, jute, pulses)	1.09	7396.89	89348.74	9790.86	1.12	238.57
Shyamol Biswas, 44 years	IFS model 1	Horticulture (banana, tuber rose)+Dairy	1.82	50551.10	823076.92	520639.74	2.72	626.92
Pradip Sarkar, 40 years	IFS model 2	Agriculture (paddy)+ fodder production (khesari)+horticulture (Marigold and Banana)+dairy (milch cow)	1.04	42413.87	574615.38	269707.69	1.88	632.69
Alaumuddin Mondal, 35 years	IFS model 3	Agriculture (paddy, mustard, jute)+ Poultry+Goat rearing	1.04	8453.40	223812.36	71005.47	1.46	342.31
Biswajit Sinha, 49 years	IFS model 4	Agriculture (paddy and jute)+ Fodder (khesari)+ Dairy	0.78	10731.43	135987.18	38871.55	1.40	288.46
Kumarjit Mondal, 65 years	IFS model 5	Agriculture (paddy)+ Dairy	1.04	6230.25	122644.62	24504.46	1.25	201.92
Kumar Mondal, 60 years	IFS model 6	Agriculture (paddy, mustard, jute)+ Horticultre (banana)+ Dairy+ Poultry	1.30	24380.40	186519.23	32814.62	1.21	386.54

Ope. Hol.,Operational holding; SREY, system rice equivalent yield; B:C ratio, benefit cost ration; Emp. Gen, employment generation

Components of IFS model

total of ₹33,300 from aman paddy, ₹24,850 from boro paddy, ₹15,400 from jute, and ₹6,000 from khesari, respectively. Regarding the livestock component, two improved breeds of milch cow with a production of 1020 kg milk/annum have been observed, resulting in a revenue of ₹26,520. His average system gross income was ₹135987.18/ha/annum with a B:C ratio of 1.40. In addition, 288.46 mandays of employment has been generated in this IFS model, which is 20.91% greater than the traditional farming system.

***IFS model 5*:** Kumarjit Mondal, a 49-year-old farmer from Kumarpur village in Chakdah block of Nadia district adopted a model of agriculture and dairy activities. He cultivated aman and boro paddy on a 1.04 ha plot of land, while also maintaining one milch cow for milk production. His earnings consisted of ₹55,200 from aman paddy, ₹59,090.40 from boro paddy, and a yield of 510 kg of milk, which generated a return of ₹13,260/annum. Nevertheless, the system gross income was documented as ₹12,2644.62/ha/annum, accompanied by a B:C ratio of 1.25. This is the sole instance in which the employment creation in the IFS model is shown to be lower than that of the traditional farming system.

IFS model 6: In the sixth IFS model (agriculture + horticulture + dairy + poultry), Kumar Mondal, a 60 years old farmer from Jalalkhali village in Krishna nagar-1 block, has combined aman paddy (0.52 ha), mustard (0.52 ha), jute (0.52 ha), banana (0.78 ha), two milch cows, and fifteen poultry birds. Based on their allocated land sizes, he made a gross income of ₹24,850 from aman paddy, ₹11,025 from mustard, and ₹28,400 from jute, respectively. When it comes to animal husbandry, there were two improved varieties of milch cows with an annual milk yield of 960 kg, resulting in a gross return of ₹28,800/annum. Additionally, fifteen poultry birds provided 1080 eggs/annum, yielding a gross return of ₹5400. This model also produced 386.54 mandays/annum, which was 62.02% more than the traditional farming system.

Through the implementation of scientific interventions and several IFS models, farmers engaged in each model have successfully boosted their revenue and enhanced their standard of living. Out of the six models described, IFS model-1, which combined horticulture and dairy components, was determined to be the most profitable with the highest B:C ratio of 2.72. In terms of employment generation, all models have reflected a growth ranging from 20.91% to 165.20% when compared with the traditional farming system, except for IFS model-5.

SUMMARY

IFS models have multifaceted benefits where the integration of different crop and livestock components facilitates the effective recycling of wastes within the system. The inclusion of different agricultural and horticultural crops, along with livestock components like dairy, poultry, fisheries, etc., assist small and marginal farmers in achieving food and nutritional security by meeting protein requirements. Nevertheless, the extensive adoption of IFS is impeded by several constraints, including challenges in locating appropriate markets to dispose of small-scale production from diverse components, absence of improved livestock breeds, limited access to credit support, high initial investment, and lack of knowledge and guidance. To overcome these challenges, capacity building, enhanced resources, extension services, and veterinary support are required to enhance the livelihood of the small and marginal farmers.

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