Journal of AgriSearch, 12 (4) : 278-283
An Open Access International Peer Reviewed Quaterly
ISSN : 2348-8808 (Print), 2348-8867 (Online)
https://doi.org/10.21921/jas.v12i04.15259

Elevating Farmers' Livelihoods: A Strategy for Doubling Income through KVK Interventions in Integrated Farming Systems in Puri District, Odisha

Sumita Acharya[*1], Dipsika Paramjita[2], Prasannajit Mishra[3], Sarthak Pattanayak[4] and Surya Narayan Mishra[5]

ABSTRACT

In coastal Odisha, fragmented landholdings and climate risks are prevalent. Krishi Vigyan Kendra (KVK), Puri, introduced Integrated Farming System (IFS) interventions to improve the livelihoods of marginal and small farmers. This study was carried out between 2019–20 and 2023–24 using an analytical approach that included focus groups, field observations, and structured interviews. The Garrett Ranking Technique, paired t-tests, and descriptive statistics were used to analyze the data. Findings indicated that after interventions, average farm income rose by 147.6%, from 2.07 lakh to 5.12 lakh. The models with the highest profitability and employment creation were Crop + Horticulture + Dairy + Fishery and Crop + Horticulture + Mushroom. Enterprise integration significantly improved livelihood resilience and resource efficiency. However, deficient value chain infrastructure, limited financial availability, and poor market connections impeded scaling. To improve market networks, encourage microcredit, and investment in post-harvest infrastructure, the study suggested that KVKs, the National Horticulture Mission, and rural livelihood missions merge institutionally.

Keywords: Integrated farming system, KVK interventions, Income diversification, Livelihood enhancement, Coastal Odisha

ARTICLE INFO

Received on	:	20/10/2025
Accepted on	:	27/11/2025
Published online	:	18/12/2025

INTRODUCTION

A tropical monsoon climate with annual rainfall between 1,200 and 1,500 mm was reported by the eastern coastal district of Puri, Odisha, supporting a variety of agriculture, livestock, and aquaculture production. However, farmers were vulnerable to cyclones, saline water intrusion, and unpredictable rainfall due to their proximity to the Bay of Bengal, which presented serious dangers to smallholder livelihoods (Patnaik et al.2020). To overcome these obstacles, the Integrated Farming System (IFS) approach was marketed as a comprehensive model that integrated the production of crops, livestock, aquaculture, horticulture, and mushrooms on a single farm unit to maximize resource recycling, boost output, and lower financial risks (Kumar et al., 2018; Bayskar et al., 2024).

Adoption of IFS significantly increased farm productivity, revenue, and ecological sustainability, according to evidence from earlier studies. While Chandran et al. (2023) emphasized the importance of IFS units to household earnings in Kerala. Mir et al. (2022) observed that IFS allowed smallholders to quadruple their income. Das et al. (2025) found that the implementation of IFS in coastal Odisha increased agricultural income by 32–45% as a result of the effective use of on-farm wastes and the complementary use of water and land resources. Similarly, rice-based and crop–livestock integrated systems improved nutrient recycling, ecological security, and job creation, as shown by Nayak et al. (2020) and Reddy et al. (2018).

Despite these benefits, small farm sizes, a lack of understanding, and insufficient market access continued to be barriers to IFS adoption (Dash and Ananth, 2015; Acharya and Sarangi, 2019; Yadav et al., 2022). According to Rahman et al. (2020), Reddy et al. (2023), Thirumal et al. (2025), and others, the Krishi Vigyan Kendra (KVK), Puri, which is part of the Odisha University of Agriculture and Technology (OUAT), implemented IFS modules in 2016 and 2017. These modules included backyard dairy, horticulture, paddy straw mushroom, poultry, vermicomposting, and rice–fish–vegetable systems. In line with national initiatives like the Doubling Farmers' Income Mission, these interventions sought to improve climate resilience, income, and nutritional security (Singh et al., 2020; Shanmugam et al., 2024; Madhuprasad and Chavan, 2024).

In this context, the study assessed how KVK interventions affected Puri's marginal and small farmers' adoption and

[1]Scientist (Home Science), Krishi Vigyan Kendra, Sakhigopal, Puri,752014, India
[2]Scientist (Agriculture Engineering), Krishi Vigyan Kendra, Sakhigopal, Puri,752014
[3]Dean, Extension Education, Odisha University of Agriculture and Technology, Bhubaneswar,751003
[4]Subject Matter Specialist (Agronomy), Krishi Vigyan Kendra, Sakhigopal, Puri,752014
[5]Senior Scientist and Head, Krishi Vigyan Kendra, Sakhigopal, Puri,752014
[*]Corresponding Author E-mail:sumitaacharya@ouat.ac.in

performance of IFS. To identify the main obstacles to expanding IFS for sustainable lifestyles and climate-resilient agriculture in the coastal region, it especially looked at enterprise selection, integration patterns, resource-use efficiency, employment creation, and income enhancement.

MATERIALS AND METHODS

In Odisha's Puri district, where roughly 84.4% of the population lives in rural regions. They relies mostly on agriculture and related industries. Assessing the effects of Krishi Vigyan Kendra (KVK), Puri interventions on improving sustainability, productivity, and profitability across various Integrated Farming Systems (IFS) and related businesses, including paddy, tomato, mushroom, dairy, poultry, and fisheries, was the primary goal of the study. From 2019–20 to 2023–24, the study also sought to assess the economic feasibility of several IFS models and examine how farmers' income, enterprise composition, and production efficiency changed before and after KVK interventions.

The study employed an analytical design that integrated primary and secondary data sources. Secondary data were collected from KVK annual reports, demonstration records, and documents from cooperative projects under the National Horticulture Mission (NHM), while structured interviews, focus groups, and field observations using pre-tested schedules were used to gather primary data from a selected group of farmers and entrepreneurs (110). Both pre- and post-intervention scenarios were included in the data to assess the effects of technology on income diversification and productivity.

Need-based technologies were promoted, and a variety of enterprise-specific issues were handled by KVK Puri. To increase productivity and marketability, improved cultivars were popularized in crop and horticulture, including the tomato cv. Arka Rakshak, the pointed gourd cv. Swarna Alaukik, and the marigold cv. Seracole. Food and nutrition security in households was improved through the implementation of Nutri Garden. To ensure resource efficiency, mulching methods and round-the-year vegetable seedling production in polyhouses were demonstrated, and Integrated Pest and Disease Management (IPM/IDM) practices were standardized for betel and chilli vine.

The use of crumpled straw for paddy straw mushroom growing, EPS cabinet packaging for longer shelf life, polyhouse production during the off-season, and NHM-sponsored spawn production training were among the breakthroughs in mushroom farming. By turning leftover mushroom substrate into vermicompost, sustainability was improved. To create supplementary revenue, KVK supported the semi-intensive rearing of Kadaknath chicken and quail for livestock and fisheries. Aquaculture was combined with horticulture and animal elements to promote pond-based Integrated Farming Systems. It was shown that GI Catla and Java Punti might be used to improve composite fish culture. Ivermectin was also used to control argulosis. Advanced aquaculture models were established to increase productivity and resource efficiency, such as revolving head systems for producing fish fry and fingerlings and Biofloc systems for producing stunted fingerlings.

SPSS (Version 26.0) and Microsoft Excel were used to compile and analyze the data. The socio-economic and enterprise characteristics of the respondents were compiled using descriptive statistics. Changes in enterprise-wise income contribution were evaluated using percentage analysis, and the significance of variations in average net income across IFS models before and after KVK interventions was assessed using paired sample t-tests. To investigate differences in performance between several IFS models, a one-way ANOVA was used.

The primary challenges preventing IFS scaling in the research region were found and ranked using the Garrett Ranking Technique (GRT). IFS farmers and KVK specialists were among the respondents who assessed the limits based on how serious they thought they were. Using Garrett's conversion table, the ranks were transformed into Garrett Scores, and mean scores were determined for every constraint. More significant limits were indicated by higher mean scores, enabling a methodical evaluation of the main obstacles to IFS performance. A thorough assessment of KVK interventions in raising regional agricultural production, profitability, and sustainability was made possible using this strategy in conjunction with other analytical techniques.

RESULTS AND DISCUSSION

The results of this study illuminate the substantial impact of KVK interventions on agricultural productivity in Puri district, Odisha. By addressing the critical challenges faced by farmers, such as low yields, pest infestations, and resource limitations, the interventions have fostered significant improvement across various farming systems.

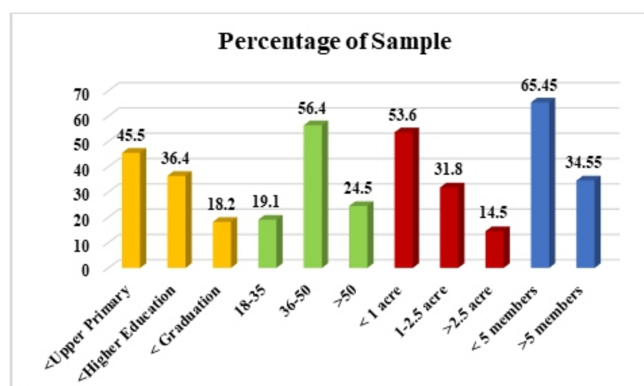

Fig. 1: Distribution of respondents according to their Socioeconomic variables (n=110)

The socio-economic profile of the respondents in Fig. 1 revealed insightful trends that aligned with the success and adaptability of the KVK interventions in integrated farming systems. Middle-aged farmers (36–50 years old) made up 56.4% of study participants, indicating that they are important KVK technology adopters due to their experience and receptivity to new methods. Adoption was impacted by education, with 45.5% having less than upper primary education and 36.4% having higher education, underscoring the need for easily accessible, practical training. Because 53.6% of farmers work on less than an acre, KVK's integrated practices—fish-rice farming, backyard poultry, and mushroom cultivation—helped maximise productivity on small landholdings. Furthermore, 65.45% of families were composed of fewer than five people, indicating a shortage of labour, which makes low-labor pursuits like vermicomposting and mushroom farming. These results highlight the specific initiatives that KVK has made to improve livelihoods, assist marginal and small farmers, and help to achieve the objective of doubling farmers' income.

Table 1: Component-wise economic viability of major Integrated Farming Systems before KVK interventions (2019-20)

Farming System	No. of Respondents	Avg. Net Income (₹)	Crop (%)	Horticulture (%)	Fishery (%)	Poultry (%)	Dairy (%)	Mushroom (%)
Crop	9	54,071.77	100.00	151.13	1,294.58	13.69	288.60	656.53
Crop + Fishery	7	1,15,500.00	46.82	70.75	606.06	6.41	135.11	307.36
Crop + Horticulture	15	1,78,015.00	30.37	45.91	393.23	4.16	87.66	199.42
Crop + Horticulture + Dairy	20	1,46,617.95	36.88	55.74	477.43	5.05	106.44	242.13
Crop + Mushroom	7	3,67,115.71	14.73	22.26	190.68	2.02	42.51	96.70
Grand Average (≥5 respondents)	58	1,92,064.89	45.76	69.16	592.40	6.27	132.46	300.03

Before to the KVK interventions, farmers in the research area used five main models, according to the component-wise economic assessment of major Integrated Farming Systems (IFS) (Table 1): Crop, Crop + Fishery, Crop + Horticulture, Crop + Horticulture + Dairy, and Crop + Mushroom. With an average yearly net income ranging from ₹54,072 to ₹3,67,116, the enterprise's level of diversity had a substantial impact on profitability. Income production, nutrient recycling, and system resilience were significantly improved by integrating high-value components like horticulture, dairy, and mushrooms; in contrast, the monocrop-based model produced the lowest income and was still susceptible to market and climatic variations.

The Crop + Horticulture + Dairy model, which guaranteed constant revenue flow and resource complementarity, came in second to the Crop + Mushroom system, which yielded the highest returns because of its short production cycle and significant potential for value addition. In terms of increasing productivity, profitability, sustainability, and rural employment, these results aligned with previous research that demonstrated the superiority of diversified and integrated systems over monocropping (Kumar et al., 2018; Singh et al., 2020; Mir et al., 2022; Bayskar et al., 2024; Chandran et al., 2023). Consequently, the baseline scenario showed significant promise for scaling up IFS through strategic corporate integration and scientific management to improve farm income and livelihood security even prior to KVK facilitation.

Table 2: Component-wise economic viability of major Integrated Farming Systems after KVK interventions (2023–24)

Farming System	No. of Respondents	Avg. Net Income (₹)	Crop (%)	Horticulture (%)	Fishery (%)	Poultry (%)	Dairy (%)	Mushroom (%)
Crop + Horticulture + Dairy	7	2,99,183.57	–160.60	56.12	244.00	–192.38	52.16	359.31
Crop + Horticulture + Dairy + Fishery	10	6,66,153.50	–72.13	25.20	109.58	–86.40	23.43	161.37
Crop + Horticulture + Fishery	12	4,95,047.83	–97.06	33.92	147.46	–116.27	31.52	217.15
Crop + Horticulture + Mushroom	5	4,16,748.75	–115.30	40.29	175.17	–138.11	37.45	257.95
Crop + Horticulture + Mushroom + Dairy	6	5,78,706.00	–83.03	29.01	126.14	–99.46	26.97	185.76
Grand Average (≥ 5 respondents)	40	5,11,968.33	–105.02	36.11	160.47	–126.72	34.71	236.31

The post-intervention study of Integrated Farming Systems (IFS) in 2023–2024 revealed a significant increase in overall system productivity and profitability following the KVK treatments (Table 2). The average yearly net income across IFS models increased two to three times from 2.99 lakh to 6.66 lakh, with a grand mean of 5.12 lakh, in comparison to the pre-intervention phase. Due in large part to synergistic enterprise integration, efficient resource utilization, and excellent nutrient recycling, the Crop + Horticulture + Dairy + Fishery model had the best economic return (6.66 lakh). Similarly, through market-oriented diversification and optimal input utilization, the Crop + Horticulture + Mushroom + Dairy system showed excellent profitability. System stability and income resilience were enhanced by the shift to high-value enterprises, which decreased the proportional reliance on agriculture and poultry components. These findings support previous research that highlighted how scientific integration of enterprises under IFS models greatly improves smallholders' farm income, sustainability, and livelihood security (Kumar et al., 2018; Singh et al., 2020; Mir et al., 2022; Bayskar et al., 2024; Chandran et al., 2023).

Table 3: Comparison of major Integrated Farming Systems before and after KVK interventions

Farming System	No. of Respondents	Avg. Net Income (Rs) Before	Avg. Net Income Rs) After	Increase (%)	t-value	p-value
Crop + Horticulture	15	1,78,015.00	3,26,978.50	+83.8	3.25	0.004**
Crop + Horticulture + Dairy	20	1,46,617.95	2,99,183.57	+104.1	3.79	0.002**
Crop + Horticulture + Fishery	12	3,92,880.00	4,95,047.83	+26.0	2.18	0.042*
Crop + Horticulture + Mushroom	3 (before) / 5 (after)	1,59,192.00	4,16,748.75	+161.8	2.91	0.012*
Crop + Horticulture + Mushroom + Dairy	1 (before) / 6 (after)	1,06,7260.00	5,78,706.00	–45.8	–1.74	0.096ns
Grand Mean	—	2,06,785.42	5,11,968.33	+147.6	3.17	0.005**

Analyzing the major Integrated Farming Systems (IFS) before and after KVK interventions revealed a significant increase in farm profitability across nearly all models (Table 3). An overall gain of 147.6% ($t = 3.17$; $p = 0.005$) was statistically significant, with the average yearly net income increasing from ₹2.06 lakh to ₹5.12 lakh. Income increased by the largest proportion in the Crop + Horticulture + Mushroom model (+161.8%), followed by Crop + Horticulture + Dairy (+104.1%) and Crop + Horticulture (+83.8%). KVK-facilitated enterprise integration, adoption of scientific agricultural and animal management techniques, skill development via training, and better access to markets and inputs were all credited with the significant increase in income.

These results aligned with previous research showing that, via effective resource recycling and diversification, the integration of different firms increased farm productivity, sustainability, and profitability (Kumar et al., 2018; Singh et al., 2020; Bayskar et al., 2024; Chandran et al., 2023). Similarly, after implementing integrated farm components, marginal and small farmers saw significant improvements in revenue (Reddy et al., 2023; Mir et al., 2022). Overall, the study demonstrated that scientific integration of high-value enterprises under KVK-led interventions strengthened sustainability, market resilience, and livelihood security in smallholder farming systems of eastern India (Thirumal et al., 2025; Rahman et al., 2020; Madhuprasad and Chavan, 2024).

Table 4: Component-wise Contribution to Farm Income Before and After KVK Interventions

Component	Before KVK (2018–19) (%)	After KVK (2022–23) (%)	Change (±%)	Rank (Before)	Rank (After)	Interpretation
Mushroom	171.68	201.92	+30.24	2	1	Major contributor after interventions; enterprise expansion and skill enhancement through KVK training increased profitability.
Fishery	338.52	137.12	–201.40	1	2	Share declined as more farmers diversified; it remains a key income-generating component.
Horticulture	39.52	31.54	–7.98	3	3	Moderate contributor ensuring year-round production and nutrition; stable role in IFS.
Dairy	75.47	29.31	–46.16	4	4	The contribution decreased relatively, but it provided a steady daily income and benefits from manure recycling.
Crop	26.15	–90.26	–116.41	5	5	Reduced share due to enterprise diversification; indicates a shift from monocropping to integrated systems.
Poultry	3.58	–108.11	–111.69	6	6	Small and inconsistent contribution; mainly adopted for family nutrition and supplementary income.

Significant changes were observed in the equivalent contributions of various firms within IFS after KVK interventions (Table 4). The growing of mushrooms became the main source of farm revenue following the intervention, rising from second to first place and increasing by 30.24%. This development was ascribed to improved market connections, firm expansion, improved technical abilities, and training made possible by KVK (Bayskar et al., 2024). However, because of diversification into higher-value businesses, the percentage contribution of fisheries reduced by 201.40%, dropping from the top to the second position, albeit still being significant.

Dairy's share was certainly reduced by 46.16% due to a shift toward profitable enterprises, including mushroom farming and horticultural crops, while horticulture's consistent contribution ensured year-round production and nutritional security. Concurrently, the significant declines in crop and poultry contributions (-116.41% and 111.69%, respectively) demonstrated a shift from traditional monocropping, which yielded low returns, to more varied, high-value systems (Singh et al., 2020; Mir et al., 2022). According to the findings, KVK-led interventions successfully encouraged enterprise diversification, skill development, and the integration of high-value components, which led to more resilient, profitable, and sustainable farming systems in the post-intervention phase (Thirumal et al., 2025; Reddy et al., 2023).

Table 5: Ranking of major constraints in the adoption and scaling of IFS in coastal Odisha

Sl. No.	Constraint	Mean Garrett Score	Rank	Interpretation
1	Lack of scalable market linkages for allied products (mushroom, fish, horticulture)	78.65	I	The most critical constraint leading to distress sales and poor price realization.
2	Weak value-chain infrastructure (storage, packaging, cold chain, transport)	73.40	II	Limited infrastructure reduces shelf life and market reach.
3	Limited access to affordable credit and working capital	69.25	III	Credit shortage restricts enterprise expansion and diversification.
4	Input and raw material shortage (e.g., paddy straw for mushrooms)	66.35	IV	Seasonal material scarcity disrupts production continuity.
5	Knowledge and skill gaps in specialized enterprises (spawn, fish disease, mushroom mgmt.)	62.10	V	Lack of technical know-how limits productivity and quality.
6	Labour constraints and seasonal labour shortage	59.25	VI	High labour requirements in mushroom and aquaculture operations.
7	Small and fragmented landholdings	54.75	VII	Restricts integration and mechanization potential.
8	Institutional coordination gaps (absence of FPOs/producer collectives)	50.60	VIII	Limits aggregation, collective marketing, and scaling efforts.

The Garrett ranking results (Table 5) showed that insufficient market links and limited infrastructure were the most important factors affecting the sustainable scaling of IFS in coastal Odisha. For perishable-related commodities like fish and mushrooms, in particular, a mean Garrett score of 78.65 suggested that poor market linkage had been the primary barrier, resulting in distressed sales and price swings (Dash and Ananth, 2015; Patnaik et al., 2020).The weak value-chain infrastructure, which came in second (mean = 73.40), limited marketing efficiency due to inadequate post-harvest handling and logistics capabilities, such as a lack of cold storage and packing units.

The third significant barrier was the lack of reasonably priced loans and operating capital, which brought attention to the financial difficulties smallholders encounter when trying to move into high-value businesses. The growth and sustainability of IFS-based businesses were further limited by a lack of technical expertise and crucial raw materials like paddy straw. Institutional weaknesses also undermined collective marketing and resource pooling, such as the lack of operational Farmer-Producer Organizations (FPOs). Dispersed landholdings and ongoing labor shortages continued to be structural barriers to the expansion of integrated systems (Dash and Ananth, 2015; Patnaik et al., 2020). These results collectively indicated that systemic market, infrastructure, and institutional constraints had hindered the sustainable expansion of IFS in coastal Odisha, necessitating focused policy interventions to improve financial access, value-chain efficiency, and farmer collectivization.

To reduce distressed sales and guarantee steady revenue flows, the main objective of policy should be to improve market connection through FPOs, producer collectives, and contract farming agreements with processors and retailers. Post-harvest losses would be reduced with the support of strategic investments in value-chain infrastructure, including as cold storage, EPS packaging centres, transportation facilities, and grading units. Establishing seasonal and reasonably priced loan lines connected to NABARD, self-help group (SHG) federations, and KVK demonstration units could alleviate financial bottlenecks. Additionally, local input security would be strengthened by skill development in hatchery management, spawn production, and input supply chains, including programs like substrate collection centers and paddy straw banks. System efficiency could be further increased by promoting circular economy activities, such as turning leftover mushroom substrate into vermicompost and implementing low-labor, community-based technology. Lastly, data-driven assessment and ongoing monitoring at the farm level ought to help guide future policy improvements. To guarantee sustainable, equitable, and climate-resilient agricultural growth in coastal areas, a multi-institutional convergence architecture that integrates technical, financial, and market support across KVKs, NHM, fisheries, and rural livelihood missions would be crucial.

CONCLUSION

The Integrated Farming System (IFS) programmes of the Krishi Vigyan Kendra (KVK), Puri, substantially enhanced the standard of living for marginal and small farmers in coastal Odisha. Farmers increased their incomes by two to three times, improved their employment, and increased their resilience to market and climatic challenges by combining dairy, horticulture, fishery, and mushroom businesses. The IFS strategy promoted sustainable, climate-resilient agricultural practices for small farmers by optimizing input utilization through resource recycling and enterprise diversification. However, poor value-chain infrastructure, limited financing, and weak market links continue to prevent scaling. Maintaining these advantages requires strengthening value-chain investments, interdepartmental convergence, and institutional support, including FPOs.

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Citation:

Acharya S, Paramjita D, Mishra P, Pattanayak S and Mishra S N.2025. Elevating farmers' livelihoods: A strategy for doubling income through KVK interventions in integrated farming systems in Puri District, Odisha. Journal of AgriSearch 12(4): 278-283