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Integrated Farming Systems: A Review of Farmers Friendly Approaches

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This work was carried out in collaboration among all authors. This review paper has prepared by the author MMS under direct supervision and guidelines of the author TSR. The author MMS was extensively involved in reviewing different source materials and prepared the draft of this paper whereas the authors TSR and AKMKP kept contribution in verifying and finalizing the manuscript.

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ABSTRACT

Integrated Farming Systems (IFS) is a set of interrelated agro-economic activities where the components interact in a particular agrarian setting. The main thrust is to minimize risks and increase profitability. Around 90-95 percent of nutritional requirements are self-supplied through resource recycling, which curtails the cost of cultivation and increases profit margins and employment. Considering the IFS's importance, this is a review of the productivity, problems, and suggestions for improving IFS. The study's methodology was to integrate the secondary sources. We found efficient integration of field crops with farm animals for sustainable production, income generation, and employment opportunities for resource-poor rural farm families. Financial support with technical assistance and guidance for improving the standard of living of the farm families is suggested. An integrated farming system demonstration center should be established in every district for potential farmers to easily visit them and be informed about IFS as an option.

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ABBREVIATION

CFS	:	Conventional Farming System,
DAE	:	Department of Extension Education,
DoF	:	Department of Fisheries,
FAO	:	Food and Agriculture Organization,
IFS	:	Integrated Farming System,
KVK	:	Krishi Vigyan Kendra,
IOBC	:	International Organization for Biological Control,
SVI	:	Sustainable value index,
FSR	:	Farming System Research,
EISA	:	European Integrated Farming Framework
HYV	:	High Yielding Variety,
CFI	:	Constraints Facing Index

1. INTRODUCTION

The Integrated Farming System (IFS) combines animal and crop agricultural systems in which the animals eat agrarian by-products and the animal's body is used in soil cultivation and provides manure that is utilized as fertilizer and fuel [1]. According to Radhamani et al. [2], IFS seeks to increase productivity and profits and minimize risks through the proper utilization of organic waste and crop residues. FAO [3] stated that "there is no waste," and "waste is only a misplaced resource which can become a valuable material for another product" in an integrated farming system.

Edwards [4] observed that conventional agriculture practices had brought economic obstacles associated with exploitation in crop production, increased expenditure of energy-related inputs, and farm income reduction. It has also caused ecological problems, such as poor diversity, soil and water pollution, and soil erosion. Thus, the adoption of integrated agricultural production systems that generally involve lower use of inputs, e.g., fertilizers, chemicals (pesticides), and cultivations, can mitigate these economic and ecological problems.

Agbonlabor et al. [5] described the Integrated Farming System as a mixed farming system in which crop and livestock components are combined in a supplementary and complementary manner.

Varughese and Mathew [6] observed that sustainable agriculture is deemed to be the goal of conservation of natural resources, environment protection, and increased prosperity

on a sustainable basis. Farming systems are interrelated agro-economic activities where the components interact with each other in a particular agrarian setting. The main thrust is to minimize risks in diversified farming, although the crop and other enterprises co-exist there. Integrated Farming Systems ensure a rational mixture of one or more elements and cropping, resulting in a complementary effect through the effective use (recycling) of wastes and crop residues. IFS is considered a source of additional income to the farmer s' community.

Tripathi and Rath [7] identified different existing farming system models from Uttarkhand such as: crops + dairy, crops + dairy + horticulture + goats, crop + goats + horticulture, crop + dairy + vegetable, vegetable + fish and crop + dairy + other animals. These were the elements in IFS there.

Three types of dairy systems e.g. smallholder systems, smallholder cooperative dairy production systems and intensive dairy production systems were identified in Devendra's study [8]. The first two systems were most important in terms of increasing intensification. In the South Asian region, Buffaloes were notably dominant, but Holstein-Friesian cross-bred cattle were primarily involved in dairy production systems.

Dhaka et al. [9] found that IFS assume greater attention of proper management of available farm resources to boost productivity besides reducing environmental degradation. The integrated farming system was an appropriate approach to minimize risk and increase production, profit, and employment with better resource utilization.

Kumar et al. [10] found that IFS usually enables the agricultural production system to be sustainable, efficient (3-6 times more profitable), and effective in the long term. Around 90-95 percent of nutritional requirement is self-sustained through resource recycling which curtails the cost of cultivation and increases profit margins and employment. To sustain food and nutritional security, the IFS approach is promising and will conserve the resource base by efficiently recycling residues and wastes within the system.

According to the UNI 11233-2009 European Standard, the International Organization for Biological Control (IOBC) defines Integrated Farming as an agricultural system where high-quality organic food, feed, fibre and renewable energy are produced using resources such as land, water, air and nature, as well as controlling factors for sustainable farming and with as little polluting input as possible [11].

Tony Worth [12] conceived Integrated Farming as a whole farm policy and whole systems approach to farm management. The farmer seeks to provide efficient and profitable production, which is economically viable and environmentally responsible and delivers safe, wholesome, and high-quality food to consumers through the efficient management of livestock, forage, fresh produce, and arable crops. He also provides conservation and enhancement of the environment to society. At the core of IF is the need for profitability. To be sustainable, the system must be profitable. Profits generate support for all the activities outlined in the IF Framework. Financial support for environmental and biodiversity activities varies throughout the European Community but in all cases requires the farmer to commit labor and planning to such activities.

EISA [13] have an Integrated Farming Framework which provides additional explanations of key aspects of Integrated Farming. These include Organization & Planning, Human & Social Capital, Energy Efficiency, Water Use & Protection, Climate Change & Air Quality, Soil Management, Crop Nutrition, Crop Health & Protection, Animal Husbandry, Health & Welfare, Landscape & Nature Conservation, and Waste Management Pollution Control.

Kumar et al. [14] concluded that the IFS model's adoption ensured economic returns and regular employment even on less than one acre of land,

which is usually non-sustainable if monocropping is being practiced. However, when the economic aspects of different models are considered, the combination crop + horticulture + poultry + fishery model ranked first in net returns and SVI (Sustainable value index) because expenditures were lower.

2. OBJECTIVES

The main goal is to determine the strengths, opportunities and future thrust of an integrated farming system.

However, the specific objectives of the study are:

- i) To identify the profitability and environmental success, in practice, of the IFS, in comparison with its stated goals
- ii) To identify the problems in implementing IFS, and
- iii) To set out suggestions for the further development of IFS.

3. RESEARCH METHODOLOGY

The research used secondary sources like academic journals, government publications, and online repositories. The published sources provided the supporting material and primary evidence for policy recommendations on integrated farming.

4. MAJOR FINDINGS

4.1 Farming System Vs. Integrated Farming System

Rana and Pankaj [15] represented the farming system as an appropriate combination of farming activities viz. cropping systems, horticulture, livestock, fishery, forestry, and poultry. They recognized that the farmers' ability to use these activities to produce profitability was the ultimate issue for agriculture. They showed that the farming system interacts with the environment but must not disturb the ecological and socioeconomic balance. Finally, they recognized that agriculture had national goals to meet as well as the goals for the farmer (profit), the consumer (food) and posterity (environmental sustainability). While these goals inherently conflict, in attempting to maximize progress toward each, the farming system will help develop the economy where it operates and raises farmers' standard of living in the country.

IFS, a component of FSR (Farming System research), introduces a change in the farming techniques for maximum production in cropping and optimal utilization of resources [16]. The farm wastes are better recycled for productive purposes in the IFS. Unlike the CFS, IFS's activity is focused around a few selected, interdependent, interrelated, and often interlinking production systems based on a few crops, animals, and related subsidiary professions. IFS envisages harnessing the complementarities and synergies among different agricultural sub-systems/enterprises and augmenting the total productivity, sustainability and gainful employment.

Hence, it is encouraged the farmers to shift from CFS to IFS for maximum resource utilization and ensure sustainability in production.

4.2 Socioeconomic Characteristics of IFS Farmers

Khalid et al. [17] summarised the socioeconomic characteristics of IFS farmers. The most of the farmers (52%) were young, less than 39 years of age and 30.83 per cent of farmers aged between 40-49 years. Those aged 50 and above were 21.66% of the total. 18.33 per cent of the IFS farmers where this research was done were illiterate but the majority had completed primary or junior secondary school. Only 3.3 percent of farmers had completed higher secondary education and graduation. Maximum 52 per cent of the farmers had 5-15 years of farming experiences and 27 per cent had up to 20 years of farming experiences. Only 18.33 per cent of the farmers having experience of more than 20 years. The percentages of the respondent who have up to 5 members and 6-10 family size are 23.33 and 48.33 respectively. The percentage of 11-15 members' family and above 15 members are 12.5 and 15.83. The percentage of farmers having less than 5 acre is 26.66. The highest percentage is 58.33 of the farmers having landholdings 5-10 acre. Only 15 per cent of the farmers had landholdings greater than 10 acres.

Singh et al. [18] stated that half of the respondent-farmers to his survey were 47-62 years of old, most of the rest being younger. Half of the respondents had completed secondary education and most of the rest completed tertiary education and 1.67 per cent were illiterate. They also found that 63.3 per cent of the respondents belonged to nuclear families. 55 per cent of the respondents had family members between 5-8

and 30 per cent of the respondents had more than 8 family members. Agriculture was the main source of income for all the respondents while 6.67 per cent respondents also had agriculture + service as a source of income. 73.33 per cent of the farmers had a medium level of social participation, 26.67 per cent respondents had high level of social participation. 40 per cent of the respondents had a medium level of mass media exposure whereas 36 per cent of the respondents had high level of mass media exposure. It was observed that 11.66 per cent of the respondents were having a medium extension contacts and maximum 88.33 per cent of the respondents had high level of extension contacts.

Uddin et al. [19] found that the average total income of the integrated farms was Tk. 124,839, and for mixed farms, it was Tk. 99,641. The income of integrated farms is higher than the national average of Tk. 115,776 (BBS, 2010). Farmers practicing the C-L-H system earned the highest annual income (Tk. 155,892) under integrated farming. Farmers practicing the C-L-P-F-H system got the highest annual income (Tk. 138,542) under mixed farming.

Mahadiket et al. [20] reported that the majority of the farmers (68%) of rice and backyard poultry farming were middle-aged, 36.8 % of them had education up to secondary school level, 60% of them were low annual income group farmers who had fair extension agency contact as well as good mass media exposure. Prasad et al. [21] reported that the integrated farmers from Sahibganj and Pakur districts of Jharkhand have a low level of education, and the majority of them were small and marginal farmers.

Nageswaran et al. [22] concluded that the plurality of the IFS practicing farmers (47.3 percent) was marginal (having land below 2.5 acres) and most of the rest were small farmers (land below 2.5 to 5.0 acres). The rest of the farmers (27.80%) were counted as large farmers (more than 5.0 acres of land). Studies conducted by Bhalerao et al. [23] indicated that the middle-aged farmers of Konkan who had medium family size and high school education had been mainly doing livestock-oriented farming most had a medium level of farming experience.

Small and marginal farmers are less capable of engaging themselves in IFS activities due to capital constraints. The literacy level, annual income, and farm size also low among the

farmers practicing IFS. But the authors are hopeful that the young people are coming towards the farming business.

4.3 Productivity and Profitability of IFS

Shukla and Tripathi [24] conducted a study based on crop-based farming's economic and employment performance both on farmers' fields and KVK center. Then they compared these results with fishery-based integrated farming at KVK Chitrakoot on a 2.5-acre plot. The crop-based gross income was Rs. 107,264/- with a B:C ratio of 2.16, the average gross income from farmers' fields was Rs 82,228/- with a B:C ratio of 2.60. The result of fishery-based farming was a gross income of Rs.458,659 with a B:C ratio of 2.95. The profitability of the fishery-based farming system was much better than that of crop-based farming both at KVK and in the farmers' own fields. The fishery-based integrated farming system provides more employment opportunities to rural people. 512 people got employment feeding fish and mushroom, fruits and vegetable cultivation, as well as by harvesting and marketing products and fish production. About 100 rural people also got the seasonal job in association with this type of fishery-based integrated farming. Crop-based farming at KVK created 197 man-days employment, and in farmers' fields, employment creation was 172-195 man-days in a year. The net income was about Rs. 236,983/- higher than the crop-based farming at KVK, farm and Rs.242,843/- more than in the farmer's field in terms of net income.

Yadav et al. [25] studied the impact of an integrated farming system on farm income. Most farmers in their study area practiced limited integration of farming enterprises. Still, all types of integrated farming system combinations were more profitable than existing farming practices. The farmers' net income was increased by maintained crop + livestock + fish integration. The farmers who want more income and to escape from poverty will target the integration of more enterprises on their farms, including crops, livestock, fisheries, apiculture, and even biogas.

Mitra et al. [26] observed that the IFS model fish culture + duck farming + azolla + pulses, generated three times more income (Rs 138,673/yr) compared with conventional agriculture (Rs 45,320/yr) and in a sustainable manner. The benefit-cost ratio in the IFS model is 2.28 compared to the traditional model (1.14).

Khalid et al. [17] results focused on Gross Margin from different integration types. The highest gross margins were obtained by full integration (Crop-livestock-poultry-vegetable): \$1,156.57. The lowest gross margin was obtained by partial integration (Crop-Livestock-poultry): \$ 994.80.

Kashyap et al. [27] noticed that crop-component enterprise was most prevalent in the beginning years of IFS and gave the highest income. As the years progressed, the sizeable contribution of dairy, goats, and horticulture to income increased. In addition to it, value addition started generating revenue. As diversification increased, income increased and reduced the dependency on a single product.

Vinodakumar et al. [28] reported that IFS model crop + goat + cow + poultry + fishery gave higher net returns (Rs 189,069/ha/yr compared to conventional cotton alone 74,552.0/ha/yr), which was 2.5 times better with the IFS system. It may be due to the inclusion of livestock components in the system, which generated regular income for the farmer.

Mukherjee [29] reported that, in the mid-hill regions of West Bengal, India, farming systems involving crop + poultry + dairy + piggery enterprises had a positive advantage in terms of economic returns. They had high gross income (Rs. 101482/ha), net returns (Rs. 24935/ha), and sustainability (88.5%) in comparison with the crop-alone component (gross income Rs. 57589/ha, net returns Rs. 14002/ha and sustainability index 44.8%). This is because of good management and no extra attention needed for a dairy component in IFS. In the IFS model, returns on investment were high and very much suitable to West Bengal's mid-hill region.

Manjunatha et al. [30] reported that, in Tamil Nadu, the IFS increased net return an average of Rs 31,807/ha/year over arable farming (Rs 19,505/ha/year). In Goa, when coconut was integrated with crop, vegetables, mushroom, poultry, and dairy incomes were enhanced Rs 17,518/ha/annum over cashew nut cultivation alone. In Madhya Pradesh, integrated farming gave a net return of Rs 17,198/ ha/year over arable farming. In Uttar Pradesh, the average enhancement in return was Rs 45,736/ha/annum over the existing crop-based farming system.

Singh et al. [18] 2014 stated PAU awardee farmers had practiced different integrated farming systems like crop + dairy, crop + floriculture, crop + fruits, crop + poultry, crops +

vegetable, crops + beekeeping etc. From his study, it was found that the highest number of respondents i.e. 76.77% had crop + dairy farming system, 5% followed crop + poultry, 11.67% had crops + beekeeping, 3.33% had crop + forestry, 16.67% had crops + fruits, and 8.33% had crops + floriculture farming system. Among all the farming systems, crops + floriculture was the most profitable system with the highest net returns of Rs. 91,824 and crops + poultry was the least profitable farming system with net returns Rs. 58,057.

According to Ansari et al. [31] on an average, 299 man-days were utilized under IIFS (Improved Integrated Farming System) as compared to 211 man-days under CFS (Conventional Farming System). Moreover, women's participation was greater (45.5% in IIFS, 24.9% in CFS) as compared to men's (36% in IIFS, 33% in CFS). Backyard poultry, followed by pig rearing, were the top enterprises engaging the household men and women for the longest duration. Thus, integrated farming was found suitable for ensuring sustainable livelihoods for North-Eastern people.

Singh et al. [32] did integrated farming (IFS) comprising crops, dairy, fishery, horticulture, and apiary at Modipuram, Meerut, Uttar Pradesh. The relative share of the different components in the order of merit was from dairy (48%), crop (41%), horticulture (6%) followed by fish (3.0%), and apiary (2%). The net returns obtained from these components were Rs. 87,029, Rs. 74,435, Rs.10,263, Rs. 4,947, Rs.4,204, respectively, of which total return from IFS unit per year (1.4 ha) was Rs.135,826. Efficient nutrient recycling made the model sustainable and eco-friendly.

Jagadeeshwara et al. [33] reported that the productivity of IFS was 26.3 percent higher than the conventional system. Among the various components, the productivity was maximum in crop yield (46.32 percent), closely followed by horticulture (16.77 percent), dairy (42.26 percent), and piggery (8.07 percent) in the southern Karnataka state. Poorani et al. [34] reported that the IFS increased the productivity, profitability, employment generation by 48, 40 and 45 per cent, respectively, over the existing conventional farming system in Palladam district of Western Zone of Tamil Nadu.

Panke et al. [35] put forward that integration should be done in such a way that the output of one element should be used as the input for the

other component in the system, with a high level of complementary effects. He concluded that the rationale behind IFS is to reduce the waste from the various sub-systems operating on the farm and consequently, it will generate employment opportunities, nutritional improved and increased earnings for the rural poor.

Alam et al. [36] suggested that integrated farming with poultry, fish, and crops can play a vital role in increasing manifold production, income, and nutrition and employment opportunities of the rural population. The overall result showed that integrated pond management with poultry, fish, and vegetables was an excellent example for sustainable production, income generation, and employment opportunities for the resource-poor rural farm families.

Jayanthi [37] concluded that integrated farming systems for different conditions enhanced farm productivity, profitability, and nutritional security. IFS could maintain soil fertility and productivity by recycling organic waste (of involved enterprises) as essential plant nutrients. Under the traditional cropping system, the mean maize grain equivalent yield was about 23,542 kg/ha/year. Under an integrated farming system, the maize grain equivalent yield was about 56,885 kg/ha/year. The net income increased under an integrated farming system as compared to the traditional cropping system because of in situ recycling of resources in the integrated farming system. The net return from the addition of linked enterprises under the integrated farming system is about Rs 150,000/ha/year, and the increased income was about 43.6 % over traditional cropping systems. Integrated farming system (involving cropping system and dairy) generated more working days of employment compared with the traditional cropping system. Traditional cropping system generated 62 man-days/ha/year. At the same time, the different cropping systems under the integrated farming system generated 122 man- days/ha/year. A maximum of 457 man- days/ha/year was generated from animal components in an integrated farming system.

Nageswaran et al. [22] reported the average annual net revenue per acre of IFS was more than 2.5 times than that of CFS in Cuddalore district of Tamil Nadu. And also in the event of failure of any crop due to delay or heavy rainfall, other enterprises in IFS would tend to compensate, which is absent in conventional farming.

Mangla [38] investigated IFS and found that the agricultural occupation was increased from 89.30 percent to 94.30 percent after the implementation of IFS program activities. The findings also indicated that financial supports might be augmented with technical assistance and guidance for improving the standard of living of rural families. The comprehensive goal of the IFS program was to create income-generating opportunities for reducing poverty through the utilization of natural resources in an improved and sustainable manner.

The benefits of an integrated farm management system cannot be overemphasized but at least the integrated farming system is helpful in decreasing the cost of production, increasing income and productivity-Ugwumba & Orji [39]; Tokrishna [40].

Patel and Dutta [41] found that efficient integration of field crops with animals like cows, fish, goats, buffaloes, sheep, etc.; birds (poultry, pigeon, duck), multi-purpose trees, horticulture, and agro-forestry systems, and other enterprises (bio-gas, apiary, mushroom etc.) clearly demonstrated the benefits over traditional cropping system, under irrigated and rainfed and dryland conditions, as well as in hilly areas.

Several review studies conducted by Radhamani et al. [2] on the economic viability of IFS indicated that the activities of IFS positively influence them. Bosma et al. [42] and Phong et al. [43] concluded that the farmers who have transformed their rice monoculture to rice-based farming systems such as rice, livestock, upland crops, and fisheries on the same farm, enabling better use of farm resources, and by that improving farm income as well as protecting the environment.

Keith et al. [44] explained the impact of Zimbabwean and South African agricultural policies issues and investment strategies. The author has found significant differences in resource utilization, policy supports and market situations in the small and commercial sector in both the countries and, thereby, different policies and investment strategies on agricultural productivity. Chang and Zepeda [45] investigated the trends in agricultural development and productivity gain in Asia and the Pacific region and described a means to attain sustainable food security in the region. They also interpreted the relative significance of various factors in determining a country's success in agriculture

and gave special attention to the role of investment in the area of physical and human capital resources in increasing agricultural productivity.

The above facts make it clear that transforming from monoculture to IFS often productive and sustainable. Integration of allied components with cropping consistently producing maximum net returns, enabling waste recycling, and ensuring year-round nutritional security among the farming communities.

4.4 Problems of IFS

Uddin et al. [19] computed CFI (Constraints Facing Index) of 15 constraints, which ranged from 70 to 276 for integrated farming and 130 to 334 for mixed farming. The majority of the farmers mentioned that low prices for outputs, non-availability and high price of HYV (High Yielding Variety) seed and scarcity of concentrate feed and fodder are the serious problems in the study areas. The computed values of CFI were 276, 264, and 235 for integrated farming and, for mixed farming, 334, 295, and 28, respectively.

According to Devendra [8], dairy goats are generally neglected in development programs, although they are particularly important in some countries. Continuous demand for milk fuels the spread and intensification of smallholder dairy production. However, this demand is associated with difficulties in milk handling and distribution, problems in maintaining hygiene and environmental pollution. The major constraints faced by the producers are, inter alia, choice of strains, breeds and availability of animals; fodder & feed resources as well as improved feeding systems; advanced breeding & reproduction, animal health care activities; management & maintenance of animal excreta; organized, functional marketing channels; and sufficient market outlets.

Pushpa [46] indicated that 86.19 percent of the respondents faced the most important constraint, was the lack of coordinated extension services. The second important constraint, faced by 80.95 percent of the respondents, was the lack of demonstration of the integrated farming system. The third important constraint was the lack of knowledge on the integration aspects of enterprises (67.62%). Lack of information on the type and size of enterprises to be included (55.24%) and lack of knowledge on effective

recycling of farm wastes (33.81%) were the other two constraints related to the third constraint. Inadequate credit facilities and 'lack of composite credit facilities' were reported as constraints by 67.62 and 49.52 percent of the respondents, respectively.

According to Poorani et al. [34] studies, the deficiency of fodder during the off-season was the main constraint in rearing livestock raised by the integrated farmers of Palladam district in the Western Zones of Tamil Nadu.

Kadam et al. [47] listed the constraints of IFS as expensive concentrated animal feed; and unavailable green fodder (40 percent); 30 per cent of the respondents complained of shortage of adequate market facilities and absence of cooperative societies; 20%, 6% and 4% of the respondents included limited scientific knowledge in animal rearing, unavailability of advanced breeds in the local markets and insufficient financial support, respectively, as the major constraints in practicing IFS.

Thamrongwarangkul [48] reported that resource-poor farmers could not invest more capital initially as a constraint since they then need immediate economic returns to meet their food requirements and pay the cost of their families' schools, medical treatments, and loan-repayment. Tipraqsa et al. [49] concluded that high start-up costs might constrain farmers from switching to integrated farming and from exploiting the benefits of resource integration.

BARC [50] reported that less organic matter in the soil is one of the major causes of soil fertility depletion in Bangladesh. Such depletion is occurring due to continuous intensive cropping without proper soil reclamation practices.

Therefore, it could be concluded from the above discussion that lack of marketing of products, high initial costs, lack of coordinated extension services, cooperative systems, lack of HYV and potential animal breeds, lack of storing and processing are considered the significant IFS problems.

4.5 Suggestions to Improve IFS

Suggestions summarised by the Vision [51] set as a goal the integration of mono-crop farms with agro-forestry, fisheries and animal husbandry as a significant components for the better utilisation of resources, enhancing farm household income

and family maintenance security of the farmers. Vision [52] suggested that integrated fish farming is a diversified and coordinated system of producing fish and agriculture/livestock produce in fish farms. Fish is the main component and agriculture/livestock are sub-components. Such integration ensures maximum utilization of water/land through the recycling of waste and by-products, minimum application of fertilizers and feeds, and maintenance of a sustained ecosystem.

Uddin et al [19] made some important policy recommendations for support of integrated farming: i. special incentives from the Department of Agricultural Extension (DAE) for irrigation and fertilizer for small and marginal farmers to enhance their productivity and profitability. ii. Department of Fisheries (DoF) should monitor seed and feed company/hatcheries to ensure good quality fingerlings; iii. Department of Livestock Services (DLS) at convenient times at village level should ensure veterinary services for dairy cattle and poultry birds, and iv. Training programs on production technologies, harvesting, processing, storage, and transportation should be offered by different institutes so that farmers can be skilled at raising field crops, livestock production, and fish culture as well

Walia and Kaur [53] stated that sustainable development in agriculture must include an IFS with efficient soil, water crop, and pest management practices. Such a policy is environmentally friendly and cost-effective.

Devendra [8] suggested a holistic approach, comprising interdisciplinary- research and development along with integrated natural resource management. An intensive focus is also needed in a shared partnership between farmers and scientists, which can help to increase productivity and sustain production systems.

Pushpa [46] suggested that integrated farming system demonstration centers should be established in all districts so that potential farmers can easily visit them and be persuaded of the benefits of an integrated strategy. He suggests that lack of knowledge of integration could be easily addressed by organizing suitable training programmes on IFS and educating the farmers.

Promoting IFS research, establishing IFS models in villages, developing marketing and cooperative

systems, enhancing extension services, appropriate governmental policies, easy credit disbursements, farmers' training are important initiatives to improve IFS.

5. CONCLUSIONS

Integrated farming systems (IFSs) are well-known for their sustainability and profitability all over the world. IFSs should be considered for widespread adoption by small and marginal farmers. They need to be shown why it is challenging for them to meet their food and other basic requirements in single-product farms. Reduced size of land holdings and continuous non-integrated agriculture is slowly decreasing farm income. To maintain farm income, it is essential to integrate the various agriculture components i.e., crops, dairy, fisheries, poultry, mushrooms, horticulture, sericulture, etc. in a single farm unit.

IFS is a holistic approach and considers interactions among the different IFS components and the environment. IFS is also a unique system in waste recycling: nothing is wasted, the by-product or waste of one system becomes the input for the other systems. In an IFS farm, labor-intensive enterprises like dairy, poultry, fruits, vegetables, sericulture, mushrooms, etc. can increase employment generation (man-days), especially for family labor. Besides, expenditure on external inputs will be decreased.

So, in a nutshell, IFS is viable economically and ecologically. However, this system is facing several problems at the field level of implementation. High initial cost, lack of marketing, credit unavailability, lack of storage and processing facilities are the major ones. Market infrastructure is needed. The nationalized banks need to simplify their loan procedures and reach out to IFS farmers with a view toward supporting them. IFS model demonstrations, incentives for irrigation and fertilizer for improving IFSs need to be provided. Various institutions could provide manufacturing, storage, distribution, and transportation programs to improve and sustain integrated farming systems.

Suppose IFS is a good system that can address issues like rural poverty, environmental degradation and making the farm family sustainable in a world of agricultural corporatization. In that case, IFS should not merely be available. Society should take an

affirmative decision to promote IFS and assist those who are willing to try to make it work.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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