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Review Article

Integrated Farming Systems: A tool for Doubling Farmer's Income

ABSTRACT

There are 115 million working farms in India, with about 80% of them being small or marginal farmers. Due to an ever-increasing population, the country's land supply is becoming increasingly scarcer per person, leaving little room for horizontal agricultural expansion. There are many advantages to integrated farming systems (IFS), such as a more efficient use of farm resources and a more eco-friendly strategy to farming. As a system of crop and livestock farming, IFS consists of at least two distinct but logically interdependent parts. Water efficiency, weed and pest control, and soil health can all be improved with IFS. It also helps to maintain water quality. Chemical fertilisers weed killers, and pesticides should be used sparingly in an integrated farming system in order to protect the environment from their harmful effects. Adopting an Integrated Farming System (IFS) ensures a stable and long-term source of farm income by integrating a number of businesses to make the most of the land's natural resources. IFS itself is important for sustainable development of farmer by improving yield, economic return, employment generation, nutritional security and livelihood.

Keywords: Economic Returns, Integrated Farming System, Nutritional Security, Sustainability.

1. INTRODUCTION

1370 million people will be in our country by 2030, and 1600 million by 2050. We'll need to produce 289 and 349 MT of food grains each of those times in order to meet future demand. By 2030, the country's current situation predicts a further reduction of cultivable land, with more than 20% of it being used for non-agricultural purposes [1]. Due to the fact that 80 percent of Indian farm families fall into the small- and marginal-farmer categories, the challenge is made all the more difficult by the shrinking average farm size and the accompanying financial restrictions on increasing agricultural investment. Increasing agricultural productivity could be a key factor in securing food and nutrition security for a large population. Adopting scientific agronomic practises and technologies to boost the productivity of traditional agricultural systems is a necessary part of this process. Unsustainable farming practises pollute the environment and endanger the livelihoods of millions of small farm holders. An important step in boosting income, food supply, and food and nutritional security in developing countries is expanding agricultural production systems in order to achieve greater sustainability and higher economic returns [2]. One of the most effective solutions for small and marginal farmers is the Integrated Farming System (IFS). By integrating multiple farm businesses and recycling crop residues and by-products on the farm, IFS hopes to increase farm employment and income. Farmers must be guaranteed a steady stream of income in order to raise their standard of living above the poverty line. To meet the challenges posed by the current economic, political, and technological environment, progress in production or steady growth in output is required. An important solution to this peculiar situation is the farming system approach, which takes into account the resources available and develops site-specific systems based on those resources, resulting in long-term development [3]. Using an IFS system, the "waste" from one component is used as an input to another component, which reduces costs and improves production or income for farmers. According

to IFS, the by-products of one type of agriculture can be repurposed as a resource for a different type. Because it makes use of wastes as resources, it not only reduces waste but also boosts the productivity of the entire farm [4]. Integrated Farming Systems (IFS) is a collection of resource-saving techniques aimed at maximising profitability and productivity, while simultaneously minimising any negative consequences of intensive farming and preserving the environment [5] [6]. The ever-increasing needs of India's ever-increasing population can be met with relative ease under the current conditions. Agriculture and its related sector, such as livestock farming, horticulture, and floriculture, as well as aquaculture, have been influenced by small and marginal farmers in India, which is unfortunate. In order to meet the demand, they seem unable to invest more capital in more intensive agricultural operations. If they want to maximise their profit and production in order to meet the nutritional needs of their customers while also providing food security, an Integrated Farming System (IFS) is essential. IFS also makes it easier for farmers to produce more by maximising resource utilisation, recycling waste, and hiring members of their own households to do the work. Agro-ecological balance is attained by maximising the yields of all component businesses, reducing the use of chemicals (fertilisers and pesticides), keeping insect-pest, disease, and plant weed populations at a low level of intensity through natural cropping system management, and all four of these objectives are addressed by IFS [7]. Through multiple enterprises that aim to maximise the utilisation of available natural resources to meet family needs, an Integrated Farming System can ensure long-term farm income stability and sustainability. This program's goal is to generate enough farm income to keep the farm family interested in farming and keep them from leaving the industry. It is imperative that IFS models be developed based on local agro-climatic conditions and holding sizes, as well as the availability of resources such as land, water, zand labour, marketing facilities, risk factors and family size. Because of the ecosystem (rain-fed/irrigated), management ability, and the surrounding socio-economic factors, the profit margin varies widely [8]. As a result, it is imperative that the IFS concept and knowledge be disseminated throughout the country's various agro-climatic regions in order to contribute to the national agenda of tripling farmers' incomes while also addressing the problem of malnutrition. IFS adoption must be aided through organisational, extension, policy, and marketing initiatives in a structured manner.

1.1. NEED AND APPROACH FOR DIVERSIFICATION OF NATURAL SYSTEMS

Existing cropping/farming systems need to be rebalanced in order to keep up with the ever-increasing demand for food as well as the preservation of agro-ecosystems. System yields can be improved while profits are increased through diversification. It is also a "highly location specific approach that involves suitable combination of complementary farm enterprises, such as cropping systems, livestock fisheries, forests, poultry, and the method possible towards the farmers to raise them for profitability." Comprehensive and innovative farming systems appear powerful tools for increasing farm family income and employment opportunities. A holistic approach focuses on increasing the overall productivity of individual components, whereas an innovative approach focuses on increasing the profitability of established farming systems by introducing new components based on perceptions of the end user.

1.2. INTEGRATED FARMING SYSTEM APPROACH AND ITS OBJECTIVES

IFS approach can be described as “A judicious mix of two or more components using cardinal principles of minimum competition and maximum complementarity with advanced agronomic management tools aiming for sustainable and environment friendly improvement of farm income, family nutrition and ecosystem services”. The farming systems strategy depends on preserving biodiversity, diversifying cropping systems, and recycling as much waste as possible [9]. Agriculture is a system in which the following goals are pursued:

- Systems involving rural communities are essential to the long-term advancement of the farmhouse.
- An integrated approach is needed to deal with the issues and problems that are emerging in India's farming sector.
- The most effective tool for increasing profitability of farming methods, particularly for small and marginal farmers, is the integrated agricultural systems approach. In fact, our previous experience has shown that the earnings from cropping itself is not adequate to meet the requirements of growers.
- Farmers' needs for cash to raise their standard of living have improved as a result of growing consumer spending in remote regions. Secondary and tertiary enterprises, such as livestock, fruit, flower, and medicinal plant cultivation, apiary, and fisheries, had to be adopted by farmers to supplement their income and food needs.
- But these integrated farming systems will have to be tailored and designed in a way that leads to substantial improvements of energy efficiency on the farm and maximises synergies

through the surrogacy of close cycles. Social acceptability, environmental friendliness, and economic viability are all requirements for these systems by;

- Improving agricultural production systems by enhancing input efficiency
- Apart from nutritional improvement sustaining the basic necessities of farm families
- Increasing the family's income by making the most efficient use of available resources and recycling waste properly

1.3. PROBLEMS OF PRESENT AGRICULTURE

- The growth rate of agriculture remains static or declining
- Food production is not sustainable to feed the future generation
- Increasing malnutrition in young children and pregnant women
- Shrinking net cultivable area due to rapid urbanization
- Aggravating environmental pollution and greenhouse gases
- Ground water table depletion due to indiscriminate use
- Shrinkage in land holdings due to increasing population
- Increment in cost of production due to shortage of feed/fodder
- Low income farms due to conventional practices
- Increasing unemployment due practicing monoculture
- Large-scale migration has created problems for farm workers.

1.4. Objectives of Integrated Farming System:

- Maintaining a steady and consistent income year round is a primary goal.
- Assuring agro-ecological equilibrium through the restoration or improvement of system productivity
- To keep away the insect-pests, diseases and weed population through natural cropping system management and keep them at low level of intensity.
- In order to provide society with healthy food and a clean environment, it is necessary to reduce the use of chemicals.
- Organic foods can be produced which more are demanding in present time.

1.5. Advantages of Integrated Farming System:

- Economic yield for every unit area per time increases as a result of the increased productivity of the farm
- Reduced costs production due to recycling of wastes leading to improved profitability.
- More economically significant components are being integrated and/or incorporated into farm production, resulting in improved sustainability.
- Integration of different farm components provides an opportunity to solve malnutrition problem as variety of food products are produced.
- Organic food production can be practiced in IFS.
- Farmers have easy access to diverse foods.
- Recycling of farm wastes for production helps in better waste management and prevents environmental pollution.
- Cash flow to the farmer round the year in integrated farming system makes the resource poor farmers to establish in the society.
- Chemical fertilizer application can be reduced by recycling of organic wastes which will also improve soil health.
- Through IFS household energy requirement can be met by biogas production, which will not escalate energy crises
- Fodder crises for livestock can be solved to some extent through incorporation of fodder/pasture/tree species in the farming system.
- In the system, the silvi-component serves as a source of fuel and timber.
- Increased timber production decreases the pressure on forest resources.
- Diversity in components rather than monoculture could provide wider opportunity for year-round employment of farm labour.
- It provides opportunity for the growth of agri-oriented industries.
- In general, IFS benefits farmers by increasing their standard of living and thereby contributing to their socioeconomic advancement.

1.6. Table 1: Components in IFS:

Agriculture	Mushroom cultivation	Goat /Sheep rearing
Fish farming	Sericulture	Nursery

Horticulture	Azolla farming	Duck rearing
Vermiculture	Dairy	Seed Production
Forestry	Rabbitery	Value addition
Pigeon rearing	Poultry	Feed mill
Apiary	Fodder production	Vegetable production

1.7. Goals of Integrated Farming System:

IFS has four main objectives:

- In order to maintain a steady and stable income, all component enterprises must be maximised in terms of their yields.
- Renewed/improved system productivity to attain agro-ecological balance.
- The management of natural cropping systems can be used to regulate the build-up of insect-pests, pathogens, and weed populations.
- Environmentally-friendly, pollution-free food and produce can be produced without the use of harmful agro-chemicals and pesticides if they are used less frequently.

1.8. Principles of FSR:

FSR is based on the following basic principles**:**

1. Increase the self-sufficiency of the farm household and the farm's resistance to external forces.
2. Diversification of enterprises to increase income, work opportunities, reducing risk, and enhancement of natural resources, the environment, and the diets of farm families.
3. It is necessary to investigate the synergy among interacting components and their interactions with each other.

2. Concept of Integrated farming system:

Mixed farming system (IFS): a crop and livestock operation divided into at least two separate but rationally interdependent parts. It is possible to increase farm productivity and profitability by creating a combination of farm businesses where farm owners define resources for the efficient use of the actual businesses. Crop, agroforestry, livestock, aquaculture, agri-horticulture, and sericulture are some of the farm enterprises [10]. International Food Systems (IFS) is a component of farming systems that considers increasing production, minimising risk, and maximising profits while improving the utilisation of organic wastes and crop residues in the field. According to Jayanthi [11], IFS is part of FRS (Farming System Research), which is concerned with transforming farming techniques to increase crop production and ensuring excellent resource utilisation. When integrating, it's important that the output of one enterprise or component serves as an input for the output of another enterprise or component, which has a significant level of complementarity impacts. Another reason for IFS's success would be that it enhances work opportunities, nutrition, and economic opportunities for rural people by reducing waste from different farming sub systems. It is a concept that encompasses the economic, ecologic, and social aspects of farming, as well as ensuring the long-term viability of productive farming landscapes [12]. Using a wide range of insights and farming models, an integrated farming approach aims to grow more food (for profit) while also delivering environmental and social benefits [13][14]. To put it another way, the integrated mixed farming system (IFS) was defined by Bahire [15] as a practise of raising a variety of independent but interdependent enterprises.

3. Benefits of IFS

3.1. IFS IN LIVELIHOOD DEVELOPMENT

According to Sheikh [16], IFS is the primary source of income for approximately 65 percent of rural populations who are reliant on agriculture. IFS is a holistic approach and considers interactions among the different component of IFS. SIFS (Specialized Integrated Farming System) is made up of four parts: basal crops, medium-duration cash crops, short-term cash crops, and value-added crops. Contracts between expert yield and domesticated animals, poultry makers for the exchange of compost and less significantly, the feed can be an instrument to build the appropriation pace of incorporated cultivating [17]. A rise in non-farm employment is also necessary to raise rural residents' incomes and living standards[16]. It is the integration of farm enterprises that a farming community assigns its resources to in order to maximise productivity and profitability of the farm through the effective utilization of available enterprises. Sustainable farming developments remain at the forefront

of global development practices, with small-holder farms erupting as a vital factor in creating long-term advancements in food security, enhanced nutrition, as well as economic growth. There are many ways to accomplish self-sustaining intensity and diversification in small farms, but the suggested model of IFS execution involves resource provisioning incorporation, within the larger rural context development, and overall improved consequences of sustainable livelihoods at the local level through an interconnected process-based approach to sustainable intensification as well as expansion in small farms [18]. Agricultural systems consider climate, soil, water, and crops; farm wastes include livestock and land; labour and capital; energy; as well as other resources; the farm family is at the heart of the system [19]. Growing farm productivity through diversification, resource integration, and access to markets, as noted by Rathore [8] is also beneficial to a sustainable life.

3.2. IFS TO IMPROVE SUSTAINABLE DEVELOPMENT

Farmers in dry and semi-arid areas are particularly concerned about farming's declining profitability. The IFS has a lot of potential for increasing profitability by lowering production costs and/or increasing productivity through the use of long-term management practises. When waste from one company is recycled and used as input by another, the IFS can reduce production costs [20] [21]. It can also reduce the amount of external inputs required [17] [22]. Agriculture is based on the idea of improving people's ability to manage change by developing their capacity to learn, how to learn, enhance problematic situations as well as communicate effectively, according to Meena [23]. Logical and systematic thinking as well as instinctive, inventive activity are encouraged in this method, which is based on experiential learning and the scientific method. Research into integrated systems takes into account the farm's various enterprises and resources, as well as the farm's cropping systems, in order to develop integrated farming systems that are sustainable. Due to climate change, yields in some regions are expected to rise and reduce in other areas, depending on the area's latitude as well as irrigation application. IFS focuses on agriculture's sustainability [24]. In order to increase agricultural productivity, manure from farm animals must be used to increase nutrients which enhance fertility of the soil and reduce the use of synthetic fertilizers, whereas crop residues can be fed to livestock [6]. It is possible for farm youth to make a regular income through IFS as a micro-business. A single component or a single crop-based business can lead to market fluctuations, so IFS minimises the incidence of failure. Lowering production costs per square foot by recycling farm residues is another advantage of IFS [25].

3.3. IFS TO IMPROVE NUTRITIONAL FOOD SECURITY

Since agriculture and the farmers who rely upon it have fallen into such disrepair, the people of the region need new farming methods, such as IFS and other high-yielding techniques, to help them feed themselves and their families. According to Patel [26], the most advantageous system for increasing the income of small and marginal farmers with secured livelihood and nutritional security is an integrated farming system with cropping system and other subsidiary livestock, boundary plantation, seasonable vegetables, horticultural crops, vermin compost and farm pond. Using integrated livestock-fish systems to dispose of manure from feed lot-type animal husbandry farms is expected to gain traction in India with the proliferation of such ventures, according to Khan [25]. Animal husbandry and fish farming will probably be developed on a large scale in India, where small-scale rural fish farming already exists. The addition of organic residues such as animal and plant wastes, according to Kumar [27], improves soil health and productivity over the long term while posing fewer environmental risks and increasing the profit margin. This system enables a long-term, profitable (3–6 fold) and highly agriculturally productive production system. Approximately 90–95 percent of dietary needs are met through resource recycling, which lowers the cost of production while increasing profit margins and the number of people employed in the agricultural industry. Consequently, the IFS approach is enticing and will preserve the resource base through effective recycling of residues and wastes inside the system, which is essential for food and nutritional security.

3.4. IFS FOR EMPLOYMENT GENERATION

Farmers saw an increase in gross revenue, net revenue, and the number of man days in a year because of the methods used by various farming systems. Murshed and Pems [28] and Sachinkumar [29] found similar results. Patel [26] predicted that Integrated Farming System would generate more jobs than a traditional farming system, according to their research. Initial research under the IFS approach advocated productivity gains of 30–50 percent and more than doubles the number of jobs than arable farming, depending on the number and type of enterprises and their maintenance. Higher level of complementarity is achieved by integrating in such a way that the output of one company can be used as the input for another. For small and marginal farmers, IFS is the best option. Not only does it help farm families be healthier and wealthier, but it also creates more jobs and makes better use of farm resources [30].

4. CHALLENGES AND OPPORTUNITIES TO INTEGRATED FARMING SYSTEM

The increasing cost of agricultural production coupled with issues of the World Trade Organization is threatening the existence of marginal and small farmers in India. Patra [31] admitted that one could imagine the survival of Indian agriculture, especially for small and marginal farmers through the adoption of Integrated Farming Systems (IFS) on scientific lines. Traditionally, farmers in India had been practicing an integrated system of farming. But, now there is a need to popularize scientific IFS models among farmers to tackle the present agricultural situation in India. However, success depends upon the understanding of input-input and product-product relationships. Farming as an integrated system has become less popular due to the many constraints faced by farmers. The constraints vary across different agro-climatic zones. The scientific interventions should be demonstrated by extension agencies to narrow down the limitations through enhancement of productivity and income. The efforts of the Government are also required to subsidize IFS models for achieving the target of doubling the farmers' income. The farmers are more vulnerable in selecting the right choices, owing to a misunderstanding on whether the two outputs have complementary, supplementary or competitive relationships. The pattern in developed nations has been toward rising agricultural specialisation, where crop and livestock enterprises are becoming progressively disconnected, despite the advantages of integrated farming [17][32]. Despite the dominance of mixed farming and animal systems in Australia, a shift to crop-only systems has occurred in recent decades. Relative crop and livestock prices, however, may play a role in slowing or reversing this trend [33]. Re-integration of agriculture in areas where it has become more specialised may necessitate additional capital investments, which may serve as an obstruction to the adoption of such systems. A decrease in agricultural labour supply or a rise in agricultural labour costs could put integrated systems at risk.

4.1. MAJOR CONSTRAINTS IN HILL AND MOUNTAIN AGRICULTURE

The major constraints in mountain agriculture are as follows:

- Mountain eco-systems are vulnerable.
- Due to the unique geomorphological, biological, and physical characteristics of mountainous regions, farming on terraced and sloping land masses with an in-appropriate land use pattern occurs.
- Farming methods that emphasise human labour rather than the use of machines.
- Scattered arable land holdings on hilly terrains.
- Natural resources can only be used to a limited extent.
- The socio-agro-economic environment is extremely sensitive to external pressures.
- Difficulty in mobility is aggravated by steep slopes and harsh conditions.
- The cost of transportation to mountainous regions is greater.
- There is a lack of agri-market infrastructure and poor access to markets.
- As a result of the remoteness of mountain regions, it is difficult to get access to better agricultural inputs and farm technology.
- There is a poor flow of dissemination of farm technology.
- Building and maintaining infrastructure is both time-consuming and costly.
- Food insecurity/malnutrition in mountain developing countries especially, South Asia, is aggravated by an increased fragility index, remoteness, and marginality.

5. FUTURE THRUST

The further thrust of IFS is:

- A database on farming systems must be created in relation to the various types of farming systems, infrastructure, economics, and sustainability.
- Farming systems with a range of holding sizes, as well as those that are more or less economically viable or widely accepted require the creation of new research modules.
- Refinement at a research station on a cultivator's field of the techniques developed there.
- Weather inclinations and climate threats must be anticipated and a contingency plan formulated to address them.
- Policy format must be prepared for planners' consideration for its large-scale promotion with minimal financial assistance either via short/medium/long term loans as well as other promotional benefits.

6. CONCLUSION

Small and marginal farmers have the best chance of success with an integrated farming system. Increased work opportunities and efficient use of farm resources lead to increased productivity for farm families as a result of integrated farming system. To ensure long-term viability and profitability of the agricultural production system, Integrated Farming System is essential. About 90% to 95% of a

plant's nutritional needs are met by recycling resources, which reduces cultivation costs and increases profitability. By adopting multiple farm enterprises, farmers can gain the substantial returns to sustain their livelihood. IFS offers low input costs for different farm enterprises leading to better returns and enhanced farm income.

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