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11. The Integrated Farming System in The Context of Agricultural Economics

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Abstract:

The Integrated Farming System (IFS) is a holistic agricultural approach that combines various farming enterprises and practices to promote sustainability, resource optimization, and diversified income sources. This chapter explores the economic dimensions of IFS by analyzing its advantages over conventional farming systems. By reviewing some research studies indicate that IFS enhances resource use efficiency, generates higher returns on investment, and provides substantial employment opportunities. It optimizes resource utilization through synergistic interactions among crops, livestock, and other components.

The diversification of income sources in IFS results in increased profitability and risk mitigation, while its focus on sustainability, resource recycling, and environmental conservation fosters a balanced and efficient agricultural system. Overall, IFS offers a comprehensive solution to enhance agricultural productivity, rural livelihoods, and environmental sustainability.

Keywords:

IFS, resource optimization, cost, return, employment generation.

11.1 Introduction:

Green revolution in India made the country self sufficient in food grain production. The present agricultural situation of country has witnessed substantial improvements in food production through intensive cultivation of a few crops. However, the dependence on a small number of crops has made farming unprofitable for farmers and un-sustainable for the ecosystem. Economic liberalization in the information technology and industrial sectors has generated new job opportunities, resulting in a shortage of labour in the agriculture sector.

As a result, farmers' attention has shifted to less labor-intensive agriculture enterprices. Unfortunately, the per capita income of individuals involved in agriculture sector is merely one-third of their counterparts in the industrial sector. The uneven distribution, fragmentation, and scattering of land holdings over region.

Approximately 45% of the total cultivable area is comprised of sub-divided and scattered farm holdings. This has severely impacted the food security specifically, of small and marginal farmers and has made farming a main reason for poverty.

From ancient times, Indian farmers have engaged in a diverse range of occupations, including farming, dairy, poultry, apiculture, sericulture *etc*. This combination guaranteed food security, soil health, and a sustainable way of life and act as complemements to each other.

In the present era of civilization the number of nuclear families increases and running a diverse enterprises on farm has become less practical and less viable. Therefore, maximizing crop yield becomes major challenges which achieved only by using advanced technology, further increasing productivity of sigle crop caused soil and environment degradation.

Apart from food crop humen being also depends on non-food crop for their survival. To address all this mentioned challenges faced in agriculture, the terminology known as "Integrated Farming System (IFS)" helps farm households in promptly raising their income.

Integrating more number of farm enterprices by farmers leads them towards achieving goal of higher yield and net income simultaneously with sustainable use of soil, environment and other resources**..** For small and marginal farmers, the challenge of boosting farm production is compounded by the need for substantial capital investment in intensive farming practices.

However, Integrated Farming Systems (IFS) offer a crucial solution by enabling increased productivity without the burden of high investments. Through strategic resource utilization, effective waste recycling, and the involvement of family labor, IFS emerges as a pivotal strategy. By treating waste as a valuable resource, IFS not only eliminates ecological waste but also significantly elevates farm productivity while concurrently curbing production costs.

11.2 Integrated Farming Systems: A Holistic Approach in Agricultural Economics:

"Integrated Farming Systems (IFS)"- A Holistic approach that integrates different farming enterprises and practices that promote diversification, sustainability, and the holistic well-being of farmers and the environment. IFS offer a solution by bringing together various components such as cultivation of crops, rearing of livestock, agroforestry, other allied activities (*i.e.,* fisheries), and utilization of other agricultural resources within a single farming system. In an Integrated Farming System, different components are interdependent and interact synergistically, creating a balanced ecosystem. This integrated approach not only ensures food and nutritional security but also promotes sustainable and resilient farming systems. It emphasizes the efficient utilization of resources, cost reduction, and income diversification.This holistic approach encompasses several key aspects:

A. **Resource Optimization**: IFS optimizes resource utilization and improves overall farm productivity. By integrating different components such as crops, livestock, or aquaculture, farmers can make efficient use of land, water, nutrients, and energy. This leads to higher yields, cost savings, and improved efficiency in agricultural production. By integrating different components, farmers can maximize resource efficiency and minimize wastage. For example, livestock can utilize crop residues or agricultural by-products as feed, while their manure can be used as organic fertilizer for crops. This resource optimization enhances productivity and reduces input costs.

B. **Income Diversification and Risk Management**: IFS provides farmers with multiple sources of income by combining different agricultural activities. By integrating crops, livestock, aquaculture, or agroforestry, farmers can generate revenue from various products and markets. Income diversification reduces dependence on a single commodity, mitigate risks associated with market fluctuations, climate variability, or pest outbreaks and enhances the economic stability of farming households.

C. **Synergistic Interactions**: The integration of different components in IFS creates synergistic interactions. For example, livestock can contribute to nutrient cycling by grazing on cover crops or agricultural residues, which helps improve soil fertility. Agroforestry systems can provide shade and windbreaks for crops, while trees contribute to carbon sequestration and biodiversity conservation. These synergies enhance overall farm productivity, sustainability, and ecological balance.

D. **Environmental Conservation and Biodiversity:** IFS contributes to environmental conservation and biodiversity preservation. By integrating trees, hedgerows, or agroforestry practices, IFS enhances habitat diversity, provides shelter for beneficial insects and birds, and promotes natural pest control. Additionally, IFS reduces soil erosion, enhances water quality, and contribute to climate change mitigation and adaptation by sequestering carbon and enhancing resilience to extreme weather events.

E. **Market Opportunities and Value Addition:** IFS offers opportunities for value addition and market diversification. Integration of livestock, fish, or horticultural crops with conventional farming allows farmers to tap into different market segments, catering to diverse consumer demands. Value-added products such as organic produce, agroforestry-based timber or medicinal plants, and niche market products can f *etc*h higher prices, increasing farm profitability.

F. **Social and Economic Benefits**: IFS has social and economic benefits for farmers and rural communities. It creates opportunities for employment, especially in activities like livestock rearing, aquaculture, or value-added processing. IFS practices often involve knowledge sharing, cooperative farming, and community-based initiatives, fostering social cohesion and participatory development. Moreover, the economic benefits from IFS, such as income diversification and improved profitability, contribute to rural livelihoods and overall agricultural development.

G. **Policy Support and Institutional Integration**: Governments and institutions play a crucial role in promoting IFS through supportive policies, financial incentives, technical assistance, and research collaboration. Effective policies and institutional integration facilitate the adoption and scaling up of IFS practices. They provide farmers with the necessary resources, knowledge, and market linkages to implement IFS successfully.

By considering the interrelationships between different components and practices, IFS provides a comprehensive and sustainable approach to agricultural economics. It recognizes the complexity of agricultural systems and seeks to optimize resource utilization, diversify income streams, conserve the environment, and improve the socio-economic well-being of farmers and rural communities.

11.3 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
- Adoption of natural cropping system management and reduce intensity of insect-pests, diseases severity and weed
- Reduction in the use of chemical-based inputs in order to provide society with healthy food and a clean environment.
- Producing Organic foods which more are demanding in present time by adopting Integrated Farming System

Factors determining implementation of Integrated Farming System

- Soil and climate
- Availability of the resources, land labor and capital *etc.*
- Present level of resources being used
- Economic aspects of implementing integrated farming system
- Resource management skill of farmer

11.4 Components of Integrated Farming System:

The components of integrated farming system can be divided into four major categories:

Sr. No.	Category	Items
A	Agri-Horti Crops	Cereal crops, pulse crop, oilseed crops, fruits and vegetables, spices, medicinal and plantation crops, flowers, fibre crops, forage crops, other commercial crops *etc*
B	Animal Husbandary	Cattle, buffalo,goat, sheep, pig, chicken *etc*
C	Aquaculture/Fishery	Fish production
D	Other categories	Food processing, Apiculture, Sericulture, Vermicompost production, mushroom cultivation, , biogas production *etc*

*Certainly, an integrated farming system can be created by combining various components such as plants (A), animals (B), aquaculture (C), and other sustainable practices (D).

By exploring combinations like A+B, A+C, B+C, A+D and more complex combinations (like B+D, C+D, A+B+C, A+B+D, A+C+D, B+C+D A+B+C+D), a comprehensive and efficient farming approach can be established to enhance productivity and sustainability.

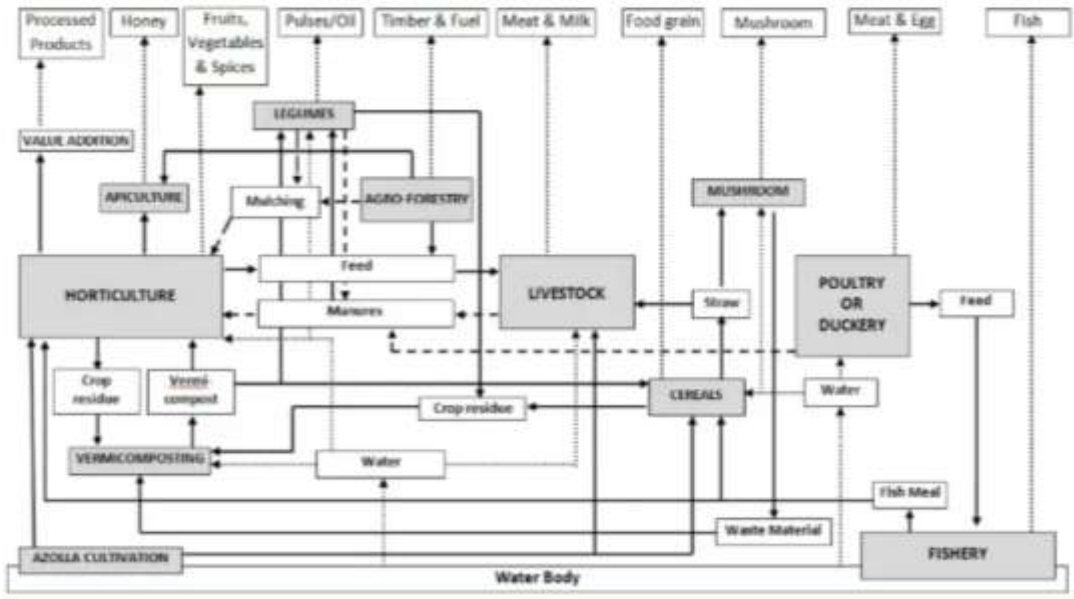

Figure 11.1: Conceptual framework of IFS by integrating various components

(Source: Roy *et al.*, 2014)

Integrated Farming Systems based on different enterprises.

The potential of various IFS in enhancing economic returns and sustainability through diversified enterprise integration.

Table 11.1: Types of Integrated Farming Systems based on different enterprises

Sr. No.	Type of IFS
1	Crop-livestockfarming system (CLFS)
2	Crop-livestock-fish farming system (CLFFS)
3	Crop-livestock-poultry-fish farming system (CLPFFS)
4	Crop-poultry-fish-mushroom farming system(CPFMFS)
5	Crop-fish – poultry farming system(CFPFS)
6	Crop-livestock-fish-vermicomposting farming system (CLFVFS)
7	Crop-livestock-forestry farming system(CLFFS)
8	Agri-silvi-horticulture system (ASHS)

(Source: Integrated farming system: Need, methods and components (agrotexglobal.com))

11.5 Advantages of Integrated Farming Systems (IFS):

- **Productivity:** IFS enhances crop and allied enterprises, leading to better space utilization and increased economic productivity over time. Soil fertility and structure improve through the use of cover crops and organic compost. Crop rotation reduces issues like weeds, pests, and diseases, revitalizing system productivity.
- **Profitability:** IFS reduces operational costs by utilizing waste materials from one enterprise as inputs for another, improving the benefit-to-cost ratio.
- **Sustainability:** By incorporating by-products from different components, IFS sustains soil fertility and production potential over extended periods. Ecosystem sustainability is promoted by avoiding deforestation.
- **Employment Generation:** Combining agriculture and livestock enterprises creates higher labor demand and more employment opportunities.
- **Agro-industries:** IFS's high agricultural output fosters the growth of agro-industries and agricultural businesses.
- **Input Efficiency:** Dependency on external inputs like fertilizers and agrochemicals decreases, enhancing input efficiency.
- **Year-round Income:** Multiple enterprises within IFS ensure a steady income throughout the year, positively impacting farmers' quality of life.
- **Diverse Food Production:**IFS enables diversified product output, ensuring the availability of various sources of nutrition and achieving food security.
- **Environmental Safety:** IFS minimizes pollution and maintains agroecological balance by effectively recycling waste materials through appropriate integration.
- **Resource Recycling:** Crop residues, livestock waste, and unused resources are efficiently recycled in IFS.
- **Adoption of Technology:** Increased profits from IFS enable farmers to afford and implement new technologies.
- **Energy Savings:** IFS reduces reliance on fossil fuels by providing alternative energy sources as byproducts, such as biogas.
- **Fodder, Fuel and Timber Production:**Perennial legume fodder trees grown on farm boundaries fix nitrogen and provide quality animal fodder. IFS produces fuel and industrial wood, curbing deforestation and aiding ecosystem preservation.
- **Water Management:**IFS can include techniques like agroforestry and contour farming that help in better water management and soil erosion control.
- **Biodiversity Enhancement**: The diverse components of IFS create a more varied habitat, promoting biodiversity and supporting beneficial insects and wildlife.
- **Risk Reduction**: With multiple enterprises, farmers are less vulnerable to market fluctuations or crop failures, reducing overall risk.
- **Climate Resilience**: The variety of enterprises in IFS can contribute to climate resilience, as different components may respond differently to changing climate conditions.
- **Soil Health Improvement**: The organic practices in IFS, such as composting and cover cropping, contribute to improved soil health and structure.
- **Reduced Chemical Dependency**: By minimizing the use of agrochemicals, IFS reduces chemical dependency, benefiting both the environment and human health.

- **Resource Optimization**: IFS optimizes the use of available resources, making the most out of land, water, and other inputs.

Overall, this holistic approach of Integrated farming contributes to a more balanced, efficient, and interconnected agricultural system.

Comparison between Integrated Farming System (IFS) and Conventional Farming System (CFS):

Conventional farming system (CFS) refers to the traditional approach of farming where individual components, such as crops or livestock, are managed separately without much integration. Comparative Analysis of IFS and CFS is given in Table 11.2 with special reference to agricultural economics.

Table 11.2: Comparative Analysis of Integrated Farming System (IFS) and Conventional Farming System (CFS) in Agricultural Economics:

Factors	**Integrated Farming System (IFS)**	**Conventional Farming System (CFS)**
Cost	Initial setup costs may be higher due to the integration of multiple components such as crops, livestock, fish, *etc.*	Initial setup costs are relatively lower as it focuses on single-component farming.
Return	Diversification of income sources can potentially lead to higher returns.	Returns may vary depending on the market conditions and the success of the single-component farming.
Resourceuse Efficiency	Efficient use of resources through synergistic interactions among different components. For example, animal waste can be used as organic fertilizer for crops.	Resource utilization may not be as efficient due to limited interactions and dependence on external inputs.
Employment Generation	Integrated systems can provide opportunities for additional employment, such as animal husbandry, aquaculture, and other value-added activities.	Limited employment opportunities as it primarily focuses on single-component farming.
Risk Management	Diversification of income sources helps in spreading risks associated with market fluctuations or climatic events.	Higher vulnerability to market fluctuations and climate-related risks due to reliance on a single component.
Overall Sustainability	IFS promotes sustainable agriculture by maximizing resource efficiency, enhancing biodiversity, and improving resilience.	CFS may have limitations in terms of long-term sustainability and environmental impacts.

11.6 Economics/ research findings on Integrated Farming System (IFS):

Cost and Returns of IFS:

- Gill *et al.* (2009) studied on the integrated farming system and agriculture sustainability in Punjab in a farmer participatory mode and revealed that incorporating dairy, fishery, and piggery components into the rice-wheat system significantly increased net returns. The rice-wheat + dairy system yielded net returns of Rs.75200 per ha, while rice-wheat + dairy + fishery further supplemented the returns to Rs. 80290 per ha. Strengthening the system with piggery raised the net advantage to Rs. 86530 per ha. Additionally, the dairy enterprise contributed Rs.10,761 per ha, and poultry enhanced the margin to Rs. 11546 per ha. These findings emphasize the economic benefits of integrating diverse components into the traditional farming system, highlighting their potential for enhancing sustainability and income generation.
- Tripathi *et al.* (2010) studied on the integration of seven different enterprises, including crop, fish, goat, vermicompost, fruit production, spice production, and agroforestry. The findings revealed that the integrated system yielded an annual net return of Rs. 230329 with a benefit-to-cost ratio of 1.07:1. The most significant contributor to the net return was fish production, accounting for 68.53 per cent, followed by vermicomposting (9.90%), spices (8.46%), and animal production (7.40%). Among the enterprises, spice production had the highest benefit-to-cost ratio of 1.83:1, second only to fishery (2.25:1), and followed by vermicomposting (1.45:1). These results indicate the economic viability and profitability of integrating multiple enterprises in the agricultural system.
- Dorge *et al.* (2015) in their study of comparative economics to assess the sustainability of different farming systems in Ahmednagar and Solapur districts in India. Three farming systems were analyzed: (I) Crops only, (II) Crops + Livestock, and (III) Crops + Livestock + Horticulture crops. The findings revealed that FS-II (Crops + Livestock) generated double the income compared to FS-I (Crops only). The majority of income in both FS-I and FS-II came from crop production. Farm expenditure accounted for over 70% of total expenditure in all farming systems. FS-II and FS-III (Crops + Livestock + Horticulture crops) demonstrated sustainable farm incomes in both regions, while FS-I fell short. However, the inclusion of income from other sources made FS-I sustainable. This suggests that additional income streams outside farming were crucial for sustainability in FS-I.
- Rashtrarakshak *et al.* (2016) revealed that the returns per rupee of investment was slightly higher (1.58) for IFS farmers as compared to Non-IFS farmers, indicating investment of one rupee will generate returns of Rs. 1.58 under IFS and Rs. 1.37 under Non-IFS situation in Hyderabad Karnataka region These findings indicate the potential economic benefits of adopting integrated farming systems in terms of higher returns on investment in the Hyderabad Karnataka region.
- Vinodakumar *et al.* (2017) that the Integrated Farming System (IFS) model consisting of crops, goats, cows, poultry, and fishery yielded significantly higher annual net returns of Rs. 189069 per hectare compared to the conventional cotton monoculture, which only yielded Rs. 74552 per hectare – a figure 2.5 times lower than the IFS system. This notable difference in returns could be attributed to the integration of livestock components within the IFS model, which introduced a consistent income stream for the

farmers.The inclusion of livestock components in the IFS model played a crucial role in generating regular income for farmers.

- Mitra *et al.* (2018) observed that IFS model comprising fish culture, duck farming, azolla, and pulses demonstrated a remarkable threefold increase in income (Rs 138,673 per year) compared to conventional farming (Rs 45,320 per year) in a sustainable manner. The B:C ratio for IFS model found to be higher (2.28) as compared to conventional farming model (1.14). These findings highlight the economic advantages of adopting integrated farming systems, showcasing their potential for higher profitability and financial sustainability compared to conventional single-crop systems.

Resource use Efficiency of Major Farming Systems:

- Rashtrarakshak *et al.* (2016) studied on the resource use efficiency of redgram cultivation in the North Eastern Region of Karnataka under Integrated Farming Systems (IFS) compared to conventional crop cultivation. The findings indicated that IFS farmers achieved slightly higher returns per rupee of investment (1.58) as compared to Non-IFS farmers (1.37). The direct estimates of production function were used to test the efficiency of different production inputs under IFS and Non-IFS farming system. They observed that the resources used efficiently in IFS compared to Non-IFS. Hence, these findings revealed that integrated farming systems demonstrated efficient utilization of resources, suggesting potential for increased productivity and profitability.
- According to Singh *et al.* (2018), their study on integrated farming systems in Banswara district of Rajasthan revealed variations in resource use efficiency. They found that inputs such as machine labour and human labour were overutilized across different farming systems. However, in rainfed areas, seeds, fertilizers, farmyard manure (FYM), and plant protection measures were underutilized. In contrast, in irrigated areas, labour, feed, and concentrates were found to be underutilized in livestock activities. These findings highlight the need for optimizing resource allocation and management practices to enhance the efficiency of integrated farming systems in Banswara district.

Employment Generation:

- Kumar *et al.* (2012) found that the integration of multiple components, such as crop + fish + duck + goat, resulted in the generation of 752 man-days followed by the integration of crop + fish + cattle, yielding 722 man-days, which was much more than conventional farming (rice - wheat). These findings highlight the significant potential of integrated farming systems in generating employment opportunities and enhancing productivity compared to conventional farming methods.
- Sharma *et al.* (2017) studied on two IFS models, One 3.5 acre model for rainfed and the other 1.5 acre model for irrigated systems. The models generated employment of 659 and 1033 mandays respectively. This substantial difference in generating employment between the two models can be attributed intensive cultivation, animal husbandry and diversification of enterprises in irrigated system as compared with rainfed model. As a result, the IFS encourages greater engagement of family labor in agricultural operations, increasing employment opportunities in rural regions. These findings highlight that IFS models, particularly in irrigated systems, can contribute

significantly to employment generation in rural areas, providing opportunities for increased engagement of family labor and contributing to rural livelihoods.

- Goverdhan *et al.*, (2018), conducted an IFS experiment in Telangana state which integrating crop + dairy + sheep + rabbit + hen + quails generated a substantial employment opportunity of 750 man-days. In comparison, conventional rice – maize cropping system, commonly practiced within the region, generated 225 man-days of employment for the same 1-hectare area. These findings highlight the significant potential of integrated farming systems in creating more employment opportunities and contributing to rural livelihoods.

11.7 Conclusion:

The concept of Integrated Farming Systems (IFS) offers a holistic and sustainable approach to agriculture, addressing the challenges faced by conventional farming systems (CFS). The integration of diverse enterprises, such as crops, livestock, fishery, poultry, and agroforestry, in IFS enhances farm productivity, resource efficiency, and income generation. Research findings have consistently highlighted the economic advantages of IFS, including higher net returns, benefit-cost ratios, and employment opportunities compared to conventional farming systems (CFS). Additionally, IFS promotes resource optimization, waste recycling, and risk management, contributing to long-term sustainability and resilience. These findings emphasize the potential of IFS in improving agricultural economics by diversifying income sources, reducing costs, and creating a balanced ecosystem. Implementing IFS can play a significant role in enhancing the livelihoods of farmers, ensuring food and nutritional security, and promoting sustainable and resilient farming systems.

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