Agro Economist - An International Journal
Citation: AE: 6(2): 47-52, December 2019
DOI: 10.30954/2394-8159.02.2019.1

AAEBM
ASSOCIATION OF AGRICULTURAL ECONOMICS & AGRI-BUSINESS MANAGEMENT

# Efficiency under Integrated Farming Systems – A Review

Pawan Kumar Sharma*, Sudhakar Dwivedi, R.K. Arora, Vipal Bhagat, Chamanpreet Kour and Mohit Sharma

*Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, J&K, India*
*Corresponding author: pawanvatsya@gmail.com

**Received:** 22-07-2019 **Revised:** 04-10-2019 **Accepted:** 20-11-2019

**ABSTRACT**

The increasing cost of agricultural production coupled with issues of World Trade Organization is threatening the existence of marginal and small farmers in India. 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 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, the success depends upon the understanding of input-input and product-product relationships. The farmers are more vulnerable in selecting the right choices, owing to misunderstanding on whether the two outputs have complementary, supplementary or competitive relationships. There may be other reasons that are restricting the large scale adoption of IFS models by farmers under different agro-ecosystems. The studies on farming system enterprises, associated synergies and economic efficiency revealed higher returns and economic sustainability under integrated system of farming. The studies have also highlighted many constraints faced in the adoption of integrated farming system which needs government interventions so as to realise better economic returns from agriculture, besides higher social benefits.

**Keywords:** Economics, Integrated farming system, doubling farmers' income

In farm planning, farmer as a decision maker takes three decisions - what to produce, how to produce and how much to produce (Van and Keller, 2006). The farmer has to decide between alternative uses of resources at his/her disposal in order to address these three different but inter-related questions. The increasing cost of agricultural production coupled with issues of World Trade Organization is threatening the existence of marginal and small farmers in India. 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. Integrated Farming System is a concept which involves integration of various agricultural enterprises *namely* crops, livestock, fishery, forestry etc. for generating higher incomes through recycling of by-products and optimum use of farm resources. The IFS model not only supplements the income of the farmers but also help in increasing the family labour employment.

Integration of enterprises is intrinsic to Indian agriculture but now there is a need to popularize scientific IFS models to realize greater profits. The farmers are, however, vulnerable in selecting the right choices, owing to misunderstanding on factor-factor and product-product relationships. The popularization and adoption of recommended

IFS models, after assessing the shortcomings in the existing scenario is required for keeping agriculture profitable and sustainable. The present paper is an attempt to review the studies conducted worldwide to underline the economics of integrated farming systems under diverse agro-climatic and agro-ecological situations.

## MATERIALS AND METHODS

The present study is an attempt to summarise findings of previous studies on integrated farming system. Therefore, secondary information was gathered and summarised to have systematic and clear idea on benefits and limitations associated with integrated farming system. 23 previous research studies on IFS published over the last 60 years started from 1969 to 2018 were reviewed. The concepts related to integrated farming systems described by different agencies have been discussed to highlight the modalities associated with adoption of enterprises in an integrated manner under different agro-climatic zones.

## RESULTS AND DISCUSSIONS

### Defining Integrated Farming System (IFS)

The coordination of processes and enterprises in farming is defined as integrated system of farming. Therefore, Integrated Farming System (IFS) is a judicious mix of one or more enterprises, including crops with complimentarity exists between them, through effective recycling of wastes and crop residues.

IFS is a component of Farming System Research (FSR) which involves change in the farming techniques for maximising production in the existing cropping pattern through optimal utilization of resources. The main principle is better recycling of farm wastes for enhancing production capacity of farms.

### Diversified, Specialized and Integrated Farming Systems

Under Diversified farming system components such as crops and livestock co-exist, but independent of each other. In economic terms, there exists supplementary relationship between different components. On the other hand, Specialized Farming System (SFS) involves intensification of farming activities for maximizing per unit farm production at a particular point of time. This involves concentrating purely on single cropping system or farming enterprise for achieving operational efficiency.

*Integrated Farming System* however focussed on interdependence, interrelationship and interlinkages of different enterprises on a farm to harnessing the complementarities and synergies among them to achieve sustainable production and gainful employment.

### Principles of IFS

Integrated Farming System (IFS) involves complex matrix of soil, water, plant, animal and environment with integration of farm enterprises following certain principles. Some of these are given below:

- Choosing enterprises according to soil and climatic features
- Selection of enterprises based on availability of the resources such as land, labor & Capital.
- Existing of complementary relationship between selected enterprises
- Optimum utilization of available resources.
- Recycling and reuse of farm wastes
- Managerial skill of farmers to manage integrated system

### Types of Integrated Farming Systems

The integrated farming system can be classified on the basis of maximum share of returns obtained from different enterprises. Soni *et al.* (2014) reviewed definitions and forms of FSR and the need for evolution in thinking about agricultural development. It was advocated to recognize context (suitability of technology), and relations within systems (system dynamics).

Based on the available information on different farm enterprises, the different types of IFS model are mentioned below:

- Crop based integrated farming system
- Livestock based integrated farming system
- Aqua based integrated farming system

## Agro-climatic zones and IFS models

The selection of integrated farming system (IFS) depends upon the agro-ecological and agro-climatic situation prevailing in a particular place. Tamil Nadu Agricultural University, India has recommended IFS models (Table 1) based on climatic factors such as, soil types, rainfall and market demand etc.

**Table 1:** Agro-climatic zones and recommended IFS models in Tamil Nadu, India

| Agro-climatic zone | Recommended IFS |
|---|---|
| Western Zone | |
| Wetland | Crop + fishery + poultry + oyster mushroom |
| | Rice-Gingelly-Maize and Rice-Soybean-Sunflower + polyculture fish rearing + Pigeon + mushroom |
| | Goat + fish + crop |
| Irrigated upland | Crossbred milch animal + biogas production + mushroom |
| Rainfed land | Crop + fodder + silvipastoral trees + thorn less prosophis interplanted with cenchrus grasses + goatry |
| North Western Zone (Rainfed) | Crop + Cows + Poultry |
| | Milch animal + Goat + Mulberry / Sericulture |
| Hilly Zone | Cow + Poultry / Broiler |
| Cauvery Delta Zone | Rice + Cow |
| | Crop + Goat |
| | Crop + duck and fish + mushroom |
| Southern Zone | Rice + fish + poultry in Periyar - Vaigai Command Area |
| | Milch cow + fish rearing + rice based cropping system in wetlands of Tirunelveli district |
| | Crop + fruit tree + goat in rainfed black clay soil |

**Source:** TNAU Agritech portal.

Similarly, Assam Agriculture University has classified different integrated systems for North-Eastern region of India as given below:

- Fish - Duck Integrated Farming System
- Livestock - Fish Integrated Farming System
- Cattle - Fish Integrated Farming System
- Poultry - Fish Integrated Farming System
- Rice - Fish Integrated Farming System

Another form of integrated farming system is commonly known as SALT i.e. sloping agricultural land technology, mainly followed in the southern Philippines. This technology caters to the production need of the small-scale hill farmers. SALT is a technology that integrates several soil conservations measures. Basically, SALT method involves planting field crops and horticultural and tree crops in strips 3-5 m wide between double rows of nitrogen-fixing shrubs and trees planted along the contour. The system minimizes soil erosion and maintains soil fertility for maintaining a stable ecosystem. The cover of vegetation aids in both water and soil conservation. SALT, as an agro-forestry technique is very much popular in Asia due to its cultural acceptability and economical reliability (Atul and Pratap, 2003).

Rainfed farming is the most important aspect of agrarian economy wherein the small and marginal farmers constitute more than eighty per cent of the holdings in India. The cost of cultivation of these small and marginal farms often exceeds the returns which poses a threat to the economic viability of farms. IFS model provides an opportunity for rational use of available resources to enhance farm income in rainfed areas.

## Economic benefits under IFS

The IFS model not only supplements the income of the farmers but also help in increasing the family labour employment. Chaubey *et al.* (2018) recommended doubling of farmers' income through transformation in agriculture production combined with integrated farming system (IFS) approaches that involves crop cultivation, dairy, poultry, fishery, mushroom cultivation, agro-forestry, piggery, beekeeping, vegetable and fruit production, use of renewable energy source (i.e. Solar energy, Biogas) etc.

The net return on investment from Integrated Fish cum Crop Farming in Anambra state of Nigeria, that utilized the waste from fish pond as organic manure in crops was 0.5 higher than that of any other alternative. In addition, the use of organic manure led to increase in the savings of the farmers (Ugwumba, 2010).

An evaluation of the Rice-Prawn ghers (RPG) was made in the south-west region of Bangladesh for the analysis of the production pattern and the economics of the freshwater prawn through direct field survey using direct questionnaire The culture of prawn in seasonally saline paddy field was highly remunerative with the benefit-cost ratio of US$ 1.25. Further, the integration of prawn culture into rice farming led to livelihood diversification on one side and ecological benefits on the other (Hasanuzzaman *et al.* 2011).

Hill agriculture is unique in the sense that it encompasses specialised farming system for sustaining livelihood of people. Horticulture, crop husbandry and livestock rearing were the major enterprises of hill farming. An integrated system of 3020 $m^2$ area in North-Western Himalayas, comprising of crops, vegetables and nursery units yielded benefit-cost ratio of 3.15, 3.81 and 4.16, respectively (Chaudhary and Thakur, 2011).

The integrated rice-fish farming system in Mekong delta of Vietnam nearly doubled the per-capita and per-hectare incomes of the households. The farm size was also 1.3 times larger than that of the rice monoculture farms. Further, the integrated system complemented the adoption of improved agricultural strategies such as integrated pest management (IPM) etc. (Bosma *et al*. 2012).

In southern Rajasthan, the large farmers gained from integrated farming systems with the increase in their net income from ₹ 37385 to ₹ 49,852 per hectare under crop-animal husbandry farming system and ₹ 51,161 to ₹ 87,710 per hectare in case of the crop-animal husbandry-horticulture farming system. The study employed multistage random sampling method to select 144 households for collecting primary data from farmers practicing IFS through personal interview method (Singh *et al.* 2013).

Similarly, in the region of north Sulawesi, Indonesia, the Integrated Farming Systems (IFS), involving the food crops in coconut and cow system yielded higher returns as compared to individual coconut-cow system or non-integrated coconut and cows. Incomes and cost of agricultural businesses was compared using ANOVA. It was recommended to analyse methods of planting crops between coconut trees for increasing the production of both coconut and food (Rundengan *et al.* 2013).

The increased benefits from combination of different components under Integrated farming systems were also reported in Western Himalayas by Roy and Kumar (2018) who assessed economics of different cropping systems under rained conditions. The integrated farming system was also assessed to be a potential option to improve farmers' income and ensure sustainable livelihood in Tamil Nadu and Haryana. The contribution of different combinations of enterprises such as poultry, fishery, sheep and goat and horticulture; with crop and dairy as base enterprises were analysed for their impact on farmers' total income. The addition of livestock in the farming system believed to achieve doubling of farmers' income within a period of five years.

**Environment and IFS models**

Environmental sustainability is supposed to be directly related to integrated system of farming. Besides, intensification of land use, the integration system exhibited reduction in erosion and increase in soil biological activity, nutrient recycling and crop yields. Integrated farming system has proved not only an innovative approach but at the same time it proved out to be highly sustainable. The integrative system helps in reusing the residues and waste products from one component to another (Patel *et al*. 2015). The rice monoculture remains the important source of food security in many countries, but still it is more useful and beneficial to use the integrated rise-fish farming due to the yield and environmental sustainability (Ahmed and Garnett, 2011). The Integrated Farming System also supplemented small holders' farm income for ensuring sustainable livelihood. The integration of resources such as land, water and animal was shown to be profitable under the technology assessment, refinement and demonstration by Krishi Vigyan Kendra-Khordha under ICAR-Central Institute of Freshwater Aquaculture. In addition to the profitability, the integrated system provided diverse employment opportunities for the unemployed rural youth (Dash *et al*. 2015). As the number of enterprises increased in the farming systems, the income also increased. Based on the evidence, it was also demonstrated that the training of the beneficiaries increased their knowledge and skill on farming systems (Bhuiya *et al.* 2014).

The crop-livestock farming system pattern drawn from developing countries for sustainable agriculture and green growth was explored by Witjaksono *et al.* (2018). The increase in demand for livestock products was considered, on one side, to be an opportunity for small farmers to earn more income, while on the other side, it was considered to pose a major threat to environment. Therefore new approach in terms of improved integrated crop-livestock system was recommended for achieving green growth development in low income countries.

### Challenges and policy issues in adoption of IFS

Although integration of farm enterprises is a proven technique for increasing farm productivity and profitability, its popularity has been reducing among farm households. This needs specific interventions by agriculture stakeholders to fill the research and extension gaps in adoption of IFS models. Archer *et al.* (2018) proposed several methods to overcome challenges and increase the adoption of integrated systems. Localized training and research was advocated for improving farmers' knowledge and skill on integrated systems. The adoption was supposed to be influenced by future developments in technology, regulations, labor availability, and demands for food and ecosystem services. Rao *et al.* (2017) attempted to expand the evaluation criteria of farming systems beyond profitability in a study conducted in Pudurmandal village of Rangareddy district of Telangana. The relationship between market dependency ratio and farm size, family size and number of components in a farming system was analysed. It was suggested that the farming systems that can minimize the need for external inputs have a key role in sustaining agricultural systems in the rainfed agriculture. The poor farmers generally have poor knowledge base for the application of the integrated farming system. Hence, only few of them had actually adopted the integrated farming system (Patel *et al.* 2015). Also, poor knowledge of the farmers and risks associated with floods and droughts resulted in poor adoption of rice-fish farming in Bangladesh. Therefore, Government support and Public-Private partnership were recommended as major strategies for proper implementation of integrated rice-fish farming system (Ahmed and Garnett, 2011).

The heavy investment in the initial years and non-availability of labour were also observed as the major constraints in adopting integrated farming system (Ponnusamy and Devi 2017).

## CONCLUSION

The demonstration of Integrated Farming Systems all across the world has indicated sufficient gains in terms of economic returns, employment generation and environmental sustainability. The reduction in popularity of practicing agriculture as integrated system is due to several constraints faced by the farmers. The constraints vary across different agro-climatic zones. The scientific interventions should be demonstrated by extension agencies for narrow down the limitations through enhancement of productivity and income. The efforts of Government are also required to subsidise IFS models for achieving the target of doubling the farmers' income.

## ACKNOWLEDGEMENTS

The authors are thankful to Indian Council of Social Science Research (ICSSR), New Delhi, as this paper is an outcome of a project funded by the Council under IMPRESS scheme.

## REFERENCES

Ahmed, N. and Garnett, S.T. 2011. Integrated rice-fish farming in Bangladesh: meeting the challenges of food security. *Food Security*, **3**: 81-92.

Archer, D.W., Franco, J.G., Halvorson, J.J. and Pokharel, K.P. 2018. Integrated Farming Systems. *Elsevier*. USDA Agricultural Research Service, Northern Great.

Atul and Partap, T. 2003. Widening Perspectives on Mountain Agriculture. *CSK HPKV, CenHRD Publication* ISBN No: 81-8207-000-7, pp 170.

Banker, R.D., Charnes, A. and Cooper, W.W. 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, **30**: 1078-1092.

Bhuiya, M.S.U., Karim, M.M. and Hossain, S.M.A. 2014. Study on integrated farming systems model development. *Journal of Bangladesh Agricultural University*, **12**(2): 325-336.

Bosma, R.H., Nhan, K.D., Udo, H.M.J. and Kaymak, U. 2012. Factors affecting farmers' adoption of integrated rice–fish-farming systems in the Mekong delta, Vietnam. *Reviews in Aquaculture*, **4**: 178-190.

Charnes, A., Cooper, W. and Rhodes, E. 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research*, **3**: 429-444.

Chaubey, D., Prakash, V., Yadav, T.C. and Singh, G. 2018. Doubling of Farmers' Income though Integrated Farming System Approaches in Bihar- A Review. *International Journal of Current Microbiology and Applied Sciences,* **7**(12): 1602-1613.

Choudhary, A.K. and Thakur, S.K. 2011. Development of integrated farming system model for marginal and small farmers of Mandi district of Himachal Pradesh: An innovative extension tool. *International conference on innovative approaches for agricultural knowledge management: Global extension experiences* held w.e.f. 9-12 Nov., 2011 at NAAS, New Delhi. *INSEE International Conference Abstracts*, pp. 554-555.

Cooper, W.W., Seiford, L.M. and Tone, K. 2006. Introduction to DEA and its uses with DEA-Solver software and references. *New York: Springer*.

Dash, A.K., Ananth, P.N., Singh, S., Banja, B.K., Sahoo, P.R., Pati, B.K. and Jayasankar, P. 2015. Empirical Proof on Benefits of Integrated Farming System in Smallholder Farms in Odisha. *Current Agriculture Research Journal*, **3**(1).

Garett, H.E. and Woodworth, R.S. 1969. *Statistics in psychology and education*. Vakils, Feffer and Simons Pvt. Ltd., Bombay, pp. 329.

Hasanuzzaman, A.F., Rahman, M.A. and Islam, S.S. 2011. Practice and Economics of Freshwater Prawn Farming in Seasonally Saline Rice Field in Bangladesh. *Mesopotamian Journal of Marine Science*, **26**(1): 69-78.

Patel, A.S., Patel, S.J., Patel, N.R. and Chaudhary, G.M. 2015. Integrated Farming of Crop and Livestock: A Review. *International Journal of Agriculture Sciences*, **7**(12): 777-781.

Ponnusamy, K. and Devi, M.K. 2017. Impact of Integrated Farming System Approach on Doubling Farmers' Income. Agricultural Economics Research Review 30 (Conference Number): 233-240; DOI: 10.5958/0974-0279.2017.00037.4.

Rao, C.A.R., Raju, B.M.K., Samuel, J., Dupdal, R., Reddy, P.S., Reddy, D.Y., Ravindranath, E., Rajeshwar, M. and Rao, C.S. 2017. Economic analysis of farming systems: capturing the systemic aspects. *Agricultural Economics Research Review*, **30**(1): 37-45.

Roy, A. and Kumar, U. 2018. Emerging Farming Systems in Western Himalaya: A State Level Analysis of Sustainability. *International Journal for Environmental Sciences and Natural Resources*, **9**(2): 555757.

Rundengan, M.L., Fanani, Z., Subagiyo, I. and Elly, F.H. 2013. Integrated Farming System Model in South Minahasa Regency- North Sulawesi", *IOSR Journal of Agriculture and Veterinary Science*, **5**(6): 01-07.

Singh, H., Sharma, S.K., Dashora, L.N., Burark, S.S. and Meena, G.L. 2012. Characterization and Economics of Farming Systems in Southern Rajasthan. *Annals of Arid Zone*, **52**(1): 67-70.

Soni, R.P., Katoch, M. and Ladohia, R. 2014. Integrated Farming Systems - A Review. *IOSR Journal of Agriculture and Veterinary Science*, **7**(10): 36-42.

Ugwumba C.O.A. 2010. Environmental Sustainability and Profitability of Integrated Fish cum Crop Farming in Anambra State, Nigeria. *Agricultural Journal*, **5**(3): 229-233.

Van, L.W.T. and Keller, L.H. 2006. Farmers' Decision Making: Perceptions of the importance, Uncertainty, and Controllability of Selected Factors. *Agribusiness*, **7**(6): 523-525.

Witjaksono, J., Suharyanto, Indrasti, R. 2018. Developing Integrated Crop-Livestock Farming System as a Strategy for Green Growth in Low Income Countries: A Brief Review, *Animal and Veterinary Sciences*, **6**(1): 12-16.