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Integrated Farming Systems for a Sustainable Future

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ABSTRACT

In the past few years, water and food security, as well as natural resources conservation and environment protection are the main issues the planet is facing today. Developing countries are struggling to affect these issues and also have to assert the twin burden of global climate change and globalization. Global climate change has started showing its impact on water resources and agricultural productivity worldwide. Therefore, promoting sustainable development through sustainable agricultural practices may be a reliable way to overcome the above issues without retarding economic growth. In India, small and marginal farmers are crucial for the agricultural economy constituting 85% of the entire farming community with an operational land of 44%. Based on the earlier studies conducted all over the country, crop cultivation alone cannot meet the demand of food and nutritional requirement and we have to focus on integrated farming. In integrated crop livestock farming system, crop residues can be used as a source for animal feed, while manure from livestock can be used to enhance crop yields. Integrated farming system (IFS) is the combination that reduces soil and water erosion by conserving and harvesting, improves soil health and soil microbial activity, essential nutrients recycling, less incidence of pest and diseases, enhances productivity with increased net income. Recent studies shows that IFS components are also known to control the weed and regarded as an important element of integrated pest management and thus minimizes the use of pesticides and thus protects the environment. IFS is the only way of efficient resource recycling within the system with enhanced soil sustainability, increased economic profitability, economic stability and preserving environmental quality and maintaining sustainability.

Keywords: *Integrated farming systems, sustainable, productivity, stability and environment.*

Sustainability is an important element in the development of integrated farming systems and is defined as a characteristic or state whereby the needs of the present and local population can be met without compromising the ability of future generation or population in other locations to meet their needs (MEA, 2005). Sustainable development can be achieved through sustainable agricultural practices which will help them in addressing socioeconomic as well as environmental issues simultaneously. Within the broad concept of sustainable agriculture, Integrated Farming Systems (IFS) hold special position as in this system nothing is wasted, the byproduct of one system becomes the input for other, with efficient soil, water, crop, livestock and pest management practices, which are environmentally friendly and cost effective (Walia and Kaur, 2013).

Integrated farming system enhances income levels of small and marginal farmers, minimizes risk of crops failure in case of single crop and creates ecological farming system which is able to make the best of local resources as efficiently as possible for the purpose of sustainable future. Maximizing land utilization encourages integrated farming system of crops, forestry and livestock within the same land space. The adoption of integrated poultry-fish-duck farming in different forms such as intensive broiler production, backyard poultry rearing, etc. leads to conservation of natural resources and provision of additional income and employment opportunities, especially to the youth and women workers in the villages.

An integrated farming system consists of many resource-conserving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of modern farming and conserving the nature (Gupta *et al.* 2012). On any farm, four natural ecosystem processes like energy flow, water cycle, mineral cycle and ecosystem dynamics work (Sullivan, 2003). These four ecosystems processes function together, complementing each other as sustainable agriculture requires system approach (Singh *et al*. 2009) and system implies a set of agricultural activities organized while preserving land productivity and environmental quality and maintaining a desired level of biological diversity and ecological stability. A number of successful IFS models have been developed and by adopting those models' farmer's income can be increased many folds as well as sustainability and economic viability of small and marginal farmers can be maintained.

Table 1. Soil nutrients as influenced by rice based farming systems

Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Rice-rice	256	41.2	556
Rice-sesame	336	42.9	725
Rice-chilli	396	43.1	676
Rice-wheat-GM	355	44.2	730
Rice+Fish-Rice+Fish	410	43.9	704
Rice+Fish- Rice+Fish-poultry	421	44.8	733
Rice-rice-GM	385	44.2	680

Table 2. Percentage reduction in biomass of weeds in rice fish integrated farming system

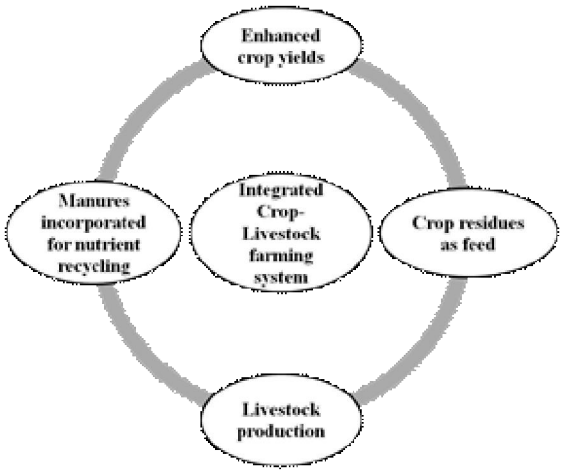
Fish species	*Echinochloa sp.* (%)	*Cyperus rotundus* (%)	*Eclipta alba*
Grass carp	33.17	31.82	28.75
Common carp	22.37	20.86	18
Grass carp and Common carp	28.113	25.18	22.78

Table 3. Man days requirement under different IFS combinations at Patna district

	Crop	Fish	Poultry	Duck	Goat	Cattle	Mushroom	Total man days
Cropping alone	512	-	-	-	-	-	-	512
Crop+Fish+Poultry	512	40	60	-	-	-	-	612
Crop+Fish+Duck	512	40	-	70	-	-	-	622
Crop+Fish+Goat	512	40	-	-	130	-	-	682
Crop+Fish+Cattle	512	40	-	-	-	170	-	722
Crop+Fish+Duck+Goat	512	40	-	70	130	-	-	752
Crop+Fish+Mushroom	512	40	-	-	-	-	70	622

Integrated crop livestock farming system

In integrated crop livestock farming system the byproducts of one enterprise can be used as input in another enterprise for making better use of resources. Crop residues were used for animal feed, while manure from livestock can enhance agricultural productivity by intensifying nutrients that improve soil fertility as well as reducing the use of chemical fertilizers (Gupta *et al*. 2012). Animal excreta can be used as fertilizer for farming purpose and also as fuel. For resource poor farmers the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.



Role of IFS in improving soil health and nutrient cycling

A study on the changes in chemical properties of soil under rice-based farming systems was conducted by Channabasavanna *et al*. (2002) at Agricultural Research Station, Siruguppa and revealed that integrated farming system also plays an important role in improving the soil health by increasing the nutritional value of soil. The results showed that (Table 1) the available N, P_2O_5 and K_2O contents of soil varied significantly. Maximum available N, P_2O_5 and K_2O was recorded in rice (fish)-rice (fish) with poultry and minimum in rice-rice system. Nutrient recycling within the system advocates the self-sustainability of the system which will not only reduce the dependency on the external inputs *viz*, seed/ fertilizers etc. but also

provide the balanced and rich nutrition to the farm family with less cost of cultivation and increased profit margin on the same piece of land which is key factor for taking care of sustainability.

Role of IFS components in weed and pest control

Kathiresan (2009) from Tamil Nadu reported that the component elements of fish culture in transplanted rice have shown to compliment weed control by 30% besides imparting sustainability as improved soil health and economic returns. The herbivores fish species *viz*. grass carp (*Ctenopharyngodon idella*) and Common carp (*Cyprinus carpio*) contributing for significantly higher biomass reduction in the three weed species *viz*. 33.17% of *Echinochloa sp*.; 31.82% of *Cyperus rotundus* and 28.75% of *Eclipta alba* in rice-fish integrated farming system (Table 2).

Additional employment generation in IFS

Kumar *et al*. (2012) studied different IFS models at Patna and identified crop + fish + duck + goat as the best integrated farming system in terms of productivity and employment generation (752 man-days/year) due to better involvement of farm family labours throughout the year. Integration of enterprises created the employment opportunities in comparison to 512 man days/year generated in cropping alone system, cropping with fish, duck and goat created additional 240 man days/annum (Table 3).

CONCLUSION

Integrated Farming System is also an eco - friendly approach in which waste of one enterprise becomes the input of another thus making efficient use of resources. It helps in improving the soil health, nutrient recycling, weed and pest control and increasing man days. As this system minimizes the use of harmful inorganic fertilizers, weedicides and pesticides which protects the environment from the adverse effects. Integrated Farming System which combines activities of arable crops with horticulture, livestock, fisheries, trees and other science related to farming on the same field at the same or almost the same time needs to be developed as a solution to food security problem resulting from decreasing food productivity area out of land conversion and climate change. It is an efficient and environmentally-friendly farming system utilizing the local resources potentially in an optimal way for a sustainable future.

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