World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

INTEGRATED FARMING SYSTEM FOR DOUBLING THE FARMERS INCOME- A REVIEW

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Article Received on 15/02/2021 **Article Revised on 05/03/2021** **Article Accepted on 25/03/2021**

ABSTRACT

In India there are 115 million operational holdings and about 80 % are marginal and small farmers. The ever increasing population leading to decline in per capita availability of land in the country creating practically no scope for horizontal expansion of land for agriculture. Only vertical expansion is possible by integrating farming components requiring lesser space and time and ensuring reasonable returns to farm families. Because of the shortfall of traditional farming system, it is no longer able to fulfil the requirement of the farmer. Shrinkage in net cultivable area due to increasing population, rapid urbanization, increased environmental pollution and green house gases. Increasing cost of production due to shortage of feed/fodder. Low farm income due to traditional practices. These problems can be overcome by Integrated Farming System instead of monoculture. Because in IFS "there is no waste", and "waste is only a misplaced resource which can become a valuable material for another product".

KEYWORDS: IFS, Crop, Livestock, increase production, rural farmer.

INTRODUCTION

In India there are 115 million operational holdings and about 80 % are marginal and small farmers (Manjunatha *et al*., 2014). To fulfil the basic/primary needs of house hold including food (cereal, pulses, oilseeds, milk, fruit, honey, meat, egg, chicken etc.), feed, fodder, fiber, etc. which warrant an immediate attention about a probable solution i.e. Integrated Farming System (IFS) because of the shortfall of traditional farming system that means it is no longer able to fulfil the requirement of the farmer. The growth rate agriculture in the country is very slow i.e below 2% so with the traditional agricultural practices it is difficult to sustain.The current scenario in the country indicates that area under cultivation may further dwindle and more than 20% of current cultivable area will be converted for non-agricultural purposes by 2030 (Gill *et al*., 2005). Due to ever increasing population and decline in per capita availability of land in the country, practically there is no scope for horizontal expansion of land for agriculture. Only vertical expansion is possible by integrating farming components requiring lesser space and time and ensuring reasonable returns to farm families. The Integrated Farming Systems (IFS) therefore assumes greater importance for sound management of farm resources to enhance the farm productivity and reduce the environmental degradation, improve the quality of life of resource poor farmers and maintain sustainability.

IFS have revalorised conventional farming of livestock, aquaculture, horticulture, agro-industry and allied activities in some countries, including India. Research on integrated crop and livestock systems has found to be highly productive and environmentally sustainable (Allen *et al.*, 2005, 2007; Russelle *et al.*, 2007). The integration is made in such a way that product of one component should be the input for other enterprises with high degree of complimentary effects on each other. The preliminary research investigations advocated the benefits of productivity improvement by 30-50% depending upon the number and kind of enterprises and their management.

Problems Of Present Agriculture

- The growth rate of agriculture remains static or declining
- The food production is not sustainable to feed the future generation
- Increasing malnutrition in young children and pregnant women
- Shrinkage in net cultivable area due to rapid urbanization
- Increasing environmental pollution and green house gases
- Depleting ground water table due to indiscriminate use

- Shrinkage in land holdings due to increasing population
- Increasing cost of production due to shortage of feed/fodder
- Low farm income due to traditional practices
- Increasing unemployment due practice monoculture.
- Problems of farm labourer due to large scale migration

What is the solution? The simple answer is "Integrated Farming Systems" which can solve the problem as integrated farming systems there is diversification of enterprises so if one of the fails due to certain reasons the other may compensate and protect the farmer.

Definition of Farming System

'Farming' is a process of harnessing solar energy in the form of economic plant and animal products. *'System'* implies a set of interrelated practices and processes organized into functional entity, *i.e.* an arrangement of components or parts that interact according to some process and transforms inputs into outputs (Frescolo,1988).

What is IFS?

IFS have been defined by many scientists in various ways. In IFS "there is no waste", and "waste is only a misplaced resource which can become a valuable material for another product" (FAO, 1977). Okigbo (1995) stated IFS as a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises. IFS is a component of farming systems which takes into account the concepts of minimizing risk, increasing production and profits whilst improving the utilization of organic wastes and crop residues (Radhamani *et al*.,2003). The IFS is a type of mixed farming system that combines crop and livestock enterprises in a supplementary and / or complementary manner (Agbonlabor *et al*., 2003).

Objectives of Integrated Farming System: following are some important objectives of IFS -

- To increase the yield of various components to provide steady and stable income throughout the year.
- Restoration or enhancement of system's productivity and achieve agro-ecological equilibrium.
- To keep away the insect-pests, diseases and weed population through natural cropping system management and keep them at low level of intensity.
- Reducing in the use of chemicals to provide chemical free healthy produce and environment to the society.
- Organic food can be produced which are more demanding in present time.

Advantages of Integrated Farming System

- Increased productivity of farm through increased economic yield per unit area per time.
- Reduced costs production due to recycling of wastes leading to improved profitability.
- Better sustainability in production on farm due to integration/incorporation of more components based on their economic importance.
- 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 type of foods.
- The 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 farmer to establish themselves in the society.
- Requirement of chemical fertilizer can be reduced by recycling of organic wastes which will improve the soil health.
- Through IFS household energy requirement can be met by biogas production and help in solving energy crises.
- Fodder crises for livestock can be solved to some extent through incorporation of fodder/pasture/tree species in the farming system.
- Silvi component used in the system provides fuel and timber wood.
- Inclusion of timber component in the farming system reduces pressure on forests.
- Instead of monoculture, diverse components may provide better scope to employ farm labour round the year.
- IFS provide opportunity for the growth of agri-oriented industries.
- Overall benefit of IFS is improved standard of living of the farmer leading to socioeconomic development.

Components in IFS

- Agriculture
- Fish farming
- Horticulture
- Vermiculture
- Forestry
- Pigeon rearing
- Apiary
- Mushroom cultivation
- Sericulture
- Azolla farming
- Dairy
- Rabbitery
- Poultry
- Fodder production
- Goat /Sheep rearing
- Nursery
- Duck rearing
- Seed Production
- Piggery

- Value addition
- Feed mill

Possible output of integrated farming system

Integrated Farming System (IFS) is an interrelated complex matrix of soil, water, plant, animal and environment and their interaction with each other enable the system economically more viable and cost-effective over the traditional monoculture farming system. It leads to produce the diversified quality of food in sufficient quantities at the same time it will maintain soil heath and kepp the environmental pollution under control. To strengthen the food chain, it is essential to eliminate nutritional disorder which has been realized on account of appearing deficiency of mineral nutrients and vitamins in food being consumed. Horticultural and vegetable crops can provide 2-3 times more energy production than cereal crops on the same piece of land and will ensure the nutritional security on their inclusion in the existing system. Livestock farming with crop raising can meet the diversified need of the people. Similarly inclusion of bee-keeping, fisheries, poultry, sericulture, mushroom cultivation on account of space conservative also give additional high energy food without affecting production of food grains. The integration of these multiple enterprises will certainly help the production, consumption and decomposition in a realistic manner in an ecosystem.

Likewise, it is pre-requisite in farming system to ensure the efficient recycling of resources particularly crop residues, because 80-90% of the micronutrients remain in the biomass (Gill *et al*., 2011). Rice straw is not recycled in an effective way in the Indo- Gangetic plains and even in Punjab also where rice cultivation is practised on 2.6 m ha produces about 16 m tonnes of paddy straw which is destroyed by burning. To curtail such precious input loss, the use of second generation machinery for efficient crop residue management to conserve moisture, improve soil micro-organism activities, regulate soil temperature, check soil erosion, suppress weed growth and on decomposition improves soil fertility. The crop residue can be used as floor thatch for cattle shed, composting, growing mushroom and as dry fodder. The community land in the villages which are accessible must be used for productive purpose. Therefore, adoption of concept like social forestry, water harvesting and recycling fishery, and stall feeding to the animals (goatery / piggery) will add to the profit margin with other numerous indirect benefits of employment and improved ecology of the area. Such types of enterprise integration generate additional income varying from Rs 20,000- 25,000/ha under irrigated and Rs 8,000-12,000 under rainfed ecosystem. The income enhancement due to integration of processing and on-farm value addition by 25- 50%, yield improvement on account of improved soil health by 0.5-1.0 tonne/ha, cost reduction by Rs.500 - 1,000/ha and employment generation by 50-75 man days/household have also been observed (Gill *et al*., 2009).

Importance of farming system research

Investigations of farming system research clearly reveal that integration of agricultural enterprises viz. crop, livestock, fishery, bee keeping, vermicompost, forestry etc. have great potential towards improvement in the agricultural economy. These multiple enterprises not only generate income to the farmer by increasing the productivity per unit but also ensure the rational use of the resources/wastes which further reduces the cost of production and maximizes the farm economy creating employment avenues. The suitable combination of crop with other enterprizes will certainly prove as a self sustained production system with least cost of production of quality food basket and better uses of wastes/resource. The farming system is governed by various forces viz., physical environment, socio economic conditions, soil types, availability of resources, market demands, operational constraints etc.

In traditional Chinese system, the animal houses were constructed over a pond so that animal waste fell directly into the water fueling the pond ecosystem, which the fish could then feast on for food. Not only were the fish harvested but the pond water, now with extra nutrients was used for irrigation in crops. The maximum return (Rs 79,064/ha) was earned from fisheries + piggery + poultry as compared to Rs 5,33,221 from the rice-wheat system and registered 48.6% gain. This also generated additional employment of about 500 man days/ha/annum.

For poor people, it starts small with ducks and chickens; then a few goats are kept for milk or fattening and to slaughter for a day of sacrifice; next a milch cow; then a bullock for ploughing in cooperation with another one buffalo family; then two bullocks. These can be used to plough the fields of others- a very lucrative business in the planting season. In India, one would add a milch buffalo at the apex of desirable animals on the farm. The poorest households kept only poultry and these households were those most dependent on common property resources for their living (e.g. use and sale of firewood from the forest).

A similar stratification has been reported in several studies from Asia. Survey on farming systems in the country as a whole revealed that milch animals; cows and buffaloes irrespective of breed and productivity is the first choice of the farmers as an integral part of their farming system. However, from economic point of view, vegetables and fruits (mango and banana in many parts of the country) followed by bee keeping, sericulture, mushroom and fish cultivation was the most enterprising components of any of the farming systems prevalent in the country.

Productivity enhancement by IFS

In view of ever increasing population leading to shrinkage of land holding that limits horizontal expansion of land for agricultural activity. So, vertical expansion through various farm enterprises requiring less space and time is the only alternative left behind that

gives high productivity per unit area and ensuring regular income especially for the small and marginal farmers round the year. The highlights about the research investigations carried out in India towards farming system outcome are discussed to conceptualize its significance towards farming community livelihood. In a study conducted at ICAR Research Complex, Goa, it was revealed that rice-brinjal crop rotation is the best in terms of productivity and profitability owing to higher yield of the brinjal. The system yielded a total productivity of 11.22 t/ha rice grain equivalent yield with a net return of Rs.46, 440/ha. Further, with the integration of mushroom and poultry production (based on the resources availability within the system) the system productivity was increased to 21, 487 kg/ha especially with rice-brinjal rotation leading to an additional returns of Rs 30,865/ha with integration. In addition, the system approach was found to sustainable as reflected from the changes in soil organic carbon and indicated by sustainability yield index.

In Tamil Nadu, the IFS increased the net return on an average of Rs 31,807/ha/year over the arable farming (Rs 19,505/ha/year). While in Goa, when coconut was inte grated with crop, vegetables, mushroom, poultry and dairy enabled to enhance Rs 17,518/ha/annum over the cashewnut cultivation alone. In Madhya Pradesh, the integrated farming gave a margin in net return of Rs 17,198/ ha/year over the arable farming. In Uttar Pradesh, the average enhancement in return was Rs 45,736/ha/annum over the existing crop-based farming system.

In Haryana, Singh *et al.*(1993) conducted studies of various farming systems on 1 ha of irrigated and 1.5 ha of unirrigated land and found that under irrigated conditions of mixed farming with crossbred cows yielded the highest net profit (Rs 20,581/-) followed by mixed farming with buffaloes (Rs 6,218/-) and lowest in arable farming (Rs 4,615/-). In another study conducted with 240 farmers of Rohtak (wheat- sugarcane), Hisar (wheat-cotton) and Bhiwani (gram-bajra) districts in Haryana which represented zones of different crop rotations revealed that maximum returns (Rs/ha) of 12,593, 6,746 and 2,317 were obtained from 1 ha with buffaloes in Rohtak, Hisar and Bhiwani, respectively. The employment potential under mixed farming conditions was predominantly from livestock rather than crop production (Tiwari *et al.*, 1999).

Economic viability of IFS in different places

The integration of crop and animals enables synergistic interaction, which has a greater total contribution than the sum of their individual effects (Edwards, 1989).

Farming system is a resource management strategy to achieve economic and sustained production to meet diverse requirements of farm households while preserving resource base and maintaining a high level environmental quality (Lal and Millu, 1990).

Ganesan *et al.* (1990) endorsed that IFS comprises of Rice-rice-rice-fallow-cotton+maize +duck cum fish yielded (Rs.24,117) almost double net return compared to cultivation rice-rice-rice-fallow-pulses (Rs.13,790) in Tamilnadu.

Singh *et al.*(1993) conducted studies of various farming systems on 1 ha of irrigated and 1.5 ha of unirrigated land in Haryana and found that under irrigated conditions of mixed farming with crossbred cows yielded the highest net profit (Rs 20,581/-) followed by mixed farming with buffaloes (Rs 6,218/-) and lowest in arable farming (Rs 4,615/-).

Singh *et al*. (1994) conducted an investigation for last 15 years in Haryana state and reported that farmers generate more employment in semi-arid tropical situations with mixed farming systems of crops and animals than arable farming system.

Devasenapathy *et al.* (1995) conducted experiment and identified that integrated farming of groundnut-blackgram-maize with integration of other enterprises such as dairy, fish, poultry and rabbit rearing resulted higher net income as compared to conventional cropping system.

Shanmugasundaram *et al.* (1995) reported that cultivation of Rice-rice gives a net return of Rs. 15,299 while IFS with Rice-rice-cotton +maize+poultry/fish gives a net return of Rs.17, 209 and Rice-rice-Azolla/Calotropis+Fish Rs. 17,488.

Singh *et al.* (1999). conducted a study with 240 farmers of Rohtak (wheat-sugarcane), Hisar (wheat-cotton) and Bhiwani (*gram*-bajra) districts in Haryana which represented zones of different crop rotations revealed that maximum returns (Rs/ha) of 12,593, 6,746 and 2,317 were obtained from 1 ha with buffaloes in Rohtak, Hisar and Bhiwani, respectively. The highest net returns from Rohtak was attributed to the existence of a better soil fertility type and of irrigation facilities coupled with better control measures compared to other zones. In terms of total man days, Rohtak had the highest employment potential followed by Hisar and Bhiwani. The employment potential under mixed farming conditions was predominantly from livestock rather than crop production.

The results of a study (Radha *et al.* 2000), conducted on survey based with three agricultural and livestock based farming systems viz., dairy, poultry and sheep rearing clearly revealed that all the farming system generated more than 3 times additional employment over arable farming. The net returns were higher in agriculture + dairy (Rs.35293) followed by agriculture + poultry (Rs.26830) and agriculture + sheep rearing (Rs.14665).

Jayanthi *et al.* (2001) conducted a study involving cropping, poultry, piegon, goat and fishery under

wetland conditions of Tamil Nadu for a period of three years. The results revealed that integration of crop with fish (400 reared in 3 ponds of 0.04 ha each), poultry (20 babkok layer bird), pigeon (40 pairs), and goat (Tellichery breed of 20 female and 1 male in 0.03 ha deep litter system) resulted in higher productivity, higher economic return of Rs 1, 31, 118 (mean of 3 year). Integration of enterprises created the employment opportunities where in comparison to 369 mandays/year generated in cropping alone system, cropping with fish and goat created additional 207 mandays/annum. The resources were recycled in such a way that fish were fed with poultry, pigeon and goat dropping. Similarly, extra poultry, pigeon and goat manure and composted crop residue of banana and sugarcane were applied to the crops.

Balusamy *et al.* (2003) clearly stated the beneficial effect of *Azolla* on rice+fish and reported that the gross income obtained in rice + *Azolla* + fish was 25.7 % more over the rice crop and 6.9 % more over the rice + fish. The net income followed the same trend. Thus rice + *Azolla* + fish on an average gave Rs 8,817/ha more over the rice monoculture and Rs.3, 219/ha over the rice + fish.

Manjunath and Itnal (2003) reported that practice of IFS comprising Coconut+forage +dairy yielded a net return of Rs.32335 while Rice-brinjal (0.5 ha) + Rice-cowpea (0.5 ha)+mushroom +poultry yielded a net return of Rs. 75360 in Goa i.e. adding more component in IFS resulted more net returns.

IFS studies conducted on farmers fields in Punjab conditions, gross profit was found to increase from Rs.81200/ha/annum in cropping (Rice-wheat) alone to Rs.154000/ha/annum in crop+dairy and Rs.113200/- in fish+piggery system of farming (Gill, 2004).

Gill *et al*. (2005) reported that the maximum return (Rs 79,064/ha) was earned from fisheries + piggery + poultry as compared to Rs 5,33,221 from the rice-wheat system and registered 48.6% gain. This also generated additional employment of about 500 man days/ha/annum.

Integrated farming system assumes greater importance to enhance the productivity besides reducing the environmental degradation. It was an appropriate approach to minimize risk and increase the production, profit and employment with better utilization of resources (Dhaka *et al.,* 2009).

In Karnataka state, integrated farming system comprises of cropping, vegetables, fisheries, poultry and goat having 26.3 per cent more productivity and 32.3 per cent more profitability than conventional rice-rice system (Channabasavanna and Biradar, 2007).

Venkatadri *et al.* (2008) showed that about 98 per cent of the farmers opined that livestock rearing reduces vulnerability in drought years, a 97.8 per cent expressed that dairy farming provides sustainable livelihoods, a 97 per cent of the sample respondents indicated that farmers suicides are less in dairy developed areas and commercial agriculture increased suicidal rate in A.P. (96.0%).

Gill *et al.* (2009) reported that adoption of concept like social forestry, water harvesting and recycling fishery, and stall feeding to the animals (goatery / piggery) will add to the profit margin with other numerous indirect benefits of employment and improved ecology of the area. Such types of enterprise integration generate additional income varying from Rs 20, 000- 25,000/ha under irrigated and Rs 8,000-12,000 under rainfed ecosystem. The income enhancement due to integration of processing and on-farm value addition by 25-50%, yield improvement on account of improved soil health by 0.5-1.0 ton/ha, cost reduction by Rs.500 - 1,000/ha and employment generation by 50-75 man days/household have also been observed.

Korikanthimath and Manjunath (2009) conducted a study at ICAR Research Complex, Goa, it was revealed that rice-brinjal crop rotation is the best in terms of productivity and profitability owing to higher yield of the brinjal. The system yielded a total productivity of 11.22 t/ha rice grain equivalent yield with a net return of Rs.46, 440/ha. Further, with the integration of mushroom and poultry production (based on the resources availability within the system) the system productivity was increased to 21, 487 kg/ha especially with rice-brinjal rotation leading to an additional returns of Rs 30,865/ha with integration. In addition, the system approach was found to sustainable as reflected from the changes in soil organic carbon and indicated by sustainability yield index.

The resource characterization study revealed that/ha improvement in profitability varied from Rs 20,000 to 25,000 under irrigated condition, resource recycling improve fertility led to 5 to 10 q/ha crop yield increase, generate 50-75 mandays/ family/ year and reduce the cost of production by Rs.500-1,000/ha. They further revealed improvement in the net profit margin varying from 30-50 %.(Manjunatha *et al.*, 2014)

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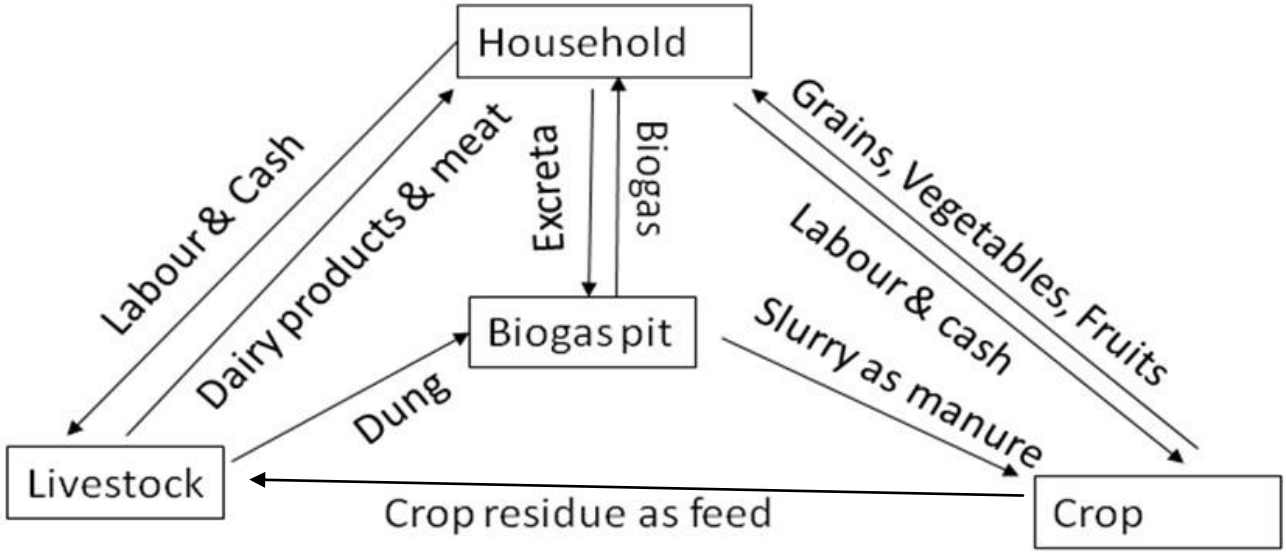

Fig: Resource flow in Crop Livestock Farming System

CONCLUSION

From the above points it is revealed that IFS enables the agricultural production system sustainable, profitable and productive. About 95 % of nutritional requirement of the system is self sustained through resource recycling. As the numbers of enterprises are increased, the profit margin increases but simultaneously coupled with increase in cost of production and employment generation though the profit increase was marginal. Further, it is evident that profit margin varied with the ecosystem (rainfed/irrigated), management skill, and socio-economic conditions. On an average profit margin on account of IFS varied from Rs 15,000 to Rs 1,50,000/ha/annum. Simultaneously it takes care of the food and nutritional security of the farming family. Therefore, the IFS concept should be promoted under all agro-climatic conditions of the country for increasing the farmers income.

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