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Integrated Farming System (IFS)- A Holistic Approach to Empower Marginal Farmers-A review paper

Toko Yarin[1]* and Suprava Biswal[1]

1. Ph.D. Research Scholar, Department of Vegetable and Spice Crops.

Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal-736165

1. Ph.D. Research Scholar, Department of Plantation Crops and Processing.

Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal-736165

Abstract

The term "Integrated Farming System" (IFS) refers to a set of collective, inter-related as well as often interlacing production systems based on a considerable number of crops, animals and other associated subsidiary ventures. It is also designed to increase the utilization of available nutrients in each system to minimize the negative impact on the environment. These are essentially integrated land-based ventures that can grow different types of horticultural crops at different times of the year, along with annual dairy and poultry, using low-cost farming techniques to Improve job creation through sustainable production. It is not only helping farmers in income generation but also encourages them to focused on using on and off farm units. In this system farmers can get benefit throughout the year by giving opportunities to other tribal farmers including females. Since farming is a labor-intensive work, in many places the involvement of female plays a very important role in women's empowerment. In present days, many tribal females of Rajasthan and Punjab are getting benefit more from their farming system which helps creating jobs for other indigenous women. Farming of various horticultural crops such as vegetable (summer and rabi type), fruit, plantation, medicinal and aromatic crops by using low-cost farm technology i.e., incorporation of organic farming at minimum input of cost can bring tremendous approaches for income generation. The main objective of this study is to bring more benefits for the small marginal farmers as well as open a new leaf for the higher income generation.

Keywords- IFS, ventures, sustainable, tribal, income generation, marginal farmer

Introduction:

In India total geographical area for farming is 328.7 million hectares whereas, only 139.4 million hectare is a net sown area (NHB). India is known as agricultural power house where farmers play as the centre of rural economy. The states like Punjab and Haryana are having 80% of net sown area whereas, Arunachal Pradesh, Mizoram and Manipur are having only 10% net sown area (NHB). Every year the population has increased immensely therefore

to feed the large population, some innovative farming method should use where vertical space will be utilized at lesser space with lesser time.

After innovation of a new farming techniques with useful farming tools, Indian farming system needs a lot of man power for carrying out all the farming operations. Even after doing a lot of hard work, marginal farmers are unable to feed their livelihood due to procuring of farming inputs like seeds, manures, pesticides, energy, feeds etc. So, to satisfy the fundamental necessities of the homestead families, foods viz., cereals, pulses, oilseeds, milk, organic product, honey, meat and so forth), fibre and fuel warrant a consideration about incorporated cultivating framework (integrated farming system).

"Integrated Farming System" (IFS) is a set of interdependent, inter-related and frequently interlocking production systems includes small number of crops i.e., mainly cultivation of various crops, animals and related subsidiary ventures. IFS is just a simple term which is generally used in agriculture sector to define the agroecological, land productivity as well as environmental sustainability to improve the farming system for the farmers. In this system, interdependent set of enterprises are formulated, which means waste of one component can be used as a source for other component of farming which will helps in development of low-cost farming technology for farmers.

After the green revolution in the year 1965-1966, farmers are mostly focus on single farming. In a single enterprise, using a lot of inorganic fertilizers, insecticides and pesticides which causes degradation of soil quality and as well as hazardous to the environment. Sometimes failure of single enterprise is more due to climatic effect, todays demanding economy, consumer preference, devastation of harmful diseases etc. But if a marginal farmer will be focused on multiple enterprises, that could give better livelihood with employment generation for a small-scale farmer. As a multiple enterprises or multiple farming which demands heavy man wages, women can be a better option for carrying out all intercultural operation that could help in empowering the woman. Food is a greater demand in the modern world due to growing population. Hence, integrated farming system is a tool used for empowering the farmers with improving livelihood.

Goals of IFS:

(1) To support a continues and steady income generation of the crop-based system productivity.

(2) To balance an agro-ecological system through lowering the population of insect-pest attack, introducing a natural farming system by avoiding the use of inorganic fertilizers, insecticides, and pesticides.

(3) To feasible a technology which make a judicious use of local resources available at farm and in local areas effectively and efficiently.

(4) To prolong prosperity, maintain the environment, and preserve the base of natural resources.

Advantages of IFS to empower the farmers:

(1) IFS makes the system more feasible with the matrix of soil, water, plants, animals, and the environment with the interactions gives more profitable than the arable farming system that increases the output of the wholesome food.

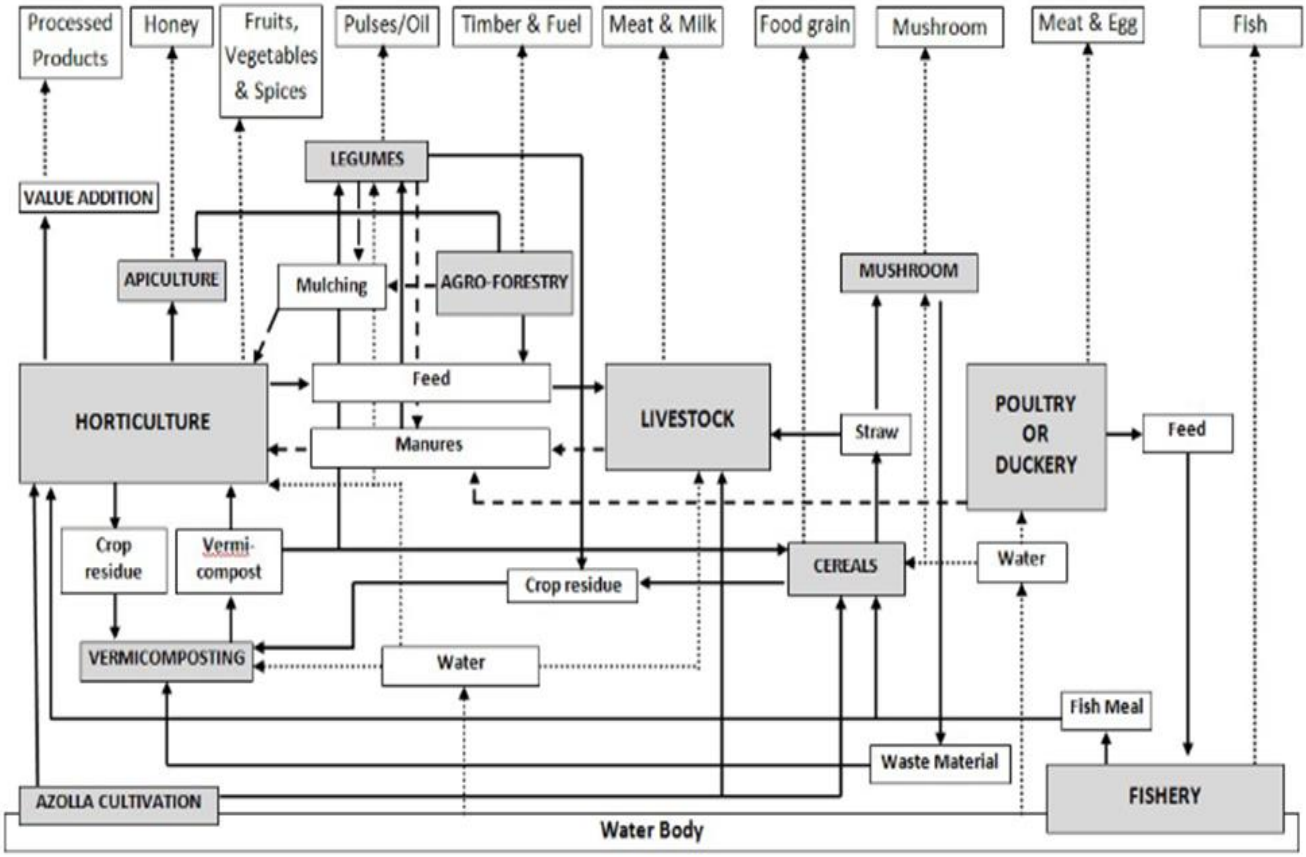
(2) The revenue generated by crops is hardly enough to keep the farmers afloat throughout the year.

(3) When the crop is in good condition, a guaranteed regular cash flow is merged with other enterprises intelligent mix of enterprises, mindful of the environmental circumstances a locality will yield bigger rewards. While doing so, Additionally, it will support efficient recycling of waste.

(4) On the same plot of land, horticultural and vegetable crops can provide up to three times as much energy as cereal crops, ensuring the sustainability of the current system's food supply and economic viability (Gill *et al.* 2009).

(5) Due to the need to conserve space, the addition of beekeeping, fishing, mushroom growing, bird rearing, goatry, and livestock also adds on high energy without compromising the production of food grains. The integration of these businesses promotes realistic production, consumption, and breakdown within an ecosystem. Since biomass and animal waste still contain between 70 and 80 percent of the micronutrients that are present in crops, proper recycling of waste is essential in farming systems (Inman *et al.* 2005).

Components of IFS to empower the marginal farmer:



Integrated farming system can be classified as four major different group. There are

(1) **Crops**= Horticultural crops like different types of vegetable (legume vegetable, bulb type, cucurbits, solanaceous etc.), fruits crops (mango, citrus, guava and temperate fruit also), ornamental and foliage plants, plantation, spices, medicinal aromatic plants, fodder crops.

(2) **Livestock and poultry**= cows, buffalos, goat, duck, hen, pig, sheep etc.

(3) **Fishery unit**= poultry unit is prepared above the pond where fish can get food and ultimately give an income generation for marginal farmers. (4) **Secondary farming**= mixed farming or inter cropping farming system, mushroom cultivation, bee keeping, biogas plant, vermicomposting.

(Source: Roy *et al.* 2014)

Energy transfer model to empower farmers:

In the present scenario where the people are very much health conscious and concerned about the food. They mostly prefer organic and fresh foods which is causing competition among the big companies to push themselves to produced more organic vegetables, fruits etc. to the customers, which is in fact opening a door for small businesses to the farmers for income generation. In India most of the farmers apart from crop cultivation, they have their own livestock which could be helpful for them in many ways such as producing organic manures, vermicompost along with organic fruits, vegetables etc. for the income generation. Also recycling of residues optimize use of resources and generate higher employment without any risk and uncertainties (Uvaneswaran and Keerthana, 2015). In recent years the demand of organic manure is also increasing tremendously in markets. There are many ways available from on and off farm units, which can be used for manure production.

Plant nutrients that are used to improves crop productivity and soil fertility that obtained from the residues of organic materials such as the waste of human, animal and plant residues is termed as manure. Manures with low nutrient content per unit quantity shows longer residual effect compared to fertilizer with high nutrient content as well as improves soil physical properties. But continuous utilization of organic manures can also deplete the soil fertility, so to replenish the fertility of soil different kinds of manure are used. It is categorized into Bulky organic manure and Concentrated organic manure.

Bulky organic manures:

The most important and extensively used bulky organic manures includes Farmyard manure (FYM), compost and green-manure which can be produced by the farmers itself on their own. All the materials that required for the preparation of FYM, compost and green manures can be obtained from the waste of cow, goat, sheep, crop residues as well as weeds around the field. All these compost materials are cheap and available with the farmers which they can turned into organic manure and shell in the market.

The advantages of Bulky organic manure are:

- Supply micronutrients along with plant nutrients to soil.
- It improves soil physical properties such as soil structure and water holding capacity.
- Addition of availability of nutrients in soil.
- The emission of carbon dioxide during the decomposition of CO_2 iacts as a fertilizer.

Farm yard manure

FYM is a combination of cow dung and urine with their litter as well as other substances like hay, straw used for cattle or fodder fed to the cattle. FYM comprises an average of 0.5% N, 0.2% $P_2$05 and 0.5% $K_2$0 (Sing, 2014). Some of the Horticulture crops such as tomato, potato, sweet potato, carrot, radish and onion etc., responds sound to the farmyard manure as well as orchard crops such as banana, orange and mango and also plantation crop like coconut.

Compost

The natural process of rotting or decomposition of organic matters through aerobic and anaerobic microorganism under control conditions is known as compost. The process can be carried out or practiced by individual farmers on their land with the available raw organic waste like crop residues, food waste, animal waste and by industries with the industry wastes in cities. Compost is a rich source of organic matter that helps in sustaining of soil fertility and sustainable agricultural production. Most common and important composting which can be produce by farmers are vermicompost and weed compost.

Vermicompost

Since vermicompost is a familiar term which is known to many farmers and common people to improve their farming system. The term is known as the composting of weeds or any plant residue with cow dung by using earth worm to create a heterogeneous mixture. This is the most adopted technology to produce organic manure. Red Wigglers (*Eisenia foetida* or *Eisenia andrei*) is one of the important worms used for this technique, whereas European nightcrawlers (*Eisenia hortensis*) can be also used. The unit can prepare according to one's capacity. It can be prepared from using low cost available materials like bamboo, thatches or paddy straw etc. following are the steps to carry out this method-

- First construct a pit with bamboo of 3.5 m × 2.1 m × 1.5 m size with thatches roof top.
- After that chop the weeds and place alternate layer of dung and chopped weeds in the pit. Then let the mix decompose for the one month.
- Now transfer the decomposed material into another pit of 3 m × 1 m × 0.5 m which could accommodate about 500 earthworms and sprinkle water regularly to avoid desiccation of the earthworm.
- A 4-inch-wide drainage should be kept all around the pit with water filled to protect the earthworm from any predators like ants and insects.
- In warmer condition it takes about 3 months to produce first batch of vermicompost.
- The upper layer should be gently removed without harming the worms and allow them to move downwards.
- After collection sieve the decompose and then can be use or sell in the market.

In present days the cost of 1 kg vermicompost is between Rs 6-20 depending upon the area as well as producer. But in renown companies, they are selling it in more than Rs 200. So small scale farmers can contact the big companies with the help of KVK's or Agriculture or horticulture department.

Weed composting

Apart from vermicompost farmers can go for another method of compost by using weeds composting which is cheaper and less time consuming than the vermicompost, even though the compost from both techniques works as same purpose. Weed mulching is the most common practice carried out by the rural farmers in their field. Therefore, implementation of weed composting by using low-cost technology to produce high quality manures can add extra income for the farmers and help them to produce organic product as well as organic manure. In this method all the material that requires to prepare a composting unit are bamboos, thatches/CGI sheets and perforated pipe/bamboo pipes. The composting unit is prepared by making three chambered (1m × 1m × 1m) structures with bamboos by placing perforated pipes/bamboo pipe vertically in middle of the first and second chamber for the aeration with thatches/ CGI sheet. After completing the construction of compost unit following steps can be carried out for the weed decomposing-

1.Firstly, collect fresh cow dung and fresh weeds/ field or vegetable waste in equal amount (1:1). The weeds should not be in flowering or fruiting stage. Also avoid any kind weeds that is having sweet aroma or sour in taste.

2.Then chop the weeds into small pieces and mixed thoroughly with fresh cow dung with foot and add little water for the consistency of the paste.

3.After mixing transfer the paste into first chamber and keep it there for 9 days to decompose.

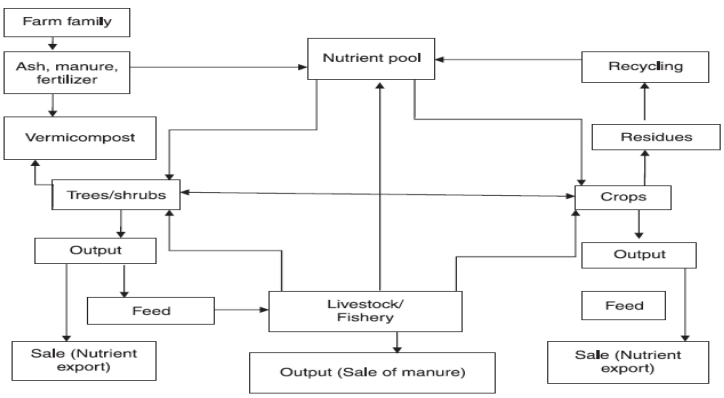
4.After 9 days transfer the paste from first chamber to second chamber and kept it there for another 7 days.

5.Next transfer the paste into third chamber and keep it there for another 5 days for the complete decompose. After that sieve it and is ready for the use. It takes total 21 days to complete this procedure.

This method is the most simple and cheapest technology for the farmers to produce organic manures on their own. According to the farmers of hilly areas of Arunachal Pradesh weed compost has shown excellent for the growth of vegetables as well as other crops.

Concentrated organic manure

Concentrated organic manures are no different that the organic manure in properties but contain high percentages of major plant nutrients like N, P_2O_5 and K_2O compared to the bulky organic manures. Concentrated manures are obtained by using raw materials of the animal or plant source like oil cakes, blood meal, fish dung, meat meal, and wool waste.



Flow chart of Major sources of manures.
Source: Kumar et al, 2018

Different types of Integrated Farming System:

Integrated farming system does not only revolve around between crop production and livestock but also includes agroforestry, Agri silviculture, silvi-pasture, horti-pasture etc (Thakur *et al.*, 2015) which could be crop-fish integration, livestock-fish integration, crop-fish-livestock integration or combinations of crop, livestock, fish, vermicomposting, and other enterprises (Uvaneswaran and Keerthana, 2015). With so much resources available, adoption of integrated farming system can provide farmers to get the higher net returns in limited land (Kerutagi *et al.*, 2019). Apart from this IFS can spring business opportunities for graduates with low cost and yield high income. Recently many farmers in India have adopted this system and earning quite profit. Some of success stories of farmers adopting different Integrated farming system are given below-

(1) Horticulture + agriculture + dairy: Integrated farming approaches is based on the 3Fs i.e., food, fodder and fuel which ensure the production system to improve productivity and efficiency (Roy *et al.*, 2014). Kaur in Ambala district has developed a farm using the model of integrated farming system in the area of 5.5 ha. In her model agricultural crops (wheat, rice and sugarcane), vegetables crops like (onion and potato i.e., mostly rabi season vegetable crops) and dairy farming like growing of fodder crops for buffaloes. Annually, her net returns are around 6.50 lakhs with total returns of around 9.50 lakhs (KVK). Another example of horticulture cum agriculture cum dairy farming from Rajasthan district of Dungarpur has developed a farm with an area of 6 ha. area. The components of her horticulture-based integrated farming system model include vegetable crops (brinjal + coriander, cauliflower + beet root + radish and tomato + coriander + spinach), spices (coriander + turmeric), agricultural crops (rice, rabi maize, wheat, gram, black gram, soyabean) and livestock (cows and buffalo). The establishments with different enterprises in a farm ensure more earning than the singular enterprise viz., cereal (40%), pulses (10%), oilseed (10%), horticulture (15%), fishery (10%), livestock (10%), poultry/piggery/goatry (2%), storage, threshing floor, implement shed, vermicompost, straw storage and farm building etc. (3%) and create more employment (Gill *et al.* 2009).

(2) Horticulture + poultry + diary + mushroom + fishery: In Uttar Pradesh, Meena *et al.*, (2022) conducted studies of IFS model with different enterprises on 1.5 ha of land under irrigated condition. Five-year result of their studies revealed that they got 6.12×103 /ha gross return/year/ha and 3.74×103 /ha of net returns with the IFS model of arable crops (1.04 ha), horticulture crops (0.22 ha), fishery (0.10 ha), mushroom (0.02 ha), poultry (10 birds), vermicompost (0.02 ha) and kitchen garden (20 m^2) per day income of 1025 from 1.5 ha, which also provided an employment opportunity for the marginal farmers for five years.

Another studies in Goa by Vijaymahantesh (2017) revealed that integrating plantation crops with vegetable crops, mushroom, poultry and diary also brings net returns of Rs 17,518/ha/annum more than the monoculture of cashewnut cultivation. Similarly, Korikanthimath and Manjunath (2009) conducted an experiment at ICAR Research complex using integrated farming system with rice, brinjal, mushroom and poultry. They have received a net return of Rs. 30865/ha with 21487 kg/ha productivity.

(3) Horticultural crop + dockery + agriculture + fishery: It has been known that duck is the natural weeder which cleans up the hedges of pond and nearby of pond area. And adding duck in IFS model enhance lots of profit both in ecological as well as economically. Kumar *et al* (2021) conduct an experiment at ICAR Research Complex for Eastern Region, Patna on Crop + Livestock (2 Cows) + Fishery cum Duckery in two acre area for ten years. The experiment profited them with net return of f Rs. 1,48,569 with B:C ratio of 1:85 which was four times higher than the rice and wheat cropping system. Similarly, Singh and Ravisankar (2015) also revealed in their studies that pond based integrated farming with crop, fish, poultry and duckery in humid areas increases water productivity 12 times i.e., okra (1.8 kg/m^3) in and 2.6 kg/m3 in French bean to 40 kg/m3.

(4) Horticultural crop + livestock + fishery + agriculture: The farmers who has this type of IFS model gets the maximum benefits both in the terms of monetary as well as employment. In this regard, Sasmal *et al* (2020) has carried out an experiment in West Siang district of Arunachal Pradesh in 0.63 ha with IFS model of fish with different combination. As per their studies, they concluded that normally the weight of fish is 506.6g in 150 days in monoculture whereas under the integrated rice fish and duck culture the weight of the fish was observed 355.84g which shows 42.38 percent higher body compare to monocultured fish weight. The studies also revealed that the famer got total yield benefits of 1271.5 kg of fish and 5793 kg of rice with souring percentage of 42.08 and 58.7 per cent respectively in total yield. Similarly, Rajappa *et al* (2022) also revealed in their studies that crop-fish-poultry-multipurpose trees produces maximum meat production i.e., 3.18q/ha. In Uttar Pradesh the studies carried out by Singh *et al* (2006) on rice + horticulture crops + dairy + poultry + fish observed the highest productivity system as well as most suitable for ecosystem improvement.

(5) Horticultural crop + livestock + apiary: Beekeeping is one of the emerging investments that is helping in economy of the country. Most of the marginal farmers are adopting apiary along with the integrated cropping system to boost their income generation. In Uttar Pradesh Singh *et al* (2012) carried out a study in 1.4 ha area with different components and got net return of Rs. 135826. It was such a vast model that required quit number of man power causing large number of employment generation i.e., 684 men days/ha/year. As per the studies conducted by Panwar *et al* (2018) the combination of 64% area + dairy (2 cow) + horticulture (20% area) + fishery 20% area) + agroforestry (3%) +vermicompost (1%) +Apiary (5 boxes) got the highest net returns with Rs 2.68 lakhs/ha/year.

Recycling of waste:

IFS being the combination of different cropping system gives more profit than the monocropping system. This model provides farmers not only the yield but also helps them in obtaining manures which saves the investment in buying FYM and organic manures. It also helps them in addition of income along with the productions. The farmers recycle or turn over the residues of farm and livestock into manures for their own use and more over they obtained 95% of nutritional requirement of the system with recycling sources (Vijaymahantesh, 2017). Apart from the farmers many studies have also supported the idea of recycling the farm waste and animal waste as it supplies healthy food and a means of amiable environment to the farm family. As per the Nutrient budgeting of the available farm wastes and crop residues, Meena *et al* (2022) revealed in their studies that with the proper

recycling management practices farmers can save upto 36% of NPK requirement as well as lessen the cost of chemical requirement for the model. Similarly, Kumar *et al* (2021) also found in their studies that using IFS model in one acre, after recycling the farm waste and animal residues they got 2.5 t goat manure, 6.62 t vegetable waste, 4.64 t rice/maize/lentil straws and 1.78 t poultry dropping resulting Rs. 3175 benefits in income and added 44.0 kg N, 29.5 kg P and 31.2 kg K in the soil that is equivalent to 93.0kg urea, 184.0 kg SSP and 52.0 Kg MOP. Likewise, (Kumar *et al.*, 2012) also revealed that IFS model under two acre produces 13.8 t cow dung, 11.3 t vegetable wastes and 1.21 t duck dropping which added Rs. 4826/year in the income after the recycling within the system.

Conclusion:

As the nation's population is increasing day by day which is directly reflecting the environmental condition also. To protect the ecology of environment, adoption of integrated farming system plays a very important role as compare to the non-integrated farming system. Since this system is interdependent with ecology, it improves the living system of the earth. As per the data interpretation, it has been found that IFS is showing positive effect on the farmers as well as industries/ cities who has adopted this system with great economic return with the increased in curve of Benefit Cost (BC) gain per unit expenditure. The economic section of the organization has also immensely improved due to the integration of more than three enterprises. Integrated farming system has profited to many small-scale farmers apart from the production of vegetable, fruits etc. by producing organic manures which brings a great impact in their earning system. It also profited the employment generation in rural areas as well as women empowerment by giving them opportunities to take part in entrepreneurship by boosting their self-confidence. Therefore, one should encourage to adopt this system to bring change in their living style.

Future Perspective:

The creation of a database on integrated farming systems (IFS) across the nation, including the size, type, and allocation method of each firm; infrastructure, economics, and the long-term economic viability of the system, etc., in various ecological circumstances. It is a system that can adds benefit components as well as replaced the less benefit components with the feasibility of time and choice of farmers and availability of market. It is necessary to establish a solid policy for planners to consider in order to promote and raise awareness of it on a large scale with some financial aid, such as loans or subsidies.

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