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A Sustainable Way for Integrated Farming System: A Case Study on Bellary District of Karnataka, India

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ABSTRACT

Sustainable development is a concept that strives to gain economic progress and to make developments in agriculture that stays for long without harming the environment. while conserving the soil biodiversity and environmental prolonged value. It also serves as a framework for integrating environmental regulations with development initiatives. Recently, there has been a pressing need to embrace greater sustainable farming methods, and a logical evaluation method is required to identify innovative management options. One kind of environmentally-friendly farming that has recently emerged is the integrated crop-livestock farming system. The importance of an integrated farm and livestock system for sustainable development, and the fact that integrated crop and livestock systems have been a foundation of agriculture for hundreds of years, imply a diverse range of integrated ecological, biophysical, and socioeconomic conditions. Sometimes it is difficult to maintain sustainable agriculture in dry areas like Bellary. Adopting an appropriate integrated agricultural system model is very important to achieve sustainability in lowland rice cultivation in the Tungabhadra project located in Karnataka. Continued rice cultivation and practice in the region have resulted in resource deprivation and condensed and decreased yields. The diminution of hereditary soil assets, the development of nuisance and pests scenarios like brown plant hopper, and the problem of weeds were also noticed.

Keywords: *The integrated farming system, Sustainable farming, Soil biodiversity, Organic, Livestock, Dairy*

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INTRODUCTION

Dryland ecosystems cover over three billion hectares and they are the homeland of 2.5 billion people, accounting for 41 percent of the world's land-living zone and further than one-third of their population. Dryland areas and their associated cultivated production arrangements are extremely important due to their size and current intense uses. Dryland ecosystems, for example, contribute around 40 percent of the overall diet grain and pulses output and back two-thirds of the cattle population in India, where this study is focused (Haileslassie *et al*., 2016). Developing an integrated farming system requires the employment of appropriate technologies. It is vital to consider how to assist farmers in improving the quality of their crops as a tool in integrated farming. Technology must also be regarded as a means of overcoming and balancing the drop in food production caused by the loss of agricultural land. Because of technology, some countries with limited land can still solve their food problems (Ansar, 2018). We have been able to design a framework for an alternative development model that will increase the viability of small and marginal farming operations in comparison to large larger ones in which the total credit goes to the integrated farming system. The phrase "Integrated farming system" is frequently used to refer to a more integrated farming method when compared to monoculture farming. It also goes by the name "Integrated Biosystem" and it describes an agriculture system that combines the production of fish and animal husbandry or livestock and crops (Soni *et al*., 2014). Long-term agricultural research has been carried out in many regions of the world in addition to developing an integrated system, and in certain cases, economic and environmental observations with the conventional method have been made. Integrated farming has proven to be equally profitable in the long run (Holland, 2020)

Sustainable development pointers try to quantify sustainable progress as a whole, captivating interest in the account of the diverse and combined farming type of knowledge. Sustainable progress or development is an idea that strives to continue financial and commercial improvement and development while conserving the environment's longstanding price and value. It also serves as an agenda for integrating environmental regulations with development initiatives (Osak & Hartono, 2016). Integrated farming systems are a production approach

that involves merging yield, cattle farming, besides Forestry practices in a similar area in a variety of ways.

- integration of crop and animal husbandry
- crops and forestry
- animal husbandry and forestry
- crop, livestock, and forestry

The decision on which to adopt will be influenced by the region's economic and geographical characteristics, as well as financial incentives, farming infrastructure and farmer capabilities, production strategy, and cultural factors (Oliveira *et al*., 2018) Sustainability should not be viewed as a destination, but rather as a goal, similar to liberty or equality, that cannot be achieved yet leads to positive change. In a development framework, such a concept is especially useful in dealing with concerns of uncertainty and risk (Gibon *et al*., 1999).

According to the existing situation in the country, the area under cultivation may decline even more by 2030. The fact that 80 percent of agricultural families in India are classified as small or marginal farmers adds to the difficulty. Efficiency enhancement could be a critical answer for guaranteeing nutrition and food safety for a huge population. This necessitates the adoption of contemporary agronomical practices and expertise that increase the productivity of traditional agricultural systems. IFS is defined as a crop and livestock enterprise that contains at least a minimum of two discrete yet rationally symbiotic sections. The IFS is defined as an aquaculture system that includes animals and uses fresh animal waste to feed fish. The situation deteriorates in marginalized and less integrated areas, which are home to the majority of the poor. Agriculture's and rural poverty alleviation's futures are dependent on how we provide food, nutrition, and sustainable livelihoods via integrated and sustainable family farming that is resistant to open market volatility and climate unpredictability (Dasgupta *et al*., 2015). Climate plays a vital effect in crop productivity in India, especially when the soil is dry. Dryland accounts for almost 62 percent of a country's total cultivated area of 142 million hectares, accounting for 42 percent of overall food output (Mynavathi & Jayanthi, 2015).

Objectives of integrated farming

The main objective of integrated farming systems is to develop technically possible and economically successful farming system models for irrigated, rainfed, hilly, and coastal locations by integrating cropping to produce income and employment from small and marginal farmland. Some main objectives are listed below (Chauhan *et al*., 2016)

- Improve efficiency
- Increase on-farm biodiversity by regulating nutrient and material flows.
- Eliminate the odors associated with some animal operations.
- Through natural cropping system management, we may control insect pests, illnesses, and weed populations under control and at a low level of intensity.
- Reduces the use of chemical and harmful fertilizers, as well as some other dangerous agrochemicals and insecticides, to offer society pollution-free, hale and hearty crop production, and a pollution-free environment.
- Maximizing the productivity of all component firms to give a more consistent and predictable income

Integrated crop-livestock-fish farming system

Rice and fish integrated Farming

Asia has been the birthplace of the integrated farming system of fish band rice farming, which has flourished since the dawn of civilization, especially as human communities began to move inland from river banks. Even though there are some successfully adopted fish and rice integrated farming system techniques in Asian continent countries, like India and China, the concept of agricultural-based pairing up, and a systematic combination of cultivation, aquaculture, and animal husbandry is still not widely used in these areas and yet to educate people (The paddy-field wetland is ideal for breeding and feeding a variety of fish **(Figure 1)**. Most spawnings in rice fields produce glue-like eggs that are generally arranged on green plants to provide extra oxygen and nutrition designed for maturing embryos (AL-Kattan *et al*., 2019; Al-Rejaboo & Jalaluldeen, 2019; Falya *et al*., 2021). However, shallow water net constructors and spawners breed in paddy fields under ideal conditions) (Paramesh *et al*., 2022).

Figure 1. Coconut and pearl millet with chicken

The ability to adopt an appropriate integrated agricultural system model is critical for achieving sustainability in the low-land rice of Karnataka's Tungabhadra project. The ongoing practice of rice-rice sequence in this area has resulted in resource degradation and yield loss. Agricultural Research Station, Siruguppa, Karnataka, undertook a field experiment in 2004-05 and 2005-06 to determine the relative performance of various rice-fish-poultry models. Over time, the integrated farming system had higher system production and net returns, according to the average. The study concluded that rice-fish-poultry may be successfully used under canal irrigation in the Tungabhadra Project area of Karnataka. Rice-fish–poultry was the best among the different models and models (Channabasavanna & Biradar, 2007). IFS has a method of Rice and fish farming and it plays a significant part in producing more nutrition, as the cohesive agricultural scheme outperforms rice culture or rice monoculture in rapports of source consumption, variability, efficiency, and together the excellence and amount of the products manufactured **(Figure 2)**. Furthermore, there are several substantial barriers to the implementation of this farming system, including a deficiency of mechanical expertise among farmers and flood and drought

concerns. This type of farming benefits should reach the people widely, especially the millions of rural people who are not aware of this type of farming (Ahmed, & Garnett, 2011).

Figure 2. Rice fields in siruguppa

Crop-Livestock

Crop/livestock rotations are designed to maintain topsoil and organic material, promote healthy soil biology, control crop weeds and diseases, and extract water from the subsoil. It will be vital to blend crops and cattle spatially. From mixed agricultural and livestock production systems to specialized and concentrated crop production, land use is rapidly changing (Bradley, 2009). crop or yield rotation including grassland provides feed for animals, which later, in turn, provides organic fertilizers for tilling the land, increasing farm income profitability and stability (fewer inputs used and market diversification), and increase sustainable development (livestock manure recycling, soil nutrient, and carbon capture and storage) (Veysset *et al*., 2014) Over the last few decades, agriculture has progressed from natural and traditional cultivation to economically productive and industrial farming practices. Increased amounts of external farm inputs have intensified environmental issues such as nutrient leaching, pesticide pollution, soil depletion, and eroding. A resource-conserving, socially supporting, viable and competitive, and the environmentally sound integrated crop-livestock system is possible. Maintaining grassland and dairy farming in less favored places, as well as keeping the landscape open, requires significant effort. Various strategies must be examined and tailored to the unique circumstances and requirements (Biala *et al*., 2007).

Tripathi and Rathi found several current farming system models, including

- crops + dairy **(Figure 3)**
- crops + dairy + horticulture + goats **(Figure 4)**
- crop + goats + horticulture
- crop + dairy + vegetable
- vegetable + fish and crop + dairy + other animals **(Table 1)**.

Farm income is slowly declining due to shrinking land holdings and continued non-integrated agriculture. Crops, dairy, fisheries, poultry, mushrooms, horticulture, sericulture, and other agricultural components must be integrated into a single farm unit to preserve farm income and also for sustainable agriculture (Pervez *et al*., 2021).

Figure 3. Animal husbandry

Figure 4. Coconut with Arecanut, black pepper plant, and goat farming in Vallegerehalli, Hassan district, Chanrayanpatna taluk, Karnataka**.**

Benefits of integrated farming

There are many benefits due to IFS where crops were grown in mixed form with livestock or another plant variety which helps in soil conservation and to maintain manure levels in the soil which makes no use of chemical fertilizers. Due to crop rotations and other sustainable practices in IFS benefits in (Viaux & Rieu, 1995)

- Helps in minimizing insects, pesticides, and disease problems
- Decrease in energy requirements
- Increases the vegetative layer on soil which increases strength towards soil erosion and protects the environment
- Decreases risks caused by irregular climatic conditions
- good balance among both outputs and inputs of nutrients, resulting in much less pressure on the environment and nature, particularly for farms or regions with intensive farm animals based on high inputs of food products (Vereijken, 1992)
- cost savings and yield boost (Vereijken, 1992)

A model for small and marginal farmers

Indian finance is primarily dependent on the countryside or rural and agrarian, and the shrinking range of land holdings and carriages severely threatens farming's long-term viability and profitability. Given the drop in each person's land accessibility from 0.5 hectors in 1950 to 1951 to 0.15 hector by the crack of the period, with a predictable additional drop to fewer than 0.1

hectors through 2020, it is critical to advance the approaches and farming skills that empower satisfactory service and employment and revenue and Payscale increment, particularly for minor and marginal farming farmers. Generalized functions of the agricultural system are presented under East Indies Situations that agricultural system researchers/workers can consider when designing an integrated agricultural system model (Behera *et al*., 2013). The study was undertaken at the research station which is located in kathalagere of davangere district. The institution's name is Agriculture and horticulture research, which is stationed in Karnataka state under the area of Bhadra command area, on an Irrigation-based integrated agricultural system for an area of about 1.0 hectares of small landholders (Kumara *et al*., 2017). A model for small and marginal farmers in reference to Kumar *et al*., 2017 review paper.

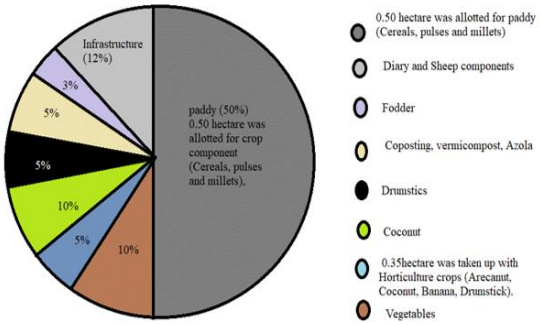

Figure 5. Example of integrated farming

Integrated farming system production in clear form

Table 1. An example of an integrated farming system for marginal farmers.

Sl no	Basic features	Area in % or area in hectors	Benefits
1.	Approximate land holding by marginal or small land farmers	0.1 to 1.0 hector	Can easily adopt IFS in marginal farms
2.	Family size	6 to 8 members (4 adults and 2 children)	If the family is big there is no need for extra pay for workers
3.	Land types • Upland • Medium land • Low land	 20% of the total area 50% of the total area 30% of the total area	Easy to divide the land for a variety of crops and livestock
4.	Upland (Kitchen gardening, fruits, coconut, lemon, vegetables, pumpkin. Etc) Medium land (Rice with mustered, tomatoes, sesamum, and green grams) Low land (Rice or cereals)	0.3 hectors 0.8 hectors 0.7 hectors	
5.	Livestock and types of livestock • Cows • Bullocks • Buffalos • Pig • Chicken • duck	0.16 hectors 2 2 2 1 to 2 10 5 to 10	Helps in getting daily income and buffalos and cows for milk and manure purposes. Pig, chicken and duck, and goats for meat purposes. Livestock also helps in regaining the strength of soil after one crop.

Some experiments were conducted in various regions of india on integrated farming systems

A typical integrated farming practice is presented in **Figure 5**. There are various success experimentations that are carried out in farmers and obtained better results. And some case studies are as followes.

- *Rice, fish, and poultry farming in one system*
  On 430 farm holdings in 12 villages of Tamil Nadu's Cuddalore, Villupuram, Nagapattinam, and Thiruvannamalai districts, Annamalai University showed an integrated rice-fish-Poultry farming system. For two and three crops, the results showed an annual increase in net return per family of 33,000/- to 50,500/ha/year.

- *Model of an integrated pig/poultry/fish/vegetable agricultural system*
  A total of 98 percent of the population of Assam's backward districts lives in rural areas. for the majority of people, pig rearing is an alternative source of income. Pig farming generates less income. ASSAM Agricultural University, Jorhat, presented an integrated system of agriculture with hybrid breed pigs/poultry, fish, and horticulture, for increased income in the Assam districts of Lakhimpur, Kokrajhar, and Karbianglong. According to the findings, a farmer can earn an average of '54,500/ and '90,000/ from the poultry-fish-vegetable and pigfish-vegetable systems, respectively.

- *Bidar, Karnataka, has a Redgram-based integrated farming method.*
  In India, red gram, known as pigeon pea, is known as Tur or Arahar. It is one of dryland farmers' most important commercial crops. Bidar district is known as Karnataka's pulse bowl, with key crops such as black gram, green gram, red gram, and Bengal gram. The potential and current yields of red gram in the Bidar district are estimated to be 2,700

kg/ha and 829 kg/ha, respectively. An Integration Farming System model combining Redgram and Bengalgram crops with vermicomposting, Azolla agriculture, and poultry was created and shown in the Bidar area of Karnataka to increase income. The integrated strategy was both productive and profitable, generating an average revenue of rupees 1,53,200 per household per year for 240 households.

Economic efficiency of ifs with some examples

In demand to upsurge the income, food, and nutrition safety in emerging countries, Agriculture yield should be expanded for greater sustainability and financial benefits. The goal of an integrated farming scheme is to increase small-scale farm employment and income by integrating multiple farm operations and reprocessing yield leftovers and also by-products of the smallholding.

The research was carried out in Tamil Nadu's Tiruvallur and Thanjavur districts. Farmers who exclusively grew paddy received a net gain of 40755/ha for spending 45942/ha. Farmers saw incremental gains when they added new firms. The incremental net benefit with enhanced administration practices is amplified by 7,880 rupees for a crop with dairy, 12,680 rupees for crop and dairy along with poultry, 57,530 rupees for the crop, dairy, and poultry with fishery, and 35,840 rupees for crop-dairy with poultry and sheep/goat rearing in one field. IFS implementation could result in extra income ranging from 9,000 to 2,00,000 per acre (Ponnusamy & Devi, 2017).

Over 13 months (June 2013-June'2014), Ganesh Mallick, rural youth from a village named Belamara in the Balipatna of the Khordha District, earned about Rs 3,75,920 from a crop-based integrated farming system and they are Some of the crops examples are paddy seeds, paddy or rice fields, pulses like green gram and horse gram, vegetables like hybrid okra and pointed groundnut, some fruits like coconut and banana which can give high yields, dairy or animal husbandry and mushroom (Dash *et al*., 2015).

Rice is the primary food of more than 90% of Manipur's people and is the foundation of the state's entire farming system. In the IIFS (improved integrated farming system) system, rice yields averaged 5,087.1 kg per hectare, compared to 3 000.15 kg in the conventional farming system. Overall, the IIFS revealed increased spending on variable costs as well as higher gross and net returns (Ansari *et al*., 2013). An integrated farming system achieves different missions and objectives such as making farmers self-sufficient by ensuring a balanced diet for family members, enhancing the quality of life by achieving maximum total net returns that provide more employment, recycling crop residues generated from the waste of plants and livestock, optimizing resource use, reducing risks and uncertainties, and maintaining environmental harmony by combining carefully chosen components/enterprises under a provided agronomic system (Patel & Dutta, 2004).

CONCLUSION

Integrated Farming combines the best of modern tools and technologies with traditional practices based on site and situation. It means using many ways of cultivation on a piece of land. Integrated Farming System (IFS) is an interdependent, interrelated often interlocking production system based on crop production, rearing animals, and related subsidiary enterprises in such a way that maximizes the utilization of resources of each system and also minimizes the negative effect of these enterprises on the environment. Irrigated agricultural systems are used to grow a wide variety of food and income crops. Rice cultivation systems built on wetlands that rely on monsoon rains augmented by irrigation. Rainfed farming systems with crop activities or mixed crop-livestock systems in humid places with high resource potential. Rainfed farming systems, which are generally mixed crop-livestock systems, are common in steep and highland locations. Through the intensification of agricultural and allied activities, an integrated farming system can enhance economically for a particular area at a particular time. The number of job openings has also increased.

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