Advancement in Prospects of Integrated Agriculture: New Era of Sustainable Rural Livelihood

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Abstract: India is an agricultural country and "agriculture is the main pillar of the national economy, plays the most major role in the socio-economic sphere of the country". In agriculture, Indian farmers face different problems. Out of which water is one of them. Water is a fundamental input into agriculture and has a decisive impact on almost all aspects of it. India is facing chronic water shortages as a result of insufficient water supply management system and climate change. Indian agriculture requires 90% ground water but that requirement is not fulfilled due to rapid groundwater depletion and poor irrigation systems. Improvements in handling of water resources integrated approach of farming are very important. In this study we discuss about the water problems of Indian agriculture and how we can achieve sustainable agriculture through Integrated farming system.

Keywords: Socio-economic sphere, Integrated farming system, Economy, Sustainable agriculture etc.

1. Introduction:

Indian agriculture is a heterogeneous system and huge sector which involves a large number of farmers. In post-independence era's incredible success stories exists which relate through the integration of innovations from the green revolution that helped to strengthen the Indian economy [1]. Agriculture to be predominant sector of the Indian economy, in which half of that sector for their livelihoods and jobs that contribute his share in gross domestic product (GDP) which has declined in recent years. In post-reform period, the rapid growth in the non-agricultural sectors, especially services, has failed to accelerate agricultural growth [2].The current global challenges of making food availability and accessibility both, in terms of quantity and quality require deliberate and far-reaching solutions. Historically, "Agricultural and Extension Services growth work has been a manage force in meeting food supply over the entire world". Despite the region's large array of natural resources, some countries face major challenges of food scarcity, hunger and malnutrition more than others.

Enormous diversity in countries' size, population, agricultural and economic development reflects the huge differences in between agricultural production systems, agro-climate potential, population density and infrastructure [3].

1.1. Current status of water in agriculture Sector:

India ranks 2nd in farm output globally. In 2013, agriculture and related sectors such as forestry and fisheries13.7 per cent contribution shares in GDP (Gross Domestic Production) and get employed 50 % of the workforce. In this sector some basic infrastructure required, includes a network of canals for agricultural activities from rivers, groundwater, well-based systems, tanks, and other rain water harvesting products. The ground water system gives largest contribution to covering in present time – In 160 million hectares of Indian cultivated land, 39 million hectares of land irrigated with groundwater, 22 million hectares lands irrigated with irrigated canals and about two-thirds of India's cultivation is still dependent on monsoon. Average size of farm land in 2010/2011 was around 1.15 ha of 138 million farms and large-scale farm occupied around 37 ha land in 2016 (BMEL India Country Report 2016). Agricultural extension has only one extension worker per 800-1000 farmers, and the degree of mechanization is less than 50 percent (BMEL India country study 2016). Water stress and scarcity indicators are used to generally reflect the total water availability and accessibility in a country or region. If the water availability per capita is less than 1700 m3 and 1000 m3, a country is classified as water stressed and water scarce, under international standards, respectively. India is already a water-stressed country under this standard, with 1544 m3 per capita water availability, and this data progressing towards water scarcity [4].

Table.1. Sector-wise shares contribution in Indian GDP

Year	Agriculture & Allied Sectors	Industry	Services
1950-51	53.1	16.6	30.3
1960-61	48.7	20.5	30.8
1970-71	42.3	24.0	33.8
1980-81	36.1	25.9	38.0
1990-91	29.6	27.7	42.7
2000-01	22.3	27.3	50.4
2012-13*	17.2	31.7	51.1
2013-14*	16.1	31.4	52.5

Source: Economic Survey of India- 2013-14

1.2. India is mainly an agricultural country:

For most Indigenous communities, agriculture is the most important occupation. Agriculture contributes about 16 percent in total GDP of India and 10 percent shares contributes in total exports. India is second largest country in the terms of total arable land; over 60 percent of India's land area is arable. In agriculture sector, products include rice, wheat, potato, tomato, onion, mangoes, sugar cane, beans, cotton, etc. shows a significant economic value. Farming is backbone of the Indian economy. Though, the overall share of country's GDP in agriculture has decreased because the growth of other sectors. Today, agriculture also plays a major position in India's overall economic scenario. Food is a critical part of life. For our food requirements we depend on the agricultural outputs. India produces food grains such as millets, cereals, pulses, etc. in very huge amount. Food that produced in the country is consumed in significant manner. Our farmer's do work hard in either day or night to feed our 1.21 billion-plus population. Apart from commercially biased agriculture, subsistence agriculture with emphasized on food production for the family of the grower is globally. Agriculture is generally practiced as the easiest way of providing food for the household. In India, agricultural contribution is more a 'way of life 'then a 'mode of businesses. Agricultural products like jute, tea, tobacco, coffee, spices, and sugar plays a significant role in India's export trade. Country exports excess food and farm products. It helps boost foreign exchange. India ranks seventh on agricultural exports.

In 2013, India exported around $39 billion worth of agricultural products. Agriculture is the basic occupation in this country and majority of population engaged on it, even large part of rural women also gives a contribution to do agriculture work. According to the 2001 census, over 56.6 per cent of India's main workers are engaged in agricultural work and agro-based activities. Many agribusiness industries are based on jute, cotton, sugar, tobacco, etc. Raw materials are delivered from agricultural production in those industries. In India, the Green Revolution began with the aim of giving greater emphasis to agriculture. The Green Revolution era that began in the 1960s witnessed a marked for increase in food crop yield. The introduction of improved farming methods in production and use of seeds with high yielding varieties (HYV), mostly wheat, had resulted in remarkable improvements in agricultural outputs. The productivity of agriculture increased tremendously that helps to giving huge economic boost to the country.

2. Sustainable Rural Livelihood:

Livelihood conceptually denotes the means, actions, entitlements, and properties of which people they serve work for living". Investments in that sector are defined in many terms like natural (land and water), social (community, family and financial), political (participation and empowerment), human (education, labour, health and nutrition), physical (roads, hospitals, markets, schools and bridges) and economic (employment, savings and credit) assets.

Some living sustainability acts becomes a function of how both men and women that make a short- term and long-term use of asset portfolios. Adaptation and coping strategies, resilient livelihoods can cope with and help to recover from shocks and stresses such as drought, civil war and policy failure [5].

Sustainable livelihood idea blends power, equity and sustainability. "Sustainable Rural Livelihood (SRL) concept is an attempt to go beyond the conventional definitions and approaches to eradicating poverty". These have been found to be too limited because they concentrated only on certain aspects or forms of poverty, either in low income, or neglected to recognize certain critical aspects of poverty, included insecurity and social inclusion.

It is now understood that more focus needs to be paid to the poor people life become easier economically, ecologically and socially with improvement and better developments in terms of various factors and processes. The SRL framework presents a more systematic, holistic approach to eliminating poverty. In livelihood, resource capitals such as human, social, ecological, physical and financial will play a greater role in dealing with shocks and stresses and sustaining or improving the individual's abilities and assets in both time present and the future without reducing the natural resource base.

3. Problems of Indian Agriculture:

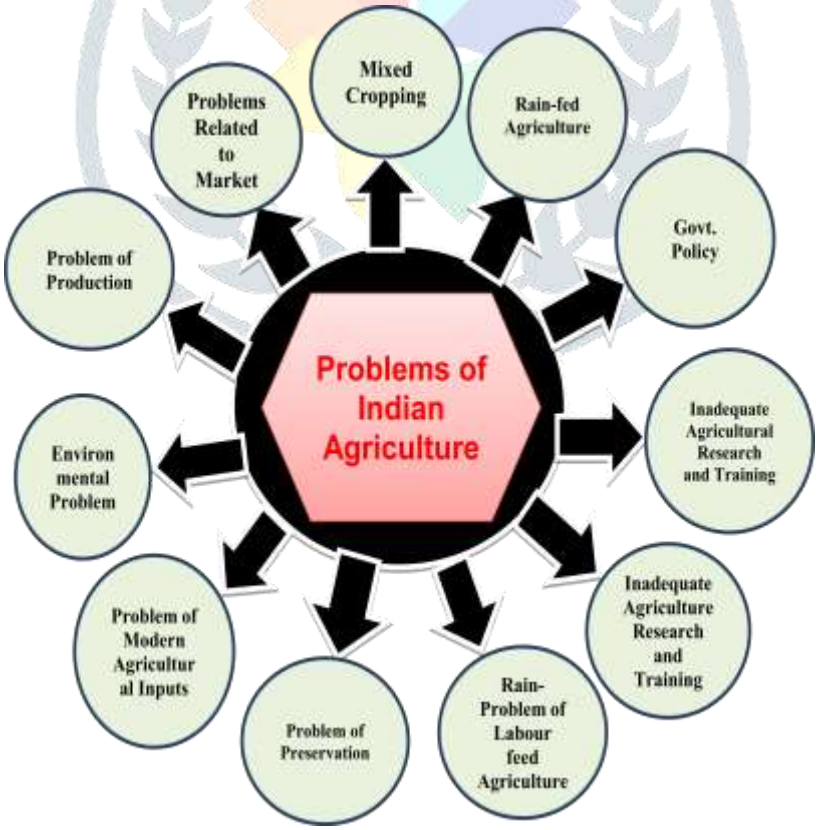


Figure 1.Showing the problems of agriculture.

3.1. Solutions to the problem:

I) Pension facility: 100 per cent farmers want pension facilities because the sector of agriculture is in danger and uncertain due to climate change. For food security at least all small farmers want a pension facility of 4 to 5 thousand rupees per month per household. If the government wants to provide pension facilities, farmers don't want any fertilizer subsidies, seeds any package for natural calories etc.

II) Industries manufacturing and cold storage facilities: 90% farmers in the villages want processing units and cold storage facilities. Especially fruits, for vegetables. So farmers will get sufficient marketing & prices.

III) Irrigation facilities: 100 per cent farmers want irrigation facilities due to farmers who are unable to manage irrigation systems for small land individuals. Therefore the government will take the initiative to provide irrigation to the small landowners.

IV) Agriculture needs to be modernized: 60 percent of farmers want to introduce modern agricultural methods to minimize expenses.

V) Provide loan facility: 0 per cent of government loan facility is required by all farmers and banks are nationalized.

VI) Special agricultural zone: 30 percent of farmers requesting special agricultural zone were authorized to irrigate and agricultural activities should be permitted just like industrial zone.

VII) Farmers education: A lot of farmers don't know about crop rotation. Although urban education has improved a great deal, in rural areas in general and in the agricultural sector, the government has ignored the same thing. Government agencies should therefore start successful processes in this regard.

VIII) Small-field clubbing: 40 per cent farmers want marginal farmers clubbing for particular crop production, many farmers owning small pieces of land will come together and continue all small-fields into one big chunk. This will help to boost the economic studies carried out by small, marginal farmers.

IX) Need for improved water management: (100 per cent) the irrigation facility currently available does not cover the entire cultivable land. It is not the absence of water in most situations, but the lack of adequate water management that causes water shortages. Improved modern rain water harvesting techniques should be developed. Excess water from perennial rivers will divert to the destitute areas.

Connecting the rivers nationally would solve this dilemma. Building national waterways can boost the irrigation plant, which will in turn save the farmers if the monsoon fails.

X) Alternative income stream for farmers: Nearly 100% of farmers agree that the government should take responsibility for providing farmers with training to learn new skills to minimize reliance on agriculture.

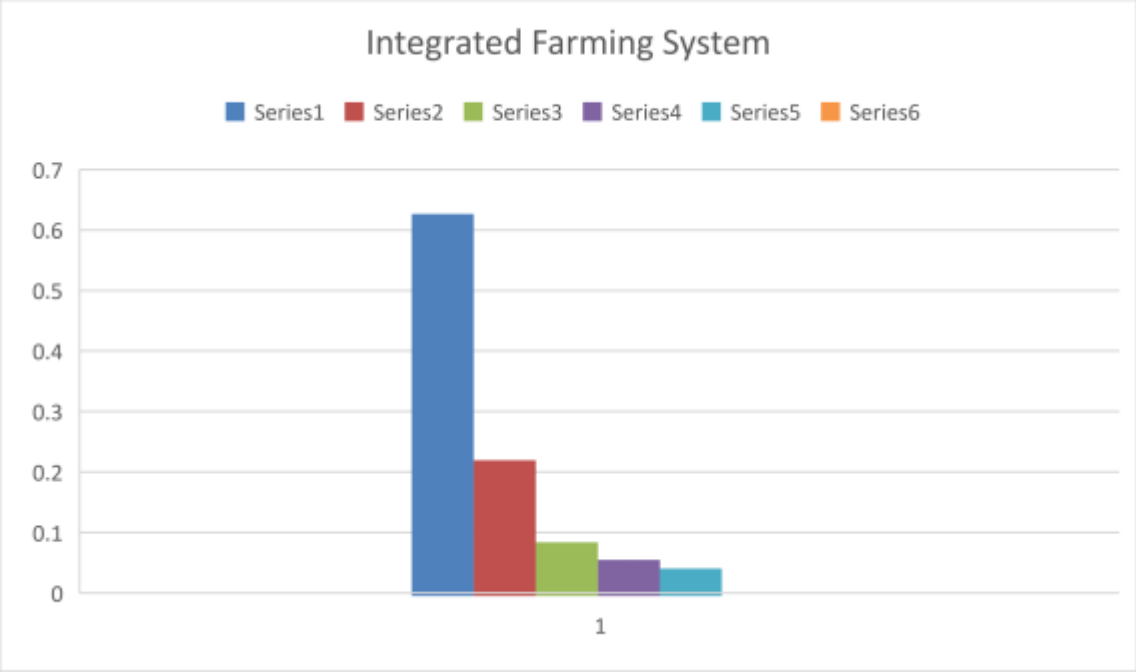
4. Definition of Farming System:

Farming' is a method of tackling solar energy in the form of economic goods in plants and animals. 'System' is a type of interrelated activities and processes organized into functional entities, i.e. subsystem or entity structures. This interacts and transforms inputs into outputs according to a certain mechanism. [6]

Some author's loosely characterized the system as a system of aquaculture integrated with livestock in which fresh animal waste is used for feeding fish. [7] These systems were described by [8] as a mixed farming system consisting of at least two separates yet logically interdependent sections of a crop and livestock company. These systems as a mixed animal crop system, where the animal portion is frequently raised on agricultural waste products while the animal is used to raise the soil and provide manure that can be used as fertilizer and fuel based on Tamil Nadu, India experience. [9]. The study was conducted in Nigeria, in which the IFS definition as a form of mixed farming system which additionally and/or complements crop and livestock enterprises. [10]The distinction between mixed farming and integrated farming is that enterprises are highly supportive and depend on each other in the integrated farming system [11].

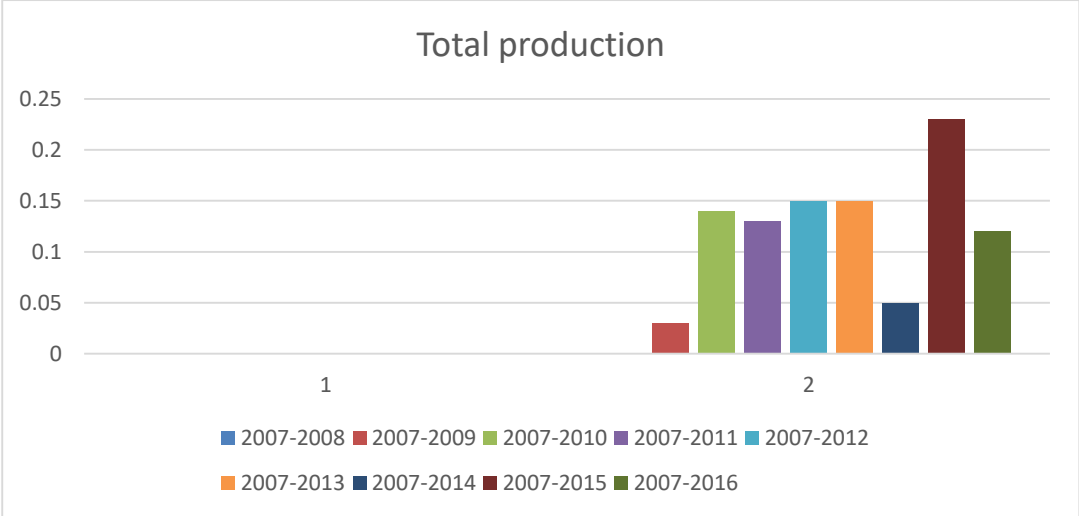
IFS were defined as the idea of minimizing risk, increasing production and benefit, as well as improving the use of organic waste and crop residues. To create the basis of the IFS definition, it is clear that there are synergies and complements between enterprises that have differentiated a crop and animal portion. Respectively, integration is typically seen when one company's outputs (typically by-products) are used in the sense of the farming method as inputs for another [12].

Identified that the integrated farming practices adopted by offenders following the introduction of the Integrated Farming System programme in agricultural horticulture-forestry-dairy vermin compost (62.14%), agriculture- horticulture forestry- dairy- vermin compost- forage crops (21.43%), agriculture-horticulture-dairy-forage crops (7.86%), agriculture-horticulture-horticulture crops (21.43%) agriculture-horticulture-forestry-dairy-forage crops (5.00%) and agriculture-horticulture-dairy (3.57%) [13].



Graph 1. Total % of Integrated Farming System

Reports that crop livestock (47.62 percent), crop-fish (9.52 percent), crop-fish-livestock (29.76 percent), livestock-fish (1.90 percent) and crop-livestock-agro processing (1.19 percent) were the integrated farming systems embraced by criminals [14].



Graph2. Showing the percentage of IFS in year wise

4.1. Components in IFS:

Following Components may be included in IFS.

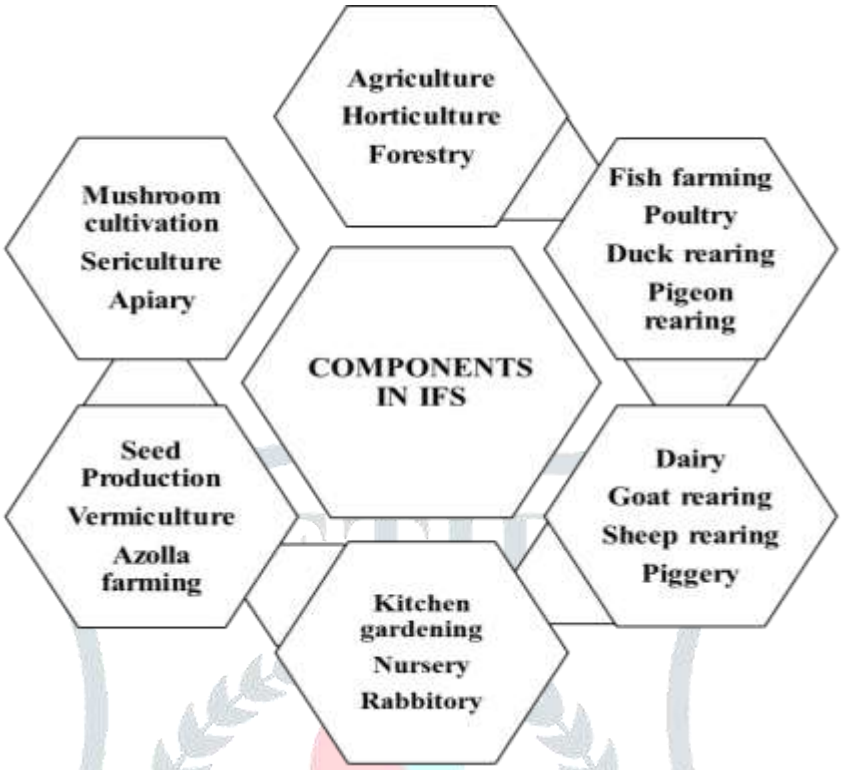


Figure 2. Components in IFS

4.2 Elements of Integrated Farming System:

Following elements may be included in IFS manifestations depending upon the single farmer's resources, interest and opportunities.

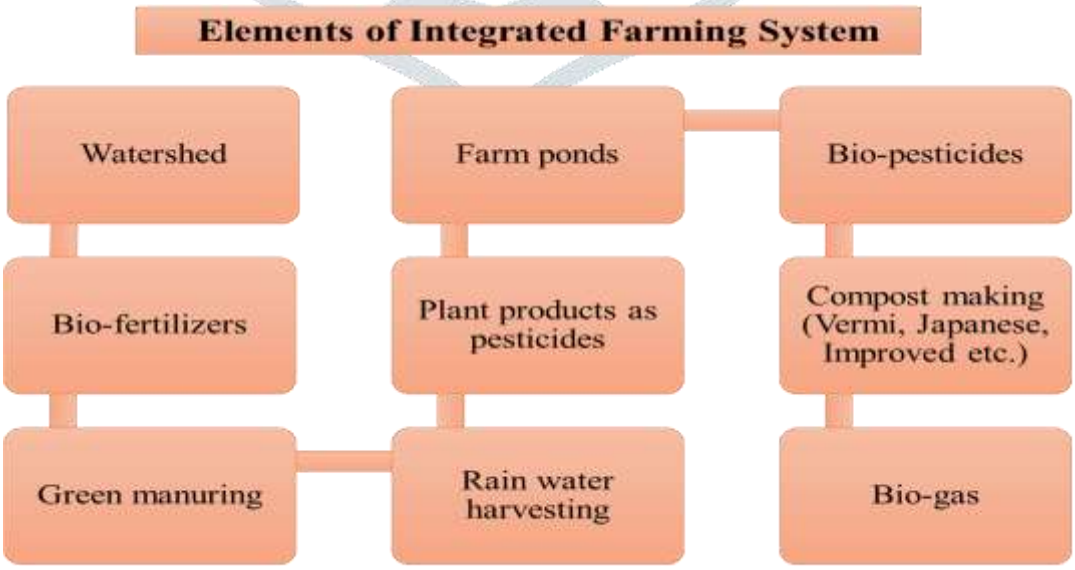


Figure 3. Elements of IFS.

5. Goals of IFS:

I. To produce steady and reliable sales, optimize the efficiency of all component companies.

II. It revives the yield of the system and achieves agro-ecological stability.

III. Prevent the build-up of insect pests, diseases, weed populations and hold them below ETL, i.e., by natural cropping system management. Limit Economic Threshold.

IV. Reducing the use of chemicals (fertilizers and pesticides) to offer chemical free healthy produce and environment to the society [15].

V. Try maintaining sustainable production system without harming resources / environment.

6. Advantages of integrated farming system:

I) Productivity: IFS offer an opportunity to economic upturn productivity per unit area per unit time by increasing the quality of increase of crops and allied enterprises.

II) Profitability: The use of by-product of one component as the input of other reduces the cost of manufacturing as well as by increasing the B/ C ratio it eliminates middleman interference.

III) Potentiality or sustainability: Organic supplementation by efficient use of related component by-products providing an opportunity to maintain yield basis likelihood for much longer periods.

IV) Nutritious food: A collection of different components with different nutritional values allows a proper and healthy source of nutrition to be generated.

V) Environmental Safety: Presumption of IFS minimizes environmental emissions to a wide region, as one component's waste materials become another's input.

VI) Recycling: Heavy waste material recycling happens.

VII) Income Rounds the year: The interactivity of company with crops, eggs, milk, mushroom, honey, cocoons silkworm offers income to the farmer throughout the year which help to decrease the economic crisis in the farmer’s family.

VIII) Assumption of New Technology: Big farmers completely assume the new technologies through the milk / mushroom / sericulture / vegetable etc. linkage that provides cash flow across the year. This inspires the small/ original farmers to go for new adorable technology to be hypothesized.

IX) Meeting the Food Crisis: Each part of the land is used efficiently. Planting on field boundaries of perennial legume fodder trees not only fixes the atmospheric nitrogen that updates the soil fertility but also reduces the problem of non-availability of quality fodder to the animal portion.

X) Employment Generation: IFS offer ample scope to employ family labour complete around the year. The combination of different components in IFS would increase the labour demand significantly which in turn reduces the problems of unemployment to a great area.

XI) Agro – industries: When the manufacturing's of one component in IFS are increased to commercial level then the manufacturing of other components acquires surplus assumption which leads to development of allied agro – industries.

XII) Increasing Input Efficiency: The utilization of inputs in different components of IFS shows high efficiency and greater benefit cost ratio.

7. Integrated fish farming:

Integrated fish farming (IFF), also called agropisci culture or Integrated agriculture-aquaculture, has come in contact in Asia dating back to more than 1500 years in India [16]. And more than 2400 years in China [17]. It is one of the best examples of mixed farming. In the east and south East Asian countries, this type of farming practices in different forms in the important ecological balanced sustainable technologies. In this technology, a combination of fish polyculture integrated with crop or live-stock production are including. IFF refers to the simultaneous culture of fish or shell fish along with other culture system. For efficient resource utilisation fish culture can be integrated with several systems [18]. The idea of IFF is to create a mutually beneficial system that shows a maximization of productivity through optimum resource use [19]. IFF serves as a model of sustainable food production by following certain principles:

1. The integration of fish and plants results in a polyculture that increases diversity and yields multiple products.
2. Local food production provides access to healthy foods and enhances the local economy.

Mainly IFF is of two types:

a) Agri-based Fish farming

b) Live-stock Fish Farming

The fish-cum live-stock farming is an innovation of high-class protein at low cost [18].

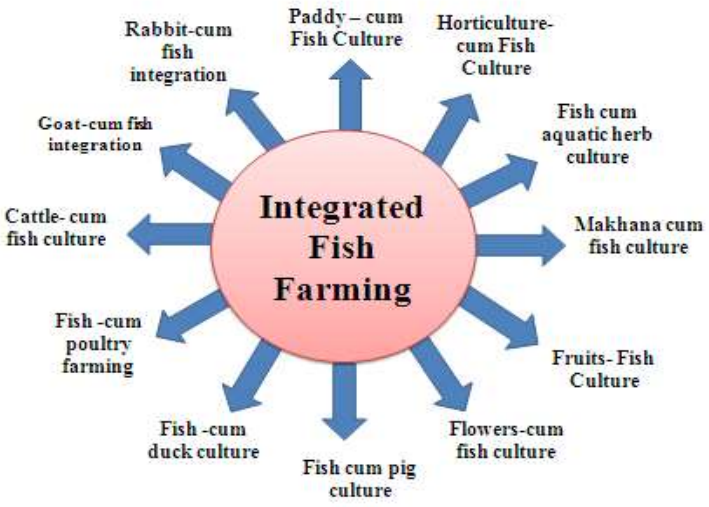


Figure 4. Showing various type integrated fish farming.

8. Present status of farming system research:

It is evident from the preparatory investigations that the integration of agricultural enterprises, such as grains, livestock, fisheries, forestry, etc., has a strong potential for improving the agricultural economy. These endeavours not only supplement the farmer's income by raising the yield per unit, but also ensure that resources are used rationally and that job opportunities are generated further. The introduction of acceptable crop choice criteria with a deep and shallow root system, the inclusion of legume crops as pick, cover and fodder crops and the hypothesis of a bio-intensive complementary cropping system alongside other enterprises would undoubtedly prove to be a self-supporting production method with the lowest production costs. The agricultural system is controlled by different factors, such as the physical climate, socio-economic conditions, political factors under various institutional and operational constraints and, above all, favourable policies of the government that can keep food security complete and livelihoods completely safe. Animal waste falls directly into the water that fuelled the pond ecosystem in the traditional Chinese method, which is why the animal houses were built over a pond that the fish could then feed on for food. Not only were the fish gathered, but the water from the reservoir, now used for irrigation in crops with extra nutrients. Compared to Rs 5, 33,221 from the rice-wheat scheme, the highest return (Rs 79,064 / ha) was obtained from fisheries + piggery + poultry and reported a benefit of 48.6 percent. This also provided around 500-man days / ha / annum of supplementary employment [20].

It begins small with ducks and chickens for poor people; then a few goats remain for milk or fattening and for a day of sacrifice to be slaughtered; then a body fluid cow; then a bullock for cultivation in partnership with another family of one buffalo; then two bullocks. These can be used to cultivate others' fields- a very profitable sowing season sector. At the apex of desirable animals on the farm in this country, one might add a body fluid buffalo. Pigs would be the second level on the ladder, according to the Vietnamese definition. This idea means beginning with small livestock and women and then eventually getting the household out of poverty. The poorest households held only poultry and these households were the ones most dependent for their livelihood on common property resources (e.g. use and selling of forest firewood). Several Asian studies have reported a similar categorization [21].

As a whole, body fluid animals have been revealed; cows and buffaloes, regardless of breed and yield, are the farmers' first preference as an integral part of their farming system through a comprehensive survey of the country's agricultural systems. Vegetables and fruits (mango and banana in many parts of the country), followed by beekeeping, sericulture, mushroom and fish production, were still the most enterprising components of any of the country's frequent farming systems from an economic point of view. The characterization study of on-farm farming systems analysed the average productivity differences across agro-climatic zones between the 27 predominant and 37 diversified farming systems. Diversity in the agricultural

System through business integration in the country's various agricultural circumstances allowed total production to be intensified in terms of rice equivalent yield ranging from 9.2 percent in the Eastern Himalayan region to as high as 366 percent in the Western-plain and Ghats region compared to the region's agricultural systems. Jayanthi models for almost all Tamil Nadu circumstances, the WTCER model for Orissa's coastal and irrigated alluvial lands, the Darshan Singh model for Punjab's irrigated conditions, the PDCSR model for .Western Uttar Pradesh, and substantially in different parts of the country suggest those farmers' incomes can be increase business diversity in a sustainable farming system.

State	Prevailing	Net return	Integrated farming System	Net returns	References
Karnataka	Rice-rice system	21,599	Rice- fish (pit at the centre of field)-poultry(reared)	62,977	[22]
			Rice-fish (pit at one side of the field) – poultry (shed on fish pit)	49, 303	
Goa	Cashew	36,330	Coconut+forage +dairy	32,335	[23]
			Rice-brinjal (0.5 ha) + Rice-Cowpea (0.5ha) +mushroom +poultry	75,360	
Madhya Pradesh	Arable farming	24,093	Mixed farming + 2 cow	37,668	[24]
			Dairy(2cows) +15 goats+10 poultry + 10 duck + fish	44,913	
Tamilnadu	Rice-rice-black gram	8,312	Rice-rice-cotton +maize	15,009	[25]
			Rice-rice-cotton +maize+poultry/fish	17,209	[26]
	Rice-rice	15,299	Rice-rice Azolla/Calotropis+Fish	17,488	
	rice-rice-rice fallow-pulses	13,790	Rice-rice-rice-fallow-cotton+maize+duck cum fish	24,117	[27]
	Cropping alone	36,190	Cropping+fish+poultry	97,731	[28]
			Cropping+fish+pigeon	98,778	
			Cropping+fish+goat	13,1118	
	Rice	22,971	Rice+fish	28,569	[29]
			Rice+Azolla+fish	31,788	
Uttar Pradesh	Crops (Sugarcane-wheat)	41,017	Crops (Sugarcane wheat) +dairy	47,737	[30]
Maharashtra	Cotton (K)+Groundnut (S)	(-) 92	Black gram(K) - Onion (R)-Maize+ cowpea	1,304	[31]
			Crop+dairy+sericulture	3,524	
			Crop + dairy	5,121	
Bihar	Rice-wheat	22,234	Cropping + poultry + goatry + mushroom	89413	[32]
Punjab	Crops (rice wheat)	81,200 (gross)	Crops (rice-wheat) +dairy Fish + piggery	15,4000 (gross) 113,20 (Gross)	[33]
Goa	Cashew	36,330	Coconut + forage + dairy Rice-brinjal (0.5 ha) + Rice-cowpea (0.5 ha) + mushroom + poultry	32,335 75,360	[34]

Table 2: Economic viability of Integrated forming system research models developed in different states of the country.

8.1. Agriculture advancement with new technologies:

Refinement in the agricultural growth is an essential aspect for leading to overall growth and development of the country. Because of, this sector sustains livelihood of 65 percent of the population. Various revolutions in agriculture have taken place to improve the sector. For example, "Green Revolution", Evergreen Revolution, Blue Revolution, White Revolution, Yellow Revolution, Bio-technology Revolution, Information and Communications Technologies (ICT) Revolution". In order to increase productiveness, it is essential to make use of technologies and what is required is the extension of these developed systems. Agriculture extension that has been combined with infrastructure is regarded as the key aspect to agricultural growth. Involvement of the private sector would help in the engagement of technologies in this sector in a fastest path. [35]

The assumption of technologies for sustainable farming systems and other agricultural practices is a challenging and a vigorous issue for the farmers, extension services, agriculture business and policy makers. "The agricultural sector needs to employ a overall of changing technologies and farm practices across various farming systems and structures to meet a diversity of changing and mixed demands from consumers and the public for food, fibre and other goods services are provided".

According to Some author there are two major drivers of successful agricultural technology in developing countries "is the availability and cost-efficient of technologies; and second one is farmer hope that adoption will remain beneficial both which decide the extent to which farmers are risk against" [36] [37]. There are number of factors which drive the above expectations, ranging from availability and size of land, family labour, prices and profitability of agricultural enterprises.

According to some author in any technology adoption process, peer effects work in three major ways: first one is that individuals profit from acting like friends/neighbours; second one is that individuals gain ability of the benefits of the technology from their friends; and third one is that particular, learn about how to use a new approach from peers" [38]. With consideration to agricultural technology adoption, risk peer effects can lead to economies of scale by lowering transportation costs but can also lead to increased competition and land prices, which can spur dis-adoption [37].

To achieve these goals, six fundamental and important practices have come to form the pillar of production in agriculture: "application of inorganic fertilizer, irrigation, intensive tillage, monoculture, chemical pest control and genetic manipulation of crop plants. Autopilot tractors, crop sensors, VRT and swath control technology, monitoring and manage crop irrigation systems via smart phone, documentation of fields

via GPS, biotechnology and ultrasounds for livestock has backbone for production and is using for its individual contribution to fertility or productiveness" [39].

9. Conclusion:

Modern integrated agricultural advance technology has been developed with keeping two important things in mind: "first thing is to obtain the highest yields possible and second thing is to get the highest economic profit possible. Thus, we can say IFF is a mutually beneficial system. This system is more helpful to farmer for source of income, quality of food, increase production and conservation for biodiversity. Therefore, by adopting this forming system we can achieve a good sustainable rural livelihood.

Acknowledgments:

Authors are thankful to the Coordinator, Centre of Science and Society, Head, Department of Botany for lab facilities; to UGC for financial support.

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