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Integrated farming system: Only way to increase farmer's Income in a sustainable manner

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Abstract
There are 115 million operational holdings in the country and about 80 percent are marginal and small farmers. To fulfill the basic needs of house hold including food (cereal, pulses, oilseeds, milk, fruit, honey, meat, etc.), feed, fodder, fiber, etc. warrant an attention about Integrated Farming System (IFS). Undoubtedly, majority of the farmers are doing farming since long back but their main focus was individual components but not in a integrated manner. At the ICAR and State Agricultural Universities level, lot of efforts have been made aiming at increasing the productivity of different components of farming system like crop, dairy, livestock, poultry, piggery, goat keeping, duckery, apiculture, sericulture, horticulture, mushroom cultivation etc. individually but lacking in their integration by following farming system approach. 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. The information on farming system in a systematic way is presented here. The methodology is explained keeping in mind the work done so far to realize better productivity, profitability and sustainable production systems that would help to solve the fuel, feed and energy crisis, create more employment avenues, ensure regular income and encourage agricultural oriented industry.

Keywords: introduction, concept of IFS, difference between IFS and mixed farming, component of IFS, socio-economic characteristics of IFS farmer, economics of IFS, constraints in IFS

Introduction
"There is no waste", and "waste is only a misplaced resource which can become a valuable material for another product" in Integrated Farming System (FAO, 1977) [12]. Integrated Farming System as a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises (Okigbo, 1995) [27]. It is as an aquaculture system that is integrated with livestock and in which fresh animal waste is used to feed fish and also reported that there are synergies and complementarily between enterprises that comprise a crop and animal component that form the basis of the concept of IFS. According to this concept, integration usually occurs when outputs (usually by-products) of one enterprise are used as inputs by another within the context of the farming system (Edwards, 1997 and Jitsanguan 2001) [11, 19]. Integrated Farming System as a mixed animal crop system where the animal component is often raised on agricultural waste products while the animal is used to cultivate the soil and provide manure to be used as fertilizer and fuel (Jayanthi *et al.*, 2000) [16]. Integrated Farming System as 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) [33]. Integrated Farming System as a type of mixed farming system that combines crop and livestock enterprises in a supplementary and / or complementary manner (Agbonlabor *et al*., 2003) [1]. Integrated Farming System is a component of Farming System Research (FSR), introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. (Jayanthi, 2006) [17]. Integrated Farming System is an integrated set of elements / components and activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis (Singh and Ratan, 2009) [41]. Integration is made in such a way that the product i.e. output of one enterprise / component should be the input for the other

enterprises with high degree of complementarily effects. Similarly the authors stated that the rationale of IFS is to minimize the wastes from the various sub systems on the farm and thus it improves employment opportunities, nutritional security and income of the rural people (Panke *et al*., 2010) [28]. Integrated Farming System as an integrated mixed farming system is the practice of raising different yet dependent enterprises and when different enterprises are dependent they are primarily complementary and supplementary to each other (Bahire *et al*., 2010) [3]. Thus, Integrated Farming System is Integrated farming (or integrated agriculture) is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrate livestock and crop production.

People connected it with mixed farming system but, there is too much difference between mixed farming system and Integrated Farming System: The difference between mixed farming and Integrated Farming System is that enterprises in the integrated farming system are mutually supportive and depend on each other. Mixed farming system consists of components such as crops and livestock that coexist independently from each other. In this farming integrating crops and livestock serves primarily to minimize the risk and not to recycle resources (Csavas, 1992) [10]. Where as in an Integrated Farming System, crops and livestock interact to create a synergy, with recycling allowing the maximum use of available resources. Crop residues can be used for animal feed, while livestock and livestock byproduct production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilization. A high integration of crops and livestock is often considered as a step forward, but small farmers need to have sufficient access to knowledge, assets and inputs to manage this system in a way that is economically and environmentally sustainable over the long term (FAO, 2001) [12]. The distinction between the integrated farming system and the commercial farming system is not absolute, but is rather a matter of degree of integration of resources in the farm system (Tipraqsa, 2006) [45].

Component of integrated farming system

The marginal and small holdings invariably keep bovines, cattle and or buffalo (1-2) along with desi fowls (10 -20) in the family backyard or ducks in areas which are coastal or have sufficient water bodies and also reported that sheep are the rare component in mixed farming systems (Chawla *et al*., 2004) [9]. The introduction of tree crops with agriculture along with the farm based allied enterprises like dairy, goat rearing, apiculture etc. as a risk management strategy to cope up with disasters like long drought season and heavy flood (Thamizoli *et al*., 2006). The Integrated Farming System model consists of field crops (Rice, groundnut, maize, pigeon, pea and ragi), horticultural crops (Yam, banana, tapioca and vegetables), vermin-composting and poultry (Vanaraja breed) in Gajapati district of Orissa (Mohanty *et al*., 2010) [23]. The various prevailing farming system models in Uttarkhand namely., crop + dairy, crop + dairy + goats + horticulture, crop + horticulture +goats, crop +dairy + vegetables, horticulture + dairy + vegetables, vegetables + dairy and crop + dairy + companion animals are the major components in IFS. (Rathi and Tripathi, 2011) [47]. The respondents from Erode district of Tamilnadu were having goat +crop, goat +dairy + crop, goat + dairy and goat +dairy +crop systems suggested that the integrated fish farming is a diversified and coordinated system and suggested that the integration of mono-crop agriculture with agro forestry, pisciculture and animal husbandry as an important components for resource utilization, enhancing farm income and livelihood security of farmers. (Manivannan *et al*., 2011) [22]. Indian vision is also suggested that the integrated fish farming is a diversified and coordinated system of producing fish and agricultural/livestock produce in fish farms with fish as the main component for maximal utilization of land/water through recycling of wastes and by - products, reduced application of fertilizers and feeds and maintenance of a balanced ecosystem (Vision, 2020) [51]. As discussed IFS have several component viz. considered in such a way it produce income and sustainable income throughout the year.

Socio-economic characteristics of Integrated Farming Systems Farmers

Majority of farmers who adopted IFS were found to be marginal (47.3%) followed by small (29.4%) and large (27.8 %) (Nageswaran et, al 2009) [24]. The livestock based farming system in Konkan has been taken up mainly by middle age farmers having high school education and medium size of family and also reported that they were possessing medium level of farming experience (Bhalerao *et al*., 2010). Majority of the farmers (68 per cent) of rice and backyard poultry farming were middle aged, 36.8 per cent of them were educated up to secondary level, 60 per cent of them were having low annual income and also they were having good mass media exposure and extension agency contact (Mahadik *et al*., 2010). The integrated farmers from Sahibganj and Pakur districts of Jharkhand are having low level of education and majority of them were belonged to small and marginal farmers (Prasad *et al*., 2011). Thus, Integrated Farming System gave big opportunity to Marginal and small farmers. If small and marginal farmers adopt Integrated Farming Systems then they can survive easily their livelihood and they can also standardize their living standard.

Economics of integrated farming systems

A successful tribal integrated farmer in Orissa who was getting enhanced the productivity as well as the profitability and sustainability after adopting the IFS as compared to the conventional farming system and earned 7 times higher Net Monetary Return (NMR) as compared to traditional method of farming. (Mohanty *et al*., 2010) [23]. The profitability of the system by integrating livestock into a crop based farming through increased financial benefits and a better use of intermediate farm resources such as manure, draft power, and crop residues. (Ngambeki *et al*., 1992). The integration of various enterprises on various sizes of land holdings tend to be more profitable than arable farming alone, and generate more employment. (Singh *et al*., 1997). Integrated farming of crop, poultry and fish culture generated 453 additional man-days over arable farming on 0.40 ha land whereas on 1 ha it was between 559 to 630 man days with almost uniform distribution throughout the year compared to 182 man days in arable farming. (Jayanthi *et al*., 1994) [18]. The integration of poultry, fish and mushroom with rice cultivation over a five-year period increases the net farm income and on-farm labour when compared with the conventional rice cropping system and also the comparative analysis suggested that diversification and integration of resource management can be productive, profitable and manageable, given access to labour and secure tenure. (Rangasamy *et al*., 1996). Integration of two or more appropriate combination of enterprises like crop,

dairy, piggery, fishery, poultry, bee keeping etc. for each farm according to the availability of resources helps to sustain and satisfy the necessities of the farmer (Itnal *et al*., 1999). The reliance upon a few crops in combination with a high risk of crop failure due to a range of factors like disease, drought etc. exposes farmers to a high degree of variability with respect to yields and income and therefore risk the diversification of farming activities should invariably improve the utilization of labour, reduce unemployment in areas where there is a surplus of underutilized labour and provide a source of living for those households that operate their farm as a full time occupation. (Thamrongwarangkul, 2001) .Several studies on the financial viability of IFS and concluded that they positively influenced the economic viability of the IFS. (Radhamani *et al*., 2003) [33]. The farmers who have transformed their rice mono-culture to rice based farming systems including rice, upland crops, livestock and aquaculture on the same farm, allowing better use of farm resources, thereby improving farm income as well as safeguarding the environment. (Bosma *et al*., 2005). The advantages of IFS like increased productivity, capital saving, family labour employment and income generation (Tipraqsa *et al*., 2007) [45]. The integration of 2 bullocks + 1 cow + 1 buffalo and 10 goats along with other subsidiaries like poultry and duck is the most beneficial system which can supplement the income of tribal people to improve their socio-economic status. And also in the event of failure of any crop due to delay or heavy rainfall, other enterprises in IFS would tend to compensate and which is absent in conventional farming. According to the Annual report 2009 - 10 the role of biodiversity in sustaining livelihoods can be enhanced through crop-livestock-fish IFS further, it depends upon the efficient resource utilization (Prein, 2002 and Nhan *et al*., 2007). The integration of crop with fish, poultry and goat resulted in higher productivity than adoption of conventional rice-rice alone and also 26.3 per cent higher productivity was reported in an IF while compared to conventional rice-rice system (Channabasavanna *et al*., 2009). The farming system revolves around better utilization of time, money, resources and family labour and also the farm family gets scope for gainful employment round the year thereby ensuring good income and higher standard of living even from the small holdings. (Biswas, 2010). The productivity of IFS was 26.3 per cent higher than the conventional system. Among the various components the productivity was maximum in crop yield (46.32 per cent), closely followed by horticulture (16.77 per cent), dairy (42.26 per cent) and piggery (8.07 per cent) in the southern Karnataka state. (Jagadeeshwara *et al*., 2011). The IFS increased the productivity, profitability, employment generation by 48, 40 and 45 per cent respectively than the existing conventional farming system in Palladam district of Western Zone of Tamilnadu (Poorani *et al*., 2011) [30]. The findings of net returns obtained from all the components was Rs. 22,887 with an increase of 32.3 per cent higher returns than conventional rice-rice system (Jayanthi *et al*., 2003 and Ravishankar *et al*., 2007) [15]. A crop livestock mixed farming model of 1.5 acre small scale holders with the employment generation of 571 man days, net income of Rs. 58,456 per year against crop farming alone with employment generation of 385 man days and net returns of Rs. 18,300 per year only (Ramrao *et al*., 2005). The mixed farming of 2 bullocks+ 1 cow+ 1buffalo + 10 goats+ 10 poultry and 10 ducks gave a net rreturn of Rs 33,076 compared to Rs 7843 from arable farming (Ramrao *et al*., 2006). The crop livestock integrated farmers were getting higher returns i.e. a farmer with 2.5 acres of irrigated land, HF and Buffaloes were earning Rs. 1, 04,321 and a farmer with 3.5 acres of irrigated land with 2 cows and 4 sheep earning 78,867 and a farmer with one acre of irrigated land with 4 HF cows were getting Rs. 1, 32,000 (Veerabhadraiah, 2007) [50]. The income from integrated crop+ livestock + goat + poultry was Rs. 98,270 than Rs. 28,600 in traditional farming system. Similarly income of Rs. 99,209 in IFS with the crop +livestock +goat + poultry than conventional farming system (Ramasamy *et al*., 2008). The annual net revenue per acre is higher for IFS as compared to CFS: the average net annual revenues per acre of IFS and CFS are Rs. 11,662. 57 and Rs.4, 553.31 respectively. Annual employment per acre is turned out to be 185.78 person days in IFS and that of CFS 89.3 persons respectively. Ray (2009) reported that the IFS with cropping, fisheries, poultry, mushroom provided a net additional income of Rs. 12,500 /ha /year and created an additional employment of 550 man days / year as compared to conventional cropping system (Nageswaran *et al*., 2009) [24]. The benefit cost ratio of 1.97 in IFS than conventional system which is of 1.64. Among the various components of Palladam district of goat recorded the highest benefit cost ratio (2.75) followed by fish (2.23), vegetables (2.00) whereas poultry showed the lowest benefit cost ratio (1.13) as a result of high cost of maintenance (Channabasavanna *et al*, 2009). The integration of 7 different enterprises namely, crop+ fish+ goat+ Vermicompost+ fruit production+ spice production+ agro forestry obtained the net return to the tune of Rs. 2, 30,329 annually with the Benefit Cost Ratio (BCR) of 1.07:1 and also reported the maximum per cent contribution of the enterprise is the fish production (68.53 per cent) followed by vermicomposting (9.90 per cent), spices (8.46 per cent) and animal production (7.40 per cent). The BCR was found to be highest for the spice production (1.83:1) after fishery (2.25:1) followed by the vermicomposting (1.45:1) (Tripathi *et al*., 2010) [47].

Constraints in Integrated Farming System

There were observed following constraints in importance of Integrated Farming System. The limited amount of capital as the main constraint in IFS. (Banerjee *et al*, 1990). The lack of animal feed throughout the year and unavailability of labour in needy times are the major production constraints in IFS (Ngambeki *et al*., 1992). Resource-poor farmers are not able to invest more capital as initial investment as a constraint since there is need of immediate economic returns to meet their food requirements, schools, medical treatments and loan-repayment. (Thamrongwarangkul, 2001). The high start-up costs may constrain farmers from switching to integrated farming and from exploiting the benefits of resource integration (Tipraqsa *et al*., 2007) [45]. The constraints as of procuring the improved breeds of livestock, timely availability of fish seed and feed, low cost energy efficient pumping machine, information on government schemes and credit support from financial institutions (Nageswaran *et al*., 2009) [24]. The constraints of IFS as high cost of concentrate feed and unavailability of green fodder (40 per cent) and 30 per cent of the respondents expressed lack of market facilities and absence of cooperative societies. 20, 6 and 4 per cent of the respondents were expressed lack of scientific knowledge on rearing of animals, unavailability of improved breeds in the local markets and lack of financial support respectively as the major constraints in the IFS (Kadam *et al*., 2010) [3]. The integrated farmers from Palladam district of Western Zone of Tamilnadu indicated the insufficient quantity of fodder to their livestock during off - season as a constraint in the IFS

(Poorani *et al*., 2011) [30].

Hence, there is a need to create the database on farming system in relation to type of farming system, infrastructure, economics, sustainability etc. under different farming situation. Need to develop research modules of farming system under different holding size with varying economically viable and socially acceptable systems. The assessment and refinement of the technologies developed at research station at cultivators' field. Need to prepare a contingent planning to counteract the weather vagaries/ climate threats under different farming situation. Need to prepare a policy draft for the consideration of planners for its promotion at large scale with nominal financial assistance either through short/ medium/ long term loans and other promotional advantage

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