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Scope of Rain-fed Integrated Farming System in Dry Farming Condition: A Review

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ABSTRACT

In India, nearly 76 million hectares of land is under rain fed cultivation and therefore, rain fed agriculture will continue to play an important role in the Indian economy. The discouraging results of conventional cropping systems in advancing the productivity of small farms were the driving force in the development of farming systems research. It views the whole farm as a system with the integration of crops, animals, poultry, soils, labour and other all available inputs and environmental influences wherein the farm family attempts to produce outputs within the limitations of its capability and resources and the socio-cultural setting. IFS seem to be the possible solution to the continuous increase of demand for food and nutrition and income stability particularly for small and marginal farmers with little resources. This new concept of IFS will help in productivity enhancement, employment generation, gave more income and nutritional security both for human and livestock. IFS different components are complementary relate with each other and one component become source of food for other components. This literature on scope of rain-fed integrated farming system in dry farming condition is reviewed and presented below.

Key words: Dry farming, Economic importance, Integrated farming system, Nutritional security.

Agriculture and allied sector form the backbone of Indian economy as it engages more than 50% of the workforce and contributes about 17% to the country's Gross Value Added (GVA). The relationship between the size of land holding and farm productivity is a complex one. The data from the latest Agriculture Census 2010-11, show the around 85% operational holding in the country is small and marginal. The number of marginal and small holdings has increased to 92.83 million and 24.78 million in 2010-11 from 75.41 million and 22.70 million, respectively. The trend of per capita land availability is nowadays on decline so it is a serious challenge to the sustainability and profitability of the farming (Siddeswaran *et al*., 2012). Therefore, it is vital to focus on factors which inhibit the productivity of small and marginal farmers, rather than attempting to reverse the trend of land fragmentation. The process may involve diversification of activities like integrated farming system undertaken by the small and marginal farmers (Government of India, 2017).

Rainfed areas in the country are more susceptible to the drought. Rainfed Area Development (RAD) Programme is being implemented by Ministry of Agriculture and Farmers' Welfare to focus on the Integrated Farming System (IFS) for enhancing productivity and minimizing risk associated with climate variabilities. Under NMSA, cropping system are sought to be integrated with allied activities like horticulture, livestock, fisheries, agro-forestry, apiculture, *etc*. (Fig 1), to enable farmers to maximize farm returns, diversify the sources of income in the event of crop damage due to drought, *etc*. (Government of India, 2017). Due to the ever-increasing population and shrinking land resources in the country, practically there is hardly any scope for horizontal expansion of land for food production. Only vertical expansion is possible by integrating appropriate farming components that require lesser space and time to ensure reasonable periodic income to farm families (Gill *et al*., 2009). Rapid population growth, urbanization and income growth in developing countries like India, the demand for food of animal origin is increasing, while also aggravating the competition between crops and livestock (increasing cropping areas and reducing rangelands).

IFS seem to be the possible solution to the continuous increase of demand for food production, stability of income and nutritional security particularly for the small and marginal farmers with limited resources. It is not only a reliable way of obtaining a fairly high productivity with substantial fertilizer economy but also a concept of ecological soundness, leading to sustainable agriculture. Further, the modest increments in land productivity are no longer sufficient for the resource-poor farmers. Hence, intelligent management of available resources, including

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optimum allocation of resources, is important to alleviate the risk related to land sustainability. The Ministry of Agriculture and Farmers' Welfare, Government of India has also given major emphasis on Integrated Farming System (IFS). Moreover, proper understanding of interactions and linkages between the components would improve food security.

Characteristice of dry farming

In India most of the dry and rainfed areas are resource constrained, eroded and dry. Rainfed agriculture is practiced under a wide variety of soil type, agro-climatic and rainfall conditions. Crops in these regions are prone to the monsoon breaks, variability in rainfall amount, diversity in crop management practice and variability of the soil type. The prolonged moisture stress may result in partial or complete failure of the crops. In terms of production, drylands account for nearly 80 per cent of the output of coarse cereals, 50 per cent of maize, 65 per cent of chickpea and pigeon pea, 81 per cent of groundnut and 88 per cent of soybean production (Diagram-1). Half the output of cotton in the country is from the dry districts (Shah *et al*., 1998).

Dry lands are characterized by limited availability of resources and mainly depends upon the prevailing weather conditions. Among them, rainfall play an importance role. Erratic and ill-distribution of rainfall coupled with high rateof evaporation in dry climate often lead to periods of water



(Source: https://agriculturearticles.wordpress.com/2016/11/30/integrated-farming-system-if/)

Fig 1: Integrated farming system.

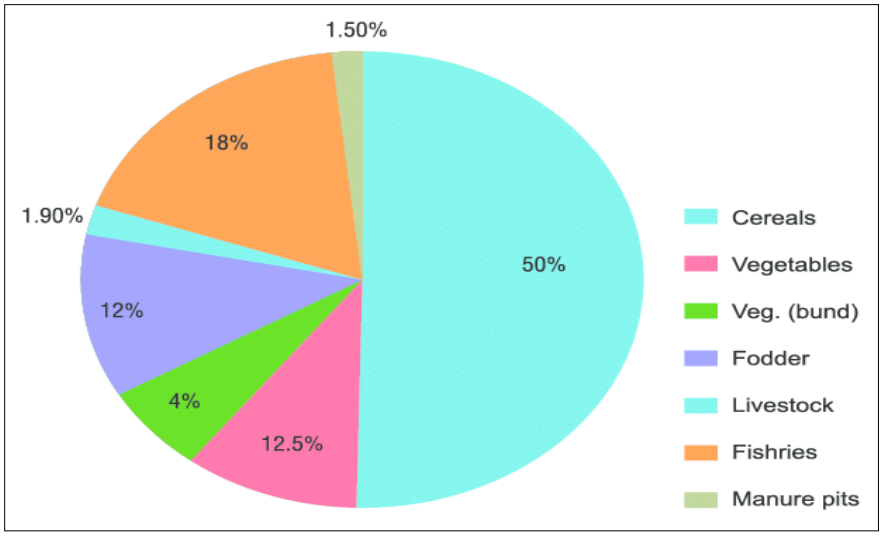


Diagram 1: Land allocation in integrated farming (Kumar *el al.,* 2012).

deficit and has serious implications for stability of crop production (Aggarwal and Kumar, 1993).

Major limitations of dry land area are moisture stress condition and deficiency of nutrients. A poor crop yield in dry farming regions is due to poor soil fertility and low water holding capacity (Sheshshayee *et al.*, 2003).

Unpredictability in the soil nitrogen (N) supply in rain fed agriculture and crop nitrogen demand present a challenge to the scientists in deciding on N fertilizer rates. Lobell (2007) Has developed general model of N rate decision-making which computes the optimal N rate that maximizes expected profit given uncertainties in N supply and demand.

The unpredictable distribution of the rainfall is major cause of instability in production and low yields of the dry land area crops. Low productivity is also a result of using traditional farming systemto cultivate crops without using fertilizer inputs. Marginal soils with low soil fertility are found in rainfed ecosystems (Velu, 2011).

Concept of rain fed integreted farming system

Rain fed integrated farming system is mainly depending on the concept that there is no waste, and waste is only a misplaced resource which can become a valuable for another product by recycling (Edwards *et al*., 1986). This approach is not only a reliable way of obtaining fairly high productivity with substantial fertilizer economy but also deriving maximum compatibility and replenishment of organic matter by way of effective recycling of organic waste obtained through integration of the various land-based enterprises (Jayanti *et al*., 2003). IFS combine livestock, aquaculture, agriculture, agro-forestry and agro-industry in an expanded symbiotic or synergistic system; so that the wastes of one enterprise become the input for other enterprise (cow dung and urine become a source of manure).

The IFS concepts associated with are practiced by number of farmers throughout the globe. A usual characteristic of these systems is that they have a combination of crop and livestock enterprises and in some cases may include combinations of aquaculture and trees. The suitable tree-crop combinations can find the place in IFS (Bhatt *et al*., 2004a). It's a component of farming systems which takes into consideration concepts of minimizing risk, increasing total production and profits by lowering external inputs through recycling and improving the used of organic wastes and crop residues. In this respect integration usually occurs when outputs (by-products) of one enterprise are used as inputs by another within the context of the farming systems. The difference between mixed farming and integrated farming is that enterprises in the integrated farming systems interact eco-biologically, in space and time, are mutually supportive and depending on each other.

Components of rain fedintegrated farming system

The selection of the components in IFS in dry land area must be based on the principle of minimizing the competition and also maximizing the complementary relationship between the enterprises. Arable farming results in lower profit or margin, however the creation of the IFS assumes a variety of alternative component combinations. Crop, livestock, birds and tree are major components of the integrated farming system and crop may have subsystem like monocrop, mixed crop, inter crop, multi-tier crops of cereal, pulses, oilseed *etc*. and livestock components may be milch cow, goat, sheep and poultry *etc.* (Fig 2).

Types of rain fed integreted farming system

Crop-aquaculture farming system

This integrated farming system is most prevailing in, Thailand, China, Japan Indonesia, India, and Philippines. Many reports suggest that integrated rice-fish farming is ecologically sound because fish improve the soil fertility by increasing the availability of N and P_2O_5 (Giap *et al*., 2005, Dugan *et al*., 2006).

Fish culturing in rice fields makes better use of the land and water as it results in maximize rice and fish yields, together with higher economic returns than rice monoculture. Within the rice-fish ecosystem, plants and animals complement and interact with the each other (Rothuis *et al.,* 1999).

Mustow (2002),reported from Kerala that integrated farming involving aquaculture has great advantages to the coastal rice lands areas such as Kole and Pokkali. In lowland rice, the entire food-chain and vast amount of fertilized water can be fully utilized by integrating rice and fish. In this rice based farming system involving fish will not only reserve trends of non-utilization and underutilization of rice field but also make rice farming more effective, consequent of such a farming system, it can sustain food security. This rice-fish based system of farming could

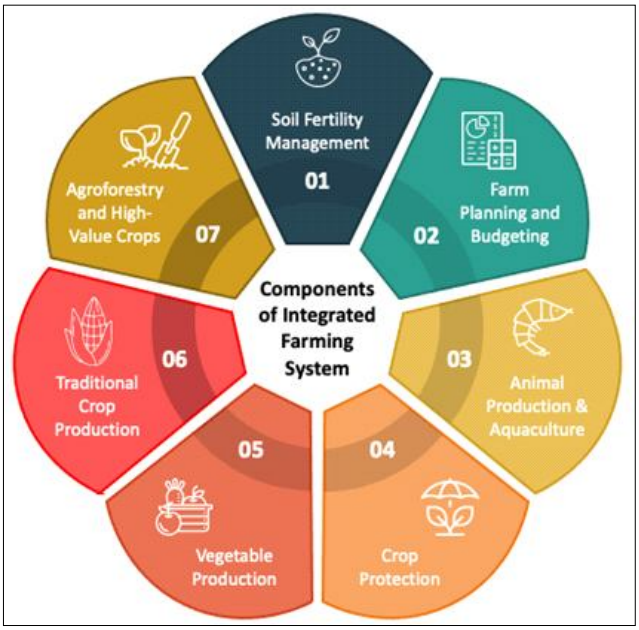


Fig 2: Components of integrated farming.

trigger a process of change whereby generate more income and economic prosperity of people living in these areas will increase leading to economic resurgence.

Crop-poultry farming system

Integrating family poultry with such production systems has nutritional opportunities and constraints. Many agriculture and forestry origin crops by-product is good source for nutritional opportunities for feeding family poultry. Given that the availability of crop residues for animal feed does not increase with rising yields, increasing the traditional feed resource base is limited (Steinfeld, 1998). Moreover, the exploration of these prospects has some natural and manmade constraints, for example, climate change, utilization of maize and rice polishing for purposes other than livestock or poultry feeds. It can be concluded that feed supplementation protocols will vary according to production system, ecological zone and the availability and cost of foodstuffs.

Crop-fish-poultry farming system

Channabasavanna *et al*., (2002) noticed from integrated farming system studies at Sirupura district of Karnataka state that rice-fish-poultry combinations gave highest net income (>Rs. 157000/ha) with an improvement in soil robustness. Channabasavanna and Biradar (2007) reported that nutritional status of soil NPK show increased trend from 187 kg/ha to 262 kg/ha (40%), 29.3 kg/ha to 33.6 kg/ha (14.6%) and 503kg/ha to 530 kg /ha (5.4%), respectively in rice-fish poultry system over traditional farming system (rice-rice).

Crop-livestock-poultry farming system

Ramrao *et al.,* (2006) studied crop-livestock integrated farming system for the marginal farmers in rainfed regions of Durg district of Chhattisgarh in Central India to find out a sustainable integrated farming model which is economically viable integrating the different component like crop, livestock, poultry and duck in 1.5- acre land holding. This integrated model having 2 bullocks + 1 cow + 1 buffaloes + 10 goats + 10 poultry + 10 ducks with crop cultivation was the best with a net income of Rs. 33076 per year against arable farming alone (7843 per year) with a cost returns of 1:2.2 and employment generation of 316 days.

Korikanthimath and Manjunath (2009) reported that poultry and farm yard manure improve soil fertility after successive rotation of different cropping systems (1.35%) as compared to no manure recycling. Recycling of paddy straw with mushroom substrate had an impact in retaining soil carbon status of the soil (1.33%).

Crop-livestock-fish-poultry farming system

Integrated farming system is playing a significance role for improving the soil health through increasing the nutritional value of soil.The main advantage of the use of livestock manure in crop production are improvements in soil physical properties and the provision of N, P, K and other micro nutrients. The application of livestock manure increases soil organic matter content, and this leads to improved water infiltration and water holding capacity of the soil as well as an increased cation exchange capacity. Manure and urine increases the soil pH level and decomposition of organic matter and termite activity (Brouwer and Powell 1995, 1998).

In Tungabhadra project conducted in area of Karnataka and integration farming system approach of crop with fish, poultry and goat resulted 26.3 and 32.3% higher productivity and profitability, respectively over conventional rice-rice system. Among the components assess, the highest net returns were obtained from crop (63.8%), which isfollowed by goat (30.9%), fish (4.0%) and poultry (1.3%), respectively (Channabasavanna *et al.,* 2009).

Advantages of rain fed integreted farming system

Integrated farming systems approach is considered as a robust tool for natural and human resource management in developing countries including India. This is a multi disciplinary whole-farm approach and extremely effective in solving the problems of small and marginal farmers. The approach aims at increasing income and employment from small-holdings by integrating various farm enterprises and recycling of the crop residues and by-products within the farm itself (Behera and Mahapatra, 1999; Singh *et al.,* 2006).

Integrated farming systems are often less risky, if managed efficiently, they benefit from synergisms among enterprises, diversity in produce . and environmental well soundness (Lightfoot 1990).

Integrated farming system is biologically integrated system, which integrates natural resources ina regulation mechanisms into farming activities to achieve maximum replacement of off-farm inputs, secures sustainable production of good quality food and other products through ecologically approved technologies, sustain farm income, eliminates or reduces sources of present environment pollutions generated by agriculture and sustains the multiple function of agriculture (IOBC ,1993).

IFS increases productivity profitability and sustainability are ensured with protective food and environmental safety. Recycling of waste material, income round the year, saving energy, meeting fodder crisis, employment generation and ultimately increasing the standard of living of the farmers are other major benefits of integrated farming system (Faroda, 2014).

It is advantageous over cropping system as it is an intensive farming and creates job opportunities to the small and marginal farmers throughout the year, one enterprise may act as insurance to other in case of crop failure, by-product of one enterprise may be used in other and also improves soil health and fertility in long run by increasing the nutritional value of soil (Olele *et al*., 1999, Ugwumba *et al*., 2010).

Integration of livestock with crop component has been found beneficial as it improves soil physical and chemical

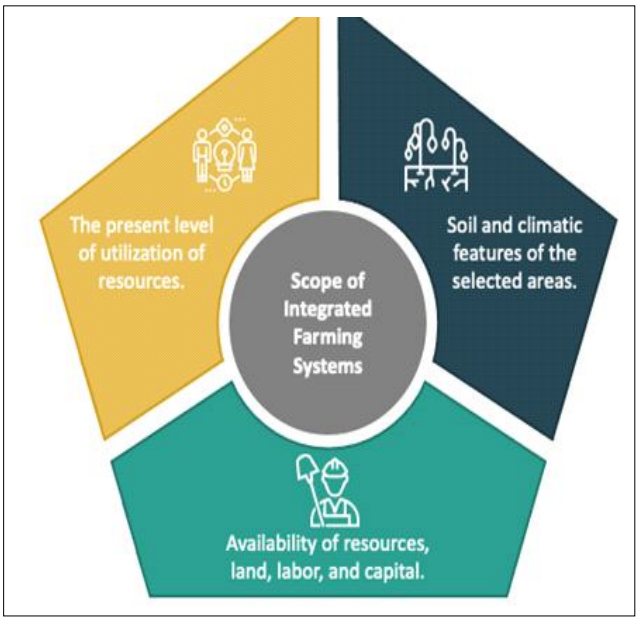


Fig 3: Scope of integrated farming.

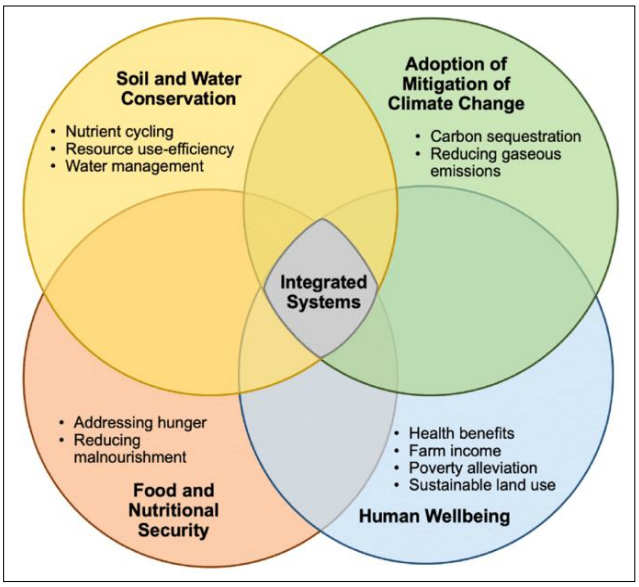


Fig 4: Economic importance of integrated farming. (Rattan Lal, 2020).

properties in terms of N, P, K and other mineral nutrients (Kumar *et al*., 2012b). The application of livestock manure increases soil organic matter content, and this leads to improved water infiltration and water holding capacity as well as an increased the capacity of cation exchange, mainly because of biological aeration. Manure and urine raise the pH level and accelerate the decomposition of organic matter and microbial activity (Brouwer and Powell, 1995, 1998).

Scope for of rain fed integreted farming system

The recognition of rain fed agriculture as a high priority area by the Government of India is an important opportunity for farmers. Programmes launched like NMSA (National Mission for Sustainable Agriculture) have identified several priority areas related to dryland farming and resources have been committed. Agricultural sciences must harness the advances in modern science tools and techniques like GIS (geographic information system), remote sensing, bioinformatics, nanotechnology, and information technology to support such major programmes. There has been a lot of work in delineating typologies (or agro-climatic/agro-ecological classification) using GIS. This can be effectively used in targeting interventions to rainfed regions. Remote sensing and GIS have potential to be applied in planning natural resource management in terventions. For example, boundaries and locations for mechanical interventions within watersheds of different scales (micro, mini, catchment, basin *etc*.) can be done by employing the relevant GIS tools. The active participation of communities will further help acceptance of the interventions.

In the present situation, the population of India is increasing a very quick likewise sky rocketing manner and we could not able to increase our production areas. So, the challenge is to increase the productivity to feed the fast growing population. Conventional farming system has caused economic problems associated with increased costs of energy-based inputs, lessened farm incomes etc. It has also produced ecological problems such as poor ecological diversity, soil erosion. and soil and water pollution. Integrated farming system (IFS) is considered as one of the best scope towards intensification of small holder farm income to ensure sustainable livelihood. Integration of resources is made through a combination of land, water and animal resources of a farm through careful planning including recycling of bio-resources (Swagatika and Pinaki, 2018).

Singh *et al.* (1993) and Singh *et al*. (1997) reported that the integration of various enterprises on various sizes of land holdings tend to be more profitable than arable farming alone and generate more employment.

A rain fed Integrated farming system is one types of resource-saving practices that main goal is achieve acceptable profits high and sustained production levels, while minimizing the negative effects of intensive farming and protect/conserve the environment (Lal and Miller, 1990, Gupta *et al.,* 2012). IFS givesmore importance for sound management of available all farm resources to increase the farm productivity and reduce the environmental degradation, improve the living standard of resource poor farmers (Kumar *et al*., 2013) (Fig 3).

Economic importance

Rain fed integration farming system is mainly depending upon weather (monsoon) because unavailability of the irrigation source. Most of the farmers adopt conventional farming practices but this is a traditional farming system; therefore, to increase income, use an integrated farming system in a rained area (Fig 4).

Majish Gomango (2010), a successful tribal farmer in Orissa state after adopting the integrated farming system earned 7 times higher Net Monetary Return (NMR) as compared to conventional farming system. His productivity as well as the profitability and sustainability got increase as compared to the conventional farming system. The benefit cost ratio of IFS was 2.70 whereas in traditional system it is 2.08.

Tripathi *et al.* (2010) reported the integration of the seven different components namely, crop+ fish+ goat+ vermicompost+ fruit production+ spice production+ agro forestry results in the net return to the of Rs. 2, 30,329 annually with the benefit cost ratio (BCR) of 1.07:1 and also the maximum per cent contribution is seen in 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 benefit cost ratio (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).

Vikaraman (1976), notice that there was little loss of nutrient from the field as those fodder crops removed were returned in the form of cattle manure in integrated farming system.

CONCLUSION

Based on above discussion, the rainfed integrated farming system is the most promising enterprise for the small and marginal farmers particularly who has less farm holding.These technological interventions have indicated an overall improvement in the farming system with increased economic status of the farmers. Integrated farming systems approach is profitable and more sustainable than the conventional mono cropping system because it not only enhance the nutritional and economic status of the farmers but increase the employment generation and makes maximum use of farm resources through recycling without disruption to environment. Also adoption of integrated farming system reduces the cost of external inputs like insecticides and chemical fertilizers. Hence, in the present scenario of agriculture sector, IFS is the effective approach for farmers of the dryland locality.

Conflict of interest

All authors declare that they have no conflicts of interest.

REFERENCES

Aggarwal, R.K. and Kumar, P. (1993). Sustainable Productivity through Organic Manure in Arid Land Ecosystem. In: Proceedings of International Symposium on Environmental degradation. CAZRI, Jodhpur. pp. 21.

Behera, U.K. and Mahapatra, I.C. (1999).Income and employment generation of small and marginal farmers through integrated farming systems. *Indian Journal of Agronomy.* **44(3):** 431-439.

Bhatt, B.P. and Bujarbaruah, K.M. (2004). Characteristics of some Indian mountain firewood trees and shrubs in the North Eastern Himalayan region. *Renewable Energy*. **29:** 1401-1405.

Brouwer, J. and Powell, J.M. (1995). Soil aspects of nutrient cycling in a manure experiment in Niger. Livestock and Sustainable Nutrient Cycling in Mixed Farming Systems of Sub-Saharan Africa. Vol II: Technical papers. In: Proceedings of an International Conference held during 22-26 November 1993 in Addis Ababa. [Powel, J.M., Fernandez-Rivera, S., Williams, T.O. and Renard, C. (Eds)]. Ethiopia. pp. 349-360.

Brouwer, J. and Powell, J.M. (1998).Micro-topography, Water Balance, Millet Yield and Nutrient Leaching in a Manuring Experiment on Sandy Soil in South-west Niger. In: Soil Fertility Management in West African Land Use Systems. [Renard, G., Neef, A., Becker, K. and Von Oppen, M. (Eds)]. Proceedings of a Workshop Held During 4-8 March 1997 in Niamey, Margraf, Weikersheim. pp. 349-360.

Channabasavanna, A.S., Biradar, D.P., Prabhudev, K.N. and Hegde, M. (2009).Development of profitable integrated farming system model for small and medium farmers of Tungabhadra project area of Karnataka. *Karnataka Journal of Agricultural Sciences*. **22(1):** 25-27.

Channabasavanna, A.S., Itnal, C.J. and Patil, S.G. (2002). Productivity, economics analysis and changes in physico- chemical properties as influenced by integrated rice-based farming system. *Indian Journal of Agronomy.* **46(1):** 1-5.

Chnnabasavanna, A.S and Biradar, D.P. (2007). Relative performance of different rice-fish-poultry integrated farming system models with respect to system productivity and economics. *Karnataka Journal of Agricultural Sciences*. **20(4):** 706-709.

Dugan, P., Dey, M.M and Sugunan, V.V. (2006). Fisheries and water productivity in tropical river basins: enhancing food security and livelihoods by managing water for fish. *Agricultural Water Management*. **80:** 262-275.

Edwards, P., Kaewpaitoon,K., McCoy, E.W and Chantachaeng, C. (1986). Pilot small scale crop/livestock/fish integrated farm. AIT Research Report 184. Bangkok, Thailand. pp. 131.

Faroda, A.S. (2014). Integrated farming system for livelihood and environmental security under rainfed conditions. (In). souvenir of National Symposium on Agricultural Diversification for Sustainable Livelihood and Environmental Security, held during 18-20 November 2014 at Ludhiana, Punjab. pp. 31-5.

Giap, D.H., Yi, Y. and Lin, C.K. (2005). Effects of different fertilization and feeding regimes on the production of integrated farming of rice and prawn Macro *Brachium rosenbergii*. *Aquaculture Research*. **36:** 292-299.

Gill, M.S., Singh, J.P. and Gangwar, K.S. (2009). Integrated farming System and agriculture sustainability. *Indian Journal of Agronomy.* **54(2):** 12-39.

GoI. (2017). Agricultural statistics at a glance, Directorate of Economics and Statistics, Govt. of India, New Delhi.

Gupta, V., Rai, P.K. and Risam, K.S. (2012). Integrated crop-livestock farming systems: A strategy for resource conservation and environmental sustainability. *Indian Research Journal of Extension Education*. **2:** 49-54.

IOBC. (1983). International organization for biological and integrated control. *Technical Bulletin*. **16(1).**

Jayanthi, C., Balusamy, M., Chinnusamy, C. and Mythili, S. (2003). Integrated nutrient supply system of linked components in lowland integrated farming system. *Indian Journal of Agronomy.* **48:** 241-246.

Korikanthimath, V.S. and Manjunath, B.L. (2009). Integrated farming systems for sustainability in agricultural production. *Indian Journal of Agronomy*. **54(2):** 140-148.

Kumar, S., Dey, A., Kumar, U., Chandra, N. and Bhatt, B.P. (2012). Integrated farming system for improving agricultural productivity. *Status of Agricultural Development in Eastern India, Chapter.* **3(6):** 205-230.

Kumar, S., Singh, S.S., Kumar, U., Dey, A. and Shivani. (2013). Sustainability of integrated farming systems in the eastern region. *Natural Resource Conservation-Emerging Issues and Future Challenges*. pp. 455-64.

Kumar, S., Subhash, N., Shivani, Singh, S.S. and Dey, A. (2012b). Evaluation of different components under Integrated Farming System (IFS) for small and marginal farmers under semi-humid climatic environment. *Experimental Agriculture.* **48(3):** 399-413.

Lal, R. and Miller, F.P. (1990).Sustainable Farming for Tropics. Sustainable Agriculture: Issues and Prospective, [Singh, R.P., (Ed)]. Indian Society of Agronomy, IARI, New Delhi. **1:** 69-89.

Lightfoot, C. (1990). Integration of aquaculture and agriculture: a route to sustainable farming systems. Naga. *The ICLARM Quarterly.* **13(1):** 9-12.

Lobell, D.B. (2007). The cost of uncertainty for nitrogen fertilizer management: A sensitivity analysis. *Field Crop Research.* **100:** 210-217.

Mustow, S.E. (2002). The effects of shading on phytoplankton photosynthesis in rice-fish fields in Bangladesh. *Agriculture, Ecosystems and Environment.* **90:** 89-96.

Olele, N.F., Nweke, F.U. and Agbogidi, O.M. (1999). Role of integrated farming system in agricultural development in the delta region of Nigeria. *Delta Agriculture.* **6:** 128-134.

Ramrao, W.Y., Tiwari, S.P. and Singh, P. (2006). Crop-livestock integrated farming system for the marginal farmers in rainfed regions of Chhattisgarh in central India. *Livestock Research for Rural Development.* **18(7).**

Rattan, L. (2020) Integrating Animal Husbandry With Crops and Trees. *Integrating Animal Husbandry With Crops/Trees.* **4:** 1-12.

Rothuis, A.J., Vromant, N., Xuan, V.T., Richter, C.J.J. and Ollevier, F. (1999). The effect of rice seeding rate on rice and fish production and weed abundance in direct seeded rice-fish culture. *Aquaculture.* **172:** 255-274.

Shah, M., Banerji, D., Vijayshankar, P.S. and Ambasta, P. (1998). India's Dryland: tribal societies and development through environmental regeneration, Oxford University Press, New Delhi.

Sheshshayee, M.S., H. Bindumadhava, A.G., Shanker, T.G., Prasad and Udayakumar, M. (2003). Breeding strategies to explain water use efficiency for crop improvement. *Journal of Plant Biology.* **30(2):** 253-268.

Siddeswaran, K., Sangetha, S.P. and Shanmugam, P.M. (2012). Integrated farming system for the small irrigated upland farmers of Tamil Nadu. Extended Summaries 3rd International Agronomy Congress, held during 26-30 November 2012 at New Delhi. **3:** 992-993.

Singh, K., Bohra, J.S., Singh, Y. and Singh, J.P. (2006). Development of farming system models for the north-eastern plain zone of Uttar Pradesh. *Indian Farming*. **56(2):** 5-11.

Singh, K. P., Singh, S. N., Kumar, H., Kadian, V. S. and Saxena, K.K. (1993). Economic analysis of different farming systems followed on small and marginal land holdings in Haryana. *Journal of Agronomy*. **9:** 122-125.

Singh, S.N., Saxena, K.K., Singh, K.P., Kumar, H. and Kadian, V.S. (1997). Consistency in income and employment generation in various farming systems. *Annals of Agricultural Research.* **18(3):** 40-43.

Steinfeld, H. (1998). Livestock and global change. In: Livestock and the Environment. Proceedings of the International Conference on Livestock and the Environment held in Ede/Wageningen, the Netherlands 16 - 20 June 1997, organized by World Bank Food and Agriculture Organization International Agricultural Centre.

Swagatika, P. and Pinaki, S. (2018). Integrated farming system in India: A holistic approach to magnify the economic status of innovative farmers. *Journal of Pharmacognosy and Phytochemistry.* **7(3):** 3632-3636.

Tripathi, H., Tomar, S.S., Pandey, R., Solanki, V.S., Singh, R., Meena, K.L.(2010). Economic feasibility of Integrated Farming System models with respect to productivity and economics. In: 22nd national seminar on "Role of Extension in Integrated Farming Systems for sustainable rural livelihood, 9th-10th Dec, Maharashtra. pp. 42-43.

Ugwumba, C.A.O., Okah, R.N., Ike, P.C., Nnabuife, E.L.C. and Orji, E.C. (2010). Integrated farming system and its effect on farm cash income in Awka South Agricultural zone of Anambra state, Nigeria, Am. *Euras Journal of Agriculture and Environment Science*. **8(1):** 1-6.

Velu, V. (2011). Soil fertility management strategies through INM in rainfed agriculture. In: CAFTA training manual on Productivity enhancement in dry lands through diversified farming options, TNAU, Coimbatore. **27(16):** 81-92.

Vikaraman, N.R., Pillai, N.G. and Sahaskanaman.(1976). Mixed farming in coconut gardens. *Indian Fmg.* **26(1):** 24-25.