International Journal of Science, Environment and Technology, Vol. 8, No 1, 2019, 177 – 184

ISSN 2278-3687 (O)
2277-663X (P)

Review Article

INTEGRATION OF LIVESTOCK WITH CROP PRODUCTION FOR SUSTAINABLE DEVELOPMENT

S.P. Dahiya, Sunil Kumar* and Manoj Kumar
Department of Livestock Farm Complex
Lala Lajpat Rai University of Veterinary and Animal Sciences,
Hisar - 125004, Haryana, India
E-mail: sunnydayzz92@gmail.com (**Corresponding Author*)

Abstract: India is an agricultural country and majority of farmers in India are small and marginal farmers which possess less than two hectares of land. Achieving livelihood security and sustainability with a single enterprise is quite difficult for these farmers. The average size of agriculture landholding in India has reduced to 1.08 hectare in 2015-16 and there is no further scope for horizontal expansion of land for agriculture. So, vertical integration of various enterprises is need of the hour. Besides livelihood security, social, economic and environmental sustainability is also ensured by the integrated farming system. In this paper, the research work on some of the livestock based integrated farming systems which are in practice in northern India has been reviewed. Most of the studies indicated that integrated farming systems yield higher returns in comparison to single farming system and waste material is also better utilized.

Keywords: Integrated farming, Manure, Sustainable development.

India is predominantly an agricultural country and the livestock is an integral and indispensable component of our agricultural system. The majority of farmers in India are small and marginal farmers. According to 10th agriculture census, small and marginal farmers holding less than two hectares of land, account for 86.2% of all farmers in India while, their share in total operated area is only 47.34% (Agriculture census, 2015-16). The average size of agriculture landholding in India is gradually shrinking and is declined to 1.08 ha in 2015-16 in comparison to 2.28 ha in 1970-71. In general, these small and marginal farmers practice subsistence farming where they want to produce a continuous, reliable and balanced supply of foods along with cash for basic needs and recurrent farm expenditure (Rani, 2015). It is difficult to achieve livelihood security and sustainability for these farmers with a single farm enterprise without turning to Integrated Farming Systems (Mahapatra 1992, 1994).

Due to explosion of population and unplanned colonization, rapid fragmentation of land holdings and shrinkage in fertile cultivated land has occurred and there is no further scope for horizontal expansion of land for agriculture. Vertical integration of land based enterprises is

*Received Jan 22, 2019 * Published Feb 2, 2019 * www.ijset.net*

need of the hour. Under these circumstances of shrinking land holding size, it is quite essential to integrate various enterprises such as dairy, poultry, beekeeping, fishery along with field and horticultural crops so as to make farming a more profitable and dependable option for the farmers (Behera *et al*., 2004).

Integration of enterprises not only helps in ensuring food, nutrition and livelihood security but also ensures social, economic and environmental sustainability (Kumar *et al*., 2017). While developing integrated systems, sustainability remains an important element. The Millennium Ecosystem Assessment (MEA, 2005) defined sustainability as a characteristic or state whereby the needs of the present generation and local population can be met without compromising the ability of future generations or population present elsewhere to meet their needs. There is an urgent need for sustainable agricultural practices for the development of small and marginal farmers.

The Integrated Farming Systems (IFS) therefore assumes greater importance in sustainable agriculture as in this system nothing is wasted, the by-product of one system becomes the input for other. Integrated farming systems with environment friendly and cost effective practices for efficient water, soil, crop and pest management must be included for sustainable development in agriculture (Walia and Kaur, 2013). High consumption of off-farm resources (Chemical fertilizers, pesticides, etc.) to enhance crop productivity during green revolution era led to food contamination, ground water pollution and soil degradation problems. These problems can also be addressed by resorting to IFS strategy as it involves recycling and reuse of farm and animal waste, which in turn will check the reliance on the off-farm resources (Kumar *et al*., 2017).

Integration of crop, pasture, and livestock is mutually beneficial to each other, since animal manure can be utilized as natural fertilizer to enhance crop production and to maintain soil fertility, whereas crop residues can be used as animal feed. In past, several efforts were made in India to develop low cost farming systems suitable for our climatic conditions by field-testing the possibilities of integration of various enterprises for small and marginal land holders. Various researchers from different regions have conducted research on the integrated farming systems from time to time. The research work on some of the livestock based integrated farming systems which are in practice in northern India has been reviewed hereunder:-

Integrated Farming System model under irrigated conditions for livelihood improvement of small farm holders developed at main research farm of the ICAR-Indian Institute of Farming

Systems Research included various components as i) crops (1.04 ha area), ii) horticulture (0.22 ha), iii) a small kitchen garden (20 m^2), iv) dairy animals (2 Murrah buffaloes +1 HF cow), v) fresh water fish production (0.1 ha), vi) mushroom unit (100 m^2) and vii) boundary plantation all around the field plots. It also consisted of a vermicompost unit (0.001 ha) and a biogas unit (ICAR-IIFSR Annual Report, 2016-17). A total of 4228 litres of milk was produced by the 3 milch animals of livestock component. Twelve tonnes of vermicompost and thirteen tonnes of FYM were also prepared. Livestock component contributed 29.56 % to the net farm income. Various nutrients viz., 49.4 kg N, 15.6 kg P and 26 kg K were also supplied by the recycling of farm dung and urine in FYM/compost form. The results indicated that in comparison to prevailing dominant cropping systems of western plain zones of UP like sugarcane-ratoon-wheat, IFS approach yielded 95% higher total farm production. Integrated Farming System model not only increased the production and profitability but also ensured the food requirement of farmer's family along with nutritional improvement. This method of integrating various enterprises resulted in a safeguard to farmers against the climatic hazards and also reduced the production cost.

Six different viable models (T_1, T_2, T_3, T_4, T_5 and $T_{6)}$ viz. sole crop, crop + 1 pair of bullocks + 1 cow, crop + 1 pair of bullocks + 1 buffalo, crop + 1 pair of bullocks + 1 cow + 1 buffalo, crop + 1 pair of bullocks + 1 cow + 1 buffalo +5 goats and crop + 1 pair of bullocks + 1 cow + 1 buffalo + 5 goats + 10 poultry birds were studied by Khan *et al*. (2015) in district Kanpur Dehat (U.P.) and they observed that integration of livestock rearing with crop production gave significantly higher ($P < 0.01$) economic returns as compared to crop production alone. Besides, land, water and other inputs were better utilized in integrated model as compared to arable farming alone. The farmyard manure from the animals was used as fertilizer for crops and 25-30% savings in fertilizer use was observed. Integrated farming system model with 1 pair of bullock + 1 cow + 1 buffalo + 5 goats along with keeping poultry birds (T_6) was found to be most beneficial and it gave quite higher returns in comparison to arable farming alone. Thus, we can say that integration of different complementary enterprises will enhance the socio-economic status of the marginal farmers living under the Central Plain Zone of Uttar Pradesh. Such IFS models may also be tried in plain areas of other states to increase the income of small and marginal farmers.

A study conducted by Singh *et al.,* (2013) in Chittorgarh and Rajsamand districts situated in sub-humid southern plains and Aravalli hills of Rajasthan to assess the economics of farming systems and to identify and characterize the major farming systems indicated that mainly two

farming systems are prevalent in the study area of southern Rajasthan viz., i) Crop-livestock farming system which is followed by 66% farmers where crop production contributed around 75% and animal husbandry contributed around 25% to total income of farmers; ii) Crop-animal husbandry-horticulture farming system which is followed by 34% farmers. Crop production contributed 42.0 to 60.70 % of total income whereas; livestock contributed 23 to 29.2%, remaining portion was contributed by horticulture. With increase in land holding size, the per cent contribution of horticulture and livestock increased whereas contribution of crop production decreased. Results indicated that farmers should diversify for getting higher income from the present farming system.

Studies were carried out on 0.6 ha and 0.4 ha irrigated land holdings in Haryana during 1991-92 to 1999-2000 and integrated mixed farming systems models were compared with arable farming systems by Singh, (2002). The mixed farming systems consisted of either crossbred cows or Murrah buffaloes and arable farming without any milch animal or with one milch animal. About 55-65 percent of the area was covered under fodder crops and rest under grain crops in mixed farming systems. Excreta and other waste material were utilized in the system by making farmyard manure. The findings of the study indicated that on 0.6 ha, the highest average net return was obtained in mixed farming with one crossbred cow irrigated land farming system, followed by from arable farming alone. Similarly on 0.4 ha, the highest average net return was obtained in mixed farming with one crossbred cow irrigated land farming system. By-products and wastes were also better utilized in mixed farming system.

Seven integrated farming systems which were prevalent in Bulandshahr district of Uttar Pradesh viz., Wheat-Rice-Livestock, Wheat-Rice-Sugarcane-Pulses-Oilseeds-Maize-Livestock, Wheat-Rice Sugarcane-Livestock, Wheat-Rice-Sugarcane-Vegetable-livestock, Wheat-Rice-Millet-Sugarcane-Oilseeds-Pulses-Livestock, Wheat-Rice-Sugarcane-Vegetable-Pulses- Livestock and Wheat-Sugarcane-Horticulture-Livestock were studied by Khan and Parashari, (2018). All these systems were wheat and rice based, while sugarcane farming was also present in five of these systems. It was observed that the prevalence of these crops in the study area is found as livestock thrives on the straw of these crops and these are also used as fodder crops. The manure from livestock also increases the productivity of crops incredibly. Most of the income of small and marginal farmers was generated from livestock. Integrated farming systems gave 6-8 fold increase in net returns in improved farming systems and value of household consumption also increased by 51.4 per cent. Study indicated that integrated crop livestock farming system is the most important farming system for maintaining the

sustainable agricultural growth and environmental balance. Productivity of land resource is increased by using this system and wasteful utilization of non-crop components is also reduced.

Ponnusamy and Devi (2017) conducted a study in two districts of Karnataka and four districts of Haryana, namely Karnal, Kaithal, Sonipat and Hisar about various aspects of integrated farming systems. Farmers in Haryana showed a shifting preference in adopting different farm enterprises. Indigenous cattle and sheep were reducing whereas, crossbred animals, goats and poultry were increasing. There was no change in buffalo-rearing while mushroom and fish farming were picking up. The milk production was the major reason for shifting the preference to crossbred animals in addition to focus of government on commercial dairy farming with crossbred animals. They observed that large ruminants could provide 29 - 32 kg manure and 12- 14 litres urine per day which enriches the soil by way of structure, texture and nutrients, leading to ultimate productivity enhancement.

Crop-livestock hill farming system is the traditional farming system in hill ecosystems and livestock contributes major share in total agricultural income of hill farmers. Besides this, shepherd-rangeland production system is practiced in Jammu & Kashmir, Himachal Pradesh and Uttarakhand where the sheep and goat flocks are reared on flora in natural hill rangeland and alpine regions (Choudhary, 2013). Farming systems in Kandi area of Jammu region were studied by Kumar, (2013). Various Farming systems viz., Crops + Livestock, Crops+ Livestock+ Horticulture, Crops + Livestock + Sericulture and Crops +Livestock+ Goatry, were identified. Around 60% of the respondents practiced Crops + livestock farming. Farming system comprising of Crops +Livestock + Horticulture had the highest benefit: cost ratio of 1.56.

Singh et al. (2017) studied the socio-economic profile of Punjab Agricultural University awardees farmers and also studied the integrated farming system followed by these farmers. They observed that different integrated farming systems like crop + dairy, crop + floriculture, crop + poultry; crop + beekeeping etc. were practiced by these farmers. Study indicated that crop + dairy farming system was most prevalent and 63% of the farmers followed it. Integrated farming systems in tribal dominant Banswara district of Rajasthan were studied by Singh and Burark (2016) and they observed that four farming systems viz., Crops + Onion nursery, Crops + Dairy, Crops + Dairy + Goat, Crops + Poultry were prevalent in the rain fed area. Farming system in which farmers reared goat and dairy enterprises along with crop (Crop + Dairy + Goat) gave highest net returns.

In our traditional agriculture, the use of plant and animal wastes as a source of plant nutrient was the accepted practice and followed from generations. But in modern agriculture, importance and aim of organic manures have failed to be recognized and there has been excessive reliance on chemical fertilizers which has not only caused the exhaustion of soil of its nutrient reserves but also resulted in soil health problems (Chandra, 2005). By adopting IFS strategy this problem can be solved as by-product of one enterprise is used as input in other enterprise and nothing is wasted. Animal waste can be used as fertilizer since manure is an excellent fertilizer containing N, P, K and other micronutrients (Table 1). Animal waste also adds organic matter to the soil which may improve soil health.

Table 1: Average nutrient content of bulky manure from livestock

Manure	N%	P_2O_5 %	K_2O%
Cattle dung, fresh	0.4-0.5	0.3-0.4	0.3-0.4
Horse dung ,fresh	0.5	0.4-0.6	0.3-1.0
Poultry manure	1.0-1.8	1.4-1.8	0.8-0.9
Cattle urine	0.9-1.2	trace	0.5-1.0
Sheep Urine	1.5-1.7	trace	1.8-2.0
Farmyard manure, dry	0.4-1.5	0.3-0.9	0.3-1.9

(Dahama, 1997)

Conclusion

In a country like India where majority of farmers are small and marginal farmers, it is essential to go for integration of various enterprises to supplement the income and production and also for sustainable development as waste material of different enterprises is utilized in an efficient manner in integrated farming systems. In northern India farmers have started opting crop-livestock integrated farming systems. Various studies have indicated that majority of farmers go for crop-dairy farming. Integration of different complementary enterprises will certainly enhance the socio-economic status of the small and marginal farmers.

References

[1] Agricultural Census (2015-16). Agriculture census division, Department of agriculture, cooperation and farmers welfare, Ministry of agriculture and farmers welfare, Government of India (2018).

[2] Annual report (2016-17). ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut - 250 110, India

[3] Behera, U.K., Jha, K.P., Mahapatra, I.C. (2004) Integrated management of available resources of the small and marginal farmers for generation of income and employment in eastern India. *Crop Research,* **27 (1)**, 83–89.

[4] Chandra, K., (2005). Organic Manures. Regional Centre of Organic Farming, Hebbal, Banglaore, India.

[5] Choudhary, A. (2013). Integrated farming systems for enhancing productivity and profitability under hill and mountain agro-ecosystems.1st edition. pp. 122-134

[6] Dahama, A.K. (1997). Organic farming for sustainable agriculture. Agro Botanical Publishers.

[7] Khan, N., and Parashari A.K. (2018). Income and Employment Generation through Integrated Crop-Livestock Farming System in Bulandshahr District: A Geographical Analysis. *Acta Scientific Agriculture,* **2(5)**, 36-39.

[8] Khan, N., Dubey, M. and Tiwari U.S. (2015). Study of economically viable farming system model for marginal farmers in central plain zone of Uttar Pradesh, India. *Global Journal of Bio-Science and BioTechnology,* **4(3)**, 252-254.

[9] Kumar, A., Arif, M. and Kadam, S.S. (2017). Integrated farming system- A model land use plan for sustainable development. *Rashtritya Krishi*, **12(1)**, 45-47.

[10] Kumar, P., (2013). A study of the farming systems in Kandi area of Jammu region. Ph.D. Thesis, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu.

[11] Mahapatra, I.C. (1992). Farming systems research challenges and opportunities. *Eastern Indian Farming System Research & Extension Newsletter,* **6**, 3–10.

[12] Mahapatra, I.C. (1994). Farming system research – a key to sustainable agriculture. *Fertilizer News,* **39(11)**, 13–25.

[13] MEA (Millennium Ecosystem Assessment) (2005). Current State and trends (Eds. Hassan, R., Scholes, R. and Ash, N.) **1**,133-134.

[14] Ponnusamy, K., and Devi, M.K. (2017). Impact of Integrated Farming System Approach on Doubling Farmers' Income. *Agricultural Economics Research Review*, **30**, 233-240.

[15] Rani, J.B. (2015). Success through farm integration- A case study of a farmer at Dhauli in the outskirts of Bhubaneswar City in Odisha. *IOSR Journal of Agriculture and Veterinary Science,* **8(10)**, 51-53

[16] Singh, H., Sharma, S.K., Dashora, L.N., Burark, S.S. and Meena, G.L. (2013). Characterization and economics of farming systems in southern Rajasthan. *Annals of Arid Zone*, **52(1)**, 67-70.

[17] Singh, R., Riar, T.S., and Gill, J.S. (2017). Integrated farming systems and socio-economic characteristics of Punjab Agricultural University awardee farmers. *Asian Journal of Agricultural Extension, Economics and Sociology*, **16(3)**, 1-5.

[18] Singh, H., and Burark, S.S. (2016). Income and employment generation under existing farming systems in tribal dominated Banswara district of Southern Rajasthan. *Economic Affairs*, **61(1)**, 119-125.

[19] Singh, K.P. (2002). Integrated farming systems for smallholders in India–models and issues for semi-arid tropical conditions. In *17th Symposium of the International Farming Systems Association. Institute of Food and Agricultural Sciences. University of Florida. Lake Buena Vista, Florida*.

[20] Walia, S.S., & Kaur, N. (2013). Integrated farming system-an ecofriendly approach for sustainable agricultural environment—a review. *Greener Journal of Agronomy, Forestry and Horticulture*, **1(1)**, 001-011.