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Doubling Farmers' Income through Integrated Farming System Approach in Purba Barddhaman District of West Bengal

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Authors' contributions

This work was carried out in collaboration among all authors. Author FHR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DG, SS and SSK managed the analyses of the study. Author SD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Integration of different enterprises / crop by utilizing farmer's available resources is one of the best multidisciplinary approaches to boosting farmers' income from production and economic point of view. In this context, awareness and dissemination of this farming approach are taken as a priority of work with multidisciplinary interventions. One model has been developed on Integrated Farming System Approach in the farmers' fields on Crop + poultry + fish or Crop + duck + fish in aquatic based production through conducting awareness camp, trainings, trials and demonstrations. This has been developed in the field of one of the farmers namely Shoyeb Hossain, a marginal farmer-cum-rural youth of Jagulipara village in Purba Barddhaman disrict of West Bengal. Although being a rural youth, he has got a pragmatic view towards latest agricultural technologies and he is keen to learn and as such he was chosen for developing the integrated farming system model in his

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backyard. He owned one pond of 1 bigha with adjoining 1.5 bigha land including bund area. The pond was mainly used for household purposes like washing with irregular or even no pisciculture while the land area was used for growing seasonal vegetables for meeting household needs and as a result he was hardly having any meaningful income from the resources. He was extensively trained towards developing the integrated farming system in his backyard which he accomplished with success. To start with he was supplied with tissue cultured banana plantlets, vegetable seedlings, poultry chicks, ducklings and IMC fingerlings. A good banana orchard intercropped with vegetables like chili, tomato, brinjal, turmeric etc. was developed. The model with Crop+ fish + poultry farming has proven more remunerative (Benefit-Cost ratio 2.40) and his earning around Rs. 1,50,000 per annum from that farm, thus inspiring other farmers to adopt this kind of intervention. Advantageous aspects such as production potentiality, insurance coverage by other crops / enterprise, flow of return motivated farming community as well as district officials. Study on changes in food security indicated that over 4 years there has been augmentation in food security of the respondents. This is due to increase in income owing to adoption of improved technologies and crop diversification. It was revealed that the annual income of the members increased from Rs.15000/-to Rs. 135000in the 4 eastern clusters but that of Galsi cluster ranged between Rs. 10500/- to Rs 82000/-. The income augmentation was positively correlated with the land holding (0.95) size of the respondents. This model has been identified by district MGNREGA and had been taken up in MGNREGA convergence programme which is being replicated in selected 200 ponds recently excavated under the programme in the district. Many workshops have been conducted on the methodologies for these interventions to all the beneficiaries, Self Help Group (SHGs) and officers of line departments involving in the convergence programme of MGNREGA of the district.

Keywords: Integrated farming system; food security index; income augmentation; marginal farmer; Purba Barddhaman.

1. INTRODUCTION

Farming systems refer to obligatory raising of crops, forest and fruit trees, animals including fisheries, piggery and duck farming, sericulture, mushroom, on a given unit of land to increase the productivity and profitability, to upgrade natural resource base and to achieve overall improvement in the environment [1].

"There is no waste", and "waste is only a misplaced resource which can become a valuable material for another product" in Integrated Farming System (IFS) [2]. Integrated Farming System is a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises [3]. IFS, as a mixed animal crop system, envisages animal component being raised on agricultural waste products while the animal is used to cultivate the soil and provide manure to be used as fertilizer and fuel [4]. The rural livelihood development and food security at household level in rural India is an important issue, where millions of poor people have been suffering in persistent hunger and malnutrition [5]. Small and marginal land with limited resources and their sustainable utilization are the major issues of the country in the present scenario of the agriculture production system. From green revolution onwards farmers are mostly concentrating on single enterprise based agricultural system that leads to deterioration of soil health, increased risk of crop failure and downward trends of productivity. In this context integration of diversified enterprises / crops by utilizing farmer's available resources is, arguably, the best sustainable approach from production and economic point of view. Integrated Farming System is archetypical of Farming System Research (FSR) which induces a change in the farming techniques for production maximization while taking care of optimal utilization of resources. [6]. 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 [7]. 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 (Fig. 1). The authors are in agreement of the view 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 [8].

The modern agriculture emphasizes two more dimensions *viz.* time and space concepts. Time

concept relates to increasing crop intensification in situations where there is no constraint for inputs. In rain fed areas where there is no possibility of increasing the intensity of cropping, the other modern concept (space concept) can be applied. In space concept, crops are arranged in tier system combining two or more crops with varying field duration as intercrops by suitable modifying the planting method.

Income through arable cropping alone is insufficient for bulk of the marginal farmers. Activities such as dairy, poultry, fish culture, sericulture, bio-gas production, edible mushroom cultivation, agro-forestry and agri-horticulture, etc., on this basis, IFS models have been suggested by several workers for the development of small and marginal farms across the country [9,10,11]. Thus, the concept of Farming system approach can be summarized as it is a holistic approach, complex in nature, interrelated of components, matrix of soils, plants, animals, power, implements, labour, capital and other inputs, influenced by political, economic, institutional and social forces, [12]. 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 [13]. 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 [14].

Indian vision 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 [15].

Unlike mixed farming, different farming components in Integrated Farming System (IFS) exist with mutual benefits. Integrated Farming System can be practiced in different way with variable intensity depending on socioeconomic structure, characteristics of soil, choice of the farmers and most importantly the resource availability of farmers. Integrated Farming System has several benefits which include creating job opportunities to the marginal farmers throughout the year as it is an intensive farming, one enterprise may act as insurance to other in case of crop failure, bi-product of one enterprise may be used in other and it also improves soil health and fertility in long run [16,17]. Integrated farming system has revolutionized conventional

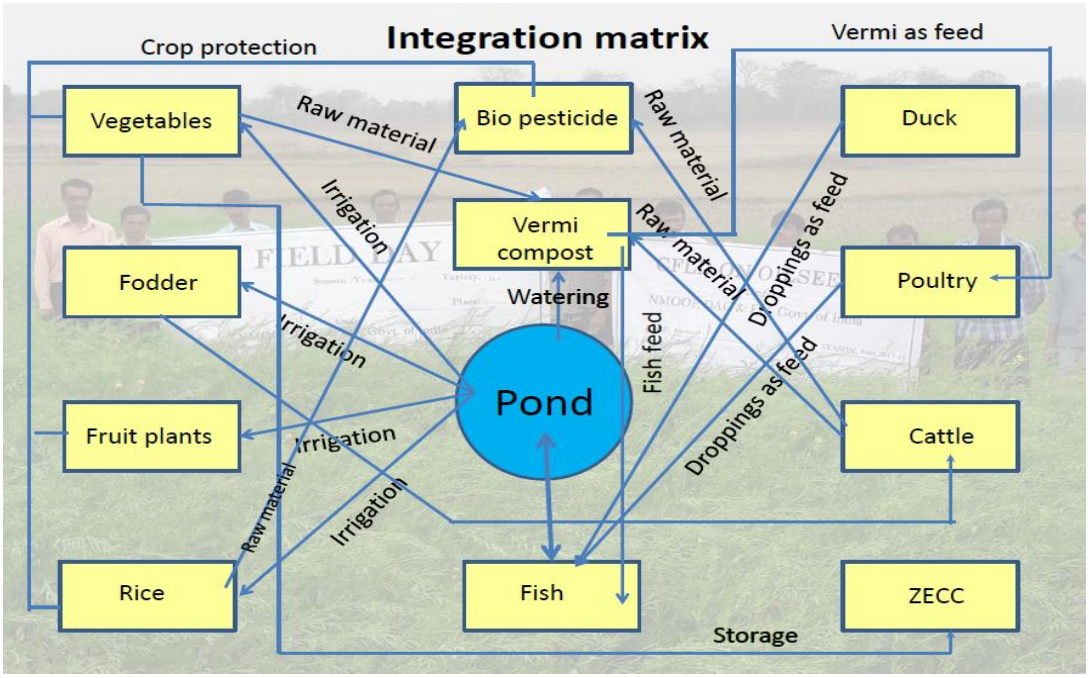

Fig. 1. Integration matrix in an IFS

farming of livestock, aquaculture, horticulture, agro-industry and allied activities [18]. It could be crop + fish integration, livestock + fish integration, crop + fish + livestock integration or combinations of crop, livestock, fish and other enterprises [19]. The objectives of this study was to find out the suitability of IFS in rural villages of Purba Barddhaman district and determine the profitability of this approach in comparison to existing farming system and better utilization of the aquatic niche based eco-system.

2. MATERIALS AND METHODS

The study was conducted in Galsi block of PurbaBarddhaman district, West Bengal during 2011-12 and 2012-13. Four villages of these blocks were selected where some of the families having pond around one bigha area with adjoining 1.5 bigha land including bund area to improve the existing practice. A total of 21 pond-based system were selected randomly. Two different models, Crop + fish + poultry and Crop + fish + duck along with the existing farmer's practice (*i.e*. only fish production) have been replicated in those selected ponds. In each case the land area 1 ha out of which 0.75ha was pond area and 0.25 ha was cultivable area. To start with, multidisciplinary trainings were conducted and selected families were supplied with tissue cultured banana plantlets; seedlings of vegetables like cauliflower, tomato, chilli etc.; poultry chicks or ducklings; and fingerlings of major carps. A good banana orchard intercropped with vegetables like chili, tomato, brinjal, turmeric was developed in the bund areas along with the composite fish culture. In each replication 30 numbers of ducklings or chicks have been provided.

The model, so developed, was extended to other blocks of Kalna I and II and Purbasthali I and II during 2014. Structured questionnaire was used to get the necessary information about IFS development needed for data analysis in the selected blocks for change in food security and income augmentation

2.1 Food Security Index

Changes in food security of the 250 respondents selected for crop diversification study was measured following the methods of Chen [20] and is given by the following equation,

$$FSI = \frac{\sum a*C_a+\sum b*C_b+\sum c*C_c+\sum d*C_d+\sum e*C_e}{N} \quad (1)$$

Where,

FSI = Food security index, a = Frequency of responses indicating food insecurity (temporal + permanent), b = Frequency of responses indicating always not enough to eat, c = Frequency of responses indicating sometimes not enough to eat, d = Frequency of responses indicating enough but not always the desired food, e = Frequency of responses enough of the desired food, N = sample size, and C_a to C_e = Coefficients of different adequate food grains, with value 1 indicating food insecurity (temporal + permanent), 2 indicating always not enough to eat, 3 indicating sometimes not enough to eat, 4 indicating enough but not always the desired food and 5 indicating enough of the kinds of desired food.

2.2 Income Augmentation

For calculation of change in income due to adoption of technology, 5 respondents were selected from each cluster through subjective sampling and were questioned for their income under various enterprises in the baseline year of 2014 and present income (December 2018).

3. RESULTS AND DISCUSSION

Firstly, it was observed from the study that manpower engagement was considerably increased in both farming system in comparison to conventional monocropping system particularly due to banana and vegetable inter-cropping system and was found beneficial for the target group who needed jobs round the year. Poultry and ducks were mostly pastured fed and both pond and cropping land facilitated to supply their feed. Data had been taken from the farm of Sk. Shoyeb Hossain for two consecutive years on productivity of each components and their cost of cultivation as well as return in monetary value. Two year's data have been pooled and presented in the Tables 1 and 2.

It was observed from the Tables 1 and 2 that farming system of Crop + fish + poultry farming was most suitable in the study area in terms of yield as well as monetary benefit which showed the B : C ratio of 2.42. It also revealed that banana-vegetable intercropping contributed considerably in additional income generation as fish culture remained at per in all the treatments. Income generated during particular year may vary because of seasonal market demand, availability of inputs, labour availability etc.

Table 1. Performance of different components of integrated farming system

Technology options	Fish yield (q/ha)	Tissue cultured banana yield(q/ha)	Vegetables yield (q/ha)	Poultry (eggs/bird/ annum)	Duckery (eggs/bird/annum)
Farmers' practice (Fish farming)	20.45	-	-	-	-
Crop+ fish + poultry farming	21.25	740	280	174	-
Crop+ fish + duck farming	21.75	725	255	-	162
C.D. (0.05)	2.34	-	-	-	-

Table 2. Economics of different components of integrated farming system

Technology options	Gross return(Rs)	Net return(Rs)	Benefit : cost ratio
Farmers' practice (Fish farming)	52140	24608	2.10
Crop+ fish + poultry farming	180680	105530	2.42
Crop+ fish + duck farming	179005	102675	2.34

Table 3. Change in food security index (FSI)

Parametric indicators	Kalna I		Kalna II		Purbasthali I		Purbasthali II		Galsi I	
	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018
Food insecure (temporal+ permanent)	13	5	12	4	18	3	15	11	21	8
Always not enough to eat	11	6	11	7	13	5	12	9	9	9
Sometimes not enough to eat	13	6	11	8	7	5	11	8	7	8
Enough but not always the kind of food desired	7	12	9	15	9	12	8	10	5	4
Enough of the kind of food desired	6	21	7	16	8	15	7	12	8	21
FSI	2.64	3.76	2.76	3.64	2.82	3.02	2.78	3.06	2.4	3.42

Study on changes in food security (Table 3, Fig.2) indicated that over 4 years, there has been augmentation in food security of the respondents. This is due to increase in income owing to adoption of improved technologies and crop diversification. It can be seen from the radar diagram (Fig. 2) that FSI have significantly increased in the clusters of Galsi, Kalna I and Kalna II (Table 4) as compared to the other two clusters of Purbasthali I and II, thusdivulged nominal increase in food security. This is ascribable to the increase amount of crop diversification in the blocks of Purbasthali where vegetables are cultivated in large areas.

It was seen that the annual income of the members have increased from Rs. 15000/- to Rs. 135000/- in the 4 eastern clusters and in Galsi cluster it ranged between Rs. 10500/- to Rs 82000/- (Table 4). The income augmentation was well correlated with the land holding (0.95) size of the respondents. When averaged over the entire group of respondents (25 nos.), the income augmentation was found to be 94% over the span of 4 years. Technology adoption and increase in terms of trade, being done in cooperative business mode and without involvement of middlemen, is chiefly ascribable to this income augmentation.

However, it should be clarified here that this increase in income is in nominal terms only and when increase in inflation is taken into account it would be much less in actual terms. Although, this model can be followed towards doubling of farmers income, actually doubling farmers income by 2022 as mandated by government will require rigorous policy measures, like increase in terms of trade further, creation of warehousing for storage, development of irrigation efficiency, enhancement of minimum support price.

Convinced by advantageous aspect of Integrated Farming System model that has been identified and recognized by the District Mahatma Gandhi

Table 4. Income augmentation of randomly selected respondents in the study area

Enterprise	Change in annual income of respondents (Rs.)														
	Kalna I														
	Jogesh Chandra Das(1.2ha)*			Somnath Singh (0.4 ha)			SubhenduMondal (2.4 ha)			Arati Das (0.4 ha)			Arup Roy (1.8 ha)		
	2014	2018	Increase	2014	2018	Increase	2014	2018	Increase	2014	2018	Increase	2014	2018	Increase
A	28000	54000	26000	9500	16000	6500	59000	94000	35000	7500	16000	8500	42000	78000	36000
B	5200	8500	3300	1800	3200	1400	0	0	0	2200	3200	1000	7800	12600	4800
C	2000	3600	1600	600	2200	1600	0	5400	5400	1600	4200	2600	3000	5400	2400
D	12000	18000	6000	0	0	0	41000	58000	17000	0	0	0	0	0	0
E	0	2600	2600	0	1500	1500	0	3500	3500	0	2900	2900	0	4200	4200
F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	47200	86700	39500	11900	22900	11000	100000	160900	60900	11300	26300	15000	52800	100200	47400
	Kalna II														
	NaserSeikh (4 ha)			Dulal Chandra Pal (3.2 ha)			Jagabandhu Pal (1.8 ha)			SubhadraMondal (0.4 ha)			Dipali Pal (0.8 ha)		
A	95000	135000	40000	76000	108000	32000	40000	82000	42000	8000	15000	7000	16000	36000	20000
B	0	25000	25000	10000	20000	10000	0	12600	12600	1800	4200	2400	4500	7000	2500
C	0	0	0	1500	6500	5000	5600	8400	2800	1500	4500	3000	1500	5500	4000
D	45000	107000	62000	36000	92000	56000	0	0	0	0	0	0	12000	25000	13000
E	0	8000	8000	0	4500	4500	0	4200	4200	0	2900	2900	0	2300	2300
F	0	0	0	0	0	0	0	0	0	0	2500	2500	0	6800	6800
TOTAL	140000	275000	135000	123500	231000	107500	52800	100200	61600	11300	29100	17800	34000	82600	48600
	Purbasthali I														
	Gobinda Das (2.5 ha)			Sujit Kumar Ghosh(1.4 ha)			Bipadbaran Ghosh(3.5 ha)			Mojammel Sk. (0.8 ha)			Probhat Das (1 ha)		
A	66000	105000	39000	35000	65000	30000	82000	135000	53000	18000	32000	14000	24000	38000	14000
B	0	0	0	6500	10500	4000	0	15000	15000	3200	6500	3300	0	0	0
C	0	6000	6000	2500	4500	2000	0	0	0	1200	4500	3300	0	4500	4500
D	45000	65000	20000	0	0	0	25000	55000	30000	0	0	0	0	0	0
E	0	0	0	0	3500	3500	0	0	0	0	2300	2300	0	5600	5600
F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	111000	176000	65000	44000	83500	39500	107000	205000	98000	22400	45300	22900	24000	48100	24100
	Purbasthali II														
	PraneswarBhowmik (2 ha)			Bishwajit Das (0.8 ha)			Rakhal Das (0.6 ha)			MajibarSk (0.4 ha)			BanamaliOrao (0.4 ha)		
A	48000	94000	46000	28000	42000	14000	22000	34000	12000	12000	22000	10000	6000	15000	9000

Enterprise	Change in annual income of respondents (Rs.)														
B	0	6500	6500	0	4500	4500	0	2500	2500	1400	4500	3100	0	2500	2500
C	5600	9000	3400	1800	8500	6700	1600	7500	5900	3500	5500	2000	0	6500	6500
D	0	12000	12000	0	0	0	0	0	0	0	0	0	0	0	0
E	0	3400	3400	0	5000	5000	0	5000	5000	0	3200	3200	2200	5600	3400
F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	52800	100200	71300	29800	60000	30200	23600	49000	25400	16900	35200	18300	8200	29600	21400

Galsi

	ParamesariBagdi (0.2 ha)			ChanchalaDeshali (landless)			RupaDeshali (Landless)			RupaMondal (0.2 ha)			RokeyaKhatun (2.2 ha)		
	2014	**2018**	**Increase**	**2014**	**2018**	**Increase**	**2014**	**2018**	**Increase**	**2014**	**2018**	**Increase**	**2014**	**2018**	**Increase**
A	6000	12500	6500	0	0	0	0	0	0	8000	17000	9000	44000	94000	50000
B	4500	6500	2000	4200	8500	4300	0	2500	2500	0	0	0	0	5500	5500
C	2800	8000	5200	2800	9500	6700	2400	4400	2000	0	6500	6500	5600	12000	6400
D	0	8000	8000	0	0	0	0	0	0	0	0	0	0	5000	5000
E	0	4500	4500	0	5000	5000	0	1500	1500	0	5500	5500	0	4500	4500
F	1200	6500	5300	0	10500	10500	0	4500	4500	1200	8500	7300	0	10600	10600
TOTAL	52800	100200	31500	7000	33500	26500	2400	12900	10500	52800	100200	28300	52800	100200	82000

*A: Crop production; B: Goatary; C: Poultry/duckery; D: Fisheries; E: Other enterprise (Vermicompost/mushroom); F: Value addition/rural crafts; *Figures within parenthesis indicate land holding size*

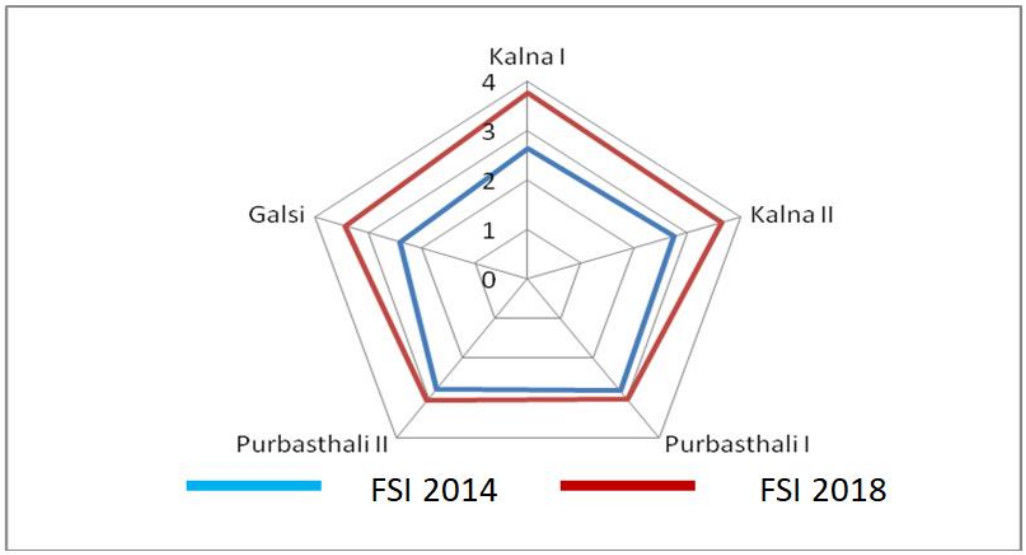

Fig. 2. Change in food security index in the study area

National Rural Employment Guarantee Act (MGNREGA) Cell and had been taken up in MGNREGA Convergence Programme which has being replicated in selected 200 ponds recently excavated under that scheme in the district where the authors of the article has been acting as implementing scientists. Many workshops have been conducted on the methodologies for these interventions to all the beneficiaries of the different areas where those ponds were excavated. Self Help Groups and officers of the line departments of the district involved in the convergence programme of MGNREGA of the district.

4. CONCLUSION

The important objective of this study was to analysis the reality and ground truth of integrated farming system in comparison to present traditional farming system and emphasizes to apply this sustainable integrated farming system for the rural livelihood development. The most notable advantage of utilizing low-cost/no-cost material at the farm level for recycling is that it will certainly reduce the production cost and ultimately improve the farm income considerably. It is no doubt that integration of different enterprises is the best possible option for better utilization of available resources for small and marginal farmers for better and sustainable income. The study also revealed that socio-economic of Indian farmers can be improved by some margin if IFS is adopted location specifically. Further research work need to be initiated for identifying and integration of region specific available resources.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Singh G. Farming systems options for sustainability of natural resources. (In:) Proceedings of Symposium on "Alternative Farming Systems: Enhanced income and employment generation options for small and marginal farmers". (Eds. A.K. Singh, B. Gangwar and SK Sharma), FSR held at Project Directorate for Cropping systems Research, Modipuram. 2005;57-64
2. FAO. China. Recycling of organic wastes in agriculture. FAO Soil Bull. 1977;40.
3. Okigbo BN. Major farming systems of the lowland savanna of SSA and the potential for improvement. In: Proceedings of the IITA/FAO workshop, Ibadan, Nigeria; 1995.
4. Jayanthi C, Rangasamy A, Chinnusammy C. Water budgeting for components in lowland integrated farming system. Agricultural Journal. 2000;87:411-414.

5. Mistri B, Majhi K. Problems and Prospects of Agriculture in BanagramMouza, PurbaBarddhaman, West Bengal.Indian Journal of Spatial Science. 2015;6(2):47-55.
6. Jayanthi, C. Integrated farming system: A path to sustainable agriculture. 2nd edition, Published by department of Agronomy, Directorate of Soil and Crop management studies, Tamilnadu Agricultural University, Coimbatore. 2006;1.
7. Singh RP. Ratan. Farming system approach for growth in Indian Agriculture. Lead paper in: National seminar on Enhancing efficiency of Extension for sustainable agriculture and livestock production, Indian Veterinary Research Institute, Izatnagar; 2009.
8. Panke SK, Kadam RP, Nakhate CS. Integrated farming system for suatainable rural livelihood security. In: 22nd national seminar on "Role of Extension in Integrated Farming Systems for sustainable rural livelihood, Maharastra. 2019;33-35.
9. Rangaswamy, A., Venkataswamy, R., Premsekhar, M., Jayanthi, C., Palaniappan, S.P. Integrated farming system for rice based ecosystem. Madras Agricultural Journal. 1996; 82 (4): 290-293.
10. Behera, U. K., Mahapatra, I. C. Income and employment generation of small and marginal farmers through integrated farming systems. Indian Journal of Agronomy. 1999; 44(3):431-439.
11. Tejeswara Rao, K., Srinivasa Rao, M. M. V., Patro, T. S. S. K. AICRP on Integrated Farming Systems, Agricultural Research Station, Vizianagaram, AP, India .Int. J. Curr. Microbiol. App. Sci. 2019; 8(09): 2629- 2642.
12. Kareem MA. Farming systems approach. Web resource; 2002.
13. Chawla NK, Kurup MPG, Sharma VP. Animal Husbandry. State of Indian farmer. A millennium study, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi and Academic Foundation. New Delhi; 2004.
14. Thamizoli PR, Rengalakshami K, Senthilkumar, Selvaraju T. Agronomic Rehabilitation and Livelihood Restoration of Tsunami Affected Lands in Nagapattinam District of Tamil Nadu. M.S.Swaminathan Research Foundation Chennai. 2006;31.
15. Vision KVK. Assam Agricultural University, Darrang, Mangaldai. 159-10. Vision 2030, 2011d. Central Soil Salinity Research Institute (CSSRI), Karnal. 2011;15.
16. Olele NF, Nweke FU, Agbogidi OM. Role of Integrated Farming System in Agricultural Development in the Delta Region of Nigeria.Delta Agric. 1999;6:128–134.
17. Ugwumba CAO, Okoh RN, Ike PC, Nnabuife ELC, Orji EC. Integrated farming system and it's Effect on Farm Cash Income in Awka South Agricultural Zone of Anambra State, Nigeria, Am-Euras. J. Agric. and Environment Sci. 2010;8(1):1-6.
18. Chan GL. Integrated Farming System. What does Integrated Farming System Do?. Available:http:// www.scizerinm.org/chanarticle.htm.2006
19. Tokrishna R. Integrated Livestock-Fish Farming System in Thailand. Available:http://www.fao.org/docrep/004/ac155e/AC155E13.hotml.2006
20. Chen SK. The establishment of evaluation and indices system for Chinese sustainable development. World Environment. 2000;1-9.

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