ECONOMIC FEASIBILITY OF INTEGRATED FARMING: A STUDY FROM WEST BENGAL

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This paper studies to show the gap in income between present traditional cultivation and integrated farming system in the remote cultivated areas of Burdwan District, as well as the prosperous feasibilities in implementation of sustainable integrated farming for rural development. The whole analysis is based on primary and secondary data. The primary data gathered from field observation during 2014 - 2015 from 125 local farmers randomly in 40 different villages of Eastern Burdwan. Out of total125 farmers, 21 were found practicing basic integrated farming. These randomised samples help in calculating income gap and taking decision towards better opportunities of integrated faming. Related Governmental statistics and relevant literatures were considered as secondary data source. The analysis shows a profit gap between traditional mono/double crop cultivation and integrated farming and the gap benchmarking indicates that integrated farming has 3 times greater income feasibilities that present cultivation system. The result found that the farmers in study area are more prefer their existing system of cultivation although there are high risk of economic losses due to increase in price of chemical fertiliser, High Yielding Varieties seeds (HYVs), modernization and concomitantly repeated crop damage and decrease market value of produced goods, leading farmers to face a serious challenge in terms of profit. In this regards, with some practical instances and successful application of model integrated farming, it is recommended that it can surely overcome such faced problems and help in reduce input cost, increase agricultural outputs, enhance consistency in income and provide better economic feasibility for decent livelihood and rural development.

INTRODUCTION

Today, Agriculture has almost turned into a non-profitable occupation in the study area because of low market price and repeated invasion of natural calamities, although more than 70% people depend on it. Recently, the Department of Agriculture and Co-operation has started a new mission as "National Mission for Sustainable Agriculture" (NMSA) for improvement of livestock with many prosperous alternatives. "Integrated Farming" (IF) may also consider as a part of NMSA. 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 (Mistri, 2015). It is an indicator of development of economy. It can be achieved in several ways (Singh et al., 1993). Agriculture is one of the most important sectors, not only in the study area but throughout the Indian economy which give its contribution to employment, food, foreign exchange and its linkage with other sector. More than 60% of the people in the study area are engaged with agriculture and allied activities. Burdwan district is characterized by mono-culture and double-culture practice, i.e. the cultivation of only one crop during a particular season or in subsequent years on alternative crop may be grown to form a rotation of leafy crop and grain crops. Integrated farming system or integrated agriculture is a commonly and broadly used term to explain a more integrated approach to farming as compared to monoculture approaches. It refers to agricultural systems that integrate livestock and crop production or integrate fish and livestock and

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may sometimes be known as Integrated Bio-systems (Soni et al., 2014).The farmers mostly prefer modern technological trends in maintaining and improving agricultural productivity instead of thinking any alternative method of cultivation which can be maintained ecological balance (Ali, 2016). In this regards, Integrated farming system able to use an inter-related set of enterprises, so that the "waste" from one production becomes an input for another part of the farming system, which reduces cost and improves production and income. This farming system ensures that wastes from one form of agriculture become a resource for another form. Since it utilizes wastes as resources, we not only eliminate wastes but we also ensure overall increase in productivity for the whole agricultural systems by keeping ecological balance (CARDI, 2010). Farming System Research offers the potential scope to solve the technology development problems. Research organizations in many countries are shifting towards farming system approach with heavy emphasis on participatory on-farm research (PDFSR, 2013). Farming is the systematic result of complex interaction among different interrelated and interdependent components like, soil, water, livestock, crops, labour and many other resources with environmental settings (Swaminathan, 2007).

In 1986, Li has attempted to review on the development of rice – fish farming system. In 1981, Nie and Wang, emphasized on the relationship between rice and fish and found that both are benefited to each other. In 2000, Jayanthi et al., based on personal observations from Tamil Nadu, India, emphasized these systems as a 'mixed animal crop system' where the animals are often raised on agricultural waste products and concomitantly these animals are used to cultivate the soil and provide manure to be used as fertilizer and fuel. In 1992, Csavas, highlighted the difference between 'mixed farming and integrated farming' and suggested that enterprises/components in the integrated farming system are mutually supportive and depend on each other. Similarly in 2016, Ehsanul HMD tried to distinguish between mixed and integrated one. In his word, mixed farming is a system of farming where crops, livestock, poultry, fish etc. are raised in a farm. In other words, mixed farming utilizes cropping patterns which involve the raising of crops, animals, and or trees. But integrated farming system has multiple objectives i.e. to enhance food production for the household, to maintain the natural resource base that contributes to food security and the well-being of the rural people, to contribute to income generation, and to be accepted by local communities. In 2003, Radhammani et al. defined Integrated Farming System as an innovative approach of farming systems which takes into account the concepts of minimizing risk from agriculture, increasing possibility of production and profits along with improving the utilization of organic wastes and crop residues in situ field.

Integrated farming system is profitable for our living environment as for IFS may considered as the agriculture for sustainable development. IFS enhance the quality of soil, less decrease the quality of water and air that happens through the chemical fertilizers and pesticides. From different studies it was found that some authors highlighted that commercial farming systems are a threat to the environment through a loss of genetic diversity and the possible negative impacts of these systems and their associated inputs including chemical fertilizers, rodent and pesticides (Ashby, 2001). On the other hand in IFS the Crop residues can be used for animal feed, while livestock and livestock by-product production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilizers and leads toward sustainable development (FAO, 2001). In this regard, integrated

farming system may be applied in the study area or may motivate the farmers to attaining a stable rural livelihood development and food security as it is a system of farming that integrates livestock, fisheries, poultry, different type of vegetables and seasonal crop production.

WHY INTERGRATED FARMING

The present agricultural system is going towards more double or monoculture practice, where a particular crop is being selected for a particular season. As far as the study area is concerned, Rice and potato are main crop which are grown throughout the year i.e. winter season (December to March) is fixed for potato cultivation and other times of the year for Rice cultivation (Aman and Boro). The main problem has been seen that if an individual phenomena like damages of crops for natural cause or certain raid of pest or fall in market price of crops are occurred, here the possibility of losses are become too high. In this concern, if integrated farming would apply the possibility of losses become decrease due to alternatively fulfilled by other selected crops or livestock.

At present a huge effort have been making towards the modernization of agriculture, subsistence farming and its diversification. Present study is an attempt to apply a sustainable farming system towards more natural and eco-friendship especially for rural agricultural development. With the effective application of integrated farming, many rural agricultural issues can be eliminated; like

- It will contribute to improving the pre-existing agricultural practice by adopting an integrating system of farming which further help in adopting a scientific basis for improvement of rural ecological balance through Sustainable Integrated Farming System (SIFS).
- The designing and application of Integrated farming model will help in increasing the public interest towards adopting and practicing for improvement of rural livelihood.

SUCCESS STORIES OF INTEGRATED FARMING

Integrated Farming (IF) is a whole farm management system through which both environment and farmers can benefited. Integrated farming enables the farmers to identify their own opportunities and threats and suite accordingly. At the same time, consider consumer interests in their business. Concomitantly, through the application of Bio-elements environmental suitability may also judge. Integrated Farming is not based on a set of fixed parameters but on informed management processes (EISA- sustainable-agriculture.org/). Some of the basic benefits of integrated farming are highlighted as below.

- This farming system increase the whole farm productivities (‘land’ in term of utilization and ‘labour’ in term of income)
- Indemnify the food and nutritional securities among the farm families throughout the year
- Reduce stress periods in the farm
- Increase the profitability of the farming enterprises and increase cash flow the farm families

The farmer who has been practicing such integrated system has benefited by many ways, precisely as follows:

Social benefits: through the integrated farming system some social benefits acquired as farm integration is labour intensive. It creates on-farm employments and most of the labour required in

the production process is contributed by farmers himself and also his family members. So, this farming gives year round availability of nutritious and seasonal food. Seasonal migration is reduced. Fodder and fuel shortage is also minimized.

Ecological benefits: from the ecological viewpoint, integrated farming reduces the ecological impact of soil and improved the soil health. 100% organic carbon of soil is increased and fossil fuel dependency is practically zero as the fertilizers, one of the most significant inputs is produced within the farm (in the form of Bio-fertilizers). This practice highly reduces the chemical contamination and not save only the environmental Components but also decrease the burden from health impacts. The diversity of crops is increased as various types of crops are cultivated including creepers, climbers, strategic crops etc. within the same farm. Many numbers or local crops are introduced here. Each and everything is recycled in the system, it is actually a zero waste farming system, as is diversified.

Economic benefits: it is evident that the economic benefits of farm integration from the above table where the average incomes are shown. The input cost is reduced through this farming as the result net income increased. The risk of farmers is reduced because alternative crops of the same field fill-up the damage gap therein. The income has also time wise and source wise diversified, i.e. the farmer is getting income throughout the year from different sources which reduce the dependency on a single system.

There are many examples of success stories throughout the country. From the different sources of Governmental organizations and Agricultural departments some success stories are collated here. Not only the stated farmers were benefited but there are hundreds and hundreds example of success stories.

Few Success Stories of Integrated Farming

Name of farmer	***Place***	***Area under IF***	***Average income (Rs)***	***Source (for more details)***
K V Umesh	Ramanagara District, Karnataka	2.5 acres	4.8 lakh	ICAR, Krishi Vigyan Kendra Ramanagara
Banamali Das	Gayadham village, South 24 Parganas West Bengal	0.25 acres land with pond and garden and 0.33 acres of lowland	1.0 lakh	DRCSC, Kolkata
Ajeet Kumar	Surang village, kishangang, Bihar	He hired 40 acres of land on lease basis	Not specified	ICAR-ATARI, Kolkata
Adhir Chandra Mahato	Kaluhar village, Purulia, West Bengal	1.50 acres	2.20 lakh	ICAR-ATARI, Kolkata
Premananda Chakraborty	Jashpur village, Purulia, West Bengal	1.50 acres	2.10 lakh	ICAR-ATARI, Kolkata
Chhabindra Prasad	Turibar village, Hazaribag, Jharkhand	1.55 acres of land and 0.7 acres of pond	3 to 3.5 lakh	ICAR-ATARI, Kolkata

Source: Collated by authors from various reports of ICAR and GoWB

OBJECTIVES OF PRESENT STUDY

Integrated farming may also be considered as an alternative farming system which aims to reduce input cost, increase agricultural outputs, reduce the chances of loss, improve the ecological

balance and enhance income for rural farmers which enable them to identify opportunities and act accordingly. The objectives of the present study include;

- Examining the present agricultural status including present cropping pattern, area under major crops and agricultural production in the study area.
- Assessing the status of present integrated farming practice as a means of sustainable agricultural system and making an analysis on profitable aspect of integrated farming based on collected data.
- Identifying the profitable aspects of sustainable integrated farming system by comparing with traditional agricultural system in term of income, expenditure, net profit and benefit cost ratio.

HYPOTHESIS

Both the null and alternative hypothesis were developed in present study and tested by statistical method. The null hypothesis states that there is no difference between the two criteria that selected for study (i.e. d = 0), i.e. there are no mean difference between traditional farming and integrated farming in terms of profit and economic feasibility. The alternative hypothesis states that integrated farming helps farmers to consistent their income and develops farming practice which led to rural livelihood development in comparison with traditional farming that currently practicing in the study area (i.e. d > 0).

MATERIALS AND METHODS

Description of Study area (Physio-socio-economic aspect):

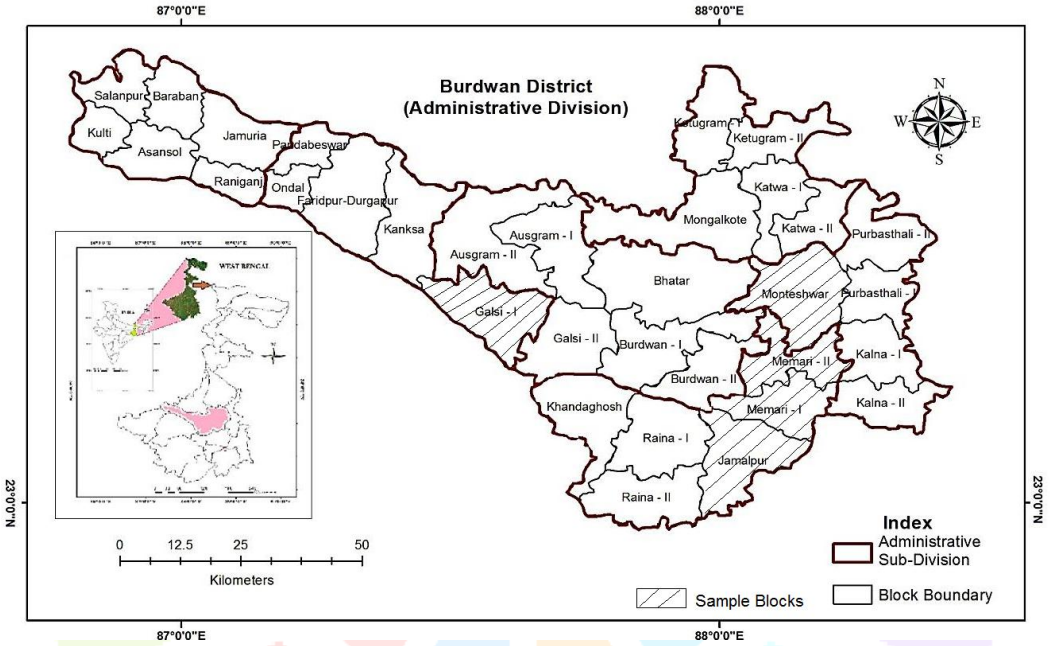
Burdwan is located between the geographical extensions of 22°56' 00″ N to 23°53' 30″ N latitude and 87°12' 30″ E to 88°13' 00″ E longitudes. Burdwan District has an area of 7,024 km². It is bounded by Birbhum and Murshidabad district on the north, Nadia District on the east, Hooghly District on the southeast, Bankura and Purulia districts on the southwest and Dhanbad district of Jharkhand on the northwest. The district is divided into six sub-divisions, naming Asansol, Bardhhaman Sadar (North), Bardhhaman Sadar (South), Durgapur, Kalna, and Katwa (Figure 1). According to census of India, Bardhhaman had population of 77, 17,563 of which male and female were 39, 66,889 and 37, 50,674 respectively (Burdwan district census- 2011). Bardhhaman is the most commencing district of West Bengal in both industrially and agriculturally. Eastern part of the district is enriched by the alluvial soil of Bhagirathi River (small stream of river Ganges), and is one of the most productive agricultural regions in West Bengal (agricultural information- 2011, Govt. of W.B). It is estimated that about 58% of its total population belongs to the agricultural population i.e. engaged in agricultural and allied activities and maximum of them belongs to rural area. The remaining 42% are counts as non- agricultural population. Excluding the eastern and south-eastern part of the district, many industries and factories are scattered here. Specially, western part of the district i.e. Asansol division is rich in coal and other mineral resources and Durgapur division is a highly industrialised sector. Many parts of these divisions contain various factories based on iron and steel processing, as well as many cement factories. So, these areas are least domination in agricultural activities.

According to Koppen's climatic classification, Burdwan is experiencing a climate which is transitional between CWg and AW type, here, 'C' indicates 'warm temperate rainy climates with

mild winter', 'W' 'dry winter, 'g ' 'eastern Ganges type with temperature trend' and 'AW' indicates 'tropical savana climates'. Measured temperature in summer season is 30˚ C while at the winter season is 20˚ C (Meteorological Survey of India, 2011). Average rainfall is 1496 millimetre (mm). The winter season starts from middle of November to end of February; this time is favourable for potato cultivation. Summer season continues between March to May. June to September is wet summer season and this time period is favourable for rice cultivation.

Figure 1

Map of the Study Area



Data collection

The present study was an attempt to emphasize on advantages aspects on applying integrated farming in an agriculturally domain district of west Bengal. The study was based on both primary as well as secondary sources of data. Primary data were collected through random sampling method from selected farmers in 5 blocks from eastern part of the district i.e. Memari-I, Memari-II, Jamalpur, Galsi- I and Monteshwar, as this parts are the most productive agricultural regions of Burdwan district (Figure 2). On the other hand, western part i.e. Asansol and Durgapur are industrial region. Primary data was collected during 2014- 2015 by direct observation from the agricultural field and interview with the local farmers. Concomitantly, Secondary data were collected from various authentic sources like District census handbook, Directorate of agriculture, Govt. of W.B and District Statistical Handbook, Bureau of Applied Economics & Statistics, Govt. of W.B. etc.

Sampling procedure

Preliminary observation was carried out in pre-sampling process in order to select the most cultivated blocks from Burdwan district during 2014-15. After selecting the blocks, the more accessible villages were chosen. Simple random sampling method was used. Sampling procedure

involved selection of blocks, selection villages and selection of respondents. Aged farmers were chosen to get responses and their views were taken into consideration for their more experiences. Thus, a total 125 respondents were taken from 8 villages of each block. A detailed synopsis of samples collection is presented here (Table 1).

Table 1

Details of sample collection for the study

Block Name	No. of Villages	No. of farmers were interviewed	No. of farmers had been found practicing integrated farming
Memari-I	8	25	7
Memari- II	8	25	4
Jamalpur	8	25	5
Galsi- I	8	25	3
Monteshwar	8	25	2
Total	40*	125**	21

Note: * and ** are the sampled villages and respondents under different Blocks are; (i) Amadpur, Bijra, Bagila, Keja, Sanui, Tatarpur, Nimo & Kenna from Memari I (ii) Akalia, Barwa, Bijur, Bohar, Chandipur, Kuchut, Paikara & Tajpur from Memari II (iii) Ajapur, Amra, Jogram, Mosagram, Nabagram, Gopalpur, Selimabad & Kerili from Jamalpur (iv) Budbud, Golgram, Kasba, Mankar, Nurkana, Pursa, Paraj, Uchchagram from Galsi I (v) Bhagra, Ghoradanga, Jamna, Jhikra, Kulut, Kusumgram, Majhergram and Tajpur from Monteshwar.

RESULTS AND DISCUSSION

Present agricultural status and trends in Burdwan district

To successful planning and implementing the integrated system of farming, it is essential to discuss the present status and trends of farming system. Burdwan is an agriculturally domain district of West Bengal state. It has been estimated on an average that about 58% of its total population belongs to the agricultural population i.e. engaged in agricultural and allied activities and maximum of them belongs to rural area. The remaining 42% are counts as non- agricultural population.

As far as the areal extensions of Burdwan district is concerned, eastern and south-eastern part of that district are intensively cultivated (all samples are collected from these part). On the other hand, western part of it belongs to belongs to extreme lateritic type of soil which is unfit for cultivation, excepting the narrow valleys and depressions of Damodar river which having rich soil and good moisture content. After 1953, the cultivation system of the district has improved with the implementation of irrigation projects under DVC (Damodar Valley Corporation). Before 1953, the farmers of major area of the district depend on monsoon for cultivation and irrigation facilities which were more primitive. The position has since been changed and an all-round agricultural development has become possible. At present with the utilization of mini and cello (in local term) with the assistance of Government of West Bengal, the problems related to irrigation are solved.

Rice is an important cash crop of the district. The rice is grown with its numerous varieties and is broadly categorised into three primary classes distinguished from one another by distinct characteristics. These are the ‘Aus dhan’ or autumn rice, the ‘Aman dhan’ or winter rice and the ‘Boro dhan’ or the summer rice. Rice covers maximum of the GCA in the district. Among commercial crops, jute, sugarcane, potato and oilseeds are major crops but they are cultivated rarely. Productivity of the major crops grown in the district are in following pattern – Rice -potato -vegetables, Rice – potato – sesame, Rice – vegetable – mustard and jute – Rice – vegetables. It is

evident from the agricultural calendar of Burdwan district that there is a close relation between the pattern of cultivation i.e. cropping pattern and the prevailing climate. This can be illustrated by the following facts;

Rice (Aman) - is sown between July and mid of August i.e. during the onset of monsoon. During monsoon, it is left to be grown on the field and harvesting is done in the post monsoon period i.e. between October to the mid of November.

Rice (Boro) - is sown in-between mid of December to mid of January; and left to be grown on the field up to the end of March and generally harvested in April and May.

Potato (as a Rabi crop) - is sown from November to the mid of December. It takes time to grow and is harvested at the last week of March (District Profile, Burdwan district, ICAR)

Table 2

Area and Production of Rice in Burdwan District

Year	*Total Rice cultivated area and production*			
	Burdwan District		*West Bengal*	
	Area (000' ha)	*Production (000't)*	*Area (000' ha)*	*Production (000't)*
1995-96	582.70	1237.40	5800.63	12636.78
2000-01	660.10	1571.40	5435.32	12428.03
2005-06	634.20	1892.90	5782.94	14510.79
2010-11	613.10	2137.60	4944.14	13389.61
2014-15	620.37	2416.30	5513.68	15376.86

Source: Department of agriculture, Govt. of West Bengal

Present Cultivated Area and Production

It is found from the analysis of 20 years data that the area and production of food grains especially Rice have been increasing in the study area, on the other hand oilseed, fibres and miscellaneous crops have been decreasing except potato production, potato cultivation is gloriously increasing day by day. It have been found after the tabulation and analysis of data from Department of agriculture, Govt. of West Bengal that out of total coverage in Agricultural area, the NSA (Net Show Area) of Rice is highest and it can be said that it covers an area of 6/7th parts. All over West Bengal, out of total Rice cultivation area, Burdwan alone covers about 11.24% and it is greatest throughout the state. 20 years data of Burdwan district on Rice cultivation and area is estimated here for better understand the existing cultivation (Table 2). Maximum farmer of here, waste greater efforts in Rice cultivation although Rice is not too much profitable grains but there is least risk of loss.

Table 3

Area and Production of Potato in Burdwan District

Year	*Total Potato cultivated area and production*			
	Burdwan District		*West Bengal*	
	Area (000' ha)	*Production (000't)*	*Area (000' ha)*	*Production (000't)*
1995-96	40.10	998.70	267.38	6139.09
2000-01	42.10	1115.00	299.66	7673.13
2005-06	43.40	1235.00	354.45	7462.86
2010-11	47.60	1471.10	386.44	13838.00
2014-15	53.30	1783.70	408.78	13421.12

Source: Department of agriculture, Govt. of West Bengal

In last 10 years a miscellaneous changes occurred here in term of potato cultivation. About 90% farmers took it as a cash crop because within a short time span huge production can derive from it. In the sampling collected area, near about 90% farmers preferred either Rice or potato. A little portions of farmers can only prefers others. Day by day potato production and its NCA become increasing. It was found that near about 790 thousand tonnes potato production increased in last 20 years in the study area (Table 3).

During 2000, oilseed covered a major portion of cultivated land. Oilseeds, especially mustards were grown with same season of potato. Bur major changes come appear in case of oilseed cultivation and maximum areas that hold for oilseed cultivation has now converted into potato cultivation. Only sesame (Til) has been left as an oilseed cultivation. Sesame is cultivated after the harvesting of potato. The gathered data shows that both the area and production of oilseed has been decreasing day by day (Table 4). Although the input cost in oilseed cultivation is comparatively very low but the farmers not prefer due their own motivation towards potato and Rice cultivation.

Table 4

Area and Production of Oilseed in Burdwan District

Year	*Total Oilseed cultivated area and production*			
	Burdwan District		*West Bengal*	
	Area (000' ha)	*Production (000't)*	*Area (000' ha)*	*Production (000't)*
1995-96	57.1	69.30	565.93	475.80
2000-01	56.20	58.40	598.55	570.66
2005-06	56.20	40.80	637.14	556.82
2010-11	53.90	31.10	681.98	726.71
2014-15	51.70	34.60	670.75	703.27

Source: Department of agriculture, Govt. of West Bengal

In terms of track farming and livestock, fruits, flowers, vegetables are also produced in Burdwan district. But vegetables cover larger area followed by fruits and flowers. The area and production of fruits and flowers are limited due climatic and other phenomena but vegetables are in increasing rate in production due to its raw-money income. Recently, 62.90 ha area is cultivated under vegetables which was only 39.60 ha during 1995-96 (Directorate of Food Processing & Horticulture, Govt. of West Bengal). There are also found some livestock in the study area from past. Livestock includes Cattle, Buffaloes, Sheep, Goats, Horse, Pigs and Poultry. Among them poultry and cattle have the highest number i.e. 5004744 and 1655904 respectively, followed by Goats (1127184) and Sheep (140873). On an average, it is found that only poultry farming have an increasing trends (presently there are more than 6506764 poultry produced which was 3543819 during 1995 (Live-stock Census Report, Govt. of W.B).

Average annual Expenditure and Income from present cultivation system

Burdwan is the only district in the state of West Bengal that is fortunate both in industry and agriculture. It is estimated that about 58% of the total population belongs to the agricultural population while remaining 42% belongs to non-agricultural (Agricultural information, http://bardhaman.nic.in/agri/agriculture.htm). Most of the farmers in the study area are middle to lower class. The rural population are largely dependent on two growing crops, i.e. rice and potato in one year (60% of whole study area) and two times rice (aman and boro, 40% of the study area). But at present due to increase in price of chemical fertiliser, High Yielding seeds, technology and

decrease market value of produced goods, leading farmers to face a serious challenge in terms of profit (Figure 3 & Figure 4). To estimate the average income and expenditure from existing cultivation system, data were collected from farmers of different villages. Moreover, to compare the collected data with integrated farming, calculation was done based on field collected data from farmers from study area for showing equal areal relationship. An average expenditure and income pattern from rice and potato is given here (Table 5).

Table 5

Annual mean incomes of farmers from present cultivation in Burdwan District

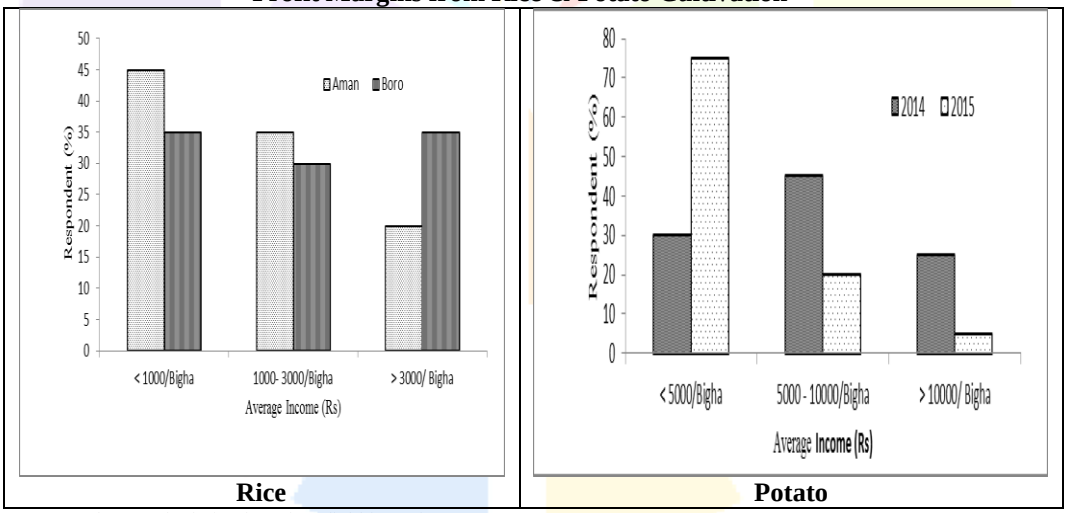
	Production (P/Year)	***Production Cost (Rs/Year)***	***Market value (Rs.)***	***Farmer's income (Rs/Year)***
Cultivable Land	***2.6 Bigha***			
Rice	36 - 39	11700	23237	11537
Potato	234 - 260	31200	46800	15600
Other Income (₹)				8000
Total Income (₹)	**35137**			

Note: P= Packet (containing 60kg for Rice/rice and 50kg for potato). Production cost includes total input costs including machinery, irrigation, labour, and inputs. Other income includes oilseed (sesame cultivation) after potato.

Source: Author's calculation based on field study.

Figure 3

Profit Margins from Rice & Potato Cultivation



Source: Author's calculation based on field interview

Present trends of integrated farming in Burdwan District

From the above discussion about the present agricultural status and trends in Burdwan district, it has been showing that only rice in food grains and potato in miscellaneous crops are increasing in their net shown area and production and a reverse case happened with other crops. As a result farmers have been suffering with loss in production due to increase the price of inputs costs i.e. chemical fertilizers, insecticides and pesticides and repeated crop damage (Ali, 2016). But output gain has been decreasing as market value is more to less fluctuate. The data furnished from primary sources i.e. field study from major agriculture domain blocks of eastern Burdwan and

direct interview with local farmers; have shown that most of the farmers are unfamiliar and not interested with integration system of farming. Only 2% farmers have been trying to locate and adopt with integrated farming system. 21 respondents have been found from 5 blocks (Memari- I. Memari- II, Jamalpur, Galsi- I and Monteshwar) who has largely interested and have been trying such type of farming in some land.

Based on primary discussion with the local farmers who have been interested and trying to practice such; it was estimated that a farmers can able to gain about 2 lacks Rupees as profit on an average of 3 Bigha (1 Acres) land excluding the input cost. An estimation of net profits of farmers who practicing integrated farming on different blocks of the study area and average profits of all blocks is concisely described here (Table 6).

Table 6

Average income from integrated farming system

	Sample Blocks					
	Memari- I	***Memari- II***	***Jamalpur***	***Galsi- I***	***Monteshwar***	***Aggregate***
Number of villages	8	8	8	8	8	40
No. Of Respondents	7	4	5	3	2	21
Average area (Bigha)	4	2.5	3	1.5	2	2.6
Average income (Rs/Year), excluding expenditure						
Fisheries	52000	30000	40000	30000	25000	35400
Vegetable	35000	25000	30000	25000	23000	27600
Fruit	6000	4000	5000	3500	2500	4200
Poultry	25000	18000	22000	12000	11000	17600
Others	22600	11560	18940	13800	9700	15320
Total	140600	88560	115940	84300	71200	100120

Note: 1 Bigha = 0.33 Acres/ 20 Katha in West Bengal (this measure of land varies in country to country and state to state)

Source: Author's calculation based on field survey.

The above information collected from the farmers who have been practicing integrated farming in different blocks of the study area. Result shows that the adoption of such farming practice increases the income of practitioners and helps them utilize every inches of land including dwelling and roof top. Variety of trees and plants on the farmland are growing by using organic manure for soil stabilization and healthy growth of crops that is safer for human consumption. They set up also fruits and vegetables patches and build water harvesting structure which is being used for rearing fish. A small piece of vacant land has been used as poultry shed including hens and ducks.

Among many, Sk Fahat (name changed) was a respondent from Gopalpur. He practiced integrated farming approximate in a total of 3 Bigha lands and gaining more than 1 lakhs per annum excluding input expenditure and family consumption. He introduced this farming system since 2007- 2008 in surrounding a circular pond at the central point, seasonal crops and different type of vegetables at the whole side of pond, a patches of fruits trees in the whole periphery like as bananas, mangoes, papes etc. There are also one poultry farm in which 50 ducks 70 hens and a maintainer's room. They highly satisfied with this type of sustainable farming.

BENEFIT COST ANALYSIS BETWEEN TRADITIONAL & INTEGRATED FARMING

Integrated farming is not profitable in term of income but it has diversified dimension including Productivity improvement, Net profit growth and fixed income, Sustainable growth in agriculture, Balanced diet, Pollution free Environment, Recycling of farm residues, Increase in employment, High standard of living etc. Integrated farming system (IFS) is the self-possessed and appropriate use of agricultural chemicals and fertilisers which is attained through a mixture of organic and biological farming system having as a result of decrease in input costs and increase in output costs (Morris and Winter, 1999). Assimilation of traditional farming with integrated farming including fish, vegetables, poultry, fruit etc. is an eco-friendly and income generating practice not only applicable but also profitable for a small or marginal farmers. Compared to many farm technologies, integrated farming with fish & vegetables are low cost technology. It saves farmers time allowing them to undertake double benefit from the same field or area (Laxmi et al 2015). Therefore, the integrated farming system (IFS) assumes greater importance for sound management of farm resources to enhance the farm productivity, reduce the environmental degradation, improve the quality of life of poor farmers and maintain sustainability (Tarai et al. 2016).

Table 7

Comparative benefits from traditional farming & integrated farming system

	Traditional Farming (TF)		***Integrated Farming (IF)***	
	Total income	***Total expenditure***	***Total income***	***Total expenditure***
Rice	23237	11700	8500	3200
Potato	46800	31200	10250	4980
Oilseed	16000	8000	1850	700
Fisheries	-	-	48400	13000
Fruit	-	-	6300	2100
Vegetable	-	-	45600	18000
poultry	-	-	31600	14000
Other crops	-	-	8400	4800
Aggregate (₹)	86037	50900	160900	60780
Net Profit (₹)	**35137**		**100120**	
B C Ratio	**1.69**		**2.65**	

Source: author's calculation based on field survey

Based on the data of field study a comparative benefit cost analysis of traditional farming & integrated farming was carried out (Table 7). The table shows that the net profit from traditional farming was Rs. 35137/ year with benefit cost ration of 1.69 from a cultivated area of 2.6 bigha during 2014-2015. But from the same size of cultivated area a total Rs. 100120/ year with benefit cost ration of 2.56 was gained during same year from integrated farming. Similar study by Desai et al. (2013) also found that Integrated farming system (IFS) recorded higher productivity and profitability than traditional method of farming.

Hypothesis Testing

The main objective of the present study was to assess the status of present integrated farming as a means of sustainable agricultural system and making an analysis on profitable aspect of integrated farming in the study area in comparison to existing traditional farming system based on collected sampled data. Hypothesis was also established before going through analysis. Pair sample t-test was used to test the significance of hypothesis. There are two types of significance to consider when interpreting the results of t-test, statistical significance and practical significance. Statistical

significance is determined by looking at the 'p-value'. The p-value provides the possibility of observing the test results under the null hypothesis. The lower the p-value, the lower the possibility of finding a result like the one that was observed if the null hypothesis was true. Thus, a low p-value indicates decreased support for the null hypothesis. But, the possibility that the null hypothesis is true and that we simply gained a very rare result can never be lined out completely. The cut-off value for defining statistical significance is eventually decided on by the researcher, but typically a value of .05 or less is more preferable. This agrees to a 5% (or less) chance of obtaining a result like the one that was observed if the null hypothesis was true. Other type is practical significance. The practical significance depends on the subject matter. It is not uncommon, especially with large sample sizes, to observe a result that is statistically significant but not practically significant. In most cases, both types of significance are required in order to draw meaningful conclusions.

Thus, mean test was carried out to understand the relationship and mean difference of income, expenditure and net profit between traditional farming and integrated farming to accept or reject the null hypothesis (H0: $\mu 1 = \mu 2$). The result shows that there are significant mean differences in net profit between the traditional farming and integrated farming.

The overall results show that in term of income, expenditure, profit and benefit-cost ratio, the integrated farming is always profitable in comparison to existing traditional farming. The scatter plot shows that income is higher in comparison to expenditure and B/C ratio is always more than 2.5 in case of integrated farming but reverse case seen for existing traditional farming.

SUMMARY AND CONCLUSION

Problems Faced in applying Integrated Farming at local level

Integrated farming, no doubt has many prosperous beneficial aspects. But there are many problems in applying integrated farming in the study area although it has greater prosperity in terms of both rural development and agricultural sustainability. The major problems are:

- Most of the farmers have been practicing traditional agricultural system, although modernizations have taken place; but they are very uninterested in adopting such system because of their proper adaptation and fear.
- Landforms are the most barriers in the application of integrated farming as cultivated land of 1- 2 bigha in most of the blocks are further sub-divided.
- Distance of the field from the household is another barrier which leads to lack of security (theft of fishes, fruits, vegetables, poultry etc.).
- The location of cultivated land under many land owners is also another problem, if it is located at one corner or one side separately, there will no problems. But in a particular portion, land clusters and merged under many land owners and it is difficult to bring such changes to imply such farming system.

Suggestions

- The model making has some initial step. If model can be arranged in a systematic way in term of IFS, it will take the farmers towards zero budget farming which is affordable and sustainable.
- Farmers should work in a small group of 3– 6 farmers, each of whom has a land of 1- 1.5 bigha, so this corporation between the farmers often addressed easily such barrier.

- There need to build a farmhouse in terms of maintain, guidance and guard the field. High voltage light and electricity facility may also be needed as a signal point for thief.
- It may not possible that everyone's land will be located at corner or such suitable site. In this case Cooperative Land Transformation (CLT) method can be applied with the assistance of each farmers and Government.

Conclusion

The important objective of this study was to analysis the reality and ground truth of integrated farming in comparison to present traditional farming system and emphasizes to apply this sustainable integrated farming system for the rural livelihood development. The most important aspect of this farming is to combine the cultivation of Rice, cereal, vegetables, fruits with fisheries and animal husbandry in such a way that various parts can be complementary and supportive to each other. For example, the excreta from poultry farming can be utilized for fisheries instead of chemical douse and processed foods for growth of fishes which may cause of degrading the natural quality of water, the dung of cows and goats can be utilized for crop cultivation instead of excessive chemical fertilizers which may cause of soil damage and chemical contaminations and others bonding system which is related with each other and each can acts as supplementary for others. It is concluded that the integrated farming practices can prevent the spread of intensive monoculture or double culture which are harmful for the long-term fertility of land. If the rural farmers plant various types of fruits, vegetables, pulses, grains and others plants in a single portion of land, the above long term cultivated land degradation problems can be eliminated. It is very important from environmental and ecological point of view. On the other hand from economical point of view, the abundance of fruits, vegetables fishes and poultry rearing make it possible for the farmers to earn extra money by selling at local market. But the estimated result found that only 2% farmers have been practicing such type of farming although it has a great potential.

Finally, it may be concluded that to eradicate rural poverty, to improve rural livelihood and maintaining ecological balance, sustainable integrated farming system plays a vital role. This farming system leads towards sustainability and eco-friendly relation in social, economic and environmental aspect. The farming system have the potential to apply not only study area but throughout the world.

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