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Effect of Integrated Farming System in Changing Household Food Security of Farmers in a *Haor* Area

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Abstract

The main purpose of the study was to determine the effect of integrated farming system (IFS) in changing household food security of the farmers in a selected *haor* area of Bangladesh. Data were collected from a random sample of 173 farmers, out of a population of 462 in one selected village of Mohanganj upazila under Netrokona district. The data were collected through personal interviewing by using a pre-tested structured interview schedule during July to October 2015. Appropriate scales were developed and used to measure the concerned variables. The eleven selected characteristics of the farmers were considered as the independent variables while change in household food security was the dependent variable. The change in household food security of farmers was measured based on change in calorie intake of the farmers after joining in IFS practices. The average per capita per day intake of food items of all the households was 734.63 g after introduction of IFS practices compared to 558.70 g before introduction of IFS practices. The highest proportion (86.13 percent) of the farmers were moderately food secure (1,806-2,121 kcal/person/day), 5.80 percent highly food secure (above 2,122 kcal/person/day), while 8.10 percent were food insecure (less than 1,805 kcal/person/day). Among the characteristics of the respondents, age, level of education, household farm size, household annual income, household size, knowledge on IFS, training exposure, decision making ability and communication exposure had significant positive relationships with their change in household food security, while household assets, number of IFS components followed by the household and organizational participation had negative relationships. Among these, age, level of education, knowledge on IFS and training exposure had significant contribution with their change in household food security.

Keywords: Integrated farming system, household food security, haor farmer

Introduction

Bangladesh is an agro-based country where agriculture plays an important role in national economy, and 80% of the populations are directly or indirectly engaged in agriculture (BBS, 2013). Bangladesh agriculture remains challenged to increase food production for a growing population while at the same time achieving more sustainable resource use and decreasing costs of production of crops (Haque, 2010). Bangladesh has made progress in reducing food insecurity through productivity increase in agriculture. Poverty is the main obstacle in achieving food security but factors such as, natural disaster, high incidence of disease, poor hygiene practices, limited nutritional awareness also contribute to food insecurity. The main biological feature of an integrated farming system is bi-product recycling; but improved space utilization, in which two subsystems occupy pan or all of the space required fix-one subsystem, may be an important aspect of increased productivity. Integrated farming systems also spread the risks associated with farming because of the increased diversity of produce. They also lead to a more balanced diet for the farming family that chooses to eat some

or its own produce. Bangladeshi farmers produce diversified products to meet their household consumption requirements and other household needs. Farm raise field crops, homestead vegetables, trees, cattle, poultry and fish (Chowdhury et al., 1993). Intensive use of land and the interactions of multiple farm components and activities make the farming systems of Bangladesh highly complex. In our country, traditionally crop, livestock and fisheries activities are integrated at the individual farm household to diversify resource use and ensure livelihood. The farming system approach improves productivity and profitability of the farms. Ensuring food security for all is one of the major challenges that Bangladesh faces today. This is especially significant for the haor area where scopes for agricultural activities are low because of flooded condition throughout the maximum period of the year. So, the GoB is taking plan programme of integrated farming system in the *haor* area to ensure food security utilizing the available resources. Therefore, it is very much needed to observe the present condition of food security in the area and the role of integrated farming system towards desired food security.

Methodology

Location, Population and Sample

The Purba Tentulia village of Mohanganj upazila was purposively selected as the study location. The village is a typical *haor* area and goes under water (5-10 m) from late May to October. Due to inundation and flood the villagers cannot grow crops all the year round. During the year 2011-2014, "Livelihood Improvement of Farming Community in *haor* Area through System Approach (LIFCHASA)" project has been implemented by Bangladesh Agricultural University to introduce integrated farming system in the village. The farm households who were the participants of the project was the target population of this study. The total target population size was 462, out of which 173 farmers (37 percent of the population) were randomly selected to constitute the sample of the study.

Variables and their Measurement

The effect of integrated farming system in changing household food security was the dependent variable of the study. It was measured based on amount of calorie intake by farm households during normal and crisis periods. The crisis period was considered when food was available at the minimum level and job opportunity was almost lacking. Change in food security of a respondent was measured based on change in calorie intake of the respondent after introduction of the project. For measuring calorie intake, simple questions were asked to the respondents to mention the amount of common food items (rice, flour, vegetable, fish, meat, milk, egg etc.) taken by the household members in a day both before and after introduction of the LIFCHASA project. The method of determining food consumption involved three phases. Firstly, consumption of rice, wheat, vegetables and pulses, fish, milk, meat and egg was determined by the amount of food consumed per day per week and per month, respectively by a respondent household. Secondly, the daily consumption of food items per person was calculated and expressed in standard unit of weight (gram). Finally, the amount of items was converted into energy on the basis of their energy content value as per guideline developed by FAO (1997). Thus, total energy was obtained by adding the energy value (Kcal) from all the items. Food consumption was divided into two periods- 'normal' and 'crisis'. Again, each period was divided as 'before' and 'after' intervention of the project. Before finding out the difference of consumption between 'before' and 'after' intervention, both the 'before' of 'normal' and 'crisis' periods were merged and averaged. In the same way, the 'after' of 'normal' and 'crisis' periods were calculated. Then, the difference of 'before' and 'after' was calculated by showing difference of the two. This difference indicated the change in food consumption due to project intervention. In this process, the 1805 Kcal was considered as the threshold point. If it is observed that the members of a respondent's household in

average were taking either 1805 Kcal or more amounts in a day then he/she was treated as food secure, otherwise he/she is treated as food insecure. On the basis of intake calories (Kcal), the change in food security level of the farmers classified into three categories following the Household Income and Expenditures Survey, 2010 (BBS, 2010).

The independent variables of this study were 13 selected characteristics of the integrated farmers. These were age, level of education, household assets, household farm size, annual household income, household size, IFS components followed by the households, knowledge on integrated farming system (IFS), organizational participation, training exposure. Standard and conventional procedures were applied to measure the variables.

Data Collection and Analysis

A questionnaire was prepared after incorporating all the variables and appropriate scales. The draft questionnaire was pretested with 20 farmers of the study area and necessary modifications were made based on the pretesting results. The first author collected the data from the selected respondents through face to face interviewing during the months of July to October 2015. The collected data were coded, compiled, tabulated and analyzed as per objectives of the study. Apart from conventional descriptive statistical measures, correlation and regression analyses were conducted to explore possible relationships among the variables and contribution of the factors to effect of IFS on change of livelihoods of the practicing farmers.

Findings and Discussion

Changes in Household Food Security

Change in household food security was the major focus, i.e., the dependent variable of the study. The change in household food security of the farmers was measured based on change in calorie intake by the respondents after participation in the project. It was observed that as a result of introduction of IFS practices the household calories consumption has been improved in the study area. The calorie consumption per person per day in a household ranged from 1204.68 to 3260.64 Kcal. The average daily per capita calorie intake by households was estimated to be 841.17 Kcal with a standard deviation of 772.42. The average was lower than the national average of 2318.3 Kcal (HIES, 2010).

Categories of farmers based on food security status

The farmers were categorized based on their food security status as measured in Kcal per capital per day. The results have been presented in the Table 1

Table 1: Distribution of the respondents according to their change in food security

Categories of the respondents	Before project		After project	
	Number	Percent	Number	Percent
Food secure (above 2122 Kcal)	8	4.6	10	5.78
Moderately food secure (1805 -2121 Kcal)	103	59.6	149	86.13
Food insecure (less than 1805 Kcal)	62	35.8	14	8.10
Total	173	100	173	100

Data presented in the Table 1 clearly indicate that the number of farmers belong to 'food insecure' drastically reduced from 35.8 percent to 8.1 percent. However, it is interesting to see that farmers elevation to food secure was not mention-worthy. That means the major shift was observed from food insecure category to moderately secure category.

Change in intake of major food items

A relative scenario of per capita consumption of selected food items by the respondents have been

presented in Table 2. The average per capita per day intake of food items of all the households was 734.63 g after introduction of IFS practices compared to 558.95 g before becoming member of IFS practices.

Table 2: Change in average per capita per day food intake of selected food items (in grams)

Food items	Before (grams)	After (grams)	Change in percent
Cereals	409.39	510.44	24.68
Vegetables	30.10	36.60	21.59
Pulse	10.05	11.42	13.63
Fish	23.09	36.10	56.34
Egg	6.63	7.84	18.25
Milk	23.69	25.58	7.97
Meat	6.00	6.65	10.83
Oil	50	100	100
Total	558.70	734.63	31.43

The t-test between 'before' and 'after' food consumption due to adoption of IFS practices by the respondents was employed to test the following null hypothesis, "There is no significant changes in before and after food consumption of the respondents due to adoption of IFS practices." The results have been presented in the Table 3.

Table 3: Comparative change pattern of the haor farming households in terms of 'before' and 'after' food consumption due to adoption of IFS practices

Food Consumption	Before (Kcal)	After (Kcal)	Change	t-value
Normal period	2030	2250	220	7.57**
Crisis period	1800	1950	150	5.99**

Tabulated value of t (0.01) =2.61, **=Significant at 0.01 level of probability, Tabulated value of t (0.05) =1.98, *=Significant at 0.05 level of probability

Farmers' perceived effect of IFS

The effect of IFS on farmers' food security status was perceived through their opinion on five aspects of the issue and the results are presented in Table 4. The Table shows that opinion index (OI) of the respondents for IFS effect on selected five aspects of household food security ranged from 315 to 410 against a possible range of 0 to 519.

Effect of IFS on household food security was also measured based on the data presented in Table 4. The integrated farming system effect on household food security ranged from 5 to 15 against the possible range 0 to 15 with an average of 10.34 and standard deviation 3.02. Based on their effect score, the respondents were classified into three categories as presented in Table 5.

Data presented in Table 5 show that 54.9 percent of the respondents felt there was medium effect of IFS on household food security, while 29.5 percent and 15.6 percent of them respectively thought that IFS had high and low effect on food security.

Selected Characteristics of *Haor* Farmers

Eleven selected characteristics of the farmers were determined in this research and considered as potential factors affecting the food security situation of the households. The salient features of the characteristics have been presented in the Table 6.

Data presented in the Table 6 show that majority (45.1 percent) of the farmers were middle aged, while almost half (48 percent) of them had primary level education followed by 28.3 percent illiterate. It was interesting to note that 85 percent farmers were landless to small land holders, while there was no farmer having high income. The situation of the farmers could be understood of observing their low household assets, where

more than half of the farmers' had low to medium household assets. These findings clearly indicate that farmers of the study area, in particular the farmers under the observation were mainly resource poor farmers – a reflection of the reality throughout the *haor* areas. An overwhelming majority (78.6 percent) of the respondent had either medium or large family size, another reality in the poverty stricken and underdeveloped *haor* areas. Majority of the respondents (79.8 percent) had medium knowledge on integrated farming and only 18 percent farmers had high knowledge on it. It is therefore, concluded that with this low level knowledge on IFS, farmers cannot implement the principles of the practice. More than 80 percent farmers had no organizational affiliation – a situation make farmers having low bargaining capacity and less hold into marketing. Finally, 63 percent of the farmers had short duration of training exposure. It may be concluded that without giving proper training, the farmers cannot implement principles of IFS. However, they received training only from the project.

Table 4: Different aspects of IFS as perceived by the respondents

Effect of IFS on household food security aspects	Extent of opinion				OI	Rank
	SA	A	SWA	NA		
Availability of food items increased because of increased food production	90	60	20	3	410	1
Household food consumption ensured due to increased availability of food	80	65	25	3	395	2
Year round food items availability increased	92	50	16	15	392	3
Purchasing capability of food increased because of increasing family income	70	55	45	3	365	4
Intake of various food items ensured due to increased availability various food items	65	35	50	23	315	5

Notes: SA= Strongly agree (Score: 3), A= Agree (Score: 2), SWA= Somewhat agree (Score: 1), NA= Not agree (Score: 0), OI= Opinion Index and RO= Rank order.

Table 5: Distribution of respondents according to their opinion on effect of IFS in household food security

Categories based on perception of effect of IFS	Respondents		Mean	Standard deviation
	Number	Percentage		
Low effect (0-5)	27	15.6	10.34	3.02
Medium effect (6-10)	95	54.9		
High effect (above 10)	51	29.5		
Total	173	100		

Relationship between the Variables

The relationship between farmers' change in household food security and their selected characteristics were explored through correlation analysis as shown in Table 7.

Data presented in Table 7 show that out of eleven selected characteristics of the farmers, eight showed significant and positive relationship with their extent of change in household food security due to their involvement in integrated farming system management. That means, with the increase of age, level of education, household farm size, annual household income, knowledge on integrated farming system, training exposure, decision making ability and communication exposure, there were substantial and significant improvement of household level food security of the farmers, who were under the involvement of integrated farming system under the LIFCHASHA project in the *haor* area.

Effect of integrated farming system

Table 6: Salient features of the selected characteristics of the respondent farmers

Characteristics and measure	Range of Scores		Respondents (n=173)			Mean	Standard deviation
	Possible	Observed	Category	No.	Percent		
Age (year)	Unknown	24-70	Young (18- 35)	71	34.0	48.83	9.81
			Middle aged (36-50)	78	45.1		
			Old (>50)	24	20.9		
Level of education (year)	Unknown	0-15	Illiterate (0)	49	28.3	4.65	3.34
			Primary (1-5)	83	48.0		
			Secondary (6-10)	37	21.4		
			Higher Secondary (>11)	4	2.3		
Household Farm size (Hectare)	Unknown	0.02-4.12	Landless (<0.2)	30	20.0	1.33	0.91
			Marginal (0.2-<0.5)	40	25.0		
			Small (0.6-<1.0)	60	40.0		
			Medium (1.1-<3.0)	30	10.0		
			Large(≥ 3)	13	5.0		
Annual household income ('000 Taka)	Unknown	45—155	Very low income (<50)	59	34.1	219.6	164.50
			Low income (51-100)	73	42.2		
			Medium income (> 100)	41	23.7		
Household size (Number of members)	Unknown	3-10	Small (2-4)	37	21.4	5.56	2.09
			Medium (5-7)	76	43.9		
			Large (> 7)	60	34.7		
Household asset (Score)	Unknown	15-40	Low (<15)	15	8.7	28.61	11.37
			Medium (16-30)	85	49.1		
			Large (>30)	73	42.2		
Knowledge on IFS (score)	0-46	13-42	Low (1-15)	3	1.7	26.84	6.45
			Medium (16-30)	138	79.8		
			High (31-45)	32	18.5		
Organizational participation (Scale score)	Unknown	0-24	No participation (0)	7	4.0	5.30	3.62
			Low (<5)	139	80.3		
			Medium (6-10)	21	12.1		
			High (>10)	6	3.5		
Training exposure (days)	Unknown	0-30	No training (0)	13	7.6	29.54	20.72
			Short duration (<7)	110	63.6		
			Medium duration (8-15)	5	2.9		
			Long duration (>15)	45	26.0		
Decision making ability (Rated score)	11-33	12-33	Low (11-18)	31	17.9	26.08	6.63
			Medium (19-26)	64	37.0		
			High (>26)	78	45.1		
Communication exposure (Rated score)	0-45	15-42	Low (>15)	3	1.7	31.69	7.63
			Medium (16-30)	75	43.4		
			High (31-45)	95	54.9		

Table 7: Relationship between the characteristics of the respondents and focus variable

Focus variable	Characteristics of the respondents	Computed 'r' value of 171 d.f.
Change of household food security	Age	0.166*
	Level of education	0.744**
	Household farm size	0.424**
	Annual household income	0.490**
	Household size	0.150
	Household assets	-0.133
	Knowledge on IFS	0.706**
	Organizational participation	-0.039
	Training exposure	0.519**
	Decision making ability	0.335**
	Communication exposure	0.324**

*****Significant at 0.05 level of probability; **Significant at 0.01 level of probability

Contribution of the Selected Independent Variables to Change in Household Food Security to the Farmers

Multiple regression analysis was computed to find out the relative contribution of the independent variables (farmers' selected characteristics) on change in household food security. Out of the eleven variables, eight variables were included in regression analysis due to their significant values in correlation analysis. Both unstandardized and standardized regression co-efficient values were computed (Table 8). It was evident that the values of multiple determination coefficients (R^2) for all the eight independent variables jointly explained 62.6 percent of variation.

Table 8: Multiple regression of change in household food security on some selected variables

Selected characteristics of the respondents	Unstandardized Co-efficient		Standardized Coefficient	t-value	Significance
	β	Std Error	Beta		
Constant	-17.166	4.091		-4.196	.000
Age	2.629	.720	.178	3.650	.000**
Level of education	.828	.185	.290	4.484	.000**
Family farm size	-.203	.227	-.052	-.896	.372
Family annual income	.299	.244	.083	1.227	.221
Knowledge on IFS	3.322	.789	.273	4.209	.000**
Training exposure	.703	.174	.273	4.052	.000**
Decision making ability	.742	.629	.069	1.179	.240
Communication exposure	-.557	.669	-.048	-.832	.407
R^2=.626, Adjusted R^2=.608, F value=34.350 at 0.000 level of significance					

To determine the best explanatory variable the method of step-wise multiple regression was employed as suggested by Droper and Smith (1981). However, the regression coefficient of only four variables, namely age, level of education, knowledge on IFS and training exposure entered in the best model and were statistically significant. The results of regression test clearly showed that farmers' change of household food security was largely influenced by their knowledge on integrated farming system and their age. That means having proper knowledge on the IFS may be considered as instrumental to receive its benefit in terms of

food security. At the same time, a farmer's experience on IFS also increased with his age as in the matured age his/her understanding on the system increased substantially. This is closely related with the level of education and training exposure – two possibly interrelated variables that also have influence on forming farmers' knowledge on IFS.

Conclusions

The findings of the study revealed that 5.87 percent of the farming households were food secured i.e. they consumed above the minimum calorie requirement (2121 kcal) for living a healthy life. A large majority (86.13 percent) of the households consumed between 1805 to 2121 kcal food items and 8.10 percent of the households consumed less than 1805 kcal food. It is important to mention here that before implementation of LIFCHASA project, 59.53 percent of the households were moderately food secured which has been raised to 86.13 percent due to introduction of IFS practices. On the other hand the number of absolute food insecure household has been decreased from 34.69 percent to 8.10 percent. Based on the findings it may be concluded that due to implementation of LIFCHASA project the extent food security of the project participants also improved to a reasonable extent. Slightly less than one fourth of the respondents achieved adequate food security due to introduction of IFS practices. Therefore, food security is still remaining a great concern for majority of the *haor* farmers of the study area. At the same times, apart from age, farmers' level of education, training exposure and knowledge on IFS were found greatly influencing their change of food security status due to involvement in the integrated farming system. That means intensive involvement of the extension agencies is instrumental to the successful practice of the integrated farming system in the *haor* area. The concerned organizations (DAE, DLS and DOF) and other NGOs therefore have ample scope to play vital role for improving food security of the *haor* farmers through supporting the integrated farming system.

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