

EFFECT OF FARMING SYSTEMS RESEARCH DEVELOPMENT OF BARI ON FOOD SECURITY OF RURAL HOUSEHOLDS

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Abstract: In spite of the remarkable progress in agricultural research and innovation for increasing food security, one fifth portion of Bangladeshi live in poverty and this makes it difficult for them to overcome the problem of food security. The purpose of this study was to analyze the food security status and contribution of Farming System Research and Development activities of Bangladesh Agricultural Research Institute (BARI) on food security of rural households concerned its Farming System Research and Development (FSRD). Food security was measured in terms of food consumption score which measures the level of food security by taking into account dietary diversity, food consumption frequency and relative nutritional importance of different food groups. The FSRD farmers were more food secure than non-FSRD farmers. Majority of FSRD farmers were found to have high food consumption score and a few non-FSRD farmers were found to have very low food consumption score. The “t” value (5.70) it was found that a significant difference existed between food consumption of FSRD farmers and non-FSRD farmers. The food consumption variability and diversification of food sources among the study areas also explored. It could be concluded that the food security of households could be increased with proper use of technology interventions and by promoting income generating activities with agricultural ventures.

Key words: BARI, Effect, Food security, FSRD sites.

INTRODUCTION

Food security is very closely related to sustainable agricultural production. Sustainable agricultural production includes mixture of different agricultural activities and completes farm management system which aims to deliver highest yield with preserving environment. According to Household Income and Expenditure Survey [1], almost one in five Bangladeshi live in poverty and 12.9 percent of the populations live in extreme poverty. Acute food insecurity is reflected in endemic malnutrition. Besides this, due to seasonal variation in agricultural employment and limited employment opportunities elsewhere millions of people in Bangladesh suffer from food insecurity throughout the year [2]. It is extensively implied that improvements of agricultural technologies

and agricultural development projects reduce poverty and improve living standard. In trying to address the problem of multidimensionality of food security, scholars and food security agencies have suggested the use of more than one valid indicators together that can complement each other in food security measurement [3]. According to WFP [4], a flourishing agriculture can play an essential role in improving food security and nutrition. Farmers need holistic management approaches that maximize farm productivity and farmers' benefit with limited set of recourses. Dixon [5] stated that agricultural interventions that only aim to enhance natural capital (increased yield) and financial capital (increased household income) might not necessarily yield food secure situations.

Bangladesh Agricultural Research Institute (BARI) is the largest multi-crop agricultural research institute in Bangladesh. BARI conducts research on a wide variety of crops, such as cereals, tubers, pulses, oilseeds, vegetables, fruits, spices, flowers, etc. It has given this noble responsibility to OFRD (On-Farm Research Development) to test those developed On-Station technologies directly to the farmers' field with FSRD (Farming Systems Research Development) sites. The concept of FSRD was initiated in 1985 to transfer BARI developed technologies directly to the farmers. There are 12 FSRD sites all over the country covering northern and eastern plain land ecosystem as well as coastal and rain-fed ecosystem of west and southern belt. This study is after-involvement evaluation attempted to quantify the effect of FSRD sites in respect to food security of the beneficiaries through collection of evidence from a selected group of households. The facilities and production inputs provided to FSRD sites are intended to bring changes in the livelihood opportunities of the target beneficiaries. FSRD activities provide farmers holistic management approach that maximizes farm productivity which has direct effect on their livelihood.



Figure 1: Map of Bangladesh showing the FSRD sites in Bangladesh

It is extensively implied that FSRD activities enhance socioeconomic characteristics and

improve food security. But there is a lack of systematic analysis of evidence that actually impacted on the beneficiaries. It is therefore an urgent need to conduct a study on food security related project regarding its effectiveness to attain sustainable food security of the project beneficiaries. The main concern of this research is to explore the contribution of FSRD in socioeconomic terms on food security of rural households. The findings of the study are expected to be useful to the researchers, planners and policy makers, extension workers to develop potential food security related project.

METHODOLOGY

Food security is one of the potential outcomes of successful livelihood strategy according to DFID [6]. On the basis of available literature it reflects that complete scenario of food security cannot be captured by any single indicator. Research over the past two decades has identified a particular set of information on conditions, experience and behavior pattern that consistency characterized the phenomenon of food insecurity [7]. According to Franckerberger [8], household food security indicators are divided into three categories, namely process, access and outcome indicators. Ellis [9] stated that household food security by the small farmers requires attention to assets, access and activities. A key theme is diversification and in turn, livelihood diversification can be analyzed through several dimensions: extent of diversification, poverty and income distribution, agriculture, environment, gender, and macro policies and reform. The effect of FSRD activities of BARI on household food security was measured by comparing food security status of beneficiary and non-beneficiary farmers. As it is difficult to capture food security in terms of food availability, food access and food utilization in one measure due to the complexity and multidimensionality of these indicators, the proxy indicator Food Consumption Score (FCS) was used [10]. The FCS as a proxy to measure food security has been developed by the World Food Program [11]. When analyzing the validity of the FCS, Wiesmann et al. [12] found that it is a useful measure because dietary diversity and food frequency are highly correlated with calorie consumption per capita.

FSRD sites were the study area for this research. FSRD sites comprise twelve districts covering eight plain land ecosystem of northern and eastern zone and three coastal and Rainfed ecosystem of west and southern belt. Representative sample of the populations were taken for collection of data following random sampling technique. From the 800 population household 240 respondents were selected. From each site besides 30 beneficial farmers 30 check farmers were also selected.

To apply the FCS, the households were grouped accordingly to their overall consumption score. Each food group is given a weight based on its nutrient content and then multiplied by the member of days a household consumed one or more items from that group per week. The Food Consumption Score (FCS) was computed by grouping together food items in order to reflect the diversity and frequency (number of days per week) of the food items being consumed by a household. For each food group, the frequency represents the number of days on item from the food group was consumed, with a range from 0 (never) to 7 (every day). A weight was assigned to each food group (according to the WFP standards, 2007) representing the nutritional importance of the food group.

In accordance with the explanations given above, the most basic estimation equation for the Food Consumption Score used for this study is -

$$FCS = A_{(cereals\&tubers)} B_{(cereals\&tubers)} + A_{(pulse)} B_{(pulse)} + A_{(vegetable)} B_{(vegetable)} + A_{(fruit)} B_{(fruit)} + A_{(meat)} B_{(meat)} + A_{(milk)} B_{(milk)} + A_{(sugar)} B_{(sugar)} + A_{(oil)} B_{(oil)}$$

Where,

A_i = Weight of food group

B_i = Number of days per week

The common diet for the people of Bangladesh is based on oil and fish, the staple and sugar are also habitual diet for Bangladeshi people. With this consideration WFP revised FCS thresholds for Bangladesh given the importance of oil, sugar and fish which was published on Technical Guideline on Food Consumption Score (FCS) in Bangladesh Context (January, 2009). The revised Food Consumption Score (FCS) threshold cut-off points and four categories are given below:

- a) Poor Consumption (≤ 28)
- b) Borderline Consumption (>28 and ≤ 42)
- c) Acceptable Low (43-52)
- d) Acceptable High (>52)

The highest weight is attached to food with relatively high energy, good quality protein and a wide range of micronutrients that can be easily absorbed (WFP, 2007). The food items were assembled into the appropriate food group, for which the maximum number of consumption was three days per week. A breakdown for each food group and the associated weight as well as the justification of such weight is presented in this table below.

Table 1 Food items, food groups and weights for calculations of the FCS and justifications (WFP, 2007)

Food	Food Group	Weight	Justification
Rice, Wheat, Corn, Other Cereals	Staples	2	Energy dense, protein content lower & poorer than legumes, micronutrients
Peanuts, Beans	Pulse	3	Energy dense, high amounts of protein but of lower quality than meats, low fat
Vegetables (green, leafy, shoots)	Vegetables	1	Low energy, low protein, no fat, micronutrients
Fruits	Fruits	1	Low energy, low protein, no fat, micronutrients
Animal Protein, Fish, Meat, Eggs	Meat & Fish	4	Highest quality protein, energy dense, fat
Milk/ Milk Products	Milk	4	Highest quality protein, micronutrients, vitamin and energy
Sugar	Sugar	0.5	Calories, energy
Oils and Fats	Oil	0.5	Energy dense, fat

FINDINGS AND DISCUSSION

Food Consumption Score

Food consumption is one of the major factors for measuring livelihood development of a person. Food consumption behavior express the proportion of various foods that

Table 2: Distribution of food consumption score of FSRD farmers and non-FSRD farmers

Food Consumption Groups	FSRD farmers			Non-FSRD farmers		
	Frequency	Percent	Mean	Frequency	Percent	Mean
Poor Food Consumption(≤ 28)	0	0	64.5	3	2.5	54.5
Borderline Food Consumption (28-42)	4	3.33		15	12.5	
Acceptable Low(43-52)	27	22.5		42	35	
Acceptable High (>52)	89	74.17		60	50	
Total	120	100		120	100	

household consume to manage their nutritional requirements. Based on FCS (Food Consumption Score) the results of households classified according to food consumption groups are presented below in Table 2.

Using the food consumption score cut-off, the results show that the households with poor food consumption score was found with non-FSRD farmers and there was no farmer with poor consumption from FSRD farmers. FSRD farmers had very little figure of borderline food consumption, and maximum respondents were from acceptable food consumption score. On the other side, 12.5 percent non-FSRD farmers had borderline food consumption score which was higher than FSRD farmers. Table 2 reveals that highest value comes from FSRD farmers group with acceptable high food consumption score (74.17 percent). According to the FCS, households with poor consumption are regarded as food insecure, while the household with borderline consumption are categorized as moderate food insecure and households with acceptable food consumption are categorized as food secure, which was also explained by Musafiri [10].

Data presented in Table 3 represent the means difference of food consumption score between FSRD and non-FSRD farmers. Finding explained that the observed score of food consumption score of FSRD farmers was 36 to 102 and for non-FSRD farmers was 25 to 104.

From the "t" value (5.701) it was found that significant difference existed between food consumption of FSRD farmers and non FSRD farmers. FSRD farmers experienced an increase of facilities to get food from homestead gardening and they expected more food consumption than non-FSRD farmers. Sultana [13] also found the significant value for food uptake by women involving in Food for Work Program. FSRD farmers are likely more innovative to use their resource especially household lands for producing. FSRD farmers are more involved with food production by controlling poultry and dairy which increase their daily food consumption score than non- FSRD farmers.

COMPARATIVE FOOD CONSUMPTION OF THE RESPONDENTS BY FOOD ITEMS

Data presented in Table 4 revealed the comparative food consumption of FSRD and non-FSRD households by food groups. The study found that the diet of the FSRD households and non-FSRD households was exclusively based on staple food and they consumed on average cereals and oils seven days with combination of pulses and vegetables.

The result found that FSRD households had highest protein and vegetable consumption than the non-FSRD households. The FSRD households' average consumption of milk and sugar were 2.12 and 4.28 days respectively. And

Table 3: Mean differences of food consumption score of FSRD farmers and non-FSRD farmers

Categories of farmers	Mean	SD	t-value	P value
FSRD	65.04	15.14	5.701**	0.000
Non-FSRD	54.47	13.54		

Scores: Observed- FSRD: (36-102), non-FSRD: (25-104); Possible- (0-112)

Table 4: Comparison of food consumption of FSRD and non-FSRD households by food groups

Food Groups	FSRD farmers		Non-FSRD farmers	
	Range	Mean	Range	Mean
Staple	7-7	7	7-7	7
Pulse	0-7	3.69	0-7	3.14
Vegetable	2-7	5.89	2-7	5.6
Fruits	0-7	2.50	0-7	1.25
Protein	1-7	4.55	0-7	3.7
Milk	0-7	2.12	0-7	1.25
Oil	7-7	7	7-7	7
Sugar	0-7	4.28	0-7	2.8

non-FSRD households have consumption of milk and sugar 1.25 and 2.8 respectively. The Table grossly concludes that the household's food consumption was based on carbohydrates that come from staple food groups. Hossain [14] found that carbohydrates dominate the rural household diets with few proteins, vitamins and minerals. The study found that vegetables consumption for FSRD and non-FSRD farmers was almost similar but slightly higher for FSRD farmers. Vegetables are very common and found almost in every season everywhere in Bangladesh. Households, generally who are not used to produce vegetables also get them easily from nearby market. That might be the possible cause of almost similar uptake of vegetables for both FSRD and non-FSRD farmers. It has been estimated that, vegetables consumption per head in Bangladesh is about 26 kg per year; traditional rice-based food habit is the main reason for consuming vegetables in this country [15].

FOOD CONSUMPTION BASED ON FOOD SOURCES

The respondents were asked to provide information about sources of food, for each of the food items consumed by the household members. Findings presented in Table 5 show that food items were obtained from different sources; especially from households own crop production, purchase and domestic livestock. Data presented in Table 5 represent the comparative distribution of food for FSRD and non-FSRD farmers by food sources.

Results show that the FSRD households had maximum value of own production for vegetable (87 percent) compared to non-FSRD household (43 percent). FSRD households had also highest value of own production for meat (14 percent) and fruits (51 percent) that were notably different from non-FSRD households. The results also show that both FSRD and non-FSRD farmers did not usually produce oil and sugar. In case of

Table 5: Comparative distribution of food sources by food items

Food items	Food sources of FSRD farmers (%)			Food sources of non-FSRD farmers (%)		
	Own	Purchase	Others*	Own	Purchase	Others*
Rice	40	60	0	46	54	0
Pulse	15	75	10	15	84	1
Vegetable	87	11	2	43	57	0
Fruits	51	29	20	46	53	1
Fish	6	62	32	6	76	18
Meat	14	86	0	2	97	1
Milk	25	75	0	30	69	1
Oil	1	97	2	0	94	6
Sugar	0	93	7	0	96	4

(*Other sources included Gift, Borrowed, Hunting and Exchanges)

fish, rural households who had access to water sources like river, ponds and sink were mainly used to hunting fish. Kobir [16] conducted a study on 'contribution of farming enterprises of the small farmers towards household food security' which revealed that only 45 percent of the annual dietary needs were satisfied through farming enterprises where crop sector alone contributed 42 percent.

The conditions of food consumption depend on purchase and/or other sources (borrowing/hunting/gift) are explained by the fact that access to the adequate productive land is a problem for many farm households. In order to buy food, the respondents rely on wage from agricultural labor and remittances to some extent. Dietary pattern of Bangladesh is based on cereals, largely rice, a little amount of pulses and small quantities of protein especially fish. That's why farmers are very fond of production cereals and vegetables. As water sources are available in almost everywhere in Bangladesh, farmers are used to uptake protein from fishes. According to BBS [17] fish is the primary protein source in Bangladesh diet contributing about 60 percent of total animal protein, while per capita fish consumption in country reaches 62.58 gm. Besides this Livestock and poultry have also a significant role in food security in Bangladesh. About 44 percent of human daily intake of animal protein comes from livestock products [18].

DIFFERENCES OF FOOD CONSUMPTION SCORE ACROSS THE STUDY AREAS

Food consumption scores were also varied from districts to districts, i.e. different FSRD sites. Food security of household largely depends on ecological and climatic factors, which may generate immense difference on food consumption in different districts. Zug [19] explained that climatic shock such as crop failure due to flood especially in the northern and southern regions during the month before the lean period also contribute immensely to the vulnerability of households.

Figure 2 represented the difference between the mean of food consumption score of households of FSRD farmers and non-FSRD farmers within study areas. Results presented in the Figure revealed that the highest value of

food consumption score for FSRD farmers was from Sherpur (69.32), Mymensingh (69.07) and Tangail (68.83) districts. It was found that in these areas FSRD households had more off-farm income along with homestead management that might increase their daily food consumption.

For non-FSRD farmers, the high value of food consumption scores was observed in Patuakhali (58.43), Tangail (57.76) and Sherpur (57.26) districts. Patuakhali district had high food consumption score for both FSRD and non-FSRD farmers because farmers got more facilities for catching fish which might increase their protein uptake as they consume fish on daily basis because of availability.

The study also revealed that Rajshahi and Sylhet districts had comparatively lower food consumption score for both FSRD and non-FSRD farmers. For Rajshahi, food consumption score of FSRD farmers was 58.76 and 52.80 for non-FSRD farmers. And for Sylhet, the food consumption score for FSRD farmers and non-FSRD farmers were 59.16 and 51.86, respectively. Raihan [20] also found a significant effect of lean season on food security in northern and southern parts of Bangladesh.

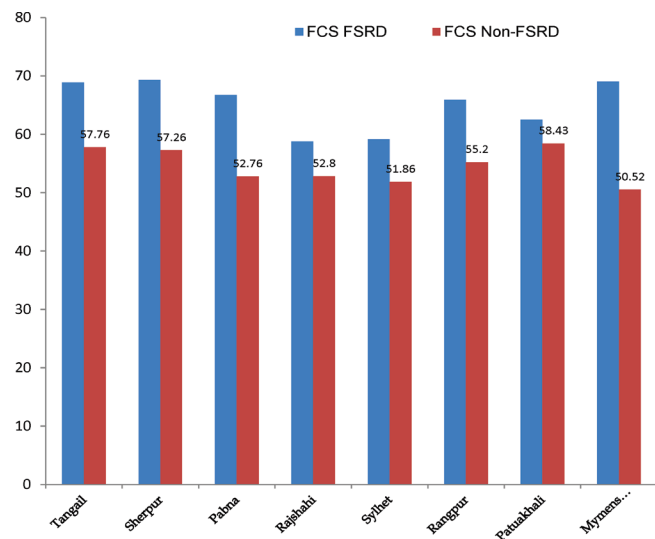


Figure 2: Difference between averages of food consumption score of households within study areas

According to food consumption score cut-off, households were classified into four different groups. This study also explored the difference of households by FCS groups among the study areas. Data presented in Figure 3 compared the food consumption groups within the study areas.

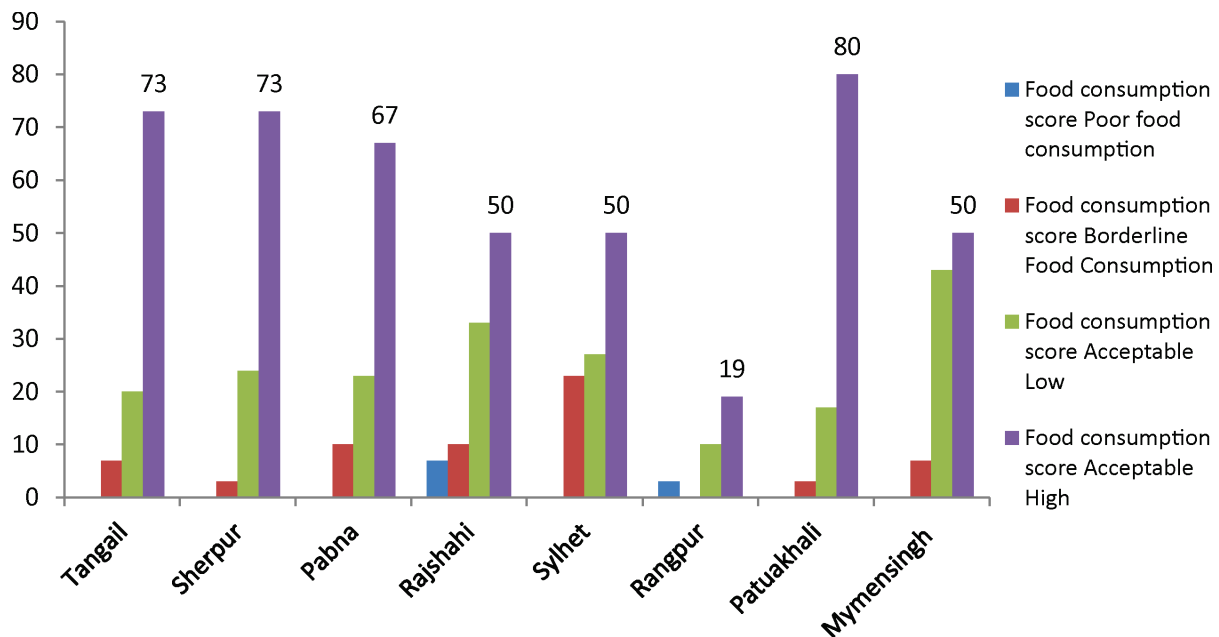


Figure 3: Comparison of food consumption group within study areas

The study indicates that household of Patuakhali had the highest value of food consumption score with acceptable high food consumption. Households of Patuakhali region have more access to hunting fish and they are habituated to intake protein everyday by consuming fish and this behavior increase their daily food consumption score. Sadeque [21] mentioned that riverside capture fisheries in the form of common property and open access resources constitute a vital component of the southern agro-ecosystem of Bangladesh.

In the general context, the study found about 73 percent farmers of Tangail and Sherpur districts belonged to acceptable high group of food consumption score. About 50 percent farmers of Rajshahi, Sylhet and Mymensingh districts were from acceptable high food consumption group. Households of Mymensingh district had more rational status of food consumption score. It could be concluded that Mymensingh district is properly food secure district than the others within this study areas.

However, the study reflected that only in Rangpur district, farmers from both FSRD and non-FSRD categories consumed very low amount of food. Only 19 percent of the farmers had high acceptable food consumption score and a significant number were still under food insecure. Rangpur and Rajshahi district

had maximum households with poor food consumption group. That may be explained by the fact that the households of those regions are still food insecure. A study conducted by the Ministry of Disaster Management and Relief (2012) found that around 31 percent of the population residing in the northern part were ultra-poor, living below the poverty line and mostly depended on manual labor for income.

CONCLUSION

The research evaluated the effect of BARI's FSRD efforts on food security in rural households of Bangladesh. Bangladesh has a highly diverse agricultural system with intricate connections between several subsystems and component within a subsystem. Farmers require comprehensive management measures which optimize agricultural production and profit from limited remedies. Using the food consumption score cut-off, the results concluded that the households with poor food consumption of non-FSRD farmers were 2.5 percent and there was no farmer with poor consumption from FSRD farmers. Findings showed that food items were obtained from different sources; especially from households own crop production, purchase and domestic livestock. It could be concluded that, among the selected districts food consumption of Mymensingh and Pabna regions were

significantly higher than other regions. The study also revealed that Rajshahi and Sylhet districts had comparatively lower food consumption scores for both FSRD and non-FSRD farmers. Farmers engaged in FSRD operations were more active in the use of technology and rely more on their own production than on the purchase of food. There are great demands of farmers to increase the number of FSRD sites. BARI authority may take necessary steps to increase the number of FSRD sites. Production inputs, particularly good quality seeds are very important for all categories farmers. It is examined that timely availability of seasonal seed is essential for good yield. Farmers will be more interested to engage them with FSRD activities if they get timely production inputs.

Acknowledgement

This material is based upon work supported by the United States Agency for International Development, as part of the Feed the Future Initiative, under the GGIAR Fund, award number BFS_G_11-00002, and the predecessor fund the Food Security and Crisis Mitigation II grant, award number EEM-G-00_04_00013, USA.

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