RESEARCH ARTICLE

LIVELIHOOD SECURITY DETERMINANTS OF THE ORGANIC FARM HOUSEHOLD IN SOUTH-EASTERN COAST OF BANGLADESH

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ABSTRACT

Organic farming is a method of crop and livestock production that sustains the demands of production of healthy and safe food for the community. Bangladesh is now highly productive area for agriculture production in the world with large varieties of agriculture crops are cultivating here. The study employed ordered logistic regression to assess the determinants of livelihood security of the organic farm households in the south-eastern coast of Bangladesh. The study was conducted in three upazilas of Chattogram district like Banskhal, Anwara and Sitakund. Multistage sampling technique was adopted for the study. Three upazilas were selected and from each selected upazila a cluster of 1-2 villages were selected at random. At the last stage 150 respondents were selected from a cluster of villages using random proportional sampling. Ordered logistic regression was applied to assess the determinants of the livelihood security. Landholding, distance access to market, possession of livestock were the significant determinants of livelihood security for the organic farm households in South-eastern coast of Bangladesh. Livelihood security of the organic farm households in coastal Bangladesh was influenced significantly by the determinants like landholding, access to market distance and possession of livestock.

KEYWORDS

South-Eastern coast of Bangladesh, Ordered logistic regression, Organic, Livelihood security.

1. INTRODUCTION

Organic farming is a method of crop and livestock production that sustains the demands of production of healthy and safe food, without dependence on chemical fertilizers, using organic matter and bio-fertilizers, cultivating with reduced tillage, environmentally safe pest management and the adoption of integrated farming systems (Pimentel et al., 2005). According to the worldwide database, it was found that there are 43.1 million ha land are under coverage of organic farming and among them Oceania holds 40 % of the world's organic land, followed by 27% in Europe and 15% in Latin America. Crop land area 10.9 million hectares. It was also found that worldwide demand for organic products remains over 5 billion USD per year. At present, Europe and North America are the regions that high concentration of organic products marketing. Besides, Asia also market for organic is more on fine in wealthy countries like Japan while others have export-oriented sectors (FiBL and IFOAM, 2014). Organic farming has the potential to contribute towards rural development and food production, allowing in many situations a good compromise between farmer income, productivity, food quality and the conservation of natural resources, and thus, an important agribusiness for farmers, owing to the premium returns from organic products (Tal, 2018; Brzezina et al., 2017; Yadav et al., 2013). It also has a significant advantage

which encompasses environmental protection and a higher resilience to environmental changes, increasing farmers' income and reducing external input cost, enhancing social capacity, increasing employment opportunities and enhancing food security by increasing the purchasing power of the people (Jouzi et al., 2013). Organic farming can substantially contribute to farmers' food security and improve farmers' livelihood (IFAD, 2005).

Sustainable livelihoods of marginal farmers can be obtained by organic farming as it has high potential in fulfilling the livelihood indicators. By adopting multi-cropping in one to two acres would improve food-security and safety, reduce the expenses of the household and might decrease health care expenditures for small farmers thus increasing the possibility to live self-sufficiently as organic products are usually more expensive than conventional products and is more profitable due to its higher price premiums (Crowder and Reganold, 2015; Uddin, 2014; Katsarova, 2015). Organic farmers often receive higher and more stable prices for their products and incurred lower cost because of the cheaper organic inputs, which increases economic benefits such as saving money by reducing input cost (Rundgren, 2006; Bolwig et al., 2009; Valkila, 2009). In addition, the consumers exhibit higher willingness to pay for organic products (Stevens-Garmon et al., 2007). Organic farming contributes in supporting

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livelihoods, sustained food security by improving nutrition intake, enhancing biodiversity, and also in reducing vulnerability to climate change (Shukla et al., 2013). It also higher bargaining power, better access to credits and markets, the chance to exchange knowledge and experiences, increase employment opportunities in rural areas and allow farmers to afford better education and health services due to higher incomes (Elzakker and Eyhorn, 2010).

Bangladesh is one of the mainly densely populated countries in the planet with more than 160 million people. There are total cultivated land under conventional practices is about 8.51 million hectare and among them estimated area used in Bangladesh for organic production nearly is about 68660 hectares which 0.19% of total land (FIBL 2015; MOA, 2015). The land area is progressively decreasing because of population growth, rapid industrialization and infrastructural development. More than 70% of the population depends on agriculture. Given the challenges that occur from the over-use of agro-chemicals in Bangladesh, a key policy intrusion for sustainable agriculture is to hearten the acceptance of agricultural technologies that rely to a superior extent on renewable or local resources. The farming structure is the major part of the organic farming, but the main dependable sector is crop that including rotation of the crop, maintenance and improvement of the soil fertility throughout the biological nitrogen fixation, use of soil microorganisms, crop residues, addition of organic manure and bio-pesticide, waste etc.

Before the introduction of chemicals, Bangladesh agriculture was fully dependent on the organic sources of fertilizers (animal manure, crop residues and domestic wastes) to fertile the land. In 1960s, with the introduction of green revolution, to follow former agricultural policy - to meet the demand of food for increasing population, some farmers started to use chemical fertilizers. Some of them used both chemical and organic fertilizers and some of them didn't adopt chemicals fertilizers due to conservativeness or lack of infrastructural facility. The objectives of the organic farming are mainly to protect natural and agricultural resource bases from further degradation and to ensure long term sustainability in agricultural system. Therefore, the understanding of organic farming status in coastal area of Bangladesh is necessary and also necessary to identify constraints of organic farming in coastal Bangladesh for visualize the overall status of organic farming in the country. The promote for organic food in Bangladesh is at an early on the period and has enormous occasion of the growth. There is a rapid growth in the demand for healthy as well as tasty food products, which are safer than industrially produced goods, follow the rules regarding animal and environmental welfare, have a sustainable approach towards production and are also high in nutrition values (Ahamed et al., 2015).

Organic farming is potentially a profitable enterprise, with a growing global market, already being supplied by 90 developing countries, but not including Bangladesh. Local consumers in Bangladesh have a fairly well-developed perception about organic products and people are interested in buying certified organic foods, and even willing to pay more for them. To gain access to this market, however, certification is a prerequisite. It is very difficult for poor smallholder or organic farmers to resolve these problems alone, and to develop their organic farms. To overcome the challenge for individual farmers in achieving this, a big amount of investment could play an important role for the development of organic agricultural in Bangladesh. This aspect will enable this sector to meet the necessary requirements of producing and marketing organic foods, both for the internal and export markets; and can secure an extra premium for the poor farmers of Bangladesh. The concerned agencies through research and small scale trials should take the necessary steps to enable the rapid expansion of organic farming in Bangladesh, and so significantly reduce poverty among the poor farmers. The objectives of this research are mainly to protect natural and agricultural resource bases from further degradation and to ensure long term sustainability in agricultural system. Based on the above mentioned situation, The objective of the study was to assess the livelihood security of familiar of organic farmers in the south-eastern coast of Bangladesh through ordered logistic regression approach.

2. MATERIALS AND METHODS

2.1 Sampling

The study was conducted three sub-districts of Chattogram district which are situated southern coastal area of Bangladesh. Banskali, Anwara and Sitakund were selected randomly. The study was done during the month of March-June, 2020. From each upazila, two villages were selected randomly, Premasia and Chandradwip from Banskali upazila, Tailipara and Raipura from Anwara upazila, Muradpur and Syedpur villages from Sitakund upazila respectively. From the selected upazilas a cluster of 1-2 villages were selected at random. At the last stage 150 respondents were selected from a cluster of villages (1-2 villages) using random proportional sampling.

2.1.1 Data Collection and Sample Design

The unit of analysis was households and for data collection, the household head (either male or female) was the survey participant. The sample size has been chosen in line with statistical formula presented by Islam, 2014.

$$n_0 = \left(\frac{z^2 pq}{d^2} \right)$$

Sample Size Distribution,

Description,

n_0 = desire sample size.

z = standard normal deviate usually set at 1.96, which corresponds to the 95% confidence level.

p = assumes proportion in the target population estimated to have a particular characteristic.

q = proportion of the estimation of population

d = allowable maximum error in estimating a population proportion.

In the case of non-response, the interviewers simply proceeded to the next household until the require dnumber of respondents for a particular area was reached (Alam et al., 2017). Moreover, four focus group discussion (FGD) were done for prospects, challenge and status of organic famring in the study areas with socio-economic variables. These opinions were then used to cross-validate the information obtained from the surveys and the key informant interviews (Table 1). Data were collected using face-to-face interviews between January to June 2019. Before the final data collection commenced, a structured survey questionnaire was tested with 20 respondents to ensure the adequacy of the information obtained and to avoid any ambiguity of questions. Statistical and analytical analysis of the study data were done by employing Statistical Package for The Social Science (SPSS: version-16).

2.2 Data Analysis

The livelihood security determinants were analysed using ordered logistic regression. In case of ordered logit we introduce a latent variable y_i^* which is not observed variable; however the properties of the variable are useful and intuitive.

- $y = 0$; if household's livelihood security level is low
- $y = 1$; if household's livelihood security level is moderate
- $y = 2$; if household's livelihood security level is high

Thus, the latent continuous variable model specification (including the logistic error term) is described as:

$$y_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \dots + \beta_n x_{ni} + \epsilon_i$$

Whereas the observed ordered categorical variable y_i model specification is described as

$$\frac{pr(y_i \geq j)}{pr(y_i < j)} = \exp \{ -\gamma_j + \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \dots + \beta_n x_{ni} \}$$

Where, y_i = livelihood security

x_{ni} = determinants

β_0 = intercept

β_n = coefficients to be estimated

ε_i = error terms

However, the difference between the security level is unknown though the variables are inherently ordered resulting in low, moderate and high. By introducing threshold variables of γ_1 and γ_2 we will be able to formulate the formal relationship between the latent (y_i^*) and observed (y_i) model specification as:

$$y_i = 0 \text{ if } y_i^* \leq \gamma_1$$

$$y_i = 1 \text{ if } \gamma_1 \leq y_i^* \leq \gamma_2$$

$$y_i = 2 \text{ if } y_i^* > \gamma_2$$

Where γ is an unobserved parameter that is estimated jointly with β .

2.2.1 Independent variables used in the model

The dependent variables for the model were the livelihood security level coded by dummy variables '0' for low, '1' for moderate and '2' for highly secured. The explanatory variables were taken up by reviewing the earlier studies based on the determinants of the livelihood security. The measurement and expected sign of the explanatory variables included in the model are given in Table 1.

Table 1: Description of variables included in Ordered Logistic regression model		
Variables	Description	Expected Outcomes
Age	Respondent's age in years	±
Family size	Number of Household member	±
Gender	1 if household head is male, 0 otherwise	±
Educational status of the household head	Literate =1, Illiterate =0	+
Total farm Income	Total farm income (INR)	+
Land holdings	Actual land holding in hectare	+
Farming experience	Number of years	+
Possession of livestock	1 if households owned livestock, 0 otherwise	+
Access to nearest market	Households access to the market (Km)	-
Access to credit	1 if the household has access to credit, 0 otherwise	±
Pest and disease	1 if food shortage is caused by pest and disease, 0 otherwise	-

3. RESULTS AND DISCUSSION

Before running the Ordered Logistic Regression model, one has to check whether the assumptions hold true. Most common assumptions were no multicollinearity and proportional odds. Multicollinearity occurs when the independent variables are highly correlated with each other. Applying the rule of thumb, if Variance inflation factor (VIF) of the variable exceeds 10, that variable is said to be highly collinear. One could use Tolerance (TOL) as a measure to detect multicollinearity. The closer TOL to zero, the greater the degree of collinearity of that variable with the other regressors. The TOL closer to 1, the greater the evidence that the variable is not collinear with the other regressors (Gujarati et al., 2014). Ordered logistic regression cannot be applied if the multicollinearity problem is detected. Perusal of Table 2 depicts that the independent variables are free from the problem of multicollinearity as both the Tolerance (TOL) and Variance inflation factor (VIF) are within the range. TOL values are all closer to 1 signifying the greater evidence that the variables are not collinear with other variables. Similarly, all the VIF values are less than 10 denoting the absence of multicollinearity.

Table 2: Multicollinearity test for organic adopter		
Variables	TOL	VIF
Household size	0.67	1.48
Age of the Respondent	0.54	1.83
Gender	0.96	1.04
Education of the respondent	0.85	1.17
Total farm income	0.77	1.30
Land holding	0.92	1.08
Possession of livestock	0.94	1.06
Access to nearest market	0.95	1.04
Access to credit	0.95	1.05
Pest and disease	0.98	1.02
Farming experience	0.54	1.86

The quality of land holdings also played a role in determining episodic food security. In our landscapes, farmers frequently cultivate several plots that are often separated by several kilometers. This could be positive from an adaptation perspective, if having several microplots implies diversifying the exposure to external shocks. On the other hand, it could be negative if the small size of the plots inhibits the farmer from reaching an efficient scale of production and results in more costly production. In our study sites, the latter appears to be the case, as having more microplots increased the probability of experiencing episodic food shortages. The proportional odds assumptions assumed that the slope coefficient which describe the relationship between the low secured to moderately secured categories of the response variables are the same with the low secured to highly secured. Perusal of Table 3 revealed that general model with Chi-Square value 12.03 with the p-value of 0.36 which was greater than 0.05 level of significance and we failed to reject the null hypothesis, thus concludes that the assumption holds true.

Table 3: Test of Parallel lines				
Model	-2 Log Likelihood	Chi-Square	df	p-value
Null Hypothesis	253.66			
General	241.63	12.03	11	.36

Perusal of Table 4 revealed that land holding, access to market and possession of livestock were the significant factors affecting the livelihood security of the organic farm adopter. With a unit increase in landholding the ordered log odds of being in higher level i.e. from low to moderate and low to highly secured level increase by 6.68 given all of the other variables are held constant. Larger farmers are associated with higher possibility to produce more food, with greater income which increases availability of capital that could increase the probability of investment in purchase of farm inputs which in turns increases food production and hence ensuring food security of farm households. Also, as the distance to market increases the probability of being in a higher level of livelihood security decreases.

This may be due to poor road conditions in the areas, the distance of the households to the market facilitates the buying of households needs and selling of their produce. The coefficient estimates indicate that with one km increase in distance access to market the ordered log odds of being in low from moderate and low to high level livelihood security decreases by 0.71 given that all of the other variables are held constant. Similar result was obtained by who reporting that proximity to the road and market centre creates access to additional income through non-farm employment opportunities, easy access to information for inputs (Khatiwada et al., 2017; Haile, 2016).

A group researcher also reported that nearer the market distance, the level of crop diversification increases (Aheibam et al., 2017). For the possession of livestock, dummy values have been assigned to households who possess livestock as 1 and households who do not possess livestock as 0. This is

the ordered log-odds estimate of comparing households who do not possessed livestock to household who possessed livestock on expected livelihood security level when the other variables in the model held constant. The ordered log odds for household who do not possessed livestock being in a higher livelihood security level is 0.75 less than the household who possessed livestock when other variables in the model are held constant.

Table 4: Summary of Ordered Logistic regression

	Predictors	Estimate	Std. Error	p-value
Threshold	[Livelihood security=.00]	-3.00	1.65	0.07
	[Livelihood security = 1.00]	-0.45	1.63	0.78
Location	Household size	0.01	0.16	0.97
	Age of the household head	-0.05	0.03	0.13
	Total farm income	0.00	0.00	0.88
	Landholding	6.90***	2.00	0.00
	Access to market distance	-0.71***	0.11	0.00
	Farming experience	0.01	0.05	0.81
	[Gender=.00]	-0.09	0.35	0.80
	[Gender=1.00]	0a		
	[Education=.00]	-0.20	0.45	0.65
	[Education=1.00]	0a		
	[Possession of livestock=.00]	-0.75**	0.36	0.04
	[Possession of livestock=1.00]	0a		
	[Access to credit=.00]	0.45	0.36	0.21
	[Access to credit=1.00]	0a		
	[Pest and disease=.00]	-0.22	0.34	0.52
	[Pest and disease=1.00]	0a		

Note*** and **indicate 1 per cent and 5 % level of significance

a. This parameter is set to zero because it is redundant.

While smallholder farmers used a variety of coping strategies to address food shortages that results from extreme weather events, many of these strategies are short-term solutions, and can potentially undermine their ability to cope with future shocks. Like smallholder farmers in other developing countries, many of the smallholder farmers reduced their food intake and/or adjusted their diet when food was lacking. Reducing food intake is a short-term solution that will be unsustainable if extreme events become more frequent and intense, as predicted. Reducing food intake is often accompanied by changes in diet, such as the reduction of meat intake and/or the increase in less nutritious or less preferred food, both of which could have longer-term impacts on household nutrition. In other studies of coping strategies, households used different means to obtain income, such as selling livestock and looking for off-farm jobs and resorting to aid from kinship networks and government and non-government organizations. However, in our study, savings, working off-farm and selling assets or livestock were used infrequently. In addition, very few households (< 10%) reported accessing food from government or non-government organizations among their coping strategies, likely reflecting the limited assistance available in rural areas across the region.

The use of coping strategies for food insecurity following extreme weather events differed among households. Farmers who experienced both recurrent and episodic food insecurity are forced to reduce their food intake and change their diet in higher proportion, because experiencing

food shortages on a recurrent basis undermines their capacity to cope with the impacts of extreme weather events. Facing drought, farmers tend to change their diet more than facing excessive rain events. That could be related to the depletion of staple foods associated with the longer duration of drought events. The general reduction in food intake and changes in diet likely results in households consuming less nutritious food and could result in lower nutritional status. However, longer-term, longitudinal studies of the farmer households (including detailed nutritional studies and health measurements) would be needed to understand the long-term impacts of climate-induced food insecurity on household nutrition and health.

4. CONCLUSIONS

Our study highlights the high prevalence of food insecurity among smallholder subsistence farmers in South-Eastern Coasyt of Bangladesh, the negative impacts of extreme weather events on smallholder farmer food security, and the limited number of coping strategies used by smallholder farmers to cope with food shortages. Our results point to the urgent need to develop policies, programs and strategies that help smallholder farmers improve their overall food insecurity (especially in the "lean" months of June–August when food insecurity is a recurring issue), as well as to increase their resilience to extreme weather shocks.

Although farmers report a series of coping strategies to address food shortages that result from extreme weather events, all of the strategies are short-term, finite solutions. Simply put, there is only so many savings a family can use or so much calorie intake can be decreased, before the household has run out of options. Furthermore, the main coping strategies reported by the families, for example decreasing food intake, using savings or selling assets and livestock, actually undermine their ability to cope with future shocks, in a setting in which most studies coincide in predicting an increase in the number of extreme hydrometeorological events

The study concluded that landholding, access to market distance and possession of livestock were the significant determinants that influenced the livelihood security of the organic farm households in Chattogram. There are four major problems have been found for organic farming in Bangladesh which are poor farmers, poor farmer– knowledge of organic farming and its benefits, insufficiency of organic inputs as well as poor marketing of organic foods. The market familiarized applied research is significant to popularize a resourceful– composting equipments at the field level. India, produces and exports a broad series of fresh and processed organic foods of fruits and agriculture crops, although the country is best known as an exporter of organic tea.

Other Asian countries like China, the Republic of Korea and Sri Lanka, are also vigorous producers and exporters of organic foods. Like other developing countries, Bangladesh has the capability to realize a noteworthy share of the worldwide organic market. This offers an occasion to augment farmers' incomes, thereby making a significant contribution towards reducing poverty for among poor farmers. From the findings the study recommends that the livestock rearing practices should be encourage among the farmers and up to some extend livestock incentives must be given to the farmers of the region besides markets for organic produce should be encourage at block level respectively by the central or the state government so that farmer can access for their input and output easily.

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