Bangladesh Journal of Extension Education *ISSN 1011-3916*
Volume 23, No. 1&2, 2011:37-44 *Research Article*

Drought Shocks of Farm Households: Evidence from Rajshahi District

M. S. Akter[1], S. Parveen[2] and M. A. Islam[3]

Abstract

The main purpose of the study was to examine the extent of shocks faced by the farm households in drought period and to identify factors that affect drought shocks of farm households in three selected area of Tanore upazila of Rajshahi district in Bangladesh. Data were collected using interview schedule from a sample of 150 drought affected farm households selected by using simple random sampling technique from a population of 499 drought affected farm households during August to September 2011. Drought shocks were measured by a four-point rating scale. Drought shocks index was computed by adding all scores obtained from 10 types of drought shocks. Correlation test was used to ascertain the relationships between each of the concerned variables and extent of drought shocks faced by the farm households. A vast majority of the farm households (83%) exposed with a high extent of drought shocks. The analysis of variance indicated that drought shocks of farm households varied significantly with formal education and household income. Six characteristics of the farm household namely formal education, earning members, family farm size, household income, household assets and cash savings had significant but negative relationship with extent of drought shocks. On the other hand age of the farm household heads and indebtedness of the farm household had significant positive relationships with the extent of drought shocks. The step-wise multiple regression analysis showed that formal education and cash savings had positive influences while indebtedness had negative influences on drought shocks of farm households.

Keywords: *Drought, shocks, farm households, Rajshahi*.

Introduction

Rural poor in developing countries are the most vulnerable community to climate change impacts because they depends mainly on livelihood activities like agriculture and forestry which are the most directly and severely affected by climate change impacts and at the same time they lack the institutional and financial capacity to withstand and cope with these impacts. Climate change brings Bangladesh at higher risks due to droughts (World Bank, 2003). Between 1960 and 1991, 19 droughts had been occurred in Bangladesh (Mirza & Paul, 1992). Since independence, Bangladesh has experienced droughts of major magnitude in 1973, 1978, 1979, 1981, 1982, 1994, 1995, 1996 and 2003 (Adnan, 2003 and Hossain, 2004).

The National Water Management Plan (NWMP) considers occurrences of drought as a major water deficiency related issue in northwest region of Bangladesh (WARPO, 2001). The northwest region of Bangladesh such as Dinajpur, Rangpur, Pabna, Rajshahi, Bogra, Joypurhat and Naogaon districts receive less rainfall averaging 1,400 mm as against the national average of about 2,150 mm. As consequences, susceptibility to and severity of drought in the western districts have been much higher

[1]Lecturer and [2]Professor, respectively, Dept. of Agricultural Extension Education; [3]Professor, Dept. of Agricultural Statistics, Bangladesh Agricultural University, Mymensingh.

than elsewhere in Bangladesh (Banglapedia, 2006). The impacts of drought shocks on farm households are diverse and can be broadly classified as economic, environmental and social. Further, impacts are often referred to as direct or indirect (Kates *et al.*, 1995). In a society where agriculture is the primary economic activity, the direct impact of a drought is observed in the form of a decrease in food production via a decrease in cultivated area and crop yield. Drought adversely affects all three rice seasons (Aus, Aman and Boro) in Bangladesh. It also causes damage to jute and other crops such as pulses, potatoes, oilseeds, minor grains, winter vegetables and sugarcane. Depending on the intensity of drought, estimated yield reduction of different crops varies from 10 to 70 percent (Adnan, 2003). Yield reductions due to drought vary from 45 to 60 percent in Transplanted Aman and 50-70 percent in Rabi crops in very severe drought situations. During 1981-1982, drought affected the production of monsoon crop (Aman) and the shortfalls from the trend were 0.5 and 0.3 million metric tones, respectively. It is also reported that total crop production was reduced by 30-40 percent in the north-western part of the country in 2006 (Rahman *et al.*, 2007).

Examples of indirect impacts are decreased employment and income. The delay in sowing and transplanting crops reduces agricultural employment. Employment opportunities are further reduced because of a diminished need for weeding and harvesting. Because of reduced food production, prices of food-grains usually rise rapidly following a drought (Ghose, 2004). Apart from loss to agriculture, droughts have significant effects on land degradation, livestock population and human health.

Therefore, a detailed assessment is essential of how farm households are affected by drought shocks. In view of the foregoing discussion, the study aimed (i) to determine the extent drought shocks faced by the farm households (ii) to determine the level of drought shocks faced by the farm households and factors influencing it.

Methodology

The study was conducted in three villages namely Narayanpur, Talukpara and Noitipara of Tanore Upazila of Rajshahi district. Tanore Upazila was selected purposively because of the severity of drought. These villages were selected purposively as drought occurs severely every year in these villages. Drought affected farm households were the target population of this study. The total target population were 499, out of which 30 percent population were selected randomly from three villages as the sample of the study. Hence, the sample size is 150. A sub-sample of 24 drought affected farmers (8 from each village) was selected for FGDs and matrix ranking. Four key informants were also interviewed for gathering their expert views about drought shocks and factors influencing it. The dependent variable of the study was the extent of drought shocks index (EDSI) of farm households. Various characteristics of the farm households were selected as independent variables of the study such as age of the farmers, formal education of the farmers, earning members of the farm households, family farm size, cash savings, indebtedness, household assets and household income of the farm household.

Different drought shocks of farm households were identified through FGDs.

Ten types of shocks under five major dimensions were selected through matrix ranking on the basis of their severity. These include: 1) Ecological shocks: lack of rainfall, depletion of ground and surface water sources; 2) Economic shocks: loss of crop yield and unemployment; 3) Health shocks: incidences of diseases; 4) Social shocks: food shortage, conflict between water users, increased poverty and scarcity of safe drinking water, 5) Psychological shock: mental dissatisfaction. The extent of drought shocks (EDS) faced by the farm households were measured on the basis of their responses to the statements in the interview schedule. Extent of exposure to shocks was measured by a four-point rating scale (0 - 3). Score 0, 1, 2 and 3 was assigned for not at all, to a slight extent, to a moderate extent and to a great extent respectively. The extent of drought shocks index (EDSI) was computed by adding all scores obtained from 10 types of drought shocks. The scores could range from 0 to 30, where 0 indicating no exposure to drought shocks, while 30 indicating the highest exposure to drought shocks.

The SPSS computer programme was used for analysing the data. Various descriptive statistical measures such as range, frequency, number, percentage, mean, standard deviation (SD), coefficient of variation (CV) and rank order were used for categorisation and describing the variables. Three statistical tools, such as analysis of variance (ANOVA), Pearson's product moment correlation coefficient (r) and stepwise multiple regression analysis were utilised both for data evaluation and hypotheses testing.

Findings and Discussion

Extent of Drought Shocks of Farm Households

For having the better understanding regarding farm household drought shocks, it was necessary to have an idea about the extent of shocks facing in 10 selected drought shocks. For this purpose, mean of drought shocks were computed. The computed mean of drought shocks against 10 drought shocks are arranged in rank order as shown in Table 1. It indicates that farm households encountered ecological shocks such as lack of rainfall and depletion of ground and surface water to a great extent. Conflict between water users followed by mental dissatisfaction were another important socio-psychological shocks faced by the farm households. As a result of scarcity of water sources, conflicts and mental stress, the farm households get less crop yields followed by shortage of food, high level of poverty and jobless. Ultimately, the members become affected by various diseases (e.g. diarrhea and dysentery) due to less access to safe drinking water.

Table 1 Extent of Drought Shocks Experienced by the Farm Households, 2011 (n =150)

Type of shocks	Mean [a] of shocks	Rank order
Lack of rainfall	2.97	1
Depletion of ground and surface water	2.93	2
Conflict between water users	2.76	3
Mental dissatisfaction	2.61	4
Loss of crop yield	2.45	5
Food shortage	2.40	6
Increased poverty	2.39	7
Unemployment	2.25	8
Incidences of diseases	2.24	9
Scarcity of safe drinking water	2.04	10

[a] Mean values of items ranging from 0 to 3

The extent of drought shocks of the farm household ranged from 17-30, with an average of 25.64 and classification of drought shocks presented in Table 2. It shows that a vast majority of the farm households (83%) exposed with a high extent of drought shocks while only 17 percent faced medium extent of drought shocks. Majority of the farm households faced medium to high extent of drought shocks due to low annual income, poor household assets and no cash savings. Households with more income and household assets can cope with drought shocks easily (Hoddinott, 2004; Shewmake, 2008).

Table 2 Distribution of Farm Households according to Extent of Drought Shocks, 2011 (n = 150)

Drought shocks category	Number	Percent	Mean (CV)	Observed range
Low extent of shock (1-10)	-	-	25.64 (15.09)	17-30
Medium extent of shock (11 - 20)	25	17		
High extent of shock (above 21)	125	83		
Total	150	100		

Figures in the parentheses indicate CV = (SD / Mean) × 100

Variation of Exposure to Drought Shocks of Farm Households according to Formal Educational Level of Farm Household Heads

ANOVA was performed in order to examine the variation of exposure to drought shocks with formal educational level of the farm households heads. Table 3 shows that the extent of exposure to drought shocks of farm households significantly differs among formal educational levels of the household heads. It also revealed that the household heads who had higher secondary level (mean = 20.45) and the secondary level (mean = 23.42) of education were comparatively less exposure to drought shocks than those had the primary level of education (mean = 27.06) and no schooling (mean = 28.70). It was reported by Paavola (2008) that higher education decreases exposure to drought shocks of farm households. So, it is important to emphasise educational needs of the members of the farm households to reduce their extent of drought shocks.

Table 3 Variation of Exposure to Drought Shocks of Farm Household according to Formal Education

Category of formal education of farm households heads	Mean	% CV	F-statistic
No schooling	28.70	5	
Primary	27.06	12	$F = 25.89^{***}$
Secondary	23.42	14	($p = 0.001$)
Higher secondary	20.45	10	
Total (n = 150)	25.64	15	

*** Indicates significance at 0.1% level (2-tailed) with 149 degrees of freedom

Variation of Exposure to Drought Shocks of Farm Households according to their Income Status

The ANOVA ($F = 5.142$, $p = 0.007$) shows significant differences in the exposure to drought shocks among the three income categories of the farm households. Table 4 indicates that the extent of exposure to drought shocks of farm households significantly differs with their income status. Brant (2007) found that farm households with poor income tend to be more exposure to drought. Drought shocks

of farm households decreases with the increase of income because the coping ability of the farm households depends on household income and saving behaviour.

Table 4 Variation of Exposure to Drought Shocks of Farm Household according to Income Status

Household income category	Mean	% CV	F-statistic
Low income	26	15	$F = 5.142^{***}$ ($p = 0.007$)
Medium income	21	10	
High income	25	6	
Total (n = 150)	26	15	

*** Indicates significance at 0.1% level (2-tailed) with 149 degrees of freedom

Relationship between the Selected Characteristics of the Farmers and Drought Shocks

Co-efficient of correlation (r) was used to explore if there was statistically significant relationship between the selected characteristics of the farmers and drought shocks. The summary of the result of correlation test is presented in Table 5.

Table 5 Relationship between the Selected Characteristics of the Farmers and Drought Shocks Index of Farm Households (EDSI)

Variables (units)	Pearson's correlation co-efficient (r)
Age (years)	0.183^{*}
Formal education (years)	-0.629^{**}
Earning members (numbers)	-0.201^{*}
Family farm size (hectares)	-0.568^{**}
Household income (taka)	-0.504^{**}
Household assets (scores)	-0.451^{**}
Cash savings (taka)	-0.683^{**}
Indebtedness (taka)	0.427^{**}

* and ** indicate significance at 0.05 and 0.01 level (2-tailed) with 149 degrees of freedom

The correlation analysis showed that age and indebtedness of the farm households were positively correlated with EDSI of the farm households. On the other hand, formal education, earning members, family farm size, household assets and cash savings were negatively correlated with EDSI of the farm households. The old farmers are more exposed to drought shocks than younger farmers because older farmers are more likely to be engaged only in agricultural work but the young farmers diversify their livelihoods by participating in both agricultural and non agricultural work. During drought period, the older farmers have no work to do due to crop failure. The negative significant correlation of formal education of the household heads with drought shocks index clearly points out that with the increase of the formal education of the household heads drought shocks of the farm households decreases. Earning members of the households have a negative significant correlation with drought shocks indicating that more earning members of the farm households contribute to lower their extent of drought shocks. The findings of Brant (2007) showed that the farm households with large numbers of earning members tend to have less exposure to climatic shocks. This is because earning members of the households engage themselves in different income generating activities, earn money and support the family during drought period and reduce the extent of shocks of farm households.

The negative significant correlation of family farm size of the households with drought shocks clearly pointed out that large farm size holding farm households are less exposure to drought shocks. Brant (2007) found that farm households having small and marginal farm size tend to be more exposed by drought shocks than farm households with large family farm size.

Household income of the farm households has a negative significant correlation with drought shocks, indicating that the farm households which had more household income they face low extent of drought shocks and cope with these shocks easily. Household assets of the farm households have a negative significant correlation with drought shocks of farm household, indicating that the farm household having high number of assets are tend to be less exposed with drought shocks as the number of assets help farm household to develop suitable coping mechanisms during any crisis.

Cash savings of the farm households has a negative significant correlation with drought shocks, indicating that the farm households which had more cash savings they face low level of drought shocks and cope with these shocks easily and ultimately, vulnerability becomes lower. It is, however, suggested that financial capital assets such as savings, remittances and pensions offer an individual different livelihood options and thereby, reduce the shocks to environmental change (Agyei *et al.*, 2011). Drought shocks of farm households increases with high level of indebtedness, this means that the farm households which take more loan during drought period, they are more exposed to drought shocks than those of farm households who take less amount of loan or do not take any loan. Thus, it could be said that formal education of the household heads, earning members, family farm size, household income, household assets, cash savings of the farm households play an important role to reduce the extent of drought shocks of farm households.

Factors Influencing Drought Shocks of Farm Households

A step-wise multiple linear regression analysis had been applied to identify significant explanatory variables that have effects on EDSI. The results of the multiple regression analysis show that among the explanatory variables, three variables such as, formal education, cash savings and indebtedness have significant influences on the drought shocks of farm households. The results of the analysis are shown in the Table 6. The variable-wise effect is explained below:

Table 6 Factors Influencing Vulnerability of Farm Households due to Drought (Step-wise Multiple Regression)

Independent variables (range of values)	Dependent variable: Cumulative Drought Shocks(CDS)			
	Unstandardised coefficients (B_i)	Standardised coefficients (β_i)	t-value	Significance level
Constant	27.98		70.40	.00
Formal education	-0.33	-0.34	-5.33	.00
Cash savings	- 0.13	-0.44	-6.80	.00
Indebtedness	0.07	0.12	3.20	.00

n = 150; Adjusted R^2 = 0.60; F = 69.65*** (Significance at 1% level); Durbin-Watson = 1.56

a) Formal education: Formal education of the farm household heads had a significant negative impact on EDSI, indicating that if formal education increases by one unit (one year of schooling), the shocks of farm households is decreased by 0.33 unit. Formal education is considered an important factor in reducing drought shocks of farm households. Agyei *et al*. (2011) found that low level of literacy instigate

high level of exposure to drought shocks. For instance, good education may increase the income earning opportunities of rural households whose livelihoods depend on agriculture (Paavola, 2008). This is because the poorly educated persons may be excluded from well-paid jobs due to lack of skills (Rakodi, 1999). In addition, education can greatly enhance a person's capacity to access information which may include the use of new technology that reduces shocks of farm households (Weir, 1999).

b) Cash savings: Cash savings of the farm households had a significant negative impact on EDSI, indicating that if cash savings of the household increases by one unit (one thousand taka) the drought shocks of farm households decrease by 0.13 unit. It is, however, suggested that financial capital assets such as savings help to reduce the drought shocks of farm households remittances and pensions offer an individual different livelihood options and thereby, reduce the vulnerability to environmental change (Hoddinott, 2004). The ability of a community to cope with the impacts of climate change vulnerability is reflected in their assets and savings behaviour (Moser, 1998).

c) Indebtedness: Indebtedness of the farm households had a significant positive impact on EDSI, indicating that if indebtedness of the household increases by one unit (one thousand taka), the drought shocks of farm households is increased by 0.23 unit.

Conclusion

The results of this study indicate that formal education and income status i.e. cash savings had inverse relationship with exposure to drought shocks. Thus, policy interventions by major intervening agencies, such as governmental organisations (GOs), non-governmental organisations (NGOs) and the community-based organisations should focus on strengthening public and household-level risk management using both mitigation and adaptation strategies to reduce the negative impacts of exposure to drought shocks. Household-level mitigation strategies should include practices that encourage crop diversification, the use of drought-tolerant crop varieties, tree plantation and improvement of soil management practices. Policies that support household-level adaptation strategies should take proper steps to increase the level of literacy of farm people. Educated farmers have opportunity to generate income from both farm and non-farm activities. At the same time, diversified income generating opportunities like establishment of agro-processed industry and small cottage industry could help farmers to raise their household income. As a result, farmers can save more money, enlarge farm size and reduce indebtedness and ultimately, reduce drought shocks. Public risk mitigation might include strategies such as rain water harvesting, conservation of water in ponds or canals, establishment of storage facilities for retaining rain water, construction of dams for irrigation and undertaking new irrigation projects.

References

Adnan, S. 2003. Living Without Floods: Lessons from the Drought of 1992. Research and Advisory Services, Dhaka.

Ageyi, P.A., Fraser, E.D.G., Dougill, A.J., Stringer, L.C. & Simelton, E. 2011. Mapping the Vulnerability of Crop Production to Drought in Ghana using Rainfall, Yield and Socioeconomic Data. *Working Paper No. 55*. Centre for Climate Change Economics and Policy. The University of Leeds, UK.

Banglapedia 2006. Banglapedia. http://www.banglapedia.org/httpdocs/HT/D_0284.HTM (search date: 06 November 2011)

Brant, S. 2007. Assessing Vulnerability to Drought in Cerea, Northeast Brazil (unpublished master's thesis). Department of Natural Resources and Environment, Michigan University, Brazil.

Ghose, A.K. 2004. Food Supply and Starvation: A Study of Famines with Reference to the Indian Sub-Cotinent. *Oxford Economic Papers*, 34(2): 389-398.

Hoddinot, J. 2004. Zimbabwe: Shocks and their Consequences Across and Within Households in Rural Zimbabwe, US Agency for International Development. http://www.reliefweb.int/node/163990 (search date: 26 March 2012)

Hossain, M. 2004. Natural Calamities, Instability in Production and Food Policy in Bangladesh, the Bangladesh Institute of Development Studies.

Kates, R. W., J.H. Ausubel and M. Berberian. 1995. *Climate Impact Assessment*. Wiley, New York.

Mirza, M.Q. and S. Paul 1992 Prakritik Durgojob O Bangladesh Paribesh (Natural Disaster and Environment in Bangladesh), Centre for Environmental Studies and Research, Dhaka.

Moser, C.O.N. 1998. The Asset Vulnerability Framework: Reassessing Urban Poverty Reduction Strategies. *World Development*, 26 (1): 1-19.

Paavola, J. 2008. Livelihoods, Vulnerability and Adaptation to Climate Change in Morogoro, Tanzania. *Environmental Sciene & Policy*, 11: 642-654.

Rahman, A.A., M. Alam, S.S. Alam, M.R. Uzzaman, M. Rashid. and G. Rabbani. 2007. *Risks, Vulnerability and Adaptation in Bangladesh, Human Development Report 2007/08*, UNDP, Human Development Report Office OCCASIONAL PAPER, 2007/13.

Rakodi, C. 1999. A Capital Assets Framework for Analysing Household Livelihood Strategies: Implications for Policy. *Development Policy Review*, 17: 315-342.

Shewmake, S. 2008. *Vulnerability and the Impact of Climate Change in South Africa's Limpopo River Basin,* IFPRI Discussion Paper No.804, http:// www. Ifpri. org/pubs/dp/ ifpridp00804. asp (Washington, DC: International Food Policy Research Institute, 2008).

WARPO, 2001. Draft Development Strategy, National Water Management Plan, Water Resources Planning Organization (WARPO).

Weir, S. 1999. The Effects of Education on Farmer Productivity in Rural Ethiopia. Centre for African Economics. Working Paper Series No 91, University of Oxford, Oxford, UK.

World Bank, 2003. *Bangladesh Climate Change and Sustainable*
Development, World Bank Report (No. 21104-BD).