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## DIRECT AND INDIRECT EFFECTS OF ECONOMIC FACTORS ON FARMERS' ADOPTION OF ECOLOGICAL AGRICULTURAL PRACTICES: A PATH ANALYSIS

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### ABSTRACT

This paper aimed at examining the direct and indirect effects of some selected economic factors on farmers' adoption of some ecological agricultural practices. Pro shika- selected ecological farmers of six selected upazilas of Bangladesh constituted the population of the study. Data were collected from a random sample of 144 farmers during February to August 2006 by using a pre-tested interview schedule. Eight selected economic factors of the farmers were considered as the independent variables and adoption of some ecological agricultural practices by the farmers was the dependent variable. The step-wise multiple regression analysis indicates that four economic factors had significant contribution to farmers' adoption of ecological agricultural practices. Path analysis shows that the variable benefit obtained from ecological agriculture had the highest direct effect ( $p_d = 0.498$ ) followed by animal-poultry excreta availability ( $p_d = 0.371$ ) in the positive direction. The next contributory economic factor was annual family income ( $P_d = -0.241$ ) in the negative direction, while commercialization of the farmers had the lowest direct effect ( $p_d = 0.148$ ) on adoption of selected ecological agricultural practice. Path analysis further demonstrates that animalpoultry excreta availability had the highest total indirect effect ( $p_i = 0.321$ ) followed by benefit obtained from ecological agriculture ( $p_i = 0.278$ ) and annual family income ( $p_i = 0.239$ ). Commercialization of the farmers had the lowest total indirect effect ( $p_i = 0.147$ ) on adoption of ecological agricultural practices.

### I. INTRODUCTION

Anti-natural agricultural practices degrade the soil and ecological balance in many ways as stated by Murakami (1991). The anti-natural practices increase the cost of production in one hand and decrease the microbial activities in the soil, on the other hand. Chemical fertilizers and chemical pesticides not only contaminate surface water, they also affect fish population and human health as well. To restore the lost ecological status, it is high time to follow ecological agriculture.

Agriculture without chemical inputs is generally understood as ecological agriculture. The practices used in ecological agriculture are known as ecological agricultural practices. Organic, mechanical, physical and cultural practices of agriculture are used in ecological

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agriculture. Ecological agricultural farming is steadily gaining popularity in the world. Ecological agriculture may produce a positive contribution to the problems created by modern conventional farming (McRobie, 1990). Proshika as an NGO is trying to promote ecological agriculture among their target farmers of Bangladesh.

Limited research work has so far been done to determine the extent of adoption of ecological agricultural practices by the farmers, and the direct and indirect effects of the factors on their adoption of ecological agricultural practices. On this consideration, the present research was conducted to determine the direct and indirect effects of economic factors of farmers on their adoption of some ecological agricultural practices.

## II. METHODOLOGY

Four hundred seventy eight Proshika-selected farmers in six upazilas namely Ghatail and Madhupur under Tangail district, Muktagacha under Mymensingh district, Pakundia under Kishoreganj district, and Belabo and Raipura under Narsingdi district were producing organic vegetables and those farmers constituted the population of the study. A total of 144 farmers were randomly selected as the sample from whom data were collected. A pre-tested Interview schedule (in Bengali language) containing direct questions and some scales was used for data collection. Data were collected during the period from February to August 2006.

Eight selected economic factors of the farmers were considered as the independent variables of this study. The measurements of the independent variables were in accordance with the measurement procedure used in the Ph.D. dissertation of Ali (2008). For easy understanding, operationalization of these variables is summarized in Table 1.

**Table 1. Summarized operationalization of the independent variables with measuring units**

Independent Variables	Measuring unit	Operationalization
1 Effective land possession	Hectares	Scale developed following Karim and Mahboob (1974)
2 Cropping intensity	Scores (%)	Scale as used by Ali (2008)
3 Animal-poultry excreta availability	Scores	Scale developed with the help of Gaur, <i>et al.</i> (1990)
4 Annual family income	'000' taka	Direct question
5 Commercialization	Scores (%)	Scale developed for the study with the help of Karim and Mahboob (1974)
6 Credit need	Scores (%)	Scale developed by Kashem (1986)
7 Marketing opportunity	Scores	Scale developed for this study
8 Benefit obtained from ecological agriculture	Scores	Scale developed for this study

Adoption of selected ecological agricultural practices was the dependent variable of the study. On the basis of the Judges' ratings, 20 ecological agricultural practices were selected for the study. The adoption of a particular ecological agricultural practice by each farmer was then measured by the following formula:

$$A = \sum_{i=1}^4 \frac{e_i}{p} 100M_i$$

Where, A = Adoption of a particular practice

$e_i$  = Effective area or area (in hectare) actually covered by the practice under respective mode

$M_i$  = weight of respective mode of application of the practice

$i = 1, 2, 3, 4$

$p$  = Potential area or area (in hectare) suitable for the practice

Thus, adoption of a particular ecological agricultural practice could range from 0 to 100. Finally, adoption of ecological agricultural practices of each farmer was then determined by adding up the scores of all the 20 ecological agricultural practices. Therefore, score of adoption of ecological agricultural practices could range from 0 to 2000, where 0 indicated no adoption and 2000 indicated very high adoption of ecological agricultural practices. Weight of mode of application of each practice was as follows:

Mode of application of the practice		Weight
Mode-1 (M <sub>1</sub> ):	No use of the practice	0.00
Mode-2 (M <sub>2</sub> ):	Less use of the practice with large use of chemical fertilizers or chemical pesticides (large use of chemical fertilizers means use of $\geq 50\%$ of the recommended doses of chemical fertilizers and large use of chemical pesticides means use of chemical pesticides for pest control at normal attack.)	0.33
Mode-3 (M <sub>3</sub> ):	Large use of the practice with less use of chemical fertilizers or chemical pesticides (less use of chemical fertilizers means use of $< 50\%$ of the recommended doses of chemical fertilizers and less use of chemical pesticides means use of chemical pesticides for pest control only at the time of severe attack.)	0.67
Mode-4 (M <sub>4</sub> ):	Use of the practice without any chemical fertilizers or chemical pesticides	1.00

### III. RESULTS AND DISCUSSION

Step-wise multiple regression analysis was done to test the contribution of the selected economic factors of the farmers to their adoption of selected ecological agricultural practices. It was found that out of 8 economic factors, four had significant contribution to their adoption of ecological agricultural practices. The economic factors, or in other words, independent variables, viz., benefit obtained from ecological agriculture, animal-poultry excreta availability, annual family income and commercialization of the farmers had significant contribution to their adoption of ecological agricultural practices.

It was not possible to find out the direct effects and indirect effects separately by regression analysis. For this reason, path coefficient analysis was employed in order to obtain clear understanding of the direct and indirect effects of selected economic factors of the farmers on their adoption of ecological agricultural practices. Path coefficients showing direct and

indirect effects of four significant independent variables (based on regression analysis) on the farmers' adoption of selected ecological agricultural practices have been presented in Table 2.

Actually, direct effect is the value of standardized partial 'b' coefficient of the independent variables having significant contribution to the adoption of selected ecological agricultural practices. On the basis of path analysis, the independent variables having direct effects on adoption of selected ecological agricultural practices have been presented below in the descending order of importance (Table 2.).

**Table 2. Path coefficients showing the direct and indirect effects of four significant economic factors on farmers' adoption of selected ecological agricultural practices**

Independent variables	Direct Effect ( $p_d$ )	Variables through which indirect effects are channeled	Indirect effects	Total* indirect effect ( $p_i$ )
Benefit obtained from ecological agriculture	0.498	Animal-poultry excreta availability	0.255	0.278
		Commercialization	0.058	
		Annual family income	-0.035	
Animal-poultry excreta availability	0.371	Benefit obtained from ecological agriculture	0.343	0.321
		Annual family income	-0.056	
		Commercialization	0.034	
Annual family income	-0.241	Animal-poultry excreta availability	0.086	0.239
		Commercialization	0.081	
		Benefit obtained from ecological agriculture	0.072	
Commercialization	0.148	Benefit obtained from ecological agriculture	0.194	0.147
		Annual family income	-0.132	
		Animal-poultry excreta availability	0.085	

\*Total indirect effect = Addition of all individual indirect effects

#### **Benefit obtained from ecological agriculture**

Benefit obtained from ecological agriculture by the farmers had the highest direct effect ( $p_d = 0.498$ ) and the 2nd highest total indirect effect ( $p_i = 0.278$ ) on their adoption of ecological agricultural practices in positive direction. The indirect effect was mostly and positively channeled through animal-poultry excreta availability. The indirect effect of benefit obtained from ecological agriculture was somewhat positively channeled through commercialization and negatively through annual family income. Farmers with more animal-poultry excreta availability could use animal-poultry excreta in their ecological field and could get more benefit from this. Ultimately, it was helpful to adopt more ecological agricultural practices.

#### **Animal-poultry excreta availability**

Animal-poultry excreta availability of the farmers had the 2nd highest direct effect ( $p_d = 0.371$ ) and the highest total indirect effect ( $p_i = 0.321$ ) on their adoption of selected ecological agricultural practices in the positive direction. The indirect effect was mostly channeled

through benefit obtained from ecological agriculture in the positive direction. The indirect effect of animal-poultry excreta availability was somewhat channeled negatively through annual family income and positively through commercialization on the adoption of ecological agricultural practices. It is quite logical that farmers getting higher benefits from ecological agricultural practices were motivated to make their animal-poultry excreta more available for higher adoption of ecological agricultural practices. Islam (2003) found that cattle and poultry rearing had significant positive relationship with composite adoption of organic manures and had significant contribution to the same.

### **Annual family income**

Annual family income of the farmers had the 3rd highest direct effect ( $P_d = -0.241$ ) in the negative direction and the 3rd highest total indirect effect ( $\pi_i = 0.239$ ) in the positive direction on their adoption of ecological agricultural practices. The indirect effect of annual family income was mostly channeled positively through animal-poultry excreta availability, commercialization and benefit obtained from ecological agriculture. Actually, animal-poultry excreta availability, commercialization and benefit obtained from ecological agriculture had positive direct effect on adoption of ecological agricultural practices. For this reason, the indirect effect of annual family income on adoption ecological agricultural practice was channeled positively through animal-poultry excreta availability, commercialization and benefit obtained from ecological agriculture. Islam (1996) found that annual income had significant negative relationship with the use of indigenous technical knowledge and had considerable contribution to use of the same. Faruque (2002) and Sardar (2002) found no relationship of family income with adoption of indigenous technical knowledge and that of integrated pest management.

### **Commercialization**

Commercialization of the farmers had the lowest direct effect ( $P_d = 0.148$ ) and the lowest total indirect effect ( $\pi_i = 0.147$ ) on their adoption of ecological agricultural practices in the positive direction. The indirect effect of commercialization was mostly channeled positively through benefit obtained from ecological agriculture. The indirect effect of commercialization was somewhat channeled negatively through annual family income and positively through animalpoultry excreta availability. Farmers having more benefits from ecological agriculture were motivated to increase their commercialization by producing various types of crops in their ecological fields. This was the reason that the indirect effect of commercialization on adoption of ecological agricultural practices was channeled positively through benefit obtained from ecological agriculture.

## **IV. CONCLUSION**

Benefit obtained from ecological agriculture had the highest direct effect followed by animalpoultry excreta availability in the positive direction. The next contributory economic factor was annual family income in the negative direction. Commercialization of the farmers had the lowest direct effect on adoption of selected ecological agricultural practices. Again, the variable animal-poultry excreta availability had the highest total indirect effects followed by

benefit obtained from ecological agriculture and annual family income. Commercialization of the farmers had the lowest total indirect effect on adoption of ecological agricultural practices.

From the findings, it may be concluded that other variables remaining constant, each of the four economic factors of farmers namely benefit obtained from ecological agriculture, animal-poultry excreta availability, annual family income and commercialization had influence and these economic factors were the determinants of the farmers' adoption of selected ecological agricultural practices.

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