Income Generation Through Edible Mushroom Cultivation: A Potential Source of Food Security for Small Households in Bangladesh

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Abstract

This paper attempted to explore mainly the consequences of mushroom cultivation practices on the family income and women's status that can play an important role to remedy food and nutritional insecurity. Primary data were collected from the selected study area, Savar Upazila of Dhaka District. Cobb-Douglas production function and both tabular and quantitative analyses were done to achieve the objectives. The paper reveals that mushroom cultivation was profitable and a considerable improvement took place in the conditions of farmers and their total annual income. The gender status in particular has improved significantly on these households as evidenced by the increased participation of mushroom culture practicing women in taking decisions on crucial socioeconomic matters in the households.

1 Introduction

The whole world is witnessing dramatic changes in global food production systems which have manifold implications on the food security and nutritional status of developing countries. The Government of Bangladesh's continued efforts to feed its current 145 million people and two million new mouths to feed

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every year from a limited supply of agricultural land is praiseworthy and highly acclaimed globally (Ad Spijkers, 2008). The cultivable land of Bangladesh was 8.16 million hectares in 1986 and during the last two decades about two million hectares of arable land has been squeezed and in 2007 the cultivable land was about 6.83 million hectares (The Daily Jaijaidin). Nearly all the arable area of the country has been brought under the plough and further horizontal expansion of land is almost impossible.

Poverty is the major factor affecting food security in Bangladesh. Despite the impressive increase in food grain, around a half of Bangladeshis remain below the established food based poverty line. And, as many as one third are living in extreme poverty and severely undernourished. Recent food price increases, country's low income, regular natural disasters, and strains on the global economic market have caused additional destabilization.

Population growth increases the demand for food. Although food grain is more available in good harvest years, Bangladesh as a whole still has a very low level of nutrition. This means many households and individuals do not eat a balanced, nutritious diet, even in good years. According to the World Bank, approximately 33 million people in Bangladesh cannot afford an average daily intake of more than 1800 kilocalories (the minimum standard for nutrition as set by the World Food Program). For people in most developing countries, the daily calorie average is 2,828. In Bangladesh, that average is only 2,190. The cultivation or resourceful search for protein rich foods must be a goal in the struggle to combat malnutrition. Due to the frequency of drought and livestock diseases in this part of the world as well as the high cost of conventional agricultural production, the people are anxious to develop an alternative source of protein with a high income generation potential. With protein contents that may be as high as 60%, source of vitamins B, D and the minerals potassium, selenium, copper, phosphorus and with health benefits such as the enhancement of body immunity systems, mushrooms are seriously a food source that could be part in any food security programmes.

Mushroom cultivation could possibly offer the solution for poverty alleviation through income generation. Considering that about five crops of oyster mushroom can be produced per year, the poverty alleviation potential of mushroom cultivation cannot be overemphasized. Unlike other agronomic crops, the set-up costs for mushroom production are low. Fertilizers, machinery, and pesticides are not used, the market price is relatively high, and profit margins for mushroom crops can be considerably higher than traditional crops. In general the fact that the enterprise takes very little space and can produce returns within a short period of

time makes mushroom growing more accessible for the destitute and landless farmers.

Although the role of mushroom cultivation has been recognized in Bangladesh, no systematic empirical economic research on this line has been conducted. This paper, therefore, makes a modest attempt to examine the increase in income from production of mushrooms and to study the impact of the production of mushroom on status of women to bring into focus that mushroom cultivation can play a priority role in Bangladesh's food and nutrition security.

After this introduction, the methodology of the study discussed in section 2. Section 3 and 4 present analysis of the results and concluding remarks, respectively. Policy implications are made in the last section.

2 Research Methods

Study area and sample size

In Bangladesh mushrooms are practiced in few areas only. As mushroom cultivation in Savar Upazila was a pilot project under Mushroom Culture Center (MCC) and keeping in view the objectives, four areas Jamsinghpur, Bank Coloni, Bydapara and Jalesshor in Savar Upazila of Dhaka district were selected for the study.

At first a few preliminary visits were made by the first researcher to the area. Then a detailed list of participants was prepared in consultation with the local mushroom farmers. Subsequently, from the total of 100 participant farmers, 60 farmers were randomly selected. A set of interview schedule was prepared for eliciting desired information from the farmers. Before finalizing the schedule, it was pretested judging the suitability of the schedule to respondents. Data were collected during the period from February to April 2008 through direct interviews with mushroom farmers using a structured survey questionnaire.

Analytical Technique

Profitability analysis of Mushroom Cultivation

To assess the profitability of mushroom production, net return or profit (?) was calculated using the following algebraic equation:

$$\pi = P_y.Y - \sum_{i=1}^{n} (P_{xi}.X_i) - TFC$$

Where,

= Net return (Tk/cycle);
P_y= Per unit price of the product (Tk/kg);
Y= Quantity of the product per cycle (kg);
P_{xi}= Per unit price of i^{th} inpurs (Tk);
X_i= Quantity of the i^{th} inputs per cycle (Kg);
TFC= Total fixed cost (Tk);
i= 1,2,3,……,n (number of inputs).

Estimation of costs and returns of Mushroom

In estimating costs the direct expenses incurred for human labour (both family supplied and hired), spawn packets (seeds), paddy straw, miscellaneous and interest on operating capital etc. were included. The home-supplied and purchased inputs were priced on the basis of market value or opportunity cost of the concerned input. Similar methodology was followed in estimating returns which included value of total mainproduct (fresh and dry mushroom) and by-product (straw).

Functional analysis

The Cobb- Douglas production function model was chosen to estimate the effects of key variables on production processes of mushroom. In this analysis, gross return was considered as 'dependent variable'. The double log form of the Cobb-Douglas model proved to be a superior alternative on theoretical and econometric grounds.

The specification of the Cobb-Douglas production function model was as follows:

$$Y_i = \alpha X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} D_1^{\beta 5} e^{ui}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the ordinary least squares (OLS) method .

$$\ln Y_i = \ln \alpha + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 D_1$$

Where:
Y=Gross return (Tk/cycle);
ln =Constant or Intercept of the Function;

X_1 =Age of the farmers;
X_2= Level of education;
X_3= Human labor cost (Tk/cycle);
X_4= Number of spawn packet (Number/cycle);
D_1= 1 (Grown under controlled environment)
$\beta_1, \beta_2 \ldots \beta_n$ 0 (Otherwise)
=Coefficient of respective variables:
ln =Natural logarithm
i =1,2,3,….,n
e =Base of natural logarithm
u_i=Error term.

3. Results and Discussion

Results of profitability analysis of Mushroom

Table 1 shows per cycle and per year costs and returns of mushroom. The results show the per cycle and per year net return of mushroom production as Tk 7001.21 and Tk 62,693.83, respectively. Undiscounted benefit-cost ratio of mushroom production per cycle and per year came out to be 1.72 and 2.65 respectively.

Table 1 :Per Cycle and Per Year Cost and Return of Mushroom Cultivation (per 150 sq.feet)

Particulars	Per cycle (2 months)	Per year (6 cycles)
Total variable cost (Tk)	5320.63	31923.78
Total fixed cost (Tk)	4447.68	5999.78
Gross cost (Tk)	9768.31	37923.31
Gross return (Tk)	16769.52	100617.14
Gross margin (Tk)	11448.89	68693.36
Net return (Tk)	**7001.21**	**62693.83**
Net return of per spawn packet (Tk)	140.38	209.52
Benefit- Cost Ratio (BCR) (undiscounted)	**1.72**	**2.65**

Sources: Adapted from Khanam, T.S (2008).

Thus the study reveals that in terms of annual net return and benefit cost ratio, mushroom cultivation is a profitable agribusiness that could generate potential income and employment by cultivating mushroom in the country.

Interpretations of coefficients of Cobb-Douglas model

It is evident from Table 2 that five explanatory variables were taken into account for Cobb-Douglas production function model of mushroom production, Five explanatory variables namely: Age (X_1), education (X_2), human labour cost (X_3), number of spawn (X_4) and growing condition (grown under controlled environment D_1) were chosen as key independent factors to estimate the quantitative effect of inputs on yield of mushroom. All these variables have been estimated with data arranged on per cycle basis. Care was taken to note that included variables were not multicollinear.

Table 2 : Estimated Values of Coefficients and Related Statistics of Cobb-Douglas Production Model

Explanatory Variables	Estimated Coefficient	Standard error	T-Values
Intercept	6.044*	0.383	15.796
Age (X_1)	-0.033	0.091	0.364
Education (X_2)	0.011	0.053	0.200
Labor Cost (X_3)	0.401*	0.118	2.853
Number of Spawn (X_4)	1.154*	0.056	13.398
Controlled Environment (X_5)	0.120**	0.056	2.145
Adjusted R^2	0.95	-	
F-Value	83.564*	-	
Returns to Scale ($S\beta_i$)	1.653	-	

Sources: Adapted from Khanam, T.S (2008).

Note: * Significant at 1 percent Level

** Significant at 5 percent Level

Table 2 shows that the regression coefficient of age and education were 0.033 with a negative sign and 0.011 with a positive sign, respectively. These coefficients are statistically insignificant, which indicates that age and level of education of the farmers were important factors affecting gross return of mushroom farms. It can

be seen from Table 2 that the regression coefficient of labour cost and number of spawn were 0.401 and 1.154 respectively. These coefficients were positive and statistically significant at one per cent probability level. This indicates that an increase in one per cent of labour cost and number of spawn, remaining other factors constant, would result in an increase in the gross return by 0.401 and 1.154 per cent respectively. The regression coefficient of grown under controlled environment was 0.120 with a positive sign. This coefficient of the dummy variable was statistically significant at five per cent probability level, which indicates that this factor is one of the main factors for gross return of mushroom farms.

It is evident from Table 2 that the value of the coefficient of multiple determination () was 0.95. It indicates that about 95 per cent of the variations of the gross return are explained by the explanatory variables included in the model. The F-value (83.564) of the estimated production function is highly significant at one per cent probability level, which implies a good fit of the model and that the included variables were adequate for explaining the variation of mushroom production. The summation of all the regression coefficients of the estimated production function ( ) of mushroom was 1.653. This implies that the production function exhibits increasing returns to scale. That is, to say, farmers growing mushrooms were operating in the first stage of production function. In this case, if all the variables specified in the production function were increased by one per cent, gross return would increase by 1.653 per cent.

Cobb-Douglas production function model revealed that the key variables included in the model were individually or jointly responsible for variation in gross return or output of mushroom. It also revealed that mushroom growers allocated their resource in the zone of increasing returns (i.e., in Stage I), which indicates that there was bright prospect to earn more returns by making optimum use of more inputs in the production of mushroom.

Changes in Household Annual Income

In this section attempts are made to take account of total household income from the components of agriculture, service, business and other sources (day labourers etc.). Here income from mushroom has been included in agricultural sources. The changes in income were assessed by before and after cultivation of mushroom. In Table 3 the findings indicate that the average yearly income of the respondent households increased from Tk 37935 to Tk 102147.50 after the families had adopted mushroom cultivation.

Table 3 : Average Changes in Annual Household Incomes of the Respondent

Source of Income	Change in annual income			
	Before (Tk)	After (Tk)	Net change (Tk)	Change (%)
Agriculture*	6050	69747.4	63697.5	1053
Business	17418.33	17583.33	165	0.95
Service	13250	13350	100	0.75
Others	1216.67	1466.67	250	21
Total	37935	102147.5	64212.3	169

Sources: Adapted from Khanam, T.S (2008).

Note: * Mushroom cultivation included with agriculture.

Income generation can provide cash for use in other areas of the economy, which in turn helps reduce poverty. Thus production of mushrooms appears to help in income generation and poverty alleviation of mushrooms growers which results in own safety of growers and their food security.

Socioeconomic Changes Occurred among the Participants

Adoption of mushroom cultivation by the respondents has played an important role in changing the socioeconomic status of the family in general. Sales of mushroom provide direct cash income to the farmers. They are also closely linked to the social and cultural lives of resource-poor farmers for whom mushroom farm ownership ensures varying degrees of sustainable farming and economic stability. Changes of socioeconomic variables there of scaling to measures were expressed in terms of no changes, small changes, medium changes and high changes. The changes of sample participation after cultivating mushroom are shown in Table 4.

The Table 4 indicates that the income change of the participants was satisfactory (small changes 30 per cent, medium changes 56 per cent and high changes 1.67 per cent). Remarkable changes have occurred in remaining all other variables such as food and nutrition, housing condition, health facilities, drinking water, using sanitary latrine, education, involvement in social activities, involvement of women in IGAs and awareness.

Status of woman and gender issue

Women play a vital role in providing food and nutrition for their families through their roles as food producers, processors, traders and income earners. Food

Table 4 : Socioeconomic Changes in Livelihood of Respondents

Indicator of changes	Socioeconomic changes of respondent families			
	No changes	Small changes	Medium changes	High changes
Income	-	41 (68.33)	18 (30)	1 (1.67)
Food and nutrition	2 (3.33)	43 (71.67)	15 (25)	-
Housing condition	26 (43.33)	30 (50)	4 (6.67)	-
Health facilities	9 (15)	40 (66.67)	11 (18.33)	-
Using drinking water	-	10 (16.67)	48 (80)	2 (3.33)
Using sanitary latrine	-	40 (66.67)	20 (33.33)	-
Clothes	37 (61.67)	23 (38.33)	-	-
Education	-	30 (50)	30 (30)	
Furniture	25 (41.67)	32 (53.33)	3 (5)	
Involvement in social, GO & NGO, political organization	5 (8.33)	38 (63.33)	16 (26.67)	1 (1.67)
Involvement of women in IGAs	-	8 (13.33)	46 (76.67)	6 (10)
Awareness	-	5 (8.33)	52 86.67)	3(5)

Sources: Adapted from Khanam, T.S (2008).

Note: Figures in parentheses indicate percentages of respondents.

utilization can be enhanced by improving women's knowledge of nutrition and food safety and the prevention of illnesses. Increasing women's involvement in decision making and their access to land and credit will in turn improve food security.

The study reveals that most of the farmers were female, Out of 60 farmers 7 (11.67 per cent) were male and 53 (88.33 per cent) were female. It is observed from Table 5 that men dominating role in decision-making has diminished to a

greater extent after the women got engaged in income generating by cultivation of mushrooms. The activities where men previously took monopoly decision made room for joint decision-making for smooth running of IGAs adopted by the females. Increased participation of women in these decision-making processes does clearly signal a positive impact.

Table 5 : Woman Participation in Household Decision Making

Decision making topics	Household women shared and participated in decision making (%)					
	Before			After		
	Man only	Woman only	Men in consultation with women	Man only	Woman only	Men in consultation with women
Spending family income	85	-	15	4	1	95
Family budgeting	94	-	6	14	-	86
Purchasing household assets	92	-	8	22		78
Household management	80	-	20	2	-	98
Take care of children	-	88	12	-	72	28
Child education	80	-	20	-	-	100
Group meeting	100	-	-	-	96	4
Decision regarding Dau/ son's marriage	56	-	44	-	-	100
Rural activities	84	-	16	48	-	52

Sources: Adapted from Khanam, T.S (2008).

The findings from this study shows that taking joint decision increased in the case of spending family income (95 per cent), family budgeting (86 per cent), purchasing household assets (78 per cent), household management (98 per cent), child education (100 per cent), taking care of children (28 per cent), decision regarding daughter's/son's marriage (100 per cent) and rural activities (52 per cent) during the study year (Table 4). It can, therefore, be said that the income generated from mushroom cultivation was helping in potential women empowerment in the society.

4 Conclusion

The region of the world where diet is sparse and nutrition is weak like Bangladesh requires use of emerging innovative technology to introduce new products like mushrooms cultivation, which will be reflected not only in the food and

nutritional security but also in improved economic condition of the country by helping them in attaining good health and providing opportunity for income generation. Particularly in the context of land scarce situation in Bangladesh, mushroom cultivation is a profitable agribusiness because mushroom cultivation on one decimal land (435 sq. feet) can generate a net return of Tk 20303.00 per cycle. The mushroom farming resulted in increased agricultural incomes and earnings. The positive socioeconomic changes have occurred and poverty has been reduced through earning income from their self-employment. Participation of women in income generation activities at home was found changing the traditional gender role scenario of the study areas that ensured proper food utilization. The specific consequences of the cultivation of mushrooms may be visualized in terms of poverty alleviation, provision of employment to women and attempt to improve the problems of malnutrition and gender issues by generating opportunities particularly to poor womenfolk to earn income from their self-employment which ensures food security.

5 Policy Implications

- Steps for increasing consumption and production of mushrooms should be undertaken. The Ministry of Agriculture and other supporting institutions should give more emphasis to encouragement of mushroom cultivation. The Ministry does not currently have sufficient officers specifically assigned to mushroom extension services.
- Donors who usually shun projects involving new technology and huge amounts of money should give support to women's groups or small farmers to initiate small local projects for mushroom cultivation as a family food source. This would go a long way to solving the problem of malnutrition, particularly protein deficiency among children, and food insecurity that is common in Bangladesh.
- To reduce poverty and achieve long-term food security for the poor and malnourished, Government and donor agencies should help them to upgrade their level of living that raise more people above the poverty line by adopting mushroom cultivation project. For this more intensive and extensive research should be conducted.

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Appendix Table 1 Per Cycle (2 months) Total Cost of Mushroom Cultivation (per 150 sq.feet)

Items	Unit	Quantity	Price per unit(Tk)	Total value (Tk)
		Variable cost		
Human labor	Man-day	36.07	80	2885.6
Spawn packet	No.	49.87	7	349.09
Paddy straw	kg	136.2	5	681
Fuel	Tk			136.33
Poly bag	Kg	4.33	159.88	692.28
House rent		Tk		280
Miscellaneous		Tk		296.33
Total variable cost		Tk		5320.63
		Fixed cost		
Making house	Tk			2749.33
Shelves/ *cika*	Tk			902.17
Bucket/ drum	No.	2.03	80.02	162.44
Cotton/nek	Tk			89.4
Cilar machine	No.	1	500	500
Interest on operating capital	Tk			44.34
Total fixed cost		Tk		4447.68
Gross cost		Tk		9768.31
Fresh product	kg	75.77	110	8334.7
Dry product	kg	8.09	1019.71	8249.45
By-product		Tk		185.37
Gross return		Tk		**16769.52**
Gross margin		Tk		11448.89
Net return		Tk		**7001.21**
BCR (Undiscounted)				**1.72**

Sources: Adapted from Khanam, T.S (2008).

Appendix Table 2 Per Year Total Cost of Mushroom Cultivation (per 150 sq.feet)

Items	Unit	Quantity	Price per unit(Tk)	Total value (Tk)
		Variable cost		
Human labor	Man-day	216.42	80	17313.6
Spawn packet	No.	299.22	7	2094.54
Paddy straw	kg	817.2	5	4086
Fuel	Tk			817.98
Poly bag	Kg	25.98	159.88	4153.68
House rent	Tk			1680
Miscellaneous	Tk			1777.98
Total variable cost		Tk		31923.78
		Fixed cost		
Making house	Tk			2749.33
Shelves/ *cika*	Tk			902.17
Bucket/ drum	No.	1		162.44
Cotton/nek	Tk			89.4
Cilar machine	No.	1		500
Interest on operating capital	Tk			1596.19
Total fixed cost		Tk		5999.53
Gross cost		Tk		37923.31
Fresh product	kg	454.62	110	50008.2
Dry product	kg	48.54	1019.71	49496.72
By-product		Tk		1112.22
Gross return		Tk		100617.14
Gross margin		Tk		68693.36
Net return		Tk		62693.83
BCR (Undiscounted)				**2.65**

Sources: Adapted from Khanam. T.S (2008).