

## COMPARATIVE PROFITABILITY ANALYSIS OF MAIZE AND TOBACCO PRODUCTION IN MANIKGANJ DISTRICT OF BANGLADESH

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### ABSTRACT

A common myth about tobacco cultivation is that tobacco is more profitable than other crops. However, tobacco farming becomes unprofitable when the opportunity costs of unpaid family labor and the costs of their significantly severe illnesses and medical care are considered. High environmental impacts from tobacco farming result in a net loss to society. To analyze profitability by comparing maize with tobacco, and estimate the health costs of individuals in tobacco-cultivated areas. A cross-sectional and comparative study was undertaken among tobacco and maize farmers with family members in Manikganj districts. A total of 120 households were selected through a multi-stage cluster sampling technique, and each household head was interviewed face-to-face using a semi-structured questionnaire to gather information on households, family members and farming. The quantitative data were analyzed using both descriptive and inferential statistical approaches. In this study, 120 households consisted of a total of 501 household members. The average land use for cultivation was 81.91 decimals for maize growers and 96.60 decimals for tobacco growers. Considering all crops in a cultivation year, the undiscounted Benefit Cost Ratio (BCR) of maize growers was higher (1.72) than that of tobacco growers (1.02). In BCR for maize production was 1.22, while tobacco production was 1.09. Moreover, Food crops cultivation is more profitable than tobacco cultivation for individual and annual crop production. To achieve a tobacco-free country by 2040, tobacco farmers should cultivate food crops that are profitable from a broader perspective instead of cultivating tobacco.

**Keywords:** Profitability, tobacco, maize, bcr, smoke-free

### INTRODUCTION

The promise of Prime Minister Sheikh Hasina to create a smoke-free nation by the year 2040 has increased Bangladesh's constitutional duty to take action against tobacco. The area of tobacco cultivation remains significantly high in Bangladesh, which is the 12th largest tobacco producer in the world (Akm Ghulam Hussain, *et al.*, 2020). When the opportunity costs of unpaid family labor, other owned resources and the health implications of tobacco production are taken into account, tobacco farming becomes a losing endeavor. Tobacco cultivation creates a significantly high environmental cost that causes a net loss to society. Many tobacco farmers are now stuck producing a crop that is labor and input intensive and brings with it a host of health and environmental dangers. Meanwhile, the cigarette companies continue to downplay or ignore the many serious economic and environmental costs associated with tobacco. Nevertheless, the availability of unpaid family labor and the options of advanced credit as well as a buy back guarantee from the tobacco companies attract farmers to engage in and continue tobacco cultivation. Multi-stage cluster sampling technique will be used for household survey. In order to provide evidence on health and economic impact of the tobacco on cultivators of tobacco cultivated area in Bangladesh. For a season, in search of even more profits, the tobacco industry has encouraged countries and farmers to grow more tobacco (Campaign for Tobacco-Free Kids, 2001). While the tobacco industry argues that tobacco farming is a major contributor to the country's economy, the seriously damaging health and environmental impacts caused by tobacco farming have been well documented (Mackay & Eriksen, 2005). To meet demand for tobacco leaf from both domestic and foreign manufacturers of tobacco products, the extent of tobacco cultivation remains considerably high. Bangladesh is the 12th largest tobacco producing country in the world [(Maps of

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world. 2018) & (Catfish, 2018) & (World list mania, 2018)]. Tobacco farming is growing fast and competing for the limited and fixed arable land of 37,674,000 acres. While in 2007–2008, a total of 72,000 acres of land was used for tobacco cultivation, it increased to 127,000 acres by 2014–2015—a 74% increase over seven years (BBS, 2016). Tobacco cultivation is highly labor intensive, as evident in similar studies conducted for Kenya (Magati *et al.*, 2016), Indonesia (Drope *et al.*, 2017) and Zambia (Goma *et al.*, 2019). During curing, tobacco farmers have to work 70 h at a stretch (Akhter *et al.*, 2018). The use of unpaid family labor is widespread. A significant number of women and child laborers are engaged in tobacco cultivation and tobacco leaf processing, which constitutes exploitation of women and children and is against the law (Children’s Act; Act No. 24 of 2013). Assisting tobacco farmers to transition to maize alternatives is a key element of comprehensive tobacco control’s end-game strategy and specifically required by the World Health Organization (WHO) Framework Convention for Tobacco Control (FCTC) (Jones *et al.*, 2008).

**Overall objective:** To analyze the profitability with comparison of maize and tobacco production in Manikganj District of Bangladesh.

### **Specific Objectives**

- i. To determine the input costs and output returns of maize and tobacco
- ii. To analysis and compare the profitability with factor affecting of maize and tobacco product

## **MATERIALS AND METHODS**

### **Selection of the study area**

Tobacco is grown many districts in Bangladesh a preliminary survey in Manikganj district was conducted to achieve the objectives of the present study.

### **Sampling technique and sample size**

The study selected 120 farmers, 62 tobacco growers and 58 maize, using a simple random sampling technique to minimize cost and time, despite not including all farmers in the area.

### **Preparation of the survey schedule:**

A preliminary questionnaire was developed to gather data from survey participants, pretested with tobacco and maize farmers, and finalized after necessary revisions and substitutions.

### **Period of the study**

Data were collected during the period of August to September in 2022 through direct interview with the farmers. Data relating to inputs and outputs were obtained by making time to time visit in the study area.

### **Data collection method:**

The study collected data through field surveys with tobacco and maize farmers. The investigator systematically interviewed farmers, explaining the research's intent and ensuring a scholarly analysis. The interview schedule was updated to ensure accurate data collection. **Processing, tabulation and**

### **Analysis of data:**

Data was manually coded, edited, and thoroughly analyzed using Microsoft Excel and SPSS, first obtained in local units and then translated into international units.

### **Analytical techniques**

The study compares costs, returns, profitability, and resource use efficiency of tobacco and maize production, estimating per hectare profitability for individual farmers in terms of gross return, gross margin, net return, and benefit cost ratio.

### **Profitability analysis**

Cost of variables inputs such as land preparation, labor, seed, fertilizer, irrigation, and insecticides were calculated. Different descriptive statistics like mean, percentage, ratio, etc. Land use cost was calculated on the basis of per year lease value of land.

### **Gross margin**

$GM = TR - VC$ ; Where,  $GM$  = Gross Margin,  $TR$  = Total Revenue,  $VC$  = Variable Cost

**Net income:**  $NI = TR - TC$ ; Where,  $NI$  = Net Income,  $TR$  = Total Revenue,  $TC$  = Total Cost

For estimating net income total cost was subtracted from total revenue. Total cost includes variable cost plus fixed cost.

### **Interest on operating capital**

Interest on operating capital was calculated by using the following formula:

Interest on Operating Capital (IOC) =  $Alit$

Where,  $Al$  = Total investment /2,  $t$  = Total time period of investment,  $i$  = interest rate which was 9 percent per year.

### **Undiscounted benefit cost ratio (BCR)**

A benefit-cost ratio (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.

BCR on TC =  $GR /TC$ , Where, GR = Gross return, TC = Total Cost, If  $BCR > 1$ , then the return from farm is economically satisfactory; If  $BCR < 1$ , then the return from the farm is not economically satisfactory; If  $BCR = 1$ , then the farm is in break- even point.

### **Cobb-Douglas production function**

Apart from the tabular analysis, the functional technique was also followed in this study. Cobb-Douglas production function model was used to estimate the effects of key variables. This model was proved the best-fit and more reliable on theoretical and econometric aspects in real world situation.

The model of Cobb-Douglas for both tobacco and maize is as follow:

$$Y = aX_1^b X_2^b X_3^b X_4^b X_5^b X_6^b X_7^b e^{ui}$$

The Cobb-Douglas production function was transformed into the following logarithmic form by logging on both sides, because it could be solved by the Ordinary Least Square (OLS) method:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + ui$$

Where, Dependent variable,  $Y$  = Gross return (Tk/ha), Independent variables,  $X_1$  = human labor cost (Tk/ha),  $X_2$  = Power tiller cost (Tk/ha);  $X_3$  = seed/seedlings cost (Tk/ha);  $X_4$  = Fertilizer cost (Tk/ha);  $X_5$  =Pesticide cost (Tk/ha);  $X_6$  = Manure cost (Tk/ha),  $X_7$  = Irrigation cost (Tk/ha)  $a$  = constant or intercept term,  $b_1$  to  $b_7$  = production coefficients of respective input variables to be estimated,  $ui$  = Error term,  $\ln$  = Natural logarithm

### **Elasticity of production (Ep)**

Production elasticity is defined as the percentage change in production divided the percentage change in the quantity of an input used for that production, providing the other variables remain constant. In measuring the elasticity of output, the Cobb-Douglas production function is very beneficial. It is possible to express the elasticity of output as- Elasticity of production,  $Ep = bi$ , If  $Ep = 1$ , Production elasticity is unity,  $Ep > 1$ , Production is elastic, and  $Ep < 1$ , Production is inelastic.

### **Return to scale (RTS)**

The return to scale can be achieved by summarizing the coefficients of regression of all explanatory variables in the output function of Cobb-Douglas.

This can be expressed as—Return to scale,  $RTS = \sum bi$ ; Where,  $n$ = number of regression, and  $bi$ = regression coefficients, If,  $RTS = 1$  then it is constant return to scale,  $RTS > 1$  then it is increasing return to scale,  $RTS < 1$  then it is decreasing return to scale.

## **RESULTS AND DISCUSSION**

### **Profitability of tobacco and maize (and accumulated) production**

For analytical advantages, the cost items were classified into two groups;

(I) Variable cost; and (II) Fixed cost.

Variable cost included the cost of all variable factors like seed, human labor, tillage, fertilizer and manure, irrigation water and insecticides and pesticides. On the other hand, fixed cost was calculated for land use cost and interest on operating capital.

**Cost of human labor:** The most important input for tobacco and other crops production is human labor. It shared a large portion of total cost of tobacco and other crops production. Table 1 shows that per hectare total human labor cost for tobacco was TK. 138079.7 (56.4%) where male labor cost was TK. 119422.3(48.8%) and female labor cost was TK. 18487.6(7.5%). On the other hand for maize production, total human labor cost was TK. 81912.3(44.09%) where male and female labor cost was TK. 74232.4(40.7%) and TK. 7550.8(4.1%) respectively.

Table 4 shows that for tobacco along with other crops cultivated in the same land all around the year, human labor cost was Tk.195386.52 which was 46.45% of total variable cost and for major crops (never tobacco cultivated land) all around the year, human labor cost was Tk. 62011.20 which was 22.29% of total variable cost.

**Table 1: Per hectare operation wise average cost for tobacco and maize production**

Inputs Costs	Crops			
	Tobacco	%	Maize	%
Male	119422.3	48.8	74232.4	40.7
Female	18487.6	7.5	7550.8	4.1
Children	169.8	0.1	129.2	0.1
Total Human Labor Cost	138079.7	56.4	81912.3	44.9
Machinery Inputs Cost	21929.7	9.0	29368.7	16.1
Materials Input Cost	84932.7	34.7	70954.6	38.9
Total	244942.1	100.0	182235.5	100.0

**Machinery input cost:** In the study area, it was found that farmers used machinery in land preparation, harvesting, carrying, threshing, curing et cetera. Table.1 show that the per hectare machinery input cost was 21929.7 which is 54.55% and TK.29368.7 which is 16.1% of total variable cost for tobacco and maize production respectively. Table 4 show that the per hectare machinery input cost for tobacco along with other crops for one year was Tk. 42307.88 which was 10.06% of total variable cost and per hectare cost for major crops( in which land tobacco never cultivated) was TK. 53204.73 which was 19.12% of total variable cost.

**Cost of power tiller:** Farmers of Tobacco and Maize used power tiller to land preparation in the study area .Table 2 show that the cost of power tiller were Tk. 16068.0 and Tk. 17190.2 for tobacco and maize respectively.

**Cost of thresher:** Animal labor never used for land preparation. All of the farmers used power tiller for land preparation in the study area. Thresher was needed for threshing Maize after harvesting. Thresher is never used for tobacco threshing in Manikganj. Table 2 shows that total cost of thresher for maize is Tk. 4299.7per hectare.

**Table 2. Per hectare machinery inputs average cost for tobacco and maize production**

Various Inputs	Tobacco		Maize	
	Total Cost (Tk.)	% of total Cost	Total Cost (Tk.)	% of total Cost
Power tiller	16068.0	73.27	17190.2	58.53
Harvesting	346.2	1.58	1283.1	4.37
Transportation	5515.5	25.15	4917.4	16.74
Thresher		0.00	4299.7	14.64
Total	21929.7	100.00	29368.7	100.00

**Cost of transportation:** After harvesting both tobacco and maize, van and rickshaw was used for carrying to their home and to local market. From table 2 total cost of transportation for tobacco was Tk. 5515.5, which is 25.15percent and for maize Tk. 4917.4, which is 16.74percent of total machinery cost.

**Material inputs cost:** For any agricultural crop production material equipment is used during field preparation. Without agricultural materials production is impossible. Material inputs includes seed, fertilizer, irrigation, pesticides et cetera. Efficient use of them can yield high production and lack of knowledge to use them properly can produce low rate of production. Table.1 show that material inputs cost for tobacco was Tk.84932.7 which was 34.7% of total variable cost. For maize production it was TK.70954.6 which was 38.9% of total variable cost.

**Cost of seed/seedlings:** For any agricultural crop production seed is the basic input. Yield of any agricultural production is highly dependent on the quality of seed. Table 3 shows that for tobacco production total seed cost was TK. 15254.55 which is 2.70 percent of total variable cost for one hectare. Again for maize production total seed cost was TK. 9097.98 which is 4.99 2.70 percent of total variable cost for one hectare. Table 4 shows that seed cost of tobacco along with other crops and major crops on a year were Tk. 32119.04 and Tk. 26693.86 for one year respectively and their percentage were 7.64 and 9.60 of total variable cost.

**Table 3. Per hectare variable and fixed average cost for tobacco and maize production**

Items	Tobacco (Tk)	% of total cost	Maize (Tk)	% of total cost
<b>A.Variable Cost</b>				
1.Human labor cost	138079.7	56.37	81912.3	44.95
2. Seed cost	15254.55	6.23	9097.98	4.99
3. Fertilizer cost	46674.99	19.06	40026.17	21.96
4. Machinery cost	21929.7	8.95	29368.7	16.12
6. Pesticide	8593.83	3.51	5070.98	2.78
10. Irrigation	14409.34	5.88	16759.47	9.20
Total Variable Cost	244942.1	100.0	182235.5	100.0
<b>Fixed Cost</b>				
Land use cost	46240.95	79.46	44027.3	89.28
Interest on Operating Capital	11955.34	20.54	5285.8	10.72
Total Fixed Cost	58196.3	100.0	49313.1	100.0
<b>B.Total Cost (A+B)</b>	303138.4		231548.6	

**Cost of fertilizer:** Farmers of tobacco and maize used Urea, TSP, MOP, DAP and SOP. From table 3 the estimated cost of fertilizers for tobacco and maize production was Tk. 46674.99 which is 19.06% of total variable cost and TK. 40026.17 which is 21.96% of total variable cost respectively. Table 4 shows that fertilizer cost of tobacco along with other crops and major crops were Tk. 58436.79 and Tk. 77306.86 for one year respectively and their percentage were 13.89 and 27.79 of total variable cost.

**Cost of irrigation:** Proper irrigation is essential for any kind of agricultural production. Tobacco and maize needed a large amount of water from land preparation to harvest. Table 3 shows that the charge of irrigation water for producing tobacco is Tk. 14409.34 and 5.88 percent of total cost. Table 4 show that the per hectare irrigation cost for tobacco along with other crops for one year was Tk. 33909.42 which was 8.06% of total variable cost and per hectare cost for major crops( in which land tobacco never cultivated) was TK. 37052.08 on a year which was 13.32% of total variable cost.

**Cost of pesticide:** Different types of insects can damage yield of tobacco and maize production. Termites, caterpillars, beetles, horned grasshoppers, rats, brown plant hopper, yellow stem borer, gal midge and leaf folder cause serious damage in tobacco and maize production. So, farmers needed to apply insecticides to control pest. Table 3 reveals the total costs of pesticides for tobacco and maize production for per hectare were Tk. 8593.83 and Tk. 5070.9 and their percentages were 3.51 and 2.78 percent respectively. Table 4 show that the per hectare irrigation cost for tobacco along with other crops for one year was Tk. 58436.79 which contributed 13.89% of total variable cost and per hectare cost for major crops( in which land tobacco never cultivated) was TK. 21926.28 which contributed 7.88% of total variable cost.

### Estimation of fixed costs

**Land use cost:** Most of the tobacco and maize producers of the study area had their own land. Land use cost was fixed for the farmers, table 3 shows that for tobacco, it was Tk. 46240.95 which was 79.46% of total fixed cost and for maize it was TK. 44027.3 which was 89.28% of total fixed cost.

**Interest on operating capital (IOC):** The interest on operation cost was calculated by taking into account all the operating cost incurred during the production period of tobacco and maize. Table 3 shows that, per hectare interest on operating costs were estimated as Tk. 11955.34 which was 20.54% and TK. 5285.8 which was 10.72% of total fixed cost for tobacco and maize respectively.

**Estimation of total cost:** The variable cost and the fixed cost were aggregated to calculate the total cost for tobacco. Table 3 reveals that total cost were Tk. 303138.4 and Tk. 231548 for tobacco and maize respectively. Table 4 show that the per hectare fixed cost for tobacco along with other crops for one year was Tk. 87851.78 in which land use cost was Tk.55792.14 (63.51%) and interest on operating cost was Tk.32059.64 (36.49%) of total fixed cost and per hectare total fixed cost for major crops (in which land tobacco was never cultivated) was TK.69350.37 in which land use cost was Tk.50530.87 (72.86%) and interest on operating cost was Tk.18819.5 (27.14%) of total fixed cost.

**Table 4. Per hectare variable and fixed average cost for tobacco along with other crops and non-tobacco crops (the land in which tobacco was never cultivated) production in the same land for one year**

Items	Tobacco along with other crops (Tk)	% of total cost	Major crops (Tk)	% of total cost
<b>C.Variable Cost</b>				
1.Human labor cost	195386.52	46.45	62011.20	22.29
2. Seed cost	32119.04	7.64	26693.86	9.60
3. Fertilizer cost	58436.79	13.89	77306.86	27.79
4. Machinery cost	42307.88	10.06	53204.73	19.12
6. Pesticide	58436.79	13.89	21926.28	7.88
10. Irrigation	33909.42	8.06	37052.08	13.32
Total Variable Cost	420596.43	100.00	278195	100.00
<b>Fixed Cost</b>				
Land use cost	55792.14	63.51	50530.87	72.86
Interest on Operating Capital	32059.64	36.49	18819.5	27.14
Total Fixed Cost	87851.78	100.0	69350.37	100.0
<b>D.Total Cost (A+B)</b>	508448.21		347545.37	

**Gross return:** Total earning amount of main product and by product is the amount of gross return. Gross return per hectare was calculated by multiplying the total amount of products by average farm gate price. By product was included for tobacco and maize production. From table 5 the gross return of tobacco and maize production were Tk. 331797.4 and Tk. 283425.7 respectively. The returns from main product and by-product specifically were Tk. 329437.8, Tk. 2359.4 form tobacco and Tk. 283304.7and Tk. 121 form maize.

**Table 5. Per hectare gross return for tobacco and maize**

Return	Tobacco	%	Maize	%
Product	329437.8	99.3	283304.7	100.0
By Product	2359.7	0.7	121.0	0.0
Total Value	331797.4	100.0	283425.7	100.0

### Profitability of tobacco and maize (and accumulated all crops) production:

Table 6 shows the profitability of tobacco and maize production. Here, the gross return of tobacco and maize per hectare were Tk. 331797.4 and Tk. 283425.7 respectively. The variable cost of tobacco was TK. 244942.1 and maize was TK. 182235.5. Total fixed cost of tobacco was TK. 58196.3 and maize was TK. 49313. Here the estimated gross margin, net return and BCR of tobacco were TK. 86855.3 TK. 28659 and TK. 1.09 respectively, again estimated gross margin, net return and BCR of maize were TK. 101190.2, TK. 51877.1 and TK. 1.22. Table 7 show that the gross return of tobacco along with other crops for one year was Tk. 518618.7 and the gross return of major crops (in which land tobacco never cultivated) for one year was Tk. 596384.38. Gross margin, Net return and BCR for tobacco along with other crops for one year were Tk. 98022.24 ,Tk.10170.46 and 1.02 respectively. Gross margin, Net return and BCR for major crops (in which land tobacco was never cultivated) for one year were Tk. 318189.38, Tk.248839.01 and 1.72 respectively. The estimated BCR (benefit cost ration) of tobacco explain that if the producer invest Tk. 1 on tobacco production, the producer get Tk. 1.09 in return.

Again, in the case of maize, if farmers invest Tk. 1 on maize production, farmers earn Tk. 1.22 in return. Both tobacco and maize products were profitable in the study area. Maize production was more profitable for the producers in the study area. For a land in which tobacco and other crops were cultivated in a year one after one, if the farmers invest Tk.1, the farmers earn Tk.1.02 after a year. Again, for a land in which any types of crop were cultivated (tobacco was never cultivated) if the farmers invest Tk. 1, the farmers get Tk. 1.72after one year. Cultivation of tobacco along with other crops one after one were less profitable but cultivation of other crops except tobacco around the year were more profitable.

**Table 6. Profitability of per hectare tobacco and maize production**

Items	Tobacco	Maize
A. Gross Return	331797.4	283425.7
B. Total Variable Cost	244942.1	182235.5
C. Total Fixed Cost	58196.3	49313.1
D. Total Cost	303138.4	231548.6
E. Gross Margin (A-B)	86855.3	101190.2
F. Net Return (A-D)	28659	51877.1
G. BCR (A/D)	1.09	1.22

**Table 7. Profitability of per hectare for tobacco along with other crops and major crops (never tobacco cultivated) production in the same land for one year**

Items	Tobacco along with other crops (Tk.)	Major crops (Tk.)
A. Gross Return	518618.7	596384.38
B. Total Variable Cost	420596.4	278195
C. Total Fixed Cost	87851.78	69350.37
D. Total Cost	508448.2	347545.37
E. Gross Margin (A-B)	98022.24	318189.38
F. Net Return (A-D)	10170.46	248839.01
G. BCR (A/D)	1.02	1.72

### Factors affecting of tobacco and maize production

#### Estimation of tobacco and maize production function

The Cobb-Douglas production function model was utilized to analyze the profitability of tobacco and maize production, considering six independent variables: human labor cost, power tiller cost, seed cost, fertilizer cost, irrigation cost, and pesticide cost. Table 8 reveals that human labor cost, machinery and

seed cost have no significant effect on the gross return of tobacco and maize production in the study area.

**Fertilizer cost (X<sub>4</sub>):** Table 8 reveals that fertilizer had no significant effect on gross return on tobacco production but the regression coefficient of fertilizer cost for maize is 0.08280 which is positive and significant at 1% level. This indicates considering all others factor constant by increasing 1% cost of fertilizer gross return increase by 0.08280%.

**Pesticide cost (X<sub>5</sub>):** From table 8, the regression coefficient of pesticide cost for tobacco is -0.0498 which is negative and significant at 5% level. . This indicates considering all others factor constant by increasing 1% cost of pesticide, gross return decrease by 0.0498% and pesticide cost had no significant effect on gross return of maize production.

**Irrigation cost (X<sub>7</sub>):** From table 8, the regression coefficient of irrigation cost for tobacco is 0.0198 which is positive and significant at 5% level. . This indicates considering all others factor constant by increasing 1% cost of irrigation, gross return increase by 0.0198%. On the other side, pesticide cost had no significant effect on gross return of maize production.

**Table 8: Estimated values of coefficients of Cobb-Douglas production function**

Explanatory variable	Co-efficient (Maize)	t-Value (Maize)	Co-efficient (Tobacco)	t-value (Tobacco)
Intercept	11.269	10.8700	12.2170	13.0971
Human labor Cost (X <sub>1</sub> )	-0.0014	-0.0161	0.1557	1.9928
Machinery Cost (X <sub>2</sub> )	-0.0202	2.3735	-0.0216	-0.7169
Seed Cost (X <sub>3</sub> )	0.0423	-0.2899	0.0071	0.2109
Fertilizer Cost (X <sub>4</sub> )	0.08280***	2.0935	-0.0966	-1.1936
Pesticide Cost (X <sub>5</sub> )	-0.0857	-3.0340	-0.0498**	-2.7141
Irrigation Cost (X <sub>7</sub> )	-0.0003	-0.0124	0.0198**	0.7431
R <sup>2</sup>	0.4886		0.2113	
Adjusted R <sup>2</sup>	0.3749		0.1253	
F-value	4.2994***		2.4557**	

(Source: Field survey, 2022)

Note: \*\*\* and \*\* indicate significant at 1% level and 5% level

**Coefficient of multiple determination (R<sup>2</sup>, adjusted R<sup>2</sup>):** The coefficient of determination (R<sup>2</sup>) in Table 8 indicates that the independent variables in the model explained 21.13% and 48.86% variation in the gross return of tobacco and maize, respectively. Adjusted R<sup>2</sup> values for tobacco and maize were 0.1253 and 0.3749, respectively, indicating that these variables still explained 12.53% and 37.49% of the variation in gross return, respectively.

**Goodness of fit (F-Value):** The F value for tobacco was found 4.2994 which were significant at 1% level indicating the good fit of the model, from table 8. The F value for maize was found 2.4557 which were significant at 5% level indicating the good fit of the model from table 8.

**Elasticity of production (Ep):** Table 9 shows that all inputs are individually inelastic for tobacco and maize production, indicating that the gross return per hectare of tobacco and maize does not significantly change with the change of independent variables.

**Table 9. Elasticity of production and return to scale**

Inputs	Maize	Remarks	Tobacco	Remarks
Human Labor Cost	-0.0014	Inelastic	0.1557	Inelastic
Machinery Cost	-0.0202	Inelastic	-0.0216	Inelastic
Seed Cost	0.0423	Inelastic	0.0071	Inelastic
Fertilizer Cost	0.08280	Inelastic	-0.0966	Inelastic
Pesticide Cost	-0.0857	Inelastic	-0.0498	Inelastic
Irrigation Cost	-0.0003	Inelastic	0.0198	Inelastic



Return To Scale ( $\sum Bi$ )	0.0175	Decreasing Return To Scale	0.0146	Decreasing Return To Scale
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(Source: Field survey, 2022)

**Return to scale (RTS):** The total elasticity of production, when equal to 1, indicates constant returns to scale. If greater than 1, it indicates an increasing return to scale, and when less than 1, it indicates a decreasing return to scale. Table 9 shows that tobacco and maize have a decreasing return to scale, indicating that farmers are operating in the rational zone of production (stage 2). From Table 9 it was obvious that if all the variables were increased by 1%, the gross return of tobacco would increase by 0.0146%. On the other side, if all the variables were increased by 1%, the gross return of maize would increase by 0.0175%.

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

Food crop cultivation is more profitable than tobacco cultivation for individual and annual crop production. To achieve a tobacco-free country by 2040, tobacco farmers should switch to food crops that are profitable from a broader perspective. Total human labor costs for tobacco per hectare were TK. 138079.7 (56.4%), of which TK. 119422.3 (48.8%) and TK. 18487.6 (7.5%) were incurred by men and women, respectively. On the other hand, the overall cost of human labor for the production of maize was TK. 81912.3 (44.09%), with the labor costs for men and women being TK. 74232.4 (40.7%) and TK. 7550.8 (4.1%), respectively. For tobacco and maize, the total cost was Tk. 303138.4 and Tk. 231548, respectively. The gross return of tobacco and maize production were Tk. 331797.4 and Tk. 283425.7 respectively. The returns from main product and by-product specifically were Tk. 329437.8, Tk. 2359.4 from tobacco and Tk. 283304.7 and Tk. 121 from maize. Tobacco's gross margin, net return, and BCR were TK. 86855.3, TK. 28659, and TK. 1.09, respectively. For maize, those estimates were TK. 101190.2, TK. 51877.1, and TK. 1.22.

### Recommendation

- It's a common misconception that tobacco is more profitable, but this is untrue. Compared to tobacco, maize is more profitable. Authority should disseminate this information to people.

## REFERENCES

- Akhter, F., Rafiqul, H. and Mujahidul, I.P. 2018. Tobacco cultivation and its impact on food production in Bangladesh. Available online: [http://ubinig.org/cpdf/21\\_53.pdf](http://ubinig.org/cpdf/21_53.pdf) (accessed on 10 November 2018).
- BBS. 2016. Yearbook of Agricultural Statistics-2015; Government of the People's Republic of Bangladesh: Dhaka, Bangladesh, 2016.
- Drope, J., Li, Q., Araujo, E.C., Harimurti, P., Sahadewo, G.A., Nargis, N., Durazo, J., Witoelar, F. and Sikoki, B.S. 2017. The Economics of Tobacco Farming in Indonesia; The World Bank: Washington, DC, USA, 2017.
- Goma, F., Drope, J., Zulu, M.R., Li, Q., Chelwa, G., Labonte, R. and Banda, J. 2017. The Economics of Tobacco Farming in Zambia; University of Zambia and the American Cancer Society: Lusaka, Zambia, 2017. Available online: <https://www.cancer.org/content/dam/cancer-org/research/economic-and-healthy-policy/economicstobacco-farming-zambia-2017.pdf> (accessed on 12 January 2019).
- Hussain, G.A.K.M., Rouf, G.A.S.S.R., Shimul, S.N., Nargis, N., Kessaram, T.M., Huq, S.M. Jagdish Kaur, J., Shiekh, M.K.A. and Drope, J. 2020. The Economic Cost of Tobacco Farming in Bangladesh. *Int J. Environ. Res. Public Health.*, 17(24): 9447. doi: 10.3390/ijerph17249447.

Jones, A.S., Austin, W.D., Beach, R.H. and Altman, D.G. 2008. Tobacco Farmers and Tobacco Manufacturers: Implications for Tobacco Control in Tobacco-Growing Developing Countries. *J. Public Health Policy*, 29(4): 406–423. doi:10.1057/jphp.2008.37 10.1057/jphp.2008.37

Mackay, J. and Eriksen, M. 2005. *The Tobacco Atlas*. Geneva: World Health Organization

Magati, P., Li, Q., Drope, J., Lencucha, R. and Labonte, R.N. 2016. *The Economics of Tobacco Farming in Kenya*; International Institute for Legislative Affairs: Nairobi, Kenya, 2016. Available online: <https://ilakenya.org/the-economics-of-tobacco-farming-in-kenya-report-by-iila-and-ac/> (accessed on 10 January 2019).