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CONTRACT FARMING IN TOMATO SEED PRODUCTION IN RANGPUR DISTRICT OF BANGLADESH: A FINANCIAL ANALYSIS

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ABSTRACT

The present study attempted to determine the contract growers' costs and returns of the open pollinated tomato seed production and resource use efficiency under different categories of farmers in some selected areas of greater Rangpur district. In total 60 open pollinated tomato seed contract growers were purposively selected in consultation with BADC personnel at the categories of marginal, small and medium farmers. Total cost, gross margin, gross return, net return and benefit cost ratio (undiscounted) were estimated for financial analysis. The results revealed that per hectare total cost, gross return and net return of open pollinated tomato seed production were estimated at Tk 220313, 384000 and 163687, respectively. Benefit cost ratios came out to be 1.64, 1.74 and 1.83 for marginal, small and medium farmers', respectively which was found a bit higher for the medium open pollinated tomato seed contract growers. The Cobb-Douglas production function model was used to estimate the values of coefficient and related statistics of production function. The coefficient of human labour cost, cost of using seed, organic manure cost, fertilizer cost and irrigation charges were statistically significant. Returns to scale was found to be 1.19 and that of the value of R^2 was 0.79. The marginal productivity analysis indicated that the contract growers in the study areas have failed to show their efficiency in using the resources. It was evident that timely and efficient uses of different inputs are most important to increase production and profitability of the open pollinated tomato seed contract growers.

Key Words: Contract farming, Profitability, Resources use efficiency

INTRODUCTION

The globalization of Bangladeshi agriculture in recent years resulted in the need for the production of export oriented quality products having comparative advantage. In this context, contract farming could be one of the best solutions which may decrease the polarization of rich and poor and thus encourage Bangladeshi farmers to compete with the very large, rich and highly indirect subsidized western farmers.

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Contract farming is defined as a system of production and supply of agricultural and horticultural produce by farmers under forward contracts. The essence of such arrangements is being a commitment to provide agricultural and horticultural produce, at a specified price and in a specified quantity to a known buyer. Contract farming can indeed be a vehicle for the modernization of agriculture in Bangladesh. It basically involves four things, pre-agreed price, quantity or acreage (minimum/maximum), quality and time. Contract farming is a case for bringing the market to the farmers, which is navigated by agribusiness farms.

Generally, there are three types of contract in agriculture viz., i) Procurement contracts, under which only sale and purchase conditions are specified ii) Partial contracts, wherein only the contracting firms supply some of the inputs and produce is bought at pre-agreed prices and iii) Total contracts, under which the contracting firm supplies and manages all the inputs on the farm and farmer is just a supplier of land and labour (Key and Runsten, 1999). Whereas, the first type is generally referred to as marketing contracts, the other two are of production contracts. Different types of production contracts allocate production and market risks between the producer and the processor in different ways. The farmers are interested to enter into contract mainly to minimize the price risk and also to reap higher profits out of this seed production activity over commercial production of crops.

Contracts are generally signed at the time of planting and specify how much produce the firm will buy at what price. Often the firm provides credit, inputs, farm machinery rentals, technical advice and retains the rights to reject the substandard produce. This provides a strong rationale, from the demand side for the contract farming as a means of raw material supply.

The seed industry in Bangladesh comprises of both public and private sector initiatives. In the private sector, there are more than 100 companies involved, with over 8000 registered seed dealers operating across the country. The recent expansion of the private sector seed companies has resulted in the engagement of thousands of contract farmers into the formal seed production chain, leading to improved livelihoods amongst the rural community. Government agencies involved in this sector include Bangladesh Agricultural Development Corporation (BADC), Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Jute Research Institute (BJRI) and Department of Agriculture Extension (DAE). The government has recently given the seed sector a "Topmost Priority" status.

Of the locally produced vegetable seeds, nearly 90.5% is accounted for by the private sector. The government agency most actively involved in vegetable seed production is BADC by the contract growers in late seventies. In Bangladesh, the per year demand for vegetable seeds are 2700 tonnes and the supply are 791.2 tonnes (63.2 tonnes for Government sectors and 728 tonnes for private sectors, respectively) (BSGDMA, 2007).

Seed is very vital input and dynamic instrument for increasing agricultural production. Superior planting materials and high quality seed is a single most important factor

enabling a country to make its agriculture more productive and cost competitive especially in the changing scenario of world agricultural trade under WTO. It has been recognized that genetically good quality seed alone can increase crop production up to 20-25 percent.

Tomato (*Lycopersicon esculentum*) is one of the most popular and nutritious vegetables of Bangladesh. Tomato is used for soup, salad, pickles, ketchup, jelly, jam etc. and in so many other ways. It can be eaten in fresh and cooked form. However, tomato occupies the top list of canned vegetables. The present investigation is an integrated effort to study all financial aspects of production of open pollinated tomato seeds. The main constraints are the area, production and marketing of open pollinated tomato seed production have not been documented by any institution or government. The information on cost and returns structure will guide the producer in readjustment and proper management of resources and to bring down the cost of production at the farm level without affecting the output. It is recognized that in order to expand the area of this crop as well as to fit this crop in the farmers cropping system, studies are needed to ascertain its cost and return situation in relation to profitability, input use and farmer's resource use efficiency. Keeping all these factors in consideration the present study was undertaken to provide information through fulfillment of the following objectives:

i) To determine the contract growers' cost and relative profitability of open pollinated tomato seed production; and
ii) To analyze the resource use efficiency in selected open pollinated tomato seed production.

METHODOLOGY

Study area and data

The present study was conducted in two Upazilas namely: Mithapukur and Pirgachha of Rangpur district since these districts are known as major vegetable seed growing districts in Bangladesh. The relevant secondary data were collected from different handouts, reports, published and unpublished documents of the Government of Bangladesh (GoB) and its different organizations and agencies. The primary data were collected from the sample seed contract growers by adopting a purposive sampling design. In all 60 open pollinated tomato seed contract growers were randomly selected in consultation with BADC personnel taking 20 contract seed growers from each of the three selected farm categories viz., marginal (0.02 to 0.40 ha), small (0.41 to 1.01 ha) and medium (1.02 ha and above) farmers, respectively. Large category of farm was not considered because of non availability in the farmers' list. The variety of *Ratan* was selected for tomato seed production. Necessary data relating to production of open pollinated tomato seeds were obtained from the selected contract farmers with the help of a pre-tested and well structured interview schedule during 2011. Contract growers who grow tomato seed on contract basis and seeds are produced under the direct and close supervision of BADC. Open pollination means transfer of pollen from one plant to the stigma of another plant.

Analytical technique

Conventional statistical analysis using average, percentages, ratio etc. were applied to derive meaningful findings in this study. Cost and return analysis were done on full cost basis. The following profit equation was used to assess the profitability of open pollinated tomato seed production:

$$\Pi = \sum P_m Q_m - \Sigma (P_{xi} X_i) - TFC$$

Where,

Π = Net return (Tk/ha);
P_m = Per unit price of produce (Tk/kg);
Q_m = Quantity of the production per hectare (kg);
P_{xi} = Per unit price of i th inputs (Tk);
X_i = Quantity of the i th inputs per hectare (kg);
TFC = Total fixed cost (Tk); and
i = 1,2,3,.....,n (number of inputs).

Cobb-Douglas production function was used to estimate the effects of various inputs for the production of open pollinated tomato seed because of the best fit of the sample data. The functional form of the Cob-Douglas multiple regression equation was as follows:

$$Y_i = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} e^u$$

The equation may be alternatively expressed as log-linear form:

$$\ln Y_i = \ln a + b_1 \ln X_{1_i} + b_2 \ln X_{2_i} + b_3 \ln_{3_i} + b_4 \ln X_{4_i} + b_5 \ln X_{5_i} + b_6 \ln X_{6_i} + b_7 \ln X_{7_i} + b_8 \ln X_{8_i} + U_i$$

Where, Y_i = Gross return (Tk/ha); ln a = Intercept or constant term; X_1 = Human Labour cost (Tk/ha); X_2 = Animal labour/power tiller cost (Tk/ha); X_3 = Cost of using Seed (Tk/ha); X_4 = Cost of organic manure (Tk/ha); X_5 = Cost of fertilizer (Tk/ha); X_6 = Cost of plant protection chemicals (Tk/ha); X_7 = Irrigation cost (Tk/ha); X_8 = Cost of staking sticks and gunny thread (Tk/ha); b_1, b_2,----,b_8 = Coefficients of the respective variables; U_i = Error term; ln = Natural logarithm; e = Base of natural logarithm; and i = 1, 2, 3,…,30.

Returns to scale was calculated the sum of the regression coefficient of the model. If this sum is 1, then there are constant returns to scale. If the sum is less than 1, there are decreasing returns to scale. Finally, if the sum is greater than 1, there are increasing returns to scale (Gujarati, 1995).

Measurement of efficiency

In order to test the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input was computed and tested for its equality to 1. i.e., $\frac{MVPx_i}{MFCx_i} = 1$.

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (X_i) as well as gross return (Y_i) at their geometric means (Dhawan and Bansal, 1977). Marginal Factor Cost (MFC) of all the inputs are expressed in terms of additional taka spends for providing individual inputs. In the present study, Marginal Factor Cost was the average price of different variable input used in the study area. When the ratio of MVP and MFC is equal to unity indicates that the resource is efficiently used. When the ratio of MVP and MFC is more than unity implying the resource is under utilized. When the ratio of MVP and MFC is less than unity implying the resource is over used (Yotopoulos, 1967).

RESULTS AND DISCUSSION

Costs and returns structure in open pollinated tomato seed production

Profitability is the main aim of any farmer. Costs and returns were calculated on the basis of actual market prices paid by the farmers. In this study, all calculations pertaining to the costs and returns of open pollinated tomato seed production were calculated on per hectare basis.

Cost structure in open pollinated tomato seed production

In this study cost of production was calculated on the basis of variable inputs like seed, fertilizer, organic manure, human labour, animal labour/power tiller, plant protection chemicals, vitamin, irrigation charges, staking sticks and gunny thread etc. Fixed cost included land use cost, depreciation and interest on operating cost of open pollinated tomato seed production.

Per hectare cost of producing tomato seed in different categories of farmers were amounted at Tk. 189967, 221110 and 251270 for marginal, small and medium farmers, respectively and on an average it was Tk. 220313 for all categories of farmers. Among the various cost items of tomato seed production, maximum cost (Tk. 145000) was found on human labour which was about 65.82 percent of the total cost (Table 1). The tomato seed production involves technically trained labour, whose wage rate is higher as compared to other labour, which incurs maximum cost on labour and provides employment to the human labour. There is a need to improve the efficiency of labour by imparting further training and also offering some incentives to the labourers in ordered to reduce the cost of labour.

Per hectare cost on staking sticks and thread was found to be Tk 18500 (about 8.40 percent) which is the second highest cost of the tomato seed production, since staking sticks and gunny threads were used only once in seed production season, which forms other important cost. There is a need to evolve durable staking sticks and thread materials which can be used for more number of production processes. Thus, the recurring cost on these items could be reduced.

Table 1. Per hectare cost structure in open pollinated tomato seed production

Sl. No.	Items	Units	Marginal farmer		Small farmer		Medium farmer		All farmer	
			Average quantity	Cost (Tk)	Average quantity	Cost (Tk)	Average quantity	Cost (Tk)	Average quantity	Cost (Tk)
A.	**Variable cost**									
1.	Human labour[1]	Man-days	511	127750 (67.25)	587	146750 (66.37)	643	160750 (63.98)	580	145000 (65.82)
a.	Family labour	Man-days	148	37000 (19.48)	170	42500 (19.22)	186	46500 (18.51)	170	42500 (19.29)
b.	Hired labour	Man-days	363	90750 (47.77)	417	104250 (47.15)	457	114250 (45.47)	410	102500 (46.53)
2.	Animal labour/ power tiller	Tk	-	2899 (1.53)	-	3436 (1.55)	-	4403 (1.75)	-	3579 (1.62)
3.	Seed	Gram	222	1110 (0.58)	264	1320 (0.70)	338	1690 (0.67)	275	1375 (0.62)
4.	Organic manure	Tonnes	14	7000 (3.68)	19	9500 (4.30)	24	12000 (4.78)	19	9500 (4.32)
5.	Fertilizer	kg	679	13234 (6.97)	748	15396 (6.96)	921	17752 (7.06)	796	15078 (6.84)
a.	Urea	kg	259	5180 (2.73)	306	6120 (2.77)	334	6680 (2.66)	299	5980 (2.71)
b.	Triple super phosphate	kg	174	4524 (2.38)	198	5148 (2.33)	224	5824 (2.32)	199	4776 (2.17)
c.	Muriate of potash	kg	142	1988 (1.05)	168	2352 (1.06)	215	3010 (1.20)	175	2450 (1.11)
d.	Gypsum	kg	87	522 (0.27)	96	576 (0.26)	123	738 (0.29)	102	612 (0.28)
e.	Micronutrients[2]	kg	17	1020 (0.54)	20	1200 (0.54)	25	1500 (0.60)	21	1260 (0.57)
6.	Plant protection chemicals	ml	648	1620 (0.85)	768	1920 (0.87)	884	2210 (0.88)	767	1917 (0.87)

Table 1 (Continue)

Sl. No.	Items	Units	Marginal farmer		Small farmer		Medium farmer		All farmer	
			Average quantity	Cost (Tk)	Average quantity	Cost (Tk)	Average quantity	Cost (Tk)	Average quantity	Cost (Tk)
7.	Vitamin	ml	486	936 (0.49)	576	1152 (0.52)	638	1276 (0.51)	567	1134 (0.51)
8.	Irrigation charges	Tk	-	3645 (1.92)	-	4320 (1.96)	-	5535 (2.20)	-	4500 (2.04)
9.	Staking sticks and gunny thread	Tk	-	14985 (7.89)	-	17760 (8.03)	-	22755 (9.06)	-	18500 (8.40)
	Total variable cost	Tk	-	173179 (91.16)	-	201554 (91.16)	-	228371 (90.89)	-	200583 (91.04)
B.	**Fixed cost**									
1.	Depreciation[3]	Tk	-	565 (0.30)	-	660 (0.30)	-	858 (0.34)	-	694 (0.32)
2.	Land rental value	Tk	-	13337 (7.02)	-	15507 (7.01)	-	18235 (7.26)	-	15693 (7.12)
3.	Interest on operating cost[4]	Tk	-	2886 (1.52)	-	3389 (1.53)	-	3806 (1.51)	-	3343 (1.52)
	Total fixed cost	Tk	-	16788 (8.84)	-	19556 (8.84)	-	22899 (9.11)	-	19730 (8.96)
C.	**Total Cost**	Tk	-	189967 (100)	-	221110 (100)	-	251270 (100)	-	220313 (100)

Note: Figures within parenthesis indicate percentage of total cost

1. Human labour used for land preparation, transportation & application of organic manure, raising nursery, planting, weeding, application of fertilizers, irrigation, plant protection chemicals, harvesting, seed extraction, drying & cleaning etc.
2. Micronutrients include boron, zinc, manganese etc.
3. Depreciation = (Purchase value – Junk value) ÷ Useful life of the asset in years [Straight line method].
4. Interest on operating cost = (Total investment ÷ 2) ×Interest rate per year (10 percent) × Length of the seed production period in month (4 months).

It was found from the study that, the contract growers' were using more than the recommended quantity of fertilizers. As a result the yield obtained might be less than the potential yield and the cost was high. In order to increase the returns, there is a need to educate the farmers to reduce the use of fertilizers in seed production activities.

Total fixed cost incurred in open pollinated tomato seed production were estimated at Tk 16788, 19556 and 22899 for marginal, small and medium farmers, respectively and their corresponding share were about 8.84, 8.84 and 9.11 percent of the total cost, respectively. In the present study, the rental value of land was very high due to the crop which was grown as irrigated crop and for hybrid seed production purpose, which forms major chunk in fixed cost item in all the crops.

Returns structure in open pollinated tomato seed production

Return was calculated by multiplying yield with its price. The return structures in open pollinated tomato seed production was found to be profitable and beneficial to the farmers in relation to the total cost incurred by them (Table 2). The average yield of tomato seed production for marginal, small and medium farmers were about 78, 96 and 115 kilogram per hectare, respectively which was found a bit higher for the medium tomato seed contract growers. Per hectare gross returns were calculated at Tk 312000, 384000 and 460000 for marginal, small and medium farmers, respectively. Further, the gross margins of tomato seed production for marginal, small and medium farmers were estimated at Tk 138821, 182446 and 231629, respectively. The net returns were calculated at Tk 122033, 162890 and 208730 for marginal, small and medium farmers, respectively. The gross returns and net returns were found to be much higher for medium farmers than other categories of farmer. Again, on an average, undiscounted benefit cost ratios came out to be 1.64, 1.74 and 1.83 for marginal, small and medium farmers, respectively.

Table 2. Per hectare returns structure in open pollinated tomato seed production

Sl. No.	Particulars	Unit	Marginal farmer	Small farmer	Medium farmer	All farmer
1.	Yield	kg	78	96	115	96
2.	Gross return	Tk	312000	384000	460000	384000
3.	Total cost (a+b)	Tk	189967	221110	251270	220313
a.	Total variable cost	Tk	173179	201554	228371	200583
b.	Total fixed cost	Tk	16788	19556	22899	19730
4.	Gross margin (2-3.a)	Tk	138821	182446	231629	183417
5.	Net return (2-3)	Tk	122033	162890	208730	163687
6.	Cost of production (3.a ÷ 1)	Tk/kg	2220	2099	1986	2089
7.	Gross margin per kilogram (4 ÷ 1)	Tk	1779	1900	2014	1910
8.	Net return per kilogram (5 ÷ 1)	Tk	1564	1696	1815	1705
9.	Benefit cost ratio (Undiscounted) (2 ÷ 3)	Tk	1.64	1.74	1.83	1.74

Resource use efficiency in open pollinated tomato seed production

The analysis of efficiency should help to identify the possibilities for increasing income while conserving resources. The role of efficiency may be viewed as an important component in policy making to stimulate income and/or promote resource conservation.

Contribution of different inputs to open pollinated tomato seed production

In the case of open pollinated tomato seed production, the output elasticity coefficients for human labour cost, cost of using seed, organic manure cost, fertilizer cost and irrigation charges were found to be positively significant (Table 3). This showed that increase in the use of these inputs would result in increase in efficiency of open pollinated tomato seed production, contributing significantly towards gross returns. The coefficient of human labour cost was 0.537 which were statistically significant at 1 percent level. This indicates that keeping other factor constant, one percent increase the cost of using human labour would lead to an increase in the gross return by 0.537 percent. The coefficients of using seed cost, organic manure cost, fertilizer cost and irrigation charges were 0. 297, 0.265, 0.089 and 0.109, respectively which were statistically significant at 5 percent level. It means that, one percent increase in the cost of using seed, organic manure, fertilizer and irrigation would lead to an increase in the gross return by 0.297, 0.265, 0.089 and 0.109 percent, respectively keeping other factor constant.

Table 3. Estimated values of regression coefficients and related statistics of cobb-douglas revenue type production function for contract growers'

Regressors	Estimated coefficient	Standard error	T-value
Intercept	4.001**	0.801	4.995
Human labour cost (X_1)	0.537**	0.123	4.366
Animal labour/power tiller cost (X_2)	-0.073	0.093	-0.785
Seed used cost (X_3)	0.297*	0.132	2.250
Organic manure cost (X_4)	0.265*	0.109	2.431
Fertilizer cost (X_5)	0.089*	0.037	2.405
Plant protection chemicals cost (X_6)	0.198	0.124	1.597
Irrigation cost (X_7)	0.109*	0.052	2.096
Staking sticks & gunny thread cost (X_8)	-0.234	0.141	-1.659
F-value (N = 60)	5.349**		
Coefficient of multiple determination (R^2)	0.79		
Returns to scale (Σb_i)	1.19		

Note: Figures within parenthesis indicate standard errors, & '**' and '*' indicates significant at 1%, 5% level respectively

The coefficient of multiple determinations (R^2) tells how well the sample regression line fits the data (Gujarati, 1995). The coefficient of multiple determinations for tomato was 0.79 which indicates that around 79 percent of the variations in gross return were

explained by the independent variables included in the model. The F-value of the equation is significant at 1 percent level implying that the variation in gross return from open pollinated tomato seed production mainly depends upon the independent variables included in the model. The sum of elasticity coefficients was 1.19 for tomato seed production which indicated increasing returns to scale. That means, one percent increase in all the factors of production simultaneously would result in an average increase of gross returns by 1.19 percent for open pollinated tomato seed production.

Resource use efficiency

The efficiency in resource allocation in respect of selected open pollinated tomato seed production has been shown in Table 4. The Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratios for organic manure cost and plant protection chemicals cost were more than one indicating that still there is scope to use these inputs and increase the gross returns of open pollinated tomato seed production. The MVP to MFC ratios for human labour cost, cost of using seed, fertilizer cost and irrigation charges were less than one and positive which indicated that the expenditure on this resource is more than the optimum level. The MVP to MFC ratios for animal labour/power tiller cost, and cost of staking sticks and gunny thread were less than one and negative. It indicated that expenditure on these inputs were more than the optimum level which leads to reduction of gross return. Hence, withdrawal of some units of these resources is profitable in the short-run.

Table 4. Marginal productivity and resource use efficiency of tomato seed production

Explanatory variables	[1]MVP	MFC	Efficiency
Human labour cost (X_1)	186.4	250.00	0.74
Animal labour/power tiller cost (X_2)	-17.1	190.00	-0.09
Seed used cost (X_3)	4.55	5.00	0.91
Organic manure cost (X_4)	1.27	0.50	2.54
Fertilizer cost (X_5)	11.27	20.12	0.56
Plant protection chemicals cost (X_6)	6.12	3.50	1.75
Irrigation cost (X_7)	15.12	18.22	0.83
Staking sticks & gunny thread cost (X_8)	-5.24	74.90	-0.07

Note: [1]Marginal value product of i^{th} resource = {Regression coefficient of the i^{th} independent variable × (Geometric mean of the output ÷ Geometric mean of i^{th} independent variable)}

From the above discussion it is clear that, the inequality of the contract growers' in the study areas have failed to show their efficiency in using the resources.

CONCLUSION AND RECOMMENDATIONS

In agriculture, seed is a vehicle to deliver almost all agro-based technological innovations so that the farmers can exploit the genetic potential of new varieties. The availability, access and use of seed of adaptable varieties are, therefore, the major determinants to

attain the efficiency and productivity of other packages like irrigation, fertilizers and pesticides. This is one of the vital keys to increase crop production, enhance food security and alleviate rural poverty in the developing countries.

Cultivation of open pollinated tomato seed was highly profitable on the basis of its return to investment. Farmers are highly pleased and encouraged with these technologies as they have the bright scope to increase their income by cultivating this crop. For upgrading the knowledge of the farmers, it is necessary to disseminate the latest information of the improved technological package of open pollinated tomato seed cultivation which will enhance the farmers to increase production. From the analysis it is clear that open pollinated tomato seed cultivation has brought changes in economic status of the sample contract growers. As this crop is very labour intensive crop, there is an ample scope for increasing employment in the rural areas of Bangladesh. To minimize higher rejection rate of seeds by the firms a predetermined quality specification may be given to the farmers in the beginning of the season. This would enable the farmers to produce the better seeds with the help of Agricultural Scientists. The scheme of crop insurance may be introduced to cover the seed production activity which involves climatic risks. Finally, the results would help the planners and policy makers in formulating suitable policies for grant of loans and fixation of prices and also throw further light on the avenue for future research in the area of open pollinated tomato seed production.

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