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An Economic Analysis on Contract Farming in Vegetables Seed Production in Selected areas of Rangpur District

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Abstract

Contract farming can be described as half-way house between farm production and corporate farming. It involves contractual relation between farmers and central processing or exporting unit/firms. Seed is a vital input and dynamic instrument for increasing agricultural production. The present study was conducted at Mithapukur and Pirgachha Upazilas under Rangpur district to assess the profitability, contribution of factors to production and changes in socio-economic status of the vegetable seed contract growers of each of the three selected vegetable crops viz., tomato, brinjal and okra. Total cost, gross margin, gross return, net return and benefit cost ratio (undiscounted) were estimated for economic analysis. Benefit cost ratios came out in the study to be 1.42, 1.96 and 1.28 for tomato, brinjal and okra seed production, respectively. The ratio was found a bit higher for the brinjal seed contract growers. The marginal productivity analysis indicated that the inequality of the contract growers in the study area have failed to show their efficiency in using the resources. The overall socio-economic status of the sample contract growers increased by about 26.02 percent. Scarcity of skilled labour, inadequate and untimely capital, non-existence of crop insurance were the problems confronting the open pollinated vegetables seed contract growers. Fixing scale of finance, crop insurance and government intervention were the suggestions of the study.

Key words: *Profitability, resources use efficiency and impact assessment.*

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Introduction

Bangladesh is an agro-based country where agriculture is considered as the backbone of the economy. About 75 percent of its population live in rural areas and 51.69 percent of total labor force are engaged in agriculture contributing about 20.16 percent of the Gross Domestic Product (GDP) in which 11.23 percent comes from crops, 1.75 percent from forestry, 2.67 percent from livestock and 4.51 percent from fisheries (GOB, 2010). Agriculture plays a vital role through employment generation, poverty alleviation and food security, and enhances standard of living by increasing income level of rural population.

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.

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 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 production contracts. But, there is a systematic link between product market and factor markets under the contract arrangements as contracts require a definite quality of produce. 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.

The production, marketing and distribution of agricultural products are becoming increasingly sophisticated for i). Modern advances in technology have made it feasible for agricultural products to be produced to specifications and preserved in fresh condition. ii). The optimum scale of operations has been increasing, especially in processing and distribution. 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 right to reject the substandard produce. This provides a strong rationale, from the demand side, for 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. Vegetable production is Bangladesh has traditionally been seasonal, with 70% of the vegetables grown in the dry winter months between November and February, and only about 30% during the rest of the year. In Bangladesh, the per year demand for vegetable seeds are 2700 MT and the supply are 791.2 MT (63.2 MT for Government sectors and 728 MT for private sectors, respectively) (BSGDMA, 2007).

The process of modernizing agriculture primarily involves intensive use of non-conventional inputs such as quality seeds, chemical fertilizers, pesticides, herbicides, irrigation, farm machinery and a network of research and extension infrastructure. The seed is a trigger point which sets in motion the process of technological change. 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. Seed is a very vital input and dynamic instrument for increasing agricultural production. It has been recognized that genetically good quality seed alone can increase crop production by up to 20-25 percent.

The present investigation is an integrated effort to study all socio-economic aspects of production of open pollinated vegetable seeds and also to identify the constraints in their production with an overall view of exploring the possibility of bringing about required improvement. The main constraint is that the area, production and marketing of open pollinated vegetable seed production have not been documented by any institution or government. Thus, the production and requirement estimates made suffer from lack of statistics. The existing marketing network for vegetable seeds produced is generally more confined and restricted. 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 farmer’s 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 ascertain the cost and returns in selected open pollinated vegetables seed production;
ii) To analyze the resource use efficiency in selected open pollinated vegetables seed production; and,
iii) To assess the changes in socio-economic status of the contract growers due to open pollinated vegetables seed cultivation.

Methodology

Study area and data

The present study was conducted in two Upazilas namely: Mithapukur and Pirgachha of Rangpur district since this district is one of the important and major vegetable seed growing districts in Bangladesh. The relevant secondary data were collected from different handouts, reports, and 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 90 open pollinated vegetable seed contract growers were randomly selected in consultation with BADC personnel taking 30 contract seed growers (20 small and 10 medium) from each of the three selected vegetable crops viz., tomato

(*Lycopersicon esculentum*), brinjal (*Solanum melongena*) and okra (*Abelmoscus esculentus*). The open pollinated varieties of *Ratan*, *Kajla* and *Choice* were selected for tomato, brinjal and okra, respectively. Farmers having land area of less than one ha (2.47 acre) and land area of one to two ha were considered as small and medium, respectively. Large category of farm was not considered because of non-availability in the farmers' list. Necessary data relating to production of open pollinated vegetable seeds were obtained from the selected contract farmers with the help of a pre-tested and well structured interview schedule during 2011. The unit of data collection was a single open pollinated vegetable seed plot of each selected contract farmer where detailed information regarding this crop cultivation was taken and analysis was done on per hectare basis. In addition, the BADC personnel give essential inputs and technical guidance in cultivation of open pollinated vegetables seed. Contract growers who grow vegetable seed on contract basis and seeds produce 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. Tabular technique was used to determine the profitability of open pollinated vegetables seed production. A production function analysis was carried out to explore the contribution and productivity of individual inputs. Cobb-Douglas production model was used because of the best fit of the sample data. The functional form of the Cobb-Douglas multiple regression equation was as follows:

For the purpose of the present empirical exercise the Cobb-Douglas production

$$Y_i = aX_{1_i}^{b_1} X_{2_i}^{b_2} X_{3_i}^{b_3} X_{4_i}^{b_4} X_{5_i}^{b_5} X_{6_i}^{b_6} X_{7_i}^{b_7} X_{8_i}^{b_8} e^{u_i}$$

function was converted into the following logarithmic (Double log) form with variables specified as under:

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

Where, Y = 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.

The regression coefficients (b_i's) were tested for their significance using 't' test at five percent and one percent probability levels. That is, t statistic = (b_i ÷ Standard error of b_i).

In order to know the goodness of fit, the coefficient of multiple determination, R^2 was calculated by using the formula viz., R^2 = (Regression sum of squares ÷ Total sum of squares).

The overall significance of the model was also tested by using the following formula.

$$\text{F-value} = \frac{\text{Regression mean of squares}}{\text{Error mean of squares}}$$

Returns to scale was calculated from the sum of the regression coefficient of the model. If this sum is 1, then there are constant returns to scale, that is, doubling the inputs will double the output. If the sum is less than 1, there are decreasing returns to scale—doubling the inputs will less than double the output. Finally, if the sum is greater than 1, there are increasing returns to scale—doubling the inputs will more than double the output (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 addition 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) at their geometric means (Dhawan and Bansal, 1977). Marginal Factor Cost (MFC) of all the inputs are expressed in terms of additional taka spent for providing individual inputs. In the present study, Marginal Factor Cost was the average price of different variable inputs used. When the ratio of MVP and MFC is equal to unity, it indicates that the resource is efficiently used. When the ratio of MVP and MFC is more than unity, it implies that the resource is under-utilized. When the ratio of MVP and MFC is less than unity, it implies that the resource is over-used (Yotopoulos, 1967).

Impact assessment: Perceived Impact Score (PIS) technique (Rahman, 2006) was used to elicit the impact of open pollinated vegetable seed cultivation on the socio-economic status of the contract growers. Each farmer indicated the extent of change that has occurred for open pollinated vegetable seed cultivation by checking any one of the four responses, i.e., excellent, moderate, average and no change. The weights assigned were 3, 2, 1 and 0 for excellent, moderate, average and no change, respectively. The PIS for a particular change items were standardized by using the following formula:

$$\text{Standardized PIS (SPIS)} = \frac{\text{Observed perceived impact score}}{\text{Possible perceived impact score}} \times 100$$

Results And Discussion

Cost and Returns Structure in Open Pollinated Vegetables Seed Production

Profitability is the main aim of any farmer. In order to earn a respectable economic return, production cost becomes an important factor and accordingly it plays a dominant role in the decision making process of the farmers. Costs and returns were calculated on the basis of actual market prices paid by the farmers. In this study, all calculations pertaining to the cost and returns of open pollinated vegetable seed production were calculated on per hectare basis.

Cost structure in open pollinated vegetables 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, fence etc. Fixed cost included land use cost, depreciation and interest on operating cost of open pollinated vegetables seed production.

It is observed from Table 1 that the total cost of open pollinated tomato, brinjal and okra seed production per hectare were Tk. 253136, 219765 and 185072, respectively, which shows that the cost was a bit higher for the tomato seed contract growers. The average total variable costs incurred in contract farming were Tk. 232676, 199690 and 165546 for tomato, brinjal and okra seed production, respectively. Among the various cost items of tomato, brinjal and okra seed production, maximum cost (Tk. 170000, 132500 and 108750) was found on human labour i.e., 67.16, 60.29 and 58.76 percent of the total cost, respectively. This was one of the important aspects of open pollinated vegetables seed production, which incurs maximum cost on labour and provides employment to the human labour.

Table 1 : Cost Structure in Open Pollinated Vegetables Seed Production

(Unit/hectare)

Sl. No.	Items	Units	Tomato		Brinjal		Okra	
			Average Quantity	Cost (Taka)	Average Quantity	Cost (Taka)	Average Quantity	Cost (Taka)
A.	**Variable cost**							
1.	Human labour[1]	Man-days	680	170000 (67.16)	530	132500 (60.29)	435	108750 (58.76)
a.	Family labour	Man-days	170	42500 (16.79)	132	33000 (15.02)	110	27500 (14.86)
b.	Hired labour	Man-days	510	127500 (50.37)	398	99500 (45.27)	325	81250 (43.90)
2.	Animal labour /power ti ller	Taka	-	3580 (1.41)	-	4520 (2.06)	-	2920 (1.58)
3.	Seed cost	Gram	275	1375 (0.54)	337	1685 (0.77)	4088	1226 (0.66)
4.	Organic manure	Tons	20	10000 (3.95)	25	12500 (5.69)	15	7500 (4.05)
5.	Fertilizer	Kilogram	831	16721(6.61)	935	19110 (8.69)	690	15950 (8.62)
a.	Urea	Kilogram	320	6400 (2.53)	375	7500 (3.41)	250	5000 (2.70)
b.	Triple super phosphate	Kilogram	215	5590 (2.21)	250	6500 (2.96)	150	3900 (2.11)
c.	Muriate of potash	Kilogram	175	2450 (0.97)	175	2450 (1.11)	100	1400 (0.76)
d.	Gypsum	Kilogram	100	600 (0.24)	110	660 (0.30)	75	450 (0.24)
e.	Di-ammonium phosphate	Kilogram	-	-	-	-	100	4000 (2.16)
f.	Micronutrients[2]	Kilogram	21	1680 (0.66)	25	2000 (0.91)	15	1200 (0.65)
6.	Plant protection chemicals	Millilitres	800	2800 (1.12)	800	2000 (0.91)	650	1300 (0.70)
7.	Vitamin	Millilitres	600	1200 (0.47)	550	1375 (0.63)	400	1400 (0.76)
8.	Irrigation charges	Taka	-	4500 (1.78)	-	5500 (2.50)	-	3500 (1.89)
9.	Staking sticks and gunny thread	Taka	-	18500 (7.31)	-	15500 (7.05)	-	17000 (9.19)
10.	Fence	Taka	-	4000 (1.58)	-	5000 (2.28)	-	6000 (3.24)
	Total variable cost	Taka	-	232676 (91.92)	-	199690 (90.87)	-	165546 (89.45)
B.	**Fixed cost**							
1.	Depreciation[3]	Taka	-	698 (0.27)	-	780 (0.35)	-	715 (0.39)
2.	Land rental value	Taka	-	16466 (6.50)	-	16466 (7.49)	-	16466 (8.90)
3.	Interest on operating cost[4]	Taka	-	3296 (1.30)	-	2829 (1.29)	-	2345 (1.26)
	Total fixed cost	Taka	-	20460 (8.08)	-	20075 (9.13)	-	19526 (10.55)
C.	**Total Cost**	Taka	-	253136 (100)	-	219765 (100)	-	185072 (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 (8.5 percent) × Length of the seed production period in month (4 months).

The vegetables seed production involves technically trained labour, whose wage rate is higher as compared to other labour. There is a need to improve the efficiency of labour by imparting further training and also offering some incentives to the labourers in order to reduce the cost of labour.

This was followed by cost on staking sticks and thread at Tk. 18500 in tomato (7.31 percent), Tk. 15500 in brinjal (7.05 percent) and Tk. 17000 in okra (9.19 percent of the total cost) 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.

It was found from the study that the contract farmers were using more than the recommended quantity of fertilizers, as a result of which 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.

The average total fixed costs incurred in open pollinated tomato, brinjal and okra seed production were (Tk. 20460, 20075 and 19526) 8.08, 9.13 and 10.55 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 a major chunk in fixed cost item in all the crops.

Returns structure in open pollinated vegetables seed production: Return was calculated by multiplying yield with its price. Returns per hectare of open pollinated vegetables seed cultivation are shown in Table 2. The return structures in open pollinated vegetables seed production were found to be profitable and beneficial to the farmers in relation to the total cost incurred by them. The gross returns and net returns were found to be much higher than their cost structure. As Table 2 shows, the average yield of tomato, brinjal and okra seed production were 90, 172 and 988 kilogram per hectare, respectively, which was found a bit higher for the okra seed contract growers. The average gross returns were calculated at Tk. 360000, 430000 and 237120 per hectare for tomato, brinjal and okra seed production, respectively. In all, the contract farmers realized net returns of Tk. 106864, 210235 and 52048 over total cost, respectively. Further, the average gross margins of tomato, brinjal and okra seed production per hectare were estimated at Tk. 127324, 230310 and 70574, respectively. The average cost of production per kilogram was observed to be Tk. 2585.29 in tomato, Tk. 1160.99 in brinjal and Tk.167.56 in okra seed production. The returns were worked out on per kilogram basis. Contract farmers realized net returns of Tk. 1187.38, 1222.30 and 52.68 per kilogram for tomato, brinjal and okra seed production, respectively. The net return per kilogram was found higher for the brinjal seed contract growers compared to other contract seed growers. Again, on an average, undiscounted benefit cost ratios came out to be 1.42, 1.96 and 1.28 for tomato, brinjal and okra seed production, respectively.

Table 2 : Returns Structure in Open Pollinated Vegetables Seed Production

(Unit/hectare)

Sl. No.	Particulars	Unit	Tomato	Brinjal	Okra
1.	Yield	Kilogram	90	172	988
2.	Gross return	Taka	360000	430000	237120
3.	Total cost (a+b)	Taka	253136	219765	185072
a.	Total variable cost	Taka	232676	199690	165546
b.	Total fixed cost	Taka	20460	20075	19526
4.	Gross margin (2 -3.a)	Taka	127324	230310	70574
5.	Net return (2 -3)	Taka	106864	210235	52048
6.	Cost of production (3.a ÷ 1)	Taka/kg	2585.29	1160.99	167.56
7.	Gross margin per kilogram (4 ÷ 1)	Taka	1414.71	1339.01	71.43
8.	Net return per kilogra m (5 ÷ 1)	Taka	1187.38	1222.30	52.68
9.	Benefit cost ratio (Undiscounted) (2 ÷ 3)	Taka	1.42	1.96	1.28

Resource Use Efficiency in Open Pollinated Vegetables Seed Production

The analysis of efficiency should help identify the possibilities for increasing income while conserving resources. 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 vegetables seed production: Regression equations were estimated separately using total gross returns as the dependent variable and the cost of using seeds, human labour, animal labour/power tiller, organic manure, fertilizers, plant protection chemicals, irrigation, staking sticks and gunny thread as independent variables for tomato, brinjal, and okra seed contract grower’s category (Table 3). The regression equation was estimated in order to capture the nature and magnitude of the effects of the independent variables on the productivity of open pollinated vegetable seeds. The coefficients were estimated by employing the Cobb-Douglas production function.

In the case of open pollinated tomato seed production, the output elasticity coefficients for human labour, seed, organic manure, fertilizer, irrigation were positive and found to be significant. 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. Elasticity coefficients for plant protection chemicals were positive but non-significant. Hence, it would not be profitable to further increase in the expenses on these resources. The elasticity coefficients for animal labour/power tiller, and staking sticks and gunny thread were negative and found to be non-significant indicating that the animal labour/power tiller, and staking sticks and gunny thread were over-used.

In the case of open pollinated brinjal seed production, the output elasticity coefficients for human labour, animal labour/power tiller, seed, organic manure were positive and found to be significant. This showed that increase in the use of these inputs would result in increase in efficiency of open pollinated brinjal seed production, contributing significantly towards gross returns. Elasticity coefficients for plant protection chemicals were positive but non-significant. Hence, it would not be profitable to further increase in the expenses on these resources. The elasticity coefficients for irrigation, staking sticks and gunny thread were negative and found to be non-significant indicating that the irrigation, staking sticks and gunny thread were over-used. The elasticity coefficient for fertilizer was negative and significant indicating that this resource influences gross returns negatively.

In the case of open pollinated okra seed production, the output elasticity coefficients for human labour, animal labour/power tiller, seed, organic manure were positive and found to be significant. This showed that increase in the use of these inputs would result in increase in efficiency of open pollinated okra seed production, contributing significantly towards gross returns. Elasticity coefficients for fertilizer were positive but non-significant. Hence, it would not be profitable to further increase in the expenses on these resources. The elasticity coefficients for plant protection chemicals, staking sticks and gunny thread were negative and found to be non-significant indicating that the plant protection chemicals, staking sticks and gunny thread were over-used. The elasticity coefficient for irrigation was negative and significant indicating that this resource influences gross returns negatively.

The coefficient of multiple determination (R^2) tells how well the sample regression line fits the data (Gujarati, 1995). The coefficients of multiple determination (R^2) for tomato, brinjal and okra seed production were estimated at 0.79, 0.83 and 0.75, respectively, which indicates that around 79, 83 and 75 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% level implying that the variation in gross return from open pollinated tomato, brinjal and okra seed production mainly depends upon the independent variables included in the model. The sum of elasticity coefficients were 1.19, 1.15 and 1.14 for tomato, brinjal and okra seed production, respectively, which indicated an

Table 3 : Estimated Values of Regression Coefficients and Related Statistics of Cobb-Douglas Revenue Type Production Function for

Regressors	Tomato		Brinjal		Okra	
	Estimated coefficient	t-value	Estimated coefficient	t-value	Estimated coefficient	t-value
Intercept	4.001** (0.801)	4.995	6.335** (0.476)	13.309	2.953** (0.915)	3.227
Human labour cost (X_1)	0.537** (0.123)	4.366	0.395** (0.103)	3.835	0.566** (0.149)	3.799
Animal labour/power tiller cost (X_2)	-0.073 (0.093)	-0.785	0.202* (0.096)	2.104	0.194* (0.083)	2.337
Seed cost (X_3)	0.297* (0.132)	2.250	0.213** (0.037)	5.757	0.229* (0.085)	2.694
Organic manure cost (X_4)	0.265* (0.109)	2.431	0.316** (0.101)	3.129	0.217* (0.093)	2.333
Fertilizer cost (X_5)	0.089* (0.037)	2.405	-0.102* (0.047)	-2.170	0.285 (0.182)	1.566
Plant protection chemicals cost (X_6)	0.198 (0.124)	1.597	0.206 (0.113)	1.823	-0.186 (0.106)	-1.755
Irrigation cost (X_7)	0.109* (0.052)	2.096	-0.013 (0.132)	-0.098	-0.069* (0.032)	-2.156
Staking sticks & gunny thread cost (X_8)	-0.234 (0.141)	-1.659	-0.063 (0.079)	-0.797	-0.091 (0.069)	-1.319
F-value (N = 30)	5.349**		8.217**		4.153**	
Coefficient of multiple determination (R^2)	0.79		0.83		0.75	
Returns to scale (Ób_i)	1.19		1.15		1.14	

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

increasing returns to scale. A one percent increase in all the factors of production simultaneously would result in an average increase of gross returns by 1.19, 1.15 and 1.14 percent for tomato, brinjal and okra seed production, respectively.

Resource use efficiency: The efficiency in resource allocation in respect of selected vegetable seed production shown in Table 4.

Tomato: The Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratios for organic manure and plant protection chemicals 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, seed, fertilizer and irrigation were less than one and positive and indicated that the expenditure on this resource is more than the optimum level. The MVP to MFC ratios for animal labour/power tiller and 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.

Brinjal: The MVP to MFC ratios for organic manure and plant protection chemicals were more than one indicating that still there is scope to use these inputs and increase the gross returns of open pollinated brinjal seed production. The MVP to MFC ratios for human labour, animal labour/power tiller and seed were less than one and positive and indicated that the expenditure on this resource is more than the optimum level. The MVP to MFC ratios for fertilizer, irrigation and 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.

Okra: The MVP to MFC ratio for organic manure was more than one indicating that still there is scope to use these inputs and increase the gross returns of open pollinated okra seed production. The MVP to MFC ratios for human labour, animal labour/power tiller, seed and fertilizer were less than one and positive and indicated that the expenditure on this resource is more than the optimum level. The MVP to MFC ratios for plant protection chemicals, irrigation and 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 Vegetable Seed Production

Explanatory variables	Tomato		Brinjal		Okra	
	MVP[1]	Efficiency	MVP	Efficiency	MVP	Efficiency
Human labour cost (X_1)	186.4 (250.0)	0.74	155.0 (250.0)	0.62	210.0 (250.0)	0.84
Animal labour/power tiller cost (X_2)	-17.1 (190.0)	-0.09	127.3 (190.0)	0.67	140.6 (190.0)	0.74
Seed cost (X_3)	4.55 (5.00)	0.91	4.70 (5.00)	0.94	0.21 (0.30)	0.70
Organic manure cost (X_4)	1.27 (0.50)	2.54	2.43 (0.50)	4.86	3.74 (0.50)	7.48
Fertilizer cost (X_5)	11.27 (20.12)	0.56	-6.74 (20.44)	-0.33	4.16 (23.11)	0.18
Plant protection chemicals cost (X_6)	6.12 (3.50)	1.75	6.87 (2.50)	2.75	-0.80 (2.00)	-0.40
Irrigation cost (X_7)	15.12 (18.22)	0.83	-0.44 (22.27)	-0.02	-0.57 (14.17)	-0.04
Staking sticks & gunny thread cost (X_8)	-5.24 (74.90)	-0.07	-15.06 (62.75)	-0.24	-6.19 (68.82)	-0.09

Note: MVP = Marginal value product, MFC = Marginal factor cost and figures within parenthesis indicate MFC.

Impact Assessment on Contract Farming

The impact has been measured on the basis of farmer's perception about the extent of change that has occurred due to open pollinated vegetables seed production. Assessment of impacts has been done for socio-demographic profile of the contract growers including food & nutrition, housing condition, using sanitary latrine, clothing, household furniture, knowledge about vegetable seed production, income, education, drinking water source, involvement in social organization, general awareness, land holding patterns, ownership of livestock, saving, women empowerment etc. This assessment has also been done through review of secondary data and literature, and collection of primary data in the relevant field.

Changes in socio-economic status of the farmers: Percentage distribution of the respondent according to their perception on different change items is shown in Table 5.

Table 5 : Socio-economic changes of the vegetable seed growers

Socio-economic characteristics	Nature of changes (%)				Total
	Excellent	Moderate	Average	No	
Food and nutrition	8	21	45	26	100
Housing condition	-	12	42	46	100
Using sanitary latrine	-	15	34	51	100
Clothing	7	17	32	44	100
Household furniture	-	13	31	56	100
Knowledge about vegetable seed production	4	23	41	32	100
Income	11	18	52	19	100
Education	3	15	62	20	100
Drinking water source	-	5	32	63	100
Involvement in social organization	4	11	47	38	100
General awareness	-	10	57	33	100
Land holding patterns	-	7	38	55	100
Ownership of livestock	-	13	42	45	100
Saving	6	13	47	34	100
Women empowerment	-	9	38	53	100

Source: Field survey, 2011.

It is observed that the highest 11 percent excellent change has occurred on income for growing open pollinated vegetables seed production based on the perception of the respondents. The change occurred 3 to 11 percent for excellent change, 5 to 23 percent for moderate change, 31 to 62 percent for average change and 19 to 63 percent for no change. From percentage distribution, it is clear that open pollinated vegetables seed cultivation has brought changes in socio-economic status of the sample contract farmers.

Changes in socio-economic status on the basis of PIS: Perceived impact score (PIS) was computed for each change item by summing the weights for responses of the respondents against that change item. PIS of a selected change item indicates, how much change occurs due to open pollinated vegetables seed cultivation during the year. The higher the PIS of a change item, the more are the impact of vegetables seed cultivation. The possible PIS of any change item ranged from a minimum of zero to a maximum of 270 (90 x 3). The overall standardized perceived impact score (SPIS) of 15 change items was found to be 26.02 percent which reflects that the overall change in socio-economic status of the contract growers increased by 26.02 percent for cultivating open pollinated vegetables seed (Table 6).

Table 6 : Impact of perceived items on the basis of PIS

Impact Factors	PIS	Standardized PIS	Percentages	Rank order
Food and nutrition	101	37.41	9.58	2
Housing condition	60	22.22	5.69	10
Using sanitary latrine	57	21.11	5.42	11
Clothing	77	28.52	7.32	6
Household furniture	52	19.26	4.93	12
Knowledge about ve getable seed production	88	32.59	8.35	4
Income	109	40.37	10.34	1
Education	91	33.70	8.64	3
Drinking water source	37	13.70	3.51	15
Involvement in social organization	74	27.41	7.02	7
General awareness	69	25.55	6.54	8
Land holding patterns	46	17.04	4.36	14
Ownership of livestock	62	22.96	5.88	9
Saving	81	30.00	7.68	5
Women empowerment	50	18.52	4.74	13
Overall change		26.02		

Source: Author's estimation, 2011.

For calculating the impact of open pollinated vegetables seed cultivation, 15 selected change items have been arranged in rank order according to their SPIS values. Data contained in Table 6 indicates that the 15 change items were not equally important in terms of extent of change that occurred. The highest SPIS was found 40.37 (10.34 %) on income while the lowest was 13.70 (3.51 %) for drinking water sources. So the impact on income was found to be the most important item among the selected items.

Conclusion

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 vegetables 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 vegetables seed cultivation which will encourage farmers to increase production. From the analysis it is clear that open pollinated vegetables seed cultivation has brought changes in socio-economic status of the sample contract growers. The overall socio-economic status of the contract growers increased by about 26.02 percent. As this crop is very labour intensive, 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 vegetable seed production.

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