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Profitability and Comparative Advantage of Oilseed Production in Bangladesh

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Production of oilseeds is very important in Bangladesh, since a lot of foreign exchange is spent for importing edible oils and oilseeds to meet domestic demand. Up-to-date and nationally representative data and information are scarce. Therefore, this paper analyses the profitability and comparative advantage of oilseed production in Bangladesh. It covers a total of 1,980 farms collected from 11 oilseed growing districts, namely Manikgonj, Faridpur, Tangail, Mymensingh, Rajshahi, Pabna, Dinajpur, Noakhali, Luxmipur, Comilla and Jessore. Four oilseed crops, namely mustard, sesame, groundnut and soybean are considered for the study. The production of local variety sesame (Til-6) and soybean is marginally profitable to the farmers compared to competing crops except *Aus* rice. The country has comparative advantage in producing oilseeds for import substitution since the DRC estimates for selected oilseed crops are less than unity. However, mustard production is not so advantageous for Bangladesh since the value of DRC is close to unity.

Keywords:Mustard, Groundnut, Sesame, Soybean, Oilseeds, Profitability, Comparative Advantage
JEL Classification:Q1, Q160

I. INTRODUCTION

An acute shortage of edible oils has been prevailing in Bangladesh during the last several decades and spending on edible oils and oilseed imports has been increasing to meet the country's demand. In 2014-15, the value of imported oilseeds and edible oils was Tk 27,612 million (US$354 million) and Tk 122,772 million (US$1,574 million) which were 0.87 per cent and 3.88 per cent of the

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total value of imports (Tk.31,65,162 million or US$40,579 million) respectively (Bangladesh Bank 2016). Besides, the area under oilseeds cultivation is decreasing over time due to various economic and technical reasons (Miah, Rashid and Shiblee 2014).

Bangladesh government has given emphasis on R&D (Research and Development) of oilseed crops and invested a lot of money for attaining self-sufficiency in oils. Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA) has released a number of improved varieties of these crops. Adoption of these varieties has created additional employment and income, and saved foreign exchange for the country (Miah, Rashid and Shiblee 2014). The aim of analysing costs and returns is to determine the amount of profit a producer is making from a particular commodity production under the given technology and investment. This is important information in deciding on whether to make an investment. The profitability of production crucially depends on its price, cost of production, and availability of technology.

In order to formulate suitable policy guidelines, policy-makers and research managers need overall information on the profitability of growing oilseed crops, its relative profitability, prevailing agricultural incentive structure, nature of price distortions, trading opportunities, and comparative advantage of growing the crops. This paper looks at financial[1] and economic[2] profitability, relative profitability, and whether Bangladesh enjoys comparative advantage in oilseed production.

II. METHODOLOGY

2.1 Study Locations and Sampling Technique

The Oilseed Research Centre (ORC) of Bangladesh Agricultural Research Institute (BARI) deals with six oilseed crops, namely mustard, sesame, groundnut, soybean, linseed, and sunflower. Among the oilseed crops, the first

[1]Financial profitability (FP) is based on calculation of market prices of inputs and outputs that farmers actually pay or receive for producing a crop. Farmers allocate land and other resources in the production of different crops on the basis of relative financial profitability.

[2]In many cases, FP differs from economic profitability (EP) because of distortions in the factor and product markets such as government taxes and subsidies, trade restrictions, monopoly elements in marketing, and segmentations in the capital market. EP involves deriving border prices of all inputs and outputs, and adjusting those prices by the economic costs of transportation and marketing.

four major oilseed crops were taken into consideration in this study. A multi-stage sampling procedure was followed to select sample farmers. In the first stage of sampling, study areas were selected purposively based on the area coverage of the aforesaid oilseed crops in 2009-10 (BBS 2011). Thus, three districts consisting of high (covered≤10% of the total area), medium (covered>10% area), and low (covered>5% area) growing areas were purposively chosen for studying each type of oilseed crop.[3] The selected districts were Manikgonj, Faridpur, Tangail, Mymensingh, Rajshahi, Pabna, Dinajpur, Noakhali, Luxmipur, Comilla and Jessore. In the second stage, three suitable (in terms of data availability, ease of data collection, accessibility and logistic supports) *Upazilas* from each district were purposively selected for each crop. Thirdly, three agricultural blocks were also purposively selected in consultation with Agricultural Officer of the respective *Upazila* for collecting primary data from each oilseed growers. Finally, a total of 540 households (3 districts×3*Upazilas*×60HHs) for each type of crop (improved and local varieties) were randomly selected from a complete list of selected oilseed growing farmers for interview to collect primary data. Thus, a total of 2,160 (540 HHs×4 crops) oilseed cultivating farmers were interviewed for the study. But, in practice, the total sample size was 1,980 because no third district was found suitable for collecting data and information on soybean cultivation. The selected oilseed crops and study areas are shown in Table I.

TABLE I
NAME OF SELECTED OILSEED CROPS AND STUDY AREAS

Oilseed crops	Study areas		
	High growing areas	*Medium growing areas*	*Low growing areas*
Mustard	Manikgonj	Rajshahi	Dinajpur
Groundnut	Noakhali	Pabna	Tangail
Sesame	Jessore	Faridpur	Comilla
Soybean	Noakhali	Luxmipur	--

2.2 Method of Data Collection and Study Period

Data and relevant information were collected through personal interviews with sampled oilseed farmers using a pre-tested structured interview schedule.

[3]In the case of mustard and groundnut, the numbers of districts under high, medium and low growing areas were 3, 3, and 16 respectively, while the respective numbers were 3, 6, and 14 for sesame. For soybean, about 96 per cent areas were under two districts (Noakhali and Luxmipur) and 3 per cent under Comilla district.

The researchers and trained enumerators collected data and information for this study. Data and information were collected during the period from October 2011 to October 2012.

2.3 Analytical Techniques

Collected data were edited, summarised, tabulated and analysed to fulfill the objectives of the study. Descriptive statistics using different statistical tools like averages, percentages and ratios were used in presenting the results of the study. However, the following analytical techniques were applied for analysing the collected data.

2.3.1 Profitability Analysis of Oilseed Cultivation

An attempt was made to estimate detailed cost and return, financial and economic profitability, and relative profitability of cultivating both improved and local/traditional oilseed varieties in Bangladesh. The financial profitability of improved oilseeds production over their local/traditional varieties was calculated using simple accounting procedures. It was examined on the basis of gross return, gross margin and benefit-cost ratio analysis. Besides, the opportunity costs of family supplied labour and cultivated land were taken into consideration in estimating total cost. Land use cost was calculated on the basis of per year lease value of land. In estimating relative profitability, the financial profitability of different competing crops was also estimated and compared with selected oilseed crops. Again, the costs and returns of improved oilseed variety were also compared with the respective costs and returns of local/traditional oilseed variety. Hence, data relating to input use for the production of selected oilseeds and their competing crops, and their market prices were collected. Besides, data on outputs and their prices were also gathered for the study.

The following equations (1 to 3) were used for estimating different costs of cultivation of oilseeds and their competitive crops at farm level.

$$VC_{ij} = \sum_{l=1}^{n} \left(X_{ij} P_{ij} \right) \quad (1)$$

$$TVC_{ij} = VC_{ij} + IOC_{ij} \quad (2)$$

$$TC_{ij} = TVC_{ij} + TFC_{ij} \quad (3)$$

where,

TC_{ij} = Total cost (Tk/ha) of j^{th} crop incurred by i^{th} farmer
TVC_{ij} = Total variable cost (Tk/ha) of j^{th} crop incurred by i^{th} farmer
TFC_{ij} = Total fixed cost (Tk/ha) of j^{th} crop incurred by i^{th} farmer
VC_{ij} = Variable cost (Tk/ha) of j^{th} crop incurred by i^{th} farmer

IOC_{ij} = Interest on operating capital (Tk/ha) of j^{th} crop incurred by i^{th} farmer

X_{ij} = Quantity of inputs used (kg/ha) for j^{th} crop by i^{th} farmer

P_{ij} = Price of inputs (Tk/kg) used for j^{th} crop by i^{th} farmer

j = Number of crops

i = Number of farmers (1.2.3……..n)

The following equations (4 to 6) were used for estimating the profitability of oilseeds and their competing crops at farm level.

$$GR_{ij} = Y_{ij} P_{ij} + Z_{ij} Q_{ij} \quad (4)$$

$$NR_{ij} = GR_{ij} - TC_{ij} \quad (5)$$

$$GM_{ij} = GR_{ij} - VC_{ij} \quad (6)$$

$$BCR_{ij} = \frac{GR_{ij}}{TC\,ij} \quad (7)$$

where,

GR_{ij} = Gross return (Tk/ha) from j^{th} crop received by i^{th} farmer

P_{ij} = Price (Tk/kg) of j^{th} crop received by i^{th} farmer

Y_{ij} = Quantity of j^{th} crop (kg/ha) received by i^{th} farmer

Z_{ij} = Quantity of byproduct (straw) of j^{th} crop (kg/ha) received by i^{th} farmer

Q_{ij} = Price (Tk/kg) of byproduct of j^{th} crop received by i^{th} farmer

BCRij = Benefit cost ratio of j^{th} crop for i^{th} farmer

2.3.2 Estimation of Domestic Resource Cost

Domestic resource cost (DRC) was estimated for evaluating the efficiency of production of oilseeds in relation to comparative advantage. DRC is the ratio of cost of domestic resources and non-traded inputs (valued at their shadow prices) of producing a commodity to the net foreign exchange earned or saved by producing the good domestically. Mathematically DRC is defined as follows (equation 8):

$$DRC = \frac{\sum D_{ij} V_i}{B_i - \sum T_{ik} V_k} \quad (8)$$

(j = 1----------m; k = 1----------n)

where,

D_{ij} = Quantity of j^{th} domestic resources and non-traded inputs used for producing **i** crop per metric ton

V_i = Price of j^{th} domestic resources and non-traded inputs (Tk/mt)

B_i = Border price of **i** crop (Tk/mt)

T_{ik} = Quantity of k^{th} tradable inputs for producing **i** crop per metric ton

V_k = Border price of tradable inputs k per metric ton.

If DRC<1, the economy can save foreign exchange by producing the **i** crop domestically, either for export or for imports substitution. This is because the opportunity cost of domestic resources and non-traded inputs used in producing **i** crop is less than the foreign exchange earned or saved. In contrast, if DRC>1, domestic costs was in excess of foreign exchange or savings, indicating that the **i** crop should not be produced domestically and should be imported instead.

III. RESULTS AND DISCUSSION

3.1 Financial Profitability of Mustard Cultivation

Oilseed production requires different inputs, such as human labour, seed, fertilizers, manure, pesticides, irrigation and land preparation tools. The average cost of cultivation of improved mustard was estimated to be Tk 51,246 (US$657)[4] per hectare, which was 12.5 per cent higher than the cost of producing BARI old mustard variety (Tori-7). This increased cost was for using the higher amount of labour, fertilisers, pesticides, irrigation and land use.[5] Again, more than 50 per cent cost was spent for fixed inputs, such as land and family labour, for both the varieties. Only the cost of seed was higher for Tori-7 variety cultivation which was due to the use of higher amount of seed compared to improved variety. The share of total cost was found to be the highest for land use (38.5-41.7 per cent), followed by human labour (23.1-25.6 per cent) and fertilisers (16-17.5 per cent) among the cost items (Table II).

The yield of BARI improved mustard varieties is much higher compared to BARI old (Tori-7). The average yield of improved mustard was 1.64 t/ha, which

[4] The conversion rate of USD during 2008-09 1$ = 78.00 BDT.
[5] Land use cost was estimated for the cropping period (4 months) at the prevailing rate in the study area.

was significantly higher (31.7 per cent) than the yield of old mustard variety (1.12 t/ha), and only 0.61 per cent lower than the potential yield of BARI mustard-15 (Table III). The yield of Tori-7 seems to be high in the study areas.

The average net return of improved mustard variety was Tk 28,860 (US$ 370) per hectare, which was also significantly higher (74.4 per cent) than BARI old mustard variety (Tori-7). This higher return was due to both higher yield and price of the produce. Miah and Alam (2008) found that the farmers who cultivated BARI mustard received 58 per cent higher net profit than Tori-7 variety. The rate of return (BCR) over total cost was higher than unity, implying that the production of both improved and BARI old variety was profitable at farm level. The BCR of improved variety (1.56) is significantly higher (25.6 per cent) compared to that of Tori-7 variety.

Previous studies also show that the cultivation of oilseed is highly profitable. Islam, Miah and Alam (2007) found mustard cultivation profitable, and estimated BCR as 2.25 over total cost. Miah and Alam (2008) estimated the net returns and BCR of HYV mustard production, which were Tk 35,676/ha (US$ 457.4) and 2.23 respectively. These returns were significantly higher than that of Tori-7 variety. Dey, Bala, Islam and Rashid (2013) analysed the profitability of mustard production using primary data from Rajshahi, Pabna, Bogra, and Rangpur districts. Their estimated average net return and BCR were Tk 14,649 (US$ 188) per hectare and 1.36 respectively.

TABLE II

COST OF MUSTARD CULTIVATION IN THE STUDY AREAS

Particular	Improved		Tori-7		t-value
	Tk/ha	%	Tk/ha	%	
A. Variable Cost (Tk)	23,496***	45.8	19,483	43.4	0.000
Hired labour	5,083***	9.9	3,689	8.2	0.000
Land preparation	4,549	8.9	4,431	9.9	0.179
Seed	631	1.2	677**	1.5	0.024
Fertilisers	8,989***	17.5	7,196	16.0	0.000
Manure	2,238	4.4	2,136	4.8	0.658
Pesticide	772***	1.5	426	0.9	0.000
Irrigation	1,045**	2.0	768	1.7	0.014
Interest on operating capital	194***	0.4	161	0.4	0.001
B. Fixed Cost (Tk)	27,750***	54.2	25,365	56.6	0.000
Land use	19,697*	38.5	18,717	41.7	0.084
Family labour	8,053***	15.7	6,648	14.9	0.000
C. Total Cost (A+B)	51,246***	100	44,848	100	0.000
D. Total Cost (Tk/bigha)	6,916	--	6,052	--	--

Note: '***' '**' & '*' represent significant at 1%, 5% and 10% level respectively.

TABLE III

PROFITABILITY OF MUSTARD CULTIVATION (TK/HA) IN THE STUDY AREAS

Particular	Improved *(n=217)*	Tori-7 *(n=323)*	t-value
1. Seed yield (kg/ha)	1,641.26***	1,120.75	0.000
2. Price (Tk/kg)	46.50	43.60	0.000
3. Gross return (Tk/ha)	80,105***	52,241	0.000
Main product	76,319***	48,865	0.000
By-product	3,786***	3,376	0.000
4. Total variable cost (Tk/ha)	23,496***	19,483	0.000
5. Total cost (Tk/ha)	51,246***	44,848	0.000
6. Gross margin (Tk/ha) (3-4)	56,609***	32,758	0.000
7. Net return (Tk/ha) (3-5)	28,859***	7,393	0.000
8. Net return (Tk/bigha)	3,895***	998	0.000
9. Rate of return			
Over variable cost (3÷4)	3.41***	2.68	0.000
Over total cost (3÷5)	1.56***	1.16	0.000

Note: *** represents significant at 1% level.

3.2 Relative Profitability of Mustard

The respondent farmers in the study areas (i.e., Manikgonj, Tangail, and Dinajpur) mentioned the names of different crops that compete with mustard. It was mentioned earlier that the cultivation of mustard is profitable at farm level. But its overall profitability was not so encouraging to the farmers as compared to many other high value competing crops in the study areas. However, the profitability of improved mustard cultivation seems very encouraging and was higher than many other competing crops, such as cabbage, maize, onion, potato, and wheat (Table IV). Now the question arises, why mustard farmers cultivate Tori-7 variety? It is likely that farmers consider cash/variable costs in producing mustard and cultivate it mainly for family consumption.

TABLE IV

RELATIVE PROFITABILITY OF MUSTARD CULTIVATION IN THE STUDY AREAS

Crop	Yield (t/ha)	Total Return (Tk/ha)	Cost of cultivation (Tk/ha)				Benefit cost ratio	
			Variable cost (VC)	Fixed cost (FC)	Total cost (TC)	Net return	Over VC	Over TC
Brinjal	6.15	92,991	45,569	9,060	54,629	38,362	2.04	1.70
Cabbage	6.49	109,267	61,215	9,060	70,275	38,992	1.78	1.55
Carrot	5.66	105,889	67,774	9,060	76,834	29,055	1.56	1.38
Cauliflower	6.33	107,772	55,631	9,060	64,691	43,081	1.94	1.67
Chili	1.95	136,157	62,583	8,941	71,524	64,633	2.18	1.90
Maize	7.36	114,568	63,256	18,538	81,793	32,775	1.81	1.40
Onion	10.51	172,066	110,451	15,819	126,271	45,795	1.56	1.36
Potato	11.01	151,684	82,500	19,074	101,574	50,110	1.84	1.49
Wheat	2.81	65,165	34,714	11,714	46,429	18,736	1.88	1.40
Lentil	1.15	64,929	33,811	7,675	41,486	23,443	1.92	1.57
Chickpea	1.16	68,805	14,901	9,465	24,366	44,439	4.62	2.82
Mustard	1.38	66,173	21,490	26,558	48,047	18,126	3.05	1.36
Improved	1.64	80,105	23,496	27,750	51,246	28,859	3.41	1.56
Tori-7	1.12	52,241	19,483	25,365	44,848	7,393	2.68	1.16

Source: Field Survey 2012; For pulses, Matin *et al.* 2012.

3.3 Financial Profitability of Groundnut Cultivation

The average costs of cultivation of BARI improved and BARI old variety (Dhaka No.1) groundnut were Tk 62,048 (US$ 795.5) and Tk 52,616 (US$ 674.6) per hectare respectively. The cost of improved groundnut cultivation was significantly higher (15.2 per cent) than that of Dhaka No.1 variety. Respondent farmers used different mix of inputs in cultivating improved variety of groundnut compared to Dhaka No.1 variety. Among different cost items, human labour, land preparation, seed, fertilisers, and land use incurred significantly higher cost for improved groundnut cultivation. Again, 55-58 per cent of the total cost was spent for fixed inputs for both types of varieties. Only the cost of pesticides was higher for cultivating Dhaka No.-1 variety compared to that of improved groundnut variety (Table V).

TABLE V
COST OF GROUNDNUT CULTIVATION IN THE STUDY AREAS

Cost heading	Improved variety		Dhaka No.-1		t_value
	Tk/ha	%	Tk/ha	%	
A. Variable cost (Tk)	36,028***	58.1	29,285	55.7	0.000
Hired labour	15,272**	24.6	13,521	25.7	0.015
Land preparation	6,616***	10.7	5,283	10.0	0.000
Seed	11,092***	17.9	8,116	15.4	0.000
Fertilisers	2,360***	3.8	1,687	3.2	0.011
Manure	135	0.2	100	0.2	0.441
Pesticides	108	0.2	180*	0.3	0.086
Irrigation	148	0.2	151	0.3	0.962
Interest on operating capital	297***	0.5	242	0.5	0.000
B. Fixed cost (Tk)	26,020*	41.9	23,331	44.3	0.001
Land use	9,730*	15.7	8,917	16.9	0.075
Family labour	15,948**	25.7	14,414	27.4	0.015
C. Total cost (A+B)	62,048***	100	52,616	100	0.000
D. Total cost (Tk/bigha)	8,374	--	7,101	--	--

Note: '***' '**' & '*' represent significant at 1%, 5% and 10% level respectively.

The cultivation of groundnut was found to be the most profitable crop in the study areas compared to the cultivation of other oilseed crops. Due to its higher profitability, a steady growth was observed both in the area and production of groundnut over time. The average yield of improved groundnut was 2.40 t/ha, which was 32.9 per cent higher than that of Dhaka No.1 variety, and 25 per cent lower than the potential yield of BARI Groundnut 5 and 6.

The farmers who cultivated improved groundnut received on an average Tk 84,200 (US$ 1079.5) per hectare as net return, which was 76.8 per cent higher than the farmers cultivating Dhaka No.1 variety. This higher return was due to the higher yield and high price of improved groundnut. The rate of return (BCR) over total cost was significantly higher for adopters (2.36) than that of non-adopters (Table VI). Kawser (1993) estimated net return and BCR of groundnut cultivation, which were Tk 2,030 (US$ 26) per hectare and 1.11 respectively.

TABLE VI

PROFITABILITY OF GROUNDNUT CULTIVATION IN THE STUDY AREA

Particular	Improved variety *(n=95)*	Dhaka No.1 *(n=445)*	t-value
1. Nut yield (kg/ha)	2,398.98***	1,613.36	0.000
2. Price (Tk/kg)	59.97***	42.71	0.000
3. Gross return (Tk/ha)	146,248***	72,190	0.000
Main product	144,934***	71,152	0.000
By-product	1,314*	1,038	0.094
4. Total variable cost (Tk/ha)	36,028***	29,285	0.000
5. Total cost (Tk/ha)	62,048***	52,616	0.000
6. Gross margin (Tk/ha) (3-4)	110,220***	42,904	0.000
7. Net return (Tk/ha) (3-5)	84,200***	19,573	0.000
8. Net return (Tk/bigha)	11,363***	2,641	0.000
9. Rate of return			
Over variable cost (3÷4)	4.06***	2.47	0.000
Over total cost (3÷5)	2.36***	1.37	0.000

Note: '***' & '*' represent significant at 1% and 10% level respectively.

3.4 Relative Profitability of Groundnut Production

Irrespective of variety, the cultivation of groundnut is profitable to the farmers of the study areas. It is even more profitable than different competing crops, namely mungbean, brinjal, lentil, *Khesari*, wheat and onion. The rate of return (BCR) over total cost was the highest for improved groundnut production among all the competitive crops reported in the study areas (Table VII). Farmers are compelled to cultivate local variety of groundnut due to non-availability of improved varieties.

3.5 Financial Profitability of Sesame Cultivation

The respondent farmers in the study areas usually use higher inputs in cultivating improved variety sesame compared to that of BARI old variety Til-6. The highest share of the total cost was for hired labour and land use in cultivating both improved and Til-6 varieties. The adopting farmers spent more on land preparation, fertiliser and manure. However, the average cost of improved sesame cultivation was Tk 42,918 (US$ 550) per hectare, which was significantly higher (6.6 per cent) than the cost incurred for cultivating Til-6 variety (Table VIII).

TABLE VII

RELATIVE PROFITABILITY OF GROUNDNUT CULTIVATION IN THE STUDY AREAS

Crop	Yield (t/ha)	Total return (Tk/ha)	Cost of cultivation (Tk/ha)				Benefit cost ratio	
			Variable cost (VC)	Fixed cost (FC)	Total cost (TC)	Net return	Over VC	Over TC
Blackgram	0.79	45,050	13,670	9,372	23,041	22,009	3.30	1.96
Chili	1.95	136,157	62,583	8,941	71,524	64,633	2.18	1.90
Mungbean	1.24	73,291	25,090	17,613	42,703	30,588	2.92	1.72
Brinjal	6.15	92,991	45,569	9,060	54,629	38,362	2.04	1.70
Lentil	1.15	64,929	33,811	7,675	41,486	23,443	1.92	1.57
Khesari	0.94	28,591	9,647	8,532	18,179	10,412	2.96	1.57
Wheat	2.81	65,165	34,714	11,714	46,429	18,736	1.88	1.40
Onion	10.51	172,066	110,451	15,819	126,271	45,795	1.56	1.36
Groundnut:	2.01	109,219	32,657	24,676	57,332	51,887	3.27	1.87
Improved	2.40	146,248	36,028	26,020	62,048	84,200	4.06	2.36
BARI old	1.61	72,190	29,285	23,331	52,616	19,574	2.47	1.37

Source: Field survey 2012; For pulses, Matin *et al.* 2014.

TABLE VIII

COST OF SESAME PRODUCTION IN THE STUDY AREAS

Cost heading	Improved variety		Old variety (Til-6)		t_value
	Tk/ha	%	Tk/ha	%	
A. Variable cost (Tk/ha)	24,527***	57.1	21,510	53.7	0.000
Hired labour	11,184	26.1	10,726	26.8	0.309
Land preparation	6,111***	14.2	5,722	14.3	0.009
Seed	452	1.1	460	1.1	0.505
Fertilizers	4,223***	9.8	3,061	7.6	0.000
Manure	633***	1.5	208	0.5	0.000
Pesticides	1,133	2.6	1,045	2.6	0.235
Irrigation	2,330	5.4	2,270	5.7	0.620
Int. on operating capital	203***	0.5	178	0.4	0.000
B. Fixed cost (Tk/ha)	18,390	42.9	18,556	46.3	0.681
Land use	8,474	19.7	8,544	21.3	0.480
Family labour	9,916	23.1	10,012	25.0	0.816
C. Total cost (A+B)	42,918***	100	40,066	100	0.000
D. Total cost (Tk/bigha)	5,792***	--	5,407	--	0.000

Note: '***' represents significant at 1% level.

The average yield of improved and BARI old variety (Til-6) sesame was 1.46 t/ha and 1.14 t/ha, respectively. The yield of improved variety sesame was 21.9% higher than that of Til-6 variety, and 2.9% lower than the potential yield of BARI Sesame-4 variety.

The average net return received by adopting farmers was Tk 13,879 (US$ 188) per hectare, which was 71.01 per cent higher than that of net return received by non-adopters. This higher return was mainly due to higher yield and high product price. The estimated rates of returns (BCRs) of improved and Til-6 variety sesame were 1.32 and 1.10 over total cost. The rates of returns scenario clearly indicate that the production of Til-6 variety sesame was marginally profitable to the farmers when all costs were taken into consideration (Table IX).

TABLE IX

PROFITABILITY OF SESAME CULTIVATION IN THE STUDY AREA

Particular	Improved variety *(n=116)*	Old variety (Til-6) *(n=424)*	t-value
1. Seed yield (kg/ha)	1,458.3***	1,140.90	0.000
2. Price (Tk/kg)	37.0	36.5	0.786
3. Gross return (Tk/ha)	56,796***	44,089	0.000
Main product	54,333***	41,643	0.000
By-product	2,463	2,446	0.875
4. Total variable cost (Tk/ha)	24,527***	21,510	0.000
5. Total cost (Tk/ha)	42,918***	40,066	0.000
6. Gross margin (3-4) (Tk/ha)	32,269***	22,579	0.000
7. Net return (3-5) (Tk/ha)	13,879***	4,023	0.000
8. Net return (Tk/bigha)	1,873***	543	0.000
9. Rate of return			
Over variable cost (3÷4)	2.32**	2.05	0.049
Over total cost (3÷5)	1.32***	1.10	0.000

Note: '***' and '**' represent 1% and 5% level of significance respectively.

3.6 Relative Profitability of Sesame

The respondent sesame farmers mentioned chili, jute, wheat, and *Aus* rice as the competing crops of sesame in the study areas. Table X presents the highest BCR for chili cultivation and the lowest for *Aus* rice. Irrespective of variety, the cultivation of sesame was not very profitable to the farmers compared to its competing crops, except *Aus* rice. Sesame farmers were compelled to cultivate

local varieties due to non-availability of improved varieties. The other causes of cultivating the less remunerative crop (sesame) were home consumption, lower cost and land suitability.

TABLE X
RELATIVE PROFITABILITY OF SESAME CULTIVATION IN THE STUDY AREAS

Crop	Yield (t/ha)	Total Return (Tk/ha)	Cost of cultivation (Tk/ha)				Benefit-cost ratio	
			Variable cost (VC)	Fixed cost (FC)	Total cost (TC)	Net return	Over VC	Over TC
Chili	1.95	136,157	62,583	8,941	71,524	64,633	2.18	1.90
Jute	2.05	73,643	37,263	8,529	45,792	27,851	1.98	1.61
Wheat	2.81	65,165	34,714	11,714	46,429	18,736	1.88	1.40
Aus rice	3.59	56,252	53,084	16,145	69,229	-12,977	1.06	0.81
Sesame:	1.30	50,443	23,019	18,473	41,492	8,951	2.19	1.21
Improved	1.46	56,796	24,527	18,390	42,918	13,878	2.32	1.32
BARI old	1.14	44,089	21,510	18,556	40,066	4,023	2.05	1.10

Source: Field Survey 2012; For *Aus* rice, BRRI 2012.

3.7 Financial Profitability of Soybean Cultivation

The adopters of improved soybean used family labour, TSP, MP and pesticides in significantly larger quantities than that of non-adopters. The average cost of cultivation of the BARI-released soybean variety was Tk 44,410 (US$ 569.4) per hectare, which was slightly higher (4.8 per cent) than the cost of cultivating traditional variety (Sohag). More than 60 per cent cost was accounted for by variable inputs and the rest was for fixed inputs. The adopting farmers spent significantly more on land preparation, seed and pesticides compared to that of non-adopters. The adopting soybean farmers used family labour significantly more than that of non-adopting farmers (Table XI).

The average yield of BARI improved and BARI old variety soybean (Sohag) was more or less the same in the study areas. The average yield of BARI improved variety soybean was 25.2 per cent lower than its potential yields, and about 5 per cent higher than the yield of Sohag variety (Table XII).

TABLE XI
COST OF SOYBEAN CULTIVATION IN THE STUDY AREAS

Particular	Improved variety		Sohag		t_value
	Tk/ha	%	Tk/ha	%	
A. Variable cost (Tk/ha)	26,669	60.1	26,369	62.3	0.726
Hired labour	10,475	23.6	11,272	26.7	0.172
Land preparation	6,577**	14.8	5,953	14.1	0.016
Seed	5,261**	11.8	4,674	11.1	0.014
Fertiliser	3,457	7.8	3,237	7.7	0.436
Manure	126	0.3	137	0.3	0.839
Pesticides	1,027*	2.3	1,224	2.9	0.063
Irrigation	1,764	4.0	1,717	4.1	0.899
Interest on operating capital	220	0.5	218	0.5	0.726
B. Fixed cost (Tk/ha)	17,741	39.9	15,925	37.7	0.127
Land use	8,779	19.8	8,878	21.0	0.909
Family labour	8,962***	20.2	7,047	16.7	0.000
C. Total cost (A+B)	44,410	100	42,294	100	0.114
D. Total cost (Tk/bigha)	5,993	--	5,708	--	0.125

Note: '***' '**' & '*' represent significant at 1%, 5% and 10% level respectively.

TABLE XII
PROFITABILITY OF SOYBEAN CULTIVATION IN THE STUDY AREA

Particular	Improved *(n=56)*	Sohag *(n=304)*	t-value
1. Seed yield (kg/ha)	1,598.3	1,518.5	0.208
2. Price (Tk/kg)	29.6	30.3**	0.041
3. Gross return	48,171	46,605	0.431
Main product	47,475	46,107	0.490
By-product	696	498	0.188
4. Total variable cost	26,669	26,369	0.726
5. Total cost	44,410	42,294	0.114
6. Gross margin (3-4)	21,502	20,236	0.514
7. Net return (3-5)	3,761	4,311	0.777
8. Net return (Tk/bigha)	508	582	0.763
9. Rate of return			
Over variable cost (3÷4)	1.8	1.8	0.899
Over total cost (3÷5)	1.1	1.1	0.279

Note: '**' represents significant at 5% level.

Not much difference was observed between the cultivate on costs of the two varieties. Therefore, the average net return and BCR for improved variety cultivation were more or less similar to the Sohag variety. However, non-adopting farmers received about 13 per cent higher net return than that of adopting farmers, which was due to the high price of output and lower cost of cultivation. Due to higher cost of production, the BCR became very low (Table XII). Akter *et al*. (2010) found soybean as the second most profitable crop in Noakhali and Laxmipur districts. Their estimated gross margin and BCR (over variable cost) were Tk 18,407 (US$ 236) per hectare and 2.23 respectively.

3.8 Relative Profitability of Soybean

The respondent soybean farmers mentioned chili, mungbean and groundnut as the competing crops of soybean in the study areas. The rates of returns (BCRs) estimated for competing crops were much higher than that of soybean (Table XIII). Soybean cultivation is confined to two districts, namely Noakhali and Laxmipur. It was opined that farmers of these two districts cultivated this less remunerative crop mainly due to family tradition and good market demand.

TABLE XIII
RELATIVE PROFITABILITY OF SOYBEAN CULTIVATION IN THE STUDY AREAS

Crop	Yield (t/ha)	Total Return (Tk/ha)	Cost of cultivation (Tk/ha)				Benefit-cost ratio	
			Variable cost (VC)	Fixed cost (FC)	Total cost (TC)	Net return	Over VC	Over TC
Chili	1.95	136,157	62,583	8,941	71,524	64,633	2.18	1.90
Mungbean	1.24	73,291	25,090	17,613	42,703	30,588	2.92	1.72
Groundnut	2.01	109,219	32,657	24,676	57,332	51,887	3.27	1.87
Soybean	1.56	47,388	26,519	16,833	43,352	4,036	1.8	1.1
Improved	1.60	48,171	26,669	17,741	44,410	3,761	1.8	1.1
BARI old	1.52	46,605	26,369	15,925	42,294	4,311	1.8	1.1

Source: Field Survey 2012; For mungbean, Matin *et al.* 2012.

3.9 Economic Profitability and Comparative Advantage of Oilseed Production

3.9.1 Economic Profitability of Oilseed Production

It is stated in the preceding sections that the cultivation of oilseeds is profitable at farm level from financial point of view. An attempt was also made

to assess oilseeds cultivation from economic point of view under import parity level in Bangladesh. It can be observed from Table XIV that the cultivation of oilseeds is also profitable. The highest net return (Tk 82,594/ton) under import parity level was calculated for groundnut, followed by sesame (Tk 44,578/ton) and soybean (Tk 5,544/ton). The lowest net return (Tk 603/ton) was found in mustard production in Bangladesh. The rates of returns (BCRs) were also higher for groundnut (4.18) and lowest for mustard (1.02) production (Table XIV).

3.9.2 Comparative Advantage of Oilseed Production

It is an expression of the efficiency of using domestic resources to produce a particular product when measured against the possibilities of international trade. A country will reduce the production of those goods which can be imported at lower relative prices. Again, the country will lead to specialise in the production of those goods which can be produced at lower relative cost. In calculating comparative advantage of oilseed production, farm gate prices of oilseeds were used as the domestic producer prices, while the c.i.f import prices of the respective oilseeds were considered in world prices. The respective world prices are available on internet (FAOStat).

Comparative advantage in producing oilseeds in the country was evaluated through calculation of their domestic resource costs (DRCs). DRC of greater than one implies that the country loses foreign exchange through domestic production (in the sense that it uses more domestic resources than it generates net value added to tradable goods and services), while a DRC of less than one implies that the production is efficient and makes a positive contribution to domestic value addition. The estimated DRCs for selected oilseed crops were less than unity, which means that the country had comparative advantage in producing oilseeds for import substitution. The comparative advantage of producing groundnut, sesame and soybean was much higher than that of mustard production in Bangladesh. It implies that mustard production was not so advantageous in Bangladesh since the value of DRC is close to unity (Table XIV). It is important to note that the area under oilseeds cultivation is decreasing over the years in spite of having comparative advantage in production. The reasons behind this decreasing trend are low relative profitability and lack of short duration improved varieties.

The estimated DRC of mustard production in the present study is well supported by the study of Dey *et al.* (2013). They estimated nominal protection coefficient (NPC) and nominal rate of protection (NRP) for mustard production at import parity level for seven years (2005-2011). It was found that the border

parity prices of mustard at producer level were higher during the last four years (2008-2011) as compared to the domestic producer prices of mustard production. This situation implied that mustard production remained in disadvantageous position in Bangladesh. However, the DRC of mustard production in this study was estimated irrespective of varieties. It would obviously be lower in the case of improved varieties of mustard. In that case, local production of mustard will be cheaper, indicating the need for research towards generation of new mustard varieties and better farm management techniques for the country.

TABLE XIV

ECONOMIC PROFITABILITY AND DOMESTIC RESOURCE COST OF DIFFERENT OILSEEDS PRODUCTION AT IMPORT PARITY LEVEL

(Value in Tk/ton)

Cost and return	Mustard	Groundnut	Sesame	Soybean
A. Cost of traded inputs*	7,945	1,257	3,561	3,115
B. Costs of non-traded inputs and domestic resources	25,754	24,739	27,733	27,029
Human labour	8,005	13,014	14,472	12,163
Mechanical power	2,772	2,758	4,191	4,116
Seed	385	4,624	310	3,292
Manure	1,364	56	434	79
Pesticides	470	45	777	643
Irrigation	637	62	1,598	1,104
Interest on operating capital	118	124	139	138
Land rent	12,003	4,056	5,812	5,494
C. Total input costs	33,699	25,996	31,294	30,144
D. Output price**	34,302	108,590	75,872	35,688
E. Net profit (D-C)	603	82,594	44,578	5,544
F. BCR (D/C)	1.02	4.18	2.42	1.18
G. Value added (Tradable) (D-A)	26,357	107,333	72,311	32,573
H**. DRC** (B/G)	**0.977**	**0.230**	**0.384**	**0.830**

Note: * Traded inputs included urea, TSP, MP and DAP; **Boarder price at farm gate.

IV. CONCLUSIONS AND RECOMMENDATIONS

This paper analyses the profitability and comparative advantage of oilseeds production in Bangladesh. It shows that the production of oilseeds is profitable both in financial and economic terms. The profitability of local variety mustard

(Tori-7) production is not encouraging but the profitability of improved variety of mustard is attractive compared to competing crops like cabbage, maize, onion, potato and wheat. Farmers generally consider cash/variable costs in producing local mustard and cultivate it mostly for family consumption. Groundnut is found to be the most profitable crop in the study areas compared to other oilseeds and competing crops. Due to its higher profitability, a steady growth is observed in the area and production over the years. The production of local variety sesame (Til-6) is marginally profitable compared to competing crops except *Aus* rice, when all costs are taken into consideration. Soybean cultivation is marginally profitable and its profitability is lower than most of its competing crops. There is not much difference observed between the profitability of local and improved varieties of soybean. Finally, the country has comparative advantage in producing oilseeds for import substitution since the DRC estimates for selected oilseed crops are less than unity.

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