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Rice-sunflower Cropping Pattern and its Contribution to Income and Food Security of Polder Farmers

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Abstract *This study mainly examined the relative profitability of the new rice-sunflower cropping pattern over traditional rice-sesame and also to assess impacts of the new cropping pattern on income earning and food security of households in a polder area under Batiaghata Upazila of Khulna district in Bangladesh. In total, 200 farmers were selected for the study. Descriptive statistics, activity budgets, logit model, food security index and partial budget were employed to achieve the objectives. The study confirmed that both the traditional T. Aman rice-sesame and new T. Aman rice-sunflower cropping patterns were profitable. Per hectare net return from new rice-sunflower pattern was relatively much higher (Tk 75,385.00/ha) than that of the traditional rice-sesame pattern (Tk 39,354.00/ha). The results of logit model indicate that five variables out of seven have influences on household's food security. The results of regression analysis indicate that the age of household head, involvement in off-farm activities, total income and food expenditure have had positive association while family size had a negative association with food security status of the households. The average daily per capita calorie intake was relatively higher for the followers of rice-sunflower*

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cropping pattern (2273.37 kcal/day) than that of the traditional rice-sesame growers (2046.80 kcal/day). The estimated food security indices for rice-sesame and rice-sunflower farmers were 0.95 and 1.00, respectively. The result of partial budget analysis revealed that the new sunflower producing households were earning much higher income than the sesame growing farmers. The study also identified farmer's perception about the new cropping pattern. It is concluded that the rice-sunflower cropping pattern has had some positive impacts on income earning and household food security of the polder farmers.

1. Introduction

The coastal area of Bangladesh covers about 20.0 percent of the whole country and over 30.0 percent of the cultivable area. About 53.0 percent of the coastal areas are affected by salinity. Agricultural land use in this area is very poor, which is roughly 50.0 percent of the country's average (Haque, 2006). Salinity causes unfavorable environment and hydrological situation that restrict the normal crop production throughout the year. Most of the lands remain fallow in the dry season (January to May) because of soil salinity and the lack of good-quality irrigation water. Supplying farmers with alternative production systems with high land and water productivity is crucial for food security, enhancing farmers' livelihood and sustaining the environment of the coastal zone. In other words, proper water management and irrigation system is very important to adopt new cropping pattern in this coastal area.

The cropping pattern usually followed in the study area is mainly sesame-*T. Aman* rice. Sesame is a summer crop and highly susceptible to water logging. Production of Sesame fluctuates widely, depending on the rainfall pattern and other environmental factors. Sunflower is a photo and thermo-neutral oilseed crop and grows well in both *Rabi* and *Kharif* seasons of Bangladesh (Saha, 1995). Per unit production of sunflower is relatively higher than the sesame and relatively less risky to grow in this area. It is, therefore, prospective and important to diversify the oilseed production through the introduction of new crop like sunflower.

Innovations in crop production and adopting new cropping pattern can play a major role in helping farmers adapt to extreme conditions and secure livelihoods in the coming years. The oilseed section of Bangladesh Agricultural Research Institute (BARI) has been conducting experiments at various sub-stations of the country. Bangladesh Rural Advancement Committee (BRAC) has also been trying to introduce rice-sunflower instead of old pattern for betterment of polder farmers.

This new cropping pattern (i.e., rice-sunflower) can perhaps give better farm income than any other existing cropping pattern and the new pattern might have some positive impacts on food security of the polder farmers. Unfortunately, no hard data are available to the farmers on these particular issues. The present study has, therefore, been designed to assess the impact of adopting new cropping pattern and also to assess whether this new pattern is more profitable over the traditional rice-sesame cropping pattern in this polder area or not.

Mannaf (2012) conducted a study on the profitability of maize production and its impact on food security. The results revealed that the rural households were food secured; it was checked by using recommended minimum calorie requirement (i.e., 2122 kcl). Nasrin (2011) studied the land tenure system and assessed its impact on food security. The study confirmed that the extent of food security situation was much better among the cash tenant households than that of the share tenant households and thereby land tenure systems affect the food security situation of the households. A logistic regression was used by Kidane *et al.* (2005) and Feleke *et al.* (2005) to assess the causes of household food insecurity. The productivity and profitability of rice and oilseed farming and studies related to food security throughout the world were conducted but comparative profitability of sunflower and sesame cultivation and their impacts on household income and food security have not yet been done in Bangladesh. Although the cultivation of sunflower started from many years ago in Bangladesh, it failed to gain popularity as edible oil and surprisingly only a few literatures are available in this country. In other words, farm management research has not yet been conducted to identify the impact of rice-sunflower cropping pattern over traditional rice and sesame cropping pattern on household income and food security of the farmers in polder area. This study is, therefore, completely a new and pioneering one. The study was undertaken with the following specific objectives:

i. to assess the relative profitability of adopting rice-sunflower over traditional rice-sesame cropping pattern;
ii. to identify the factors influencing the food security status of farming households;
iii. to estimate the contribution of new pattern to the household income and food security; and
iv. to assess the perception of the farmers towards the new cropping pattern.

2. Research methods

Five adjacent villages namely Amtola, Baruiabad, Titukhali, Debitola, and Boyervanga of polder number 30 from Batiaghata Upazila in Khulna district of

Bangladesh have purposively been selected for the study. In total 200 farmers, 100 from each of the selected cropping patterns were selected for the study. A simple random sampling technique was followed for traditional rice-sesame farmers while purposive sampling was employed for selecting new rice-sunflower farmers. Primary data were collected using a structured interview schedule. The relevant secondary data were collected from the concerned government and research reports, online materials and periodicals. The formal data for the study were collected during the August-September 2012. It was, of course, a normal year. Data were collected through direct interviews by making personal visits to the houses of the selected individual farmers. Activity budget (see Dillon and Hardaker 1993) is the most common method in determining and comparing the profitability of enterprise activities. Profit is defined as the difference between the total revenue and total cost. The following profit equation was employed to prepare activity budgets of the selected crops like rice, sesame and sunflower from the viewpoints of individual farmers:

$\pi = TR - TC$

Or, $\pi = TR - (VC + FC)$

Where,

π = Net returns (Tk/ha);

TR = Total return (Tk/ha);

VC = Variable cost (Tk/ha);

TC = Total cost involved in producing the concerned crops.

To assess the impact of new pattern and factors influencing the food security status of farming households two stages of analysis were done. At first, a food security index (Z) was constructed and food security status of each household was determined based on the food security line using the recommended daily calorie intake approach and then a logit model was used to estimate the food security status of household as a function of a set of independent determinants. A household which had daily per capita caloric intake up to 2122 kcal was regarded as food secure and those below 2122 kcal were regarded as food insecure households.

The mathematical representations are as follows:

$Zi = Yi/R$ (Babatunde *et al.* 2007)

Where.

Z_i = Food security status of i^{th} households which take values of 1 for food secure households or 0 for food insecure households;

Y_i = Daily per capita calorie intake of i^{th} household;

R = Recommended Per capita daily calorie intake; and

I = 1,2,3,…….,100.

Based on the household food security index (Z), the Logit model was estimated to identify the determinants of food security to assess the impact of rice-sunflower cropping pattern on food security.

The implicit form of the model was as follows:

$Z_i = \beta X_i + U_i$ (Babatunde *et al.* 2007)

Where,

Z_i = the food security stains of i^{th} household;

X_i = Vector of explanatory variables;

U_i = Error term; and

β = Vector of parameter estimates.

The explanatory variables included in the model were:

X_1 = Household size;

X_2 = Age of household head;

X_3 = Farm size;

X_4 = Per capita production;

X_5 = Household income;

X_6 = Involvement in off farm activities;

X_7 = Food expenditure;

To measure the impact of rice-sunflower cropping pattern on household food security the food insecurity gap, the surplus index and the headcount ratio of food security were calculated for the sample households based on food security line.

Surplus index or food insecurity gap was used to measure the extent to which a household is food secure or insecure.

The index is given as:

P = $\frac{1}{M}\sum_{i=1}^{m} Gi$ (Babatunde *et al.* 2007)

Where,

P = Surplus index or food insecurity gap;

M = Number of household that are food secured (for surplus index) or food insecured (for food insecurity gap); and

G_i = Per capita calorie intake deficiency (or surplus) faced by i^{th} household.

$G_i = \left(\frac{Yi-R}{R}\right)$ (Babatunde *et al.* 2007)

The head count ratio measures the percentage of the population of household that are food secured or insecured.

This is defined as:

H= $\frac{M}{N}$ (Babatunde *et al.* 2007)

Where,

H = Head count ratio;

M = Number of individuals that are food secured (for surplus index) or food insecured (for food insecurity gap); and

N = Population size.

Partial budget was employed to assess the impact of rice-sunflower cropping pattern on household income. It was used to compare the costs and benefits of alternatives faced by farm business. The costs and revenues needed for a partial budget can be identified by considering the following four basic questions about a proposed change (such as switching from traditional sesame to new sunflower cultivation:

a. What new or additional costs will be incurred?
b. What current costs will be reduced or eliminated?
c. What new or additional revenue will be received?
d. What current revenue will be lost or reduced?

3. Results and discussion

Profitability of *T. Aman* Rice, Sesame and Sunflower Production

A quick way to assess the profitability was to calculate gross return and gross cost. To obtain the value of net return, both cost of production and value of output

Table 1 : Summary Results of Growing of T. Aman Rice, Sesame and Sunflower per Hectare

Particulars	T Aman rice	Sesame	Sunflower
A. Gross returns (Tk/ha)	56,238.00	41,888.00	103,501.00
B. Gross costs (Tk/ha)	35,270.00	23,502.00	49,084.00
C. Net returns (Tk/ha)	20,968.00	18,386.00	54,417.00
D. BCR (Undiscounted)	1.59	1.78	2.11

Sources: *Adapted from Appendix Tables 1, 2 and 3*

(gross return) were calculated. The results of the estimation of the costs and returns have been made by employing individual activity budgets and presented in Appendix Tables 1, 2 and 3. The summary results of the profitability analysis of T. Aman rice, sesame and sunflower are presented in Table 1. Since T. Aman rice cultivation was the most common in both the selected new and traditional cropping patterns in the polder area, the difference in profitability between sunflower and traditional sesame was very important.

It is evident from the summary results presented in Table 1 that the farmers were earning much higher profit per hectare by cultivating new sunflower (Tk 54,417.00/ha) than the traditional sesame (Tk 18,386.00/ha). The undiscounted BCR (Benefit-cost ratio) of sunflower production is also much higher (2.11) than the cultivation of sesame (1.78). The findings clearly indicate that the farmers of the polder area can have much higher net return per hectare by adopting sunflower.

New Rice-Sunflower versus Traditional Rice-Sesame Cropping Pattern

Table 2 shows the positive impact of adopting new rice-sunflower cropping pattern over the traditional rice-sesame on income earning of the polder farmers.

Table 2 : Impact of Adopting New Rice and Sunflower Pattern over Traditional Rice and Sesame on per Hectare Net Return

Particulars	New rice-sunflower pattern	Traditional rice-sesame pattern	Impact of new over traditional pattern
A. Net returns (Tk/ha)	75,385.00	39,354.00	+ 36,031.00
B. BCR (Undiscounted)	1.89	1.67	+ 0.22

Sources: *Adapted from Appendix Tables 1, 2 and 3.*

Both per hectare net return (Tk 75,385.00/ha) and undiscounted BCR (1.89) of T Aman rice-sunflower cropping pattern were much higher than the followers of the traditional T Aman rice-sesame pattern. In other words, a farmer can have an extra amount of Tk 36,031.00 profit from a hectare of cultivable land by adopting new T Aman rice-sunflower cropping pattern.

The results presented in Appendix Tables 1, 2 and 3 revealed that per hectare cost of sunflower cultivation was much higher than that of the sesame and rice cultivation, since the costs of seeds, fertilizers and human labours were relatively much higher for sunflower cultivation. Most of the farmers did not use any fertilizer for sesame cultivation which was followed by T Aman rice cultivation. Since sunflower farmers had to apply fertilizers in their crop-field and the sowing method of sunflower was also different from sesame, human labour for sunflower cultivation was much higher than that of the sesame. For producing rice and sesame farmers did not use irrigation water but sunflower production farmers had to apply irrigation water.

The findings clearly indicate that production of T. Aman rice, sesame and sunflower was profitable from the viewpoints of individual farmers, although there are some differences in profitability among these selected individual crops. There was a significant difference in profitability between the followers of the rice-sunflower cropping pattern and traditional rice-sesame cropping pattern. The

Table 3 : Estimation of the Logistic Regression of Determinants of Food Security Status of Farm Household

Variable	Coefficient	Standard Error	Level of Significance	Exponential coefficient (odds ratio
Constant	-3.837	1.533	0.012	0.022
Household size	-0.726	0.320	0.023*	0.484
Age of household head	0.011	0.019	0.544	1.011
Farm size	0.586	0.851	0.492	1.796
Per capita production	0.003	0.001	0.052**	1.003
Income	0.002	0.001	0.005*	1.002
Involvement in off farm activities	0.920	0.509	0.070***	2.510
Food expenditure	0.002	0.001	0.003*	1.002

Source: *Adapted from Afsar (2013, p. 73).*

Note: * indicates significant at 1% level

** indicates significant at 5% level

*** indicates significant at 10% level

main reason was that per hectare yield of sunflower was much higher in polder area than that of the traditional sesame. The Sunflower cultivation provided a higher net return to the farmers due to its higher yield potential. Despite of some marketing problems, the new rice-sunflower cropping pattern has currently been gaining popularity in the polder area day by day.

Factors Influencing the Food Security Status of Farming Households

For assessing determinants of farm household's food security, logit model was estimated. Seven explanatory variables were identified to be major determinants of food security in this study. Among the seven factors considered in the model, five were found to have a significant impact in determining household food security (Table 3). These are household size, per capita production, household income, involvement in off farm activities and food expenditure.

Large household size exerts more pressure on consumption. The per capita food availability declines as family size increases due to population growth. The coefficient of household size which was significant at 1 percent level, -0.726 means there is a negative relationship between household size and food security and odds ratio was 0.484 means a unit increase in household size will reduce the probability of household to be food secure by 0.484.

The age of household head had a positive coefficient but statistically insignificant indicating that the older the household head, the higher the probability that the household would be food secures.

The larger the farm size, the higher the production level. It is thus expected that households with larger farm size are more likely to be food secure than those with smaller farm size. The coefficient of farm size was 0.586 and the odds ratio was 1.796 which was positive but statistically insignificant.

Per capita aggregate production was computed by dividing the output realized by the farm family after deducting all kinds of payments and post harvest losses, by the household size. This result implies that per capita aggregate production was positive and significant at 5 percent level. This indicates that the higher the per capita aggregate production, the higher is the probability that the household would be food secure. A unit increase in per capita production will increase the probability of household to be, food secure by 1.003.

The income is expected to boost household's food production and also access to more quantity and quality food. Household's income was positive and significant at 1 percent level, indicates that the higher the household income, the higher is the probability that the household would be food secure. A unit increase in the level of income will increase the probability of household to be› food secure by 1.002.

Off-farm activities was measured based on whether or not the household was engaged in off-farm activities. A household which was not engaged in off-farm activities takes the value zero and the household with off-farm activities takes the value one. It enables farmers to modernize their production by giving them an opportunity for applying the necessary inputs. Involvement in off farm activities was positive and significant at 10 percent. This indicates that households which were engaged in non-farm activities were nearly 2.51 times likely to food secure than those households who were not engaged in off farm activities, other things remaining the same.

Food expenditure has a low but positive coefficient that was significant at 1 percent level. A unit increase in food expenditure increase, the probability of household to be food secure by 1.002. This indicates that the higher the amount of food expenditure i.e. the higher the amount of taka spend on food purchase, the higher the likelihood of food security.

Table 4 : Food Security Indices for Sampled Farm Household under Two Cropping Patterns

Categories	Food security indices	Food secure households	Food insecure households	All
Rice-sesame	Food security index	1.05	0.85	0.95
	Percentage of households	50.00	50.00	100
	Per capita daily calorie availability (kcal)	2236.97	1806.15	2046.80
	Food insecurity gap/ surplus index (P)	0.05	-0.15	-
	Head count index (H)	0.50	0.50	-
Rice-sunflower	Food security index	1.07	0.90	1.00
	Percentage of households	60	40	100
	Per capita daily calorie availability (kcal)	2271.52	1919.18	2273.37
	Food insecurity gap/ surplus index (P)	0.07	-0.10	-
	Head count index (H)	0.60	0.40	-

Source: *Adapted from Afsar (2013, p. 76).*

Impact of Rice-Sunflower Cropping Pattern on Household Food Security

Table 4 shows the per capita daily calorie intake from different food items by the households. Average per capita calorie intake by households under rice-sesame cropping pattern was estimated 2046.80 kcal which is lower than the recommended daily calorie intake 2122 kcal per day. The average per capita calorie intake was relatively higher for the households under rice-sunflower cropping pattern which was 2273.37 kcal and above than the recommended daily calorie intake 2122 kcal per day.

Results of food security index indicated that per capita calorie intake varied between two categories of farmers. Among the rice-sesame farmers 50.00 percent households were food secure and obtained 2236.97 kcal per capita per day. The rest of the farmers were food insecure. The food security index for rice-sesame farmer was 1.05; the value of this index for insecured households it was 0.85. The food security gap or surplus index shows that the food secure households exceeded the food poverty line by 5.00 percent, while food insecure households fell short of the required calorie intake by 15.00 percent. Farmers who follows rice-sesame cropping pattern in the study area could be regarded as food insecured though 50.00 percent of the selected households were food secured; because their (food secured and insecured households) average daily calorie intake was 2,046 kcal per day per capita which was lower than the required calorie intake of 2,122 kcal.

Table 4 shows that farmers who cultivated sunflower in the study area could be classified as food secure, given the fact that only 40.00 percent of the sampled households were not able to meet the recommended calorie intake of 2,122 kcal per capita per day. About 60.00 percent farmers of rice-sunflower farmers were food secure and obtained 2271.52 kcal per capita per day. The surplus/shortfall index (P) shows that the food secure households exceeded the calorie requirements by 10.0 percent, while the food insecure households was 7.0 percent less than the minimum recommended calorie intake. So, rice-sunflower cropping pattern clearly affect the food security situation of selected households.

Impact of Rice-Sunflower Cropping Pattern on Household Income

The additional income from sunflower production had a significant contribution to total household income of the sunflower growers. Table 5 reveals that the net change in profit, as stated before, is Tk. 36,031.00 because revenue from sunflower cultivation is higher than sesame though its cost of production is higher. If farmers replace sesame with sunflower they can obtain additional Tk. 36,031.00 per hectare.

Table 5 : Partial Budget Analysis for the Replacement of per Hectare Sesame with Sunflower

Items	Debit (Tk/ha)	Items	Credit (Tk/ha)
a. Cost for new sunflower cultivation	49,084.00	a. Additional revenue for sunflower cultivation	103,501.00
b. Revenue foregone for sesame	41,888.00	b. Cost saved for not cultivating sesame	23,502.00
Total	90,972.00	Total	127,003.00
Net change in farm income (Tk/ha) = (127,003.00 – 90,972.00) = 36,031.00			

Source: *Adapted from Afsar (2013, p. 77).*

The key point which has been explored through this discussion is that, households following rice-sunflower cropping pattern have higher income and better food security status than those who have not been producing sunflower in the study area.

Farmers' Perception about Sunflower Cultivation

The responses of farmers regarding sunflower cultivation were analyzed and presented in Table 6. After realizing the positive impacts of sunflower farming on household income and food security many farmers were willing to choose rice-sunflower cropping pattern. Some farmers have had an innovative idea to grow sunflower; and some of them are still hesitating to grow this crop.

Some farmers were a bit worried about the risk of adopting a new crop like sunflower in their cropping pattern. As the production cost of sunflower is relatively higher than the sesame many of them were hesitating to produce sunflower. On the other hand, farmers who produced sunflower did not get the fair price for their product. In the study area, there is no formal market for sunflower. As a consequence, many of sunflower producers were uncertain to get fair price of their product and often they could not sell sunflower to nearby market when farmers were required some cash to meet basic needs of households. Despite the fact, some farmers were interested to cultivate sunflower as they knew about the higher per hectare yield of sunflower. Sunflower is mainly grown in the study area for edible oil and it was used mainly for cooking purposes in the households. Another advantage was that the farmers who grew sunflower did not buy edible oil like soybean and/or mustard oil from market by spending their huge amount of household income. Nevertheless, the current adoption rate of sunflower is, perhaps, far better than ever before.

The farmers were divided into three groups. Some of them wanted to cultivate only sesame, some of them wanted to cultivate only sunflower and the third group wanted to cultivate both sesame and sunflower. In the study area 40.00 percent farmers gave their opinions in favour of only sesame production since its production technique is very simple and well known to them; and they can have cash by selling it at any time in the local market. 25.00 percent of the total sampled farmers were in favour of sunflower production. Meanwhile, these farmers have had a good impression about sunflower production. The reasons behind this positive attitude about sunflower cultivation were that they could properly utilize their land as well as surplus family labour; also met the demand of edible oil from owned households and having profit.

Finally, 70 farmers were in favour of both sesame and sunflower production which was 35.00 percent of the total due to the suitability of land area, facility of irrigation water (Table 6). They argued that all lands were not suitable for sunflower cultivation since irrigation facilities were not available to those plots.

Table 6 : Farmers' Willingness toward Crop Production

Farmers' opinions regarding crop cultivation	Number of respondents	% of total
In favour of sesame cultivation	80	40.00
In favour of sunflower cultivation	50	25.00
In favour of both sesame and sunflower cultivation	70	35.00
Total	200	100.00

Source: *Adapted from Afsar (2013, p. 80).*

4. Policy Implications and Conclusion

This study confirmed that the rice-sunflower cropping pattern is more profitable than the traditional rice-sesame pattern from the viewpoints of individual farmers. Sesame growing farmers had to face a lot of crucial problems such as saline water, water logging and risk of yield variability due to rainfall. To reduce these problems as well as risk of growing sesame, sunflower may be considered as a risk-free, high yielding and income generating good substitute for sesame. The concerned extension and NGO officials should, therefore, encourage farmers to adopt this new pattern in polder areas of Batiaghata Upazila in Khulna district for making more household income and food security.

As marketing system of sunflower as a completely new crop has not yet been developed in the study area, many local farmers are still in horns of a dilemma whether or not they should grow sunflower in their plots although it is a profitable crop. This profit could further be increased if efficient marketing system could be developed within the shortest possible time in the study area. The policy makers and/or concerned officials must pay an immediate attention to solve marketing problems of the sunflower farmers.

It can, therefore, cautiously be concluded that this new rice-sunflower cropping pattern positively affects the farm productivity and food availability at the household level and thereby overall food security of the polder farmers. The new rice-sunflower cropping pattern can be adopted elsewhere in the polder areas and thus the farmers can have higher household income and better food security status than followers of those of the traditional rice-sesame cropping pattern.

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Appendix Table 1
Activity Budgets: Per Hectare T. Aman Rice Production

Items of returns /costs	Total quantity/ha	Per unit price (Tk)	Returns/Costs (Tk/ha)	% of total
A. Gross Returns				
Main product (Rice)	3046 kg	17.00	51,782.00	92.07
By-product (Straw)	n.a	-	4456.00	7.92
Total returns	-	-	56,238.00	100
B. Gross Costs				
C. Variable Costs				
Seedlings	n.a	-	3627.00	10.28
Power tiller	3 times	8/decimal	5928.00	16.81
Human labour	69 Man-day	300/Man-day	20,700.00	58.69
Urea	92 kg	20.00/kg	1840.00	5.22
TSP	57 kg	22.00/kg	1254.00	3.56
MOP	16 kg	16.00/kg	256.00	0.73
Fertilizers cost	-	-	3350.00	9.50
Insecticides	n.a	-	1087.00	3.08
Total	-	-	34,692.00	98.36
D. Fixed Costs				
Interest on OC	-	@10%	578.00	1.64
Total	-	-	578.00	1.64
E. Total costs	-	-	35,270.00	100.00
F. Gross Margin (A - C)		-	21,546.00	-
G. **Net Return** (A - E)		-	20,968.00	-

Source: *Adapted from Afsar (2013, p. 63).*

Appendix Table 2
Activity Budgets: Per Hectare Sesame Production

Items of return/cost	Total quantity/ha	Per unit price (Tk)	Returns/costs (Tk/ha)	% of total
A. Gross Returns				
Yield	952 kg	44.00	41,888.00	100
B. Gross Costs				
C. Variable Costs				
Seed	11 kg	54/kg	594.00	2.53
Power tiller	3 times	8/decimal	5928.00	25.22
Human labour	55 Man-day	300/Man-day	16500.00	70.21
Fertilizers cost	-	-	-	-
Insecticides	-	-	-	-
Total	-	-	23,022.00	97.96
D. Fixed Costs				
Interest on OC	-	@10%	480.00	2.04
Total	-	-	480.00	2.04
E. Total costs	-	-	23,502.00	100.00
F. Gross Margin (A - C)		-	18,866.00	-
G. Net Return		-	18,386.00	-

Source: *Adapted from Afsar (2013, p. 64).*

Appendix Table 3
Activity Budgets: Per Hectare Sunflower Production

Items of costs/ returns	Total quantity/ha	Per unit price (Tk)	Costs/returns (Tk/ha)	% of total
A. Gross Returns				
Main product	1957 kg	51.00	99,807.00	96.43
By-product	n.a	-	3694.00	3.57
Total returns	-	-	103,501.00	100
B. Gross Costs				
C. Variable Costs				
Seed	10 kg	1060.00/ kg	10,600.00	21.60
Power tiller	3 times	8/decimal	5928.00	12.08
Human labour	75 Man-day	300/ Man-day	22500.00	45.84
Urea	124 kg	20.00/kg	2480.00	5.05
TSP	106 kg	22.00/kg	2332.00	4.75
MOP	56 kg	15.00/kg	840.00	1.71
Gypsum	-	-	-	
Fertilizers cost	-	-	5652.00	11.51
Irrigation		-	2465.00	5.02
Insecticides	n.a	-	1134.00	2.31
Total	-	-	48,279.00	98.36
D. Fixed Costs				
Interest on OC	-	@10%	805.00	1.64
Total	-	-	805.00	1.64
E. Total costs	-	-	49,084.00	100.00
F. Gross Margin (A - C)		-	55,222.00	-
G. Net Return		-	54,417.00	

Source: *Adapted from Afsar (2013, p. 64).*