Economics of shifting land from field crops to hog plum (*Spondias mombin* L.) cultivation in southern Bangladesh

M.H.K. Sujan1*, A.K. Ghosh1, M. Sultana2, F. Islam2 and F.T. Sadia2

Received 31 October 2020, Revised 10 December 2020, Accepted 24 December 2020, Published online 31 December 2020

**A B S T R A C T**

The study was carried out to analyse the economics of shifting land from field crops to hog plum cultivation in southern Bangladesh during July to September 2018. A total of 120 farmers were selected by using multistage stratified random sampling technique to collect primary data. Result of the study shows that the per hectare average total cost of hog plum cultivation was Tk. 94,126. The average yield of hog plum was 7.97 t ha⁻¹. Net return from hog plum cultivation was Tk. 126,921 per hectare. By cultivating hog plum, farmers obtained 56 to 93% higher net return than the other existing cropping patterns. Since the BCR (2.94), NPV (Tk. 2215,000) and IRR (59%) were very high, the land shifting decision towards hog plum cultivation was sensible. However, BCR was very low in the initial stages of hog plum plantation. Initial investment support from public or private sector could facilitate the growth of this cultivation practice.

**Keywords:** Influencing factors, Land shifting, Multiple regression, Profitability, Project analysis.

1Dept. of Development and Poverty Studies, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. 2Dept. of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

*Corresponding author’s email: mhksujan@sau.edu.bd (M.H.K. Sujan)

Cite this article as: Sujan, M.H.K., Ghosh, A.K., Sultana, M., Islam, F. and Sadia, F.T. 2020. Economics of shifting land from field crops to hog plum (*Spondias mombin* L.) cultivation in southern Bangladesh. Int. J. Agril. Res. Innov. Tech. 10(2): 155-163. https://doi.org/10.3329/ijarit.v10i2.51589

**Introduction**

Per capita income, food production and GDP of Bangladesh has been increasing over the time (BBS, 2019). With the social and economic development of the country, food consumption pattern has changed in favour of high value crops such as fruits and vegetables from staple food crops (Joshi, 2005). In recent years, demand for fruits has grown much faster than the demand of food grains. Production and distribution of fruits have opened up a great opportunity for achieving food, nutritional and financial security of the country (Khandoker et al., 2017). The consumption pattern of the people depicts that there has been a constant increase in demand for fruits as compared to other crops in recent years. The total cultivable land under fruits production raised from 0.86% in fiscal year (FY) 2014-15 to 2.80% in FY 2018-19 (BBS, 2019). In 2019, national fruits production was about 4.95 million metric tons and around 11.06 lakh acres of land were used for that purpose (BBS, 2019). Among the various fruits; banana, mango, jackfruit, litchi and guava are mostly important as these are being commercially cultivated in Bangladesh. Besides these, the cultivation of hog plum is gaining popularity among farmers due to its promising higher profitability (Islam and Sujan, 2016). Amaechi (2015) found that hog plum farmers would have both economic and aesthetic benefit if they cultivate it on their fallow or cultivable lands. Hog plum is grown well throughout the southern parts of the country (Rahman, 2015). The soil and climatic conditions of Bangladesh, especially southern regions, are suitable for hog plum cultivation. In 2018-2019, the area under hog plum production was about 18,437 acres and the total production was about 40,623 metric tons (BBS, 2019). Moreover, huge portions of lands in southern parts of the country are now substituting to hog plum cultivation. The growth rates of yield, production and area of hog plum are increasing year after year. Hog plum has emerged as an important option for crop diversification in the southern parts of the country (Islam and Sujan, 2016). With this option, people of those parts of the country ensure a continuous source of income even without their conventional agricultural practices. The land alteration decisions are generally investigated at the macro level by using distributive lag model, which capture the role of different economic and non-economic factors of...
decision making process. However, research works related to land shifting behaviour from field crops to fruits cultivation are very rare. Khandoker et al. (2014) attempted to analyse the impact of shifting land from cereal crops to Jujube cultivation in northern region of Bangladesh. Sarker et al. (2014) and Khandoker et al. (2017) investigated the profitability of shifting land from field crops to mango cultivation in northern Bangladesh. However, there was a serious dearth of literature on the production and distribution of hog plum fruits in southern Bangladesh. Therefore, an attempt was taken to analyse the economics of shifting land from field crops to hog plum cultivation in southern Bangladesh.

Methodology

A micro-level study based on primary cross-section data was designed to attain the objectives of this study. The methodology of the study was mainly about the sampling procedure, collection of data and analytical framework.

Area selection: The study was conducted in two major hog plum (amra) growing districts of Bangladesh, namely Jhalokathi and Pirojpur. Jhalokathi sadar upazila and Pirojpur sadar upazila under Jhalokathi and Pirojpur district, respectively, were selected purposively for administering questionnaire survey. For this study, primary data were collected by using pre-tested questionnaire during the month of July to September, 2018.

Sampling technique and sample size: A multistage stratified random sampling technique was followed to select sample farmers for the study. At first, two districts were selected purposively considering their higher quantities of hog plum (amra) production. In the second stage, one upazila from each district and two villages from each upazila were selected accordingly. Finally, sixty farmers were selected randomly from each district amassing a total of 120 farmers from the total study areas. Population stratification was necessitated for common heterogeneity among agricultural household (Nyariki, 2009). Special attention was given to ensure the representativeness of different aged plantation of hog plum. Collected data were rearranged based on the span of hog plum cultivation. The respondents were categorized according to their stage of hog plum cultivation as 1st year, 2nd-3rd year, 4th-5th year, 6th-10th year, 11th-15th year and 16th-20th year.

The IRR was calculated with the following formula:

\[
\text{Internal Rate of Return (IRR)} = \frac{\text{Lower discount rate} + \text{Difference between two discount rates} \times \frac{\text{Present worth of cash flows at lower discount rate}}{\text{Absolute difference between the present worth of the cash flows}}}{\text{Present worth of cash flows at lower discount rate}}
\]

Analytical techniques

a) Tabular technique: Collected data were edited, summarized, tabulated and analysed to fulfill the purpose of this study. Descriptive statistics like averages, percentages and ratios were used in presenting the results in a tabular form. The profitability of hog plum cultivation was examined on the basis of gross return (GR), gross margin (GM), net return (NR) and benefit cost ratio (BCR) analysis. Besides, the imputed value of family labour was taken into account in the time of total cost approximation. Per year lease value of land was considered for determining the land use cost. Project analysis and sensitivity analysis were also included on the paper. Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) were calculated (at 5% discount rate) with the following formulas used by Sarker et al. (2014) and Khandoker et al. (2017):

Net Present Value (NPV): The net present value (NPV) of an investment is the discounted value of all cash inflows and cash outflows of the project during its lifetime. It can be computed as:

\[
\text{NPV} = \sum_{t=1}^{n} \frac{B_t - C_t}{(1 + r)^t}
\]

Benefit Cost Ratio (BCR): The benefit cost ratio (BCR) of an investment is the ratio of the discounted value of all cash inflows to the discounted value of all cash outflows during the life of the project. It can be estimated using the following formula:

\[
\text{BCR} = \sum_{t=1}^{n} \frac{B_t}{C_t (1 + r)^t}
\]

Internal Rate of Return (IRR): Internal rate of return (IRR) is the rate of return at which the NPV of a stream of incomes is nullified. The IRR is computed as:

\[
r = \frac{\text{Present worth of cash flows}}{\text{Absolute difference between the present worth of the cash flows}} - \text{Average discount rate}
\]

Where, \( B_t \) = Total benefit (Tk. ha\(^{-1}\)) in time \( t \) 
\( C_t \) = Total cost (Tk. ha\(^{-1}\)) in time \( t \) 
\( r \) = Rate of interest (discount rate) 
\( t \) = Number of years (\( t = 1, 2, 3 \ldots \ldots 20 \))
b) Statistical technique

Multiple regression model

The OLS regression model was used to analyse the factors influencing the extent of land shifting behaviour, where both the economic and non-economic factors were considered as explanatory variable. The relative income was included as explanatory variable to test its extent of influence. The following multiple linear regression function was fitted for present study-

\[ Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U_i \]

Where, \( Y \) = Shift of area from field crops to hog plum cultivation (decimal)
\( X_1 \) = Relative income (‘1000 Tk. ha\(^{-1}\) year\(^{-1}\))
\( X_2 \) = Yield (t ha\(^{-1}\))
\( X_3 \) = Education (years of schooling)
\( X_4 \) = Farm size (decimal)
\( X_5 \) = Age of the farmers (year)
\( X_6 \) = Hog plum farming experience (year)
\( X_7 \) = Non-farm income (‘1000 Tk. ha\(^{-1}\) year\(^{-1}\))

\( \alpha \) = Intercept
\( \beta_1, \beta_2, \ldots, \beta_8 \) = Coefficients of the respective variables to be estimated
\( U_i \) = Random error

Results and Discussion

Intercropping with hog plum

A portion of the sample farmers practice intercropping with hog plum. Among the intercrops, majority of the farmers (23.33%) preferred intercropping with potato & arum followed by bitter gourd & cauliflower (20.83%), snake/water gourd & cabbage (18.33%), sweet gourd & tomato (17.50%), papaya (15.00%), Indian spinach & red amaranth (13.33%), chili (11.67%) and brinjal (10.83%) (Table 1). The study also found that 14.17% of the farmers did not adopt any intercrops with hog plum cultivation. Reason behind that no intercropping might be the extra care for hog plum saplings.

Cost of hog plum cultivation (including intercrops)

For estimating the cost of production, all the variable cost i.e. land preparation, human labour, sapling, manures, fertilizer, insecticides, etc. were calculated per hectare basis. Both cash cost and imputed value of family supplied inputs were included in the calculation. Interest on operating capital (IOC) was also considered for determining the cost of hog plum cultivation. The cost of land use was calculated on the basis of per hectare lease value of land. Table 2 represents the cost of hog plum cultivation in different years. The average total cost of hog plum cultivation in all years was Tk. 94,126 per hectare of which 65% were variable cost. Land use cost comprised the largest share (33%) of the total cost. On an average, labour cost contributed 27% of the total cost. Fertilizers cost shared only 6% of the total cost. Farmers in the study areas spent on an average, Tk. 14,787 (16% of total cost) per hectare for cultivating intercrops. The cost for saplings and supporting sticks were Tk. 20,232 and Tk. 4,130 per hectare, respectively and incurred on the first year only. Land preparation cost was Tk. 14,165 and incurred at the beginning of the project. Most of the cases, in the first year, farmers took extra care of hog plum saplings. For this reason, the cost and benefits from intercropping in the first year were comparatively low.

Table 1. Types of crops cultivated in hog plum field as intercrop.

| Types of crop                          | % farmers responded | Average |
|----------------------------------------|---------------------|---------|
|                                        | Pirojpur            | Jhalokathi |
| Potato & Arum                         | 25.00               | 21.67   | 23.33 |
| Bitter gourd & Cauliflower            | 21.67               | 20.00   | 20.83 |
| Snake/Water gourd & Cabbage           | 20.00               | 16.67   | 18.33 |
| Sweet gourd & Tomato                  | 16.67               | 18.33   | 17.50 |
| Papaya                                | 16.67               | 13.33   | 15.00 |
| Indian spinach & Red amaranth         | 15.00               | 11.67   | 13.33 |
| Chilli                                | 13.33               | 10.00   | 11.67 |
| Brinjal                               | 11.67               | 10.00   | 10.83 |
| No intercrops                         | 15.00               | 13.33   | 14.17 |

\[ X_8 = \text{Food crop (wheat/rice) requirement at home ('1000 Tk.)} \]
\[ \alpha = \text{Intercept} \]
\[ \beta_1, \beta_2, \ldots, \beta_8 = \text{Coefficients of the respective variables to be estimated} \]
\[ U_i = \text{Random error} \]
Table 2. Cost of hog plum cultivation including intercrops (figured in Tk. ha⁻¹).

| Particulars                  | 1st year | 2nd-3rd year | 4-5th year | 6-10th year | 11-15th year | 16-20th year | All years |
|-----------------------------|----------|--------------|------------|-------------|--------------|--------------|-----------|
| A. Variable Cost            | 91506    | 49521        | 56229      | 60445       | 59029        | 51108        | 61306     |
| Hired labour                | 11876    | 9873         | 16794      | 22197       | 24679        | 19737        | 17526     |
| Family labour               | 10917    | 7246         | 7368       | 6376        | 5310         | 5194         | 7072      |
| Land preparation            | 14165    | 0            | 0          | 0           | 0            | 2361         | 3372      |
| Saplings                    | 20232    | 0            | 0          | 0           | 0            | 3372         | 4042      |
| Manures                     | 7398     | 2122         | 1511       | 495         | 1100         | 2538         | 2527      |

| Fertilizers                 |          |              |            |             |              |              |          |
|-----------------------------|----------|--------------|------------|-------------|--------------|--------------|-----------|
| Urea                        | 1628     | 1420         | 1524       | 1361        | 1137         | 1257         | 1388      |
| TSP                         | 3980     | 3730         | 2573       | 1976        | 2365         | 1886         | 2752      |
| MoP                         | 1824     | 1129         | 1047       | 986         | 1328         | 1205         | 1253      |
| Gypsum                      | 220      | 192          | 147        | 171         | 0            | 124          | 142       |
| Insecticides                | 3492     | 2758         | 3869       | 3578        | 4036         | 3579         | 3552      |
| Irrigation                  | 4268     | 3683         | 4587       | 3921        | 3890         | 2968         | 3886      |
| Stick                       | 4130     | 0            | 0          | 0           | 0            | 688          | 613       |
| Intercrop                   | 7376     | 17368        | 16791      | 19384       | 15184        | 12620        | 14787     |

| B. Fixed cost               | 33575    | 32525        | 32693      | 32798       | 32763        | 32565        | 32820     |
| Interest on operating capital | 2288   | 1238         | 1406       | 1511        | 1476         | 1278         | 1533      |
| Land use cost               | 31287    | 31287        | 31287      | 31287       | 31287        | 31287        | 31287     |
| Total Cost (A+B)            | 125081   | 82046        | 88922      | 93243       | 91792        | 83673        | 94126     |

Note: Figures in the parentheses indicate the percentage of total cost.

**Profitability of hog plum cultivation**

In the study areas, average yield of hog plum was 7.97 t ha⁻¹ year⁻¹. Farmers did not get any yield from hog plum cultivation in the first year. They started getting yield from 3rd years of plantation. On 4th year, yield was 5.32 t ha⁻¹. The highest amount of yield (15.15 t ha⁻¹) obtained from 11 to 15 years old hog plum garden. After 15 years, yield rate had decreased. Returns from hog plum cultivation in different years are presented in Table 3. Average gross return per hectare was Tk. 221,047 per year. The average gross return from intercrops was Tk. 29,867 per hectare. The highest net return was also found in the 11th-15th year (Tk. 297,825 ha⁻¹ year⁻¹) followed by 6th-10th year (Tk. 286,904 ha⁻¹ year⁻¹). Average gross margin and net margin of hog plum cultivation were Tk. 159,741 and Tk. 126,921 per hectare, respectively. In the study areas, farmers have to spend on an average Tk. 12 for producing 1 kg hog plum. The average undiscounted BCR on total cost was 2.47. Higher cost incurred in the first couple of years for hired labour, land preparation, sapling, manures and sticking with no return from hog plum influenced the BCR to be lowest in the initial years of plantation.

Table 3. Profitability of hog plum cultivation with intercrops.

| Particulars                  | 1st year | 2nd-3rd year | 4-5th year | 6-10th year | 11-15th year | 16-20th year | Average |
|-----------------------------|----------|--------------|------------|-------------|--------------|--------------|---------|
| A. Total cost (Tk. ha⁻¹)    | 125081   | 82046        | 88922      | 93243       | 91792        | 83673        | 94126   |
| Variable cost               | 91506    | 49521        | 56229      | 60445       | 59029        | 51108        | 61306   |
| Fixed cost                  | 33575    | 32525        | 32693      | 32798       | 32763        | 32565        | 32820   |
| Cost of intercrops          | 7376     | 17368        | 16791      | 19384       | 15184        | 12620        | 14787   |
| B. Yield of hog plum (kg ha⁻¹) | 0     | 1830         | 5320       | 14250       | 15150        | 11245        | 7966    |
| C. Price (Tk. kg⁻¹)         | 24       | 24           | 24         | 24          | 24           | 24           | 24      |
| D. Gross return of hog plum (Tk. ha⁻¹) | 0     | 43920        | 127680     | 342000      | 363600       | 269880       | 191180  |
| E. Gross return of intercrop (Tk. ha⁻¹) | 20381  | 35194        | 39505      | 38147       | 26017        | 19958        | 29867   |
| F. Total gross return (Tk. ha⁻¹) | 20381  | 79114        | 167185     | 380147      | 389617       | 289838       | 221047  |
| G. Gross margin (Tk. ha⁻¹)  | -71125   | 29593        | 110956     | 319702      | 330588       | 238730       | 159741  |
| H. Net return (Tk. ha⁻¹)    | -104700  | -2932        | 78263      | 286904      | 297825       | 206165       | 126921  |
| I. BCR on TC (undiscounted) | 0.16     | 0.96         | 1.88       | 4.08        | 4.24         | 3.46         | 2.47    |
| J. Per unit production cost (Tk. kg⁻¹) | -     | 51           | 18         | 7           | 6            | 8           | 12      |
Returns on investment in hog plum cultivation

Most of the cases, opportunity cost of capital is considered as the discount rate for project analysis. The results of this calculation presented on Table 4 and Table 5. For assessing benefit-cost ratio (BCR) and net present value (NPV), the costs and returns were discounted at 5% rate of interest.

Table 4. Financial analysis of hog plum cultivation project in the study areas.

| Year | Gross cost (Tk.) | Gross benefit (Tk.) | Discount factor at 5% | PW of cost at 5% | PW of benefit at 5% |
|------|------------------|---------------------|----------------------|-----------------|---------------------|
| 1    | 125081           | 20381               | 0.952                | 119125          | 19410               |
| 2    | 82046            | 79114               | 0.907                | 74418           | 71759               |
| 3    | 82046            | 79114               | 0.864                | 70874           | 68342               |
| 4    | 88922            | 167185              | 0.823                | 73156           | 137544              |
| 5    | 88922            | 167185              | 0.784                | 69673           | 130994              |
| 6    | 93243            | 380147              | 0.746                | 66979           | 283672              |
| 7    | 93243            | 380147              | 0.711                | 66266           | 270163              |
| 8    | 93243            | 380147              | 0.677                | 63111           | 257298              |
| 9    | 93243            | 380147              | 0.645                | 60105           | 245046              |
| 10   | 93243            | 380147              | 0.614                | 57243           | 233377              |
| 11   | 97912            | 389617              | 0.585                | 53699           | 227801              |
| 12   | 97912            | 389617              | 0.557                | 51113           | 216953              |
| 13   | 97912            | 389617              | 0.530                | 48679           | 206622              |
| 14   | 97912            | 389617              | 0.505                | 46361           | 196783              |
| 15   | 97912            | 389617              | 0.481                | 44154           | 187412              |
| 16   | 83673            | 289838              | 0.458                | 38332           | 132778              |
| 17   | 83673            | 289838              | 0.436                | 35606           | 126455              |
| 18   | 83673            | 289838              | 0.416                | 34768           | 120434              |
| 19   | 83673            | 289838              | 0.396                | 33112           | 114699              |
| 20   | 83673            | 289838              | 0.377                | 31535           | 109237              |
| Total|                 |                     |                      | 1141780         | 3356780             |

| Net present worth | (PW of benefit at 5%)-(PW of cost at 5%) | 2215000 |
| BCR               | (PW of benefit at 5%)/(PW of cost at 5%)  | 2.94    |

Table 5. Financial analysis of hog plum cultivation project in the study areas.

| Year | Incremental benefit | Discount factor at 55% | PW of benefit at 55% | Discount factor at 60% | PW of benefit at 60% |
|------|---------------------|------------------------|----------------------|------------------------|----------------------|
| 1    | -104700             | 0.645161               | -67548.39            | 0.625000               | -65437.50            |
| 2    | -2932               | 0.416233               | -1220.40             | 0.390625               | -1145.31             |
| 3    | -2932               | 0.268537               | -787.35              | 0.244141               | -715.82              |
| 4    | 78263               | 0.173250               | 13559.06             | 0.152588               | 11941.99             |
| 5    | 78263               | 0.117774               | 8747.78              | 0.095367               | 7463.74              |
| 6    | 286904              | 0.072112               | 20689.33             | 0.059605               | 17100.81             |
| 7    | 286904              | 0.046524               | 13347.95             | 0.037253               | 10688.01             |
| 8    | 286904              | 0.030016               | 8611.58              | 0.023283               | 6680.00              |
| 9    | 286904              | 0.019365               | 5555.86              | 0.014552               | 4175.00              |
| 10   | 286904              | 0.012493               | 3584.43              | 0.009095               | 2609.38              |
| 11   | 297825              | 0.008606               | 2400.56              | 0.005684               | 1692.94              |
| 12   | 297825              | 0.005200               | 1548.75              | 0.003553               | 1058.09              |
| 13   | 297825              | 0.003355               | 999.19               | 0.002220               | 661.30               |
| 14   | 297825              | 0.002164               | 644.64               | 0.001388               | 415.32               |
| 15   | 297825              | 0.001396               | 415.90               | 0.000867               | 258.32               |
| 16   | 206165              | 0.000901               | 185.74               | 0.000542               | 111.76               |
| 17   | 206165              | 0.000581               | 119.83               | 0.000339               | 69.85                |
| 18   | 206165              | 0.000375               | 77.31                | 0.000212               | 43.66                |
| 19   | 206165              | 0.000242               | 49.88                | 0.000132               | 27.29                |
| 20   | 206165              | 0.000156               | 32.18                | 0.000083               | 17.05                |
| Total|                    |                        | 11013.85             |                        | -2286.13             |
The benefit cost ratio (BCR) was calculated by dividing the present worth of the gross benefit by the present worth of the gross cost. BCR was 2.94 at 5% discount rate, which implies that the project was profitable. The simplest discounted cash flow measures of the project worth is the net present worth (Khandoker et al., 2017) which is determined by subtracting present worth of costs from present worth of benefits. The estimated net present worth of the project was Tk. 2215,000 per hectare.

Average earning capacity of capital used in a project over the project life is represented by internal rate of returns (IRR). It refers to that discount rate which negates the present worth of cash inflows and outflows. In the project of hog plum cultivation, IRR was 59%. This opportunity was highly acceptable because it was much higher than the opportunity cost of capital.

### Sensitivity analysis

The effects of adverse changes in the project are estimated by sensitivity analysis. Three adverse situations are assessed for the project under this study. The first situation is constant return but cost increased by 10%. The second situation is constant cost but return decreased by 10%. The third situation is both cost increased and return decreased by 10%. The results of sensitivity analysis are presented in Table 6. At 5% discount rate, greater than one BCR, positive NPV and higher IRR than opportunity cost of capital imply that investment in hog plum cultivation was remunerative for 10% increased cost with constant return, 10% decreased return with constant cost, even at the worst situation of 10% increased cost with 10% decreased return.

### Profitability of existing cropping patterns other than hog plum

*Cropping patterns followed by farmers before shifting land to hog plum cultivation*

Farmers of the study areas follow various types of cropping pattern. Most of them cultivate two crops in a year. Some of them cultivate three crops also. Before starting hog plum cultivation, they cultivated mainly Boro, T. Aman, T. Aus, Pulse crops (mostly Kheshari), Potato and some short duration vegetables. A total of 18 types of cropping patterns were found. Mostly followed 8 cropping patterns are presented in Table 7. The highest percentage (22.50%) of farmers mentioned that they followed Fallow-T. Aus-T. Aman cropping pattern followed by Boro-Fallow-T. Aman (20.00%), Pulse-Fallow-T. Aman (12.50%), Potato-Fallow-T. Aman (10.00%) and Boro-Fallow-Fallow (8.33%) in their field before starting hog plum cultivation.

### Table 6. Result of sensitivity analysis of hog plum cultivation.

| Situation                                     | BCR at 5% | NPV at 5% (Tk.) | IRR (%) |
|-----------------------------------------------|-----------|-----------------|---------|
| Current situation                              | 2.94      | 2215000         | 59      |
| Cost increased by 10% but return constant      | 2.67      | 2100822         | 53      |
| Cost constant but return decreased by 10%      | 2.65      | 1879322         | 52      |
| Cost increased and return decreased by 10%     | 2.41      | 1765144         | 46      |

### Profitability of cereal crops cultivation in the study areas

Potato-Fallow-T. Aman was the most profitable cropping pattern (BCR on TC was 1.37) before shifting land to hog plum cultivation. Details about the calculation are presented on Table 8. Total cost for Potato-Fallow-T. Aman pattern was Tk. 152,535 and net return was Tk. 56,438 per...
 hectare. Per hectare total cost for Pulse-Fallow-T. Aman pattern was Tk. 105,250 whereas it was Tk. 126,355 for Wheat-Fallow-T. Aman pattern. Boro- Fallow-T. Aman pattern required Tk. 91,783 as total cost, which was lower than that of Boro- T. Aus-Fallow (Tk. 93,237 ha⁻¹). The net return of different cropping pattern varies from Tk. 9,391 (Boro-Fallow-Fallow) to Tk. 56,438 (Potato-Fallow-T. Aman). Estimated BCR on total cost ranged from 1.16 to 1.37 along with different practiced pattern. On the other hand, it ranged from 1.49 to 1.84 based on variable cost.

Table 8. Profitability of cereal crops cultivation (figured in Tk. ha⁻¹).

| Cropping pattern | Total Cost | Total Variable Cost | Gross Return | Gross Margin | Net Return | BCR on TC | BCR on TVC |
|------------------|------------|---------------------|--------------|--------------|------------|-----------|------------|
| Potato-Fallow-T. Aman | 152535 | 133752 | 208973 | 95401 | 56438 | 1.37 | 1.84 |
| Pulse-Fallow-T. Aman | 105250 | 77050 | 137878 | 60828 | 32628 | 1.31 | 1.79 |
| Wheat-Fallow-T. Aman | 129355 | 91477 | 160470 | 68933 | 3415 | 1.27 | 1.76 |
| Boro-Fallow-Vegetables | 121208 | 89715 | 151510 | 61795 | 30302 | 1.25 | 1.69 |
| Boro-T. Aus-Fallow | 93237 | 61235 | 111682 | 50447 | 18445 | 1.20 | 1.82 |
| Boro-Fallow-T. Aman | 91783 | 61018 | 109222 | 48204 | 17439 | 1.19 | 1.79 |
| Fallow-T. Aus-T. Aman | 65785 | 48201 | 77626 | 28705 | 11841 | 1.18 | 1.59 |
| Boro-Fallow-Fallow | 58691 | 45627 | 68082 | 22455 | 9391 | 1.16 | 1.49 |

Relative profitability of hog plum cultivation in contrast to other prevailing crops

The costs and returns of different cropping pattern were compared with hog plum cultivation to analyse the comparative profitability. The cost of hog plum cultivation were higher than that of Boro-T. Aus-Fallow, Boro-Fallow-T. Aman, Fallow-T. Aus-T. Aman and Boro-Fallow-Fallow cropping pattern. On the other hand, for Potato-Fallow-T. Aman, Pulse-Fallow-T. Aman, Wheat- Fallow-T. Aman and Boro-Fallow-Vegetables cropping pattern, the production cost were higher than that of hog plum cultivation. Details information regarding relative profitability of hog plum cultivation are presented on Table 9 and Table 10. Total cost of Boro-Fallow-Fallow cropping pattern was 38% lower than that of hog plum cultivation whereas it was 62% and 34% higher for Potato-Fallow-T. Aman and Wheat-Fallow-T. Aman cropping pattern, respectively. However, in monetary term, per hectare total cost incurred for hog plum cultivation was Tk. 35,435 more than that of Boro-Fallow-Fallow cultivation whereas it was Tk. 58,409 less than that of Potato-Fallow-T. Aman cropping pattern.

The gross return and net return from hog plum cultivation were higher than that of all the inspected cropping patterns. Hog plum cultivators secured 69% higher gross return than that of Boro-Fallow-Fallow cropping pattern. Farmers obtained 56 to 93% higher net return than the cropping patterns analysed in this study. BCR of hog plum cultivation was also higher than that of any other examined cropping patterns.

Table 9. Relative profitability of hog plum cultivation with other prevailing crops.

| Comparing points | Boro-T. Aus-Fallow | Boro-Fallow-T. Aman | Fallow-T. Aus-T. Aman | Boro-Fallow-Fallow |
|------------------|--------------------|---------------------|----------------------|-------------------|
| Total cost lower than hog plum (Tk.) | 889 | 2343 | 28341 | 35435 |
| Total cost lower than hog plum (%) | 1 | 2 | 30 | 38 |
| Gross return lower than hog plum (Tk.) | 109365 | 111825 | 143421 | 152965 |
| Gross return lower than hog plum (%) | 49 | 51 | 65 | 69 |
| Net return lower than hog plum (Tk.) | 108476 | 109482 | 115080 | 117530 |
| Net return lower than hog plum (%) | 85 | 86 | 91 | 93 |

Table 10. Relative profitability of hog plum cultivation with other prevailing crops.

| Comparing points | Potato-Fallow-T. Aman | Pulse-Fallow-T. Aman | Wheat-Fallow-T. Aman | Boro-Fallow-Vegetables |
|------------------|-----------------------|----------------------|----------------------|------------------------|
| Total cost higher than hog plum (Tk.) | 58409 | 11124 | 32229 | 27082 |
| Total cost higher than hog plum (%) | 62 | 12 | 34 | 29 |
| Gross return lower than hog plum (Tk.) | 12074 | 83169 | 60577 | 69537 |
| Gross return lower than hog plum (%) | 5 | 38 | 27 | 31 |
| Net return lower than hog plum (Tk.) | 70483 | 94293 | 92806 | 96619 |
| Net return lower than hog plum (%) | 56 | 74 | 73 | 76 |
Factors influencing the land shifting decision towards hog plum cultivation

Multiple linear regression analysis was done for investigating the influence of different factors for shifting land from field crops to hog plum cultivation. Estimated results are presented on Table 11. The explanatory variables included in the model explained around 82.95% of variations in land shifting behaviour. The significant F-value (73.38) indicates that all the explanatory variables included in the regression model were important.

Table 11. Factors influencing the land shifting decision of farmers towards hog plum cultivation.

| Explanatory Variable                        | Parameters | Co-efficient | Sd. Error | P-values |
|--------------------------------------------|------------|--------------|-----------|----------|
| Intercept                                  | β₀         | 69.845***    | 25.834    | 0.008    |
| Relative income (Tk. ha⁻¹ year⁻¹)           | β₁         | 0.639'       | 0.354     | 0.074    |
| Yield (t ha⁻¹)                             | β₂         | 0.049        | 8.830     | 0.996    |
| Education (years of schooling)              | β₃         | 0.431        | 2.088     | 0.837    |
| Farm size (decimal)                        | β₄         | 0.108'       | 0.063     | 0.091    |
| Age of the farmers (year)                  | β₅         | -0.818'      | 0.428     | 0.059    |
| Hog plum farming experience (year)         | β₆         | 0.245        | 1.491     | 0.870    |
| Non-farm income (Tk. ha⁻¹ year⁻¹)          | β₇         | 0.094        | 0.880     | 0.915    |
| Food crop requirement (Tk.)                | β₈         | -0.696'      | 0.366     | 0.060    |
| R²                                         |            | 82.95%       |           |          |
| F-value                                    |            | 73.38        |           |          |

Note: *** and * indicate significant at 1%, and 10% level, respectively.

Conclusions

The study was conducted to analyse the economics of shifting land from field crops to hog plum cultivation. Results of the study show that lower cost of production and higher return from hog plum cultivation than that of any other cropping pattern influenced the farmers to shift their land from field crops to hog plum cultivation. Findings also reveal that BCR of hog plum cultivation was its lowest limit in the initial stage of production but it turned out to be higher onwards till fifteen years of plantation. Support from formal or informal sectors for initial investment might play a pivotal role to flourish this unorthodox cultivation practice. Relative income and farm size had positive effect whereas farmer’s age and food crops requirement had negative effect on land shifting behavior towards hog plum cultivation. Production of hog plum in fallow land or land where other crops are not grown well would increase the relative income and secure available cultivable land for cereal crops. Motivation should be given to the farmers for cultivating hog plum in these lands.

References

Amaechi, O.L. 2015. Evaluation of Uses and Marketing Potential of Spondias mombin Linn. (Hog Plum) in Ibadan Metropolis. Int. J. Agric. Forest. Fish. 3(1): 1-6. Retrieved from: http://www.openscienceonline.com/journal/archive?journalId=706&papierId=1275

BBS. 2019. Year book of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People’s Republic of Bangladesh, Dhaka, Bangladesh. Retrieved from: http://www.bbs.gov.bd/PageWebMenuContent.aspx?MenuKey=234

Islam, F. and Sujan, M.H.K. 2016. Rationality of hog plum cultivation in Jhalokathi district, an empirical analysis in the socio-economic context of Bangladesh. J. A. Soc. Sci. Human. 2(1): 8-18. http://dx.doi.org/10.15520/2126

Joshi, P.K. 2005. Crop Diversification in India: Nature, Pattern and Drivers. National Centre for Agricultural Economics and Policy Research, New Delhi, India. Retrieved from: http://www.adb.org/Documents/Reports/Consultant/Tar-IND-466/Agriculture/joshi.pdf

Khandoker, S., Miah, M.A.M., Khatun, M., Hoq, M.S. and Kundu, N.D. 2014. Impact of shifting of land under cereal crops to jujube cultivation in selected areas of Bangladesh. Bangladesh J. Agril. Res. 39(2): 243-262. http://dx.doi.org/10.3329/bjar.v39i2.20427
Khandoker, S., Miah, M.A.M., Rashid, M.A., Khatun, M. and Kundu, N.D. 2017. Comparative profitability analysis of shifting land from field crops to mango cultivation in selected areas of Bangladesh. *Bangladesh J. Agril. Res.* 42(1): 137-158. [http://dx.doi.org/10.3329/bjar.v42i1.31986](http://dx.doi.org/10.3329/bjar.v42i1.31986)

Nyariki, D.M. 2009. Household data collection for socio-economic research in agriculture: Approaches and challenges in developing countries. *J. Soc. Sci.* 19(2): 91-99. [https://doi.org/10.1080/09718923.2009.11892696](https://doi.org/10.1080/09718923.2009.11892696)

Rahman, H. 2015. Hog plum yield aplenty in Pirojpur: Traders sending the popular fruit to different districts across the country. The Daily Star. Retrieved from: [http://www.thedailystar.net/country/hog-plum-yield-aplenty-pirojpur-137518](http://www.thedailystar.net/country/hog-plum-yield-aplenty-pirojpur-137518)

Sarker, F.I.M.G.W., Biswas, J.C. and Maniruzzaman, M. 2014. Climate change adaptation and economic profitability: Crop land shifting to mango orchard in Rajshahi region. *Bangladesh Rice J.* 18(1&2): 8-17. [http://dx.doi.org/10.3329/brj.v18i1-2.22995](http://dx.doi.org/10.3329/brj.v18i1-2.22995)