# Profitability and Yield Gap Analysis of Binasoybean-3 in Some Selected Areas of Bangladesh

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## ABSTRACT

Soybean is an important oil crop in Bangladesh to ensure high returns and self-sufficiency in oilseed production. This study aimed to estimate yield gap, cost and return, factors and constraints identification. The study was conducted in three major Binasoybean-3 growing areas of Bangladesh, namely Noakhali, Lakshmipur and Barishal. The estimated yield gap I was 0.17 t ha$^{-1}$ (6.97%) and yield gap II was 0.22 t ha$^{-1}$ (9.97%). The lowest total yield gap was 0.33 t ha$^{-1}$ (13.60%) observed in Lakshmipur and it was the highest 0.50 t ha$^{-1}$ (21.05%) in Noakhali district. The average yield gap was 0.39 t ha$^{-1}$ (16.95%). The coefficients for Seed, MoP and Human labor were positively significant at 1% level. On the other hand, numbers of power tiller, urea and pesticide costs were found to be positively significant at 5% level. TSP and Gypsum were found to be positively significant at 10% level. The total cost of production in the field level of Binasoybean-3 was in Tk. 54247.06 ha$^{-1}$, where 33.36% was fixed costs and 66.64% was variable cost**.** The highest cost at the farm level was in Barisal (Tk. 54668.40 ha$^{-1}$) followed by Noakhali and Lakshmipur in Tk. 54253.22 and Tk. 53819.57 ha$^{-1}$, respectively. The major shares of the total cost were human labor, power tiller, fertilizer, seed and power tiller. The highest net return (Tk. 39524.69 ha$^{-1}$) comes from Lakshmipur district and the lowest net return (Tk. 22720.17 ha$^{-1}$) comes from Barishal district. The undiscounted Benefit Cost Ratio (BCR) was 1.73, 1.66 and 1.42 for Binasoybean-3 at the field level for Lakshmipur, Noakhali and Barishal, respectively. The average Benefit Cost Ratio (BCR) was 1.60. Farmers of Binasoybean-3 growing areas faced various constraints to their cultivation non-availability of quality seed at proper time (49.70%), lack of knowledge about improved technology (48.77%), lack of soil moisture during sowing time (45.44%), disease and pest infestation (40.05%), lack of credit facilities (33.66%) and the insufficient or high price of labor in harvesting time (43.11%). Binasoybean-3 production in the study areas was profitable and farmers received a higher return on their investment.

**Key Words:** Yield gap, profitability, Binasoybean-3, constraints and policy guideline.

## INTRODUCTION

Soybean is one of the important oilseeds in Bangladesh due to a lot of foreign exchange is spent for importing edible oils and oilseeds to meet domestic demand (Myint, 2020; Eleuch *et* al., 2021). Every year we produce only 20% oilseed and 80% is imported to meet the demand (Phuong, 2015; Abu *et* al., 2011; Orsi, 2017; El Khier *et* al., 2008). The crop is now grown in a wide range of environments, extending from semi-arid tropics and sub-tropics to temperate regions (Islam *et* al., 2018; Raikwar *et* al., 2013). The world produces about 3 million metric tons of soybean seeds every year on average. World production of soybean was estimated to be 333,671,692 tonnes produced on 121.53 million ha, yield was 2.76 t ha$^{-1}$ in 2017. Brazil (114,269,392 tonnes) and United States of America (96,793,180 tonnes) produce together more than 60% of world's total soybean followed by Argentina (55,263,891 tonnes), China (15,728,776 tonnes), India (13,267,520 tonnes), while Paraguay (8,520,350 tonnes), Bangladesh (110,785 tonnes) were producing countries in the world (Borchani *et* al., 2010; Eleuch et al., 2017; Lee *et* al., 2008). As a result of its high demand, any quantity of the product offered to the market is easily sold. This increasing demand for soybean seed provides Bangladesh an opportunity to increase its production to meet the international demand for the commodity. In Bangladesh, soybean exports were estimated to be about 163895 m tons in 2019-20 (BBS, 2020; Agro, 2020). The realization of the potential of soybean production in the acquisition of foreign currency for the country made the production of the crop a prominent priority in the agricultural sector of Bangladesh.

Profitability is defined as the total value of production minus the total cost of production. The Bangladesh government places significant importance on the research and development of oilseed crops and invests a lot in attaining self-sufficiency in edible oils. Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA) have released a good number of improved varieties of oilseeds. The area, production and productivity of oilseeds in 2019-20 were 1183000 hectares, 972000 m tons, and 1773 kg ha$^{-1}$, respectively (BBS, 2021). A study on financial analysis of soybean cultivation aimed at determining the input use and cost return to aid farmers in improving or increasing their profitability. Some relevant studies were conducted to find out the profitability of soybean cultivation, but this study was conducted to estimate the cost and return data for major soybean varieties of Bangladesh, especially for updating the database. However, the objectives were i) to estimate the costs and return of Binasoybean-3 cultivation in the study areas; ii) to find out the yield gap of Binasoybean-3 at the farm level; iii) to identify the factors affecting the yield gap of Binasoybean-3 and iv) to suggest some policy guidelines to minimize the yield gap. Moreover, a comprehensive analysis is essential to explore the causes of low adoption and to identify ways to expand oilseed cultivation. This study delves into the challenges and opportunities present in the oilseeds sector of Bangladesh.

## METHODOLOGY

The study was conducted in three major Binasoybean-3 growing areas of Bangladesh, namely Noakhali, Lakshmipur and Barishal. A total of 180 farmers were randomly selected as sample size by using a multistage sampling method in the study area, 60 from each District. Data were collected from Binasoybean-3 growers through an interview schedule. Some descriptive statistics were used in analyzing the collected data. In the study, costs and return analysis were done on full cost basis.

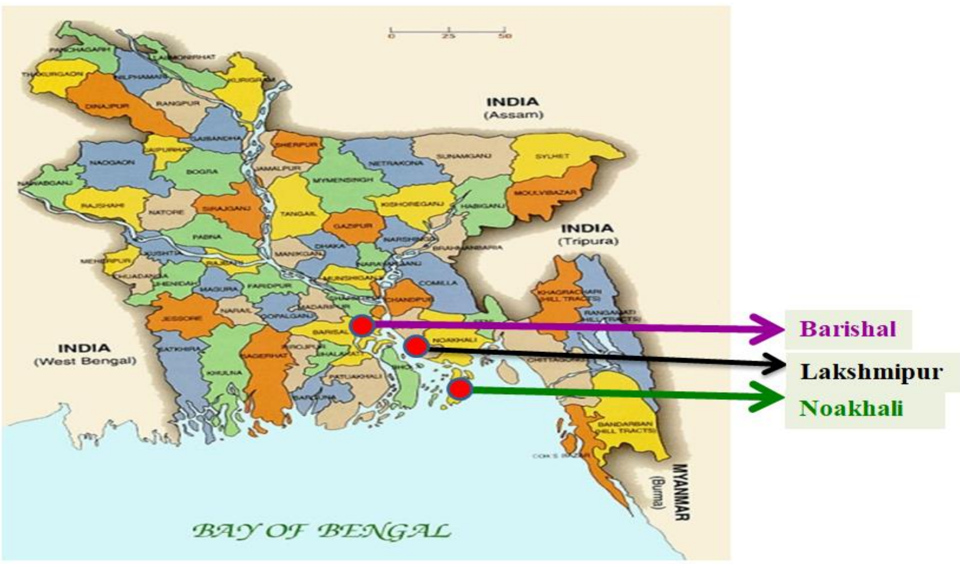


Fig. 1: Locations of the study

Profitability is defined as the difference between the total revenue and total cost. The following algebraic profit (**π**) equation was employed for testing the net return.

$$\pi = TR - TC$$

$$= TR - (VC + FC)$$

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$$\pi=\sum Q_y.P_y+\sum Q_b.P_b-\sum_{i=1}^{n}(X_i.P_{xi})-TFC$$

Where,

$\pi$ = Net returns (Tk. $ha^{-1}$);

$Q_y$= Total quantity of the relevant outputs (kg $ha^{-1}$);

$P_y$= Per unit prices of the relevant outputs (Tk. $ha^{-1}$);

$Q_b$= Total quantity of the concerned by-products (kg $ha^{-1}$);

$P_b$ = Per unit prices of the relevant by-products (Tk. $ha^{-1}$);

$X_i$ = Quantity of the concerned $i^{th}$ inputs;

$P_{xi}$ = Per unit price of the relevant $i^{th}$ inputs;

TFC = Total fixed cost involved in the concerned crop production;

i= 1, 2, 3, ..., n (number of inputs).

The concept of yield gap as suggested by Zandstra *et al.* (1981) was used in this study. Total yield gap can be decomposed into two parts i.e. Yield gap I and Yield gap II. Yield Gap I refers to the difference between the research station's yield and potential farm yield obtained at demonstration plots, while Yield Gap II is the difference between the yield obtained at the nearest potential farmers and the actual yield obtained on farmers' fields. The yield gaps were estimated as follows:

$$\text{Yield Gap I}=[(Y_R-Y_P)/Y_R]\times 100$$

$$\text{Yield Gap II}=[(Y_P-Y_F)/Y_P]\times 100$$

Where,

$Y_R$ = the yield of research stations,

$Y_P$ = the yield of potential farm, and

$Y_F$ = the yield of actual farm.

The production of Binasoybean-3 is likely to be influenced by different factors, such as, seed, chemical fertilizer, power tiller, human labor, etc. The following Cobb-Douglas production function model was used to estimate the parameters. The functional form of the Cobb-Douglas production function model was as follows:

$$Y=AX_1^{b1}X_2^{b2}.....................X_n^{bn}e^{ui}$$

The production function was converted to logarithmic form so that it could be solved by the least square method i.e.

$$\text{Log } Y=\text{Log } a+b_1\log X_1+.......................+b_n\text{Log } X_n+e^{ui}$$

The empirical production function was the following:

$$\ln Y=\alpha+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+b_5\ln X_5+b_6\ln X_6+b_7\ln X_7+b_8\ln X_8+U_i$$

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Where,

Y= Yield of Binasoybean-3 (kg $ha^{-1}$)

$X_1$ = No. of power tiller

$X_2$ = Amount of Seed (kg $ha^{-1}$)

$X_3$= Amount of Urea (kg $ha^{-1}$)

$X_4$= Amount of TSP (kg $ha^{-1}$)

$X_5$= Amount of MoP (kg $ha^{-1}$)

$X_6$= Amount of Gypsum (kg $ha^{-1}$)

$X_7$= Pesticide

$X_8$= Human Labor

Loga=α= constant value

$b_1$, $b_2$ ,............. , $b_8$ = Co-efficient of the respective variables and

$U_i$ is an independently and identically distributed two sided random error.

## RESULTS AND DISCUSSION

### Cost of Binasoybean-3 cultivation

The analysis revealed that total variable cost of Binasoybean-3 cultivation was Tk. 36149.29 $ha^{-1}$ which was 66.64% of total cost of production (Table 1). The highest cost item was family labor which accounted for about 22.54% of the total cost. Hired labor cost was 20.61% of total cost and ranked second cost item. Family labor and rental value of land was considered as fixed cost of production. The land use cost was Tk. 5872.85 $ha^{-1}$ which accounted for about 10.83% of total cost respectively. Total cost of production included variable costs and fixed costs incurred for Binasoybean-3 cultivation. On an average, the total cost of production in field level of Binasoybean-3 was in Tk. 54247.06 $ha^{-1}$ where 33.36% was fixed costs and 66.64% was variable cost**.** The highest cost in farm level was in Barisal (Tk. 54668.40 $ha^{-1}$) followed by Noakhali and Lakshmipur in Tk. 54253.22 and Tk. 53819.57 $ha^{-1}$, respectively. The major shares of total cost were human labor, power tiller, fertilizer, seed and power tiller (Table 1).

Table 1. Cost component of Binasoybean-3 in the study areas

| Cost Component | Noakhali | Lakshmipur | Barishal | Average | % of all |
|---|---|---|---|---|---|
| Hired-labor (man-days $ha^{-1}$) | 10304.03 | 11656.09 | 11588.57 | 11182.90 | 20.61 |
| Power tiller | 6293.82 | 7020.51 | 6576.26 | 6630.20 | 12.22 |
| Seed | 7764.23 | 6326.08 | 6817.02 | 6969.11 | 12.85 |
| Fertilizer | 4967.00 | 5080.32 | 5420.07 | 5155.80 | 9.50 |
| Urea | 987.70 | 1015.58 | 1125.77 | 1043.02 | 1.92 |
| TSP | 1988.40 | 1830.84 | 2054.80 | 1958.02 | 3.61 |

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| | | | | | |
|---|---|---|---|---|---|
| MP | 518.73 | 607.35 | 552.85 | 559.64 | 1.03 |
| Gypsum | 419.22 | 592.20 | 668.77 | 560.06 | 1.03 |
| Organic manure | 1052.95 | 1034.35 | 1017.87 | 1035.06 | 1.91 |
| Pesticide and Insecticide | 2777.45 | 2921.17 | 3076.35 | 2924.99 | 5.39 |
| Interest on operating capital | 3210.65 | 3300.42 | 3347.83 | 3286.30 | 6.06 |
| **Total variable cost** | **35317.18** | **36304.60** | **36826.11** | **36149.29** | **66.64** |
| Family labor(man-days ha$^{-1}$) | 12388.05 | 12388.12 | 11898.58 | 12224.91 | 22.54 |
| Land use cost | 6114.35 | 5560.50 | 5943.72 | 5872.85 | 10.83 |
| **Total Fixed cost** | **18502.39** | **17948.62** | **17842.29** | **18097.77** | **33.36** |
| **Total Cost** | **53819.57** | **54253.22** | **54668.40** | **54247.06** | **100.00** |

Source: Field survey, 2022

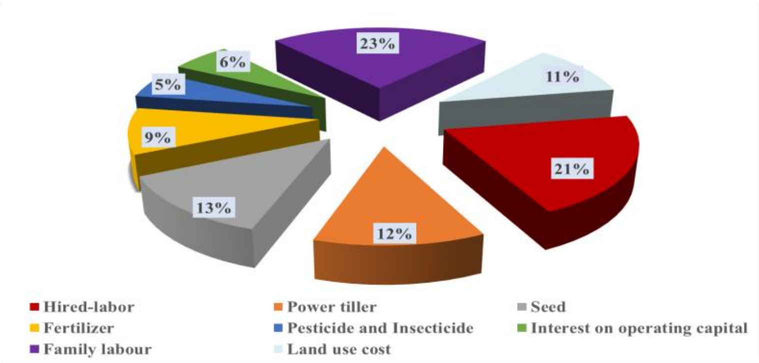


Fig. 2. Per hectare share of cost (%) of Binasoybean-3 production

**Profitability of Binasoybean-3 cultivation**

The primary criteria for the determination of acceptance of a crop is its profitability. This is based on the calculation of market prices of inputs and outputs that farmers actually pay or receive for producing a crop, along with the quantities used for each. The production cost, gross return, gross margin, benefit cost ratio, and other factors related to the cultivation of Binasoybean-3 at different locations are discussed below:

The average yield of Binasoybean-3 was 2012.11 kg per hectare with an average price of approximately Tk. 41.39 per kg. The average gross return and gross margin of Binasoybean-3 cultivation were Tk. 86894.46 ha$^{-1}$ and Tk. 50745.17 ha$^{-1}$, respectively. Among the study areas, the gross return was found highest in Noakhali (Tk. 89516.91 ha$^{-1}$) followed by Lakshmipur (Tk. 93777.90 ha$^{-1}$) and Barishal (Tk. 77388.57 ha$^{-1}$). The average net return was Tk. 32647.40 ha$^{-1}$. The highest net return (Tk. 39524.69 ha$^{-1}$) comes from Lakshmipur district and the lowest net return (Tk. 22720.17 ha$^{-1}$) comes from Barishal district for Binasoybean-3. The undiscounted Benefit Cost Ratio (BCR) over full cost basis were 1.73, 1.66 and 1.42 for Binasoybean-3 in field level for Lakshmipur, Noakhali and Barishal, respectively. The average Benefit Cost Ratio (BCR) was 1.60 in all study areas which indicates that all of the Binasoybean-3 producers were economically profitable (Table 2).

Table 2: Profitability of Binasoybean-3 cultivation among the study areas

| Type | Noakhali | Lakshmipur | Barishal | Average |
|---|---|---|---|---|
| Yield (kg ha$^{-1}$) | 2001.40 | 2171.30 | 1863.65 | 2012.11 |

| | | | | |
|---|---|---|---|---|
| Yield (Tk. kg$^{-1}$) | 42.85 | 41.57 | 39.76 | 41.39 |
| By product (Tk. ha$^{-1}$) | 3757.00 | 3517.00 | 3290.00 | 3521.33 |
| **Gross Return** | **89516.91** | **93777.90** | **77388.57** | **86894.46** |
| Total variable cost | 35317.18 | 36304.60 | 36826.11 | 36149.29 |
| **Total Cost** | **53819.57** | **54253.22** | **54668.40** | **54247.06** |
| Gross Margin | **54199.73** | **57473.31** | **40562.46** | 50745.17 |
| Net Return (Tk. ha$^{-1}$) | **35697.34** | **39524.69** | **22720.17** | **32647.40** |
| **Benefit Cost Ratio (BCR)** | **1.66** | **1.73** | **1.42** | **1.60** |

Source: Authors' calculation

In Table 3 and Fig. 3, the results showed that the farmers highest yield was obtained from Lakshmipur (2.17 t ha$^{-1}$) followed by Noakhali (2.00 t ha$^{-1}$) and Barishal (1.86 t ha$^{-1}$) districts. The average yield of Binasoybean-3 at the research station was 2.40 t ha$^{-1}$ (Table 3). As seen from Table 3, the estimated average yield gap I was 0.17 t ha$^{-1}$ (6.97%) and the average yield gap II was 0.22 t ha$^{-1}$ (9.97%). The lowest total yield gap was 0.33 t ha$^{-1}$ (13.60%) observed in Lakshmipur and it was the highest 0.50 t ha$^{-1}$ (21.05%) in Noakhali district. Considering all, the average yield gap was 0.39 t ha$^{-1}$ (16.95%) and much scope for yield enhancement in the variety.

Table 3. Estimated yield gap of Binasoybean-3 in different locations

| **Particular** | **Noakhali** | **Lakshmipur** | **Barishal** | **Average** |
|---|---|---|---|---|
| **Average yield of research station ($Y_{R}$), t ha$^{-1}$** | 2.50 | 2.50 | 2.21 | 2.40 |
| **Average yield of potential farm ($Y_P$ ), t ha$^{-1}$** | 2.23 | 2.36 | 2.11 | 2.23 |
| **Average yield of actual farm($Y_F$), tha$^{-1}$** | 2.00 | 2.17 | 1.86 | 2.01 |
| **Yield gap I (%)** | 0.27 (10.80) | 0.14 (5.60) | 0.10 (4.52) | 0.17 (6.97) |
| **Yield gap II (%)** | 0.23 (10.25) | 0.19 (8.00) | 0.25 (11.68) | 0.22 (9.97) |
| **Total yield gap (%)** | 0.50 (21.05) | 0.33 (13.60) | 0.35 (16.20) | 0.39 (16.95) |

Source: Authors' calculation

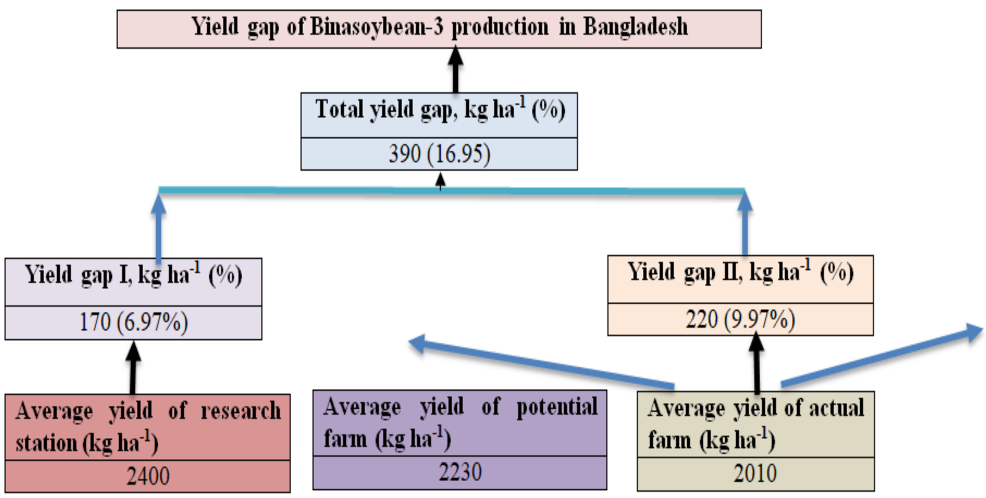


Fig. 3. Yield gap of Binasoybean-3 production in Bangladesh

### Major factors that influence the yield gap of Binasoybean-3

Farmers in the study areas used various inputs for Binasoybean-3 cultivation. In Table 4, the district-wise farmers have to maintain according to the recommended dose in some extant but in average, the farmers among the study areas did not consider the recommended doses of seed rate and fertilizer. The average seed rate was 60.60 Kg ha$^{-1}$, Urea 48.28 Kg ha$^{-1}$, MoP 77.33 Kg ha$^{-1}$, TSP 115.18 Kg h$^{-1}$, Gypsum 66.01 Kg ha$^{-1}$, respectively.

Table 4. Input–use pattern of Binasoybean-3 growing farmers

| Factors | Seed Kg ha$^{-1}$ | Urea Kg ha$^{-1}$ | TSP Kg ha$^{-1}$ | MoP Kg ha$^{-1}$ | Gypsum Kg ha$^{-1}$ |
|---|---|---|---|---|---|
| **Recommendation** | 45-55 | 50-60 | 150-175 | 100-120 | 80-115 |
| **Noakhali** | 67.52 | 54.87 | 116.96 | 80.75 | 71.92 |
| **Lakshmipur** | 55.01 | 56.42 | 107.70 | 82.82 | 59.22 |
| **Barishal** | 59.28 | 33.54 | 120.87 | 73.96 | 66.88 |
| **Average** | 60.60 | 48.28 | 115.18 | 77.33 | 66.01 |

Source: Field survey, 2022

Other factors which were also responsible for the yield of Binasoybean-3 are described in Table 5. On average, 86.18% respondent used power tiller three times and 13.82% more than three times, 76.49% weeded their lands 1 time and 95.19% spray pesticide and insecticide to control disease and insect.

Table 5. Input–use pattern of Binasoybean-3 growing area

| Factors | Noakhali | Lakshmipur | Barishal | Average |
|---|---|---|---|---|
| **Power Tiller (%)** | | | | |
| Three times | 88.20 | 86.90 | 83.45 | 86.18 |
| More than 3 | 11.80 | 13.10 | 16.55 | 13.82 |
| **Weeding (%)** | | | | |
| No Weeding | 14.23 | 11.20 | 10.41 | 11.95 |
| Weeding (1) | 74.74 | 78.19 | 76.53 | 76.49 |
| Weeding (2) | 11.03 | 10.61 | 13.06 | 11.57 |
| **Pesticide and insecticide (%)** | 98.55 | 94.31 | 92.72 | 95.19 |

Source: Field survey, 2022

In Table 6, the contribution of specified factors affecting the production of Binasoybean-3 could be seen from the estimation of the regression equation. Very few farmers used manure, so this was not included in the equation. The result showed that few coefficients do not have the expected sign. However, the coefficients for Seed, MoP and Human labor were found to be positively significant at 1% level. On the other hand, the number of power tiller, urea and pesticide costs were found to be positively significant at 5% level. TSP and Gypsum were found to be positively significant at 10% level. The positive sign indicated that using more of these inputs in Binasoybean-3 production could increase the yield to some extent.

Table 6. Factors affecting the yield gap for Binasoybean-3 in the study areas

| Item | Co-efficient | t-value | P>t-value |
|---|---|---|---|
| Intercept | 1.536 | 4.060 | 0.000 |
| Power tiller ($X_1$) | 0.111** | 2.460 | 0.015 |
| Seed ($X_2$) | 0.574*** | 8.300 | 0.000 |
| Urea ($X_3$) | 0.023** | 0.710 | 0.000 |
| TSP ($X_4$) | 0.222* | 3.400 | 0.001 |
| MoP ($X_5$) | 0.559*** | 3.140 | 0.088 |
| Gypsum ($X_6$) | 0.187* | 5.680 | 0.000 |
| Human Labor ($X_7$) | 0.216*** | 1.620 | 0.054 |
| Pesticide Cost ($X_8$) | 0.325** | 2.710 | 0.048 |
| Coefficient of multiple determination ($R^2$) | 0.932 | | |
| F-Value | 8.145** | | |
| Return to scale | 1.096 | | |

Note: '*' '**' and '***' indicate significant at 10%, 5% and 1% level.

The coefficient of multiple determination ($R^2$) tells how well the sample regression line fits the data (Gujarati, 1995). It is evident from Table 6 that the values of $R^2$ were 0.932 means that around 93 percent of the variations in gross return for Binasoybean-3 were explained by the independent variables included in the model. The F-values of all districts were 8.145 which were highly significant at 5% level of probability implying that all the explanatory variables were important for explaining the variations in gross returns of the Binasoybean-3 variety in the study area (Table 6). The summation of all the production coefficients indicates the return to scale. The sum of elasticity coefficients was 1.096 in case of Binasoybean-3 meaning increasing returns to scale (Table 6). This means that a 1 percent increase in all inputs simultaneously would result on average 1.096 percent increase in the gross return of Binasoybean-3. This value was greater than 1 means that the farmers are operating in the region of increasing return to scale. More clearly, the farmers still have the scope to allocate more inputs in their oilseed crop field as it will generate a higher return than production cost.

**Constraints of Binasoybean-3 Cultivation**

Farmers of Binasoybean-3 growing areas faced various constraints to their cultivation such as non-availability of quality seed at the proper time (49.70%), lack of knowledge about improved technology (48.77%), lack of soil moisture during sowing time (45.44%), disease and pest infestation (40.05%), lack of credit facilities (33.66%) and the insufficient or high price of labor in harvesting time (43.11%) were reported to be main constraints to Binasoybean-3 cultivation in Bangladesh. Major constraints mentioned by the farmers and the percent of respondents who faced this constraint for the yield gap of Binasoybean-3 are described as below in Table 7.

Table 7. Major Constraints of Binasoybean-3 cultivation

| Sl. No | Particulars | Noakhali | Lakshmipur | Barishal | Average |
|---|---|---|---|---|---|
| 1. | Timely non-availability of quality seed | 42.77 | 50.45 | 55.89 | 49.70 |
| 2. | Lack of knowledge about recommended production technology | 46.15 | 48.80 | 51.36 | 48.77 |

| | | | | | |
|---|---|---|---|---|---|
| 3. | Lack of soil moisture during sowing time | 41.54 | 43.69 | 51.10 | 45.44 |
| 4. | Disease and pest infestation | 51.82 | 38.33 | 30.01 | 40.05 |
| 5. | Lack of credit facilities | 29.45 | 42.89 | 28.64 | 33.66 |
| 6. | Insufficient and high price of labor in harvesting time | 49.67 | 40.11 | 39.55 | 43.11 |
| 7. | Others* | 38.88 | 25.65 | 45.21 | 36.58 |

* Non-availability of quality fertilizer at the proper time, natural calamities, etc.

**Some policy guidelines to reduce the Yield Gap**

The majority of the respondent farmers wanted to provide Binasoybean-3 varieties for the next year due to higher yield and higher profit. In order to decrease the yield gap of Binasoybean-3 at the farm level, there ensure timely adequate supply of quality seed. Hands-on training and crop management practices for the Binasoybean-3 growing farmers are also important. Frequent interaction was needed among farmers, extension personnel and scientists. Different Government and commercial bank should widen their area to provide loans to the farmers for the smooth running of small farming. Some techniques should be used to reduce the lack of soil moisture during sowing time. Ensuring labor facilities during harvesting time influences groundnut farmers to a greater extent to reduce the yield gap. In different locations, it should follow balanced fertilizer use and remedial measures infestation of insects, etc at the farmers' level. There needs to be appropriate steps on these aspects so that farmers become enthusiastic about Binasoybean-3 cultivation.

## CONCLUSION

It is concluded from the aforesaid discussion that the Binasoybean-3 production in the study areas is profitable. Binasoybean-3 farmers received a higher return on their investment. Reducing the yield gap of Binasoybean-3 is urgent for sufficiency in oilseed production or reducing the oil import. The study found that in Bangladesh, we are losing 0.39 $t \cdot ha^{-1}$ (16.95%) yield of Binasoybean-3. If we could reduce these gaps, our total production per year will be increased which will support in achieving food security as well as Sustainable Development Goals (SDGs).

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**Conflict of interest**

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

**Author contribution**

The contribution of the first author was greater than the others in the present study. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

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