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# Estimation of cost of cultivation, profitability in different farm sizes as well as growth and instability of mustard in West Bengal

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**ABSTRACT**

*The main objectives of this study are to estimate the cost of cultivation, profitability rate and net return for various groups of farmer-producers in Burdwan district of West Bengal in 2019-20 based on the primary data collected from the farmers.B-C ratio and Compound growth rate (CGR) techniques were applied to calculate the profitability, instability and growth of yield parameter of the crop. Area, production and productivity have a positive rate of growth, but production level shows some variabilities.The yield of this crop varies from small to large farmers, and the cost of cultivation has also exhibited increasing tendencies. Large size groups have a larger net income (Rs. ha$^{-1}$) than medium to small size groups.The improved and updated package and practices attempted to improve output and income in a timely manner. However, it is recommended that all agronomic operations i.e. weeding, application of irrigation and pesticide application for this crop be completed on time, because time is a very important factor that plays a significant role in yield and quality.Any operations in the field of agriculture that are completed before or after time will result in lower yield and quality.*

***Keywords*:** B-C ratio, compound growth rate, instability, yield parameter**,** mustard

India is the world's largest producer of oilseeds, and oilseed crops are an important part of the country's agricultural system. India, behind the United States, China, Brazil, and Argentina, is the world's fifth biggest vegetable oil economy, with an annual turnover of almost Rs. 80,000 crores. India produces 6-7 per cent of all vegetable oils, grows 12- 15 per cent of the world's oilseeds, and consumes 9-10 per cent of all edible oils (USDA, 2010). Mustard is one of the most essential and highly demanded edible oilseed crops grown in West Bengal, accounting for over 53% of the state's total oilseed production(Dutta, 2016). India imports about 60-65 per cent of its total domestic demand for edible oils (State of Indian Agriculture, 2015-16), mustard is also likely to replace soybean in the poultry industry, as the production of the latter is affected (FAOSTAT, 2018). Because of variances in mustard cultivars, cultural traditions, and environmental circumstances, mustard yields in the Upper Midwest have been inconsistent Brown mustard's area is progressively increasing at the price of additional Brassicae, owing to its advanced yields, stronger resistance to pests and diseases, and greater tolerance to humidity stress. The most essential edible oil comes from mustard. The seeds' or other forms' composition ranges from 30 to 48 percent. The oil obtained is our country's primary cooking medium, and no other edible oil can easily replace it. The seed and oil are used to flavor curries and vegetables, as well as a condiment in pickles. Most of the oil cake is used to feed cattle. Young plant leaves are utilized as a green vegetable. Because of its high cost, mustard oil is only used in a restricted number of industrial applications. Mustard is grown in India during the *rabi* season, which spans between September and October (Kushwah *et al.*, 2016). Nitrogen treatment in three equal splits boosts seed, stover, and biological yields in this crop (Narayan, 2017; Mahapatra, 1993).

Mustard was the major oilseed through out the last few decades in West Bengal, but recently there has been a slow down in the growth of mustard crop while sesame is fast coming up as a major oilseed. Rajasthan produces 40.82 per cent of the total mustard production whereas West Bengal produces only 8.64 per cent mustard in the country. West Bengal does not occupy any significant position in terms of either acreage or production of oilseeds. A brief review of literature regarding yield and production of mustard crops reveals that a number of factors like shortage of HYV seeds and lack of poor managerial attention can be held responsible for the poor performance of the oilseeds sector in the state. Hence, the specific objectives of the study were to assessed the cost of cultivation and profitability of mustard in various farm sizes in West Bengal.

The study was carried out in Burdwan district of West Bengal during the period of 2019-20. A multi-stage

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random sampling design was adopted for the ultimate selection of potato growers. Two blocks namely Jamalpur, and Kalna-I were selected purposively on the basis of maximum area and production of mustard crop. Further, six villages from selected blocks were selected. Finally, a sample of 30 mustard growers were considered in the study which consisted of 10 small (0.5-2ha), 10 medium (2-4 ha) and 10 large farmers (4 ha and above). For the first objective, CAGR and Instability index have been analyzed.

***The compound yearly growth rates (CAGRs)***

The Compound Yearly Growth Rates were calculated by applying semi log functions, which are a functional form that is acceptable (Gujarati, 1988). Many more research used the formula to calculate CAGR, which is expressed as follows:

$$Y = ab_t u_t$$

Where,

In the time period t, Yt =Area of crop/ Productivity/ Production (Dependent Variable).

a = intercept of model

bt = Regression Coefficient/slope parameter= (1 +r)

t = No. of year which considers value 1, 2, ... ..., n

ut = the year t's error term

The Cobb-Douglas (C-D) production function was transformed into the log linear or double log form so that it can be solved by the ordinary least square method (OLS):

$$\log Y = \log a + \log b$$

The following function was used to calculate the compound growth rate (r) of area, production, and productivity in percentage:

$$\text{CAGR(r) (\%)} = \{\text{antilog (ln b)-1}\} * 100$$

The significance of the slope parameter or regression coefficient was determined using the student's t-test.

***Instability Index***

Wide fluctuations in mustard yield due to weather,economic environment, availability of material inputs and different anthropogenic actives is known as instability. Instability index in mustard yield was measured by the coefficient of variation. Calculating the coefficient of variation of residuals is the most popular approach for determining instability. Mehra (1981) utilised this method to compute and compare agricultural production instability before and after new technology were introduced. After detrending the data set, Hazel (1982) devised a novel approach by generating a variable (Zt) and computing it by adding the mean of the dependent variable to residuals (et) as follows :

$$Z_t = e_t + \bar{Y}$$

As a measure of instability, the Zt coefficient of variation was employed. Ray (1983) devised a simple measure of instability based on yearly growth rate standard deviation.This technique satisfied characteristics such as de-trended data instability and comparability.

In this case, Cuddy-Della Valle (1978) introduced the Adjusted Instability Index to assess instability related through the rate of expansion in area, production, and productivity of main crops such as food grains, cash crops, pulses and oilseeds, as well as total vegetables and fruits.The formula is presented as-

$$\text{Adjusted Instability Index} = CV\sqrt{1-\bar{R}^2}$$

$$\text{Coefficient of Variation (C.V)} = \frac{Standard\ deviation}{mean} \times 100$$

$\bar{R}^2$ = coefficient of determination

The current study has been organized in a randomly selected village in the Burdwan district of West Bengal during the *rab*i season in 2019-2020 with farmer-scientist partnerships on the farmers' field for the second goal. One farmer has been chosen at random from each of the three size groups: small, medium, and big. Varuna variety is recommended for good response with seed rate of 5 kg $ha^{-1}$ and timely treatment with N:P:K @ 120:40:40 kg $ha^{-1}$ (Kalita *et al*., 2017). The crop was swon in the farmer's field during the first fortnight of October, and it was also recommended that 15 to 20 kg of sulphur be used to improve the yield by improving the quality. Mukherjee (2014) and Jat *et al*. (2003) both showed a surge trend in production with increased sulphur levels. Thinning, irrigation, and other cultural methods have become increasingly important in increasing production. All data was gathered using the survey technique, and tabular analysis was employed to analyse it. A family schedule was used to collect data on family size, crop area, spending, and net income, among other things.

***Cost concepts in farm management***

The cost concepts of CACP approach to farm costing is widely used in India. In the older context, these cost concepts, in brief, are Cost A1, Cost A2, Cost B1, Cost B2 and Cost C. The many cost elements that must be included under each cost concept, as well as their imputation techniques and examples, are shown below:

**Cost A1 : This component of cost includes the value of**

- Casual hired labor (man $hours^{-1}$ $days^{-1}$) Man Days = 8 Man hours
- Attached labor (man $hours^{-1}$ $days^{-1}$)
- Hired bullock labor (pair hours)
- Imputed value of owned bullock labor (pair hours)
- Hired machinerylabor (hours)
- Imputed value of owned machine labor (hours)
- Seeds (kg or qtls)

- Farm yard manures and fertilizers (NPK kg-nutrients)
- Plant protection(PPC) chemicals (g $lit^{-1}$ or ml $lit^{-1}$)
- Irrigation charges (hours)
- Interest on working capital (@12.75% per annum on half-life period of crop)
- Depreciation on own farm machinery
- Land revenue cases taxes

Total of all above mentioned cost items makes up Cost-A1

Cost-A2: Cost-A1 + rent funded for leased-in land

Cost A2 = Cost A1+ Rent paid for leased-in land,

Cost B1 = Cost A1 + interest value of owned fixed capital assets (excluding land)

Cost B2 = Cost B1 + Rental value of owned land (net of land revenue) and rent paid for leased-in land

Cost-C: Cost-B + imputed value of farm family labor (man hours)

Cost C has been considered as the final cost of cultivation accounting or gross cost.

**Rates of return over various cost concepts**

A Gross returns are the total value of the core product plus any by-products. The primary goods and by-products must be imputed using real marketed prices, unless the market prices at the time of inquiry are used.

B Farm business income or revenue = Gross income (GI) - Cost A1

C Family labor income or revenue = Gross income - Cost B

D Net income = Gross income - Cost C

E Farm investment income or revenue = Farm business income - Wages of own family labor

However, Dr. Abhijeet Sen's expert committee for refining the cost of cultivation/ cost of production estimates recommended (1979) modified concept of cost of cultivation :

Cost-A1: All types of variable cost excluding farm family labor wages and including depreciation

Cost-A2: Cost-A1 + Rent paid for leased-in land

Cost-B1: Cost-A1 + Imputed interest on the value of owned capital assets (excluding land)

Cost-B2: Cost-B1 + Imputed rental value of revenue for owned land or Net of land revenue + rent paid for leased-in land

Cost-C1: Cost-B1 + Imputed value of farm family labor

Cost C2: Cost B2 + Imputed value of farm family labor

Cost C2*: Cost C2* will be estimated by taking into account statutory minimum or actual wage rate whichever is higher.

Cost C3: Cost C2* + 10 per cent of cost C2* for managerial function performed by farmer.

Gross returns were calculated based on the actual prices of mustard at which individual farmers sold their mustard seeds and its byproducts (Anonymous, 2020).

Table 1 shows the compound annual growth rate of area, production, productivity of mustard from 1991-92 to 2019-20. The data on area, production and productivity has been collected from Agriculture at a Glance journal. All three agronomic parameters i.e.area production and productivity appeared to have a positive CAGR.

**Table 1: Compound annual growth rate of area, production and productivity of mustard in West Bengal during 1991-92 to 2019-20**

| | CAGR% |
|---|---|
| Area | 1.52* |
| Production | 3.21** |
| Productivity | 1.58** |

*Note: * and **means 1% and 5% level of significance, respectively*

Production has the highest growth rate of 3.21 per cent, while area has the lowest growth rate of 1.52 per cent. The adoption of advanced technology, disease and pest resistance improved varieties, moisture conservation strategies, and other factors might all contribute to the rapid pace of crop increase.

Table 2 shows the level of instability related with mustard production, area, and productivity. Productivity appears to be steadier than area and production in this case. The production fluctuated the most, at 16.55 per cent followed by area (11.62 %) and productivity (8.66 %). Lower value (8.66) of Instability Index states that productivity has shown less variation compared to area and production which implies a consistent and stable level of productivity.The larger variation of cultivated area in West Bengal may be the cause of high production instability.

**Table 2: Instability index for the growth rates of area, production and productivity of mustard**

| | Instability index |
|---|---|
| Area | 11.62 |
| Production | 16.55 |
| Productivity | 8.66 |

Table 3 presents that the yield of small size farmers, medium size farmers, and large size groups of farmers were 6.48 ‘q’/acre, 7.48 ‘q’/acre, 7.99 ‘q’/acre and 7.32 ‘q’/acre, respectively, resulting in rising trends from lesser to greater ones. Yields would rise in all size groups if farmers knew how to implement the full package of approaches in an acceptable length of time, as shown in the table.

**Table 3:Yield and price of mustard crop for different groups farm sizes (acre)**

| Farm size | No. of farms | Seed rate (kg acre$^{-1}$) | N: P: K. (kg acre$^{-1}$) | | | Yield (Qt acre$^{-1}$) | Sale rate of grain yield (Rs /Kg) |
|---|---|---|---|---|---|---|---|
| Small farm | 10 | 2.02 | 48.58 | 16.19: | 16.19 | 6.48 | 32.50 |
| Medium farm | 10 | 2.02 | 48.58: | 16.19: | 16.19 | 7.48 | 30.00 |
| Large farm | 10 | 2.02 | 48.58: | 16.19: | 16.19 | 7.99 | 35.50 |
| Average farm | 10 | 2.02 | 48.58: | 16.19: | 16.19 | 7.32 | 32.25 |

If nitrogen is administered three times in an equivalent quantity, there is a potential of increased yield as well as a stronger role in thinning.

Table 4 shows that the total cost of cultivation for small size of farms to large size of farms (Rs ha$^{-1}$) were found Rs. 18,950, Rs. 19,644 and Rs. 20,135, respectively where per hectare gross income (Rs ha$^{-1}$) Rs. 42,500, Rs. 50,725 and Rs. 61,520 respectively. It shows an increasing trend from small farm size group to large one.

**Table 4 : Cost of cultivation and net income of mustard crops for different farm size groups (Rs ha$^{-1}$)**

| Farm size | Number of farms | Cost of cultivation (Rs ha$^{-1}$) | Gross Income (GI) (Rs ha$^{-1}$) | Net Income (NI)(Rs. ha$^{-1}$) | Benefit-Cost ratio |
|---|---|---|---|---|---|
| Small farm | 1 | 18,950 | 42,500 | 23,550 | 1:2.3 |
| Medium farm | 1 | 19,644 | 50,725 | 31,081 | 1:2.7 |
| Large farm | 1 | 20,135 | 61,520 | 41,385 | 1:3.1 |
| Average farm | 1 | 19,576 | 52,635 | 32,006 | 1:2.7 |

Net income for small, medium, and big farmers were Rs. 23,550 per hectare, Rs. 31,081 per hectare, and Rs. 41,385 per hectare, respectively. Groups of a great size have been created, revealing rising patterns. In mustard crop, the benefit cost ratio was 1:2:3 in small groups, 1:2:7 in medium groups and 1:3:1 in bigger groups. Table 3 illustrates that big groups of farmers were paid more for their production.

**Table 5: Ideal cost of cultivation (CoC) and net income of mustard crops for different groups of farm size**

| Farm size | Total Cost (Rs ha$^{-1}$) | Gross Return (Rs ha$^{-1}$) | Net Return (Rs ha$^{-1}$) | Net Return per Rupee of cost |
|---|---|---|---|---|
| Small farm | 1649.00 | 4300.00 | 651.00 | 2.20 |
| Medium farm | 1469.00 | 4816.00 | 3347.00 | 2.75 |
| Large farm | 1502.00 | 5024.00 | 3522.00 | 2.75 |
| Average farm | 1510 .00 | 4726.00 | 3216.00 | 2.64 |

**Note**: *Total cost comprises expenditures for acquired and own inputs (at market pricing)*

The economics of cost and net return per rupee of cost of mustard under ideal condition has been presented in Table 5. From the above table, it was exposed that gross return was recorded to be higher than total cost under ideal case for all types of mustard farmer.The costs of cultivation for small farmers were higher due to more cost for high dose of fertilizer and irrigation.The average net return per rupee of cost obtained per hectare for marginal and small farmers were Rs. 2.20 and Rs. 2.75, respectively. Mustard cultivation was found to be equally profitable for small and other types of farmers, but net returns were higher for other types of farmers than for small farmers. As a result, it is necessary to make mustard profitable by revising the minimum support price of mustard, which will encourage small farmers to grow more.

## CONCLUSION

The trend of direct relationship was perceived between net returns and land holdings of farmers for the given area which was due to various management and socio-economic factor. However, farmers do not catch any other improved alternative crops to interchange with mustard, hence it was observed to continue with mustard.The reason for higher expenditure on cultivation of potato crop is due to higher cost of seed, manure and fertilizer and expensive labour. Another considerable reason for continuous cultivation of mustard by farmers was physical factors matching to nurture this crop.The cost of cultivation of mustard shown increasing trend from small to large farmer. It could be due to fact that large size of land holding farmer incur more cost on modern farm input. Thus, it is

concluded that, the mustard bears a huge potentiality of production in the study area.The production and productivity along with profitability of mustard production could be increased if the cost of seed, market price of mustard and labour requirement problems are managed properly from the effort of all the concerned stakeholders.

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