

Research Paper

# Financial Performance and Potential Feasibility of Black Rice (*Oryza sativa* L. Indica) Cultivation in Assam: An Empirical Study

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Received: 28-07-2023

Revised: 25-11-2023

Accepted: 04-12-2023

## ABSTRACT

This paper explores the economic and financial performance of black rice production in the upper Brahmaputra valley region of Assam. Black rice, known for its rich nutritional value and cultural significance, has gained attention from agri-entrepreneurs and development projects aiming to promote its cultivation. The study employs various accounting ratios, such as gross profit ratio, profit-volume ratio, and expenses ratio, to assess the profitability and financial health of black rice farmers in three different categories based on farm size. Through a comprehensive analysis of primary data collected from 170 farmers, the study reveals that category C farmers, with the largest farm size, achieve the highest average gross profit and gross profit ratio, followed by category B and category A. Similarly, category C farmers incur higher expenses on machinery and fertilizers but maintain the lowest expense ratio. Conversely, category A farmers have the highest expense ratio but achieve the lowest average gross profit and profit volume ratio. Break-even analysis and margin of safety are employed to understand the profitability and financial strength of black rice farmers. The study finds that category C farmers have the highest break-even point and the highest margin of safety ratio, followed by category B and category A. The research concludes that black rice cultivation holds immense potential for economic growth and livelihood improvement in Assam. However, despite favorable agro-climatic conditions, commercial production remains limited. Further research is needed to understand the barriers to scale up production and promote the systematic adoption of black rice cultivation to achieve nutritional security and enhance livelihoods in the region.

## HIGHLIGHTS

- This study aims to assess economic and financial performance of black rice production in Assam.
- Study employs various accounting ratios (gross profit ratio, profit-volume ratio, and expenses ratio) to assess profitability and financial health of black rice farmers in three farm size categories.
- Black rice cultivation shows potential for economic growth and livelihood improvement in Assam.

**Keywords:** Black rice, Financial Performance, Feasibility, Profitability, Break even

The study of rice production holds immense significance due to its long-standing dominance in the Indian economy. Rice serves as a major cereal crop in developing nations and constitutes a staple meal for over half of the world's population, with Asia being responsible for approximately 95 percent of its global production (Saravanan, 2014). According to FAOSTAT (2021), China leads as the

primary rice producer, trailed by India, Indonesia, and Bangladesh. China and India together account for more than half of the world's total rice output. India, renowned for being a significant producer

**How to cite this article:** Hazarika, B.B. and Chakraborty, D.K. (2023). Financial Performance and Potential Feasibility of Black Rice (*Oryza sativa* L. Indica) Cultivation in Assam: An Empirical Study. *Econ. Aff.*, 68(04): 1921-1927.

**Source of Support:** None; **Conflict of Interest:** None



of both white and brown rice, contributes to about 20 percent of the overall global rice production (Saravanan, 2014). While white rice remains the primary choice for consumption, it's worth noting that various unique rice cultivars containing color pigments exist, such as black rice, red rice, and brown rice. The specific data on colored rice production dates back to 2003 when Chaudhary (2003) cited China as having the highest black rice resources (62%), followed by Sri Lanka (8.6%), Indonesia (7.2%), India (5.1%), the Philippines (4.3%), Bangladesh (4.1%), and fewer resources found in Malaysia, Thailand, and Myanmar (Saravanan, 2014). In the Northeastern states of India, rice is the most important crop in terms of area and output, and it significantly contributes to increased food security and this region has tremendous potential to increase the production of rice crops. (Majumder *et al.* 2019).

In India, the primary cultivation of black rice is concentrated in the northeastern regions of the nation. Locally known as Chakhao in Manipur, this crop holds significant importance in the socio-cultural customs of the local Meitei Community. While it has been historically grown by only a few individuals, the agricultural potential of black rice has caught the attention of several agri-entrepreneurs who have ventured into the black rice industry. Their endeavors have been remarkably successful, garnering attention from both local and national newspapers and websites, which have extensively covered their achievements. In the case of Assam, obtaining secondary data on black rice proves to be a challenging task, as it is not available in any official sources provided by the Assam government. However, certain news sources have indicated promising developments in the Goalpara and upper Brahmaputra valley regions of the state in terms of generating income through black rice cultivation. Despite progress being made, the agricultural process for black rice in Assam is still in its experimental stage. The suitability of Assam's soils and weather conditions presents a significant opportunity for the commercial production of black rice in the region.

Notably, the World Bank-funded Assam Agribusiness and Rural Transformation Project (APART) has initiated the production of new black rice varieties sourced from different states

across India. This project aims to further explore and promote black rice cultivation in the region, potentially opening avenues for economic growth and agricultural development.

The sample farmers of the study said that people are no longer interested in growing rice, and a lot of land is sitting fallow for years. Due to the high value and high value addition of black rice, there is a great potential to rekindle public interest in rice cultivation on a commercial scale. Since rice production still requires a lot of labour, it can provide a lot of opportunities in rural areas to reduce unemployment, especially among educated unemployed. In Assam, black rice cultivation may be an option to increase livelihood stability and achieve nutritional security through value addition, however compared to other land-based farming, there is still a low level of commercial production and a lack of a systematic technological approach. Even though it has good agro-climatic conditions, a high rate of return, and is cost-effective, research is now required to determine the true causes of the poor commercial production.

Hence to address the above-mentioned concerns, studying financial performance of the crop can therefore be viewed of as a means of effective evaluation.

This objective of this study is to assess the economic and financial performance of black rice production in Assam.

## MATERIALS AND METHODS

The sampling procedure commenced with the application of purposive sampling to select the study area. The upper Brahmaputra valley agro-climatic zone was chosen for this research, comprising six districts, including Majuli district. Among these districts, Golaghat, Jorhat, Majuli, and Sivasagar were selected due to their similar climatic conditions falling within the 'hot humid to humid' category (<http://rkbassam.in/>). Furthermore, the cropping intensities in the selected districts showed minimal variation, with Golaghat, Jorhat, and Sivasagar districts exhibiting cropping intensities of 153.7, 149.5, and 134, respectively (rkbassam.in).

Primarily primary data provide the foundation of the study. The primary data were collected in the year of 2022. District Agriculture Officers (DAOs)

at the district level and Agricultural Development Officers (ADOs) at the block level initially assist in the respondent selection because secondary data are not officially available.

The study employed both purposive and snowball sampling techniques. Initially, the upper Brahmaputra valley agro-climatic zone was purposively selected. For selecting farmers from each sampled district, the snowball sampling technique was used. Snowball sampling, also known as chain-referral sampling, is a non-probability sampling method used when individuals with specific traits are difficult to locate. In this approach, existing subjects refer and recruit additional samples needed for the research study. In this study, the researchers first identified one farmer with the assistance of district-level agriculture officers, and then this initial farmer facilitated the identification of other existing farmers. A total of 170 samples were included in the study.

To analyze the financial performance, various accounting ratios such as Gross Profit Ratio, Profit Volume Ratio, Labour Expenses Ratio, Miscellaneous Expenses Ratio, Break-Even Point, and Margin of Safety were calculated.

For getting a clear picture, we categorized the farmers into Category A, B and C, based on the size of their farms. Those are like: Category A = 0 *bigha* < Farm Size < 2 *bigha*; while category B = 2 *bigha* ≤ farm size < 4 *bigha*; and category C = 4 *bigha* ≤ farm size ≤ 6 *bigha*. Here 1 *bigha* equals 0.25 hectare.

**Gross Profit Ratio:** The link between gross profit and net sales is estimated by the gross profit ratio. It looks at how much a good's selling price per unit can drop without costing a farm any money to operate. It suggests that the better gross profit ratio better will be the result. The following formula can be used to determine gross profit ratio.

$$\text{Gross Profit Ratio} = \frac{\text{Gross Profit}}{\text{Net Sales}} \times 100$$

Where,  $\text{Gross Profit} = \text{Net sales} - \text{Cost of goods sold}$

The formula's all inputs are given in monetary terms. Average gross profit and average sales are taken into account for the study's convenience when computing gross profit ratio. As a result, the revised formula drawn is provided below:

$$\text{Gross Profit Ratio} = \frac{\text{Average Gross Profit}}{\text{Average Net Sales}} \times 100$$

Profit-Volume Ratio (P/V Ratio):

A higher P/V ratio implies that a farm's product is in good financial condition, as it represents the contribution from sales as a percentage of sales value. The ratio, which reflects the change in profit due to change in volume, aids in analyzing the profitability of a line of product as well as the overall profitability of a number of items.

The formula for calculating P/V Ratio is as follows—

$$\text{Profit Volume Ratio} = \frac{\text{Total Contribution}}{\text{Total Sales}} \times 100$$

$$\text{Where, Contribution} = \frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}} \times 100$$

Instead of just considering simple sales and variable costs, the average sales and average variable costs of black rice farmers have been considered for the convenience of the current study. As a result, the modified formula is as follows:

$$\text{Profit Volume Ratio} = \frac{\text{Average Sales} - \text{Average Variable Cost}}{\text{Average Sales}} \times 100$$

### Expenses Ratio

The relationship between different expenses and net sales is shown by the expense ratio, which reveals the average total variation in expenses. It is calculated by dividing each expense category or group by net sales. The costs include things like expenses for labour, raw materials, machineries, fertilizers and other things. This ratio implies that profitability of the farm decreases with increasing ratios and vice versa.

The expenses ratio is expressed as —

$$\text{Expenses Ratio} = \frac{\text{Expenses}}{\text{Sales}} \times 100$$

The following sections determine the various expense ratios related to growing black rice in the sample area.

## Labour Expenses Ratio

The following formula is used to determine the labour expenses ratio.

$$\text{Labour Expenses Ratio} = \frac{\text{Average Labour Expenses}}{\text{Average Sales}} \times 100$$

## Machinery and Fertilizer Expenses Ratio

The following formula is used to determine the machinery and fertilizer expenses ratio.

$$\text{Machinery and Fertilizer Expenses Ratio} = \frac{\text{Average Expenses on machinery and fertilizer}}{\text{Average Sales}} \times 100$$

## Miscellaneous Expenses Ratio

To calculate miscellaneous expenses ratio, the following formula is taken into consideration.

$$\text{Miscellaneous Expenses Ratio} = \frac{\text{Average Miscellaneous Expenses}}{\text{Average Sales}} \times 100$$

## Break Even Analysis

In order to determine the profitability of the black rice producers in the survey zone, the break-even point is examined. The sales level at which total revenue equals total cost, with no profit or loss, is known as the break-even point. This point implies that if sales rise beyond this threshold, the farm achieves profit (abnormal profit), and if they go below this cutoff point, the farm will suffer a loss. Break-even points are calculated in the current study using sales value.

To calculate the average break-even point (sales), the following formula is taken into consideration.

$$\text{Average Break Even Point (sales)} = \frac{\text{Average Fixed Expenses}}{\text{Contribution Margin Ratio}}$$

Where,  $\text{Contribution Margin} = \text{Total Net Sales} - \text{Total Variable Cost (TVC)}$

And,  $\text{Contribution Margin Ratio} =$

$$\frac{\text{Contribution Margin}}{\text{Total Amount of Net Sales}}$$

## Margin of Safety

A farm's financial situation might be strong or weak depending on the excess of actual or budgeted sales above break-even sales, which is what the margin of safety suggests. As is common knowledge, the break-even point is the sales level at which no profit and no loss is achieved. Sales above this level result in profit, which serves as a margin of safety. The gap between actual sales and sales at the break-even point is the margin of safety.

The Margin of Safety ratio can be calculated using the following formula –

$$\text{Margin of Safety Ratio} = \frac{\text{Margin of Safety}}{\text{Sales}} \times 100$$

## RESULTS AND DISCUSSION

In this section, we unveil the outcomes of our investigation into the different counting ratios mentioned above within distinct categories of black rice farmers. The examination seeks to illuminate the financial dynamics of farmers belonging to Categories A, B, and C. Before embarking on a detailed analysis, we revisit the central goals of our study and underscore the significance of these findings.

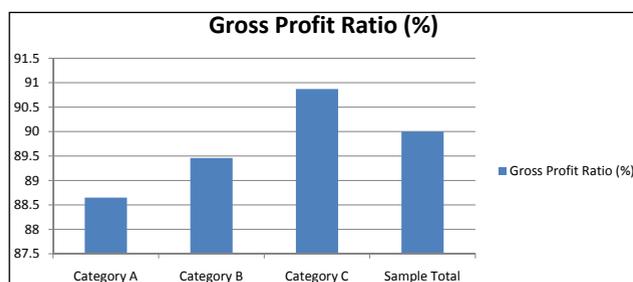
**Gross Profit Ratio:** It is imperative to recognize the role of gross profit and the gross profit ratio as vital metrics in assessing the economic performance of black rice farming.

The gross profit ratio of different categories of black rice farmers are shown in Table 1.

**Table 1:** Average Gross Profit and Gross Profit Ratio

Categories of farmers	Average Gross Profit (₹)	Average Sales (₹)	Gross Profit Ratio (%)
Category A	13822.73	15590.91	88.65
Category B	53744.75	60075	89.46
Category C	101178.30	111333.30	90.87
Sample Total	53438.75	59375	90.00

From the table 1, it is found that the farmers of category C are having highest average gross profit and gross profit ratio, followed by category B and category A. Fig. 1 shows the gross profit ratio of different categories of the black rice farmers.



**Fig. 1:** Gross Profit Ratio of Different Categories of Black Rice Farmers

### Profit-Volume Ratio (P/V Ratio)

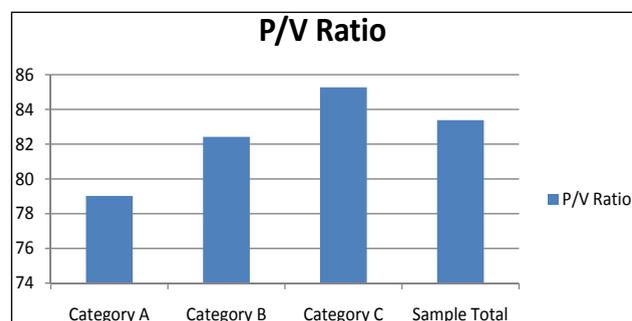
Table 2 displays the calculated P/V ratio for the different categories of black rice growers.

**Table 2:** Profit Volume Ratio of different categories of farmers

Categories of farmers	Average Sales (₹)	Average Variable Costs (₹)	P/V Ratio (%)
Category A	15590.91	3270	79.02
Category B	60075	10558	82.42
Category C	111333.30	16396.67	85.27
Sample Total	59375	9867.50	83.38

As can be seen in the table 2, Category C, which has the widest range of farms in the sample, has the greatest average sales as well as the highest average variable costs, with Category B and Category A following Category C in that order. In case of P/V ratio also, same order is followed.

In Fig. 2, the profit volume ratio of different categories of black rice farmers are shown.



**Fig. 2:** Profit Volume Ratio

### Labour Expenses Ratio

Table 3 shows the labour expenses ratio of different categories of the sample black rice farmers.

**Table 3:** Labour Expenses Ratio

Categories of farmers	Average Sales (₹)	Average labour expenses (₹)	Labour Expense Ratio
Category A	15590.91	1000	6.41
Category B	60075	3140	5.23
Category C	111333.30	5333.34	4.79
Sample Total	59375	3045	5.12

Table 3 reveals that the farmers of category C have highest average labour expenses followed by category B and category A. On the other hand, category C farmers are having lowest labour expenses ratio, followed by category B and category A.

### Machinery and Fertilizer Expenses Ratio

Table 4 shows the machinery and fertilizer expenses ratio of different categories of the sample black rice farmers.

**Table 4:** Machinery and Fertilizer Expenses Ratio

Categories of farmers	Average Sales (₹)	Average expenses on machinery and fertilizer (₹)	Machinery and Fertilizer Expense Ratio
Category A	15590.91	1818.19	11.67
Category B	60075	6030	10.03
Category C	111333.30	9388.89	8.43
Sample Total	59375	5577.50	9.39

### Miscellaneous expenses Ratio

Table 5 reveals that the farmers of category C are having highest volume of expenses on machinery and fertilizers and lowest of its ratio, followed by category B and category A.

**Table 5:** Miscellaneous expenses Ratio

Categories of farmers	Average Sales (₹)	Average miscellaneous expenses (₹)	Miscellaneous Expenses Ratio
Category A	15590.91	363.64	2.34
Category B	60075	1090	1.81
Category C	111333.30	1433.35	1.28
Sample Total	59375	967.50	1.62

Table 6 reveals that category A is incurring lowest average miscellaneous expenses with highest of its ratio. Category B and category C are following category A in the same orders of the volume of average miscellaneous expenses and the ratios.

### Break-Even Analysis

Table 6 shows the average break-even points (sales) of different categories of farmers from the surveyed area.

From the table 6, it is observed that the highest average BEP sales is earned by the category C farmers with ₹ 25056.47, followed by the category B and category A with ₹ 16165.86 and ₹ 2658.23 respectively.

The Fig. 3 shows the total break-even point in terms of different categories of black rice farmers.

### Margin of Safety Analysis:

From the Table 7, it is found that Category C farmers are having highest average margin of safety of ₹ 86276.83, while category B and category A farmers are having ₹ 43909.14 and ₹ 12932.68 respectively.

The Fig. 4 represents the margin of safety ratio of different categories of black rice farmers of the studied zone.

In the upper Brahmaputra Valley, the farmers who belong to category A have highest margin of safety ratio with 82.96 per cent, followed by category C farmers with margin of safety ratio of 77.49 and category B with 73.09 margin of safety ratio.

### CONCLUSION

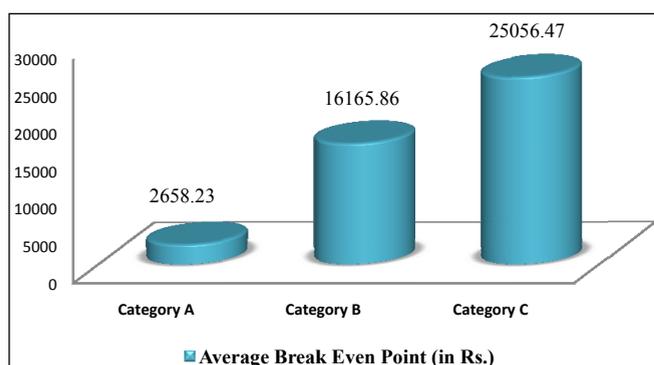
India is experiencing rapid economic growth, but it faces several challenges, including a growing population, diminishing agricultural

**Table 6:** Break Even Point in terms of Sales

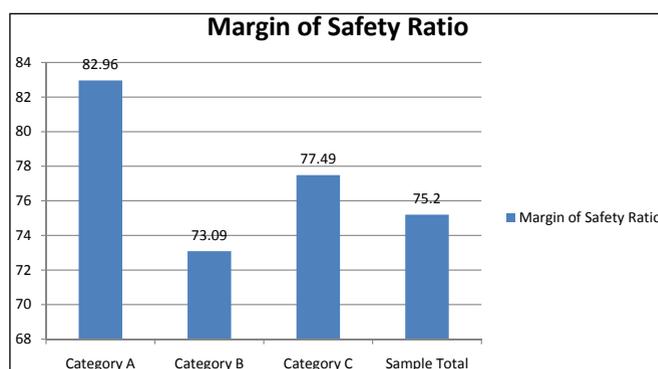
Categories of farmers	Average fixed costs (in ₹)	Average Variable costs (in ₹)	Average Sales (in ₹)	Contribution Margin Ratio	Average BEP Sales (in ₹)
Category A	2100	3270	15590.91	0.79	2658.23
Category B	13256	10558	60075	0.82	16165.86
Category C	21298	16396.67	111333.30	0.85	25056.47
Sample Total	12218	9867.50	59375	0.83	14720.49

**Table 7:** Margin of Safety Ratio

Categories of farmers	Average Sales (in ₹)	Average BEP Sales (in ₹)	Average Margin of Safety (in ₹)	Margin of Safety Ratio (%)
Category A	15590.91	2658.23	12932.68	82.96
Category B	60075	16165.86	43909.14	73.09
Category C	111333.30	25056.47	86276.83	77.49
Sample Total	59375	14720.49	44654.51	75.20



**Fig. 3:** Total Break Even Point in terms of Sales



**Fig. 4:** Margin of Safety Ratio

land, environmental changes, water wastage, and the demand for high-quality food. One solution to address these issues and ensure food and nutritional security while combating malnutrition is the cultivation and use of black rice. Black rice offers numerous nutritional and therapeutic benefits with minimal negative environmental impact. It is rich in various nutrients, including flavonoids, fiber, minerals (such as iron, copper, and potassium), and vegetable proteins. The bran of black rice contains high levels of antioxidants, particularly anthocyanins, which contribute to its distinctive color and offer health benefits, including potential protection against diseases like cancer and atherosclerosis (Shende *et al.* 2020).

In the state of Assam, approximately 70% of residents are engaged in agriculture, but there is a declining interest in rice cultivation, leading to extensive fallow lands. The cultivation of black rice presents an opportunity to revive interest in rice farming on a commercial scale due to its high value and value addition potential. In the Majuli area, black rice is being sold for a premium price of ₹ 400 per kilogram in the global market, making it a lucrative option for farmers. Additionally, rice cultivation can create employment opportunities, particularly for educated individuals, and help reduce unemployment in rural areas.

Despite the favorable agro-climatic conditions and the promising economic returns, black rice's commercial production in Assam remains limited and lacks a systematic technological approach. Further research is needed to identify the underlying reasons for this limited production. Conducting studies on production behavior, farmer productivity, and financial performance can be instrumental in effectively evaluating and enhancing black rice cultivation as a means to improve livelihood stability and achieve nutritional security through value addition in Assam.

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