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Economic Analysis of Traditional Brick Kiln Units- A Case Study in Dibrugarh District

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Abstract
This research paper investigates the economic analysis of traditional brick kiln units in Dibrugarh District, Assam, India, shedding light on an age-old industry that remains largely unchanged despite its historical significance. The brick-making sector is characterized as labor-intensive and seasonal, offering employment opportunities, particularly in rural areas. It plays a pivotal role in meeting the ever-growing demand for bricks driven by urbanization and construction activities. However, the industry's unorganized nature and lack of professionalism pose challenges. The study employs a production function analysis to examine the relationship between inputs (raw materials, labor, fuel, and miscellaneous costs) and output and also economies of scale face by the brick industry of Dibrugarh District. The findings indicate the importance of raw materials, labor, and fuel in influencing brick production. Overall, this research underscores the potential for the brick industry to contribute to the national economy while highlighting the need for sustainable practices and government support.

Keywords
Brick, Production Function, Economies of Scale

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Introduction

Brick making is one of the most ancient industries and as old as the Indus Valley civilisation. But the brick making process is still traditional and conventional. It still use old hand moulding process for shaping for shaping bricks, sun drying method and chimney for burning bricks. In modern times the developed and developing countries takes several attempts to organise the brick making units but it has remained unorganised and far from the large scale one. Despite of its smallness and unorganised nature it has the potentiality to contribute to the national economy in terms of employment. The brick industry is demand oriented industry which demand is directly interlinked with the development of an economy. Brick is the major key raw material for construction activities and construction activities is regarded as the backbone of the developing process. An up moving economy always encourages construction activities and as there is close substitute for bricks, the demand for bricks grows upward.

The brick manufacturing process is purely a labour intensive activity and also it requires a limited investment. It absorbs a large number of rural unskilled labours compared to the other small scale industries as it does require trained labour. Moreover the production process of brick kiln units is seasonal and the brick season fits well with agricultural cycle.

The brick sector in India is also unorganised and small scale unit. With the advent of economic change, the urbanisation and construction process of India grows tremendously which continuously expands the demand for bricks. India is second largest producer of bricks in the world, has an annual turnover of more than Rs 140 million (Gupta & Narayan 2010). In India brick units run as small scale unit with more than 150000 brick field throughout the country, each unit manufacture on an average between 10-100 million brick per year. Apart from labour intensiveness, limited investment, seasonal nature of production, it contributes a lot to the national economy from the angle that it is the key materiel for construction as well as it provides employment opportunities for rural households.

The process of brick making has not changed much over the centuries or geographies. Traditionally the main steps followed to make bricks are explained below

1. Material procurement - The clay is mined and stored in the open to make it soft.
2. Tempering - The clay is then mixed with water to achieve the right consistency for molding. Mixing is done manually with hands and feet.
3. Moulding - A lump of the mixture is taken, rolled in sand, and shaped into the mold. Sand is used to prevent the brick from sticking to the mold.
4. Drying - The molds are emptied onto a drying area and left to dry in the sun. Generally, it takes about two weeks for them to be ready for firing.
5. Firing - The green bricks are arranged in a kiln, and insulation is provided. This process takes 20-25 days to complete the firing.
6. Sorting - Afterward, the bricks are sorted based on their color. Color serves as an indication of the level of burning. Typically, bricks are subdivided into four types: 1st class brick, 2nd class brick, Jhawa or Picket, and broken.

1. Brick kiln units in Assam

The historical monuments and age old buildings of Assam proves that the practices of brick used in Assam is many years ago. The different size, shape and colours of old bricks clearly prove that the different types of bricks were used in different period of time in Assam. The demand for bricks in Assam has been increasing year by year with the increase in urbanisation and other construction activities. Assam is the major consumer of brick in NER comprising nearly 70% of the total consumption which is going to be around 4000-5000 million piece in 2013-15. There is a huge gap between the demand supply of bricks in Assam which requires a large amount of brick kilns to meet the demand and supply gap. Due to the heavy rains in the state the brick production takes place for around 6-7 months in a year. Generally, most of the labourers with some past experience travel to this region from West Bengal and Bihar during the season for brick manufacturing. The key raw materials of brick kiln units are fine clay and little quantity of sand which are easily available in the riverside of Assam which also helps the growing of brick industry significantly.

The Pollution Control Board of Assam categorised the brick kiln units into three parts

1. Small BTK (Bull's Trench Kiln) - Less than 15,000 bricks per day
2. Medium BTK - 15,000 to 30,000 bricks per day
3. Large BTK - Above 30,000 bricks per day

2. Objectives

The research work has been planned with the following objectives:

1. To study the productivity of the brick kiln industry in Dibrugarh district.
2. To analyze the optimum production size of brick kiln units.

3. Review of Literature

Singh I (1990) had designed a study to analyse some important aspects of brick kiln units in the state of Haryana with special reference to Sonepat district. In the state of Haryana, brick kiln industries occupies a very important place in relation to the industrial structure but it has remained in the state of neglect. For the purpose of study, twenty five brick kiln units were selected randomly. This study investigated the three major aspects of the industry viz; management, finance and labour. It was found that the enforcement of various labour laws applicable to the brick kiln units had been found faulty and due to this the skilled labour force of brick industries had been decreasing from year to year.

Mukhopadhay A (1993) has studied about the economies of brick industry. This study covers 56 brick field located in the Uttarpara area which runs by people with little professional skill. This study has made an attempt to analyse the nature and dimensions of the problem of efficiency differences among the brick units operating in the study area. This study has found that smaller units of the area are in a better position to utilise the inputs most effectively than the larger units. There is absence of professionalism for which the brick units fail to identify the optimal size of the unit.

Monorangan E (1998) has conducted a research about scale, technology and efficiency of brick industry in Tamilnadu. Here, two districts of Taminadu viz, Chengalpattu and Dharmapuri are selected for the coduct of sample survey. It is found that all the brick units have been facing the problem of labour shortage which further reduces the number of annual output. This study endorses the positive relationship between sale and technology in the study area which implies that relatively smaller units are labour intensive and larger units are capital intensive. In the study area, the sophisticated technology fails as it increases the cost of production and hence the price of bricks.

Pranmalai K (2004) has made an attempt for a detailed analysis and understanding of traditional brick units on Madurai district. Here a census method is used for collecting data regarding total 307 no of traditional brick units. He found that the brick industry is male dominated industry where locational advantage plays a most important role. Brick units require only a small investment but it provides employment for many unskilled rural labourers.

Bera R (2010) seeks to examine the problem and prospects of brick industry of West Bengal. After independence the

production of brick unit in the state continued to be undertaken mostly by private sector and demand for bricks in the state, at present being met almost entirely by private sector. The brick units employ almost 5.2 lakhs of people which belong to the weaker section of society.

Gowthaman C (2012) has made an attempt to analyse the production and marketing of bricks with regard to registered brick industries in Namakkal district. It includes the method and cost of production, investment, pricing, channels of distribution and the problem of brick industries. For the study the researcher has taken the sample with census method. It was found that approximately 6000 workers are employed in various process of brick production in the district. Production and marketing practices of brick manufactures includes four stage i.e. production, pricing, distribution and promotion.

4. Research Methodology

The present study is carried out to understand the existing brick kiln units in Dibrugarh District and to know the production activities and evaluate their nature of production, marketing, income and employment generation and also the socio-economic conditions of brick labourers.

4.1 Brief Description of locale

The Dibrugarh district of Assam occupies an area of 3381 km^2. The district extends from 27 degree 5'38" N latitude and 94 degree 33'46" E to 95 degree 29'8" E longitude. It is bounded by Dhemaji district on the north, Tinsukia district on the east, Tirap district of Arunachal Pradesh on the south and Sivasagar district on the west.

4.2 Statement of the problem and justification of the study

With the pace of economic development and growing volume of urbanization, construction of infrastructure and other developmental activities the demand for bricks grows up every year. Almost all of the brick kiln units are cottage and small scale traditional skill oriented industries. The brick kilns operate seasonally and therefore they face various fluctuations in case of price and supply. With this background an attempt is made to address a few issues related to brick industry.

Dibrugarh district of Assam is endowed with natural resources enabling for mass production of bricks. The availability of key raw materials clay and sand on the banks of rivers has increased the production activities of bricks. At the same time, the demand for bricks is also increases due to the rapid rate of urbanization at the study area.. It is one of the most rapid growing urbanized districts of Assam. It has led to an increase in the numbers of residential, educational institutions, hospitals, commercials etc. All this requires huge quantities of construction materials which come from nearby areas. Moreover Dibrugarh District has second highest registered factories of Assam. According to the source Chief Inspector of Factories, there are total no of 495 units of registered factories in Dibrugarh district.

4.3 Data Source

Primary data are collected from the owners of sample brick units as well as the brick labourer. For the collection of primary data a detailed and well-structured interview schedule was designed. Keeping in view the objectives of the study the relevant information were collected from the sample respondents through personal interview method.

Secondary data are collected from the Pollution Control Board, Dibrugarh. The brick units must be renew their certificate for running on district Pollution Control Board every year. For collecting secondary data on brick kiln unit, also go through the District Industrial Centre (DIC). But DIC does not provide any separate list of registered brick units. But it maintains a register for all industries in the districts which provides information on date of establishment of unit name/s of proprietor/ partners, initial capital investment, labourer employed. The limitation of DIC data is that the data related only to the date of registration of brick units. Though the units renew their registration every year the register maintained by the DIC gives only the information furnished by the units at the initial year of registration but not the data furnished by the units at the time of renewal of registration in the subsequent years.

4.4 Sample Design

The present study is done in 5 clusters of Dibrugarh District viz; Joypur, Chabua, Sepon, Demow and Tingorai Chariali. The data collected from District Pollution Control Board is considered as sample frames for the study. It is very difficult to get any clear idea as there is no any reliable published source on brick units. So to arrive at the exact population some adjustment has done.

According to the District Pollution Control Board, the Dibrugarh district has approximately 68 brick kiln units from which 50 units are selected randomly.

5. Production Function Analyses

A production function refers the way in which output is related to the inputs that used. To maximise the profit at minimum cost, producer choose the best combination of factors.

Input and output relationship and the resultant profits are the main interests of our study. Generally, the production of brick units depend on four major variable factors such as clay and soil, labour, fuel and other miscellaneous input. Traditionally in production function analysis, the all inputs are expressed in physical terms. But in case of brick industry, there are no any common units for input to measure the physical quantity. In physical terms, clay is expressed in terms Centimetre; fuel is in tonnes sand is in CFT etc. Again in case of labour there is different category of labour and the wage rate for each category is different. Besides, different category of labours absorbs different no's of labours. Therefore it is very critical to determine the men days of labour input. Moreover, the wage is paid purely on contractual basis depending on the productive capacity which means that

higher wage for higher production and vice- versa. Again in case of total production, the physical quantity cannot be determined exactly. Because, there are four types of bricks produced per rotation which is stated earlier. One of those categories is broken which cannot measured in a unit but can express in money value. Therefore to analyse the input output relationship, the all variables are taken in monetary terms.

Since, in brick kiln units, production function is considered to be the function of raw materials, wage, fuel and other miscellaneous inputs. To establish the functional relationship between inputs and output and also to observe the intensity of factor used, a multiple linear regression model, a stochastic form of C-D production function is used. The productivity of the brick units is regressed with the use of raw materials, wages, fuel and other miscellaneous inputs. The equation for multiple linear regression model is as follows

$$Y = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} e^u \tag{1}$$

Here, Y represents the value of the total output of the brick units, and X_1, X_2, X_3, and X_4 represent the costs of raw materials, wages, fuel costs, and other miscellaneous costs, respectively, in monetary terms. β_1, β_2, β_3, and β_4 represent the parameters, and u is the disturbance term. β_0 is the constant term.

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Taking the logarithm to linearize Equation (1), we get:

$$\begin{aligned}\ln(Y) = {} & \beta_0 + \beta_1 \ln(X_1) \\ & + \beta_2 \ln(X_2) + \beta_3 \ln(X_3) \\ & + \beta_4 \ln(X_4) + U\end{aligned} \tag{2}$$

Now by applying the linear equation (2) in the surveyed data, the following results are found

Table 1. Estimated C-D Production Function

Variable	Estimated Coeff.	t Value	VIF
Constant (β_0)	1.732	6.710	-
Raw Materials (β_1)	0.198	2.072*	3.417
Wage (β_2)	0.506	4.203*	2.973
Fuel (β_3)	0.278	2.805*	2.450
Miscellaneous (β_4)	-0.007	-0.118**	1.346

* = 1% level of significance, ** = 5% level of significance

Here, $R = 0.93$, $R^2 = 0.870$, Adjusted $R^2 = 0.852$, and $F = 48.66^*$.

The standard error is 0.17.

Now, the estimated model for Equation (2) is as follows:

$$\begin{aligned}\ln(Y) = {} & 1.732 + 0.198 \ln(X_1) + 0.506 \ln(X_2) \\ & + 0.278 \ln(X_3) - 0.007 \ln(X_4)\end{aligned}$$

The multiple linear regression model is estimated based on data collected from 34 sample brick units in Dibrugarh district. The function is estimated using a linear regression model, where Y is the dependent variable, and X_1, X_2, X_3, and X_4 are the independent variables. The natural log values are used for all the variables.

In the estimated model: - $\beta_1 = 0.198$ signifies that, keeping the other inputs fixed, a one percent increase in the cost of raw materials leads to an average of about 19 percent increase in the value of output. - $\beta_2 = 0.502$ signifies that, keeping the other inputs fixed, a one percent increase in the cost of labor payment leads to a 50 percent increase in the value of total output. - $\beta_3 = 0.278$ signifies that, keeping the other inputs fixed, a one percent increase in the cost of fuel leads to an average of about 27 percent increase in the value of output. - $\beta_4 = -0.007$ signifies that, keeping the other inputs constant, a one percent increase in miscellaneous costs leads to an average decrease of 0.007 in the value of total output.

The coefficient of determination is quite high, $R^2 = 0.870$, implying that 87 percent of the variability in the dependent variable can be explained by the independent variables. Additionally, the value of VIF indicates that there is no problem of multicollinearity.

6. Returns to Scale

To determine the returns to scale of the brick industry in Dibrugarh district, the study employs a one-tailed t-test of the parameters. In the case of increasing returns to scale, we test the following hypotheses:

$$\text{Null hypothesis } (H_0) : \sum_{i=1}^{n} b_i = 1$$

$$\text{Alternative hypothesis } (H_A) : \sum_{i=1}^{n} b_i > 1$$

The t-statistics is computed as follows:

$$t \sum_{i=1}^{n} b_i = \frac{\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4}{\text{S.E}(\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4)}$$

Where the standard error of parameters is estimated as:

$$\begin{aligned}\text{S.E}(\beta_0 + \beta_1 + \ldots + \beta_4) = {} & \\ & \sqrt{\text{var}(\beta_0) + \text{var}(\beta_1) + \ldots + \text{var}(\beta_4)} \\ & + 2\text{cov}(\beta_0\beta_1) + 2\text{cov}(\beta_1\beta_2) + \ldots \\ & + 2\text{cov}(\beta_3\beta_4)\end{aligned} \tag{3}$$

By applying the above formula, the returns to scale are calculated to be 0.975, which is marginally less than 1, with a t-value of 3.36. Therefore, this suggests that the brick industry exhibits constant returns to scale. A higher t-value would provide stronger evidence against the null hypothesis, indicating a significant difference from the hypothesized value, while a t-value closer to zero would suggest no significant difference.

7. Conclusion

As a concluding remark we can say that despite the huge growth potentialities, the brick industry fails to attain a satisfactory position due to the absence of professionalism and government support. The overall analysis of brick units in Dibrugarh Districts reflects that the brick kiln units of the district faces various constraints in smooth and efficient running. As the second largest populated and largest populated country, there is much pressure of population on land. Therefore it is very wasteful to use the land for making bricks and this process also reduce the fertility of agricultural land. Therefore, in this regard the government should aware and should take legal procedures about land using matters.

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