# STOCHASTIC FRONIER ANALYSIS OF TECHNICAL EFFICIENCY IN AGRICULTURAL PRODUCTION IN MALUR TALUK OF KOLAR DISTRICT OF KARNATAKA.

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## Abstract

Agriculture is a source of livelihood of farmers in Malur taluk in Kolar district of Karnataka.

Increased agricultural productivity meets future demand for food for the growing population. Technical efficiency is a form of productive efficiency with maximum output for a given set of inputs. It analyses the technical efficiency of farmers in Malur taluk of Kolar district of Karnataka with a view to determine the factors that affect technical efficiency of farmers. A multistage random sampling technique was adopted in selecting the sample of agricultural production of farmers. There is a need to improve the overall efficiency of the farmers with the available inputs and technology. The variable that were identified are having significant effects on technical efficiency level of farmers are size of land, material inputs, labour cost and machinery.

## Key words

Technical efficiency, Multistage sampling, Agricultural production, material inputs

## Introduction:

Agriculture is a source of livelihood of farmers in Malur taluk in Kolar district of Karnataka. Most of the people depend on agriculture for meeting their daily needs as well as their subsistence. The farmers grow various types of food grains. Since the implementation of green revolution major changes has taken place in agriculture production. To boost up farmers in agriculture activities is only through intensive agriculture production, increasing agricultural productivity as well as resource base efficiency. Increased agricultural productivity meets future demand for food for the growing population. Agricultural productivity play a significant role by linking demand and supply side .Demand side increases agriculture production and raise the earning of rural population and create more demand local industrial products whereas supply side supplies raw material for industrial or other non-agricultural sector.

Crop failures, inefficiencies in agriculture productivity and production inefficiency among farmers widen the gap between demand and supply of agricultural products. Agricultural production measures the quantity of agricultural output produced for a given quantity of inputs leads to economic growth in agriculture sector.

Technical efficiency is a form of productive efficiency with maximum output for a given set of inputs. Productive efficiency is the efficient resource input mix for any given output-the combination that minimizes the cost of producing the level of output, the combination of inputs that for a given monetary outlay maximizes the level of production (Ephraim and Welbon 1998)

This study analyses the technical efficiency of farmers in Malur taluk of Kolar district of Karnataka with a view to determine the factors that affect technical efficiency of farmers.

## Review of literature:

Sakshi and Sonia Khajuria (2015) in their study on the "Agricultural Productivity in India Trends, Challenges and Suggestions" analysed the trends and patterns of agricultural productivity, causes of low productivity and various schemes of government. The study observed that there was low agricultural productivity and lack of finance. It concluded that all these needs are to be sorted out with the support of government by taking new initiatives and spread the information related to agricultural crops.

Rekha Misra et al. (2016) in their study on the "Agricultural Credit in India in the 2000's Growth, Distribution and Linkages with Productivity" analysed the relationship between agricultural credit and agricultural productivity. It had a positive impact on the intensity of agricultural credit on total factor productivity. It concluded that agricultural sector required continued policy support to move on to a sustainable and high growth path.

Asif Reza Anik et al. (2017) in their study on the "Agricultural Productivity Growth and Role of Capital in South Asia" assessed agricultural sustainability in South Asia. The study revealed that in South Asia there were little or no variation in technical and scale efficiency changes among countries. The major drivers of agricultural total factor productivity growth were the levels of natural, human, technology and capital endowments, whereas financial capital and crop diversification had opposite effects.

## Profile of Malur

The present study was confined to the farmers in four villages in Malur taluk in Kolar district of Karnataka. Malur is 46 kilometers (29 mi) from Bangalore City and 26 km from Kolar. Malur is located at 13.00°N 77.94°E. It has an average elevation of 910 meters (2,990 ft). Malur was also called Malligepura in earlier days because the farmers here grow large number of jasmine flowers.

Hullimangala Village is best known for growing capsicum and rose by new technology. Kodihalli is another village in Malur taluk famous for varieties of roses, and most of roses from here is exported to other states of the country. Most of the villages in the Malur taluk grows grains, vegetables and flowers and they sell their agricultural produce in Bangalore market.

## Methodology

The study was conducted in Malur taluk of Kolar district of Karnataka. Data were collected from primary sources. A multistage random sampling technique was adopted in selecting the sample of agricultural production of farmers. In the first stage, the area of Malur was selected. In the second stage, four highly intensive credit blocks were chosen. In the third stage 500 respondents were selected from four areas that is 125 each from Agrahara, Kambipura, Koduru and Araleri area. The statistical technique used is stochastic frontier analysis of technical efficiency

## Limitation

The study has few limitations. The respondents were reluctant to provide correct information regarding their agriculture productivity of various crops.

## Finding of the study

### Socio-Economic Characteristic of Farmers

An examination into the socio-economic conditions of farmers is highly essential for determining the living conditions and standard of living of the farmers. The variables associated with these are ‘age’, ‘community’, ‘family size, ‘education’, ‘years of experience’ and ‘income’.

Area wise analysis of age of farmers revealed that 64 percent of the farmers in Agrahara, 71.2 percent in Kambipura and 59.2 percent in Koduru and 56.8 percent in Araleri area were in the age group of 25-50 years. The average age of the farmers in the study area was 44 years. farmers. Around 48 percent belonged to ‘backward community’, 26 percent belonged to ‘forward community’ and 20 percent belonged to ‘scheduled castes’. The percentage of farmers from scheduled tribes was 6 percent. Most of the farmers had a family size of below 5 members. The above table revealed that 83 percent of the farmers in the study had a family size of below 5 members. Around 17 percent of the farmers had above 5 members in their family.

Around 45.4 percent of the respondents in the research area is involved in farming for 20 to 30 years,34.6 percent of the farmers are engaged in farming for 10 to 20 years, 14.2 percent of the farmers are involved in farming for above 40 years. Only 5.8 percent of the farmers are engaged in farming for below 10 years. Most of the farmers had a family size of below 5 members. The above table revealed that 83 percent of the farmers in the study had a family size of below 5 members. Around 17 percent of the farmers had above 5 members in their family. Around 41.6 percent of Agrahara area, 57.6 percent of Kambipura area, 70.4 percent of Koduru area and 52 percent of Araleri area farmers had a monthly income of ` 15000-` 30000.

Stochastic Frontier Production

The stochastic frontier approach was used for the technical efficiency. The form of the frontier production function used in the study was

$$\mathbf{Ln\ (y) = \beta o + \beta_1 Ln\ X_1 + \beta_2 Ln\ X_2 + \beta_3 Ln\ X_3 + \beta_4 Ln\ X_4 + V_{it}}$$

Y = Value of production (In Rs.)

$X_1$= Area under cultivation (In hectares)

$X_2$= Material Inputs (In Rs.)

$X_3$= Value of Labour (In Rs.)

$X_4$= Farm Machineries and equipments used (In Rs.)

$V_{it}$ = Error Team

The explanatory variables were used to explain the efficiency were included in the model while estimating the measures of technical efficiency.

**Table- 1**

**Maximum Likelihood Estimates of the Stochastic Frontier Analysis**

| Variables and Parameters | | ML Estimate Coefficient | | | |
|---|---|---|---|---|---|
| | | Agrahara | Kambipura | Koduru | Araleri |
| **Constant** | $ß_0$ | 4.565*** | 4.565*** | 6.391*** | 7.133*** |
| **Size of land (Hectares)** | $ß_1$ | 1.882** | 1.882** | 1.125 | -0.442 |
| **Material Inputs (RS)** | $ß_2$ | 0.0684 | 0.0684 | 0.0486 | 0.1516** |
| **Labour cost (RS)** | $ß_3$ | -0.0350 | -0.0350 | -0.0960 | -0.0418 |
| **Machinery (RS)** | $ß_4$ | -0.072 | -0.072 | -0.349*** | -0.5352*** |

| | | | | | |
|---|---|---|---|---|---|
| **Sigma Squared** | $\sigma^2$ | 0.364*** | 0.364*** | 0.389*** | 0.4530*** |
| **Gamma** | | 0.411 | 0.411 | 0.6644*** | 0.7840*** |
| **LR test** | | 0.183 | 0.183 | 3.588 | 7.574 |
| **Log Likelihood Function** | | -95.369 | -95.369 | -83.431 | -82.72 |

Note: *** Statistically Significant at 1 percent

The above table presents the estimated coefficients for the frontier model. The MLE method is more representative of the data set for agricultural producers. The results of the stochastic frontier production function estimates are shown in table 1. In Agrahara area the material inputs elasticity is positive and highly significant. Hence, if investment is increased by one percent on material inputs it could raise the agricultural production by 0.23 percent. Investment in materials inputs could bring a significant improvement in the performance of agricultural production. This implies that investment in material inputs remains an important contributor to the improvement of technical efficiency in agricultural production practiced in the Agrahara area. The elasticity of size of land presents a negative sign and it's not statistically significant. The labour and machines hired for ploughing and investment are not significant, and its elasticity is positive.

The overall technical inefficiency effects are evaluated in terms of the parameters associated with □$^2$and □(Arif et al., 2012). The estimate for the variance parameters σ is significantly different from zero at one percent level. This indicates statistical confirmation of the presumption that there are differences in Technical Efficiency (TE) among the producers in Agrahara area. The gamma value (γ) of the MLEs of stochastic frontier production model is 0.5430. This value is statistically significant at the 1percent level, implying that 54.3% of variability of revenue from agricultural production are attributed to technical inefficiency in agricultural production techniques. And the rest (45.7percent) is due to random noises. Moreover, the presence of technical inefficiency was tested by the Likelihood Ratio (LR) test which was 1.2935 and less than critical chi square value 12.483(given by Kodde and Palm, 1986). Therefore, the null hypothesis of no technical inefficiency was accepted.

In Kambipura area the size of land elasticity is positive and highly significant. Hence, if the area under cultivation increases by one percent it could increase the agricultural production by 1.88 percent. This implies that the area under cultivation remains an important contributor to the improvement of technical efficiency in agricultural production practiced in the Kambipura area. The elasticity of labour cost and machineries hired for ploughing and harvesting presents a negative sign and it's not statistically significant. The material inputs is not significant, and its elasticity is positive.

The gamma value (γ) of the MLEs of stochastic frontier production model is 0.411. This value is statistically insignificant implying that 41.1percent of variability of revenue from agricultural production are attributed to the technical efficiency in agricultural production techniques. And the rest (58.9percent) is due to random noises. Moreover, the presence of technical inefficiency was tested by the Likelihood Ratio (LR) test which was 0.183 and less than critical chi square value 12.483 (given by Kodde and Palm, 1986).Therefore, the null hypothesis of no technical inefficiency was accepted.

In Koduru area are the elasticity of size of land and material inputs presents a positive sign and it's not statistically significant. The variable labour cost is not significant, and its elasticity is negative.Machines hired for ploughing and harvesting is negative and highly significant. Hence it can be inferred that one percent increase in machine cost will lead to a decline in the agricultural production by 0.35 percent. This may be due to the inefficient use of machines which are hired.

The gamma value (γ) of the MLEs of stochastic frontier production model is 0.6644. This value is statistically significant at 1percent level, implying that 66.4percent of variability of revenue from agricultural production are attributed to technical inefficiency in agricultural production techniques. And the rest (33.6percent) is due to random noises. Moreover, the presence of technical inefficiency was tested by the Likelihood Ratio (LR) test which was 3.588 and less than critical chi square value 12.483 (given by Kodde and Palm, 1986). Therefore, the null hypothesis of no technical inefficiency was accepted.

In Araleri area the materials inputs elasticity is positive and highly significant. Hence, if investment increased by one percent on material inputs,it could raise the agricultural production by 0.15 percent. Investment in material input could bring a significant improvement in the performance of agricultural production. This implies that investment in materials inputs remains an important contributor to the improvement of technical efficiency in agricultural production practiced in the Araleri area. The elasticity of size of land and labour presents a negative sign and it's not statistically significant. But the machines hired for ploughing and harvesting is negative and significant at one percent level.This shows that if one percent increase in hiring machine cost increases,it will lead to a decline in the agricultural production by 0.54 percent.This could be due to the inefficient use of machines which are hired or poor quality of machines.

The gamma value (γ) of the MLEs of stochastic frontier production model is 0.7840. This value is statistically significant at 1 percent level, implying that 78.4 percent of variability of revenue from agricultural production are attributed to technical inefficiency in agricultural production techniques. And the rest (21.6 percent) is due to random noises. Moreover, the presence of technical inefficiency was tested by the Likelihood Ratio (LR) test which was 7.574 and less than critical chi square value 12.483 (given by Kodde and Palm, 1986).Therefore, the null hypothesis of no technical inefficiency was accepted.

**Table- 2**

**Frequency Distribution of Technical Efficiency Estimates**

| Efficiency Level % | Agrahara | | Kambipura | | Koduru | | Araleri | |
|---|---|---|---|---|---|---|---|---|
| | No | Percentage | No | Percentage | No | Percentage | No | percentage |
| **40-49** | 3 | 2.4 | 0 | 0 | 5 | 4 | 8 | 6.4 |
| **50-59** | 5 | 4 | 8 | 6.4 | 11 | 8.8 | 12 | 9.6 |
| **60-69** | 5 | 4 | 20 | 16 | 22 | 17.6 | 79 | 63.2 |
| **70-79** | 76 | 60.8 | 80 | 64 | 65 | 52 | 9 | 7.2 |
| **80-89** | 31 | 24.8 | 12 | 9.6 | 15 | 12 | 10 | 8 |
| **90-99** | 5 | 4 | 7 | 5.6 | 7 | 5.6 | 7 | 5.6 |
| **Total** | 125 | 100 | 125 | 100 | 125 | 100 | 125 | 100 |
| **Mean efficiency** | 0.76 | | 0.75 | | 0.70 | | 0.66 | |
| **Minimum** | .41 | | .53 | | .42 | | .43 | |
| **Maximum** | .91 | | .90 | | .93 | | .92 | |

The result derived from the ML estimates show Technical Efficiency (TE) indices range from 0.41 to 0.91with a mean value of 0.76 in Agrahara area. The average efficient farmers in Agrahara area to achieve the technical efficiency level of its most efficient counterpart he could realize about (0.91-0.76/0.91) increase in production. This gives about 16.48 percent increase in production. The least efficient farmers can increase to production of 54.9 percent (0.91-0.41/0.91) to achieve the required technical efficiency of the most efficient farmers. Among the farmers 60.8 percent are producing at 70-79 percent efficiency level.

In Kambipura area the technical efficiency range from 0.90 to 0.53 with a mean value of 0.75. The average efficient farmers in Kambipura area to achieve the technical efficiency level of its most efficient counterpart could realize about (0.90-0.75/0.90) increase in production. This gives about 16.66 percent increase in production. The least efficient farmers can increase to production of 41.1

percent (0.90-0.53/0.90) to achieve the required technical efficiency of the most efficient farmers. Among the farmers 64 percent are producing at 70-79 percent efficiency level.

The farmers in Koduru area technical efficiency range from 0.93 to 0.42 with a mean value of 0.70. The average efficient farmers in Koduru area to achieve the technical efficiency level of its most efficient counterpart he could realize about (0.93-0.70/0.93) increase in production. This gives about 24.73 percent increase in production. The least efficient farmers can increase the production of 54.8 percent (0.93-0.42/0.93) to achieve the required technical efficiency of the most efficient farmers. Among the farmers 52 percent are producing at 70-79 percent efficiency level.

The technical efficiency in Araleri area range from 0.43 to 0.92 with a mean value of 0.66 . The average efficient farmers in Araleri area to achieve the technical efficiency level of its most efficient counterpart could realize about (0.92-0.66/0.92) increase in production. This gives about 28.26 percent increase in production. The least efficient farmers can increase the production of 53.2 percent (0.92-0.43/0.92) to achieve the required technical efficiency of the most efficient farmers. Among the farmers 63.2percent are producing at 60-69 percent efficiency level.

Except for Araleri area, allthe farmers were producing at 76-79 percent efficiency level. In Araleri area it was 60 -69 percent efficiency level.

## Conclusion

The study shows that farmers in the Agrahara, Kambipura, Koduru and Araleri area are not fully technical efficient with the available inputs. So, there is a need to improve the overall efficiency of the farmers with the available inputs and technology. The variable that were identified are having significant effects on technical efficiency level of farmers are size of land, material inputs, labour cost and machinery.

## Suggestions

- Appropriate policy measures should be adopted for the provision of incentives for material inputs and machinery.
- Government policies should encourage experienced farmers to continue farming which reduces labour cost and improves efficiency.

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