

Economic Analysis of Maize Production and Marketing in Khammam District, Telangana

Abstract:

Maize is the most important cereal and it is mostly used as grain, feed, fodder, starch and industrial products. In the present study, an attempt was made to calculate the cost of cultivation, find out resource use efficiency, price spread and market efficiency of maize in different marketing channels and to find out constraints in production and marketing of hybrid maize in the study area. The study area selected was Chinthakani mandal of Khammam (dist.). A multi-stage sampling method involving a combination of purposive and random sampling procedures was employed in drawing up the sample block, villages and farmers for collecting primary data. Sixty farmers (23 marginal, 20 small and 17 large) were selected at random by proportional probability sampling technique. In the study Maximum likelihood Estimation (MLE) technique was used in stochastic frontier production for finding out the technical efficiency. The coefficients of stochastic regression model were used to calculate the Marginal Value Product of Variable Inputs (MVP) and its ratio R with Marginal Factor Cost (MFC) used to determine resource use efficiency (RUE). The price spread was applied to measure the degree of pricing efficiency, marketing costs; market margins to calculate Index of the marketing efficiency (MEI). Total fixed cost for marginal, small and medium farmer are Rs.7337.43, Rs.7281.84 and Rs.7261.11 respectively. The benefit cost ratio is Maximum in case of medium farmers with at 2.7:1, followed by small farm (2.5:1) and marginal farmers (1.5:1). The gross returns from a hectare land are highest in case of medium farm with Rs 89364.63, followed by small (75396.54) and marginal (64845.89). A significant difference indicates sub-optimal allocation of resource. Labour, fertilizer and machine are under-utilized in the study area. The study suggested that a well-built strong infrastructure provision with efficient use of inputs and without marketing malpractices would show the way to an economically well-built maize economy.

Key words: Maize (*Zea mays* L.), Production and Marketing of maize, Maximum likelihood Estimation (MLE), Marginal Value Product of Variable Inputs (MVP), Marginal Factor Cost (MFC), resource use efficiency (RUE), Index of the marketing efficiency (MEI).

31 Introduction:

32 (Maize history and climate)

33 Maize (*Zea mays* L.) was one of the first plants cultivated by farmers between 7000 and
34 10,000 years ago, with evidence of maize as food coming from some archaeological sites in
35 Mexico where some small corn cobs, estimated to be more than 5000 years old, were found in
36 caves. Other theories describe maize as originating in the region of in the high lands of Bolivia,
37 Ecuador, and Peru as evidenced by the presence of popcorn in South America (FARA 2009).
38 The spread of maize from its center of origin in Mexico to various parts of the world has been
39 remarkable and rapid with respect to its evolution as a cultivated plant and as a variety of food
40 products. It can be grown successfully in variety of soils ranging from loamy sand to clay loam.
41 However, soils with good organic matter content having high water holding capacity with neutral
42 pH are considered good for higher productivity (Wokabi, 1998). Fertile well-drained alluvial or
43 red loams free from coarse materials and rich in nitrogen are the best soils for its successful
44 growth.

45 The cultivation of maize in India is characterized by inter-cropping i.e. along with and in
46 pulses, vegetables and oil seeds. It can be grown under varied climatic conditions. Maize is
47 mainly a rainfed kharif crop, it requires 50-100 cm of rainfall and it cannot be grown in areas of
48 more than 100 cm rainfall. In areas of lesser rainfall, the crop is irrigated. This crop usually
49 grows well under temperatures varying from 21°C to 27°C, although it can tolerate temperatures
50 as high as 35°C. Maize is an inferior grain which is used both as food and fodder. Because of its
51 worldwide distribution and relatively lower price maize has wider range of uses. (Source:
52 Meteorology department of PJTSAU)

53 (Overall Economics Strategy of Maize)

54 Maize is one of the most versatile emerging crops having wider adaptability under varied
55 agro-climatic conditions. It is an important cereal crop in world after wheat and rice. The
56 importance of the crop lies in its wide industrial applications besides serving as human food and
57 animal feed. As the demand for the crop is growing globally due to its multiple uses for food,
58 feed and industrial sectors new production technologies offer great promise for increasing
59 productivity to meet the growing demands of consumers.

60

61

Comment [O1]: Remove the brackets

Comment [O2]: Consider revising to "economic potential of maize", remove the brackets, if table has to remain, include some information that can link the table to the discussion in the subtitle, if not the table is hanging.

62 **Table 1: Top 10 Maize producing countries in the world in 2015.**

Rank	Country	Production (Million Metric Tons)
1.	USA	363
2.	China	229
3.	Brazil	77
4.	European Union	65
5.	Ukraine	26
6.	Argentina	25
7.	India	23
8.	Mexico	23
9.	South Africa	13
10.	Russia	12

(Source:www.perfectinsider.com)

63 **Strategy of Maize in Telangana**

Comment [03]: Consider revising the sub-title "Overview of maize potentials in Telangana"

65 The role of agriculture sector in the state economy is very significant. It produces 30
66 percent of the income and 78 percent of the working population is dependent directly and
67 indirectly on agriculture and mostly dependent on rainfall. Monsoon and seasonal conditions
68 play a major role in the agricultural production. The contribution of agriculture and livestock
69 under primary sector to the state Telangana is the twelfth largest state in India in terms of area.
70 Gross Domestic Product for the year 2012-13 is 13.67 per cent (BES of Andhra Pradesh, 2012-
71 13). Telangana is one of the large maize producing states in India. In Telangana, maize is
72 cultivated in all the districts (except Hyderabad) in both the Kharif and Rabi seasons. The total
73 maize production doubled in the state within the past ten years (DES, 2014). The maize
74 production in the state has been largely influenced by increasing demand from the feed industries
75 and various industrial uses (Ranjit Kumar *et al.*, 2014). Major maize growing districts in
76 Telangana are Karimnagar, Warangal, Nizamabad, Mahaboobnagar, Khammam and Medak.
77 Area and production of maize have increased manifolds in the state during the previous decade.
78 In Medak district, the maize yield has declined over the years with very high instability (Kumar
79 *et al.*, 2013). Since maize demand is increasing consistently, it has become important to
80 understand the existing maize situation in the newly formed Telangana state and plan the future
81 of maize in the state based on the past and present situation.

82 **Materials & Methods:**

83 **Study Area:**

Comment [04]: Add more concise information about the description of the study area. You do not need to completely cut out the entire information in the previous manuscript

84 The study was confined to Khammam district of Telangana. The selected villages
85 represent fairly well the agro-climatic, Socio-economic situation of the Khammam district.

86 **Sampling Technique**

87 A multi-stage sampling method involving a combination of purposive and random
88 sampling procedures was employed in drawing up the sample. The first stage was purposefully
89 selecting the district and secondly purposefully selecting the EPAs. The purpose for selecting
90 area was based on highest productivity of maize per hectare and climatically suitable area and it
91 was help for economic researcher for reference in future research. The selected sites were
92 Chinthakani mandal of khammam district EPAs. Thirdly, the sampling units (households) were
93 sampled randomly from the selected EPAs where equal number of households was drawn from
94 each EPA. For the purpose of selecting desired number of sampling units from each village, the
95 farm households of these villages were listed separately.

96 The households listed were again stratified in to 3 size groups.

97 Households having less than one hectare of operational land holding

98 (<1ha, marginal).

99 Households having one to two hectare of operational land holding

100 (1-2 ha, small).

101 Households having two to four hectare of operational land holding

102 (2-4ha, medium).

103 23 marginal farmers, 20 small farmers and 17 large farmers were selected at randomly.

104 Thus a total 60 respondents were selected at random for the purpose of this research study.

105 **Prevailing Marketing Channels**

106 Channel-I (Producer→ Consumer)

107 Channel-II (Producer→primary wholesaler→→retailer Consumer)

108 Channel-III(Producer→primary→wholesaler→seconadary wholesaler→reatailer →Consumer)

109 Channel-IV (Producer→retailer→Consumer)

110 **Analytical Technique**

111 In the study, a number of analytical approaches were used. They include; Descriptive
112 Statistics, stochastic frontier analysis (SFA), marketing margins, marketing costs, marketing
113 efficiency index (MEI) and price spread.

114

115 **Descriptive Statistics**

116 Descriptive Statistics such as mean, standard deviation and percentages were calculated
117 on all variables including; maize area (ha), yield (kg/ha), seed (kg/ha), labour used (man-day
118 /ha), chemical fertilizer (kg/ha), manure (tonnes/ ha), cost of pesticides and insecticides (rupee □
119 ha), credit access (per cent), extension services (per cent), age of head (years), education (years),
120 experiences (years), total agricultural areas (ha).

121 **Farm Business Analysis**

122 The following cost concepts were used to find out the costs structure in the production of
123 Maize. Variable costs (seeds, Manure, Fertilizer, Human labour etc.).

124 Fixed costs (Rental value of land, Interest in fixed capital Depreciation).

125 Total costs = Total variable cost (TVC) + Total Fixed Cost (TFC)

126 For examining the cost of cultivation of Maize with its market price, the following concepts were
127 worked out;

128 Table No : Cost concepts

129 **Cost groups Items of the costs included**

130 Cost A1 Seed, Manure, Fertilizer, Human labour, Hired labour, pesticides etc

131 Cost A2 Cost A1 + rent paid for leased in land

132 Cost B1 CostA1 + interest on fixed capital

133 Cost B2 Cost B1+ rent paid on leased in land+ rental value of owned land

134 Cost C1 Cost B1+imputed value of family labour

135 Cost C2 Cost B2+ imputed value of family labour

136 **Estimation of measures of farm income employed the following measures:**

137 Gross Farm Income: (GI) was estimated at prevailing market prices of main product and
138 bi-product at the time of harvest.

139 Net Farm Income (NI): NI was calculated by deducting total cast (TC) from Gross Farm Income
140 (GI).NI=GI – TC

141 Farm business Income (FBI): its disposable income but of the enterprise and defined as retunes
142 to family labour, owned land, owned fixed capital and management. It is expressed as FBI =
143 Gross Income – Cost A2.

144 Family labour Income: it is the return to family labour (including management). It is defined as;
145 FLI = Gross Income – Cost B2.

146 Return on Kwacha: it was estimate by dividing Gross Income (GI) by Total Cost (Cost C2), B: C
147 ratio = GI/ TC.

148 **Stochastic Frontier Analysis (SFA)**

149 Stochastic frontier Analysis (SFA) was employed to analyse the data collection. The
150 frontier production differs from production function in the sense that its disturbance term has two
151 components, one to account for technical inefficiency and the other to permit the random event
152 due to measurement errors (Tran *et al.* (1993; Amaza, 1999).

153 The empirical Stochastic Frontier Production Model used for the study of the analysis of
154 technical efficiency is expressed as follows:

155
$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + v_i - u_i \text{ ---- (1)}$$

156 Where

157 $\ln Y_i$ = Output (Kg of Maize of the farmer)

158 X_i = Farm size (in hectares)

159 X_2 = seed (Kg/ha)

160 X_3 = Hired labour used (in man days)

161 X_4 = Fertilizer used (in Kg)

162 X_5 = family labour used (in man days)

163 X_6 = Herbicides used (in litters)

164 V_i = Random noise

165 U_i = Inefficiency effect which are non- negative, half normal distribution

166 The technical efficiency (T.E) of an individual farm is defined in terms of the ratio of the
167 observed output (Y_i) to the corresponding frontier output (Y_i^*), given the available technology,
168 conditional on the level of input used by the farm. Hence the technical efficiency of farm is
169 expressed as follows:

170
$$T.E. = Y_i/Y_i^* = f(X_i, \beta) \exp(V_i - U_i) / f(X_i, \beta) \exp(V_i) = \exp(-U_i). \text{ ----- (2)}$$

171 The technical efficiency of the i - th farm is given by $TE_i = \exp(-u_i)$ and has value
172 between 0 and 1, with 1 defining a technically efficient farm. Since only the difference between
173 both random terms $w_i = v_i - u_i$ can be observed, u_i is predicted by its conditional expectation
174 given the estimate value of w_i : $E[u_i/w_i]$ (Coelli *et al.* 1998). The conditional distribution of
175 u_i/w_i is that of a truncated N ($\mu_i^* \sigma^2$), where $\mu_i^* = (w_i \sigma_u^2 - \mu_i \sigma_v^2) / (\sigma_u^2 + \sigma_v^2)$ and $\sigma^2 =$
176 $\sigma_u^2 \sigma_v^2 / (\sigma_u^2 + \sigma_v^2)$ (Jondrow *et al.* 1982).

177 The socio- economic factors affecting level of technical efficiency model was defined by:

178
$$T.E. = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \beta_6 Z_6 \text{----- (3)}$$

179 Where,

180 T.E = Technical Efficiency

181 Z_1 = Farming experience (in years)

Z1 = Gender of the respondent
 Z3 = Age of the respondent (in years)
 Z4 = Literacy level (in years)
 Z5 = Family size (number of persons in farmer's household)
 Z6 = Number of contact by extension agent (in number)
 $\delta_0 - \delta_6$ = Are parameters to be estimated.

The Maximum Likelihood Estimation (MLE) for all parameters of the Stochastic Frontier Production function and the inefficiency model defined above and the technical efficiency were obtained using R project software.

Resource Use Efficiency

The estimation coefficients from the stochastic regression model above were used to calculate the MVP and its ratio R with MFC used to determine the economics efficiency of resource used. The model was estimated as follows;

$$R = MVP / MFC \text{ -----(4)}$$

Where,

R = efficiency ratio

MVP = Marginal Value Product of Variable Inputs

MFC = Marginal Factor Cost (price per unit inputs)

Based on economics theory, a farm maximizes profits with regards to resource use when the ratio of the marginal return to opportunity cost is one. The values are interpreted as follows; If r is <1; resource is excessively used or over utilize hence decreasing the quantity use of that resource increases profits.

If r is > 1; resource is under use or is being underutilized hence increase in the rate of use will increase profit level. If r is = 1; it show that the resource is efficiently used, that is optimum to utilization of resource hence the point of profit maximization (Olukosi and Ogunbile, 1989).

Estimation of Technical Efficiency (Stochastic Frontier Production)

In this study we were interested to find out the individual and the overall technical efficiency of different size group of maize farmer. For the estimation of the technical efficiency we have used stochastic frontier production function. While it was also possible to use the technique with a single input and output. This technique was also capable of taking panel data as well as single time cross section data for calculation of inefficiency of the individual farm.

Farrell (1957) introduced the idea of an empirical approach to efficiency by the firm specific quotient of observed production Y_i to optimal production Y_i^* . Stochastic production

frontiers indicate the maximum expected output for a given set of inputs. Explicit representation of this relationship as a production frontier allows a detailed characterization of input and output relationships. So when assuming cross sectional data for n units indexed by i (i = 1,..., n) using K (k = 1, ...,K) different inputs contained in the input efficiency .

$$TE_i = Y_i / [Y_i]^* = Y_i / (g(x_i; \beta)) \in [0,1]$$

TE_i = Technical efficiency

Y_i = Represents the output for the i-th firm

Y_i^* = Represent optimal production of ith firm

$g(X_i; \beta)$ = a deterministic production function.

x_i = input vector x_i to produce a single output Y_i

The main idea of the stochastic frontier production function was what the contribution of the technology different individual farms were employing in the production process. So we can write the output including stochastic terms

$$Y_i = g(x_i; \beta) \cdot e^{v_i} \cdot e^{-u_i}$$

Transforming into log is

$$\log(Y_i) = \log(g(x_i; \beta)) + v_i - u_i$$

Where,

v_i were assumed to be independent and identically distributed random error which have normal distribution with mean zero and unknown

$$\text{Variance } \sigma_v^2. \quad v_i \sim N(\mu_v; \sigma_v^2)$$

u_i were non-negative unobservable random variables associated with the technical inefficiency of production, such that, for the given technology and levels of inputs, the observed output falls short of its potential output.

u_i can be defined as:

$$u_i = \{\exp[-\eta(t - T)]\} u_h, (2)$$

Where

η = is an unknown parameter to be estimated.

In the following we assume a simple Cobb-Douglas production function

$$g(X_i; \beta) = e^{\beta_0} X_i^{\beta_k}$$

Transforming into Log

$$\log(X_i; \beta) = \beta_0 + \sum_{k=1}^K \beta_k \log X_{ik}$$

The output model was given by

$$\text{Log}(X_i; \beta) = \beta_0 + \sum_{k=1}^K \beta_k \text{Log } X_{ik} + v_i + u_i$$

This gives us firm specific technical efficiency point in Cobb-Douglas case.

$$TE = (g(x_i; \beta) \cdot e^{-v_i} \cdot [e^{-u_i}]^{\gamma}) / (g(x_i; \beta) \cdot e^{-v_i}) = e^{-u_i}$$

Maximum likelihood Estimation (MLE) technique has been used in stochastic frontier production for finding out the technical efficiency.

In this study SPF was used to find out the individual technical efficiency of onion farmer as well as the overall efficiency of onion farmer under study. As we assume that our sample represents the whole population we can get an idea how efficient our onion farmer in Odisha or in other words how inefficient they are.

$$\sigma^2 = \sigma^2 + \sigma_v^2 \quad \text{and} \quad \gamma = \sigma^2 / (\sigma^2 + \sigma_v^2)$$

In this study, the stochastic frontier production function of Cobb-Douglas form was specified as follows

Model Specification for the particular study

$$\text{Ln}(Y_i) = \beta_0 + \beta_1 \text{Ln}(A_i) + \beta_2 \text{Ln}(S_i) + \beta_3 \text{Ln}(L_i) + \beta_4 \text{Ln}(F_i) + \beta_5 \text{Ln}(IR_i) + \beta_6 \text{Ln}(O_i) + V_i - U_i$$

Where:

i	=	It refers to ith farm (i = 1,2,3,...,N), (N=121)
Ln	=	represents the natural logarithm (ie. to base e)
Y	=	represents the quantity of Onion produced (in Qtl)
A	=	Area under onion (in Ha)
S	=	Seeds used (in Rs)
L	=	Human Labour used (in Man-days)
F	=	Fertilizer used (in Rs)
IR	=	Irrigation Expenditure (in Rs)
O	=	Expenditure on Other activities (in Rs)

V_i & U_i were the random variables defined above.

The technical efficiency of the i-th farmer can be calculated as:

$$TE_i = \exp(-u_i)$$

Marketing Costs, Margins and Marketing Efficiency Indices

Producer's Share in Consumer's Kwacha

It is the price received by the farmer, to the retail price, expressed as a percentage. If P_r is the retail price and P_f is the price received by the farmer, then the producer's share in the consumer's rupee P_s may be expressed as follows;

$$P_s = (P_f / P_r) \times 100 \text{ ----- (5)}$$

Total Cost of Marketing

The total cost incurred on the marketing either in cash or in kind by the producer-seller and other various intermediaries involved in the sale and the purchase of the commodity till the commodity reaches the ultimate consumers, may be computed as follows;

$$MC = MC_f + MC_{m1} + MC_{m2} + \text{-----} + MC_{mn}, \text{ (6)}$$

Where,

MC= Total cost of marketing of paddy

MC_f= Total cost paid by the producer from the time of the produce leaves the farm till he sells it.

MC_{m1}= Cost incurred by the *i*th middle man in the process of buying and selling the products.

Marketing Margin of The Middlemen

Marketing margin was calculated by determining price various at different segment and compare them with the final price paid by the consumer. The formula for total marketing margin was as follows;

$$MM = (RP - FP) / RP \times 100 \text{ ----- (7)}$$

Where,

MM= Marketing Margin

RP= Retail Price

FP= Farm gate Price

Marketing Efficiency

Marketing efficiency is the ratio of the market output to market input. An increase in this ratio represents improved efficiency and decrease denotes reduced efficiency. It is the effectiveness or competence with which a market structure performs its designed function.

Marketing efficiency is represented as follows.

$$MEI = V / I - 1 \text{ (Shepherd's formula) ----- (8)}$$

Where,

MEI= Index of the marketing efficiency

V= Value goods sold/ retail price

I= Total marketing cost

According to Acharya and Agarwal (2001) MIE is the ratio of net price received by the farmer to the total marketing cost plus total margins follows;

$$MEI = FP / (MC + MM) \text{ ----- (9)}$$

Where,

MEI= Marketing efficiency Index

FP = Farmer Price

MC= Marketing cost

MM = Marketing margin

Constraint Analysis

The sample farmers and traders were asked to mention constraints and challenges they face in the production and marketing of maize. The questionnaire had pre- identified constraints from which farmers and traders were asked to indicate if they faced such constraints. Farmers were also asked to indicate any other constraints that did not appear on the list of pre-identified constraints. The frequency table and percentage were computed

Results and Discussion

Cost structure and return on maize cultivation in the sample farms

For decision making process in any farm business analysis, cost structure composition is crucial. The cost structure include variable cost, fixed cost, cost ratios etc. The analysis of cost and return indicates profitability of the farm business. The concept of cost and return used in the present discussion are the same as generally adopted in the farm management studies conducted in the country. This section provides the cost structure prevailing in the study area. The costs were determined keeping into account the inputs that the farmers in the study area use in the maize cultivation. The total variable cost of marginal farmers were higher than small and medium farmers (Table 8)

Variable cost of maize cultivation in the sample farms

The variable cost is such cost which varies with the level of production. These costs include the cost of inputs responsible for production such as labour (human and machinery), seed, machine, manure, fertilizer, pesticides and interest on working capital. It is observed from the table 7 that, the average variable cost per hectare is Rs. 16296.66 in all sample farms for one hectare of maize cultivation. It is found from the study that, the per hectare variable cost is high in marginal farms i.e.Rs.17858.90, followed by medium and small farms Rs.16376.57 and Rs.14131.83 respectively. Seed accounted highest percentage of total variable cost i.e. 31.01% in all farm size. Plant protection chemical accounts the next highest of total variable cost i.e. 19.14%.The per hectare expenditure on Manure is Rs. 2317.20 which accounted for 14.22% of the TVC that

is third highest of all the input cost. On an average, the per hectare expenditure on interest on working capital was 6.54% of TVC that is the least among all input. The per hectare expenditure on fertilizer and labour was Rs.2234.81 (13.71%) and Rs. 1386.94 (8.51%) respectively (Table 7).

Table 7. Composition of variable cost of Maize Production (rupees per hectare) in different categories of farm holdings

Particulars	Marginal Farmers	Small Farmer	Medium farmer	All farms
Seed	4806.00 (26.91%)	4860.00 (34.39%)	8724.70 (53.27%)	5053.20 (31.01%)
Fertilizer	2638.51 (14.77%)	2228.78 (15.77%)	1695.73 (10.35%)	2234.81 (13.71%)
Labour	1656.94 (9.27%)	1356.02 (9.59%)	1058.02 (6.46%)	1386.94 (8.51%)
Plant protection chemical	4143.95 (23.20%)	2704.96 (19.14%)	2121.87 (12.95%)	3118.62 (19.14%)
Machine	1491.82 (8.35%)	971.40 (6.87%)	777.73 (4.74%)	1116.02 (6.84%)
Manure	1953.35 (10.93%)	1086.16 (7.68%)	927.16 (5.66%)	2317.20 (14.22%)
Interest on working capital	1168.33 (6.54%)	924.51 (6.54%)	964.54 (5.88%)	1065.87 (6.54%)
Total variable costs	17858.90 (100.00)	14131.83 (100.00)	16376.57 (100.00)	16292.66 (100.00)

(Figures in parenthesis are percentage of total cost)

Fixed cost of maize cultivation in the sample farms

Fixed cost is also important part of total cost calculation which decide whether the farmer to stay in farm business or not. It is observed from table 8, that on an average about Rs.7297.31 was spent on fixed inputs on one hectare of maize cultivation. Total fixed cost for marginal, small and medium farmer is Rs.7337.43, Rs.7281.84 and Rs.7261.11 respectively, that the trend was highest cost for marginal farm followed by small and medium farm subsequently. Out of all the components of TFC, rental value of owned land for Rs.6666.66 (91.35%) which is highest cost among all the fixed input and Rs. 41.66 (0.57%) is on land revenue which was least among all the fixed cost. Rental value of own land and land revenue is same for medium, small and marginal farms i.e. Rs.41.66. Depreciation was more for marginal and small farmers as compared to medium farmers because they use their own machinery like thresher and sprayer for

operational farm business. On an average about, depreciation accounts 111(1.52%) of the total cost was spent on total fixed cost.

Table- 8. Composition of Fixed cost of maize production (rupees per hectare) in different categories of farm holdings

Particulars	Marginal Farmers	Small Farmers	medium farmers	All farms
Rental value of land	6666.66 (90.85%)	6666.66 (91.55%)	6666.66 (91.81%)	6666.66 (91.35%)
Land revenue	41.66 (0.57%)	41.66 (0.57%)	41.66 (0.57%)	41.66 (0.57%)
Depreciation	149.10 (0.48%)	97.14 (0.44%)	77.77 (1.07%)	111.60 (1.52%)
Interest on fixed capital	480.01 (6.54%)	476.38 (6.54%)	475.02 (6.54%)	477.39 (6.54%)
Total fixed cost	7337.43 (100%)	7281.84 (100%)	7261.11 (100%)	7297.31 (100%)

Total cost Farm size gross income and of maize cultivation in the sample farms

It was observed from the Table 9, that TC is about Rs.23589.97 on an average for one hectare of maize cultivation. Total cost is higher for marginal farms followed by medium followed by small farm. On an average, Rs 25196.33, Rs.23637.68 and Rs.21413.67 are spent by marginal, medium and small farmers in the study area. The TC has been partitioned into variable and fixed cost. TVC constituted 60.06% of TC and TFC constituted 30.93% of TC on an average. The amount of variable and fixed cost is Rs.16292.66 and Rs. 77297.31 respectively for all farms on an average. The amount of fixed cost is high in marginal farm followed by small and medium farms and variable cost shown high in marginal farms followed by medium and small farms. The table reveals that per hectare return of maize was Rs. 89364.63 highest in case of medium farms followed by small farms Rs. 75396.54 and marginal farms Rs.64845.89. on an average, total revenue for all farm is Rs 75346.46 in one hectare of maize cultivation. The cost of production per quintal of maize is highest for marginal farms i.e. Rs.25196.33 followed by medium farms Rs.23637.68 and small farms Rs 21413.67 and on average, total cost of production for all farm is Rs 23589.97 in one hectare of maize cultivation. On an average about Rs.51756.49 net profit gained in maize cultivation in the study area overall. Out of which, highest net return is in case of medium farmer Rs.65726.95, followed by small farmers Rs.

53982.87 followed by marginal farmers Rs. 39649.56 is seen in the study area. From Table 9 the average benefit cost ratio is 2.1:1 in the study area. Hence, it is concluded that maize cultivation is profitable for all farms in the study area.

Table 9. Total cost of Maize Farm size gross income and cost of production (rupees per hectare) in different categories of farm holdings

Particulars	Marginal Farmers	Small Farmers	Medium farmers	All farms
Total variable cost(TVC)	17858.90 (70.87%)	14131.83 (65.99%)	16376.54 (69.28%)	16292.66 (69.06%)
Total fixed cost (TFC)	7337.43 (29.13%)	7281.84 (34.11%)	7261.11 (30.71%)	7297.31 (30.93%)
Total costs (TVC+TFC)	25196.33 (100.00)	21413.67 (100.00)	2361.11 (100.00)	23589.97 (100.00)
Cost of production (TC)	25196.33	21413.67	23637.68	23589.97
Gross return (TR)	64845.89	75396.54	89364.63	75346.46
Net return (TR-TC)	39649.56	53982.87	65726.95	51756.49
Benefit cost ratio (B:C Ratio)	1.5:1	2.5:1	2.7:1	2.1:1

Farm efficiency measures in different farm sizes

These ratio measures like gross ratio, fixed ratio and operating ratio were calculated to find farm efficiency measures. Farm efficiency is the ratio of total expenses to gross income. It is a combined measure of profit making ability of the farm which expresses the percentage of the gross income consumed by the expenses and is therefore, indicative of absolute size of business. It represents profit margin for business as a whole. Table 10 indicated that gross ratio was highest for marginal farms (0.38) followed by small farms and medium farms (0.28) and (0.26) respectively. Fixed cost ratio was highest for marginal farms (0.11) followed by small farms and medium farms i.e. (0.09) and (0.08) respectively. But in case of operating ratio it is highest in case of marginal farm followed small farm and medium farm i.e. (0.27), (0.21) and (0.18) respectively. Table 10 shows that, an average of all farms of the gross ratio was 0.31, fixed ratio was 0.09 and operating ratio was 0.21 in the study area.

Table 10: Farm efficiency measures in different farm sizes

Categories of farmers	Gross ratio	Fixed ratio	Operating ratio
marginal farmers	0.38	0.113	0.27
small farmers	0.28	0.096	0.21
medium farmers	0.26	0.008	0.18
All farmers	0.31	0.009	0.21

Technical Efficiency of maize production in the study area

More or less technical efficiency tells about how the resources used in production process used impact on output or not. Whether, the inputs have significant impact on output or not, that is clarified. Here from Table 11, it is found that there are number of variables like seed, manure, fertilizer, credit, labour, machine etc. but it was found that, labour, fertilizer and machine have significant impact on maize production in the study area as per the 'z' value by frontier analysis model.

Table 11 Estimation of Technical Efficiency from a Stochastic Frontier Analysis Model

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	5.118538	0.956145	11.3533	8.636e-08 ***
Log seed	0.046418	0.052970	0.8763	0.380864
log manure	0.586356	0.085193	9.0136	0.610753**
log pesticide	0.013805	0.034768	2.3971	0.691323
log fertilizer	0.687901	0.075174	12.1693	0.442282
log credit	0.127557	0.116835	1.0918	0.274937
log labour	0.149610	0.134352	3.1136	0.465463***
log machine	0.662397	0.057897	11.4409	< 2.2e-16 ***
sigma Sq	0.058519	0.018277	3.2019	0.001365 **
gamma	0.977845	0.125197	7.8105	5.697e-15 ***

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 and log likelihood value: 63.29569**

Resource use efficiency in different categories of farms

The resource use efficiency of variable input (X_i) was examined by MVP_{X_i}/P_{X_i} ratio. The acquisition cost of resource was taken as rupee one. The MVP_{X_i}/P_{X_i} ratio indicates optimum use of resource. In order to find out optimum use of resource the difference of MVP and price ratio from unity was tested. A significant difference indicates sub-optimal allocation of resource. It was observed from the Table 12, that there was there we found that labor, fertilizer and machine are under utilized in the study area the MVP is higher than the unit price of inputs. Very weak picture of efficient use of input is seen in the study area. Ogunniyi. 2008 reported that there was underutilization of resources like farm size, labour, fertilizer, chemical and seed for maize in Oyo state of Nigeria.

433 **Table 12. Resource use efficiency different inputs used**

Variable	Coefficient Or Elasticity P	App (Y/p)	Mpp ($E_p \cdot \text{App}$)	Output Price	Vmp ($\text{Mpp} \cdot P_y$)	Input Price	Allocation (Mpp/Input Price)
Ln Labour (Man Day)	5.54	11.56	64.04	1197	76655.88	250	306.62
Ln Machine (Hour)	1.11	57.70	64.04	1197	76655.88	1000	76.65
Ln Manure (Tractor)	2.31	27.72	64.03	1197	76643.91	1000	76.64

434 **Prevailing Marketing Channels**

435 There are numbers of market intermediaries working in the study area. About six marketing
 436 channels identified in the study area. Those channels were given as follows:

437 Channel-I (Producer→Retailer→Consumer)

438 Channel-II (Producer→Government Agency→Consumer)

439 Channel-III (Producer→Trader→Consumer)

440 Channel-IV (Producer→ Broker→ Retailer→Consumer)

441 Channel-V (Producer→Commission Agent →Retailer→Consumer)

442 **Total production, consumption and marketed surplus of Maize**

443 Total maize surplus was disposed through broker, trader, commission agent, government
 444 agency and retailer. A perusal of Table 13 indicated that the marketed surplus of maize was
 445 disposed off by the producers according to preference and importance they gave to each outlet.
 446 Here we found that, the farmers in the study are marketed all the maize that is produced as they
 447 are not consuming for family purpose i.e. growing the crop as a cash crop. Hence, the total
 448 marketed is 100% of total production. Out of average 65.05 quintal maize production, medium
 449 farmers produce highest i.e 75.89 quintals per hectare as compared to small (64.20) and marginal
 450 farmer (55.18 quintal)per hectare, hence the same amount is total marketed surplus.

451 **Table-13. Total production, consumption and marketed surplus of maize of different**
 452 **categories of maize producers (quintal per season per hectare)**

Farm category	Total production (q)	Total consumption (q)	Total marketed surplus (q)
Marginal farmers	55.18 (100.00)	0(0.00)	55.18 (100.00)

Small farmers	64.20 (100.00)	0(0.00)	64.20 (100.00)
Medium farmers	75.89 (100.00)	0(0.00)	75.89
All farmers	64.05 (100.00)	0(0.00)	64.05

(Figure in parentheses indicate the percentage of marketed surplus

Marketing cost, margin and producer's share in consumer's rupee through different marketing channel

Marketing cost and margin of maize at producer level was varied according to selected market, method of sale, quantity of marketed surplus, distance from production point to market and type of storage materials. From Table 14, it was observed that marketing cost was highest in Channel IV i.e Rs. 10.2 and margin was also more as compare with other four channels i.e Rs. 17.71 per quintal of maize. But in case of producer's share in consumer's rupee was Rs. 91.33 which was higher in channel II than Channel I, III, IV and V. In case of marketing efficiency was 2.30 was highest in channel II.

Table 14. Marketing cost, margin and producer's share in consumer's rupees of different marketing channels

Sl. No.	Particulars	Channel I	Channel II	Channel III	Channel IV	Channel V
1	Producer's Share in Consumer's price	85.5	91.33	84.45	72.11	79.21
2	Marketing Cost	7.8	5.4	8.0	10.2	8.9
3	Marketing Margin	6.7	3.27	8.55	17.71	11.69
4	Consumer price	100.00	100.00	100.00	100.00	100.00
5	Marketing Efficiency	1.60	2.30	1.16	1.22	1.40

Constraints in production and marketing of Maize Farmers

Production problems in the study area were presented in Table 16. All problems perceived by farmers were analyzed by Garrett ranking technique. Almost 41.6 score was gone for bird damage to maize cod as they eat and destroy it, which fetched less production to the farmer in the study area. About 21.3 score was given to lack of capital like not easy availability of fund; the government is not giving any incentive or subsidy to the farmer on the credit borrowed. Lack of technical input is the third most important problem (score 8.4) in the study area. In case of constraints in marketing, almost 35.6 score was gone for low market price of maize which fetched less profit to the farmer in the marketing. Irregular payment for maize by

474 purchaser accounted about 31.4 of the score which got second next problem of marketing faced
 475 by maize producer. About 19.6 scoring complained was lack of transportation facility. Other
 476 problems are lack of market information, lack of storage facility which scores about 7.4 and 6.0.

477 **Table 15. Ranking of Various Constraints in Production Faced by Maize Farmers**

Sr. No.	Constraints in production	Score	Rank	Constraints in marketing	Score	Rank
1	Lack of knowledge	4.9	VII	Lack of Market Information	7.4	IV
2	Lack of quality seed	7.8	IV	Lack of transportation Facility	19.6	III
3	Lack of training	6.3	VI	Lack of Storage Facility	6.0	V
4	Bird damage	41.6	I	Low Price	35.6	I
5	Seed infertility	7.5	V	Irregular Payment	31.4	II
6	Lack of capital	21.3	II			
7	Lack of technical input	8.4	III			

478 **Conclusions**

- 479 1. Total variable cost of marginal farmers was higher than small and medium
480 farmers.
- 481 2. Trend for fixed cost was highest for marginal farms followed by small and
482 medium farm
- 483 3. Total cost was higher for marginal farms. Gross return was higher for marginal
484 farmers. In case of net return and BC ration were higher in medium farms.
- 485 4. Farm efficiency in marginal farms was highest (0.38) followed by small(0.28) and
486 medium (0.26)
- 487 5. Labour, fertilizers and machine have significant impact on maize production.
- 488 6. Total marketed surplus was higher in medium farmers i.e 75.89 and Producers
489 share in consumer rupee was more in Channel II
- 490 7. Bird damage was major constraints in production of maize and low price was
491 major constraints in marketing of maize.

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