

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. Telangana is one of the large maize producing states in India. The maize production in the state has been largely influenced by increasing demand from the feed industries and other industrial units. Maize grain yield is more than 4 tonnes per hectare is noticed only in Khammam district. In the present study(,) an attempt was made to calculate the cost of cultivation of maize in different farm sizes, to find out resource use efficiency in different farm sizes, to calculate the 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 multistage 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 has been used in stochastic frontier production for finding out the technical efficiency. The estimation coefficients from the 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 that shows the trend is highest cost for marginal farm followed by small which subsequently followed by medium farm. 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,

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fertilizer and machine are under-utilized in the study area; the MVP is higher than the unit price of inputs. Producer's share in consumers rupee (91.33) is observed to be high in case of marketing channel II (Producer→Government Agency→Consumer) with highest marketing efficiency (2.30) and low (72.11) in marketing channel IV (Producer→ Broker→ Retailer→Consumer). 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, Marketing, Cultivation, 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).

Introduction:

(Maize history and climate)

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

The cultivation of maize in India is characterized by inter-cropping i.e. along with (and in) pulses, vegetables and oil seeds. It can be grown under varied climatic conditions. Maize is mainly a rainfed kharif crop, it requires 50-100 cm of rainfall and it cannot be grown in areas of more than 100 cm rainfall. In areas of lesser rainfall, the crop is irrigated. This crop usually

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grows well under temperatures varying from 21°C to 27°C, although it can tolerate temperatures as high as 35°C. Maize is an inferior grain which is used both as food and fodder. Because of its worldwide distribution and relatively lower price maize has wider range of uses. It is used directly for human consumption, in industrially processing foods, as live-stock feed and industrially nonfood products such as starches, acids, alcohols and ethanol a substitute for petroleum based fuels. Its stalk is fed to cattle. Among cereals and millets oil is only from maize extracted. Strong demand for ethanol production has resulted in increased maize prices and has provided incentives to increase maize acreage. Both maize dry-milling and wet-milling methods of producing ethanol generate a variety of economically valuable by - products, the most prominent of which is distillers' dried grains with soluble, which can be used as a feed ingredient for livestock.

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(Overall Economics Strategy of Maize)

Maize is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. It is an important cereal crop in world after wheat and rice. The importance of the crop lies in its wide industrial applications besides serving as human food and animal feed. As the demand for the crop is growing globally due to its multiple uses for food, feed and industrial sectors new production technologies offer great promise for increasing productivity to meet the growing demands of consumers. It is cultivated in nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36 % (782 m t) in the global grain production.

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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)

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The United States of America (USA) is the largest producer of maize contributes nearly 35 % of the total production in the world and maize is the driver of the US economy. The USA has the highest productivity ($> 9.6 \text{ t ha}^{-1}$) which is double than the global average (4.92 t ha^{-1}), whereas, the average productivity in India is 2.43 t ha^{-1} . It gives highest average grain yield (30.5 Qt/ha) as compared to major cereals such as wheat (19.0 Qt/ha) and rice (25.9 Qt/ha). The status maize enjoys as one of the highest yielding among world's major crops. Also when compared to other crops, the economics of maize cultivation is lowest. It is estimated that in 2012, the total world production of maize was 875,226,630 tons, 27 with the United States, China, and Brazil harvesting 31%, 24%, and 8% of the total production of maize, respectively (Nongnooch 2013).

Indian strategy of Maize

The maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, popcorn in peri-urban areas. The predominant maize growing states that contribute more than 80 % of the total maize production are Andhra Pradesh and Telangana (20.9 %), Karnataka (16.5 %), Rajasthan (9.9 %), Maharashtra (9.1 %), Bihar (8.9 %), Uttar Pradesh (6.1 %), Madhya Pradesh (5.7 %), Himachal Pradesh (4.4 %). Apart from these states maize is also grown in Jammu and Kashmir and North-Eastern states. Hence, the maize has emerged as important crop in the non-traditional regions i.e. peninsular India as the states like Andhra Pradesh and Telangana which ranks 5th in area (0.79 m ha) has recorded the highest production (4.14 m t) and productivity (5.26 t ha^{-1}) in the country. In India, maize is the third most important food crops after rice and wheat.

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Maize contributes nearly 9 % of total food production. India was the largest producer of maize in the world, with 1406000 MT during the year 2011. The country ranks sixth in maize production with 3.39% share in total work production. India has increased its share in the cereal products in the international market. The country has exported 28, 25,610.60 MT of given cereals to the worlds for the worth of Rs. 4,037.50 crores during the year 2014 - 15. The major export destinations are Indonesia, Bangladesh, Vietnam and Nepal during 2014 – 15 (Ephraim, 2009).

Table 2: India’s maize import and export data during 2004-14 (Source: USDA)

Year	Production(mt)	Imports(mt)	Exports(mt)	Total consumption (mt)	Stock to consumption ratio
2004-05	14.2	0.003	0.4	13.9	2.40
2005-06	14.7	0.004	0.5	14.2	2.30
2006-07	15.1	0.004	1.2	13.9	2.30
2007-08	19	0.004	4.5	14.2	4.30
2008-09	19.7	0.013	2.6	17	4.40
2009-10	16.7	0.024	1.9	15.1	3.00
2010-11	21.7	0.019	3.5	18.1	3.20
2011-12	21.8	0.003	4.6	17.2	3.30
2012-13	22.2	0.01	4.7	17.5	3.50
2013-14	23	0.01	3	19.1	6.60

Strategy of Maize inTelangana

The role of agriculture sector in the state economy is very significant. It produces 30 percent of the income and 78 % of the working population is dependent directly and indirectly on agriculture and mostly dependent on rainfall. Monsoon and seasonal conditions play a major role in the agricultural production. The contribution of agriculture and livestock under primary sector to the state Telangana is the twelfth largest state in India in terms of area. Gross Domestic Product for the year 2012-13 is 13.67 per cent (BES of Andhra Pradesh, 2012-13). Telangana is one of the large maize producing states in India. In Telangana, maize is cultivated in all the districts (except Hyderabad) in both the Kharif and Rabi seasons. The total maize production doubled in the state within the past ten years (DES, 2014). The maize production in the state has been largely influenced by increasing demand from the feed industries and various industrial

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uses (Ranjit Kumar *et al.*, 2014). Major maize growing districts in Telangana are Karimnagar, Warangal, Nizamabad, Mahaboobnagar, Khammam and Medak. Area and production of maize have increased manifolds in the state during the previous decade. In Medak district, the maize yield has declined over the years with very high instability (Kumar *et al.*, 2013). Since maize demand is increasing consistently, it has become important to understand the existing maize situation in the newly formed Telangana state and plan the future of maize in the state based on the past and present situation.

Status of Maize in Khammam district

Khammam is one of the major producers of maize in the state of Telangana, standing in first place with productivity of 6.17 in the year 2010 - 11, 4.98 in 2011 - 2012 tonnes per hectare both Kharif and Rabi seasons. The productivity in the year 2012 - 13 was 4.17, in 2013 - 14 were 3.36, and in 2014 - 15 were 6.53. The district stands in fifth place in total area cultivated under maize with 0.16 lakh ha, while Karimnagar in first place with 0.54 lakh ha, followed by Warangal with 0.40 lakh ha. Khammam is in third place in production with 1.05 lakh tonnes, while Karimnagar is in first place with production of 2.97 lakh tonnes and Warangal in second place, 2.58 lakh tonnes as reported till 2015. The total production of maize in the district can be increased radically with increase in area of cultivation (Kumar *et al.*, 2013).

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Note: Your introduction does not give your statement of problem and objectives. A good introduction should have all these covered. Also, the introduction is too bogus. There is no flow in this work at all. Be specific, are you talking about the world's maize production or India? Please recast the introduction for better meaning. Just summarize in two or three pages.

Materials & Methods:

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Study Area:

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

Profile of the study area

Telangana

The state of Telangana emerged as 29th state in the Indian Union as per the Andhra Pradesh Reorganization Act, 2014. Telangana is a state in the Southern region of India. It has an area of 1,12,077 sq.kms. The Economy of Telangana is mainly driven by agriculture. Agriculture plays a pivotal role in the economy of the state and the better performance of this sector is vital for inclusive growth. About 55.49 % of the State's population is dependent on some form or the other on farm activity for livelihoods, it is imperative to increase the farm incomes and ensuring sustainable growth in Telangana to reduce poverty. The share of agriculture to state GSDP in 2014-15 is 9.3 % at current prices.

Telangana state is geographically located in a semi-arid area and has a predominantly hot and dry climate. Summers start in March, and peak in May with average high temperatures in the 42 °C (108 °F) range. The monsoons enter in the state in June and lasts until September with about 715 mm of precipitation. A dry, mild winter starts in late November and lasts until early February with little humidity and average temperatures in the 22–23 °C (72–73 °F) range. The average annual rainfall in the state is about 906.6 mm and 80% of annual rainfall is received from the south-west monsoons (June-September) recorded a highest rainfall during 2013-14 with 1212.2 mm. During 2013-14, production of total food grains was recorded at 107.49 lakh tonnes. Of the total food grains production, production of cereals and millets was 102.78 lakh tonnes, production of maize was 35,24,907 tonnes. The average productivity of Maize is 1716 Kgs. in Telangana. Maize is cultivated in all the districts (except Hyderabad) in both the Kharif and Rabi seasons. The total maize production doubled in the state within the past ten years (DES, 2014). The maize production in the state has been largely influenced by increasing demand from the feed industries and various industrial uses (Ranjit Kumar *et al.* 2014).

Khammam District

The district lies between 16 45' and 18°35' of the north latitude and 79°47' to 81°47' of the east longitudes. The district is bounded on the north by Chhattisgarh and Orissa states and on

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the other three sides by different districts of the state. The district has geographical area of 16,029 sq.km with a total population of 25, 78,927. The district is divided into four revenue divisions with headquarters at Khammam, Kottagudem, Bhadrachalam and Palwancha. The district comprises 46 revenue Mandals.

There are nine towns including four municipalities and 1,242 revenue villages with a population of 5.08 lakhs. The density of population is 161 per sq.km that is increased by 23 per sq.km from 1991 census. Tekulapalli, Chinturu, Gundala, Dummugudem, Velairpad, V R Puram, Mulkalapalli, Kunavaram and Singareni are main tribal mandals. The district has largest forest area of 8.4 lakh hectares.

Khammam District is a district in the eastern region of the state Telangana of in India. Khammam city is the district headquarters The Godavari River enters Khammam district from Warangal district and flows nearly 250 km across the district. Khammam district is one of the Coal mining districts of India. The district has the Singareni Collieries head town, Kothagudem which is also called Coal town of South India.

The district has a population density of 175 per km. Its population growth rate over the decade 2001-2011 was 8.5%. Khammam has a sex ratio of 1010 females for every 1000 males, and a literacy rate of 65.46%.

Climate for Khammam Average Weather in Khammam for January Sunlight 9 hours a day Coldest January temperature 12 °C Coldest daily temperature 16 °C Warmest daily temperature 28 °C Warmest January temperature 38 °C Discomfort Moderate Morning Humidity 76% Evening Humidity 45% Rain in January 4 mm Average Weather in Khammam for February Sunlight 10 hours a day Coldest February temperature 15 °C Coldest daily temperature 19 °C Warmest daily temperature 29 °C Warmest February temperature 40 °C Discomfort Moderate Morning Humidity 67% Evening Humidity 39% Rain in February 9 mm Wet days for February 1 days Khammam experiences typical Indian climatic conditions. Summer season is hot and the temperatures can climb rapidly during the day. Monsoon season brings certain amount of rainfall and the temperatures gradually reduce during this period. After the onset of the monsoon day temperatures are much lower and as the winter approaches they reduce further.

215 Summer season is from March and lasts till the end of May. During this time day
216 temperatures are high and can reach 40 °C to 42 °C. Humidity is low as it is not located near the
217 ocean. Conditions are generally dry during this period and the temperatures range from a
218 minimum of 35 °C and can rise up to a maximum of 40 °C to 45 °C. Monsoon season brings
219 much needed relief from the heat. Monsoon seasons are from the months of June to September.
220 Temperatures average around 30 °C during this period. The place gets rain from the South West
221 Monsoon. Some amount of rainfall can be experienced in the October as well. Winter season is
222 from December to February. January is usually the coldest parts of the year. Temperatures range
223 around 28 °C to 34 °C during this time. Winter is from December to February, summer is from
224 March to June South West Monsoons July to September North East Monsoons October to
225 November Rain storms and cyclones are common in the region during the rainy season, which
226 starts with the monsoons in early June. The cyclones could occur any time of the year, but
227 commonly between August and November.

228 The district is drained by Godavari and Krishna river systems. The district forms part of
229 Godavari river basin. The main crops of the district are rice, jowar, bajra, cotton and chillies. The
230 total cropped area in the district is 4,39,050 ha which forms about 30 percent of the total
231 geographical area. Of the total cropped area 42 percent area is irrigated out of which 18 percent
232 area is irrigated (81161 ha) through Canal, tank and lift irrigation. Groundwater irrigation
233 accounts for 22 percent of the total irrigated area (1,00,382 ha).

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source: Maps of India

Figure-1: Geological image of Khammam District

Table 3: Source of Irrigation, Khammam 2011-12

Irrigation source	Area irrigated in ha
Canals	52605
Tanks	13275
Lift Irrigation	14440
Tube Wells	56979
Dug wells	43403
Other Sources	841
Gross Area Irrigated	181543
Area Irrigated more than Once	23021
Net Area Irrigated	158522

(**Source:** Central Ground Water Board, Ministry of Water Resources)

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239 **Table 4: Average temperature, rainfall of Khammam**

Month	Average high °C	Average low °C	Average precipitation mm	Average precipitation days
Jan	30.6	20.2	18.7	0.8
Feb	32.4	21.8	4.1	0.9
Mar	34.6	24.0	18.3	0.5
Apr	36.6	26.3	12.9	0.5
May	39.7	28.0	68.5	2.4
Jun	38.3	28.2	61.0	3.6
Jul	35.8	26.9	108.3	6.5
Aug	35.0	26.5	115.5	7.3
Sep	34.9	26.0	148.0	6.8
Oct	33.0	24.8	24.8	8.8
Nov	31.3	22.5	175.1	5.8
Dec	30.6	20.6	31.5	1.8
Year	34.4	24.7	1,009	45.6

(Source: India Meteorological Department)

242 **Table 5: Rainfall in Telangana state from 2007-08 TO 2013-14(in mm)**

Year	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Total rainfall	940.0	820.9	681.7	1100.8	660.6	916.8	1212.2
South West Monsoon	734.6	755.2	494.99	894.4	601.1	707.2	851.5
North East Monsoon	61.6	38.6	122.0	152.6	24.0	141.8	243.2

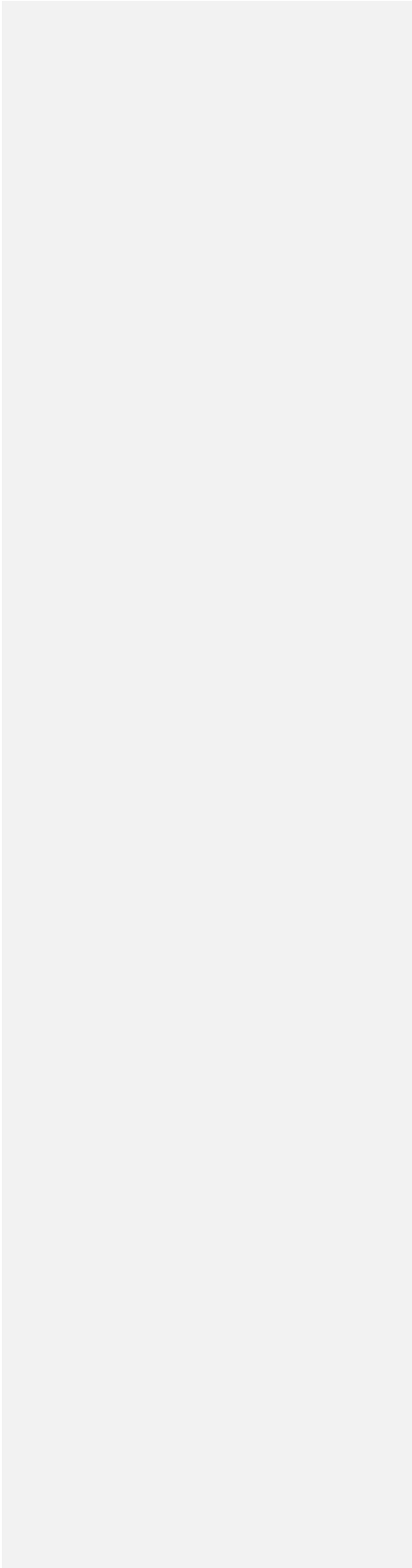
(Source: Directorate of Economics and Statistics Government of Telangana)

245 **Table 6. Areas, Production and Productivity of Maize in India during 2013-2014**

State	Area (000ha)	% All India	Production (000MT)	% to All India	Yield (kg/ha)
Andhra Pradesh & Telangana(composite)	1.06	11.28	4.97	20.40	4673
Karnataka	1.38	14.66	3.98	16.36	2883
Maharastra	1.21	12.83	3.08	12.63	2544
Bihar	0.75	7.97	2.02	8.29	2684

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Tamil Nadu	0.30	3.18	1.64	6.72	5450
Madhya Pradesh	1.00	10.64	1.51	6.20	1506
Rajasthan	0.93	9.83	1.50	6.17	1621



Uttar Pradesh	0.74	7.85	1.24	5.08	1671
Gujarat	0.46	4.89	0.69	2.84	1501
Himachal Pradesh	0.29	3.17	0.53	2.18	1776
Jammu & Kashmir	0.30	3.17	0.53	2.18	1776
West Bengal	0.13	1.37	0.52	2.15	4059
Jharkhand	0.26	2.76	0.52	2.12	1988
Punjab	0.13	1.38	0.51	2.08	3900
Others	0.48	5.09	0.97	3.99	-----
All India	9.43	100.00	24.35	100.00	2583

(Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation)

Sampling Technique

A multi-stage sampling method involving a combination of purposive and random sampling procedures was employed in drawing up the sample. The first stage was purposefully selecting the district and secondly purposefully selecting the EAPs. Why are you purposefully selecting the district, you should indicate. The selected sites were Chinthakani mandal of khammam district EPAs. Thirdly, the sampling units (households) were sampled randomly from the selected EPAs where equal number of households was drawn from each EPA. For the purpose of selecting desired number of sampling units from each village, the farm households of these villages were listed separately. The households listed were again stratified in to 3 size groups.

Households having less than one hectare of operational land holding(<1ha, marginal).

Households having one to two hectare of operational land holding (1-2 ha, small).

Households having two to four hectare of operational land holding (2-4ha, medium).

Farmers of these three groups have been designated as 23 marginal farmers, 20 small farmers and 17 large farmers were selected at random. Thus a total 60 respondents were selected at random for the purpose of this research study.

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Comment [O17]: Reason for using this sampling technique

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Prevailing Marketing Channels

- Channel-I (Producer→ Consumer)
- Channel-II (Producer→primary wholesaler→→retailer Consumer)
- Channel-III(Producer→primary→wholesaler→seconadary wholesaler→reatailer →Consumer)
- Channel-IV (Producer→retailer→Consumer)

Analytical Technique

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

Descriptive Statistics

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

Farm Business Analysis

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

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

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

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

Table No : Cost concepts

Cost groupsItems of the costs included

Cost A1	Seed, Manure, Fertilizer, Human labour, Hired labour, pesticides etc
Cost A2	Cost A1 + rent paid for leased in land
Cost B1	CostA1 + interest on fixed capital
Cost B2	Cost B1+ rent paid on leased in land+ rental value of owned land
Cost C1	Cost B1+imputed value of family labour
Cost C2	Cost B2+ imputed value of family labour

Estimation of measures of farm income employed the following measures:

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

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

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

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

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

Stochastic Frontier Analysis (SFA)

Stochastic frontier Analysis (SFA) was employed to analyse the data collection. The Stochastic Frontier Production Function Analysis was proposed independently by Aigner *et al.*, 1977; Meeusenans Van Den Broeck, 1977). The frontier production differs from production function in the sense that its disturbance term has two components. One to account for technical inefficiency and the other to permit the random event due to measurement errors (Tran *et al.* (1993; Amaza, 1999).

Comment [O19]: Summarize in two sentences

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

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

Where

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

X_i = Farm size (in hectares)

X_2 = seed (Kg/ha)

X_3 = Hired labour used (in man days)

X_4 = Fertilizer used (in Kg)

X_5 = family labour used (in man days)

X_6 = Herbicides used (in litters)

V_i = Random noise

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

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

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

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

The technical inefficiency effects (u_i) are frequently estimated in a first step and the determinants of inefficiency are obtained in a second in a second-stage regression. However, this can induce both bias and inefficiency in the estimates. Therefore, inefficiency effects are simultaneously conditioned on several specific factors and estimated using the parameterisation (Battese and Coelli, 1995):

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

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

Where,

T.E = Technical Efficiency

Z₁ = Farming experience (in years)

Z₂ = 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)

– β_0 = 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. Though the technique has been changing continuously how the different size group responds to it and reflected in the maize output was our concern. For the estimation of the technical efficiency we have used stochastic frontier production function. One of the advantages of the SPF technique over other analysis was that several inputs in the production process can be incorporated into the analysis. 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^* . As per micro economic theory production processes were technical relations of employed inputs to maximum attainable output. Stochastic production frontiers indicate the maximum expected output for a given set of inputs. They were derived from production theory and were based on the assumption that output was a function of the level of inputs and the efficiency of the producer in using those 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 ($i = 1, \dots, n$) using K ($k = 1, \dots, K$) different inputs contained in the input efficiency.

Comment [O21]: Summarize in few sentences

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

TE_i = Technical efficiency

Y_i = Represents the output for the i -th firm

Y_i^* = Represent optimal production of i th 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

Variance σ^2_v . $v_i \sim N(\mu_v; \sigma^2_v)$

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.

(As the studies not dealing with estimating time varying efficiencies and study explains no to η in the command line of FRONTIER 4.1)

$u_h = h = 1, 2, \dots, N$, were non-negative random variables that were assumed to be independently and identically distributed obtained by truncation of the normal distribution with unknown mean, μ , and unknown variance σ^2_u .

(In the present study we have not given any value to the μ as we assume it to be a half normal distribution in the command line of the FRONTIER 4.1. In case of truncated normal distribution μ would have taken non-zero value.)

Comment [O22]: Just state the equation

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

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

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

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

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.

If $u_i = 0$, the farm was hundred per cent efficient and if $u_i = 1$ then the farm was not efficient at all. Maximum-likelihood estimates of the parameters in the model were obtained using FRONTIER 4.1 which was developed by Coelli, 1994. The parametric model was estimated in terms of the variance parameters,

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

In case of cross-sectional data, the technical inefficiency model can only be estimated if the inefficiency effects U_i 's were stochastic and have particular distributional properties (Battese and Coelli, 1995). Therefore it was of interest to test the null hypotheses that technical inefficiency effects, γ , were non-stochastic. The parameter, γ , has a value between zero and one, in such a way that it was desirable to test the null hypothesis of $H_0: \gamma = 0$ (full efficiency). Whether traditional production function was an adequate representation of the sample data or not can be tested as we assume in OLS that the summation of the error term was zero. If it will be so, the non-negative random variable u_i will be absent from the model then the OLS method and Maximum likelihood have no difference. The generalised likelihood-ratio test statistic can be calculated from the logarithms of the likelihood function associated with the unrestricted and restricted maximum likelihood estimates for the special case in which the appropriate parameter was zero by using the program FRONTIER 4.1 (Battese and Tessa, 1993). The test will substantiate the use of Maximum likelihood over OLS.

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

Model Specification for the particular study

Comment [O23]: Please summarize

Comment [O24]: All these are not necessary

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

i = It refers to i th farm ($i = 1, 2, 3, \dots, N$), ($N=121$) $\ln$
= 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,

UNDER PEER REVIEW

MC= Total cost of marketing of paddy

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

MCm1= Cost incurred by the ith 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;

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

Where,

MM= Marketing Margin

RP= Retail Price

FP= Farm gate Price

Marketing Efficiency

The price spread was applied to measure the degree of pricing efficiency. For farmers, it was calculated by deducting costs of marketing from gross price. For traders in all the channels, the price-spread focused on the trader's surplus as a percentage of total marketing costs.

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

Comment [O25]: Please go straight to the point

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; $MEI = FP / (MC + MM)$ ----- (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

The methodology is full of irrelevancies, get a copy of a journal and learn to summarize.

Results

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. Table-7, below illustrates the composition of variable cost while table 8 illustrates the composition of fixed cost per hectare basis in each farm category.

Comment [O26]: No implication and connection with literature

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. And per hectare expenditure on machine was fifth place in total variable cost i.e 116.02(6.84 %)

Comment [O27]: No implication and corroboration with other work/literature.

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 is 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. The trend like highest cost for marginal farm followed by small and medium farm was seen in case of depreciation and interest on fixed capital.

Comment [O28]: No literature to support your findings and what does your result imply

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. Benefit cost ratio 616 is 2.1:1 in the study area on an average. Hence, it is concluded that maize cultivation is profitable 617 in the study area.

Comment [O29]: Implication and literature to support

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 size gross income of Maize

The Table 10 reveals that per hectare return of maize is Rs. 89364.63 that is 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. On an average Rs.51756.49 net return is seen in all farms in the study area. It was seen that highest return in case of medium farm followed by small and marginal farm.

Comment [O30]: Implication ??????????

Table 10. Farm size gross income received by different categories of farmers per hectare

Categories of farmers	Gross income	Net income
Marginal Farmers	64845.89	39649.56
Small Farmers	75396.54	53982.87
Medium Farmers	89364.63	65726.95
All farmers	75346.46	51756.49

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 11 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. On an average, the gross ratio, fixed ratio and operating ratio in the study area is 0.31, 0.09 and 0.21 respectively.

Table 11: 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

Comment [031]: Please do as previously instructed

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 12, 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 12 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 ***

402 **sigma Sq** 0.058519 0.018277 3.2019 0.001365 ** **gamma**
403 0.977845 0.125197 7.8105 5.697e-15 ***

404
405 **Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1 and log likelihood value: 63.29569**

407 **Resource use efficiency in different categories of farms**

408 The resource use efficiency of variable input (X_i) was examined by MVP_{X_i}/P_{X_i} ratio. The
409 acquisition cost of resource was taken as rupee one. The MVP_{X_i}/P_{X_i} ratio indicates optimum use of
410 resource. In order to find out optimum use of resource the difference of MVP and price ratio
411 from unity was tested. A significant difference indicates sub-optimal allocation of resource. It
412 was observed from the Table 13, that there was there we found that labor, fertilizer and machine
413 are under utilized in the study area the MVP is higher than the unit price of inputs. Very weak
414 picture of efficient use of input is seen in the study area. Ogunniyi. 2008 reported that there was
415 underutilization of resources like farm size, labour, fertilizer, chemical and seed for maize in Oyo
416 state of Nigeria.

Comment [O32]: Implication for your findings

420 **Table 13. Resource use efficiency different inputs used**

Variable	Coefficien t Or Elasticity P	App (Y/p)	Mpp ($E_p \cdot App$)	Output Price	Vmp ($Mpp \cdot P_y$)	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

421 680

422 681 **Prevailing Marketing Channels**

There are numbers of market intermediaries working in the study area. About six 683 marketing channels identified in the study area. Those channels were given as follows:

Channel-I (Producer→Retailer→Consumer)

Channel-II (Producer→Government Agency→Consumer)

Channel-III (Producer→Trader→Consumer)

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

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

Total production, consumption and marketed surplus of Maize

Total maize surplus was disposed through broker, trader, commission agent, government agency and retailer. A perusal of Table 14 indicated that the marketed surplus of maize was disposed off by the producers according to preference and importance they gave to each outlet. Here we found that, the farmers in the study are marketed all the maize that is produced as they are not consuming for family purpose i.e. growing the crop as a cash crop. Hence, the total marketed is 100% of total production. On an average 65.05 quintal maize is produced in the study area and hence same the marketed surplus. Out of it, medium farmers produce highest per hectare as compared to small and marginal farmer i.e.75.89quintatl, 64.20 quintal and 55.18 quintal respectively, hence the same amount is marketed surplus.

Comment [033]: No implication

Table- 14. Total production, consumption and marketed surplus of maize of different 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
Factors affecting marketed surplus
Marketing cost, marketing margins, producer’s share in consumer’s rupee and marketing efficiency of dairy farmers are different in different marketing channels. Marketing cost, margin of maize at producer level varies according to selected market, number of marketing middleman involved, method of sale, quantity of marketed surplus, distance from production point to market and type of cost of storage materials. The quantity of maize marketed depends upon a number of factors like maize production, maize unit price, family size, age and education of farmer. It was evident from the Table 15, that price of maize had positive and significant impact on marketed surplus; however family size had positive and significant impact on maize marketed surplus. On the other hand distance to market had negative and significant impact on maize marketed surplus. The (R^2) i.e. Adjusted co-efficient of multiple determination is 56.39 percent, and coefficient of determination is 60.08 percent with ‘F’ value 16.26 .hence it is found that, it was that 60 percent of variation in marketed surplus was explained by the five independent variables.

Comment [O34]: Report in past tense, no implication and literature to support your result

Table 15: Factors affecting marketed surplus

Estimate	Coefficients	Std. Error	t value
(Intercept)	-77.408	31.1789	-2.482
Family size	2.1728*	0.9987	2.1756
Distance to market	-0.7315*	0.2610	-2.801
Price of maize	0.1053*	0.0234	4.4915
Education of farmer	0.5552	0.5687	0.9763
Land holding	3.9988	0.6674	5.9912
Coefficient of determination (R^2)	0.6008		
Adjusted R-squared	0.5639		
F-statistic	16.26		

Signif. codes: ' 0.01 '***' 0.05 '*.' 0.1 ' ' 1

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. Marketing cost, marketing margins, producer’s share in consumer’s rupee and marketing efficiency of maize farmers in different channel I is presented

in Table 16. It was observed that producer’s share in consumer’s rupee was 85.5, marketing cost and margin are 7.8 and 6.7 and marketing efficiency is 1.60.

Comment [O35]: ???????????

Table 16. Marketing cost, margin and producer’s share in consumer’s rupees of channel-I

Sl. No.	Particulars	Marketing Channels I
1	Producer’s Share in Consumer’s price	85.5
2	Marketing Cost	7.8
3	Marketing Margin	6.7
4	Consumer price	100.00
5	Marketing Efficiency	1.60

Marketing cost, margin and producer’s share in consumer’s rupees of channel-II

Marketing cost, marketing margins, producer’s share in consumer’s rupee and marketing efficiency of maize farmers in different channel II is presented in Table 17. It was observed that producer’s share in consumer’s rupee was 91.33, marketing cost and margin are 5.4 and 3.27 and marketing efficiency is 2.30 respectively.

Comment [O36]: No implication

Table 17.

Sl. No.	Particulars	Marketing Channels II
1	Producer’s Share in Consumer’s price	91.33
2	Marketing Cost	5.4
3	Marketing Margin	3.27
4	Consumer price	100.00
5	Marketing Efficiency	2.30

Marketing cost, margin and producer’s share in consumer’s rupees of channel-III

Marketing cost, marketing margins, producer’s share in consumer’s rupee and marketing efficiency of maize farmers in different channel III is presented in Table 18. It was observed that producer’s share in consumer’s rupee was 84.45, marketing cost and margin are 8.0 and 8.55 and marketing efficiency is 1.16 respectively.

Comment [O37]: No implication

Table 18.

Sl. No.	Particulars	Marketing Channels III
1	Producer's Share in Consumer's price	84.45
2	Marketing Cost	8.0
3	Marketing Margin	8.55
4	Consumer price	100.00
5	Marketing Efficiency	1.16

Marketing cost, margin and producer's share in consumer's rupees of channel-IV

Marketing cost, marketing margins, producer's share in consumer's rupee and marketing efficiency of maize farmers in different channel IV is presented in Table 19 .It was observed that

producer's share in consumer's rupee was 72.11, marketing cost and margin are 10.2 and 17.71 and marketing efficiency is 1.22 respectively.

Comment [O38]:
No implication

Table 19.

Sl. No.	Particulars	Marketing Channels IV
1	Producer's Share in Consumer's price	72.11
2	Marketing Cost	10.2
3	Marketing Margin	17.71
4	Consumer price	100.00
5	Marketing Efficiency	1.22

Marketing cost, margin and producer's share in consumer's rupees of channel-V

Marketing cost, marketing margins, producer's share in consumer's rupee and marketing efficiency of maize farmers in different channel V is presented in Table 20 .It was observed that

producer's share in consumer's rupee was 79.21, marketing cost and margin are 8.9 and 11.69

and marketing efficiency is 1.40 respectively. It was found from all the tables of channels,

highest producer's share in consumer's rupee in channel I and hence the marketing efficiency.

Table 20.

Sl. No.	Particulars	Marketing Channels V
1	Producer's Share in Consumer's price	79.21
2	Marketing Cost	8.9
3	Marketing Margin	11.69
4	Consumer price	100.00

5	Marketing Efficiency	1.40
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762 **Production Constraints of Maize Farmers**

763 Production problems in the study area were presented in Table 21. All problems 764 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 **wasis** 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 burrowed etc. lack of technical input is the third most important problem (score 8.4) in the study area, as the crop needs latest equipments for cob plucking etc. other problems are lack of quality inputs, insufficient skill, seed infertility **lack of knowledge** etc.

Comment [O39]:
No implication

Table-21. Ranking of Various Constraints in Production Faced by Maize Farmers

Sl. No.	Constraints	Score	Response rank
1	Lack of knowledge	4.9	VII
2	Lack of quality seed	7.8	IV
3	Lack of training	6.3	VI
4	Bird damage	41.6	I
5	Seed infertility	7.5	V
6	Lack of capital	21.3	II
7	Lack of technical input	8.4	III

Marketing constraints of Maize farmers

Marketing problems in the study area were presented in Table 22. All problems perceived by farmers were analyzed by Garrett ranking technique. 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 purchaser accounted about 31.4 of the score which got second next problem of marketing faced by maize producer. About 19.6 scoring complained was lack of transportation facility. Other problems are lack of market information, lack of storage facility which scores about 7.4 and 6.0.

Table-22 various constraints in marketing faced by maize farmers

Sl. No.	Constraints	Score	Response rank
1	Lack of Market Information	7.4	IV
2	Lack of transportation Facility	19.6	III
3	Lack of Storage Facility	6.0	V
4	Low Price	35.6	I

5	Irregular Payment	31.4	II
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PlsPlease do the needful and summarize all your results in less than four pages... your reporting style is poor.

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. Table 7, below illustrates the composition of variable cost while table 8, illustrates the composition of fixed cost per hectare basis in each farm category.

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, manure, fertilizer, pesticides and interest on working capital. It may be observed from the table 7, of result chapter that, the average variable cost per ha is Rs. 16292.66 in all sample farms for one hectare of maize cultivation. It is found from the study that, the per hectare variable cost decreased with the increase in the farm size i.e. It is Rs. 17858.90, Rs.14131.83 and Rs.16376.57 respectively in marginal, small and medium farmer. It is due to, with increase in farm size, the farmer afford more inputs and techniques. Seed cost accounted highest percentage of total variable cost i.e. 31.01% in all farm size, because in maize crop seed price is more. Plant chemical accounts the next highest of total variable cost i.e.19.14%. Manure accounts the next highest of total variable cost i.e.14.22%.The per hectare expenditure on fertilizer is Rs.2234.81 which accounted for 13.71% of the TVC, mainly potassium and phosphorus for cob formation and maturity of the TVC. The per hectare expenditure on interest on working capital was 6.54%

Comment [O40]: This goes along with your results...

of TVC that is the least among all input costs. The per hectare expenditure on labour and machine was Rs.1386.94 (8.54%) and Rs. 1116.02 (6.84%) respectively.

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, result chapter, 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 is highest cost for marginal farm followed by small followed by medium farm. Out of all the components of TFC, rental value of owned land for Rs.6666.66 (90.85%) 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 because all famers are paying on hectare basis. Depreciation was more for small and marginal farmers as compared to medium farmers for operational farm business. On an average about, depreciation accounts 111.60 (1.52%) of the total cost was spent on total fixed cost.

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

It was observed from the Table 9, of result chapter 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 due to higher variable and fixed cost. TVC constituted 69.06% of TC and TFC constituted 30.93% of TC on an average, it is due to farmers in the study area paying more rental value i.e.Rs.20000 per year for three seasonal maize crops. 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 because, as cost increased side by yield increases, hence return increases which indicating the operation of economic of scale. On an average, total revenue for all farms 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, as total cost increase, hence cost of production

increases. On an average about Rs.51756.49 net profit gained in maize cultivation in the study area over ally. 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, it is due to more yield in case of medium farmer.

Farm size gross income of rice

The Table 10, of result chapter reveals that per hectare return of maize is Rs. 89364.63 that is 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 acre of maize cultivation. On an average Rs.51756.49 net return is seen in all farms in the study area. It was seen that same trend is followed in everywhere in case of gross return and net return like highest return in case of medium farmer followed by small farmer followed by marginal farmer., all the reasons are discussed in previous sub heading.

Farm efficiency measures in different farm sizes

Table-11, of result chapter indicated that gross ratio was highest for marginal farms (0.38) followed by small farms and medium farms (0.28) and (0.0.26) 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 due to lowest fixed cost of marginal farms, same trend followed in case of operating ratio also it is highest in case of marginal farm followed by small farm medium farm i.e. (0.27), (0.21) and (0.18) respectively. On an average, the gross ratio, fixed ratio and operating ratio in the study area is 0.31, 0.09 and 0.21 respectively.

Technical Efficiency of maize production in the study area

It is found from the Table 12 of result chapter that labour, manure and machine have significant impact on maize production in the study area, where as other factors like fertiliser, pesticide, credit etc have no significant impact on maize production.

Resource use efficiency in different categories of farm

It was observed from the Table 13 of result chapter that there was there we found that labor, manure and machine are under utilized in the study area as 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.

Total production, consumption and marketed surplus of maize

It is found from the Table 14 of previous chapter, On an average 64.05 quintal hectare maize is produced in the study area and hence same the marketed surplus. Out of it, medium farmers producing highest per hectare as compared to small and marginal farmer i.e. 75.89 quintal, 64.20 quintal and 55.18 quintal respectively, hence the same amount is marketed surplus.

Factors affecting marketed surplus

Table 15 of result chapter depict that the price of maize had positive and significant impact on marketed surplus; however family size had positive and significant impact on maize marketed surplus. On the other hand distance to market had negative and significant impact on maize marketed surplus. The (R^2) i.e. adjusted co-efficiency t of multiple determination is 56.39 percent, and coefficient of determination is 60.08 percent .it was that 60 percent of variation in marketed surplus was explained by the five independent variables other is the disturbance term. It is due to, number of inputs in maize production, and has no significant impact on output i.e. yield.

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

It is seen from table 16 of result chapter that channel I, producer's share in consumer's rupee was 85.5, marketing cost and margin are 7.8 and 6.7 and marketing efficiency is 1.60. In channel II, producer's share in consumer's rupee was 91.33, marketing cost and margin are 5.4 and 3.27 and marketing efficiency is 2.30 respectively. In channel-III, producer's share in consumer's rupee was 84.45, marketing cost and margin are 8.0 and 8.55 and marketing efficiency is 1.16 respectively. Channel IV is presented producer's share in consumer's rupee is 72.11, marketing cost and margin are 10.2 and 17.71 and marketing efficiency is 1.22

respectively. In channel V producer’s share in consumer’s rupee was 79.21, marketing cost and margin are 8.9 and 11.69 and marketing efficiency is 1.40 respectively. It was found from all the tables of channels, highest producer’s share in consumer’s rupee in channel II and hence the marketing efficiency. It is concluded that, with increase in marketing middle man, marketing efficiency decreases.

Production constraints of maize farmers

It is seen from table 17 of result bird damage, lack of capital and lack of technical inputs are three major production problems in the study area. Cobs are mostly eaten by birds and they left if in damage from which leads major loss to maize farmer. Other major problems are like absence of suitable credit agency to avail loan easily with lowest interest rate, lead farmer’s unwillingness to go for maize production.

Marketing constraints of maize farmers

Table 18, shows that low market price, irregular payment and lack of transportation facility are major marketing problems in the study area. Farmers are not getting more prices, forced to sale produce below MSP due to perish ability nature of cob, hence exploited by middle man.

This section should contain your summary, conclusion of your study and findings and recommendations

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Comment [O41]: Get appropriate APA referencing style

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