

**STUDY ON PRODUCTION AND
MARKETING OF *RABI* JOWAR IN
KURNOOL DISTRICT OF ANDHRA
PRADESH**

BY
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B.Sc. (Ag.)

**THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF THE DEGREE OF**

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2021

DECLARATION

I, **K. VASANTHA**, hereby declare that the thesis entitled “**STUDY ON PRODUCTION AND MARKETING OF RABI JOWAR IN KURNOOL DISTRICT OF ANDHRA PRADESH**” submitted to the **Acharya N.G. Ranga Agricultural University, Guntur** for the degree of **MASTER OF SCIENCE (Agriculture)** majoring in **AGRICULTURAL ECONOMICS** is the result of original research work done by me. I also declare that no material contained in this thesis has been published earlier in any manner.

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No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance and help received during the course of investigation have been duly acknowledged by the author of the thesis.

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LIST OF CONTENTS

Chapter No.	Title	Page No.
I	INTRODUCTION	1-3
II	REVIEW OF LITERATURE	4-16
III	MATERIAL AND METHODS	17-28
IV	RESULTS AND DISCUSSION	29-61
V	SUMMARY AND CONCLUSIONS	62-68
	LITERATURE CITED	69-72

LIST OF TABLES

Table No.	Title	Page No.
3.1	Sample size pertaining to market intermediaries of <i>Rabi</i> jowar	18
4.1	Compound growth rates of area, production and productivity of jowar in India	31
4.2	Compound growth rates of area, production and productivity of jowar in Andhra Pradesh	34
4.3	Compound growth rates of area, production and productivity of jowar in Kurnool	37
4.4	Family composition and family labour contribution on selected farms	39
4.5	Education level of the respondents	40
4.6	Average size of land holding of sample farms	41
4.7	Cropping pattern on selected farms	42
4.8	Asset structure of selected farms	43
4.9	Human Labour Utilisation – Operation Wise in <i>Rabi</i> jowar Cultivation	44
4.10	Cattle and machine labour utilization in <i>Rabi</i> jowar cultivation	45
4.11	Material inputs used in cultivation of <i>Rabi</i> jowar	46
4.12	Cost of cultivation of <i>Rabi</i> jowar according to component wise	47
4.13	Costs concepts- <i>Rabi</i> jowar production	48
4.14	Output and returns per hectare of <i>Rabi</i> jowar	49
4.15	Costs and returns per quintal of <i>Rabi</i> jowar production	49
4.16	Measures of farm income- <i>Rabi</i> jowar production	50
4.17	Production elasticities of input factors in <i>Rabi</i> jowar	51
4.18	Allocative efficiency of resources in <i>Rabi</i> jowar production	52
4.19	Marketing costs for one quintal of <i>Rabi</i> jowar in channel-1	55

4.20	Marketing costs for one quintal of <i>Rabi</i> jowar in channel-II	55
4.21	Marketing costs for one quintal of <i>Rabi</i> jowar in channel-III	56
4.22	Price spread for one quintal of <i>Rabi</i> jowar	58
4.23	Indices of marketing efficiency in selected marketing channels	59
4.24	Farmers perception on constraints in cultivation of <i>Rabi</i> jowar	60
4.25	Farmers perception on constraints in marketing of <i>Rabi</i> jowar	61

LIST OF ILLUSTRATIONS

Fig No.	Title	Page No.
3.1	Mandal map of Kurnool district	27
3.2	Chart showing the sampling design	28
4.1	Area ('000 hectares) of jowar in India	31
4.2	Production ('000 tonnes) of jowar in India	32
4.3	Productivity (Kg/ha) of jowar in India	32
4.4	Area (hectares) of jowar in Andhra Pradesh	34
4.5	Production (tonnes) of jowar in Andhra Pradesh	35
4.6	Productivity (Kg/ha) of jowar in Andhra Pradesh	35
4.7	Area ('000 hectares) of jowar in Kurnool	37
4.8	Production ('000 tonnes) of jowar in Kurnool	38
4.9	Productivity (Kg/ha) of jowar in Kurnool	38

LIST OF SYMBOLS AND ABBREVIATIONS

<i>et al.</i>	:	and other
etc.	:	and so on
e.g.	:	For example, for instance
Fig.	:	Figure
%	:	Per cent
S.No.	:	Serial Number
ha	:	Hectare
Kg/ha	:	Kilogram per hectare
<i>i.e.</i>	:	That is
Kg	:	Kilogram
No.	:	Number
qtl	:	Quintal
Rs.	:	Rupees
Viz.,	:	Namely
CGR	:	Compound Growth Rate
DES	:	Directorate of Economics and Statistics

ABSTRACT

Author of the thesis	: K. VASANTHA
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The current study entitled “study on production and marketing of *Rabi* jowar in Kurnool district of Andhra Pradesh” was undertaken to examine *Kharif*, *Rabi* and overall compound growth rates of area, production and productivity of jowar. To estimate costs and returns and to assess the resource use efficiency in cultivation of *Rabi* jowar. To identify different channels of marketing and to realize the efficient channel for marketing of *Rabi* jowar in Kurnool district and to evaluate the perception of farmer’s in production of *Rabi* jowar.

The major jowar producing states are Maharashtra, Karnataka, Gujarat, Madhya Pradesh and Andhra Pradesh. In Andhra Pradesh the purpose of selecting Kurnool district was, because of its highest area and production under *Rabi* jowar when compared to other districts. Selection of mandals and villages was made based on the criterion of maximum area under *Rabi* jowar. Probability proportionate sampling was employed to select the number of farmers from the selected villages and the total sample constitutes to 120. The selected villages were B. palli, Hussainapuram, Tangutur and Nandavaram in Banaganapalli, Koilakuntla, Peddakoperla, chinnakoperla and vallampadu in Koilakuntla, P. chintakunta, Kotakandukur, Allagadda and Bathaluru in Allagadda. The data regarding marketing of *Rabi* jowar was collected from commission agents, wholesalers cum processors and retailers. Both primary and secondary data was collected and considered in the study. Data required for the study were collected from various unpublished and published sources. The data for calculating growth rates covered a period of 18 years commencing from 2000-01 to 2017-18.

Growth rates of *Rabi* jowar in India and Kurnool district were negative for area and production and positive in case of productivity, increase in yield was observed because of application of fertilizers, irrigation and use of high yielding varieties. The growth rates of area, production and productivity were significant in Kurnool district. In Andhra Pradesh all growth rates of *Rabi* jowar were positive.

Human labour is the most influencing component among various factors involved in the production process. The total cost of cultivation of *Rabi* jowar per hectare was calculated as ₹ 53,657.14. Among the total costs 75.42 per cent was

occupied by variable costs and remaining 24.57 per cent was occupied by fixed costs. Cultivation cost of *Rabi* jowar according to cost concepts were calculated and they were, cost A₁ ₹35066.94, cost B₁ ₹35919.14, cost B₂ ₹47169.14, cost C₁ ₹42404.14, cost C₂ ₹53654.14 and finally cost C₃ ₹59019.55. Gross returns from per hectare of *Rabi* jowar was ₹78,000 and net return was ₹24,342.86. Farm income measures were worked out per hectare of *Rabi* jowar. The farm business income was worked out as ₹42933.06. Family labour income and farm investment income were ₹30830.86 and ₹31082.65 respectively. When Returns per rupee of investment were worked out they stood at 0.41. The independent variables included in the function expressed above 76 per cent of variation in the production of sorghum output on the farms considered. The production elasticity of seeds remained non-significant which is not the same in case of other independent variables. The MVP/MFC ratios indicate that human labour was underutilized, tractor power was over utilized, fertilizers were over utilized and pesticides were underutilized.

Three marketing channels were identified in the marketing of *Rabi* jowar in the study area. Total costs incurred in channel-I, channel-II and channel-III were ₹199, ₹ 254 and ₹ 278 respectively. Producer share in consumer rupee in channel-I, channel-II and channel-III were 88.08 per cent, 86.96 per cent and 84.49 per cent respectively. Channel-I was most efficient for marketing *Rabi* jowar in the district. The major constraint faced by the farmer's during cultivation of *Rabi* jowar was inadequate and untimely rainfall during the period of harvesting (76.33), the second constraint was high wage rate (66.32), the third constraint faced by the farmer's was high rate of fertilizers and pesticides (55.72). The major constraint faced by the farmer's during marketing was lack of storage facilities (78.32), which resulted in distress sale. Second constraint faced by the farmer was difficulties in transportation (64.31), due to this reason farmer was forced to sell his produce in the village at low prices. Third constraint faced by the farmer was unstable prices (59.75), jowar fetches less price during post harvest period due to high arrivals of produce to market and later it increases.

Chapter – I

Introduction

Chapter-I

INTRODUCTION

Agriculture is the major occupation in India, nearly 70 per cent of country's population depends on agriculture either directly or indirectly for their livelihood. Production of food grains has increased from 51 million tonnes during 1950-51 to 285.2 million tonnes during 2018-19 (FAO, 2019). Agricultural sector employs nearly 50% of the population and accounts to 70% of income of the people in rural areas (Kumar *et al.* 2017). Hence, growth of any country depends on growth in its agricultural sector.

Over the years, production of millets has improved in India but the per capita consumption decreased to 50 per cent from 75 per cent in 1970s. In the pre-Green Revolution era, that is from 1965-66, millets were grown in 36.90 million hectares. In 2016-17, the area under millets declined to 14.72 million hectares (60 per cent less area) due to change in consumption pattern, unavailability of millets, dietary habits, low yield, less demand and conversion of irrigated area from millet cultivation to rice and wheat (Ministry of Agriculture and Farmers welfare). As a result, nutrients like, Vitamin-A, protein, iron and Iodine levels fell in children and women. Production of millets will surely help in providing nutritional values and prevents malnutrition.

Millets are generally cultivated in low-fertile land, tribal and rain-fed areas. These areas include Andhra Pradesh, Gujarat, Chhattisgarh, Haryana, Rajasthan, Maharashtra, Madhya Pradesh, Karnataka, Tamil Nadu, Uttar Pradesh and Telangana. Millets are often referred as coarse cereals and also nutria-cereals because of nutrient richness of grains. India is the leading producer of millets followed by Africa. Although millets take up relatively a lower position among food crops in Indian agriculture, they are important from food security point of view at farm and regional level. Millets are possibly the first cereals to be used for domestic purposes. They are one of the oldest foods known to human. Millets are small seeded grasses that are hardy and grow well in dry zones with limited soil fertility and moisture. Millets are unique because of their short growing period. Millets are easy to digest because of their non-glutinous and non-acid forming characters. They are better than polished rice because they release less

amount of glucose over longer time period. Major millets grown in India are jowar, bajra, ragi, banyard millet, proso millet, foxtail millet and kodo millet. Jowar is called as great millet due to its grain size among the millets.

In the world, area under jowar was about 41.31 million hectares and the production is 59.83 million metric tonnes in the year 2018-2019 (www.Indiastat.com). India contributes about 16% of world's total jowar production (Zalkuwi *et al.* 2015). In India, during the year 2018-19, area and production of jowar were 40.9 million hectares and 3.48 million tonnes respectively. Productivity of jowar in India was 849 kg/ha (www.Indiastat.com). Jowar is the fourth most important crop cultivated in both *Kharif* and *Rabi* seasons in India. The major jowar producing states are Maharashtra, Karnataka, Gujarat, Madhya Pradesh and Andhra Pradesh. Area under jowar in Andhra Pradesh was 30,000 hectares and 1,10,000 hectares in *kharif* and *Rabi* respectively contributing to the total production of 300.4('000 tonnes) in the year 2018-19 (DES). Kurnool district occupies first position in area and production of jowar. Area of jowar in Kurnool district was about 742 and 63673 hectares in *kharif* and *Rabi* respectively and with total production of 60252 tonnes and the productivity was 935 kg per hectare in the year 2018-19 (DES). In India major states that consume *Rabi* jowar are Maharashtra, Karnataka, Andhra Pradesh and Gujarat. Nearly 50 % of total *Rabi* jowar produced is sold in different marketing channels. Maharashtra accounts for 60 per cent of jowar arrivals in regulated markets followed by Madhya Pradesh (14 per cent), Karnataka (8 per cent) and Andhra Pradesh (5 per cent). (ICRISAT report, 2011).

JUSTIFICATION

There is reduction in annual rainfall year by year in Kurnool district. Jowar requires lesser amount of water than other crops like rice and chickpea. So, many of the farmers are shifting their cultivation to jowar. The quantity of jowar is also increasing gradually in the local markets and the value added products are becoming popular recently because of their benefits to health. Jowar is gaining importance because of its use to diabetic patients which control sugar levels. Under these perspectives the present study entitled "study on production

and marketing of *Rabi* jowar in Kurnool district of Andhra Pradesh”, was carried out with the following objectives

Objectives of investigation:

1. to analyse the trends in area, production and productivity of *Rabi* jowar in Kurnool district of Andhra Pradesh
2. to estimate the costs and returns of *Rabi* jowar cultivation.
3. to assess the resource use efficiency of *Rabi* jowar production; and
4. to identify marketing channels and to estimate marketing costs and margins.

Scope of study

This study will be useful to know the yield and use of available resources and income level of farmers in the study area. Even though this is a micro level study, the findings of the study can be used in framing policies related to growth of crop in the study area. This can be used to answer the queries regarding the profitability of jowar in the study area.

Limitations

Due to limitation in time and resources only data has been collected from 3 mandals of Kurnool district, they are Banaganapalli, Allagadda and Koilakuntla. Hence, the findings may be applicable for only those three mandals. The data was collected by using survey method. The data collected may not be accurate because it is out of remembrance of farmers because they did not maintain any field records. Anyhow by asking cross questions to the farmers sincere efforts have been made to collect accurate data.

Plan of thesis

Thesis is separated in to five sections. Chapter I is introduction to the topic of study which also include objectives and hypothesis. Chapter II contains a brief review of study conducted on the selected topic. Chapter III includes materials and methods. Chapter IV is for results and discussion. At last chapter V is meant for summary and conclusions of the study conducted.

Chapter – II

Review of Literature

Chapter – II

REVIEW OF LITERATURE

In this chapter an attempt is made to critically review the literature of past research work done in relevance to the present study. A brief account of the previous research work done on the study is presented under the following heads.

2.1 Studies on compound growth rate

2.2 Studies on costs and returns

2.3 Studies on resource use efficiency

2.4 Studies on marketing aspects

2.1 STUDIES ON COMPOUND GROWTH RATE

Kalamkar *et al.* (2002) examined the growth in area, production and productivity of principal crops in India over a period of 49 years (1949-50 to 1997-98). It was observed that the growth rates of principal crops in India over the period were positive and significant. The growth rates of jowar are -0.70 (area), 0.93 (production) and 1.65 (yield) and significant at 1 per cent level. It was concluded that area under jowar, bajra and gram declined over the years. But, the production and productivity increased positively and significantly.

Rao and Parwez (2003) analyzed the growth in area, production and productivity of sorghum and relative contribution of area and yield to the production over the last thirty years i.e. from 1978-1998. The findings revealed a virtual deceleration in sorghum *Kharif* and *Rabi* area during the identified sub-periods and the overall period. The state of Andhra Pradesh presented a disfavor for both *Kharif* and *Rabi* sorghum mainly because of negative contribution of area and productivity towards production level.

Rao and Reddy (2005) worked out the growth rates of area, production and productivity of groundnut for the period I (1988-89 to 2002-03) and period II (1953-56 to 2002-03) in the three geographical regions of Andhra Pradesh and also Andhra Pradesh state as a whole. Their study revealed that the compound growth rates of area, production for the period-I, were negatively significant in coastal Andhra,

Telangana and Andhra Pradesh state as a whole. However, in period –II, the compound growth rate of area is significant only in Rayalaseema, production is significant in all the three regions and Andhra Pradesh state as a whole and productivity is significant in coastal Andhra and Andhra Pradesh state as a whole.

Charulya *et al.* (2011) estimated growth rates of area, production and yield of sorghum in India for a period of fifty years. The total time period is divided in to three sub periods they are, post- independence (1947-65), public supported growth (1965-85) and private sector driven growth (1965-2010). The highest negative growth rate in area was observed in case of Gujarat followed by Andhra Pradesh and Madhya Pradesh. Similarly, the decrease in production was also highest for Gujarat (-3.57%) followed by Madhya Pradesh (-3.0%) and Andhra Pradesh (-2.99%). The positive growth in production was observed only in case of Maharashtra for whole period. The productivity growth rates were positive among all the states. It was highest for Gujarat followed by Andhra Pradesh.

Saraswati *et al.* (2012) estimated the growth in area, production and yield of different crops in Karnataka using compound growth function. Growth rates showed a significant positive growth in area under pulses, vegetables, spices and fruits while cereals showed significant negative growth. The area under major and minor millets experienced a substantial annual decrement. The area under jowar has registered a negative growth of -2.974 per cent, the production recorded a negative growth rate of -1.05 per cent and the productivity recorded a slight positive growth during the study period.

Narawade (2013) made an attempt to study the state-wise growth performance of coarse cereals like jowar, bajra and maize during the pre- and post-reforms period in India. The entire period of 30 years was divided into 3 sub-periods viz., 1981-82 to 1990-91, period-I as pre-reform period, 1991-92 to 2000-01, period II as post reform period and 2001-02 to 2006-07, period III as a later post reform period. The study showed that jowar has registered dismal growth performance at all India level. The output growth rate was stagnant during 1980s and registered negative growth rate in the 1990s at all India level. During later post reform period the output growth rates has increased significantly in orissa (4.56%), Haryana (-5.31%) and Rajasthan (11.81%) due to yield increase. Jowar output growth rate has

registered negative growth rate during all sub-periods due to loss in area in the states of Andhra Pradesh and Gujarat.

Michaelraj *et al.* (2013) examined the area, production and productivity of millets in India from the year 2001-2012. They concluded that the harvested area of millets in India gradually decreased in an alternative years of 2005-2008 and from the year of 2009 onwards the area harvested gradually increased and again from 2011 it has fallen. Highest negative growth rate was observed as -21.30 per cent in the year 2012 in terms of area and in terms of production it was observed as -30.00 per cent in the year 2009.

Ahmad *et al.* (2015) examined trends in area, production and yield of cereals and coarse cereals in India as well as Nigeria from period 1982-2012. The average area, production and productivity in India under cereals was 99787727.63 ha, 215096746.9 tonnes and 2.156 tonnes/ha respectively and from Nigeria was 77547885 ha, 101037721 tonnes and 1.30 tonnes/hectare. The negative growth rates of area under coarse grains were experienced from the period of 1970 to 1990's. A higher growth rate registered in yield (2.54 per cent) and also a production is 1.92 per cent in 1970's. The decline in coarse cereals production, which is largely grown for self-consumption, has occurred along with change in labour market and due to changes in consumption pattern in rural India.

Malathi *et al.* (2016) estimated growth rate of area, production and productivity and measured contribution of different components to the growth rate of millets during the last six decades i.e. 1950-51 to 2011-12 in India. They concluded that there was a positive growth during 1950-51 to 1980-81 and negative growth in subsequent years. Growth in production of millets was mainly due to increase in per hectare yield during the period from 1950-51 to 2011-12. Increase in production of sorghum, pearl millet, finger millet, and total millets were contributed by their yields, whereas area and its interaction with yield have adversely affected the production.

Kumar *et al.* (2017) studied growth performance of principal crops in north Bihar during four decades i.e. from 1974 to 2014. To analyse the long term growth patterns of major crops, the compound growth rates calculated for the period 1967-68 to 2007-08 have been divided in to 4 categories they are high (>4 per cent),

medium (2.0-3.9 per cent), low (0-1.9 per cent) and negative. Rice, wheat and maize had high production growth rate up to 1990 and later moved to medium growth rate. Rice and maize had negative production growth rate in 2000-2011 however maize came back to high production growth rate category in 2010-11 to 2014-15 and this was only due to increasing area under winter maize in Bihar. Production growth rate of pulses was negative and this was probably due to low yield potential and risk proneness of pulse crops.

Sakamma *et al.* (2017) employed exponential growth model to find out the growth in area, production and productivity of finger millet. Growth rates were computed for a period of 30 years from 1984-85 to 2013-14. The study period was divided into four periods. The growth in area for overall period indicated that, area under finger millet for India (-2.594%) was declining at a faster rate compared to Karnataka (-1.811%). Similar trend was observed during period I, II, III and IV. The implementation of Public Distribution System and National Food Security Mission, the minimum support price have adversely affected the area under finger millet in both Karnataka as well as India.

Singh and Sharma (2018) estimated the trend and growth of area, production and yield of small millets in Madhya Pradesh and India during the period 2001-15. It was observed that the area and production of small millets was found to be decreased with 7.05 & 1.35 and 5.41 & 2.32 per cent per year while the productivity was found to be increased by 6.13 & 3.37 per cent per year in Madhya Pradesh and India respectively. The study revealed that the interaction effect of area and yield followed by area effect were found to be major contributor towards decrease in production of small millets in Madhya Pradesh.

Ranjeet *et al.* (2018) analysed the growth rates in area, production and yield of *Kharif* and *Rabi* crops in malwa plateau agro climatic zone of Madhya Pradesh. The growth rates were estimated using compound growth rate function for a period of 15 years from 1999-2000 to 2013-14. The growth of sorghum in area, production and yield are -4.34, 0.048 and 4.84 respectively. It was observed that there is significant negative growth in area, significant positive growth in productivity and insignificant positive growth in production of sorghum.

Pavithra *et al.* (2018) estimated growth in the area, production and productivity of food grains from 1990-91 to 2014-15 in Karnataka using compound growth rate analysis. The highest positive growth was observed in maize area and production were 7.74 per cent and 7.64 per cent respectively. Negative growth of -0.10 per cent was observed in maize productivity. The negative significant growth was observed in area of finger millet i.e. -1.81 per cent. Among cereals, paddy and sorghum were found to be non-significant for growth of area, production and productivity.

Ashwini *et al.* (2019) analyzed growth rates and coefficient of variation of major millets for period from 1990-2017 for the major five districts of Andhra Pradesh. In case of sorghum Guntur showed high growth rates but high instability in production and yield. Andhra Pradesh and all the districts has shown declining trend except the growth rates in Guntur which showed higher, positive and significant results in area (11.93 per cent), production (25.09 per cent) and yield (11.74 per cent) of the sorghum. The growth of productivity seemed to be increasing in Kurnool, Prakasam and state level due to use of high yielding varieties coupled with irrigation and fertilizer application might have led to increase in productivity of sorghum.

2.2 STUDIES ON COSTS AND RETURNS

Tawale *et al.* (2009) revealed that use of hired human labour, family human labour, machine labour, and use of fertilizers were more in irrigated *Rabi* jowar production than in rainfed *Rabi* jowar production. On the contrary, use of bullock labour and seed was more in rainfed *Rabi* jowar production than in irrigated *Rabi* jowar production. Per hectare net profit of irrigated *Rabi* jowar was Rs. 2519.17 and by that of rainfed *Rabi* jowar was Rs. 14700. The output-input ratio was 1.29 on irrigated *Rabi* jowar and 1.14 on rainfed *Rabi* jowar farms. Per quintal cost of production was Rs. 680.33 on irrigated *Rabi* jowar farm and Rs. 649.92 on rainfed *Rabi* jowar.

Deshmukh *et al.* (2010) analysed costs, returns and profitability of pearl millet production. The results revealed that per quintal cost of production in pearl millet was Rs. 512.31 on large farm followed by Rs. 484.19 and Rs. 476.80 on medium and small farms respectively. Per hectare net profit was Rs. 3170.86 in

small farm followed by Rs. 2575.81 and Rs. 1806.57 on medium and large farms respectively. The output-input ratio was 1.18, 1.17 and 1.12 on small, medium and large farms respectively. The per hectare net profit showed an inverse relationship with size of land holdings.

Adhikari (2012) conducted a study on the economics of finger millet production in Pokhara valley of Nepal in 2006. The cost of production (NRs. 23847.60/ha) and gross revenue (NRs.24638.23/ha) were significantly higher at Kalabang site than in Begans. The productivity of finger millet was significantly higher in Kalabang. The price of finger millet was NRs. 16.91/kg at Kalabang and NRs.17.35/kg at Begnas. Profit of finger millet cultivation was higher at Kalabang (NRs. 790.58/ha) than in Begans (NRs. 602.45/ha). The benefit cost ratio was highest in Begnas (1.05).

Hile *et al.* (2013) estimated per hectare cost of cultivation of *rabi* sorghum i.e. Cost 'c' was 22036.33. The total cost of cultivation of *rabi* sorghum, cost A was 12058.17 and cost B was 18111.92. Over the size groups, the total cost of cultivation for one hectare of *rabi* sorghum was 22222.61, 20485.57 and 22992.61 for small, medium and large size group of holdings respectively. The cost 'A' was 11862.14, 10808.15 and 12922 for small, medium and large size groups of holdings respectively. The cost 'B' was 17972.61, 16705.57 and 19062.61 for the size groups in order. It was noticed that per hectare gross income received was 27004.00, 25695.00 and 25729.00 for small, medium and large size groups of holdings respectively. At the overall level it was 25897 with per hectare production of 7.07 quintals. It was seen that medium size group of *rabi* sorghum growers got more profit followed by small size group and large size group.

Verma and Banafar (2013) analysed economics of minor millets in Bastar district of Chhattisgarh. They estimated that the cost of cultivation per hectare of kodo, kutki and ragi was Rs. 2866.75, Rs. 2751.01 and Rs. 3342.10 respectively. Net income from these millet crops were observed as Rs. 959.63, Rs. 771.26 and Rs. 7508.89 respectively. It was observed that on an average input-output ratio in kodo, kutki and ragi was 1:1.33, 1:1.28 and 1:3.25 respectively. All the costs increased with the increase in the size of farms. Ragi is most remunerative crops prevailing in the Chhattisgarh region.

Kusuma *et al.* (2013) analysed the data collected during the study and tabular analysis was employed. The per hectare total cost of cultivation of foxtail millet worked out to be as Rs. 11607.21. Farmers got 12 quintals of main product and 4.5 quintals of by-product worth Rs. 17190 per hectare. The gross returns from both main product and by-product worked out to Rs. 14940 and Rs. 2250 respectively. The net return realized from foxtail millet cultivation was Rs. 5582.79 per hectare.

Reddy (2013) studied an economic analysis of rainfed farming in chittoor district of Andhra Pradesh. The gross returns per hectare of groundnut, redgram, sunflower, bajra, jowar and ragi were Rs. 40,875, Rs. 28,500, Rs. 32,000, Rs. 27,250, Rs. 26,900, Rs. 25,875 and net returns per hectare of the same crops were Rs. 8,334.04, Rs. 6,949.50, Rs. 8,627.96, Rs. 7,889.16, Rs. 7,788.54 and Rs. 6,835.28 respectively.

Zalkuwi *et al.* (2015) analysed and compared costs and returns of sorghum production in India and Nigeria. The CACP cost concepts revealed that the average output was 17.68 quintals and 18.14 quintals per hectare in India and Nigeria respectively. The gross margin and net farm income from sorghum production was calculated as Rs. 28281.90 and Rs. 17354.30 and Rs. 29810.00 and Rs. 20642.10 per hectare in India and Nigeria respectively. But the benefit cost ratio was same for both the countries.

Tandel *et al.* (2018) examined the economics of finger millet production in south Gujarat region. It was observed that the cost of cultivation cost C_3 was worked out to be Rs. 23727.48 per hectare. Cost A_1/A_2 , cost B_1 , cost B_2 , cost C_1 and cost C_2 were Rs. 9334.67, Rs. 9370.09, Rs. 13170.44, Rs. 17770.09 and Rs. 21570.44 per hectare respectively. The net returns were estimated at Rs. 2181.71 per hectare. Farmers were able to secure a net income of Rs. 1.10 per every rupee spent in finger millet cultivation.

Durgad *et al.* (2019) calculated costs and returns of foxtail millet and little millet in Ballari and Koppal districts of Karnataka. Cost of cultivation of foxtail millet and little millet was worked out and major share in variable cost include labour cost and material cost. The net returns worked out to be 12,116 and 11,506 with a return per rupee of investment of 1.60 and 1.52 for foxtail and little millet

farmers respectively. Total cost of cultivation was 20,055 and 22,278 for foxtail and little millet respectively.

2.3 STUDIES ON RESOURCE USE EFFICIENCY

Deshmukh *et al.* (2010) conducted a study resource productivity, resource use efficiency and optimum resource use in pearl millet production. Cobb-Douglas production function was fitted to the data. The results revealed that the regression coefficients of bullock labour (0.181), area (0.330) and family human labour (0.112) were positive and significant. It revealed that these resources when increased by one per cent each, that led to increase the production of pearl millet grain by 0.181, 0.330 and 0.112 per cent, respectively. Use of bullock labour was optimum as 8.99 pair days followed by area (0.58 ha) and family human labour (10.42 man days). The sum of production elasticities was 0.80 which indicated decreasing return to scale.

Chapke *et al.* (2011) examined the resource-use efficiency in sorghum production in coastal region of Andhra Pradesh. The value of coefficient of Cobb-Douglas production function was 0.648 and this value indicates decreasing returns to scale. The ratio of MVP to the MFC was greater than unity for all inputs but was less in seeds and irrigation. This implies that fertilizers, labourers and agrochemicals were underutilized, while negative values of the ratio for seeds and irrigation inputs were over-utilised. It means that the returns from sorghum were likely to increase if more of inputs such as fertilizers, labourers and agrochemicals were used.

Hile *et al.* (2013) attempted to study the resource use structure and resource use productivities of *rabi* sorghum in western Maharashtra. Cobb-Douglas production function was employed to estimate resource use efficiency in cultivation of *rabi* sorghum. The functional analysis has indicated that five variables viz., human labour (X_1), manures (X_2), nitrogen (X_3), potash (X_4) and irrigation (X_5) are significant. These variables affect the productivity by the producer for *rabi* sorghum.

Pagare *et al.* (2013) in their study on resource use productivity, resource use efficiency of *rabi* jowar growers in Marthwada region revealed that area and machine labour found significant on small farms. On medium farms area, human labour and seed were significant and for large farms area, machine labour and human labour were significant. Cobb- Douglas production function was used and the

results depicted that on small farms only area (2.08) and machine labour (2.04) were found significant. On medium farms, area (2.161), human labour (2.13) and seed (2.067) were significant and for large farms, area (2.51), machine labour (2.03) and human labour (2.10) were significant. In small farms area and machine labour was underutilized. On medium farms area was over utilized, whereas seed and human labour were underutilized. On large farms, human labour was over utilized, whereas area and machine labour were underutilized.

Raut and Trimbak (2016) revealed that elasticity of production under *rabi* jowar was 0.82 through estimates of Cobb-Douglas production function. It indicates that independent variables included in the function expressed above 82 per cent of variation in the production of *rabi* jowar output. Resource productivity and marginal product of area under *rabi* jowar was 13.11 quintals. MVP to price ratio was 3.60, which showed that there was higher scope to increase area under *rabi* jowar.

Hamsa *et al.* (2017) conducted a study on resource use efficiency of major food crops under rainfed conditions in Karnataka. In rainfed ragi, the regression coefficients for bullock pair (1.27) and FYM (0.94) were positive and statistically significant. The MVP to MFC ratio was the highest for bullock pair followed by FYM and seeds thus indicating the scope for higher use of these inputs from the present level to optimize returns. The technical efficiency of rainfed ragi was 0.7 and allocative efficiency was 0.63.

Begum (2017) calculated resource productivity in jowar cultivation by considering four independent variables among which human labour and seeds were positively significant at 5 per cent level. The regression coefficients of machinery use and fertilizers were positively related but not significant. The adjusted coefficient of multiple determination (\bar{R}^2) was 0.8511. This indicates that the variables included in the model explained about 85.11 per cent of variation in the production of jowar.

Rohith *et al.* (2018) analyzed the extent of efficiency in resource use of major crops cultivated in Karnataka. The results showed that the ratio of MVP to MFC was away from one, in most of the crops highlighting the inefficiency in resource use. The human labour (0.945) was optimally utilized and there is great scope for use of machine labour (8.57) in canal paddy. There is scope for use of human labour

(2.09), bullock labour (3.28), machine labour (4.44), nitrogen (0.29) and capital cost (2.51) in rainfed redgram. Among the different inputs, machine labour has the greater scope for its enhanced usage to augment the output and substantial use of ground water will enhance productivity of the crops.

Durgad *et al.* (2019) analyzed resource use efficiency of foxtail and little millet in Bllari and Koppal districts of Karnataka. Coefficient of multiple determination (R^2) for foxtail and little millet were 0.97 and 0.95 respectively. The output elasticity of human labour (0.2122), bullock labour (0.1450), machine labour (0.0829) and seed (0.1592) was positively significant in foxtail millet, thus indicated that were underutilized and can increase returns per increment in application of above mentioned resources. Fertilizer cost was non-significant for foxtail millet returns. Similarly, in little millet cultivation, the output elasticity of human labour (0.3378) and machine labour (0.0279) were positively significant in little millet thus indicated underutilization of resources and returns can be increased per increment in application of above mentioned resources. And bullock labour, seed and fertilizers were non-significant.

2.4 STUDIES ON MARKETING ASPECTS

Deshmukh *et al.* (1997) studied marketing of farm commodities in western Maharashtra and concluded that in nearby regulated market the per quintal marketing cost of *rabi* jowar and wheat were worked out to Rs. 29.39 and Rs. 30.44, whereas the per quintal marketing cost of these commodities in weekly market was below six rupees. It was observed that in total marketing cost of *rabi* jowar and wheat the proportion of commission agents were 47.60 per cent and 43.86 per cent respectively.

Bansode (2002) worked out average per quintal marketing costs for *kharif* and *rabi* jowar as Rs. 34.53 and Rs. 45.70 respectively. The major items of cost were packaging, commission and transportation. Producers share in consumer rupee was 70.18 per cent in *kharif* jowar and 78.96 per cent in *rabi* jowar. While, the share of marketing cost and margins were 29.82 per cent and 21.04 per cent in *kharif* and *rabi* jowar respectively. The marketing costs and producers share in consumer rupee were highest in *rabi* jowar when compared to *kharif* jowar.

Deshmukh *et al.* (2009). Analyzed marketed surplus and price spread in case of pearl millet in the year 2008-09 in Beed district of Maharashtra. He selected three marketing channels. The results revealed that price paid by consumer was highest as Rs. 920 per quintal in channel-III in which producer's share in consumer's rupee was 66.21 per cent. In case of channel-II, price paid by consumer was Rs. 775 per quintal in which producer's share in consumer's rupee was 77.80 per cent whereas in channel-I, price paid by consumer was less as compared to channel-II and channel-III. It was Rs. 599 per quintal in which producer's share in consumer's rupee was highest *i.e.* 97.66 per cent as compared to channel-I and channel-II. Net price received by producer was highest in channel-III. Similarly, price spread was also highest in channel-III and it was found that channel-III was beneficial to both producer as well as intermediaries.

Adhikari (2012) conducted a study on marketing of finger millet in Pokhara valley of Nepal. Major portion of finger millet was found to be marketed directly from producers to consumers. Very little amount of produce was marketed through middlemen. In Kaski district, the marketing channel of finger millet was different from other crops. Most of the finger millet produced in study site was consumed at the same site to meet the demand of finger millet in the district. Hetauda and Trisuli were found to be the major source of finger millet for Pokhara valley which was marketed up to the villagers through wholesalers, millers and retailers.

Navadakar *et al.* (2012) identified that the farmers sold their maize directly in Agricultural Produce Market Committee. Thus, the channel of distribution of maize was producer-wholesaler-retailer-consumer/processing unit. The marketing cost incurred during the sale of maize in channel-I was Rs. 203.28 per quintal. The marketing cost in channel-II was Rs. 47.50 per quintal. In channel-I the marketing efficiency of *kharif* maize was 1.13 and 1.11 in Ahmednagar market and Kajat market respectively. In channel-II, the marketing efficiency at local market was 1.10. So, Ahmednagar market was efficient for marketing of the maize.

Hile *et al.* (2013) observed two marketing channels in study area in case of *rabi* sorghum. They are channel-I: producer → commission agent → wholesaler retailer → consumer, channel-II: producer → commission agent cum wholesaler retailer → consumers. Out of these two marketing channels channel-I is most prominent channel. The average per quintal cost of marketing for *rabi* sorghum was

worked out to 223.56 in channel-I, while in channel-II average per quintal cost of marketing was 9.63. The price spread per quintal of *rabi* sorghum in channel-I and channel-II were 2750 and 1859.63 respectively.

Verma and Banafar (2014) made an attempt to study the price spread of minor millets in Bastar district of Chhattisgarh. The data were collected to the crop year 2007-08. The total marketing cost paid by the retailer was Rs. 32.60 per quintal. The sale price of producer came to Rs. 395 and Rs. 400 in channel-I and channel-II respectively. In case of channel-II net price received by producer was being Rs. 400, the price paid by consumers per quintal was Rs. 534 and producer's share in consumer's rupee was 74.9 per cent.

Raut and Trimbek (2016) estimated total marketed surplus in four channels they are channel-I, channel-II, channel-III and channel-IV as 1.77 quintals, 2.40 quintals, 5.20 quintals and 1.98 quintals. Total marketed surplus was 10.95 quintals. The channel-I and II are good for consumer point of view as they have paid only Rs. 1894.72 and Rs. 1991.53 per quintal respectively. Whereas in channel-III and IV the consumer has paid Rs. 2171.9 and Rs. 2266.43 per quintal respectively.

Reddy *et al.* (2017) conducted a study on the economics of marketing channels and efficiency of marketing of finger millet in Karnataka. He identified three marketing channels, they are channel-I: producer - village trader - retailer consumer, channel-II: producer - village traders – wholesalers - consumers and channel-III: producer - commission agent – wholesalers - consumer. The producer share in consumer rupee was 82.30 per cent, 80 per cent and 77.12 per cent in channel-II, channel-III and channel-I respectively. The price spread was highest in channel-III followed by channel-II and channel-I respectively.

Poonam *et al.* (2018) analysed the economics of marketing of pearl millet in Jhunjhunu district. There was no difference identified in the marketed and marketable surplus. The survey also revealed that the channel-II (producer- commission agent-wholesaler-retailer) was more remunerative than channel-I (producer-commission agent-wholesaler-retailer) because producer's share in consumer rupee was 83.29 percentage and the share of wholesaler was 6.15 percentage. The price spread was calculated and it was 16.7 percentage and within this percentage 9.19 per cent is of marketing cost and 7.51 per cent is of marketing margin.

Murulidhar *et al.* (2019) collected data from 60 maize farmers, 15 commission agents, and 15 village merchant/trader using simple random technique. The results revealed two marketing channels for maize. Channel-I was practiced by 66.66 per cent respondents and channel-II was practiced by 33.33 per cent respondents. In the total price spread the share of marketing costs and margins were 75 per cent and 25 per cent in channel-I, while in channel-II they were 80 per cent and 20 per cent respectively. The producer's share in consumer's rupee was relatively more in channel-II than in channel-I. Thus, channel-I was found to be relatively more efficient than channel-I.

Chapter – III

Material and Methods

Chapter III

MATERIALS AND METHODS

This chapter presents the procedural details in selecting the sample, method of data collection and analytical techniques employed in attaining the objectives of the study. This chapter is presented under the following heads.

- 3.1 SAMPLING DESIGN
- 3.2 COLLECTION OF DATA
- 3.3 METHODS OF COMPUTATION
- 3.4 TOOLS OF ANALYSIS

3.1 SAMPLING DESIGN

Probability proportionate sampling cum random sampling technique was employed for selection of sample in the present study. Chart of sampling design was depicted in figure 3.2

3.1.1 Selection of the district

In Andhra Pradesh, kurnool district ranks 1st in both area and production of *Rabi* jowar. So, the district is purposively selected for the research study area. Kurnool district mandal map was depicted in figure 3.1.

3.1.2 Selection of mandals

The list of all 54 mandals of kurnool district, was prepared and three mandals Viz., Banaganapalli, Koilakuntla and Allagadda were purposively selected for the present study based on the maximum area under *Rabi* jowar.

3.1.3 Selection of villages

All the villages in selected mandals were listed out and four villages from each selected mandals were purposively selected based on the criterion of maximum area under *Rabi* jowar thus making the total sample villages to twelve. The selected villages were B. palli, Hussainapuram, Tangutur and Nandavaram in Banaganapalli, Koilakuntla, Peddakoperla, chinnakoperla and vallampadu in Koilakuntla, P. chintakunta, Kotakandukur, Allagadda and Bathaluru in Allagadda.

3.1.4 Selection of respondents

All the farmers in the selected villages were listed out and probability proportionate sampling was employed to get the sample from each village. The total sample size constitutes to 120. After getting the sample the farmers were selected randomly.

For eliciting the information pertaining to the marketing aspects of *Rabi* jowar in Kurnool district, the following marketing agencies have been selected by employing simple random sampling technique and represented in Table 3.1.

Table 3.1 sample size pertaining to market intermediaries of *Rabi* jowar

Marketing channels	Producer	Commission agent	Wholesaler cum processor	Retailer	Consumer
Channel -I	69	13	20	-	34
Channel -II	18	-	11	-	20
Channel -III	13	8	5	14	16

3.2 COLLECTION OF DATA

A well-structured pre tested schedule was employed to collect the requisite information from the list of the farmers.

3.2.1. Primary data

The primary data needed for the study regarding both production and marketing aspects were collected from the farmers by personal interview method with the help of a pre tested schedule. The data on family composition, land holding, farm inventory, the data on input-output coefficients and prices of factors and farm products were collected from the selected respondents. Besides, the data on quantity purchased, price paid/received, costs incurred were collected from the market intermediaries. Every effort was made at the time of interview to convince the respondents that the study was undertaken purely for research and not for any other purpose. The data for the present study were pertained to the agricultural year 2018-2019.

3.2.2 Secondary data

The secondary data on area, production and productivity of jowar at country level, state level and district level were collected from www.indiastat.com, minister of agriculture and farmers welfare, Directorate of Economics and Statistics (DES).

3.3 METHODS OF COMPUTATION

An economic analysis of *Rabi* jowar cultivation requires proper estimation of costs of inputs, input services and the valuation of output. The procedure followed in computation of production costs of *Rabi* jowar is delineated below.

3.3.1 Human labour

Human labour was quantified in terms of productive man-work units (usually about 8 hours of productive work turned out by a worker on the farm). Actual days worked in performing various cultural operations in the production of *Rabi* jowar were recorded separately for male and female, family and hired labour. The women-days were converted in to man equivalent days by assigning a ratio of 1.5 woman days equivalent to one man-equivalent day. Wages paid in cash or kind or in combinations of both were computed in rupee equivalent. Family labour was imputed at the prevailing wage rate of casual labour employed for similar operations in the study area.

3.3.2 Bullock labour

It included both owned and hired cattle power and was measured in terms of plough units of 6 hours. The cost of either owned or hired bullock labour was estimated at the prevailing wage rates in the study area.

3.3.3 Tractor services

Tractor services both owned and hired were charged at the prevailing rates in the locality per an hour of work.

3.3.4 Seed

The cost of purchased seed was estimated at the prevailing market price.

3.3.5 Fertilizers and plant protection chemicals

The cost of fertilizers and plant protection chemicals was estimated on the basis of prevailing market price.

3.3.6 Interest on working capital

It was calculated at the rate of 12 per cent per annum (the rate at which the institutional agencies advance short term loans) for half of the amount for full crop period and for the rest of the amount for half of the crop period since the financial resources were used at different stages of crop cultivation. Imputed value of family labour was excluded while computing the interest on working capital.

3.3.7 Rental value of owned land

It was charged at the prevailing lease rates for the different crops in the study area for owner farmers.

3.3.8 Land revenue

Land revenue actually paid by the farmers was considered.

3.3.9 Depreciation

Annual amount of depreciation on each working asset owned by the farmers was calculated by following the straight line method. Later it was apportioned based on the acreage under different crops.

3.3.10 Interest on fixed capital

It was estimated at the rate of eight per cent as the fixed deposits in commercial banks would fetch this rate of interest. Then the amount so calculated was apportioned on crop acreage. Since rental value was considered, land value was excluded from fixed capital.

3.3.11 Cost of cultivation

Cost of production refers to the total cost incurred to produce a specific quantity of a product in any farm business.

3.3.12 Marketing aspects of *Rabi* jowar

The information pertaining to marketing aspects of *Rabi* jowar was collected from producers, commission agents, wholesalers cum processors, retailers and consumers which include the quantity sold/purchased, the price paid/received, expenditure on labour, transport, taxes and other incidental charges.

3.3.12.1 Marketing costs

These include weighing, loading, unloading, commission, rent, taxes etc which were paid by the market functionary per quintal of the produce.

3.3.12.2 Marketing margin

This referred to the net share to the different marketing intermediaries for particular quantity of produce after deducting marketing costs from gross marketing margins at each stage of handling the commodity.

3.3.12.3 Price spread

Price spread is defined as the difference between price paid by consumer and price received by farmer per unit quantity of produce.

3.4 TOOLS OF ANALYSIS

Both conventional and functional analyses were employed to analyze the data and arrive at valid conclusions. Simple arithmetic averages and percentages were worked out in order to find out costs, returns and farm efficiency measures. Functional Analysis was used to estimate the resource use efficiency.

3.4.1 Estimation of compound growth rate

The secondary data on area, production and productivity of jowar in India, Andhra Pradesh and Kurnool were used to analyze the trends. The data on area, production and productivity of *Kharif*, *Rabi* and overall data of jowar from 2000-01 to 2017-18 was used for study which was collected from www.indiastat.com, Ministry of Agriculture and Farmers Welfare and Directorate of Economics and Statistics.

The compound growth rate of jowar was estimated using the exponential curve.

$$Y = ab^X$$

Where,

Y= Dependent variable in period (Area, Production and Productivity)

a= Intercept

b= Regression coefficient

x= Year which takes values (1, 2n)

It has been estimated as linear equation after taking the log for both sides. The data used for the period was 2000-01 to 2017-18 i.e. 18 years.

$$\text{Log } y = \log a + x (\log b)$$

$$\text{Growth rate (\%)} = [\text{Antilog}(\log b) - 1] * 100$$

The compound growth rates were tested for their significance by F test

3.4.2 Conventional Analysis

Averages and percentages were calculated through conventional analysis. The same pertaining to resource base, costs, returns and various measures of farm income were calculated and presented in the study.

3.4.2.1 Cost concepts

Cost concepts defined by Commission for Agricultural Costs and Prices (CACCP) were followed to estimate the cost of cultivation and derive the measures of efficiency *viz.*, farm business income, family labour income, net income and farm investment income cost concepts were used. The cost concepts *viz.*, cost A₁, cost A₂, cost B₁, cost B₂ and cost C₁, cost C₂, cost C₃ were used in the present study and they are derived as follows.

Cost A₁

This cost includes values of hired human labour, owned and hired cattle labour, owned and hired tractor services, seeds, fertilizers, farm yard manures, plant protection chemicals, depreciation, repairs, land revenue and interest on working capital.

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

Cost B₁ = Cost A₂ + Interest on value of owned fixed capital assets (excluding land)

Cost B₂ = Cost B₁ + Rental value of owned land and rent paid for leased-in land

Cost C₁ = Cost B₁ + Imputed value of family labour

Cost C₂ = Cost B₂ + Imputed value of family labour

Cost C₃ = Cost C₂ + 10 per cent of cost C₂ as management cost. (On account of managerial functions performed by farmers).

3.4.2.2 Farm efficiency measures

Farm business income = Gross income – Cost A₁

Family labour income = Gross income – Cost B₂

Net income = Gross income – Cost C₂

Farm investment income = (Gross income – Cost C₃) + (Cost B₂ – Cost A₁)

Returns per rupee of expenditure = Net income / Cost C₃.

3.4.3 Functional Analysis

Production function analysis was used to study the resource productivity and resource use efficiency. Among different types of production functions, Cobb-Douglas production function was selected for the present study because of its relative advantage over other production functions. The first order derivative of production function will give marginal value products. The ratio between the marginal value product to factor cost (opportunity cost) has been considered a measure for resource use efficiency.

3.4.3.1 Cobb-Douglas Production Function

The Cobb-Douglas production function was found to be more appropriate and best fit to estimate the resource productivity. This function is a power function and linear in logarithms. Production elasticities of resources can be obtained directly and the sum of elasticities of production provides the estimates of returns to scale.

The Cobb-Douglas production function is specified in the following power form as

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} \dots e^u$$

Y = Yield in quintals

X₁: Human labour in mandays

X₂: Machine power in hours per hectare

X₃: Seed in kg

X₄: Manures in tonnes

X₅: Fertilizers in kg

X₆: Plant protection chemicals in kg per hectare

a: Intercept

μ: Stochastic disturbance term

e: Napier base

b₁ to b₅ partial elasticity coefficients of X₁ to X₅ inputs

For ease in computation, the production function can be presented in logarithmic form as

$$\ln Y_c = \ln A + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + \mu$$

In order to know the goodness of fit, the adjusted coefficient of multiple determination (\bar{R}^2) was calculated using the following formula:

$$\bar{R}^2 = \left[1 - \left(1 - R^2 \right) \times \left[\frac{(n-1)}{(n-k)} \right] \right]$$

Where,

R²: Unadjusted coefficient of multiple determination

n: Number of sample observations

k: Number of parameters estimated from the sample including intercept.

3.4.3.2 Marginal Value Products

Equality of marginal value product to factor cost is the basic condition that must be satisfied to assess resource use efficiency. In Cobb-Douglas production

function, marginal physical product of X_j , the j^{th} input factor is given by the following equation.

$$Y_i = A X_{1_i}^{b_1} X_{2_i}^{b_2} \dots X_{j_i}^{b_j} \cdot e^{\mu_i}$$

For $i = 1$ to n farms

$j = 1$ to k inputs

$$\text{MPP of } X_j \text{ input} = \frac{b_j \bar{Y}}{\bar{X}_j} \text{ where,}$$

MPP = Marginal Physical Product of j^{th} input

b_j = Partial elasticity coefficient of j^{th} input.

\bar{Y} = output of the crop at its geometric mean level.

\bar{X}_j = j^{th} independent variable at its geometric mean level.

The marginal value product for each factor is obtained by multiplying the MPP of each factor with unit price of output i.e.

$$\text{MVP} = \text{MPP} \times P_y$$

Marginal value productivities are compared with acquisition costs in order to study the resource use efficiency. An input is said to be efficiently used when its MVP = MFC.

3.4.4 Resource use efficiency

This is worked out by computing the ratio of marginal value product to opportunity cost. If the ratio is less than one, it indicates that too much of the particular resource is being used under the existing price conditions and vice versa. If MVP to factor cost ratio is equal to one, it indicates efficient resource use.

3.4.5 Marketing efficiency

This includes effectiveness of the marketing system with which marketing service is performed, the cost at which the service is performed and the effect of this marketing cost and the method of service performed.

Acharya's Index of Marketing efficiency (Acharya and Agarwal, 1999) is used in the present study

$$ME = \frac{FP}{[MC + MM]}$$

Where,

ME= Marketing efficiency

FP= Price received by farmer

MC= Marketing cost

MM= Marketing margin

3.4.6 GARRETT'S RANKING TECHNIQUE

Garrett's ranking technique was employed to prioritize or rank the problems posed by the farmers in production and marketing of *Rabi jowar*.

Garratt's Formulae for converting rank into per cent is given by:

$$\text{Per cent position} = 100 * (R_{ij} - 0.5) / N_j$$

Where,

R_{ij} = Rank given for i^{th} factor (constraint) by j^{th} individual,

N_j = Number of factor (constraints) ranked by j^{th} individual.

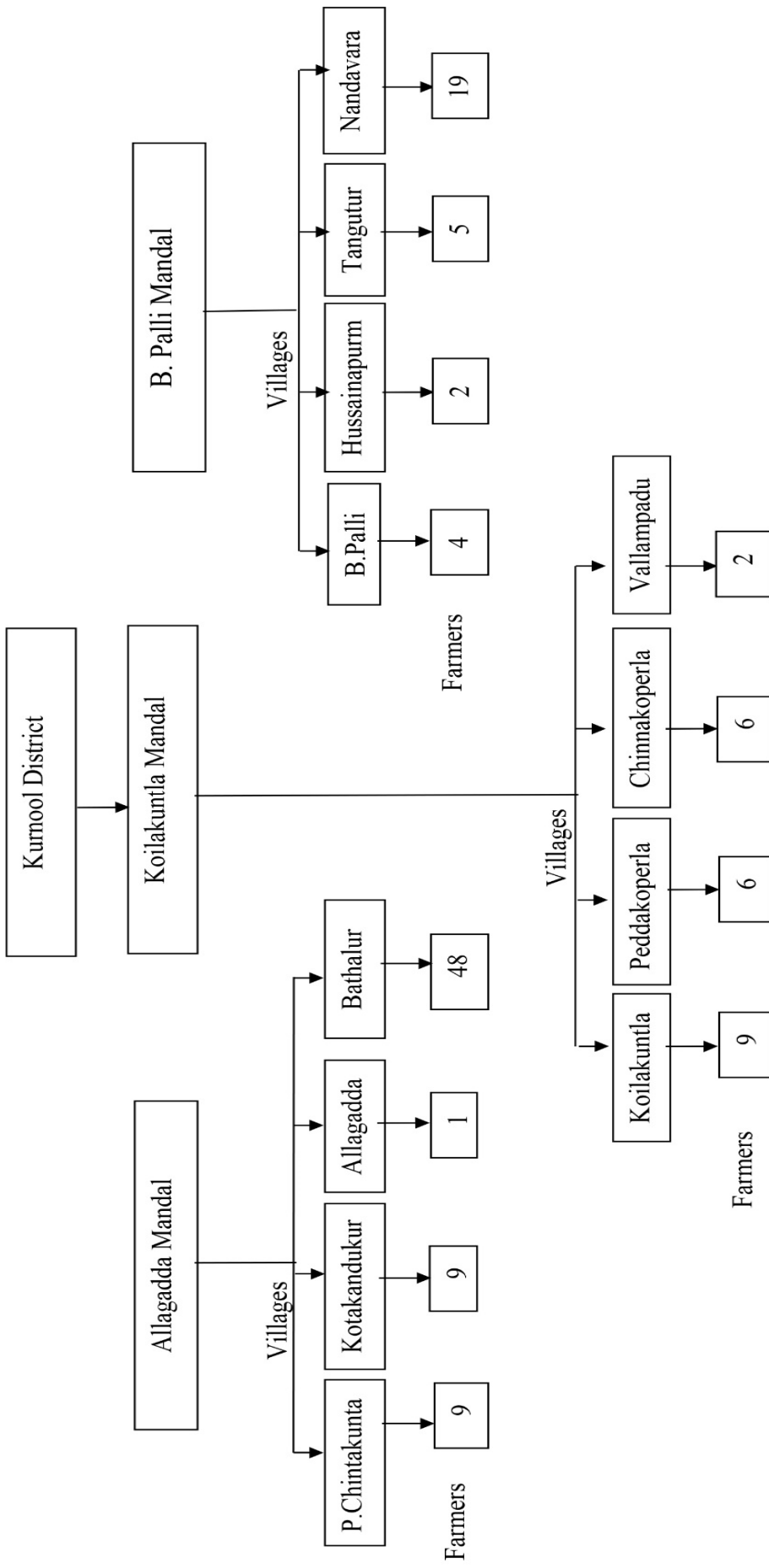


Figure 3.2 Chart showing the sampling design

Chapter – IV

Results & Discussion

Chapter-IV

RESULTS AND DISCUSSIONS

In agreement with the preset objectives of the study, collection of data and analysis has been completed using proper techniques. This chapter includes the presentation of results emerged from the research work. For convenience and easy understanding, this chapter has been presented under the following sub-headings.

- 4.1 Compound growth rates of area, production and productivity of jowar
- 4.2 Socio-economic profiles of selected farmers in Kurnool district of Andhra Pradesh
- 4.3 The costs and returns of *Rabi* jowar
- 4.4 Resource productivity and allocative efficiency of *Rabi* jowar in the study area
- 4.5 Marketing aspects of *Rabi* jowar
- 4.6 Constraints faced by the farmers in production and marketing of *Rabi* jowar

4.1 COMPOUND GROWTH RATES OF AREA, PRODUCTION AND PRODUCTIVITY OF JOWAR

To study the growth performance of jowar over a period of 18 years i.e. from 2000-01 to 2017-18 compound growth rate method was used and the data regarding area, production and productivity has been collected from Ministry of Agriculture & Farmer's Welfare, www.Indiastat.com and Directorate of Economics and Statistics. The compound growth rates of area, production and productivity of jowar were represented in Tables 4.1, 4.2 and 4.3.

4.1.1 Growth rates of area, production and productivity of *Kharif* jowar in India

The area and production of *kharif* jowar was reduced over a period of 18 years i.e. from 2000-01 to 2017-18. Negative and significant growth rates were observed in case of area and production, they were 11.9 and 11.5. On the contrary, productivity was increased over a period of 18 years. Hence, there was a positive growth rate of 0.4 which was non-significant. Even if there was decrease in area and production there was a slight increase in productivity. But, the increase was not

significant. There was reduction in area of jowar in *Kharif* season due to the reason that many of the farmers were shifting to other remunerative crops. The reason was the poor quality of grains in *Kharif* season due to occurrence of rains at the time of harvesting and due to this reason they were fetching lower market price. Change in consumer preferences for rice and wheat than coarse cereals resulted in the reduction of demand for *Kharif* jowar. *Kharif* production has declined, even though crop improvement efforts by the breeders were successful. (Charulya *et al.* 2011).

4.1.2 Growth rates of area, production and productivity of *Rabi* jowar in India

In *Rabi* season the area and production of jowar was reduced from 2000-01 to 2017-18. Therefore, negative growth rates were observed in case of area and production, they are 6.3 and 1.6. Growth rate of area was significant and production was non-significant. On the contrary, productivity was increased over a period of 18 years. Hence, there was a positive growth rate of 4.9 which was significant. Although there was decrease in area and production there was a slight increase in productivity. The negative growth rate observed in case of production was not significant. There was reduction in area which has been diverted to other commercial crops like sunflower, groundnut, soybean, maize, cotton, castor, chickpea and sugarcane in various states. Main reasons for diversion were improved cultivars and attractive market prices of other crops when compared to jowar and availability of irrigation facilities. Despite of adopting improved varieties due to constant fall in acreage, negative growth trend was observed in production of *Rabi* jowar. (Charulya *et al.* 2011).

4.1.3 Growth rates of area, production and productivity of *Kharif* and *Rabi* jowar in India

The area and production of jowar was reduced from 2000-01 to 2017-18. Therefore, negative growth rates were observed in case of area and production, they are 8.6 and 6.9 and they were significant. On the contrary, productivity was increased over a period of 18 years. Hence, there was a positive growth rate of 1.8 which was non-significant. Despite of decrease in area and production there is significant increase in yield of jowar. Reduction in area is due to shifting of farmers to other remunerative crops. Though, there was reduction in area, productivity has been increasing, but it was not significant. Employment of new technology and use

of high yielding varieties does not contribute much in increasing the yield. (Malathi *et al.* 2016). Area, production and productivity of jowar in India were depicted in the form of graphs and shown in fig: 4.1, fig: 4.2 and fig: 4.3.

Table 4.1: Compound growth rates of area, production and productivity of jowar in India

(In percentage)

Season	Area	Production	Productivity
<i>Kharif</i>	-11.9**	-11.5**	0.4 ^{NS}
<i>Rabi</i>	-6.3**	-1.6 ^{NS}	4.9*
Total	-8.6**	-6.9**	1.8 ^{NS}

Note: ** denotes Significant at 1 per cent level,

* denotes Significant at 5 per cent level,

NS denotes Non- Significant

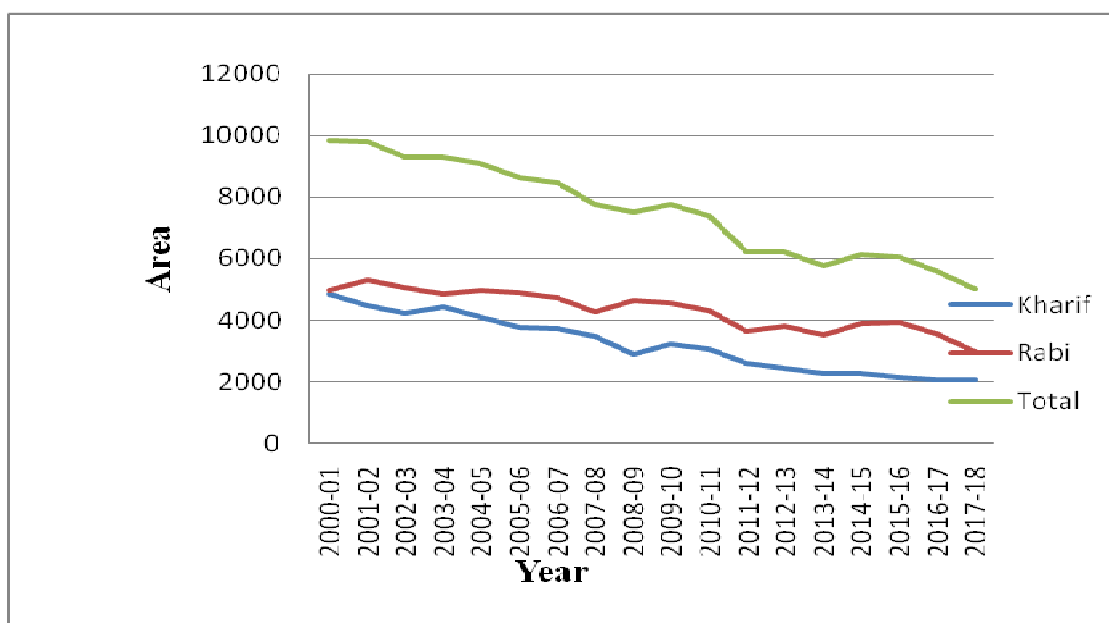


Figure 4.1: Area ('000 hectares) of jowar in India

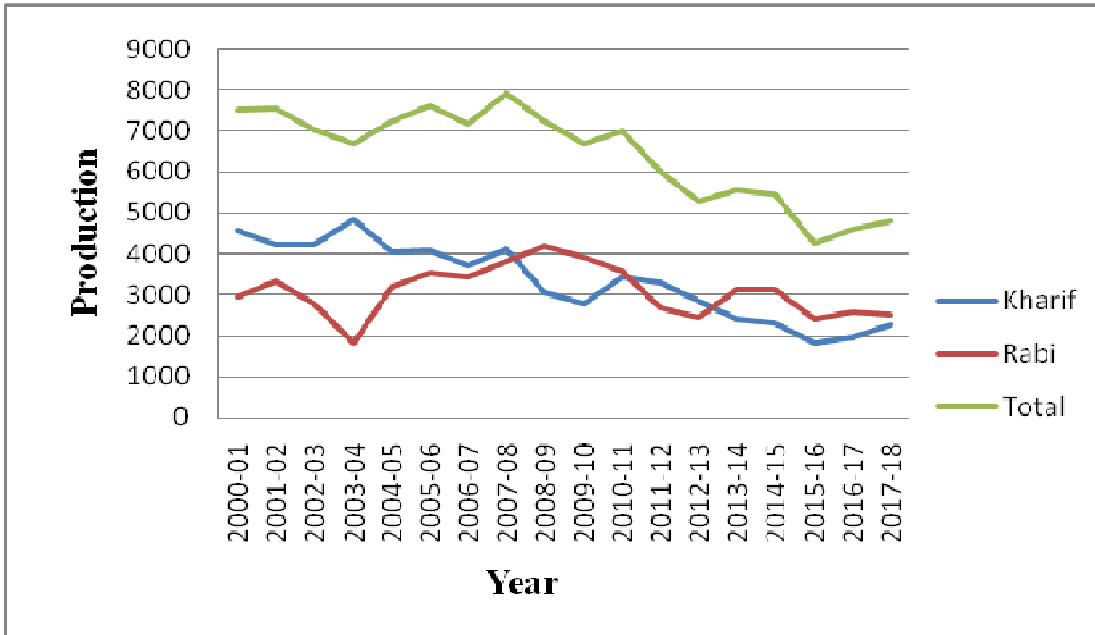


Figure 4.2: Production ('000 tonnes) of jowar in India

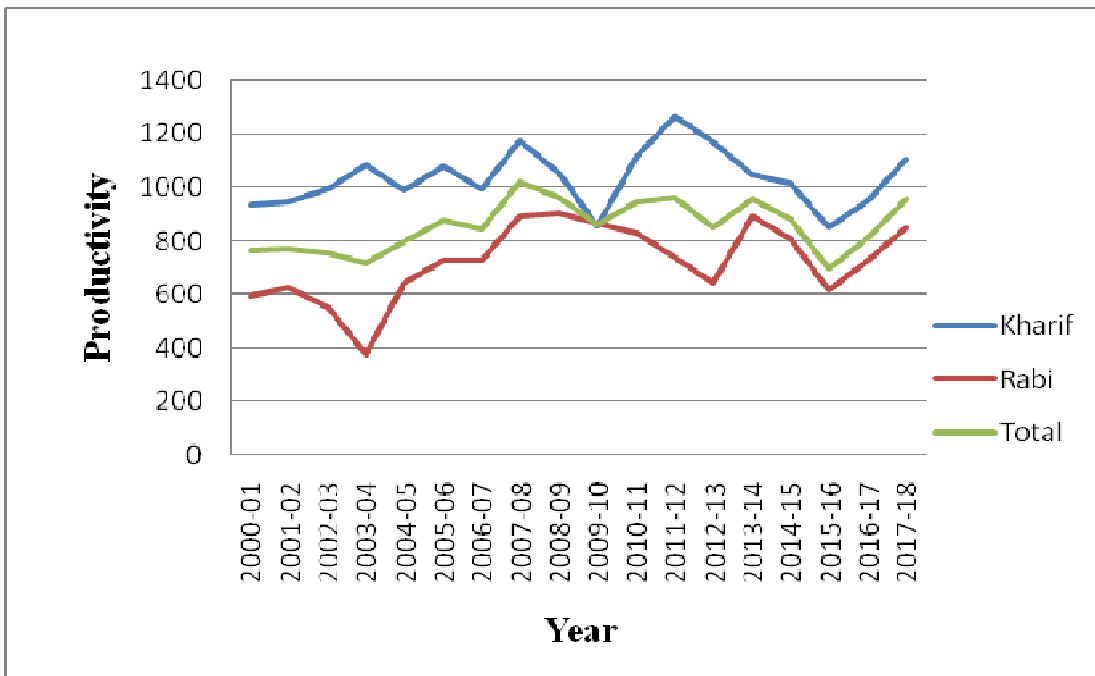


Figure 4.3: Productivity (Kg/ha) of jowar in India

4.1.4 Growth rates of area, production and productivity of *Kharif* jowar in Andhra Pradesh

The area and production of jowar was reduced from 2000-01 to 2017-18. Therefore, negative growth rates were observed in case of area and production, they are 5.0 and 1.3 and were non-significant. On the contrary, productivity has increased over a period of 18 years. Hence, there was a positive growth rate of 6.4 which was significant. Even if there was decrease in area and production there was a slight increase in productivity. The negative growth rates of area and production were not significant. Area under *Kharif* jowar has shown a sharp decline even though there has been a major breakthrough in case of improved varieties. The decrease in production was mainly due to decrease in area even though productivity contributed positively to the production. This positive contribution of yield was not sufficient to stabilize the production of *Kharif* jowar. (Rao and Parwez 2003).

4.1.5 Growth rates of area, production and productivity of *Rabi* jowar in Andhra Pradesh

The area and production of jowar has increased from 2000-01 to 2017-18. Productivity also increased over a period of 18 years. Therefore, positive growth rates were observed in case of area, production and productivity they are 10.4, 29.7 and 17.4 respectively. Growth rate of area was non-significant and significant in case of production and productivity respectively. There was a gradual increase in area, production and productivity. The positive change in production was mainly due to positive contribution of productivity towards production of *Rabi* jowar. (Rao and Parwez 2003).

4.1.6 Growth rates of area, production and productivity of *Kharif* and *Rabi* jowar in Andhra Pradesh

The area and production of jowar has increased from 2000-01 to 2017-18. Productivity also increased over a period of 18 years. Therefore, positive growth rates were observed in case of area and production and productivity they are 5.1, 20.5 and 15.3. Growth rate of area was non-significant and significant in case of production and productivity. There was a gradual increase in area, production and productivity, which is due to increase in importance of millets and increase in consumption of jowar. Area, production and productivity of jowar in Andhra

Pradesh were depicted in the form of graphs and shown in fig: 4.4, fig: 4.5 and fig: 4.6.

Table 4.2: Compound growth rates of area, production and productivity of jowar in Andhra Pradesh

(In percentage)

Season	Area	Production	Productivity
<i>Kharif</i>	-5.0 ^{NS}	-1.3 ^{NS}	6.4 ^{**}
<i>Rabi</i>	10.4 ^{NS}	29.7 ^{**}	17.4 ^{**}
Total	5.1 ^{NS}	20.5 [*]	15.3 ^{**}

Note: ** Significant at 1 per cent level,

* Significant at 5 per cent level,

NS Non- Significant

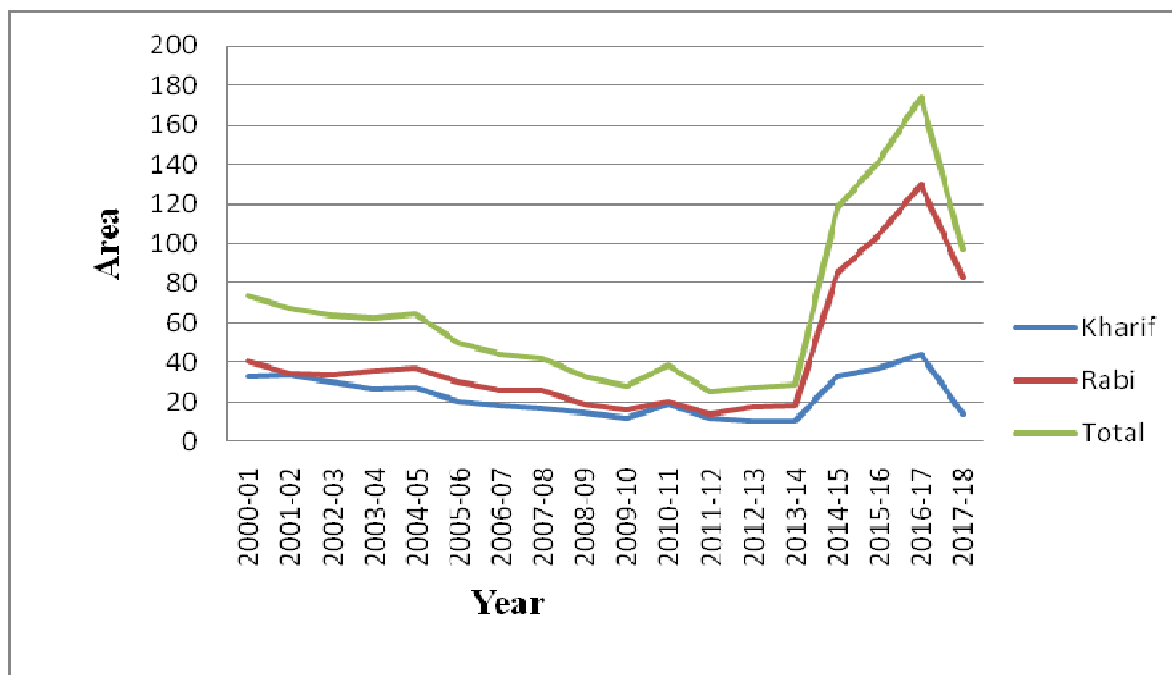


Figure 4.4: Area (hectares) of jowar in Andhra Pradesh

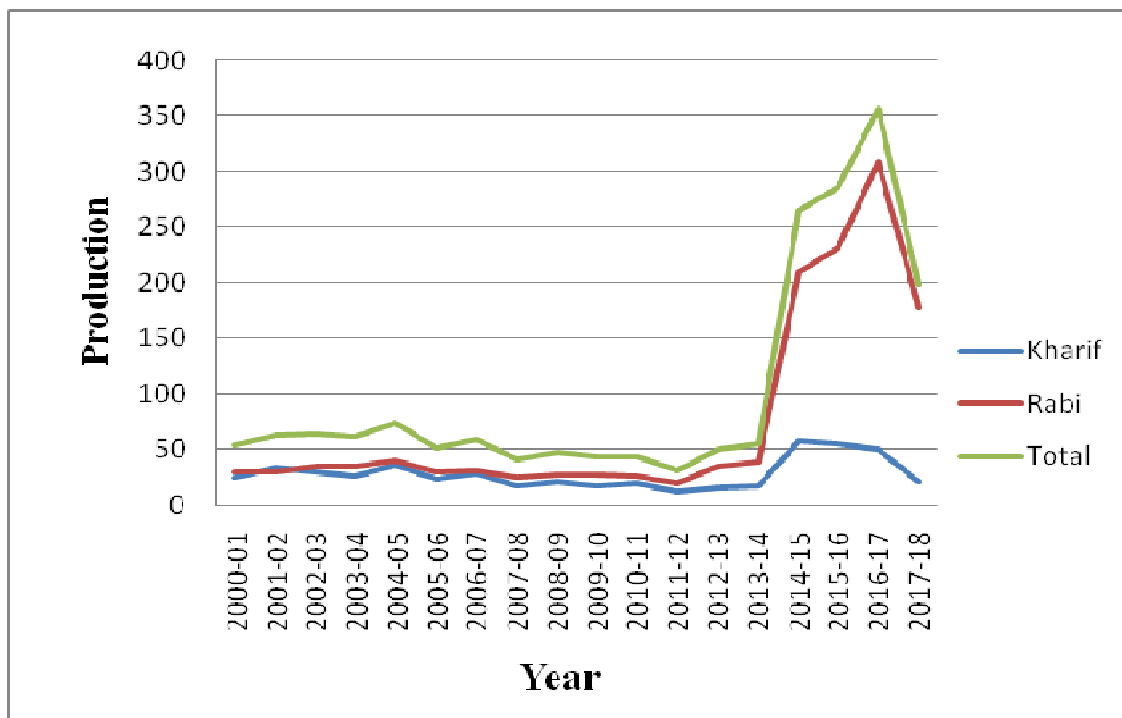


Figure 4.5: Production (tonnes) of jowar in Andhra Pradesh

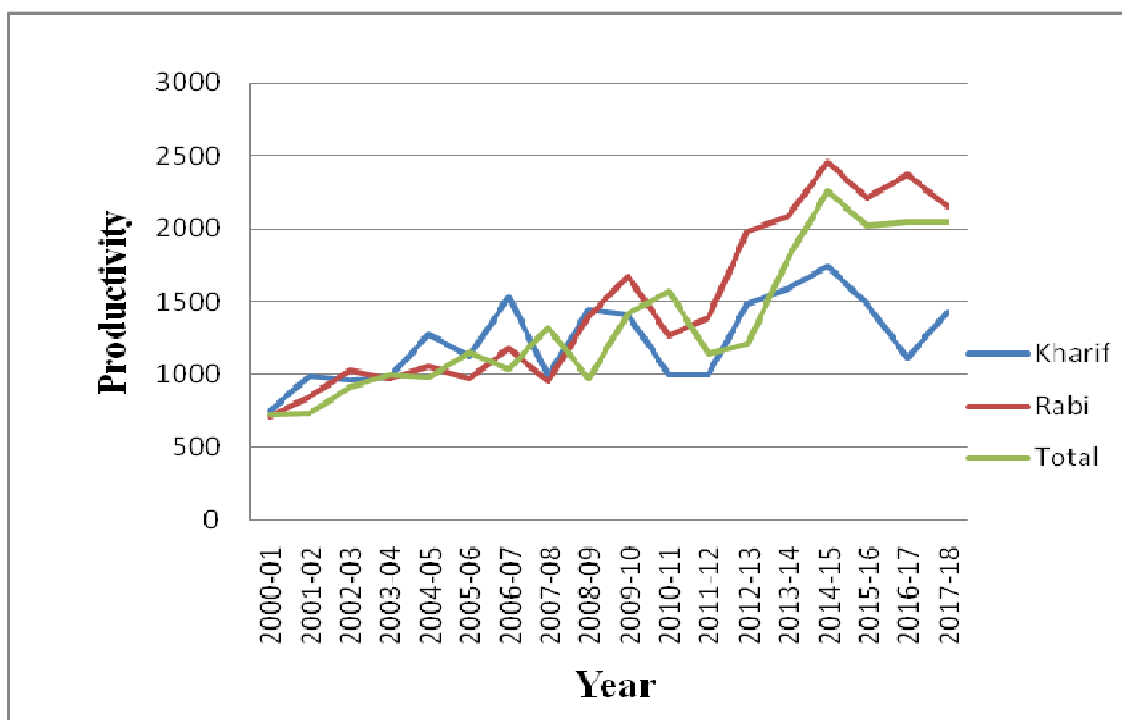


Figure 4.6: Productivity (Kg/ha) of jowar in Andhra Pradesh

4.1.7 Growth rates of area, production and productivity of *Kharif* jowar in Kurnool district

The area of jowar decreased from 2000-01 to 2017-18. On the contrary, production and productivity of jowar were increased over a period of 18 years. Therefore, positive growth rates were observed in case of area, production and productivity they are 4.4, 9.6 and 4.9 which were non-significant. Even though positive growth rates were observed in area, production and productivity they were not significant. Positive growth rate was observed in case of area because of suitability of black cotton soils in the study area for cultivation of jowar. Also, the increased demand in the market for jowar contributed to the positive growth rates of area and production.

4.1.8 Growth rates of area, production and productivity of *Rabi* jowar in Kurnool district

The area and production of jowar were reduced over a period of 18 years. Therefore, negative growth rates were observed in case of area and production, they are 8.6 and 5 and they were significant. On the contrary, productivity was increased over a period of 18 years. Hence, there was a positive growth rate of 3.7 which was significant. Even though there was decline in area and production, increase in yield was observed which might be because of application of fertilizers, irrigation and use of high yielding varieties. (Saraswati *et al.* 2012).

4.1.9 Growth rates of area, production and productivity of *Kharif* and *Rabi* jowar in Kurnool district

The area and production of jowar has reduced from 2000-01 to 2017-18. Therefore, negative growth rates were observed in case of area and production, they are 7.4 and 4.1 and they were non-significant. On the contrary, productivity was increased over a period of 18 years. Hence, there was a positive growth rate of 3.5 which was non-significant. Even though negative growth rates were observed in area and production there was a positive growth in productivity. Even though there was positive growth in yield it was not significant because, the use of high yielding varieties, fertilizers and irrigation were unable to overcome the negative impact of area and production. Area, production and productivity of jowar in Kurnool were depicted in the form of graphs and shown in fig: 4.7, fig: 4.8 and fig: 4.9.

Table 4.3: Compound growth rates of area, production and productivity of jowar in Kurnool

(In percentage)

Season	Area	Production	Productivity
<i>Kharif</i>	4.4 ^{NS}	9.6 ^{NS}	4.9 ^{NS}
<i>Rabi</i>	-8.6 ^{**}	-5.0 [*]	3.7 [*]
Total	-7.4 ^{NS}	-4.1 ^{NS}	3.5 ^{NS}

Note: ** Significant at 1 per cent level,

* Significant at 5 per cent level,

NS Non- Significant

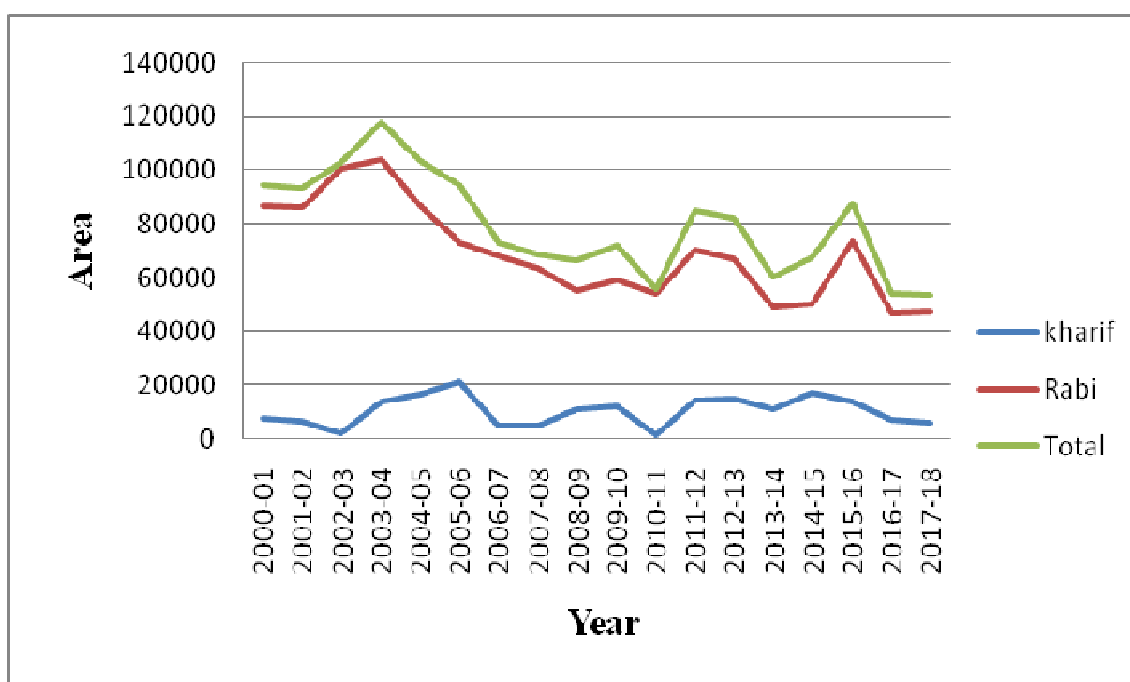


Figure 4.7: Area ('000 hectares) of jowar in Kurnool

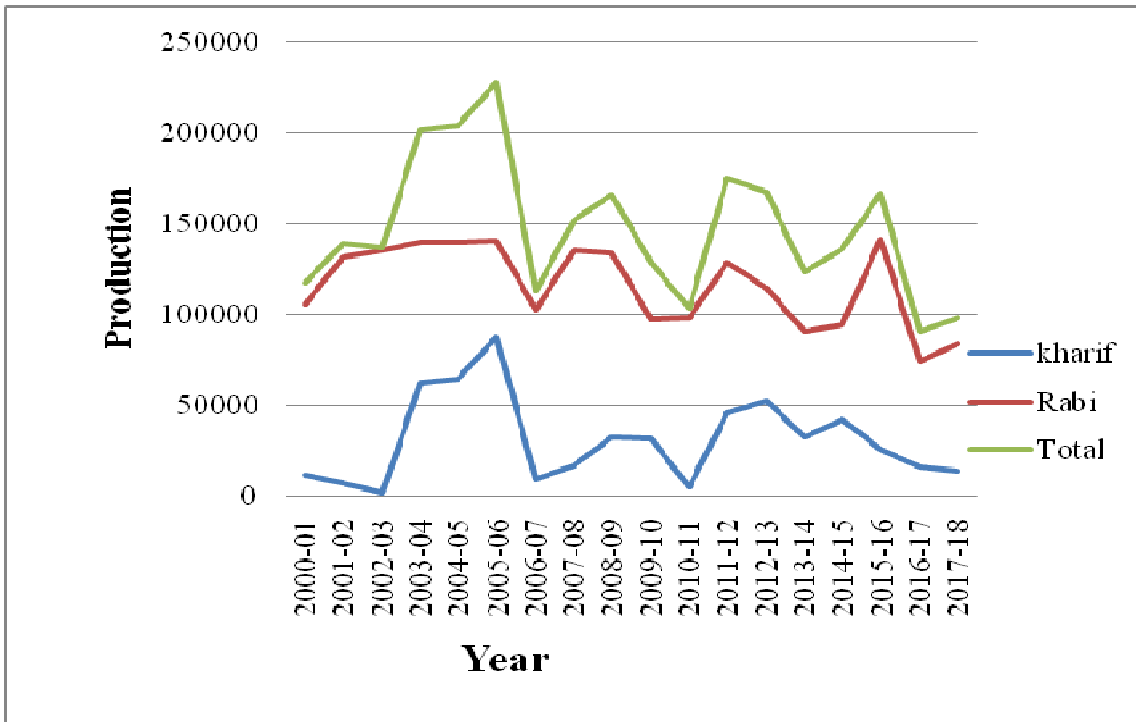


Figure 4.8: Production ('000 tonnes) of jowar in Kurnool

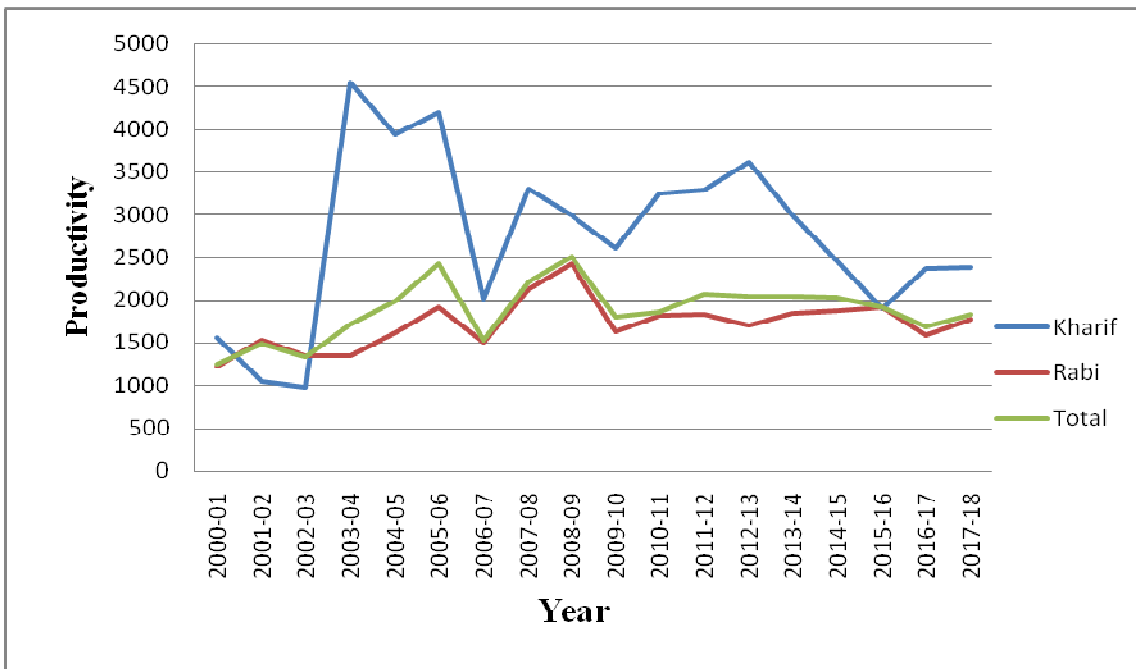


Figure 4.9: Productivity (Kg/ha) of jowar in Kurnool

4.2 SOCIO-ECONOMIC PROFILE OF SELECTED FARMERS IN KURNOOL DISTRICT

The details of family size, educational status, availability of family labour, details of land holding, economic status of farmers towards farm inventory and cropping pattern are included in the socio-economic profile.

4.2.1 Composition of family respondents

Composition of family members regarding female, male, children and farm workers in the family were represented in Table 4.4

From the table 4.4 it was clear that the average size of family was 3.87 members. Out of the total family member's male, female and children were 1.24, 1.13 and 1.50. The participation of total family members in farm works was 2.1 man days. Out of the total man days 53.33 per cent of share was taken by men and the remaining 46.66 was occupied by female members. There was no participation of children in any agricultural operations.

Table 4.4 Family composition and family labour contribution on selected farms

(In number)

S. No.	Particulars	Farms family	Percentage
1. Family composition			
a.	Male	1.24	32.04
b.	Female	1.13	29.19
c.	Children	1.50	38.75
	Total	3.87	100
2. Farm family workers			
a.	Male	1.12	53.33
b.	Female	0.98	46.66
c.	Children	--	--
	Total	2.1	100

4.2.2 Education level of respondents

Education level of farmers is very important as it helps farmer to identify new technologies and modern production methods and also it helps to increase the efficiency in organization of farms which results in maximum returns.

From the Table 4.5 it was clear that 33.33 per cent of members from the selected farms were illiterates. Out of the total population 12.50 per cent were studying in primary school, 25.00 per cent were studying in secondary school and 29.16 per cent were from college. Majority of the members are illiterates in the farms selected.

Table 4.5 Education level of the respondents

(In number)

S. No.	Category of education level	Farms	Percentage
1.	Illiterate	40	33.33
2.	Primary school	15	12.50
3.	Secondary school	30	25.00
4.	College	35	29.16
	Total	120	100

4.2.3 Average size of land holding of selected farms

The main important factor that influences production level and farmers income is farm size. Farm size is uttered in terms of hectares.

The average size of land holding of farmer was 2.64 hectares. The shares of dry and irrigated lands were 23.86 per cent and 76.13 per cent respectively. The main sources of irrigation in the study area were Kurnool Cudapah canal and bore wells. The average size of land holdings of selected farmers were presented in Table 4.6.

Table 4.6 Average size of land holding of sample farms

(In hectares)

S. No.	Particulars	Farms	
		Area	Percentage
1	Dry land	0.63	23.86
2	Irrigated land	2.01	76.13
	Total	2.64	100

4.2.4 Cropping pattern on selected farms in Kurnool district

In Kurnool district crops were grown mainly in two seasons they were *Kharif* and *Rabi*. Crops mainly grown in the selected area were paddy, black gram, cotton, chickpea and jowar. Jowar was grown in 0.35 hectares during *Kharif* and in 0.98 hectares during *Rabi* in dry land. Jowar can be grown on black soils even with less amount of water. So, the decrease in availability of water during *Rabi* season has increased the area under jowar. Chickpea was grown in 0.54 hectares in dry land during *Rabi*. Black gram was cultivated in both dry and irrigated lands during *Kharif* season. Out of the total cultivated land under irrigation during *Kharif* 46.27 per cent was occupied by paddy and 29.78 per cent was occupied by blackgram and the remaining 23.93 per cent was occupied by cotton. Similarly, out of total irrigated land under cultivation during *Rabi* 18.24 per cent was occupied by rice and remaining 81.75 per cent was taken by jowar. The cropping intensity on selected farms was 210 per cent. Cropping pattern on selected farms was represented in Table 4.7.

Table 4.7 Cropping pattern on selected farms

(In hectares)

S. No.	Particulars	Farms	
		Area	Percentage
1	<i>Kharif</i> dry land		
	Black gram	0.43	55.12
	Jowar	0.35	44.87
	Total	0.78	100
2	<i>Kharif</i> irrigated land		
	Black gram	0.56	29.78
	Paddy	0.87	46.27
	Cotton	0.45	23.93
	Total	1.88	100
3	<i>Rabi</i> dry land		
	Chickpea	0.54	35.52
	Jowar	0.98	64.47
	Total	1.52	100
4	<i>Rabi</i> irrigated land		
	Rice	0.25	18.24
	Jowar	1.12	81.75
	Total	1.37	100
	Gross cropped area	5.55	
	Cropping intensity (%)	210	

4.2.5 Asset structure of selected farms

The economic position of farmers can be known by asserting the composition of their farm assets. Hence, the value of per hectare farm assets were estimated and presented in Table 4.8. The value of land and farm buildings were ₹15,22,627.35 and ₹9189.63 respectively. Among the total assets a major share of 90.37 was occupied by land itself. The value of implements and machinery was ₹95,450.94 and the value of livestock was ₹ 57,468.91. The value of total assets including the land value was ₹16,84,736.83 and by excluding the land value was ₹1,62,109.48.

Table 4.8. Asset structure of selected farms

S. No.	Particulars	Farms	Percentage
1.	Value of land	1522627.35	90.37
2.	Value of farm buildings	9189.63	0.54
3.	Value of implements and machinery	95450.94	5.66
4.	Value of livestock	57468.91	3.41
5.	Value of total assets		
a.	Without land value	162109.48	9.62
b.	With land value	1684736.83	100

4.3 COSTS AND RETURNS OF *RABI* JOWAR

Any enterprise to gain profitability depends on its cost structure, output and price received by entrepreneur. Cost structure depends on expenditure made on inputs and services utilized in the process of production.

4.3.1 Human labour utilization on sample farms

Human labour is the most influencing component among various factors involved in the production process. The reason behind this is that successful completion of operations in the farm heavily depends on the human resources involved. So, an effort had been made to analyze the labour utilization pattern in the sample of jowar farms considered. The result is presented in Table 4.9.

A keen observation of Table 4.9 revealed that the total man days employed in the production of per hectare *Rabi* jowar was 38.78. Cultural operations performed in *Rabi* jowar are land preparation, sowing, spraying of fertilizers and plant protection chemicals, irrigation, weeding, inter cultivation, harvesting and threshing. Among the total man days 12.97 and 25.81 are owned and hired man days respectively. Highest numbers of man days are observed in harvesting, they are 13.76(35.48). Least number of man days are seen in inter cultivation and they are 0.68(1.75). Land preparation is the first and foremost cultural operation in cultivation of jowar and the total number of man days required for land preparation are 5.02(12.94). Next important operation is sowing and totally 3.04(7.84) man days

are required. The man days required for spraying of fertilizers and plant protection chemicals are 3.24(8.35) and 2.79(7.19) respectively. Weeding is the further most important operation which requires 3.50(9.02) man days. Threshing is the last operation done by farmer on the threshing floor with 5.66(14.59) man days.

Table 4.9: Human labour utilisation – operation wise in *rabi* jowar cultivation

(In man days per hectare)

S.No.	Particulars	Owned	Hired	Total
1	Land preparation	2.10 (16.19)	2.92 (11.31)	5.02 (12.94)
2	Sowing	1.26 (9.71)	1.78 (6.89)	3.04 (7.84)
3	Fertilizers	1.18 (9.09)	2.06 (7.98)	3.24 (8.35)
4	Plant protection	1.24 (9.56)	1.55 (6.00)	2.79 (7.19)
5	Irrigation	0.45 (3.47)	0.65 (2.52)	1.00 (2.58)
6	Weeding	1.98 (15.27)	1.52 (5.89)	3.50 (9.02)
7	Intercultivation	-	0.68 (2.63)	0.68 (1.75)
8	Harvesting	2.5 (19.27)	11.25 (43.58)	13.76 (35.48)
9	Threshing	2.26 (17.42)	3.40 (13.17)	5.66 (14.59)
10	Total	12.97 (100)	25.81 (100)	38.78 (100)

Note: Figures in parenthesis indicate percentages

4.3.2 Cattle and machine labour utilization in sample farms

Cattle labour is only used in inter cultivation in *Rabi* jowar. Generally, cattle labour is calculated as cattle pair days. *Rabi* jowar inter cultivation was done only once. The total cattle pair days per hectare were 1.0. Out of the total cattle pair days 0.16 was done with owned cattle and remaining 0.84 was done with hired cattle.

In *Rabi* jowar machinery was used in two operations called land preparation and sowing. The total number of working hours of machinery per hectare was calculated as 7.72(100). Total working hours for land preparation are 3.75(48.57), out of this 1.75 and 2.00 hours of work is done with owned and hired machinery respectively. The working hours for sowing are 3.97(51.42) and out of the total working hours of sowing 1.50 and 2.47 hours of work is done with owned and hired machinery respectively. The results of cattle and machinery use were presented in Table 4.10.

Table: 4.10: Cattle and machine labour utilization in *Rabi* jowar cultivation

S. No.	Particulars	Owned	Hired	Total
Cattle labour (In cattle pair days per hectare)				
1	Inter cultivation	0.16 (16.00)	0.84 (84.00)	1.00 (100)
Machine labour (Hours per hectare)				
1	Land preparation	1.75 (53.84)	2.00 (44.74)	3.75 (48.57)
2	Sowing	1.50 (46.15)	2.47 (55.25)	3.97 (51.42)
3	Total	3.25 (100)	4.47 (100)	7.72 (100)

Note: Figures in parenthesis indicate percentages

4.3.3 Material inputs utilized in cultivation of *Rabi* jowar in sample farms

In cultivation of *Rabi* jowar material inputs used were seeds, fertilizers and plant protection chemicals. All these material inputs were calculated for one hectare of land. On an average seed used to sow in one hectare was 14.5 kgs. The seed rate of *Rabi* jowar was observed to be excessive than recommended in the study area. The fertilizers mainly used are urea and DAP. The quantities of fertilizers applied to the crop were 150 and 125 kgs of urea and DAP respectively. The plant protection chemicals used were corogen and dimethoate at the rate 1.5 and 1 liters respectively. The quantities of inputs used were presented in Table: 4.11.

Table: 4.11: Material inputs used in cultivation of *Rabi* jowar

(Per hectare)

S. No.	Particulars	Units	Farms
1.	Seeds	Kilograms	14.5
2.	Fertilizers		
a.	Urea	Kilograms	150
b.	DAP	Kilograms	125
3.	Plant protection chemicals		
a.	Corogen	Liters	1.5
b.	Dimethoate	Liters	1.0

4.3.4 Cost structure of *Rabi* jowar

Economic costs include both explicit and implicit costs. To arrive at the profitability of any project these costs should be covered by gross income. Usually farmers feel satisfied only when gross income exceeds explicit costs. More specifically, the total costs were divided in to operational and fixed costs. Hence the above costs were worked out for per hectare of *Rabi* jowar crop and mentioned in Table 4.12.

Total cost of cultivation of *Rabi* jowar per hectare was calculated as ₹ 53,657.14. Out of this ₹ 40,472.94 and ₹ 13,184.20 are operational costs and fixed costs respectively. The operational costs include costs on human labour, bullock labour, tractor power, seeds, fertilizers, plant protection chemicals and interest on working capital. Among the operational costs the major portion was constituted by human labour which amounted to ₹ 19,342. Human labour is the major contributing factor to the total cost of cultivation accounting to 36.04 per cent of total cost in the study area. The results are inconformity with Zalkuwi *et al.* (2015). The next highest amount was spent on tractor power i.e. ₹ 11,580. The cost on fertilizers and pesticides was ₹ 3250 and ₹ 3836 respectively. The cost on bullock labour was ₹ 750. The cost on seeds was worked out as ₹ 725. Seed cost was least among the operational costs and similar results were reported by Tandel *et al.* (2018). The interest on working capital was calculated based on interest given to crop loans by commercial banks in Kurnool district which was 12 per cent and it was calculated as

₹ 989.94. The fixed costs include land revenue, depreciation on machinery and rental value of owned land. The land revenue was ₹ 100 and rental value of owned land was ₹ 11,250. Among the fixed costs rental value was observed as highest with a share of 20.97 per cent of total cost. Depreciation was calculated for machinery used by the farmer in the farm business and it was worked out as ₹ 982. Interest on fixed capital was calculated based on interest fixed by commercial banks on long term loans which was eight per cent and it was worked out as 852.2. Similar result was reported in a study by Kusuma *et al.* (2013).

Table 4.12: Cost of cultivation of *Rabi* jowar according to component wise

(In rupees per hectare)

S. No.	Particulars	Farms	Percentage
I	Operational costs		
1.	Human labour	19342.00	36.04
a.	Owned	6485.00	12.08
b.	Hired	12857.00	23.96
2.	Bullock labour	750.00	1.39
3.	Tractor use	11580.00	21.58
a.	Owned	4875.00	9.08
b.	Hired	6705.00	12.49
4.	Seed	725.00	1.35
5.	Fertilizers	3250.00	6.05
6.	Plant protection chemicals	3836.00	7.14
7.	Interest on working capital	989.94	1.84
	Total operational costs	40472.94	75.42
II	Fixed costs		
8.	Land revenue	100.00	0.18
9.	Depreciation	982.00	1.83
10.	Rental value of owned land	11250.00	20.97
11.	Interest on fixed capital	852.20	1.58
	Total fixed costs	13184.20	24.57
III	Total costs	53657.14	100

4.3.5 Cost concepts of *Rabi jowar*

The cost concepts generally employed in the farm management studies are used in the current study. Hence, Cost A₁, Cost A₂, Cost B₁, Cost B₂, Cost C₁, Cost C₂ and Cost C₃ were utilized in the present study. Cost C₂ is the ample one because it includes both fixed and variable costs and therefore provides basis to compare different types of operational holdings. Cultivation cost of *Rabi jowar* according to cost concepts were calculated and mentioned in Table 4.13.

The numbers in the Table 4.13 indicate the values of cost A₁ as ₹35066.94, cost B₁ as ₹35919.14, cost B₂ as ₹47169.14, cost C₁ as ₹42404.14, cost C₂ as ₹53654.14 and finally cost C₃ as ₹59019.55.

Table: 4.13: Costs concepts- *Rabi jowar* production

S.No.	Particulars	Farms
1.	Cost A ₁ /A ₂	35066.94
2.	Cost B ₁	35919.14
3.	Cost B ₂	47169.14
4.	Cost C ₁	42404.14
5.	Cost C ₂	53654.14
6.	Cost C ₃	59019.55

4.3.6 Output and returns per hectare of *Rabi jowar*

The material output and income from per hectare *Rabi jowar* were presented in Table 4.14.

From the close perusal of Table 4.14 the main product and by product (fodder) yields can be known as 37.5 quintals and 60 quintals respectively. The price of one quintal jowar grains was ₹2000 and the total value of 37.5 quintals was ₹75,000. The total value of by product per hectare was ₹3,000. Therefore, gross returns from per hectare of *Rabi jowar* was ₹78,000.

Gross income alone does not notify success of any farm business even though it is best measure to estimate farms production and efficiency. For this reason net income was calculated. Relation between net income and success of farm business is directly proportional. Net income per hectare *Rabi jowar* was ₹24,342.86.

Table: 4.14: Output and returns per hectare of *Rabi* jowar

S.No.	Particulars	Units	Farms
1.	Yield in physical units		
a.	Main product	qtls	37.50
b.	By product	qtls	60.00
2.	Yield in monetary terms		
a.	Main product	Rs.	75000.00
b.	By product	Rs.	3000.00
3.	Gross returns	Rs.	78000.00
4.	Cost of cultivation	Rs.	53657.14
5.	Net returns	Rs.	24342.86

4.3.7 Costs and returns per quintal of *Rabi* jowar

The costs and returns per quintal of *Rabi* jowar were presented in Table 4.15. From the close perusal of table it was clear that total cost incurred was ₹53,657.14. Among the total costs 75.42 per cent was occupied by variable costs and remaining 24.57 per cent was occupied by fixed costs. Gross returns received from the cultivation of *Rabi* jowar was ₹78,000 and the net return was ₹24,342.86. Even if the gross income received by farmer was more *i.e.* ₹78,000, net income was less than half of gross income due to increase in cost of cultivation. The raise in cost of cultivation was mainly due to high wages of labour, excessive use of seeds, over utilization of fertilizers and tractor power.

Table: 4.15: Costs and returns per quintal of *Rabi* jowar production

S. No.	Particulars	Farms	Percentage
1.	Costs		
a.	Variable costs	40472.94	75.42
b.	Fixed costs	13184.20	24.57
c.	Total costs	53657.14	100
2.	Returns		
a.	Gross returns	78000.00	
b.	Net returns	24342.86	

4.3.8 Measures of farm income

Any business enterprise has two elements and they are costs and returns. Costs indicate the worth of inputs utilized in the production process and returns indicate the value of output achieved. Success of any farm business depends on comparative magnitude of costs and returns. A vital element in farm business is the way of allocation of resources. A measuring tool is required to provide guidelines and standards for evaluating the use of resources. Therefore, to achieve this farm efficiency measures were computed Viz., farm business income, family labour income, farm investment income and net income. Returns per rupee of investment were computed in addition to farm efficiency measures and the results were presented in Table 4.16.

Farm income measures were calculated out per hectare of *Rabi* jowar. The farm business income was worked out as ₹42933.06. Family labour income and farm investment income were ₹30830.86 and ₹31082.65 respectively. When Returns per rupee of investment were worked out they stood at 0.41. Farmers were capable to get net income of 0.41 per rupee spent on *Rabi* jowar cultivation.

Table: 4.16: Measures of farm income- *Rabi* jowar production

S. No.	Particulars	Farms
1.	Gross income	78000.00
2.	Net income	24342.86
3.	Farm business income	42933.06
4.	Family labour income	30830.86
5.	Farm- investment income	31082.65
6.	Returns per rupee of investment	0.41

4.4 RESOURCE PRODUCTIVITY AND ALLOCATIVE EFFICIENCY OF *RABI* JOWAR

4.4.1 Resource productivity

Farmers must plan to maximize the returns from given limited resources. Hence, to achieve this farmer need to make some adjustments in allocation of resources. To explain input output relationships Cobb-Douglas production function

was employed. Coefficient of multiple determination, regression coefficients and standard errors were estimated and presented in Table 4.17.

Based on the results presented in the Table 4.17, adjusted coefficient of multiple determination was 0.76. This explained that independent variables included in the function expressed above 76 per cent of variation in the production of jowar output on the farms considered. The independent variables considered were human labour, tractor power, seed, fertilizers and plant protection chemicals. Among them human labour, tractor power, fertilizers and plant protection chemicals were statistically significant and their production elasticities were worked out as 0.08, -0.14, -1.46 and 1.57 respectively. By one per cent increase in plant protection chemicals the output will be increased by 1.57 per cent. One per cent increase in tractor power and fertilizers has reduced the output by 0.14 and 1.46 per cent respectively. The production elasticity of seed was 0.80 and it remained non-significant.

Assessment of production elasticities of independent variables considered in the model for *Rabi* jowar has given some interesting facts. Seed and plant protection chemicals were the only independent variables which showed comparatively higher potential on increased output.

Table: 4.17: Production elasticities of input factors in *Rabi* jowar

S. No.	Particulars	Regression coefficients
1.	No. of farmers	120
2.	Intercept	2.28
3.	Human labour in man days (X_1)	0.08* (0.096)
4.	Tractor power in hours (X_2)	-0.14** (0.061)
5.	Seed in kg (X_3)	0.80 ^{NS} (0.042)
6.	Fertilizers in kg (X_4)	-1.46** (0.434)
7.	Plant protection chemicals in lit(X_5)	1.57** (0.429)
8.	Adjusted coefficient of multiple determination \bar{R}^2	0.76

Note: Figures in parenthesis indicate standard error

** Significant at 1 per cent level

* Significant at 5 per cent level

NS Non-Significant

4.4.2 Allocative efficiency

The coefficients of independent variables estimated from the model were considered to calculate marginal value product (MVP) and marginal factor cost (MFC). Ratio of marginal value product to marginal factor cost was used to determine resource use efficiency. If the ratio is equal to one then it indicates that resource is being used efficiently. If the ratio is greater than one it indicates that the resource was being underutilized and by increasing its use will automatically increase the output. If the ratio is less than one then it indicates overutilization of resource and decreasing its quantity use will help in increasing the output. The ratios were calculated for *Rabi* jowar farms and were presented in Table 4.18.

The MVP/MFC ratio for human labour was 0.059 which indicates that it was being underutilized and it indicate that every additional rupee spent on human labour will add Rs. 0.059 to the returns of *Rabi* jowar. The ratio of tractor power was calculated as -0.008 which showed that it was over utilized and every additional rupee spent on tractor power will reduce ₹0.008 to the returns. The ratios of fertilizers and plant protection chemicals were -8.87 and 0.13 respectively. Fertilizers were over utilized and every additional rupee spent on fertilizers will reduce ₹8.87 to the returns and plant protection chemicals were underutilized and every additional rupee spent on plant protection chemicals will add ₹0.13 to the returns of *Rabi* jowar. Therefore, increased use of human labour and plant protection chemicals and decline in use of tractor power and fertilizers may lead to increase in gross returns. (Chapke *et al.* 2011).

Table: 4.18: Allocative efficiency of resources in *Rabi* jowar production

S. No.	Particulars	MVP	MFC	MVP/MFC
1.	Human labour	592.58	10000	0.059
2.	Tractor power	-13.27	1500	-0.008
3.	Seed	NS	NS	NS
4.	Fertilizers	-17748.1	2000	-8.87
5.	Plant protection chemicals	156.06	1200	0.13

Note: NS denotes Non-Significant

4.5 MARKETING ASPECTS OF *RABI* JOWAR

A well-organized marketing system guarantees the producer's a better price for their produce. The surplus gained by the producers will induce them to invest in purchase of modern inputs, so that the production and productivity may increase. Marketable surplus of producers will be sold through different ways and as a result it will reach the consumers through different channels of marketing. Farmer's income not only depends on production and productivity but also by the method of marketing their produce. Hence, to calculate the success of a farm business, one should possess the knowledge on both production and marketing aspects. Therefore, an effort was made to study marketing costs, marketing margins, price spread and marketing efficiency of *Rabi* jowar.

4.5.1 Marketing channels

The following three marketing channels were identified in marketing of *Rabi* jowar in the study area.

Channel-I

Producer-commission agent- wholesaler cum processor -consumer

Channel-II

Producer-wholesaler cum processor-consumer

Channel-III

Producer-commission agent-wholesaler cum processor-retailer-consumer

4.5.2 Costs incurred in marketing of *Rabi* jowar

Marketing costs incurred by producer and middlemen for one quintal was presented in Tables 4.19, 4.20 and 4.21 respectively.

Channel-I

In this channel after harvesting of *Rabi* jowar the producer sold his product to commission agent and by paying commission charges to the agent immediately the produce was transported by wholesaler to the godown and later processed, from there it was sold finally to the consumer. Costs incurred by producer were bag cost and hiring charges they were ₹ 25 and ₹5 respectively. Among the costs incurred by

producer maximum share was taken by bag cost *i.e.* 12.55 per cent. Cost incurred by commission agent was only communication charge and it was ₹10. The costs incurred by wholesaler cum processor were labour charge, loading and unloading charges, transportation, license fee, electricity charge, charge, storage charge, depreciation and packing charges they were ₹ 13, ₹10 ₹20, ₹12, ₹16, ₹8, ₹20, ₹60 respectively. Highest amount was spent on packing which occupied 30.14 per cent of total cost incurred by wholesaler cum processor. Total costs incurred in this channel were ₹199. Most of the farmers in the district followed this channel for marketing of *Rabi* jowar.

Channel-II

In this channel after harvesting of *Rabi* jowar the producer transported the produce to wholesaler cum processor and from there it was transported to godown and the grains were processed and packed and later it was directly sold to consumer. Costs incurred by producer were bag cost, transportation costs and hiring charges they were ₹24.50, ₹4.00 and 5.50 respectively. The costs incurred by wholesaler cum processor were labour charge, license fee, electricity charge, transportation charge, storage charge, depreciation, market fee, loading and unloading charges, packing charges and miscellaneous costs; they were ₹13, ₹15, ₹18, ₹20, ₹8, ₹25, ₹ 26, ₹10, ₹80, ₹5 respectively. The total costs incurred in this channel were ₹ 254. Out of total costs incurred maximum share was occupied by packing of produce *i.e.* 31.49 per cent. The least was taken by miscellaneous charges which was 1.96 per cent.

Channel-III

In this channel the producer sold his product to commission agent from there it was transported to wholesaler cum processor and then to retailer from where it was sold to consumer. The cost incurred by producer was only bag cost *i.e.* ₹30. Cost incurred by commission agent was communication charge and it was ₹10. The costs incurred by wholesaler cum processor were labour charge, license fee, electricity charge, transportation charge, storage charge, depreciation, market fee, loading and unloading charges, packing charges and miscellaneous costs, they were ₹ 13, ₹15 ₹18, ₹20, ₹8, ₹ 25, ₹26, ₹10, ₹80, ₹5 respectively. Finally, costs incurred by retailer were weighing charges and labour charges, they were ₹5 and ₹12

respectively. The total marketing costs incurred in this channel was ₹ 278. Out of total costs maximum share was occupied by packing charges which was 28.77 per cent.

The above results indicate that highest expenditure was made on transportation and packing charges. The cost paid on other items was rational and has not shown much control over total marketing costs in marketing of *Rabi jowar*. Similar results were obtained by (Navadkar *et al.* 2012).

Table: 4.19: Marketing costs for one quintal of *Rabi jowar* in channel-I

S. No.	Particulars	Amount in Rs.	(%)to total costs
1.	Producer		
i)	Bag cost	25.00	12.55
ii)	Hiring or crate charges	5.00	2.51
	Sub total	30.00	15.07
2.	Commission agent		
i)	Communication charge	10.00	5.02
3.	Wholesaler cum processor		
i)	Labour charge	13.00	6.53
ii)	Loading and unloading charges	10.00	5.02
iii)	Transportation charges	20.00	10.04
iv)	License fee	12.00	6.02
v)	Electricity charge	16.00	8.03
vi)	Storage charge	8.00	4.01
vii)	Depreciation	20.00	10.04
viii)	Packing charges	60.00	30.14
	Sub total	159.00	79.89
	Total costs	199.00	100

Table: 4.20: Marketing costs for one quintal of *Rabi jowar* in channel-II

S. No.	Particulars	Amount in Rs.	% Total costs
1.	Producer		
i)	Bag cost	24.50	9.64
ii)	Transportation charges	4.00	1.57
iii)	Hiring charges	5.50	2.16
	Sub total	34.00	13.38

2.	Wholesaler cum processor		
i)	Labour charge	13.00	5.11
ii)	License fee	15.00	5.90
iii)	Electricity charge	18.00	7.08
iv)	Transportation charge	20.00	7.87
v)	Storage charge	8.00	3.14
vi)	Depreciation	25.00	9.84
vii)	Market fee	26.00	10.23
viii)	Loading and unloading charges	10.00	3.93
ix)	Packing charges	80.00	31.49
x)	Miscellaneous	5.00	1.96
	Sub total	220.00	86.61
	Total costs	254.00	100

Table: 4.21: Marketing costs for one quintal of *Rabi* jowar in channel-III

S. No.	Particulars	Amount in Rs.	% Total costs
1.	Producer		
i)	Bag cost	25.00	8.99
ii)	Hiring or crate charges	5.00	1.79
	Sub total	30.00	10.79
2.	Commission agent		
i)	Communication charge	10.00	3.59
3.	Wholesaler cum processor		
i)	Labour charge	13.00	4.67
ii)	License fee	15.00	5.39
iii)	Electricity charge	18.00	6.47
iv)	Transportation charge	20.00	7.19
v)	Storage charge	8.00	2.87
vi)	Depreciation	25.00	8.99
vii)	Market fee	26.00	9.35
viii)	Loading and unloading charges	10.00	3.59
ix)	Packing charges	80.00	28.77
x)	Miscellaneous	5.00	1.79
	Sub total	220.00	79.13
4.	Retailer		
i)	Weighing	5.00	1.79
ii)	Labour charge	12.00	4.31
	Sub total	18.00	6.11
	Total costs	278.00	100

4.5.3 Marketing margins and price spread of *Rabi jowar*

To determine producer's share in consumer rupee, the finest indicator is price spread. Price spread is defined as the difference between price paid by consumer and price received by farmer per unit quantity of produce. Overall efficiency of marketing channel was eventually determined by intermediaries. Price spread of *Rabi jowar* in three different marketing channels was represented in Table 4.22.

In channel-I price received by producer per quintal was ₹2610 and the marketing cost incurred was ₹ 30. Finally, the net price received for one quintal of *Rabi jowar* was ₹2580. In case of commission agent the purchase price per quintal was ₹2610, cost was ₹10 and the margin was ₹10. Purchase price of wholesaler cum processor was ₹2630 for one quintal, costs incurred were ₹199 and the margin received by him was ₹100. The purchasing price of consumer in channel-I was ₹2929 per quintal. The net price received by farmer was ₹2580 and the price paid by consumer was ₹2929. The producer share in consumer rupee was 88.08 per cent.

In channel-II the price received for per quintal of *Rabi jowar* by producer was ₹2600 and the marketing cost incurred was ₹34. Finally, the net price received by producer was ₹2566. The purchase price of wholesaler cum processor per quintal of produce was ₹2600, marketing costs incurred were ₹220 and the margin was ₹130. The purchase price of consumer in this channel was ₹2950. The producer share in consumer rupee was 86.96 per cent.

In channel-III price received by producer per quintal was ₹2580 and the marketing cost incurred was ₹30. Finally, the net price received for one quintal of *Rabi jowar* was ₹ 2550. In case of commission agent the purchase price per quintal was ₹2580, cost was ₹10 and the margin was ₹10. Purchase price of wholesaler cum processor was ₹2630 for one quintal, costs incurred were ₹220 and the margin received by him was ₹140. The purchase price of retailer per quintal was ₹2960, marketing costs were ₹18 and the margin was ₹40. The selling price of retailer or purchasing price of consumer in channel-III was ₹3018 per quintal. The producer share in consumer rupee was 84.49 per cent.

The producers share in consumer rupee for all the three channels was 88.08 per cent, 86.96 per cent and 84.49 per cent respectively. The price received per

quintal was more in channel-I than channel-II. The producer share in consumer rupee was highest in channel-I due to the reason that, marketing costs incurred and margins received by middlemen were less when compared to remaining two channels. Similar results obtained by (Hile *et al.* 2013).

Table: 4.22: Price spread for one quintal of *Rabi jowar*

(In rupees)

S. No.	Particulars	Channel-I	Channel-II	Channel-III
1.	Price received by producer	2610.00 (89.10)	2600.00 (88.13)	2580.00 (85.48)
	Market costs	30.00 (1.02)	34.00 (1.15)	30.00 (0.99)
	Net price	2580.00 (88.08)	2566.00 (86.96)	2550.00 (84.49)
2.	Commission agent			
	Purchase price	2610.00 (89.10)	-	2580.00 (85.48)
	Market costs	10.00 (0.34)	-	10.00 (0.33)
	Margin	10.00 (0.34)	-	10.00 (0.33)
3.	Wholesaler cum processor			
	Purchase price	2630.00 (89.79)	2600.00 (88.13)	2600.00 (86.14)
	Market costs	199.00 (6.79)	220.00 (7.45)	220.00 (7.28)
	Margin	100.00 (3.41)	130 (4.40)	140.0 (4.63)
4.	Retailer			
	Purchase price	-	-	2960.00 (98.07)
	Market costs	-	-	18.00 (0.59)
	Margin	-	-	40.00 (1.32)
6.	Consumer purchasing price/ retailer selling price	2929.00 (100)	2950.00 (100)	3018.00 (100)

Note: Figure in parenthesis indicates percentages to the total

4.5.4 Marketing efficiency

This includes effectiveness of the marketing system with which marketing service is performed, the cost at which the service is performed and the effect of this marketing cost and the method of service performed. The efficiency of all the three marketing channels was mentioned in the Table 4.23.

Marketing efficiencies of channel-I, channel-II and channel-III were 7.39, 6.68 and 5.44. Efficiency of channel-I was highest among channel-II and channel-III. Marketing costs incurred in channel-I was less when compared to other two channels. Also, the producer share in consumer rupee was highest in channel-I. Reasonable and remunerative price was received by farmer in this channel without causing any loss to the consumer and also to the intermediaries. Therefore, Channel-I was most efficient for marketing *Rabi* jowar in the district. Similar results were obtained by (Navadkar *et al.* 2012).

Table: 4.23: Indices of marketing efficiency in selected marketing channels

S.No.	Particulars	Channel-I	Channel-II	Channel-III
1.	Price received by the farmer	2580.00	2566.00	2550.00
2.	marketing costs + marketing margins (MC+MM)	349.00	384.00	468.00
3.	Index of marketing efficiency	7.39	6.68	5.44

4.6 CONSTRAINTS FACED BY THE FARMERS IN PRODUCTION AND MARKETING OF RABI JOWAR

To evaluate the perception of farmers about the production and marketing of *Rabi* jowar qualitative questions were asked and the data collected was analyzed with garrett ranking method. The results obtained were presented in Table 4.24 and Table 4.25.

4.6.1 Constraints faced by the farmers in cultivation of *Rabi* jowar

The mean scores presented in the Table 4.24 clearly indicate that the major constraint faced by the farmer's during cultivation of *Rabi* jowar was inadequate

and untimely rainfall during the period of harvesting (76.33), which reduced the grain quality and was the main reason for the reduction in yield quality of *Rabi* jowar. The second constraint was high wage rate (66.32), farmer's felt that it was the main reason for increase in cultivation cost. The third constraint faced by the farmer's was high rate of fertilizers and plant protection chemicals (55.72), because many of the farmer's were unable to meet the high costs of fertilizers and pesticides. The fourth constraint faced by the farmer's was high rate of ploughing by tractor (51.75), many of the famer's were hiring the tractors for ploughing and they felt that hiring charges were too high. The fifth constraint was high prevalence of pests and diseases (39.73) like stem borer. Few farmers felt that labour shortage in farm (38.05) and non-availability of loan in time (22.63) were the constraints in cultivation of *Rabi* jowar.

Table 4.24 Farmers perception on constraints in cultivation of *Rabi* jowar (n=120)

S.No.	Particulars	Mean score	Ranking
1	High wage rate	66.32	2
2	Labour shortage	38.05	6
3	Inadequate and untimely rainfall	76.33	1
4	High rate of fertilizers & pesticides	55.72	3
5	High prevalence of pest & diseases	39.73	5
6	High rate of ploughing by tractor	51.75	4
7	Non- availability of loan in time	22.63	7

4.6.2 Constraints faced by the farmers in marketing of *Rabi* jowar

The mean scores presented in the Table 4.25 clearly indicate that the major constraint faced by the farmer's during marketing was lack of storage facilities (78.32), which resulted in distress sale. Second constraint faced by the farmer was difficulties in transportation (64.31), due to this reason farmer was forced to sell his produce in the village at low prices. Third constraint faced by the farmer was unstable prices (59.75), jowar fetches less price during post harvest period due to high arrivals of produce to market and later it increases. Few farmers felt that Lack of information on market intelligence (48.15) and high marketing costs (37.63) were the constraints faced in marketing of *Rabi* jowar.

Table 4.25 Farmers perception on constraints in marketing of *Rabi* jowar (n=120)

S.No.	Particulars	Mean score	Ranking
1	Lack of storage facilities	78.32	1
2	Lack of information on market intelligence	48.15	4
3	Difficulties in transportation	64.31	2
4	Unstable prices	59.75	3
5	High marketing costs	37.63	5

Chapter – V

Summary & Conclusions

Chapter V

SUMMARY AND CONCLUSIONS

Agriculture is the major occupation in India, nearly 70 per cent of country's population depends on agriculture either directly or indirectly for their livelihood. In the pre-Green Revolution era, that is from 1965-66, millets were grown in 36.90 million hectares. In 2016-17, the area under millets declined to 14.72 million hectares (60 per cent less area) due to change in consumption pattern, unavailability of millets, dietary habits, low yield, less demand and conversion of irrigated area from millet. Production of millets will surely help in providing nutritional values and prevents malnutrition. Millets are generally cultivated in low-fertile land, tribal and rain-fed areas. Major millets grown in India are jowar, bajra, ragi, banyard millet, proso millet, foxtail millet and kodo millet. Jowar is called as great millet due to its grain size among the millets. Jowar is the fourth most important crop cultivated in both *Kharif* and *Rabi* seasons in India.

In India, during the year 2018-19, area and production of jowar were 40.9 million hectares and 3.48 million tonnes respectively. Productivity of jowar in India was 849 kg/ha. The major jowar producing states in India are Maharashtra, Karnataka, Gujarat, Madhya Pradesh and Andhra Pradesh. Area under jowar in Andhra Pradesh was 30,000 hectares and 1,10,000 hectares in *kharif* and *Rabi* respectively contributing to the total production of 300.4('000 tonnes) in the year 2018-19. Area of jowar in Kurnool district was about 742 and 63673 hectares in *kharif* and *Rabi* respectively and with total production of 60252 tonnes and the productivity was 935 kg per hectare in the year 2018-19.

There is reduction in annual rainfall year by year in Kurnool district. jowar requires lesser amount of water than other crops like rice and chickpea. So, many of the farmers are shifting their cultivation to jowar. The quantity of jowar is also increasing gradually in the local markets and the value added products are becoming popular recently because of their benefits to health.

The present study entitled "Study on production and marketing of *Rabi* jowar in Kurnool district of Andhra Pradesh", was under taken to examine cropping pattern, input use, costs, resource productivity and allocative efficiency and

marketing aspects on selected farms of *Rabi* jowar were carried out with the following objectives

5.1 OBJECTIVES OF INVESTIGATION:

1. to analyse the trends in area, production and productivity of *Rabi* jowar in Kurnool district of Andhra Pradesh
2. to estimate the costs and returns of *Rabi* jowar cultivation.
3. to assess the resource use efficiency of *Rabi* jowar production; and
4. to identify marketing channels and to estimate marketing costs and margins.

The study was conducted in Kurnool district of Andhra Pradesh. In Andhra Pradesh, Kurnool district ranks 1st in both area and production of jowar. So, the district is purposively selected for the research study. The list of all 54 mandals of Kurnool district was prepared and three mandals *viz.*, Banaganapalli, Koilakuntla and Allagadda were purposively selected for the present study based on the maximum area under jowar. All the villages in selected mandals were listed out and four villages from each selected mandals were purposively selected based on the criterion of maximum area under jowar thus making the total sample villages to twelve. The selected villages were Banganapalli, Hussainapuram, Tangutur and Nandavaram in Banaganapalli, Koilakuntla, Peddakoperla, chinnakoperla and vallampadu in Koilakuntla, P. Chintakunta, Kotakandukur, Allagadda and Bathaluru in Allagadda. All the farmers in selected villages were listed out and probability proportionate sampling was employed to get the sample from each village. The total sample size constitutes to 120. The data regarding marketing of *Rabi* jowar was collected from commission agents, wholesalers cum processors and retailers.

5.2 MAJOR FINDINGS FROM THE STUDY

Growth rates for area, production and productivity of jowar in India were calculated for a period of 18 years i.e. from 2000-2018. In case of *Kharif* jowar growth rates of area and production were negative and significant. On the contrary, growth rate of productivity was positive and non-significant. Growth rates of *Rabi* jowar were negative for area and production and positive in case of productivity. These growth rates were significant for area and productivity and non significant for

production. Overall growth rates of jowar in India were negative and significant in case of area and production and non-significantly positive for productivity.

Growth rates of area, production and productivity jowar in Andhra Pradesh were calculated for a period of 18 years i.e. from 2000-2018. In case of *Kharif* jowar growth rates of area and production were negative and non-significant. On the contrary, growth rate of productivity was positive and significant. Growth rates of *Rabi* jowar were positive for area, production and productivity. These growth rates were non-significant for area and significant for production and productivity. Overall growth rates of jowar in India were positive in case of area, production and productivity. Significant growth was observed for production and productivity. Whereas, non-significant growth rate was observed in case of area.

Growth rates of jowar in Kurnool were calculated for area, production and productivity for a period of 18 years i.e. from 2000-2018. In case of *Kharif* jowar growth rates of area, production and productivity were positive and non-significant. Growth rates of *Rabi* jowar were negative and significant for area and production. On the contrary, positive and significant growth was observed in case of productivity. Overall growth rates of jowar were negative and non-significant in case of area and production and positive for productivity which was not significant.

The average size of family was 3.87 members and the participation of family members in farm works was 2.1 man days. Out of the total man days 53.33 per cent of share was taken by men and the remaining 46.66 was occupied by female members. There was no participation of children in any of the agricultural operations. Nearly, 33.33 per cent of members from the selected farms were illiterates. Out of the total members 12.50 per cent were studying in primary school, 25.00 per cent were studying in secondary school and 29.16 per cent were from college. Majority of the members are illiterates in the selected farms. Crops mainly grown in the selected area were paddy, black gram, cotton, chickpea and jowar. Jowar was grown in 0.35 hectares during *Kharif* and in 0.98 hectares during *Rabi* in dry land. Jowar can be grown on black soils even with less amount of water. So, the decrease in availability of water during *Rabi* season has increased the area under jowar. Out of total irrigated land under cultivation during *Rabi* 18.24 per cent was occupied by rice and remaining 81.75 per cent was taken by jowar. Black gram was

cultivated in both dry and irrigated lands during *Kharif* season. The cropping intensity on selected farms was 210 per cent. The value of land and farm buildings were ₹15,22,627.35 and ₹9189.63 respectively. Among the total assets a major share of 90.37 was occupied by land itself. The value of implements and machinery was ₹95,450.94 and the value of livestock was ₹ 57,468.91. The value of total assets including the land value was ₹16,84,736.83 and by excluding the land value was ₹1,62,109.48. The average land holding of farmers growing *Rabi* jowar in the district was 2.64 hectares.

The total human labour used in cultivation of per hectare *Rabi* jowar in terms of man days was 38.78. Among total man days used in cultivation 12.97 and 25.81 was by owned and hired labour respectively. The proportion of hired labour was more when related to owned labour. The cattle labour utilized in terms of cattle pair days per hectare was 1.00 per hectare. Regarding the machine labour utilization, in terms of hours total hours utilized per hectare was 7.72. Machine labour utilized for land preparation and sowing was 3.75 and 3.97 hours respectively. The proportion of hired machine labour was more when compared to owned machine labour.

The amount of seed utilized per hectare was 14.5 kgs per hectare. Fertilizers used are urea and DAP, amounts to 150 and 125 kgs respectively. Nearly, 2.5 liters of plant protection chemical was used in cultivation of *Rabi* jowar per hectare.

The total operational costs incurred were ₹40,472.94 per hectare. Among operational costs highest portion was spent on human labour *i.e.* 36.04 per cent and the least portion was spent on seeds (1.35 per cent). The total fixed costs incurred were ₹13,184.20. Total cost of cultivation of *Rabi* jowar per hectare was ₹53,657.14. The values of cost A₁ as ₹35066.94, cost B₁ as ₹35919.14, cost B₂ as ₹47169.14, cost C₁ as ₹42404.14, cost C₂ as ₹53654.14 and finally cost C₃ as ₹59019.55.

The main product and by product yield was 37.5 quintals and 60 quintals respectively. The price of one quintal jowar grains was ₹2,000 and the total value of 37.5 quintals was ₹75,000. The total value of by product per hectare was ₹3,000. Therefore, gross returns from per hectare of *Rabi* jowar was ₹78,000. Net returns per hectare of *Rabi* jowar was ₹ 24,342.86.

Measures of farm income are farm business income, family labour income and farm investment income. They were worked out as ₹42933.06, ₹30830.86 and ₹31082.65 respectively. The return per rupee of investment was 0.41.

Cobb-Douglas production function was employed to estimate resource use efficiency and resource productivity of *Rabi* jowar. The adjusted coefficient of multiple determination was 0.76. This explained that independent variables included in the function expressed above 76 per cent of variation in the production of jowar output on the farms considered. The independent variables considered were human labour, tractor power, seed, fertilizers and plant protection chemicals. Among them human labour, tractor power, fertilizers and plant protection chemicals were statistically significant and their production elasticities were worked out as 0.08, -0.14, -1.46 and 1.57 respectively. By one per cent increase in plant protection chemicals the output will be increased by 1.57 per cent. One per cent increase in tractor power and fertilizers has reduced the output by 0.14 and 1.46 per cent respectively. The production elasticity of seed was 0.80 and it remained non-significant.

The MVP/MFC ratio for human labour was 0.059 which indicates that it was being underutilized and its increase in use will help in increasing the output. The ratio of tractor power was calculated as -0.008 which showed that it was over utilized and reduction in its quantity will increase output. The ratios of fertilizers and plant protection chemicals were -8.87 and 0.13 respectively. These ratios indicated that fertilizers were over utilized and plant protection chemicals were underutilized.

Three marketing channels were identified in the study area. They were channel-I (producer-commission agent- wholesaler cum processor-consumer), channel-II (producer-wholesaler cum processor-consumer), and channel-III (producer-commission agent-wholesaler cum processor-retailer-consumer). Total costs incurred in all the three marketing channels were calculated. Total marketing costs incurred in channel-I was Rs. 199, in channel-II were ₹254 and in channel-III were ₹278. Price spread was calculated for all the three channels. In channel-I net price received by producer per quintal was ₹2580 and purchasing price of consumer was ₹2929 per quintal. In channel-II the net price received by producer was ₹2566

per quintal and purchasing price of consumer was ₹2950 per quintal. In channel-III the net price received by producer was ₹2550 per quintal and purchasing price consumer was ₹3018 per quintal. The producers share in consumer rupee for all the three channels were 88.08 per cent, 86.96 per cent and 84.49 per cent respectively. Marketing efficiencies of channel-I, channel-II and channel-III were 7.39, 6.68 and 5.44. Channel-I was most efficient for marketing *Rabi* jowar in Kurnool district.

Perception of farmers about the cultivation and marketing of *Rabi* jowar was evaluated by asking qualitative questions. Mean scores were calculated for all the constraints given by the farmer's and ranking was given based on the score obtained. The major constraint faced by the farmer's during cultivation of *Rabi* jowar was inadequate and untimely rainfall during the period of harvesting (76.33), the second constraint was high wage rate (66.32), the third constraint faced by the farmer's was high rate of fertilizers and pesticides (55.72), the fourth constraint faced by the farmer's was high rate of ploughing by tractor (51.75), the fifth constraint was high prevalence of pests and diseases (39.73) like stem borer. The major constraint faced by the farmer's during marketing was lack of storage facilities (78.32), which resulted in distress sale. Second constraint faced by the farmer was difficulties in transportation (64.31), due to this reason farmer was forced to sell his produce in the village at low prices. Third constraint faced by the farmer was unstable prices (59.75), jowar fetches less price during post harvest period due to high arrivals of produce to market and later it increases. Few farmers felt that Lack of information on market intelligence (48.15) and high marketing costs (37.63) were the constraints faced in marketing of *Rabi* jowar.

5.3 CONCLUSIONS

Growth rates of *Rabi* jowar in India and Kurnool district were negative for area and production and positive in case of productivity. The growth rates of area, production and productivity were significant in Kurnool district. In Andhra Pradesh all growth rates of *Rabi* jowar were positive.

Among the operational costs the major portion was constituted by human labour and the least amount was spent on seeds. In cultivation of *Rabi* jowar for every rupee of investment there was a net return of 0.41. The production elasticity of seeds remained non-significant which is not the same in case of other independent

variables. The MVP/MFC ratios indicate that human labour and plant protection chemicals were underutilized, tractor power and fertilizers were over utilized.

Marketing costs were highest in channel-III when compared to other two channels. The price received by producer and marketing efficiency was highest in channel-I. Channel-I was most efficient for marketing *Rabi* jowar in Kurnool district. Major constraint faced by farmer's during cultivation of *Rabi* jowar was inadequate and untimely rainfall during the period of harvesting, which reduced the grain quality and was the main reason for the reduction in yield quality of *Rabi* jowar and the major constraint faced by the farmer's during marketing was lack of storage facilities, which resulted in distress sale.

5.4 POLICY IMPLICATIONS

1. Human labour and plant protection chemicals were underutilized, tractor power and fertilizers were over utilized. Hence, there is a need to develop optimum plan for efficient use of resources in *Rabi* jowar.
2. Government should construct storage structures to save the farmer from distress sale.
3. Government should procure more produce directly from the farmers. So, that the producer will gain more profit.
4. On priority basis prices of fertilizers and pesticides can be reduced and may be made available in time to every farmer.

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