Resource use efficiency of hybrid maize production in Chhindwara district of Madhya Pradesh

THESIS

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By

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CERTIFICATE - I

This is to certify that the thesis entitled ***"Resource use efficiency of hybrid maize production in Chhindwara district of Madhya Pradesh"*** *submitted in partial fulfilment of the requirement for the degree of* ***MASTER OF SCIENCE IN AGRICULTURE (Agricultural Economics and Farm Management)*** *of the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by* ***Mr. DEEPAK KORDE*** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.*

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigation has been acknowledged by him.

(Dr. N.K.Raghuwanshi)
Chairman of the Advisory Committee

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CERTIFICATE - II

This is to certify that the thesis entitled ***"Resource use efficiency of hybrid maize production in Chhindwara district of Madhya Pradesh"*** *submitted by*

Mr. Deepak Korde *to the J.N. Krishi Vishwa Vidyalaya, Jabalpur, in partial fulfilment of the requirements for the degree of* ***Master of Science in Agriculture*** *in the* ***Department of Agricultural Economics and Farm Management*** *has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination of the same.*

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V ITA

The author of this thesis Deepak Korde was born on 16 oct. 1986 at Pandhurna Block of Chhindwara District (M.P). He passed his High School (10^{th}) in year 2003 R.D.High School, Pandhurna with 50% marks. He passed his Higher Secondary in the year 2005 from Govt. Agriculture Higher Secondary School, Pandhurna, Chhindwara with 74% marks.

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* * *

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Place: Jabalpur ***(DEEPAK KORDE)***

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Chapter – I

INTRODUCTION

1.1. The Problem

Maize is considered the third most important cereal crop after rice and wheat in the world. This cereal is referred as Miracle crop and Queen of the Cereals due to its high productivity potential compared to other Graminacea family members. It is a seasonal crop, annually it can be harvested thrice i.e., in Kharif, Rabi and summer seasons. Maize usually grown as a pure crop in some instances it can be taken up as an inter crop with different crop combinations like sugar cane, cotton, vegetables, legume crops etc.

Maize, in recent past, is gaining more popularity across the globe than any other cereals crops due to its significant utility in diversified sectors in various forms like in industrial production as a major feed source for animals and for human consumption. In addition to this utility factor, low cost of cultivation, easy adaptability to various climatic conditions, increasing productivity, minor fluctuation in prices compared to other cereals and finally high potential for export demand from all over the world.

On global front, in recent past, maize gained a tremendous importance on rising demand from diversified sectors like food, feed and ethanol production. As a result since last one decade acreage under maize cultivation is continuously on increasing trend to meet the rising demand. Average under corn cultivation increased to 157.1 million hectares in 2009-10 up by 14.5% from 137.19 million hectares in the year 2006-07.

In India, maize is the third important cereal crop cultivated after rice and wheat cultivation. In the world production, India stands in fifth position interns of corn production. In India in last one decade maize production have shown a tremendous improvement from 11.50 million tonnes to present level of 19.73 million tonnes due to increased average on increasing demand form feed industry , export demand, ethanol production demand etc. From sole kharif crop this year harvested about 15.5 million tonnes and rabi crop estimating around 4.23 million tonnes. This year India’s production had broken the historical high production of 19.73 million tonnes in 2008-09.

Madhya Pradesh accounts 1.14 million tonnes in an area of 0.84 million hectares with with productivity of 1361 kg per hectare which is quite low as compared to the national average of 2414 kg per hectare. The primary reasons for such low rice productivity could be among others ignorance of farmers about latest improved technologies and their reluctance to change their traditional farming practices, since the prospect of obtaining a marginal surplus depends largely on weather conditions in the state and the fear of possible crop failure certainly discourages the farmers to accept the advanced technologies. It is widely acknowledged that the risk and uncertainties associated with farming at best, can be controlled by adoption of improved cultivation technologies or different diversified farming systems in which crop production is combined with any livestock raising such as dairy, poultry, piggery, fishery etc., to ensure balanced production system. Several of good quality hybrids are available in the market but in Madhya Pradesh maximum of the maize growers are using local varieties and performing traditional agriculture practices.

In Madhya Pradesh Chhindwara, Dhar, Jhabua, Betul, Rajgarh and Mandsaur are the major maize producing districts. Chhindwara district is the leading district in terms of both area as well as production. The total area under maize in this district is about 94.7 thousand hectares with production of 288.7 thousand tonnes in 2011-12. The climatic conditions of the district are extremely suitable for maize crop. There is a wide scope for increasing area and production in the district. In this situation it is essential to know the reasons of low adoption of improved practices. Thus, present study was canvassed to know the existing knowledge and adoption gap among the farming community of maize growers of the Chhindwara district with the following objective

1.2. Significance of the study

The study will help provide scientific information on the necessary social and psychological factors that would influence the acceptability of the new crop and any large scale irrigated maize production in the study area as well as in M.P. This would be instrumental in bridging the current social and psychological knowledge gap on irrigated maize. It will also form the basis for understanding the psychological and social factors underlying the adoption of a new crop by farmers. Psychological factors represent the uncertainties

created in the minds of adopters of this innovation, as well as the opportunity it provides to reduce uncertainty through solving the individual farmers' perceived problems. Social factors on the other hand are related to the extent to which other farmers will be dependent on the subjective evaluation of the innovation by individuals they consider to be more like themselves, thus farmers who have previously adopted the innovation.

Furthermore, it will help promote sustainable large scale irrigated Hybrid maize production in order to ensure reliable income for farmers and invariably reduce poverty levels in M.P. and India. Also, important is the fact that unearthing the potential ability of Indian farmers to sustainably produce irrigated Hybrid maize on a large scale will provide policy makers and investors the necessary information regarding the viability of such a project.

Finally, the study will be instrumental in designing appropriate educational programs to fill in the gap in farmers' knowledge as well as predispose them to having an objective perception of the crop before and during its introduction. This is paramount because irrigated maize is new and require special care that is otherwise absent in irrigated maize cultivation and as a new crop it is only proper that farmer's have adequate knowledge about it so as to ensure a sustainable cultivation.

Thus the present study sought to provides answer to the following questions.

- What is the existing level of inputs used and hybrid maize produced on sample farmers?
- What is per unit cost incurred and returns obtained from hybrid maize production?
- Did the farmers rationally allocated available funds on various resources used in hybrid maize production?
- What are the possibilities of readjustment of the resource for profit maximization?
- Various constraints hindering technological adoption and augmenting hybrid maize production on sample farm etc.

In view of above discussion it has been felt necessary to assess the costs incurred and return obtained from hybrid maize by the farmers as well efficiency of resource use and constraints in hybrid maize production so that the hidden obstacles could be focused in some definite term and some suggestible suggestions could be given. Thus, this study was taken with the following specific objectives.

1.3. Specific Objectives

1. To measures costs and returns of Hybrid maize production on sample farm
2. To estimate resource use efficiency of important inputs in Hybrid maize production.
3. To identify constraints associated with production of Hybrid maize and measures to minimize constraints.

The study could have been expanded to wider perspective to bring a number of interesting findings but the time disposal with other limitations with researcher have not permitted to do so. However, this study in itself promises a very health technical analytical exercise.

1.4. Assumption

1. The farmers have limited resources and have to operate within resource limitation.
2. It is assumed that the main objective of the farmers is to maximize profits.
3. It is also assumed that farmers are free to make any decision regarding their farming business.

1.5. Limitations

The most important limitation of this study is that it pertains to the data collected for only season (kharif) of the agricultural year 2011-12. The farmers do not keep any systematic records of their farming practices and have provided the information based on their recall memory. Thus, there is possibility of certain bias to enter in the present study.

The study includes only those factors which are under the control of the farmers and contribute significantly towards the returns and use of resources. There is no reference is made to factors like risk and uncertainty.

Lastly the study covers 60 farmers selected from five villages of Chhindwara block of Chhindwara District.

Chapter – II

REVIEW OF LITERATURE

To analyse any problem, it is necessary to understand the research work done in past related to different parameters. Their interrelationship inferences drawn and the method used to analyse their relationship etc. This chapter deals with review of research work already done related to problem of study in hand to provide support to the finding of the present study.

Anjenyula, *et al.* (1984) conducted a study to know the variations in resources use and productivity by size of farms in turmeric production in Guntar district. In this study the Cobb- Douglas function to output was used. The study concluded that for all sizes of Turmeric farms all the inputs were used in excess of the requirement. Hence, the Turmeric grower- irrespective of size group, can increase gross returns from the crop by diverting all his excess inputs to the production of other crops and other farm activities.

Singh (1988) conducted a study to find out the constraints of rabi Crop production in Parwanala watershed, situated in the Sehore and Phanda block of Sehore and Bhopal district of M.P. for the year 1984 – 85. He observed that the main reason for low productivity of major rabi crops was the higher adoption gap which reflected in higher investment gap. The major constraints for lower adoption were lack of capital, high prices of fertilizers, lack of desire high yielding seed, unavailability of fertilizers inputs, lack of irrigation facilities etc. These constraints are mainly become of financial handicap; hence the finance needs to be made available particularly in the water shed area for marginal and small farmer.

Kennedy and Nivasula (1990) examined the costs and returns, resource use efficiency and production constraints of growing the three cereal crops viz., maize, and rice in Guntur Andhar Pradesh. A total sample of 150 farmers was selected from ponnur. Gurazala and Rentachintala, Mandals; the data relates to the 1986-87 crop season. Resource productivity, returns to scale and resource use efficiency were estimated using a Cobb- Douglas production function. Carreff's ranking technique was employed to test severity

of production constraints. The calculated elasticity of land, human labour and plant protection chemicals were positive indicating increase in these variables would increase gross returns, maize and rice exhibited constant returns to scale but red gram exhibited increasing returns to scale. The constraint as of highest importance by farmer was lack of technical knowledge regarding pulses cultivation.

Bhaulero *et al*. (1992) studied input use efficiency of seeds, fertilizer, insecticides, human labour and irrigation with the help of Cobb_Douglas production function fitted to data obtained from for none vegetables, rainfed and irrigated groundnut and mixed and pure mustard. Marginal value of productivity (MVP) marginal cost (MC) ratio. The result obtained from indicated except negative values for labour for all the crops mustard and over-use or misuse of seed, fertilizer's and irrigation for some of the vegetables MVP-MC ratio, which are mostly greater than unity in vegetable and irrigated groundnut for most of the inputs, indicated their efficient use, and less inputs, indicate their efficient use, and less than unity of some of the vegetables rain-fed groundnut and pure mustard, indicated less than optimum.

Sharma *et al*. (1992) observe3d that the elasticity coefficients with respect to human labour were positive and significant in all the crops other than chilies, working capital turned out to be significant in all the crops. However, bullock labour was non significant. The marginal value productivity of working capital was higher than that of human labour in all the crops. Increasing returns to scale were observed in potato, peas, cauliflower and Brinjal, indicating that it is rational to use more of inputs in these crops to get higher returns.

Sharma and Nema (1992) reported that economic analysis of soybean production in rain fed areas of Vindhyanchal region of Madhya Pradesh. India. Indicated that the cost of cultivation was Rs.2257/ ha. and decreased with farm size. The rental value of land accounted for the highest share of total cost, followed by seed cost, hired human labour, bullock labour charges and imputed value of family labour. Average yield was 9.6q/ha, which is double the break- even yield of 4.9q/ha. Average net farm income, family labour income, farm investment income and farm business income was estimated as

Rs 722, Rs 965, Rs 1468 and Rs 1711 per ha, respectively. A return of Rs 2.35 per rupee invested was obtained.

Shukla *et al.* (1992) studied on the input use efficiency of seeds, land, human labours and irrigation in the cultivation of wheat in Chiraigaon block of Varanasi district in Uttar Pradesh. Input use efficiency was studied by estimating MVP/MC ratios. The results indicated positive bi values for both the crops. MVP/MC ratio also was found to be more than unity. Indicating their optimum use. The need is to emphasized and ensues timely and adequate supply of the above mentioned inputs with technical know how at reasonable cost, within the reach of the farmers.

Singh *et al.* (1992) found that the marginal value productivity (MVP) of human labour in the cultivation of wheat increased. They shows that there is more use of human labour on small farms resulting in comparatively less marginal returns per unit of labour use. On medium and large farmers, more use of machine labour and less use of human labour has resulted highest in period II (1986-88) on all size groups of farmers. The ratio of MVP to factor cost indicated that on small farm in period (1980-82).the highest returns per rupee invested (Rs1.68) closely followed by human labour (Rs1.64). In period II however, human labours resulted highest additional return per rupee invested on large farm (Rs4.35) where as on medium and small farms the highest returns per rupee invested were obtained from irrigation

Murariu *et al.* (1994) found that the Dry matter yields of maize silage hybrids Turda 200, Turda 215, Fundulea 270, Eva, Carla and Panonia ranged from 15.58 t/ha in Turda 200 to 18.49 t in Panonia in chernozem soilistan

Sharma *et al.* (1995) conducted a field experiment during 1985-86 and 1987-88 at New Delhi, India to compare the productivity and economics of eight intensive annual cropping system. Relay cropping of maize (*Zea mays* L.) potato (*Salanum tuberosum* L.) $_+$ wheat (*Triticum aestivum* L. emend. *Fiori L* Paol.) gave the highest productivity (16 qt. wheat equivalent/ha) gross income (Rs 41726/ha) net income (Rs 18145/ha) and labour employment (388 man days/ha). Maize potato-wheat sequential cropping. Which gave the second highest productivity (13.9 t wheat equivalent/ha) and gross income

(Rs. 34759/ha) was very poor in net return (Rs. 495/ha) Green gram (*Phaseolus radiatus* L.) maize wheat cropping system proved the second best in net income, though the first two crops contributed only 9 percent and 17 per cent of the total net income respectively compared with 74 per cent by the third crop. Pigeon pea (*Cajanus cajan* L. Mill. Sp) + green gram wheat as the third best cropping system, gave 50 per cent net income from the first two crops and the remainder from the third. Thus, pigeon pea did not prove a suitable replacement for maize

Nayak and Raj (1996) reported constraints faced by oilseed growers in Cuttack district, Orissa, India (during 1992) .Data collected from a sample of 100 farmers from 14 village in two blocks of the district indicatd that high cost of seeds, fertilizers and plant protection chemicals, ltimately irrigation, inadequate credit and subsidy, ltimately supply of inputs, and inadequate transportation and storage facilities are the major constraints faced by the oilseed growers.

Kurdikeri *et al.* (1998) conduct a field experiment in Karnataka to study the influence of seed size on field performance in maize hybrids (Zea maize L.) he is taking 5 maize cultivarsans found that the grain yield was not significantly affected by seed size (7.5-11 mm, 7.0-7.5 mm or 6.75-7.00 mm).

Kale and Sale (1999) examined resource productivities of the sugarcane crop in western Maharashtra were examined based on secondary data spread over the nine districts of the region. For the study of resource productivities a Cobb- Dougulas type production function was fitted to the input-output data. The analysis of production function in adsali, sure and ration sugarcane crops showed that the selected six variables explained 71,87 and 84 per cent variations in output in the 3 crops, respectively, during 1987-88 and 81,90 and 85 per cent variation in output during 1992-93. The resource productivity analysis of adsali indicated that area, human labour and fertilizer were influential determinants.

Soni *et al* (2000) conducted a study on the impact of improved wheat production technology. Including high yielding varieties with cultural practices in Sagar district, Madhya Pradesh, India. Demonstration field produced

significantly higher yields than the farmers practices. Farmers harvested 29.81q/ha and 14.17 q/ha, under irrigated and unirrigated conditions respectively with the traditional system of cultivation. The progressive farmers harvested 20 per cent higher yield than the traditional system. They concluded that investment in modern technologies proportionately enhanced output and net income.

Tiwari, (2001, 2002) studied constraints related to soybean production and productivity, namely short growing period available in Indian latitudes, stagnant genetic potential for yield, or availability of inputs at farm level, rain fed nature of water scarcity at critical stage of plant growth, insect-pests and disease, to quality improvements problems, poor seed longevity and mechanical damage to soybean seed, inadequate mechanization and partial adoption of technology by farmers are identified.

Gaddi *et al*. (2002) observed with the help of capital input did not exert significant influence on cotton production, while the plant nutrients (-0.2452) was excessively used in the case of sample farms also. The cobb-Douglas type of production function turned to be good fit since R^2 and F-values were significant at one per cent probability level. About 90 per cent of the variation in cotton production on the farmer's fields was explained by the variables included in the model. The production elasticity of all the inputs on all the farms were variably in lower than unity implying diminishing marginal productivity with respect to each of these inputs human labour and capital, coefficient were significant at one percent on all the farms seed coefficient exerted significant influence on cotton production on all sample farms, barring large farms were coefficient was negative (0.1042), but non significant. The geometric mean value of inputs showed that human labour and bullock worked used in higher quantity on demonstration plots, whereas use of all the inputs was more on the farmer fields.

Jat and Singhi (2003) conducted at field experiment during 1998-99 and 1999-2000 at Udaipur (Rajasthan) to assess the productivity and profitability of bread wheat (Triticum aestivum) and durum wheat (I. durum) intercrops under less one – irrigation raised bed planting compared to existing planning pattern of sole wheat on flat bed and to identify suitable wheat

cultivar for these inter cropping system and found that furrow irrigated rained bed planting of wheat recorded the highest yield and net returns. Among cultivars HI 948 (durum wheat) gave the highest wheat equivalent yield (5.89 tonnes/ha) productivity (41.4kg/ha/day) and net profit (Rs. 26306/ha) compared with the rest of the cultivars.

Sharma *et al.* (2003) reported that constraints in adoption of improved chickpea technology in Madhya Pradesh revealed a wide adoption gap of improved production technology in chickpea by farmers which was highest in use of micro nutrients (99%) and lowest in proper field preparation (10%). Wide yield gap was also observed between the potential yield and the yield obtained by chickpea growers, which may be attributed to various constraints, unavailability of HYVs seed (59%) lack of knowledge about soil testing facility (79%) high cost of fertilizers (76%) irregular power supply (98%) lack of capital for purchase of weedicides (61%) and insecticides (76%) irregular power supply (9%). Among the institutional constraints non-availability of quality inputs through cooperative society (51%) were the top most constraints in the area.

Dalvi *et al*. (2004) studied on constraints faced by soybean growers in adoption of soybean cultivation technology in Marathwada region, Maharshtra, India and the relevant data was by personal interview schedule from 120 soybean growers. The data indicated that non-availability of hybrid soybean seed in time, high cost of seed, shortage of farmyard manure, high cost of chemical fertilizer, insecticides and pesticides, non-availability of chemical fertilizer in time and non-availability of labours were the constraints faced by farmers.

Carrier *et al.* (2005) revealed that fitness costs associated with insect resistance to transgenic crops producing toxic from *Bacillus thuringiensis* (Bt) reduce the fitness on non-Bt refuge plants of resistance individuals relative to susceptible individuals. Because costs may vary among host plants, choosing refuge cultivars that increase the dominance or magnitude of costs could help to delay resistance. Specifically, cultivars with high concentrations of toxic phytochemicals could magnify costs.

Jain *et al.* (2005) conducted a study on soybean-wheat cropping system for 3 consecutive year during 1999-2000 to 2001-2002 in Jabalpur district of Madhya Pradesh, with the objective to maximize the productivity and profitability of system. Study reveled that recommended dose of fertilizers to both crops significantly increased the grain yields of crop components and it was remuneration also without deterioration of soil properties, application of 10 tones FYM/ha to Soybean along with different fertilizers dose increased the grain yields of both crops. The use of recommended seed rate of wheat also helped to increase the productivity, net monetary return and benefit cost ratio of entire soybean-wheat system.

Pal (2006), examined the resource use efficiency, which covered trend in level and efficiency of input and water resources particularly in irrigated area. Response of critical inputs like fertilizers is decreasing and there is declaration in the growth of total factor productivity of irrigated agriculture. The decrease in fertilizer response was because of inefficient management of soil moisture. However, the response was much better in tube well irrigated areas due to better control on quality of irrigation. There is a need for assessing the optimal fertilizer response level under field conditions and possibility to enhance it by balanced use of plant nutrients and management of soil moisture. As regards efficiency of water use, although it has increased over time but still remains less than 40 per cent, and the efficiency is much lower in the irrigated areas.

Haque (2006), examined the resource use efficiency in Indian agriculture. While some farmers may attain maximum physical yield per unit of land at high most, some other achieved maximum profit per unit of inputs used. Also in the process of achieving maximum yield and returns, some farmers may ignore the environmentally adverse consequences, if any, of their resource use intensity. Logically all enterprising farmers would try to maximize their farm returns by allocating resources in an efficient manner, but as resources (both qualitatively and quantitatively) and managerial efficiency of different farmers very widely, the net returns per unit of inputs used also very significantly from farm to farm. Also a farmer's access to technology, credit, market and other infrastructure and policy support, coupled with risk

perception and risk management capacity under erratic weather and price situation would determine his farm efficiency.

Singh *et al.,* (2007) conducted a study to estimate production cost and return of sugarcane cultivation in Uttar Pradesh, India, during 2003-04. Data were gathered by administering a pre-tested schedule to 150 sugarcane growers. Results showed that the average production cost of sugarcane was Rs. 36730.32/ha, which varied from 35303.93/ha on small farms and Rs. 39396.11/ha on large farms. The average net return was Rs. 36290.95/ha, with lowest return of Rs. 13364.01/ha. It is concluded that the State Advisory Price announced by the Uttar Pradesh Government is sufficient to meet the production cost of sugarcane. It is suggested that the Government should take more interest to increase the supply of sugarcane to sugar factories rather than gur and khandsari.

Muhammad *et al.,* (2008) resulted that the maximum number of grain per cob, maximum 1000 grain weight and ultimately maximum grain yield was obtain in maize hybrid HG-3740 at local condition of Faisalabad, Pakistan

Aziz *et al.,* (2011) studied performance of BARI hybrids, BARI hybrid maize -2, BARI hybrid maize -3, BARI hybrid maize -5,and pacific -984, at three different location and they found that the BARI hybrids maize-5 produce maximum grain yield at all 3 locations. So BARI hybrid maize-5 might be suitable for cultivation in hilly areas of Bangladesh.

Kertikova *et al.* (2011) Investigation of economic characteristics of maize hybrids from the FAO mid-late and late group: II. In order to satisfy the stockbreeding with roughage (silage), according to a number of authors, it is indispensable to perform periodical studies on the productivity of newly developed, recognized and regionalized maize hybrids under different ecological conditions. The objective of the study was to investigate the economic characteristics of maize hybrids from the FAO mid-late and late group and their suitability for production of biomass for silage under the conditions of the Pleven region. The field trial was carried out during the period of 2004-2006 under non-irrigated conditions on slightly leached, medium-deep chernozem. Eight maize hybrids were studied belonging to two

FAO hybrid groups - mid-late (Kn-511, Kn-512, Kn-517 and Kn-M530) and late (Kn-601, Kn-611, Kn-625, Kn-683 A). The evaluation of the hybrids according to maturity groups showed higher yielding capacity of dry biomass for those from the late group, as compared to the maize hybrids from the mid-late group. The highest-yielding and promising hybrid in the mid-late group was Kn-517, the yield of which was 18243,3 kg/ha, and in the late hybrid group Kn-683A with biomass yield equaling to 20340,0 kg/ha. The mentioned two hybrids are the most suitable for cultivation under the conditions of the Pleven region for forage biomass production.

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Chapter – III

PROFILE OF THE STUDY AREA

A research programme requires the knowladge of the area in which an investigation is to be carried out. General characteristics of the study area will facilitate the discussion with regard to similarities and variation of various components and this will help in providing the background and importance of the study area.

1. Location of the district:

The name Chhindwara has been derived from the word 'Chhind' which basically is a name of a local tall tree surrounding the district.Chhindwara District ranks 1st in area (11,815 km².) in Madhya Pradesh State and occupies 3.85% of the area of the state. Chhindwara district was formed on 1 November 1956. It is located on the South-West region of 'Satpura Range of Mountains'. It is spread from 21.28 to 22.49 Deg. North (latitude) and 78.40 to 79.24 Deg. East (longitude) and spread over an area of 11,815 km².

Table 3.1: Geographical condition of Chhindwara district

District	North latitude	East latitude	Sea level (Meter)
Chhinnwara	$21^0$28' to $22^0$50'	$78^0$15" to $79^0$25'	675

Source: District Statistical handbook of Chhindwara 2010-2011.

General boundarie

This district is bound by the plains of Nagpur District (in Maharashtra State) on the South, Hoshangabad and Narsinghpur Districts on the North, Betul District on the West and Seoni Districts on the East.

Area and population

Chhindwara District ranks 1st in area (11,815 km².) in Madhya Pradesh State and occupies 3.85% of the area of the state. The District is divided into 11 Tahsils (Chhindwara, Parasia, Junnardeo, Tamia, Amarwara, Chourai, Bicchua, Sausar,Umreth,Mohkhed and Pandhurna), 12 Development Blocks

(Chhindwara, Parasia, Junnardeo,Damua, Tamia, Amarwara, Chourai, Bicchua, Harrai, Mohkhed, Sausar and Pandhurna). There are 9 Nagar Palikas (Chhindwara, Parasia, Junnardeo,Damua and Pandhurna), 8 Nagar Panchayats (Sausar, Amarwara, Chandameta Butaria, Newton Chikli, Harrai, Mohgaon, Chourai, and Lodhikheda). Apart from this there are 10 small towns (Dighawani, Jatachapar, Iklehara, Pagara, Kalichapar, Damua, Pala Chourai, Bhamori, Ambada and Badkuhi).

There are 1,984 villages in the district, out of which 1,903 villages are inhabited. The district is divided into 19 Revenue Circles, 319 Patwari Halkas. There are 808 Panchayats in the district. 'Chhindwara' is the Parliamentary Constituency in the district and there are 8 Assembly Segments (Jamai, Chhindwara, Parasia, Damua, Amarwara, Chourai, Sausar and Pandhurna). As per Census 2001 the total population of Chhindwara town is 1,22,309 and of the district is 18,48,882 with a population density of 156 people per km². There are 953 females for every 1000 males. The sex ratio of Rural Chhindwara is more (962) than that of Urban Chhindwara (926). As per Census 2001, the average literacy rate of the district is 66.03%, which is above the average of the MP state's 64.08%. The literacy rate in the rural area of the district is 60.76% and that of urban area is 81.46%.

According to the 2011 census Chhindwara District has a population of 2,090,306,[1] roughly equal to the nation of Macedonia[2] or the US state of New Mexico.[3] This gives it a ranking of 218th in India (out of a total of 640).[1] The district has a population density of 177 inhabitants per square kilometre (460 /sq mi) .[1] Its population growth rate over the decade 2001-2011 was 13.03%.[1] Chhindwara has a sex ratio of 966 females for every 1000 males,[1] and a literacy rate of 72.21%.[1]

General description of Chhindwara block

Chhinnwara agricultural block is one of the 11 agricultural blocks of Chhinnwara district. Chhinnwara is district headquarters, it lies in between $21^0$28" to $22^0$50 north latitude and $78^0$15" to $79^0$25" east latitude and 401 meters above mean sea level. It covers 842.50 square km of geographical area. Chhinnwara block cover 221 villages, gram panchayat 91 and Janpad panchayat 1.

Table 3.2. Geographical situation of Chhindwara block

Block	North latitude	East latitude	Sea level (m)
Chhinnwara	$23^0$10" to $24^0$42	$75^0$35" to $70^0$21"	655

Source: District Statistical handbook of Chhindwara 2011-12

Topography

It is located on the Southwest region of 'Satpura Range of Mountains'. There are five major rivers which flow through the district namely Kanhan, Pench, Jam, Kulbehra, Shakkar and Doodh. Kanhan river flows in the Southern direction through the western parts of Chhindwara Tahsil and mixes with the Wenganga river. Jam river flows mostly through the Sausar region and joins with the Kanhan river. Pench river flows in the border areas of Chhindwara and Seoni Districts and mixes with the Kanhan river in Nagpur District. Kulbehra river starts at Umreth and flows through Chhindwara and Mohkhed and joins with Pench river. Around 4212.556 km². area of the district is covered under forest. Bamboo, Teak, Harra, Saalbeej, Tendu Patta are the major forest wealth.

Climate and rainfall

Chhindwara has a subtropical climate. Like most of north India it has a hot dry summer (April–June) followed by monsoon rains (July–September) and a cool and relatively dry winter. Average annual rainfall is 1,183 mm. Minimum temperature during winter is 4 to 6 degree Celsius while maximum temperature during summer is 38 to 42 degree Celsius.

The normal annual rainfall of Chhindwara district is 1087.2 mm. The district receives maximum rainfall during south-west monsoon period i.e. June to September. About 85.7 % of the annual rainfall falls during monsoon season. Only 14.3 % of the annual rainfall takes place between Octobers to May period. Thus, surplus water for ground water recharge is available only during the southwest monsoon period.

The normal maximum temperature noticed during the month of May is 39.4^0 C and minimum during the month of December 9.8^0 C The normal

annual mean minimum and maximum temperatures has been worked out as 18.2^0 C and 30.6^0 C respectively.

During the south-west monsoon season, the relative humidity generally exceeds 87% (August month) and the rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 33%. May is the driest month of the year.

The wind velocity is higher during the pre-monsoon period as compared to post- monsoon period. The maximum wind velocity, 9.5 km/hr observed during the month of June and minimum, 3.3 km/hr during the month of November. The average annual wind velocity in is 5.4 km/hr.

Table 3.3 Average block wise annual rainfall in the study area in the year 2011-12 (Unit=mm)

S. No.	Block	June	Jul	Aug	sep	Oct	Nov	D.	J.	F.	M.	A	M	Total
1	Chhindwara	155.0	271.2	285.4	122.6	35.4	70.1	-	-	-	-	-	-	939.7
2	Mohkhed	122.8	440.0	378.0	151.8	11.o	158.6	-	-	-	-	-	-	1262.2
3	Tamiya	86.2	209.2	359.2	261.4	0.0	38.0	-	-	-	-	-	-	954.0
4	Junnardeo	127.0	277.0	387.0	145.4	58.8	47.2	-	-	-	-	-	-	1042.4
5	Parasiya	151.6	343.1	338.1	120.5	25.0	48.0	-	-	-	-	-	-	1026.3
6	Amarwara	128.2	375.6	580.2	193.0	50.8	85.1	-	-	-	-	-	-	1412.9
7	Harrai	78.1	165.6	340.2	183.2	11.2	10.0	-	-	-	-	-	-	788.3
8	Chourai	170.3	349.1	336.7	164.9	11.8	54.4	-	-	-	-	-	-	1087.2
9	Sausar	187.2	374.4	276.6	205.0	31.6	64.8	-	-	-	-	-	-	1139.6
10	Bicchua	192.8	386.1	236.5	239.6	89.2	62.1	-	-	-	-	-	-	1206.3
11	Pandhurna	117.0	471.2	344.6	83.4	41.6	64.6	-	-	-	-	-	-	1122.4
Total		137.1	331.7	350.5	169.5	30.5	68.7	-	-	-	-	-	-	1088.0

Source: Department of Agriculture Chhindwara 2011-2012.

Table 3.4: Demographic features of the Chhindwara district and Chhindwara block.

S. No.	Particulars	Chhindwara district	Chhindwara block
1.	Total population	2090306	312980
	Male	1081508	158490
	Female	1008798	154490
	Male to female ratio	952	960
2.	Population of SC Caste	250401	40998
3.	Population of ST Caste	771205	190332
4.	Other caste	1128700	81650
5.	Rural Population	1490121	195850
6.	Urban Population	510185	103773
7.	Rural to Urban Population Ratio	71:29	64:36
8.	Density of population / km	180	198

Source: District statistical hand book Chhindwara 2011-12

Demographic feature:

The 20,90,306 people lived in the Chhindwara district as shown in table 3.4. The majority of population lives (71%) in rural area than the urban areas (29%). It proves predominance of rural characters. The total males and female population of Chhindwara district was 1081508 and 1008798 respectively. The Chhindwara district of Male to female ratio in 952 and Chhindwara block 960.

The caste wise population contribution shows other caste (54%) followed by schedule caste (12%) and schedule tribes (36.89%) in the Chhindwara district. If Chhindwara block distribution of other caste was highest (26.08%) compared to schedule caste (13.09%) and schedule tribes (60.61%). The rural and urban population. In Chhindwara block was (83.26) percent to the total population respectively.

Soil type

The soils in the district are generally of three types Viz., black cotton soil, sandy loam soil and clayey loam soils. The black cotton soils occur mainly in Sausar Tahsil while sandy loam soil is found in Chhindwara Tahsil. The clayey loam is predominant in Amarwara Tahsil. The northern hilly region covered by loamy soils, are very shallow, somewhat excessively drained, developed by moderately steep slopes and are marked by severe erosion.

Table: 3.5 Land use pattern in Chhindwara District and Chhindwara block (2011- 2012) (Area in ha)

S. No.	Particular	Chhindwara (district) area (ha)	Per-centage	Chhindwara (block) area (ha)	% share to district	Percen-tage
1.	Total geographical area	1188923	100	62141	5.22	100
2.	Forest area	276870	23.28	1826	0.65	2.93
3.	Area under non-agriculture used	21458	1.80	2990	13.93	4.81
4.	Cultivable waste land	8300	0.69	300	3.61	0.48
5.	Other un-cultural land excluding fallow land	55765	4.69	5370	9.62	8.64
6.	Cultivated land	8400	0.70	300	3.57	0.48
7.	Fallow land	51671	4.34	1375	2.66	2.21
8.	Net Sown area	489571	41.17	42913	8.76	69.05
9.	Double cropped area	166121	13.97	22688	13.6	36.5
10.	Total cropped area	655692 (100)	-	97711 (100)	10.0	-
11.	Net irrigated area	489571 (74.66)	-	30817 (49.72)	8.76	-
12.	Total irrigated area	489571 (51.4)	-	30817 (31.53)	8.76	-

Source: Department of Agriculture Chhindwara 2011-12

The land utilization pattern of Chhindwara district is shown in Table 3.5 inferred that the total geographical area of Chhindwara district is 1188923 hectares out of which 41.17 per cent was under cultivation and 1.80 percent was put under non agriculture uses. The forest area covered only 23.28 percent to the total geographical area. The percentage of area under land not available for cultivation was 4.69 percent. The total fallow land and cultivable waste land accorded for 4.34 and 0.69 percent can be brought under ploughing with planned development of crop production system. The double cropped area was observed to be 13.97 and percent to the total cropped area at the district and Chhindwara block respectively.

The not irrigated area was 489571 hactare and covered 74.66 percent to net sown area. The cropping intensity was observed to be 122 percent in Chhindwara district.

The land utilization pattern reveals that there was hardly any scope of extending the cultivable area. The only way of increasing the cropping intensity was to enhance the cropping intensity by efficient utilization of resources and skillful management of farming business.

Table 3.6 Cropping pattern of Chhidwara district and Chhidwara block (2011-12)

Crops	Total area(ha) Chhidwara District	Percentage to total cropped area	Chhidwara Total area (Block)	Percentage to total cropped area
Cereals crops				
Paddy	18316	2.92	351	0.53
Wheat	114454	18.25	14784	22.54
Sorghum	36610	5.83	1511	2.30
Maize	94579	15.08	14571	22.22
Other cereals	24989	3.98	16	0.024
Total cereals	31233	46.08	31233	47.63

Pulses crop				
Gram	43287	6.90	4138	6.31
Arhar	27517	4.38	1342	2.04
Urd	8818	1.48	389	0.59
Other	14758	2.35	717	1.09
Total pulses	94380	15.05	6556	9.99
Oil seeds				
Til	2105	0.33	21	0.032
Linseed	608	0.096	00	0.0
Groundnut	19856	3.16	1487	2.26
Mustard	418	0.066	8	0.12
Soybean	161591	25.77	20242	30.87
Other oil seed crops	14594	2.32	421	0.64
Total oil crop	199172	31.76	22179	33.82
Sugarcane	11799	1.88	1417	2.16
Total fruit	9326	1.48	00	0.0
Total vegetable	16471	2.62	3201	4.88
Total spice	6730	1.07	949	1.44
Chari	221	0.035	30	0.045
Total net sown area	627047	100	65565	100
Cropping intensity (%)	122	-	130	-

Cropping pattern:

The cropping pattern shows the crop wise (cereals, pulses and oil seeds etc.) distribution of cropped area which gives an indication of the intensity of land use. Wheat, Maize, Soybean are the main crops grown in Chhindwara district.

The crop wise cropping pattern of Chhindwara district are given in table 3.6 it is quite evident from the table that soybean,Wheat and Maize are the most important crops which occupied a leading position in the cropping pattern of the district. Accounted more than 25.77, 18.25 and 15.08 percent of the total cropped area.

The cereal crops sown in Chhindwara block is maximum (31233 ha) that was 47.63 percent under cereal crop was highest in the Chhindwara block area followed by oil seeds crops 31.76 percent and less area was allocated under in pulses crop 9.99 percent. Further crop wise, the cereals crops were fund to be 31233 hectare which was contributed 46.08 percent. The pulses sown in 94380 hectare that was 15.05 percent. The oilseed area sown in 199172 hectare which was 31.76 percent in the total cropped area in Chhindwara district

Area Production and Productivity:

The data shown from the table 3.7 that it is depicted the hybrid Maize rank 1st in production (280048 tonnes) with average productivity of 2961kg/ ha. of total major crop area in district. The wheat crop rank 3rd in production (189536 tonnes) with average productivity of 1656 kg / ha. of the district respectively.

The hybrid maize crop rank 2nd in area (94579 hac.)but hybrid maize crop rank 1st in production (280048 tonnes) during kharif season. In rabi season wheat crop was the main crop occupied 114454 hectare and 189536 tones production with average productivity of 1656 kg/ha.The total major crops area contribution was highest hybrid maize followed by soybean, wheat and then sorgham

Table 3.7: Production and productivity of Chhindwara district (2011-2012)

S.No.	Crops	Production (000' tonne)	Productivity (Kg / ha)
1.	Paddy	26064	1423
2.	Wheat	189536	1656
3.	Sorghum	48728	1331
4.	Maize	280048	2961
5.	Barley	-	-
6.	Gram	32249	745
7.	Arhar	15547	565
8.	Mung	484	405
9.	Urd	2954	335
10.	Sugarcane	48728	1331
11.	Lentil	207	341
12.	Groundnut	29407	1481
13.	Til	787	374
14.	Soybean	194394	1203
15.	Mustard	78	186

Source: Department of Agriculture Chhindwara 2010-2011

Table3.8 Source wise irrigated area in Chhindwara (2010-11)

S. No .	Source	Chhindwara District			Chhindwara block		
		Number	Irrigated area	%to total irrigated area	Number	Irrigated area	%to total irrigated area
1.	Canals	71	12245	7.21	12	590	2.56
2.	Tube wells	10286	32098	18.91	2771	3765	16.34
3.	Wells	93265	99593	58.70	12148	15932	69.17
4.	Ponds	63	7368	4.34	10	691	3.0
5.	Other source	-	18355	10.81	-	2053	8.91
6.	Net irrigated area	-	169659	100	-	23031	100
7.	Total irrigated area	103587	169659	100	14941	23031	100
8.	Net Sown area		489571			42913	
9.	Total cropped area		655692			22688	

Irrigation

Intensity (%) = 100 %

Source: Department of Agriculture Chhindwara 2010-2011

Irrigation facilities:

Source wise:

Irrigation is considered to be the carrier of Agricultural technology for enhancing the agricultural production and irrigation is one of the important input which improve productivity of crop. The table 3.8 shows the sources wise net irrigated area in the district. It may be noted from the table that the net irrigated area in the district was 169659 hectare The Wells are main source of irrigation, which provided irrigation facilities to the extent of 58.74 percent of the net irrigated area in district. Further second important source of irrigation is Tube well which were covering an area of 32098 hectares which contributed 18.91 percent of the net irrigated area. There was only 7.21 percent area irrigated by canals. The other source covered for 10.81 percent area in district to the net irrigated area. The tube-wells and wells were main source of irrigation which was contributed 77.61 percent area in district The area under irrigation through ponds was negligible in this district.

Table 3.9: Operational holding according to size of Chhindwara district and Chhindwara Block(2010-11)

Particulars	Chhindwara district				Chhindwara block				Average size holding (ha.)	
	No.	% of total No.	Area	% of total No.	No.	% of total No.	Area	% of total No.	district	Block
Marginal (upto 1 ha)	199220	49.44	70254	10.71	15420	42.90	8178	12.46	0.352	0.530
Small (1-2 ha)	99866	24.78	180398	27.51	9337	25.98	12490	19.03	1.80	1.33
Semi-medium (2-4 ha)	64236	15.94	169458	25.84	6225	17.31	16122	24.57	2.63	2.58
Medium (4-10 ha)	33641	8.34	166412	25.37	4042	11.24	19340	29.48	4.94	4.78
Large (more than 10 ha)	5940	1.47	69170	10.54	928	2.58	9471	14.13	11.64	10.20
Total	402903	100	655692	100	35952	100	65601	100	1.62	1.82

Source: Department of Agriculture Chhindwara 2010-2011

Distribution of land holding:

Farm size plays an important role in the adoption of farm technology by the farmers. The Table 3.9 shows the category wise distribution of land holding in Chhindwara district.

The total number of operational holding of Chhindwara district was 402903 with 655692 ha. of cultivated land. Amongst the area under different holding it was found maximum in small size (27.51%) followed by semi medium (25.84%), medium (25.37%), large (10.54%) and marginal (10.71%) in the district. The average size of holding in district was 1.62 ha. Thus maximum farmers fulls under marginal category (0 to 1 ha.) The average size of holding is large, medium, semi medium small and marginal size of farm were found 11.64, 4.94, 2.63, 1.80 , 0.352 ha. respectively. While the number of farmers was found more in marginal category (49.44%) followed by small (24.78%), semi medium (15.94%), medium (8.34%), large (1.47%) respectively.

Table: 3.10 Number of farm machinery year (2010-11)

S. No.	Source	Chhindwara district	Chhindwara block
1.	Plough		
	Wooden	172540	31474
	Iron	27876	8242
2.	Bullock trolley	53539	5194
3.	Irrigation by pump		
	Diesel	888	47
	Electricity	89520	11938
4.	Tractor	9537	1229
5	Net sown area	489571	42913

Source: KVK Chhindwara (2010-2011)

Agricultural implements

The data presented in the table 3.10 shows position of agricultural implements in the district. The total number of wooden and non plough recorded in district was 172540 and 31474 and in Chhindwara block was 27876 and 8242 respectively. The Chhindwara district and Chhindwara block plough are highest in wooden plough. The wooden plough reported in Chhindwara block was 18.24 percent of the district and the bullock cart was 5194 which is 9.70 percent of the district. The total number of bullock cart in Chhindwara district was 53539 respectively. The oil pump was recorded in Chhindwara block 47 which is 5.29 percent of the district. The total number of oil pump in Chhindwara district was 888 respectively. The number of electricity pump in Chhindwara district was 89520 The electricity pump was recorded in Chhindwara block 11938 which is 13.33 percent of the district. The total number of tractor is Chhindwara district was 9537 The tractor was Chhindwara block 1229 which is 10.29 percent of the district.

Table: 3.11 Cattle population of Chhindwara district and Chhindwara block

	Category	Population of Chhindwara district	Population of Chhindwara block
A.	Cow and Bullock		
	Male (over 3 years)	314952	79565
	Female (over 3 years)	195108	30155
	Young stock (over 3 years)	21349	3400
	Total	**723359**	**113120**
B.	Buffaloes		
	Male (over 3 years)	3802	680
	Female (over 3 years)	74646	12545
	Calves (over 3 years)	57280	18900
	Total	**135728**	**32125**
C.	Total number of goats	306934	80980
D.	Total number of pigs	5331	940
E.	Total number of sheep	822	112
F.	Total number of Horses	2155	433
G.	Total number of Donkeys	402	12
H.	Total Poultry	469798	18000

Live Stock and Poultry:

Live stock and poultry status have been shown in Table 3.11. Data reveals that Chhindwara block alone share 14.32 percent of the total livestock of the district.

The total number of cow recorded in district was 723359 and in Chhindwara block was113120 which is 15.63 percent of the district.

Similarly the total number of buffalos in district was 135728 and in Chhindwara block was 32125 which is 23.66 percent of the district. Chhindwara block accounted 26.38 percent of the total goals recorded in the district. In Chhindwara district total sheep was 822 and Chhindwara block showed 13.62 percent of the sheep population in district. Poultry recorded was 46798 and 18000 which is 38.46 percent of the district.

Chapter – IV

RESEARCH METHODOLOGY

As per objectives stated earlier this chapter deals with the research methodology and analytical tools employed for the collection and analysis of data. The research methodology adopted have been described into following sub-heads.

4.1 The study area

4.2 Selection of respondent

4.3 Data needed

4.4 Period of study

4.5 Method of inquiry

4.6 Analysis of data

4.7 Description of variable

4.1. The study area

The Chhindwara district comprises eleven blocks viz. Chhindwara, Parasia, Junnardeo, Tamia, Amarwara, Chourai, Bicchua, Sausar, Umreth, Mohkhed and Pandhurna Among these blocks, Chhindwara, occupied maximum area and production under Hybrid Maize in the district. Thus, Chhindwara, block was selected purposively to fulfill the objectives of the present study. The villages of this block, growing Hybrid Maize was enlisted from the record of RAEO/panchyat secretary. From this list three villages namely Chandangaon, Rohanakla and Ner. were selected randomly.

4.2. Selection of respondents

From the selected villages the cultivators grown Hybrid Maize were recorded which was further classified in to three size group based on size of holdings viz. small (up to 2 ha), medium (2.01 to 4 ha) and large (above 4/ha). From each size group , 20 farmers were selected by simple random sampling method, which totaled to 60 in number. Respondents from sample farms according to size group have been given in table 4.1.

Table 4.1. Selection of respondents according to size

Size group	Total No. of Hybrid Maize growers	No. of farmers selected	Percentage of farmers selected
Small	53	20	37.73
Medium	48	20	41.66
Large	33	20	60.60
Total	134	60	44.77

4.3 Data Needed

The primary data were collected from the selected cultivators and were recorded as follows:

I. Socio-economic features of respondents.

II. Cropping pattern of sample farms.

III. Information related to cost of different field operations.

(a) Types of labour engaged for different field operations.

(b) Material cost involved.

(c) Returns from main and by products.

(d) Price of main and by products and

The secondary data relates to background of the study area were collected from Statistics of Madhya Pradesh and, Hand Book of Chhindwara district published by D.D.A. office of Chhindwara.

4.4 Period of study

The collected data pertains to the agricultural year 2012-13

4.5 Method of inquiry

Survey method was used for collection of the relevant data from selected cultivators four to five visits were made to contact each cultivator. For collection of data personal interview using pre-tested schedule were used. Before collection of data, each respondent was briefly explained about the objectives of the study and assured them that the supplied information is kept confidential and was used only for research purpose.

4.6 Analysis of data

The collected data have been complied, processed and analyzed to estimate the cost of production, profit, input output ratio, resources productivity and constraints in Hybrid Maize production. Keeping in view the objectives of the study the collected data were tabulated and analyzed statistically and average, percentages method were used to analyze the collected data. Following techniques were used to analyzed the collected data.

4.7 Cost of cultivation (Rs/ha)

Both operational and fixed cost were worked out to estimate the cost of cultivation of hybrid maiz.

Operational cost:

These costs are related to the out lays on variable inputs that are used up during the production process. This cost includes expenditures on seed, fertilizers, manure, water, hired and owned labour, insecticide, pesticides etc.

Fixed cost:

These costs refer to the value of services from fixed resources and as such are overhead costs since they are not the functions of output. They are the same at all level of production. Rent, interest, depreciation constitutes fixed cost.

Costs of cultivation of Hybrid Maize were also worked out according to various cost concept used in farm management studies. The cost concepts used are –

Cost A_1 = All actual expenses incurred in the Hybrid Maize production.

Cost A_2 = Cost A_1 + rent paid for leased in land.

Cost B_1 = Cost A_2 + interest on value of fixed capital excluding land.

Cost B_2 = Cost B_1 + rental value of owned land.

Cost C_1 = Cost B_1 + imputed value of family labour.

Cost C_2 = Cost B_2 + imputed value of family labour.

Cost C_3 = Cost C_2 + 10 per cent of cost C_2

Cost of production: It is the ratio of total cost incurred on Hybrid Maize production and physical output obtained on sample farms.

$$\text{Cost of production (Rs/qt.)} = \frac{\text{Total cost – value of by product (Rs/ha.)}}{\text{Main product (qt/ha)}}$$

1. Profitability concept

(i) **Total production:** Main product and By product.

(ii) **Gross income:** (includes the following)

(a) Gross income = Value of main product + value of by product.

(b) Cash received on account of the sale of farm produce.

(c) Value of the produce, main or by product used for home consumption.

(d) Value of the seed stored for sowing purpose.

(iii) **Net income:** Gross income minus total expenses of production. Seed, manure and fertilizers, wages of hired labour and imputed value of unpaid family labour, depreciation, rent, interest on owned and working capital and managerial cost.

Net income = Gross income - Cost C_3

(iv) **Input – output ratio**

$$\text{Input – output ratio} = \frac{\text{Gross income(Rs/ha)}}{\text{Total cost(Rs/ha)}}$$

(v) Family labour income = Gross income – Cost B_2

Break-even point

Break-even point indicates a situation where farmers neither earn profit nor in loss. In other word break-even points is a point where total cost meet total return plotted on a graph sheet. Break-even points were obtained as follow:

Break even yield (qt./ha)

$$\text{Break even yield (qt./ha)} = \frac{\text{Total Cost – Value of by product}}{\text{Output price (Rs/qt.)}}$$

Break even cost (qt./ha)

$$\text{Break even cost (qt./ha)} = \frac{\text{Total Cost – Value of by product}}{\text{Physical production (qt/ha.)}}$$

Production function:

The production function commonly used for estimating the resources productivity is power function. The Cobb-Douglas production function was used for estimating the productivity of resources used in Hybrid Maize production by the sample farmers.

This function was used because its R^2 value was observed to be 0.96 which indicates that functions is best fitted and able to explain the variables (X_1 to X_5) which we have taken and study to the extent of 96 per cent. We can also compute the increasing, decreasing or constant return to scale by working out elasticity of variables taken under study. The function not only shows the resources use efficiency but with the help of it we can readjust the selected variable for getting profit.

The dependent and independent variables included in the function are given below

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5}$$

Where, Y = Gross values of output (main product + by product) estimated at market price of the product in rupees/ha.

a = constant

(a) Independent variables:

X_1 =Human labour cost (in Rs./ha)

X_2 = Machine labour cost (in Rs/ha)

X_3 = Seed (in Rs./ha)

X_4 = Plant protection (in Rs./ha)

X_5 = Fertilizers (in Rs./ha)

2. Marginal productivity of the resources (MVP):

From the above production function the M.V.P. of each resource was worked out. The marginal productivity of particular input ''x_1' at geometric mean of input and output expressed in following equation.

$$MVPXi = Bi \frac{\overline{Vi}}{\overline{Xi}} Pxi$$

Where,

$\overline{VI}$ = Gross value of out put (Rs.)

$\overline{Xi}$ = Factor of production

bi = Regression coefficient of Xi

Pxi = Price of Xi

Opinion survey of respondent regarding constraints responsible for low production of Hybrid Maize on sample farm were also conducted by using interview schedule.

Chapter – V

RESULTS AND DISCUSSION

This chapter deals with the results of the cross section data collected from the sample holding and analyzed in the light of the objective stated in chapter first. The results have been discussed under the following sub-heads.

5.1 Sample profile

5.2 Costs and return of hybrid maize crop.

5.3 Resource use efficiency.

5.4 Constraint in hybrid maize production.

5.1 Sample profile

The cross section data collected from sample holding have been analyzed and presented in the following pages to speak about general characteristics of the sample respondents.

5.1.1 Family composition

Table 5.1. Average family size and type of family on sample farm

Size group	Family size			Total	Average family size	Types of family		Total
	Children	Adult				Individual	Joint	
		Male	Female					
Small	45.00 (35.71)	42 (33.33)	39.00 (30.95)	126 (100)	6	14.00 (70.00)	6.00 (30.00)	20 (100)
Medium	50.00 (36.76)	45.00 (33.08)	41.00 (30.14)	136 (100)	7	13.00 (65.00)	7.00 (35.00)	20 (100)
Large	58.00 (36.47)	54 (33.96)	47.00 (29.55)	159 (100)	8	3.00 (10.00)	17.00 (90.00)	20 (100)
Overall	153.00 (36.34)	141.00 (33.49)	127 (30.166)	421 (100)	7	30.00 (50.00)	30.00 (50.00)	60 (100)

(Figures in brackets indicate percentage to the total)

Family type of sample respondents under different size groups are presented in the Table 5.1 which revealed that individual family system on sample farms was dominating in small and medium farm. However, joint family system both in number and percentage term was higher on large farm because of sound economic conditions and requirements of more human labour to perform various operations on the farm.

As shown in table 5.1 total family members was 421 comprising 60 families. Average family size ranged between 6.00 to 8.00 on different farm with an average of 7.00 in sample farm. Thus, positive relation with family size and farm size was observed on sample farm. Highest average family members of 8.00 were in large farm and lowest of 6.00 in small farm. Maximum number in case of large farm was due to joint family system prevalent in the study area.

5.1.2 Age and caste

Table 5.2. : Average age and caste of the sample respondents

Size group	Average holding (ha)	Average age (years)	Caste (No.)				Total
			Gen.	OBC	SC	ST	
Small	1.50	38.00	3.00 (15.00)	6.00 (30.00)	5.00 (25.00)	6.00 (30.00)	20.00 (100.00)
Medium	3.20	41.00	2.00 (10.00)	8.00 (40.00)	6.00 (30.00)	4.00 (20.00)	20.00 (100.00)
Large	7.50	43.00	7.00 (35.00)	10.00 (50.00)	2.00 (10.00)	1.00 5.00	20.00 (100.00)
Overall	5.15	41.00	12.00 (20.00)	24.00 (40.00)	13.00 (22.00)	11.00 (18.00)	60.00 (100.00)

(Figures in brackets indicate percentage to the total)

Table 5.2 gives the general information regarding average age and caste of sample respondents. Table 5.2 revealed that average age of the respondents ranged between 38 to 43 years in different farm with an average of 41 years of sample respondents. Thus, majority of the sample farmers belong to medium age group which works hard jobs on their farms.

Regarding caste, maximum respondents 40% of the total belonged to other back ward class followed by schedule caste 22%, general 20% and 18% respondents were schedule tribes. Similar trend with respect to sample farmers belonging to different caste was observed irrespective of different size of farm.

5.1.3 Literacy level

Education is one of the important component for the building confidence and habit of scientific thinking and action for solving emerging problems. The knowledge on the education levels of family members play crucial role in understanding of new methods of production keeping in view the importance of education, literacy level of sample house holds was worked out and same have presented in Table: 5.3

Table 5.3. Level of education of sample respondents

Size group	Education level					Total
	Illiterate	Literate				
		Primary	Middle	High school	Inter and above	
Small	08 (40)	08 (40)	02 (10)	02 (10)	0 (0)	20 (100)
Medium	05 (25)	08 (40)	04 (20)	03 (15)	0 (0)	20 (100)
Large	02 (10)	02 (10)	06 (30)	09 (45)	01 (05)	20 (100)
Overall	15 (25)	18 (30)	12 (20)	14 (23)	01 (02)	60 (100)

(Figures in brackets indicate percentage to the total)

As shown in Table: 5.3 numbers of educated house holds and size of farms are positively related which was normal phenomenon in this country. The proportion of literate on sample farm was 75 per cent. It was highest in case of large farm (90%) followed by medium farm (75%) and small farm (60%). On small farm the number of uneducated members were more in comparison to their counterparts belonging to higher size groups.

5.1.4 Source of new information

Table 5.4: Source of new information reported by respondents

Size group	Source of new information					
	Govt. office/Ag.office	News paper	Media, TV/ Radio,	Neighbors and Friends	Exhibition	Other
Small	6 (35.00)	5 (31.00)	5 (28.00)	10 (28.00)	5 (25.00)	4 (27.00)
Medium	7 (35.00)	5 (31.00)	6 (33.00)	11 (31.00)	6 (30.00)	5 (33.00)
Large	7 (35.00)	6 (37.00)	7 (39.00)	15 (42.00)	9 (45.00)	6 (40.00)
Overall	20 (100.00)	16 (100.00)	18 (100.00)	36 (100.00)	20 (100.00)	15 (100)

(Figures in brackets indicate percentage to the total)

Table 5.4 revealed that the main source of information was neighbour and friend Government officials, exhibition, TV/Radio, News paper etc, other concerned officials were totally reluctant or took negligible interest in the dissemination of information.

5.1.5 Land use pattern

Table 5.5: Land use pattern of sample farms (in ha)

Particulars	Size group			Overall
	Small	Medium	Large	
Total holding	30.00 (100.00)	64.00 (100.00)	150.00 (100.00)	82.00 (100.00)
Area under cultivation	28.00 (93.33)	58.00 (90.62)	134.00 (89.33)	73.33 (89.42)
Uncultivated land	0.80 (2.66)	2.00 (3.12)	10.00 (6.66)	12.80 (15.61)
Net sown area	28.00 (93.33)	58.00 (90.62)	134 (89.33)	73.33 (91.09)
Fallow land	1.20 (4.00)	4.00 (6.25)	6.00 (4.00)	11.20 (13.66)
Irrigated area	24.00 (80.00)	50.00 (78.12)	120.00 (80.00)	64.66 (78.85)

(Figures in brackets indicate percentage to the total)

Table 5.2 shows that the average size of holdings ranged from 1.50 ha to 7.50 ha on different size of farm with an average of 5.15 ha on sample farm. The 91.09 percent net sown area available from cultivator out of total area avalble with the sample from. The minimum area under cultivation in relative term was on large farm (89.33%) against maximum in case of small farm (93.33%). Thus, proportionate area under cultivation revealed inverse relation with the farm size. The net irrigated area was 78 to 80% of cultivated area on sample farm and the uncultivated area was 2 to 6% in different size of groups.

5.1.6 Cropping pattern

Cropping pattern indicated the level of development and the economic prosperity of the region. It specifics the type of crops and proportion of area allocated under each crop.

Table 5.6: Cropping pattern on sample farms (in ha)

S. No.	Crops	Size group			Overall
		Small	Medium	Large	
A.	**Kharif**				
1.	Hybrid Maize	17 (28.12)	36 (32.72)	80 (31.25)	133 (31.74)
2.	Soybean	05 (9.43)	11 (10.00)	30 (11.71)	46 (10.97)
3.	Jwar	04 (7.54)	07 (6.36)	15 (5.85)	26 (6.20)
	Other	02 (3.77)	04 (3.63)	09 (3.51)	15 (3.57)
	Sub Total	28 (52.83)	58 (52.72)	134 (52.34)	220 (52.50)
B.	**Rabi**				
1.	Wheat	14 (26.41)	31 (28.18)	85 (33.20)	130 (31.02)
2.	Gram	05 (9.43)	08 (7.27)	13 (5.07)	26 (6.20)
3.	Hybrid Maize	04 (7.54)	07 (6.36)	15 (5.85)	26 (6.20)
4.	Other	02 (3.77)	06 (5.45)	09 (3.51)	17 (4.05)
Total		25 (47.16)	52 (47.27)	122 (47.62)	99 (47.49)
Gross cropped area		53 (100)	110 (100)	256 (100)	419 (100)
Cropping intensity (%)		175	173	170	172

(Figures in brackets indicate percentage to the total)

In other words cropping pattern refers to the numbers of crops grown in a piece of land during a period of time. The cropping patterns adopted by sample farmers have been presented in the table 5.6. As depicted in table. The main crops grown by the sample farmers during Kharif season were hybrid maize and soybean. area ploughed under crops during Kharif season was higher than that under rabi crops irrespective of farm size because of profitability and favourable market conditions prevalent in the study area. hybrid maize was the main crop of Kharif season which alone shared 31.74%. wheat crop was the main crop of Rabi season which alone shared 31.02% of total cropped area.

5.1.7 Cost of cultivation

In the farm management studies costs are viewed from different angles for different purposes. Costs of cultivation are used by the Agricultural Cost and Price commission for fixation of support price of agricultural commodities. Besides this, they are also useful in farm planning and policy making. Therefore, due consideration should be given to cover both fixed and operational costs to operate agriculture as a business and not as a way of life only.

The farmers cultivated Hybrid Maize crop in 31.74% of the gross cropped area of the sample farm. It is observed from the Table 5.7 that the total cost incurred in cultivation of Hybrid Maize at the overall farm level was Rs. 34700 per hectare which was higher in small farm (Rs. 37180/ha) and lowest in large farm (Rs. 32281/ha) revealed inverse relation with the farm size due to scale economies. The operational cost was Rs. 13864, nearly 40 per cent of the total cost and the fixed cost was accounted for Rs. 9058, around 26.10 per cent of the total cost.

Table 5.7: Cost of cultivation of Hybrid Maize on sample farm (Rs/ha)

Particulars		Size group			
		Small	**Medium**	**Large**	**Overall**
1. Operational cost					
A. Human labour	Family	3804.08 (10.23)	2696.29 (7.78)	2073.19 (6.42)	2857.85 (8.14)
	Hired	5313.05 (14.28)	5878.46 (16.96)	5608.15 (17.37)	5600.08 (16.13)
B. Bullock labour	Owned	2507.38 (6.74)	2339.15 (6.75)	2505.62 (7.76)	2450.71 (7.06)
C. Machine labour	Owned	980.42 (2.63)	2339.82 (6.75)	3162.45 (9.79)	2160.89 (6.22)
	Hired	2382.98 (6.40)	-	-	794.32 (2.28)
Sub Total		14987.7 (40.31)	13253.72 (38.26)	13350.01 (41.35)	13863.88 (39.95)
2. Material cost					
A. Seed		3600.00 (9.68)	3060.00 (8.83)	2700.00 (8.36)	3120.00 (8.99)
B. fertilizer & manure		4409.79 (11.88)	4390.94 (12.67)	4028.74 (12.47)	4276.49 (12.32)
C. Irrigation		-	-	-	-
D. PPM		140.22 (0.37)	150.75 (0.43)	180.12 (0.55)	157.03 (0.45)
Total material cost		8150.01 (21.92)	7601.69 (21.94)	6908.86 (21.40)	7553.52 (21.76)
Interest on working capital@10%		1156.88 (3.11)	1042.77 (3.01)	1012.94 (3.13)	1070.86 (3.08)
Total operational cost		24294.59 (65.34)	21898.18 (63.21)	21269.81 (65.88)	22487.52 (64.80)
3. Fixed cost					
A. Rental value of land		8418.66 (22.64)	8306.66 (23.97)	6500.00 (20.13)	7741.77 (22.31)
B. Depreciation		220.00 (0.59)	430.00 (1.24)	740.00 (2.29)	463.33 (1.33)
C. Revenue/tax		17.00 (0.04)	17.00 (0.04)	17.00 (0.04)	17.00 (0.04)
D. Interest on fixed cost@10%		850.00 (02.28)	840.00 (2.42)	837.00 (2.59)	842.33 (2.42)
E. Total fixed cost		9505.66 (25.56)	9593.66 (27.69)	8077.17 (25.02)	9058.83 (26.10)
A. Total cost (Operational + Fixed cost)		33800.25 (90.90)	31491.34 (90.90)	29346.81 (90.90)	31546.13 (90.90)
B. 10% managerial cost		3380.02	3149.13	2934.68	3154.61
C. Total Cost		37180.27 (100)	34640.37 (100)	32281.66 (100)	34700.66 (100)
Grain production (q/ha)		45.00	43.00	39.00	42.33
By product (q/ha)		47.00	53.00	50.00	50.00

(Figures in brackets indicate percentage to the total cost)

The labour cost on an average accounted to be 39.95 per cent of the total cost which varied from 40.31 per cent in small farm to 41.35 per cent in large farm. The variation in total labour requirement among different size farms is due to difference in the style of operational practices. Among material cost, seed alone contributed about one-tenth of the total cost lowest (Rs. 2700/ha) being in large farm and highest being in small farm (Rs. 3600/ha). Manure and fertilizer together was responsible to cost 11.88 to 12.67 per cent of the total cost for different size groups. plant protection measure cost was around 0.44 per cent of the total cost. Interest on working capital was to the extent of 3.08 per cent of total cost on various sizes of farms. Rental value of land fixed items shared more than one-fourth (22.31%) of the total cost revealed decreasing trend with farm size in absolute terms. The yield of main product per hectare was found to be 42.33 quintals/ha lowest being in large farm (39q/ha) and highest being in small farm (45q/ha), indicating the intensive cultivation of hybrid maize by sample farmers.

5.1.8 Cost Concept

Almost everyday in farm organization and operation cost consideration enters. It is an important tool for measuring farm business activities. The farm management specialists have specified cost of cultivation into cost A_1, A_2, B_1, B_2 Cost C_1, C_2 & C_3. These cost concepts have already been taken up in the methodology chapter. In this section efforts have been made to discuss according to (various costs concepts) cultivation of hybrid maize sample farmers and different size groups of land holdings.

Table 5.8. Cost of cultivation of hybrid maize according to cost concept on sample farms.

(Rs./ha)

S. No.	Cost	Size group			
		Small	Medium	Large	Overall
1	Cost A_1 and A_2	20727.51	19684.89	19953.62	20110.00 (57.95)
2	Cost B_1	21577.51	20488.89	20790.62	20952.62 (60.38)
3	Cost B_2	29996.17	28795.55	27290.62	28694.11 (82.69)
4	Cost C_1	25381.59	23185.18	22863.81	23810.19 (68.61)
5	Cost C_2	33800.25	31491.84	29363.81	31541.96 (90.90)
6	Cost C_3	37180.27	34640.37	32281.66	34700.76 (100)

(Figures in brackets indicate percentage to the total)

The table 5.8 clearly shows that on an average total cost of (cost c_3) Rs. 34700.76 per hectare was required to produce this crop of which 58% comprised for the variable cost commonly known as cost $A_1$and A_2 After adding interest on fixed capital to cost A_1, the cost went upto 60% as cost B_1 and when imputed value of land was further added it was increased upto 82 per cent. Thus, the and 10 per cent cost of the cost C_2 when added in this cost, it form total cost or cost C_3. Table further inferred that cost A_1 to Cost C_3 decreases with the increase in size of holding. The per cent of various costs to cost C_3 did not show any significant difference among different farms in cultivation of hybrid maize on sample farm.

5.1.9 Profitability concepts

In any field of business activity profit is the prime consideration. Thus, how much a farmer earns as net income and family labour income as a producing unit and how much satisfaction he and his family derives as a consuming unit are the major deciding factor in organisation and operation of farm. Hence, in this section efforts have been made to discuss the gross income, net income over operational and total cost, family labour income, input-output ratio, cost of production of hybrid maize

Table 5.9: Profitability of hybrid maize production on sample farm (Rs/ha)

S. No.	Economic parameter	Size group			
		Small	**Medium**	**Large**	**Overall**
1	Total operational cost	24294.59	21898.18	21269.81	22487.52
	Total cost	37180.27	34640.37	32281.66	34700.76
2	Main produce	45000	43000	39000	42334
3	By produce	5512	5840	5320	5557
4	Gross income	50512	49840	44320	48224
5	**Net income over**				
(i)	Operational cost	26217.41	27941.18	23050.19	25736.26
(ii)	Total cost	13331.73	15199.63	12038.34	13523.23
6	Input output ratio	1:1.3	1:1.4	1:1.2	1:1.3
7	Family labour income	20515.83	21044.45	17029.38	19529.88
8	Farm business income	29784.49	30191.11	24366.38	28113.99
9	Cost of production(Rs/q)	700.74	682.19	731.12	704.03

(Figures in brackets indicate percentage to the total)

From the table 5.9 it is clear that when physical output and by-product are converted into monetary terms the total cost from hybrid maize are Rs. 37,180 Rs. 34,640 and Rs. 32,281 in case of small, medium and large farm with an average of Rs. 34,700 on sample farm. Thus, total cost hybrid maize decrease with an increase in farm size.

Input-output ratio in other words can be termed as the return per rupee of investment. The input-output ratio was more favourable to small farm (1:1.3), followed by medium farm (1:1.4) and large farm (1:1.2). Therefore, it could be concluded that there in an decrease in the ratio of input-output as the size of land holding increase.

A glance of the date given in the table 5.9 shows that per hectare net income over operational cost ranged between Rs. 21269 to Rs. 24294 per hectare. The variation noted reduced in terms of family labour income due to inclusion of a relatively higher imputed value of family labour. The net-income and family labour income decreased with the increase in size groups. The average per hectare family labour income was Rs. 19529 and was Rs. 20515 in the case of small farm, Rs. 21044 and Rs. 17029 in the case of medium and large size groups respectively. The cost of production per quintal varied from Rs. 682 to Rs. 731 with an average of Rs. 704. It can be said the difference was not quite extra-ordinary between the different size classes.

5.1.10 Break-even analysis

Break even analysis is carried out to arrive at that minimum level at which optimum conditions of cost and returns is equated that is no profit no loss point.

Table 5.10: Break even yield (q/ha) and price (Rs./q) of hybrid maize on sample farm.

Particulars	Size group			
	Small	Medium	Large	Overall
I. Yield (q/ha) (i) Break even	31.53	29.33	28.53	29.80
II. Actual	45.00	43.00	39.00	42.33
III. Gap	13.47 (42.91)	13.67 (46.60)	10.47 (36.69)	12.53 (42.04)
I. Price (Rs./q) (i) Break even	700.74	682.17	731.32	704.03
II. Actual	1000	1000	1000	1000
III. Gap price (Rs./q)	299.26 (42.70)	317.13 (46.59)	268.28 (36.64)	295.12 (41.91)

(Figure in parentheses shows percentage change over break- even)

The table 5.10 reveals that selected small farmer will not be at loss even if their actual yield of hybrid maize is lowered by 13.47 quintals per hectare. Similarly in case of medium farm an yield lessened by 13.67 qt. per hectare of the actual yield will be able to cover the total cost of cultivation per hectare. The hybrid maize growers on large farms is at no profit no loss position if yield level on these farms is 28.53 qt/ha which is 36.69 per cent higher then actual yield. At the over all level hybrid maize yield would remain proposition of no profit and no loss if actual yield declined by 12.53 qt/ha. Thus, the existing cost of cultivation and physical output of crop yielded sufficient profit to the small farmers.

Similarly actual market price of hybrid maize obtained by sample farmers is 1000 which is higher than break even price ranged between 79 to 86 per cent in different size farms. Thus, sample farmers are in profitable position in existing yield and price obtained in the study area.

5.11 Resource use productivity of hybrid maize

The regression coefficient of different inputs in the production function were estimated separately for each size group and for the overall sample farms. The estimated values of the regression coefficient of all the input for all the farmers are presented in table 5.11 the value of coefficient of multiple determination (R2) were found to be quite high in all size groups (82 to 91.1) which indicated that the selected resource in the production function was the best fit.

Table 5.11: Regression coefficient of resources used in hybrid maize production.

Particulars	Size group			
	Small	Medium	Large	Overall
No. of farmers	20	20	20	60
Constant (a)	1.110	1.825	1.946	1.265
Regression coefficient (b) of				
(X1)	0.135	0.099	0.311*	0.196
	(0.215)	(0.201)	(0.176)	(0.104)
(X2)	0.452*	0.824**	0.424*	0.464***
	(0.257)	(0.328)	(0.241)	(0.145)
(X3)	0.421*	0.439*	0.375*	0.330***
	(0.239)	(0.249)	(0.213)	(0.084)
(X4)	0.120*	-0.021	-0.013	0.009
	(0.068)	(0.100)	(0.045)	(0.032)
(X5)	0.377*	-0.216	-0.107	-0.045
	(0.214)	(0.181)	(0.096)	(0.052)
∑bi	1.057	0.734	0.733	0.954
R^2	0.918	0.827	0.848	0.856

(Figures in brackets indicate standard error of regression coefficient)

* Significant at 10% level of significance

** Significant at 5% level of significance

*** Significant at 1% level of significance

The return to scale is the sum of the elasticities of resources includes in the power function, which indication the behavior of change of total return while changing the level of all the inputs simultaneously in the same proportion. At the overall level the sum of regression was 0.954 and 1.057 on small group 0.733 and 0.736 on medium and large group of farmer respectively which indication decreasing return to scale in all size groups except small farmer.

The values of coefficient of human labour was found significant in large size catageory 0.135, 0.099, 0.311*. The value of coefficient of machine labour for all the three size groups were significant at 10 percent level of significance but of overall level of coefficient as found high significance at 1 percent of level of significance . It shows that if we increase machine labour investment by 1%, keeping other input factors constant we obtain only 0.45, 0.82 and 0.42 present increased production in small, medium and large respectively.

The values of coefficient of seed for size small, medium and large were observed to be 0.42, 0.43 and 0.37 respectively and were found significant at 10% level. It show that addition of this variable will increase production of the crop. The value of coefficient in all sample size was 0.33 and significant at 5% level which indicated that seed addition in cultivation of hybrid maize crop will increase its production as for as all sample respondents are concerned.

The regression coefficient of incesticede and pesticide for small, medium and large farmer and all sample size group were observed to be 0.120, -0.021,-0.013 and 0.009 respectively. The values of coefficient in medium and large size groups were negative and insignificant but small group size the value was positive and significant at10% level so it indicated that three is still contribution of this variable in the production of hybrid maize crop in small group of farmer.

The regression coefficients of fertilizer to small, medium and large group of farmer were found to be 0.377, -0.216, -0.107 respectively and in significant in case of medium and large group of farmer. While in case of small farmer the value was positive and significant at 10% level which show

that, there was no scope to increase fertilizer in small group of farmer only on production of hybrid maize crop. Overall it could be concluded that variation in human labour in large group of farmer machine labour and seed in all the three size groups, insecticide and fertilizer only in size group small, will increase the production of hybrid maize crop if increased.

5.12 Marginal Value Product:

Table 5.12: Marginal value of product of resources used in hybrid maize production.

Resource	Size group		
	Small	**Medium**	**Large**
	MVPi	MVPi	MVPi
X_1	0.828	0614	1.422
X_2	4.262	10.673	4.856
X_3	7.964	1.123	5.939
X_4	5.120	-0.719	-0.765
X_5	4.615	-0.425	-0.787

The marginal value productivity of each selected input was estimated at geometric mean of gross output and their respective input factors for hybrid maize crop are presented in table 5.12

The marginal value productivity of human labour for hybrid maize crop were 0.83, 0.61 and 1.42 for small, medium and large size farmer respectively which show that an additional rupee invested on small and medium size farmer will add only Rs 0.82 and Rs. 0.61 to the return while in case of large farmer. It is advisable to invest on this input for hybrid maize production.

Data show that if we increase the investment on machine labour and seed in all the three size groups will add positive return to the gross income. The marginal value productivity of insecticides and pesticide were 5.12, -0.71 and -0.76 rupees on small, medium and large group indicated that any investment on this input would bring negative return to the gross income the

MVP of the input insecticide and pesticide was negative because of the negative & coefficient of the factor.

The MUP of fertilizer were 4.61, -0.425 and -0.78 rupee on small, medium and large farmer group respectively.

5.13 Constraints

Analysis into costs and returns for hybrid maize production of sample farmers discussed in the previous section reveal the fact that many farmers have not used recommended levels of inputs and level of hybrid maize production will also than what is under recommend hybrid maize. Therefore, it was thought proper to find out the constraints,in reaching goal as shown under scientific management. The technological economic and institutional constraints were reported by the respondents which have been presented in Table.

Table 5.13 Constraints in hybrid maize production

S. No.	Constraints relating to	Size Group				Ranking
		Small (N=20)	Medium (N=20)	Large (N=20)	Overall (N=60)	
1.	Knowladge about seed variety,rate	15 (75)	17 (85)	16 (80)	48 (80)	II
2.	Unavailable irrigation	12 (60)	10 (50)	03 (15)	25 (42)	X
3.	Unawareness of NPK dosage	15 (75)	13 (65)	10 (50)	38 (63)	VIII
4.	Unfavorable product price	15 (75)	13 (65)	17 (85)	45 (75)	III
5.	Unfavorable climate condition	11 (55)	13 (65)	15 (75)	39 (65)	VII
6.	Lack of capital	19 (95)	17 (85)	15 (75)	51 (85)	I
7.	Attack of disease and pest	14 (70)	13 (65)	15 (75)	42 (70)	VI
8.	Low plant population	11 (55)	10 (50)	09 (45)	43 (71)	V
9.	Shortage of labour	09 (45)	09 (45)	11 (55)	29 (48)	IX
10.	Higher cost of cultivation	17 (85)	14 (70)	13 (65)	44 (73)	IV

(Figures in brackets indicate percentage to the total)

The Table 5.13 show The lack of capital was reported as a main constraint in hybrid maize production irrespective of the size of holdings followed by low plant population, knowledge about seed variety, unfavorable price, high cost of cultivation, low plant population, attack of disease and pest, unfavorable climate condition, unawareness of NPK dosage, shortage of labour and water scarcity as reported by 80, 75, 71, 70, 65, 63, 48, and 42 percent of the house hold.

This identified constraints need to minimize throw extension service financial assistant for increasing the adoption of production technology and achieving then level of production of hybrid maize on sample farm.

Chapter – VI

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

Maize (*Zea mays .)* is a major cereal crop and emerging as third most important crop in India after rice and wheat. Maize is having special significance because in addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. It provides the nutritional security as it contains 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 1% ash. Due to its high yielding potential, it is called queen of cereals.

At global level, India ranks 4th in area and 7th in production of maize. Agriculture contributes major amount of our gross domestic product, i.e. 14.2 %. Maize is grown in 8.26 million hectares in India with the production of 16.72 million tones and productivity is 2024 kg/ha. In Madhya Pradesh it is grown in 0.83 million hectare area with the production of 1.05 million tones, and productivity is 1256 kg /ha Focused research on single cross hybrid across the country has helped in increasing production and productivity of hybrid maize.

Hybrid maize under optimum crop production, protection and nutrient management can produce economically more yield as compared to commercial varieties. Recently some new hybrids are evolved and it is necessary to evaluate their comparative performance.

Specific Objectives:

1. To measures costs and returns of Hybrid maize production sample farm
2. To estimate resource use efficiency of important inputs in Hybrid maize production.
3. To identify constraints associated with production of Hybrid maize and measures to minimize constraints.The study was confined to Chhindwara district of Madhya Pradesh state.

Chhindwara district comprises 11 blocks viz; Chhindwara, Mohkher, Tamia, Junnardev, Parasia, Amarwara, Harrai, chourai, sousar, Bichua and Pandhurna etc.

In order to keep the study within manageable limits only one block that is Chhindwara was selected purposively. A cluster of hire villages producing maximum hybrid maize were selected in consultation with A.D.A. and other officials of Agricultural Department. The list of hybrid maize growers in the selected villages were prepared according to their size of holding viz; small (up to 2 ha), medium (2.01 to 4 ha) and large (above 4 ha) and 20 hybrid maize growers were selected by simple random sampling method, totaled to 60 in number.

The required data were collected by the survey method, and personal interview of respondents with the help of pre-tested question schedule. The primary data pertain to Agricultural year 2012-13 Various farm business analysis were carried out to analyze the collected data. The data were analyzed in light of objective using cost of cultivation and profitability concept. The Cobb-Douglas production function was used for estimation of resource use efficiency of recommended hybrid maize technology by the sample farmers. Opinion of the respondents were also shorted out to identified the constraints in Hybrid maize production.

Conclusion

- The micro level analysis of the data of sample holding characterized by 5.15 hectare of average size of holding rang from 1.50 to 7.50 ha on sample farms. The area under cultivation on sample farm was 89.42 per cent which decreased as the farm size increased.
- The average strength family size of the sample respondents was 7.00 which was directly associated with farm size.
- About 40 per cent of the sample respondents belongs to OBC followed by Scheduled caste 22 per cent, general caste 20 per cent and least percentage belongs to scheduled tribes 18 per cent.

- Cropping pattern of the sample respondents is dominated by Soybean and hybrid maize in kharif and gram and wheat during rabi season. hybrid maize alone shared over 33 per cent of the gross cropped area on sample farm their relative contribution increased as the farm size increase. Cropping intensity on sample farm was 172 per cent which ranged between 175 per cent on small farm to 170 per cent on large farm.

- Total cost per hectare incurred in hybrid maize production on sample farm was Rs. 34700.76. which decreased as the farm size increased. The proportion of operational cost and fixed cost to total cost on sample farm was 63 and 38. of the total cost was alone contributed by owned and family labours which varied between 38 to 40 per cent on different farm.

- Cost of cultivation according to various cost concepts (Cost A_1 to Cost C_3) in different size of farms decreased as the farm size increased.

- Net income obtained from hybrid maize production was Rs. 13523.23 per hectare with maximum of Rs. 15199.63/ha on medeum farm to Rs. 12038.34/ha on large farm revealing inverse relations with the farm size. Input-output ratio was 1:1.3 with marginal variations in different size of holdings. Cost of production of hybrid maize varied from Rs. 682.19 to Rs. 731.32 with an average of Rs. 704.03 per quintal revealing to extra ordinary difference between the different size farms.

- Coefficient of multiple determinations (R^2) in the fitted Cobb-Douglas production was 0.85 indicating the included variables explained 96 per cent variations in dependent variable. The value of R^2 varied between 0.91 in small farm to 0.84 in case of large farm. The sum of regression coefficients of selected variable on different farm was less than unity indicating decreasing return to scale.

- Regarding resource use productivity of hybrid maize indicated that human labour was found significant in case of large farmer

- The coefficient insecticides and pesticides and fertilizer was found significant in case of small farmer. While coefficient of machine labour

and seed were found significant across all the size of groups and overall level the coefficient was found highly significant indicated that the above variable contributing in the production of hybrid maize.

- The marginal value productivity of the resource was found more than 1 for the variables which are found significant.
- The lack of capital was reported as a main constraint in hybrid maize production irrespective of the size of holdings followed by low plant population, knowledge about seed variety, unfavorable price, high cost of cultivation, low plant population, attack of disease and pest, unfavorable climate condition, unawareness of NPK dosage, shortage of labour and water scarcity as reported by 80, 75, 71, 70, 65, 63, 48, and 42 percent of the house hold

Suggestions

Based on the findings of the study some suggestions for higher and equitable production of hybrid maize are given below:

1. The soci-economic backwardness of farmers of study area is a higher obstacles in acceptance of the improved technology. It is suggested that frequency of extension visits should be increased to encourage more, wider spread and adoption of farm technology.
2. Improved hybrid maize producers may be cultivated intensively by adopting full package of practices. Provision of cheap credit followed by marketing and processing techniques is an urgent need of the area.
3. The wide gap between productivity level of hybrid maize and attainable yields was observed in the study area. Yield gap can be decreased by augmenting the productivity level of hybrid maize. throw resource adjustment and reallable resources use under cob-Douglas production function. Thus, sincere efforts be made by the extension personnel to motivate the farmers to adopt non-conventional production technology. Krishi Vigyan Kendra should identify the problems of farmers and feed back and solution of constraints be provided in time to the farmers.

4. To raise the fund for hybrid maize research 1 per cent cess/tax be imposed on the farmers who sell their produce in mandi. The accumulated fund be used for location specific research related to increase the hybrid maize productivity.

5. The cost of cultivation incurred in hybrid maize production be reduced by curtailing the labour cost and reallocation of available budgets be made in various production factors to raise the benefit.

6. Needs to developed the cultivators in which AFLATOXIN is not present for its wider availability at international level.

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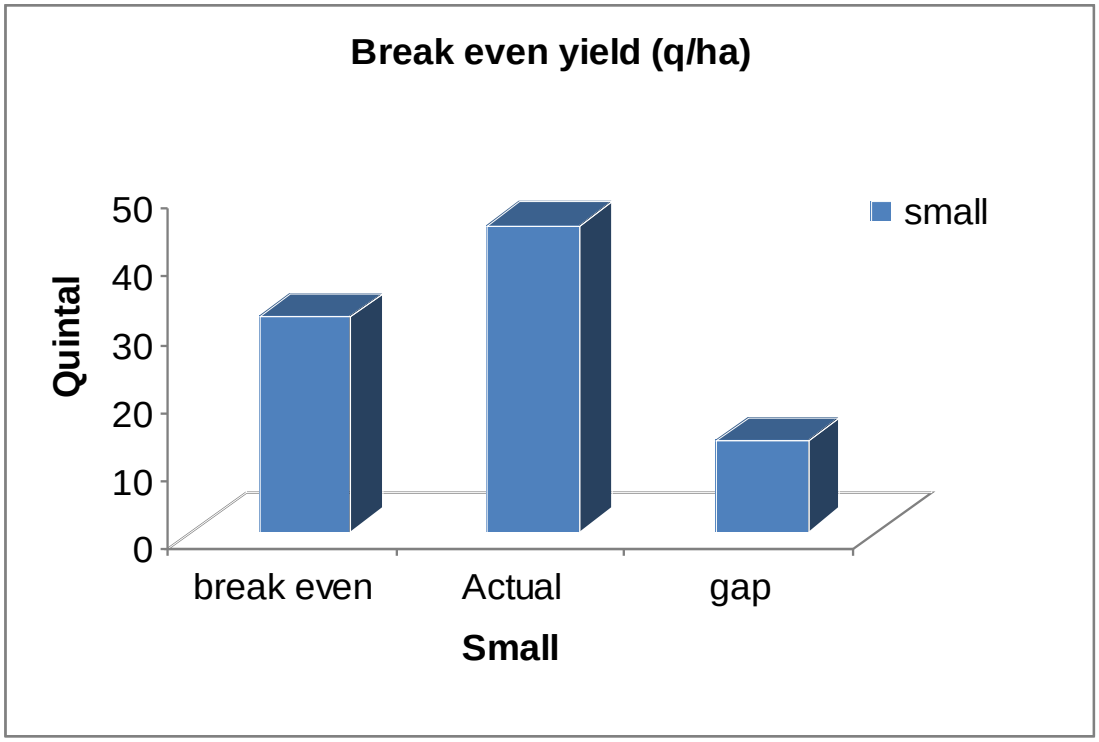


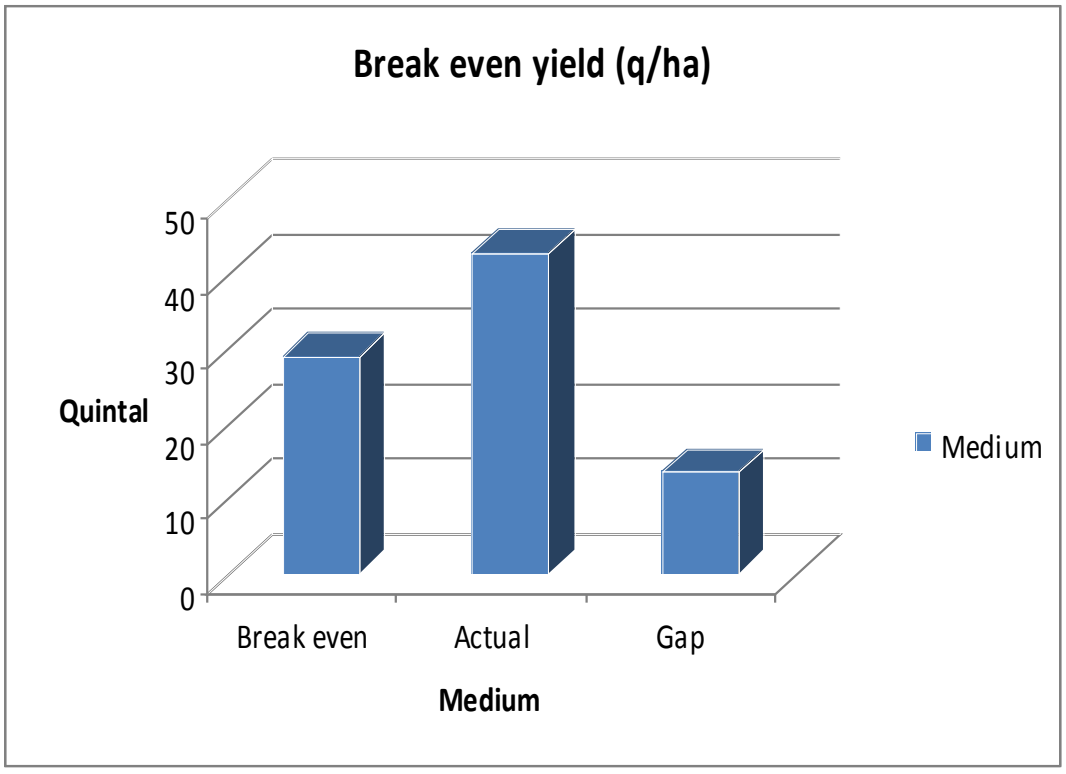
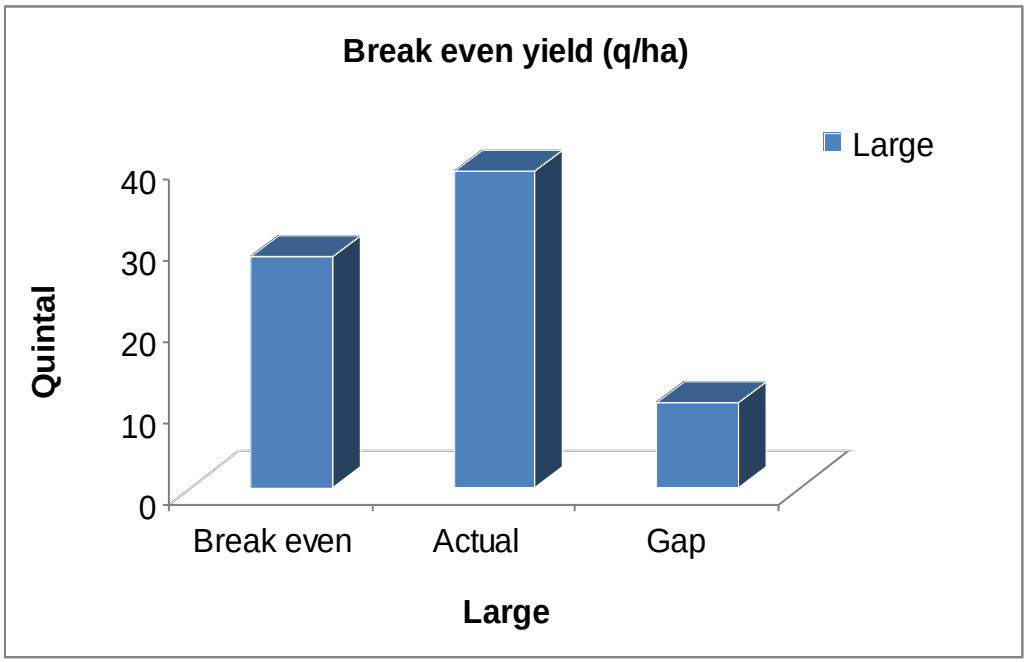


Fig.5.5: Break even yield analysis of small and medium sample farm (q/ha)



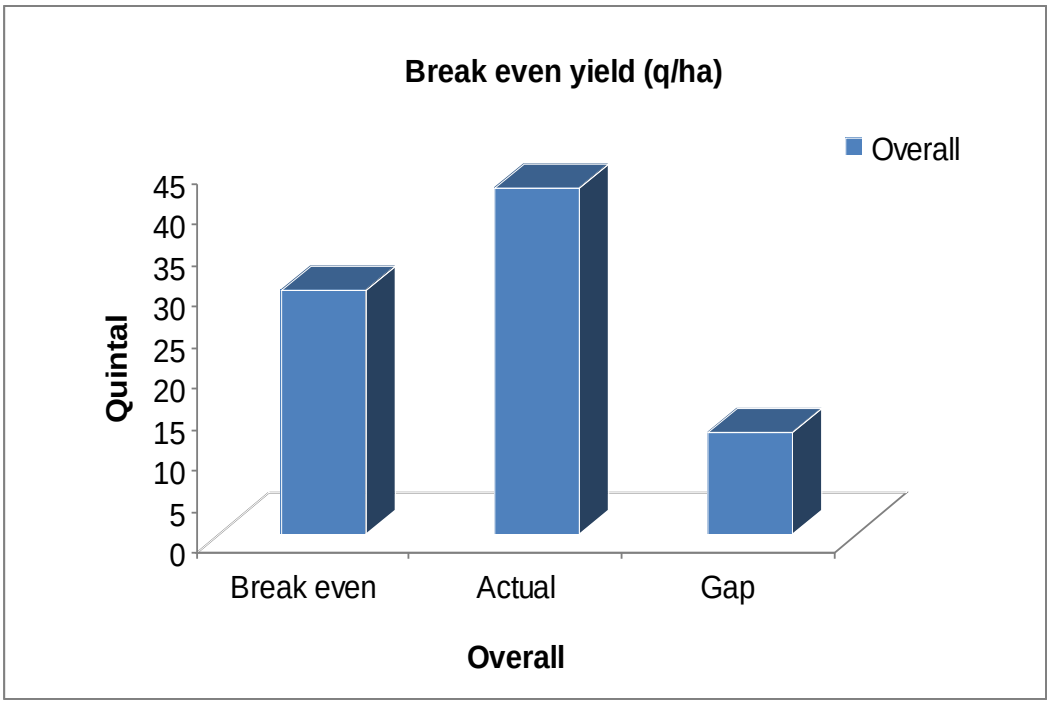
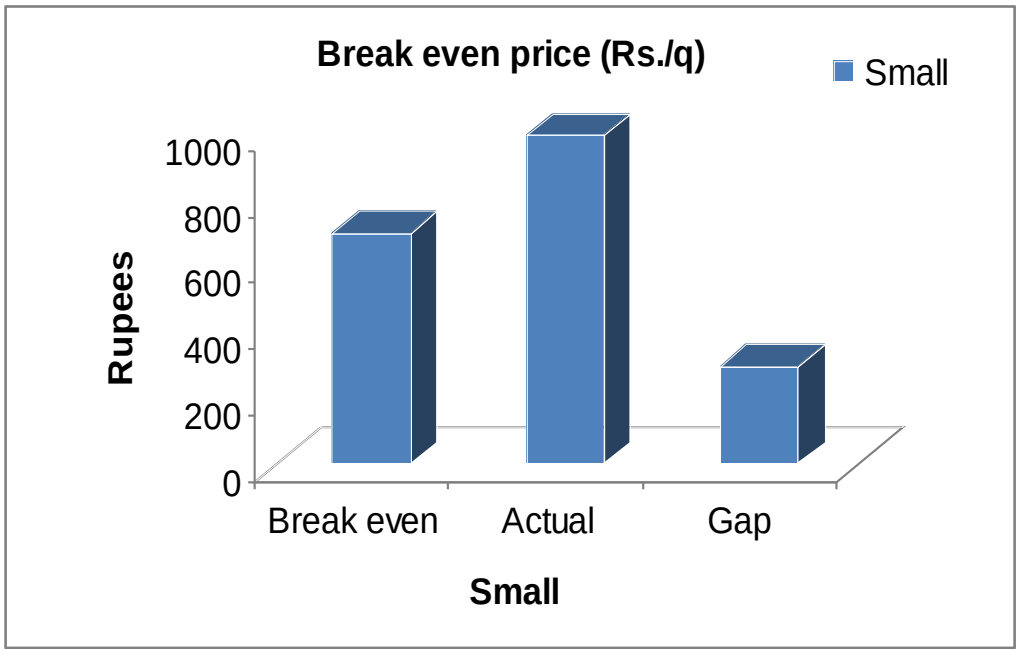


Fig.5.6: Break even yield analysis of Large and Overall sample farm (q/ha)



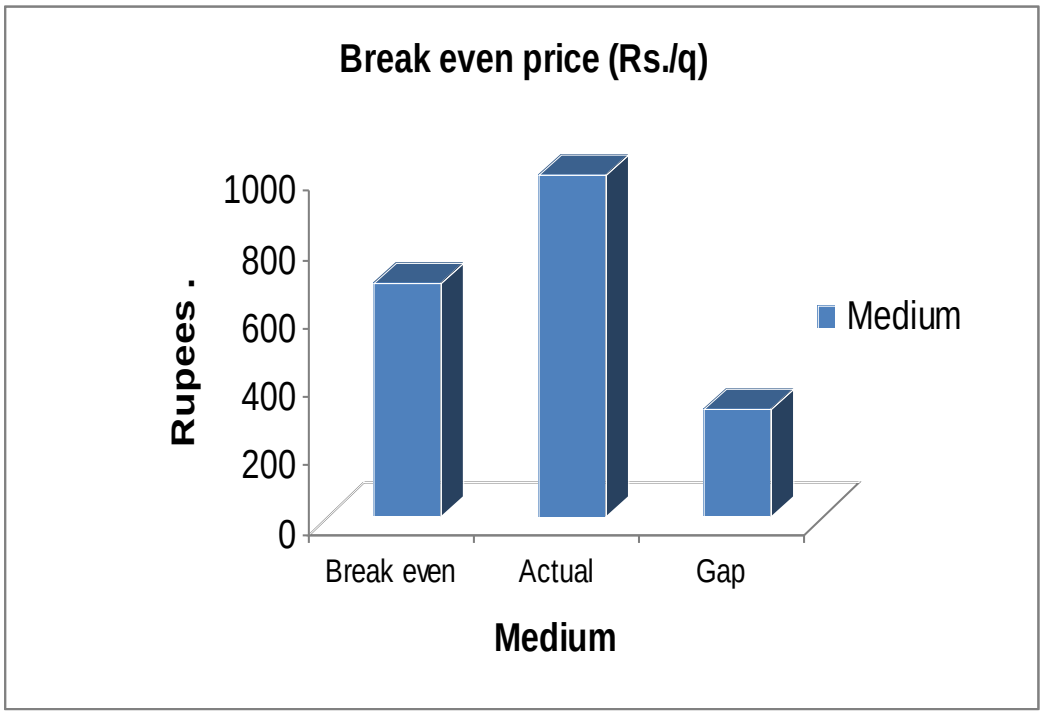
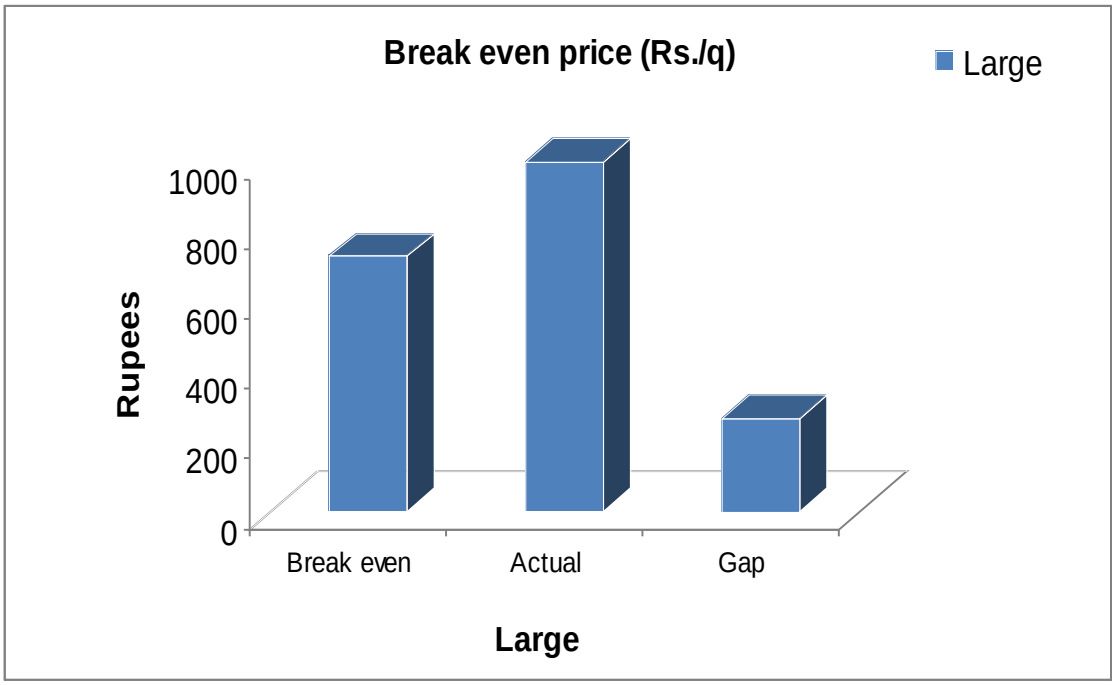


Fig.5.7: Break even Price analysis of small and medium sample farm (Rs./q)



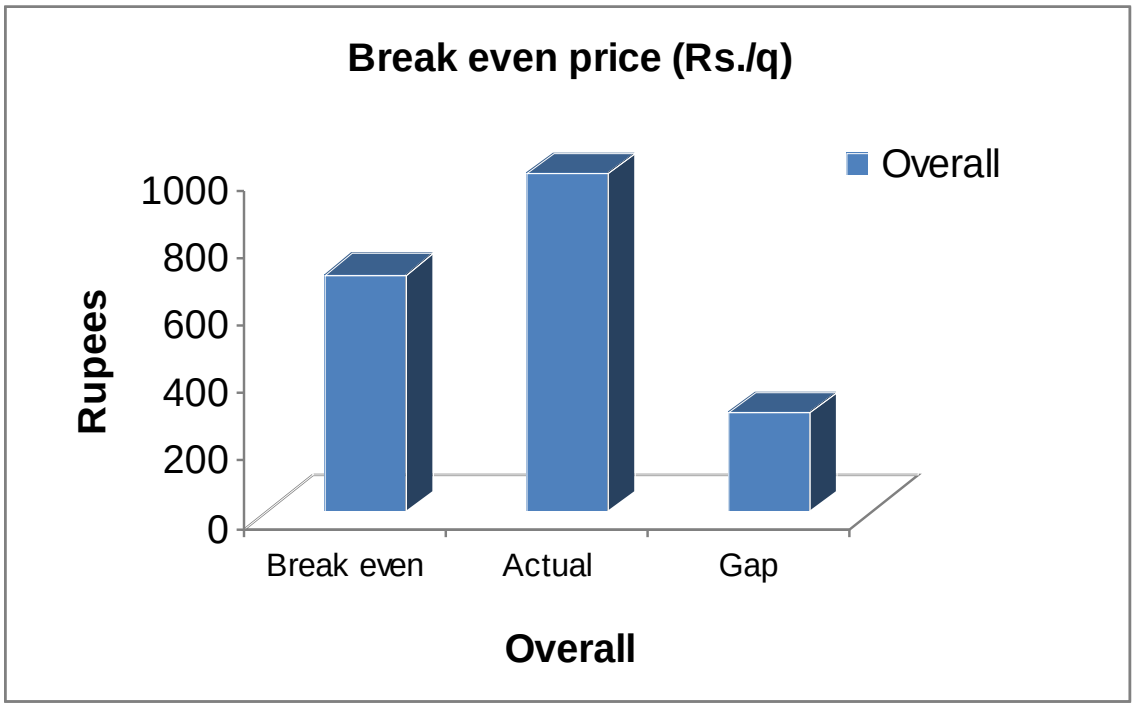
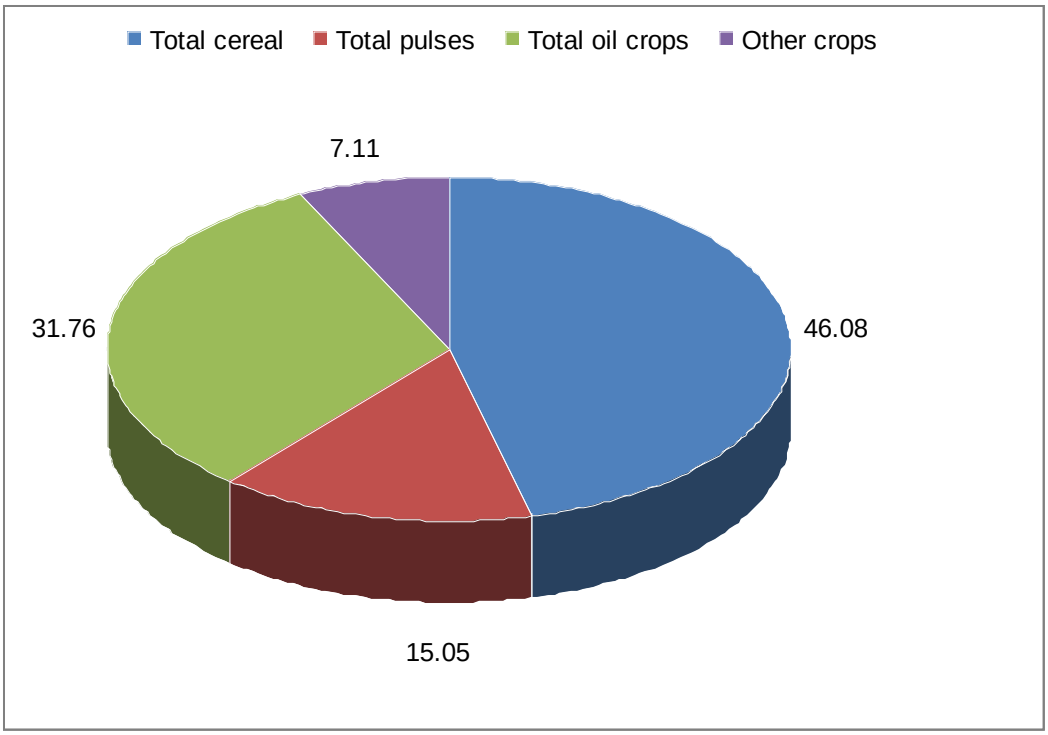


Fig.5.8: Break even Price analysis of Large and Overall farm (Rs./q)



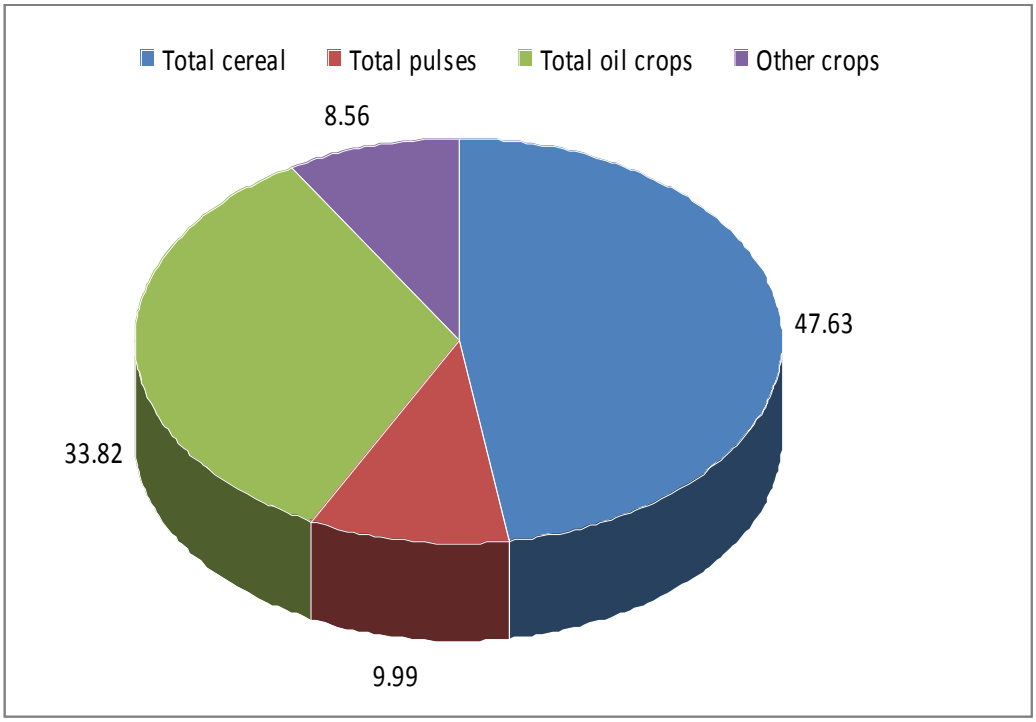
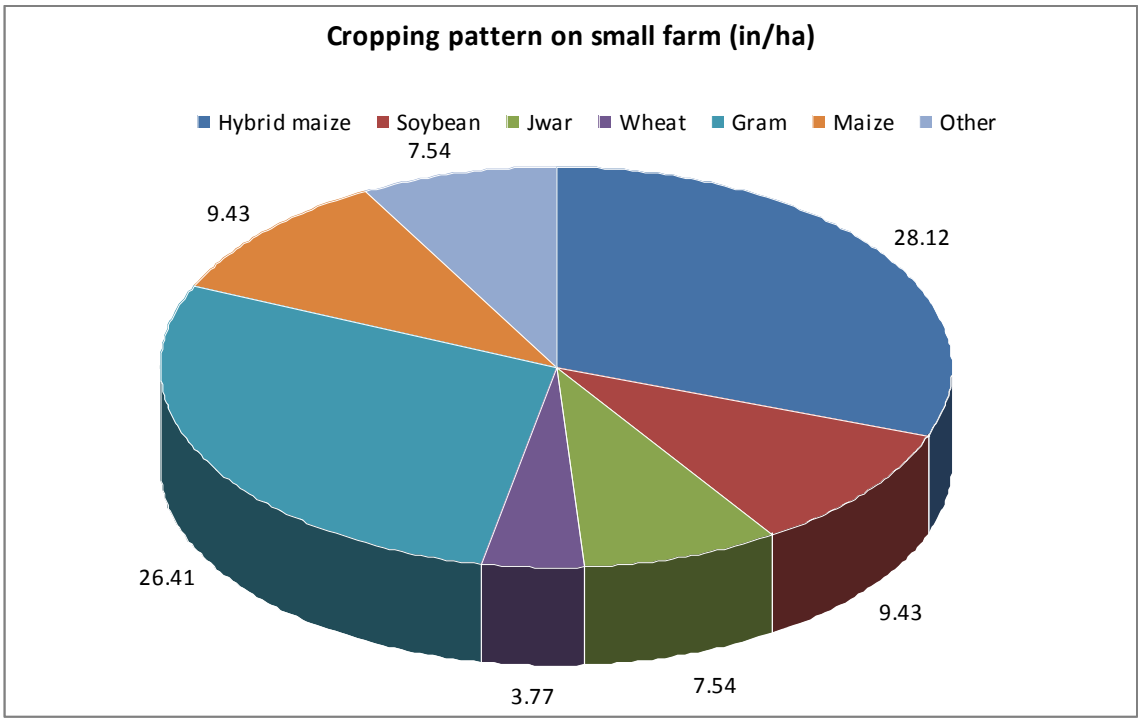


Fig.3.1 Cropping pattern of Chhindwara District and Block



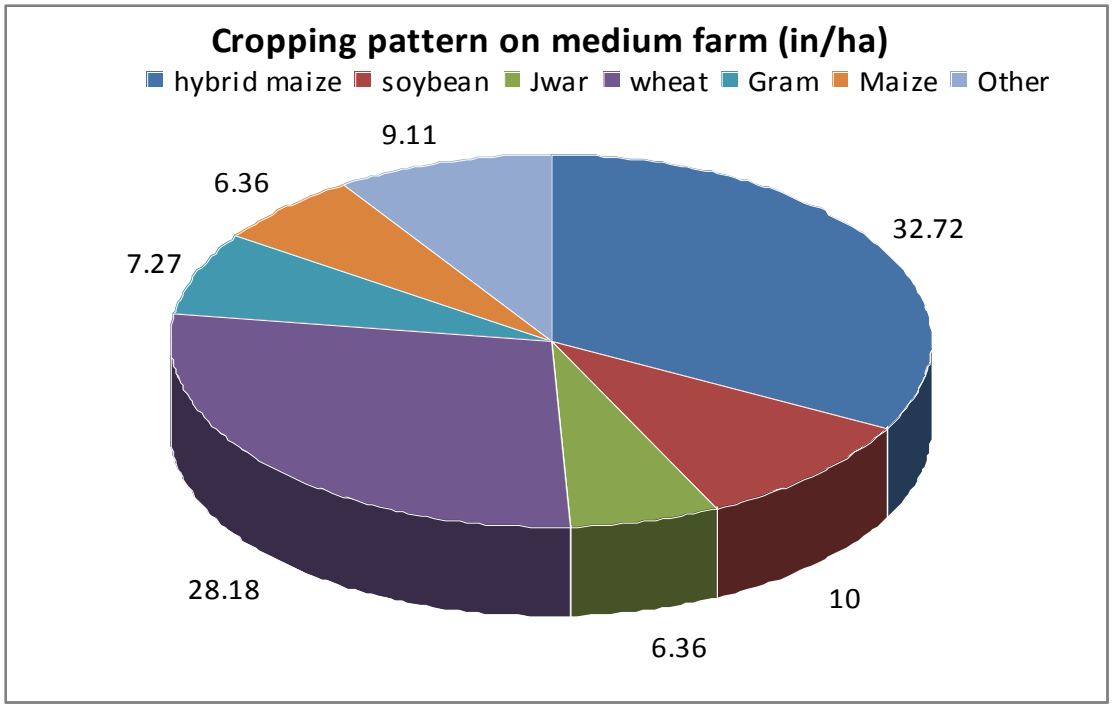
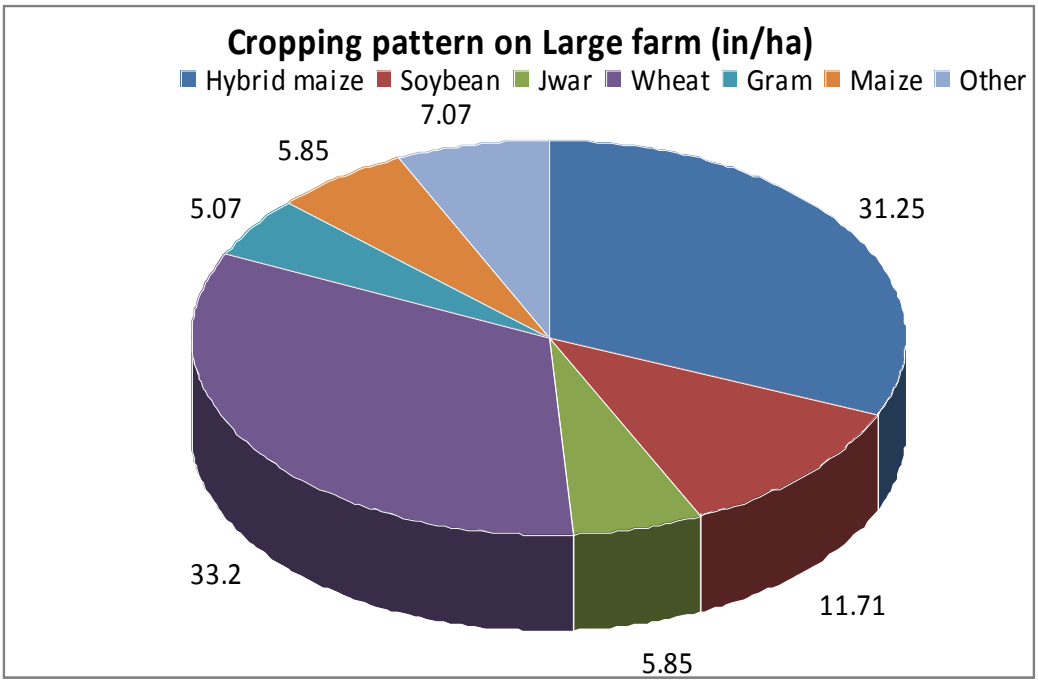


Fig. 5.1: Cropping pattern on small and medium sample farms (in ha)



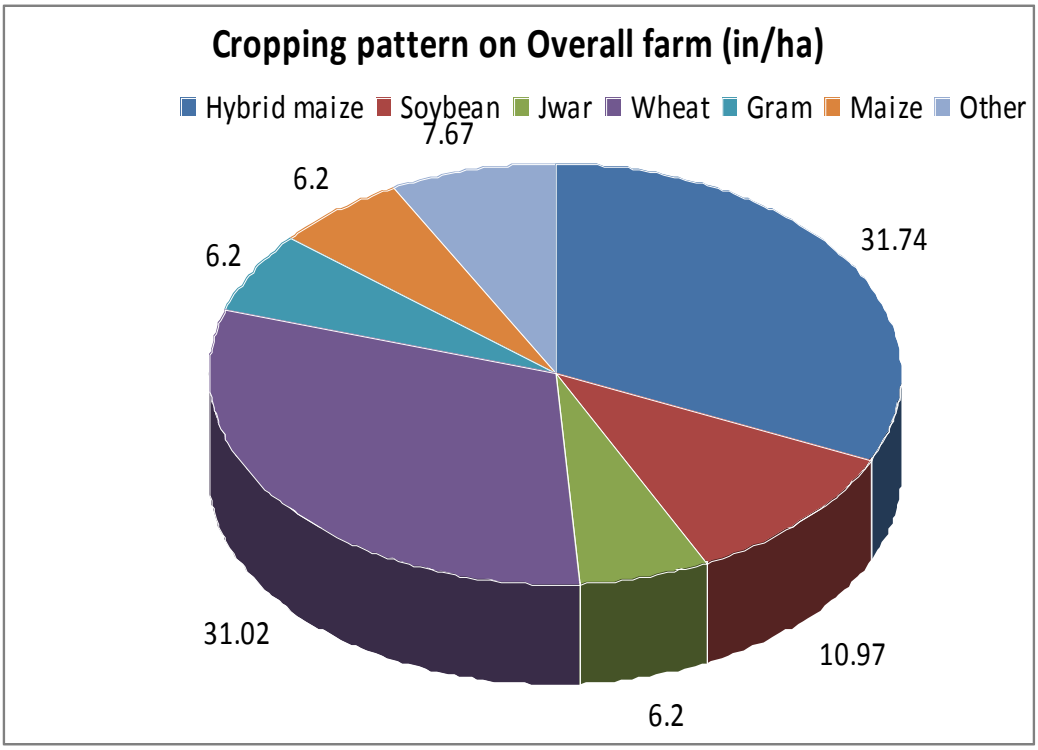
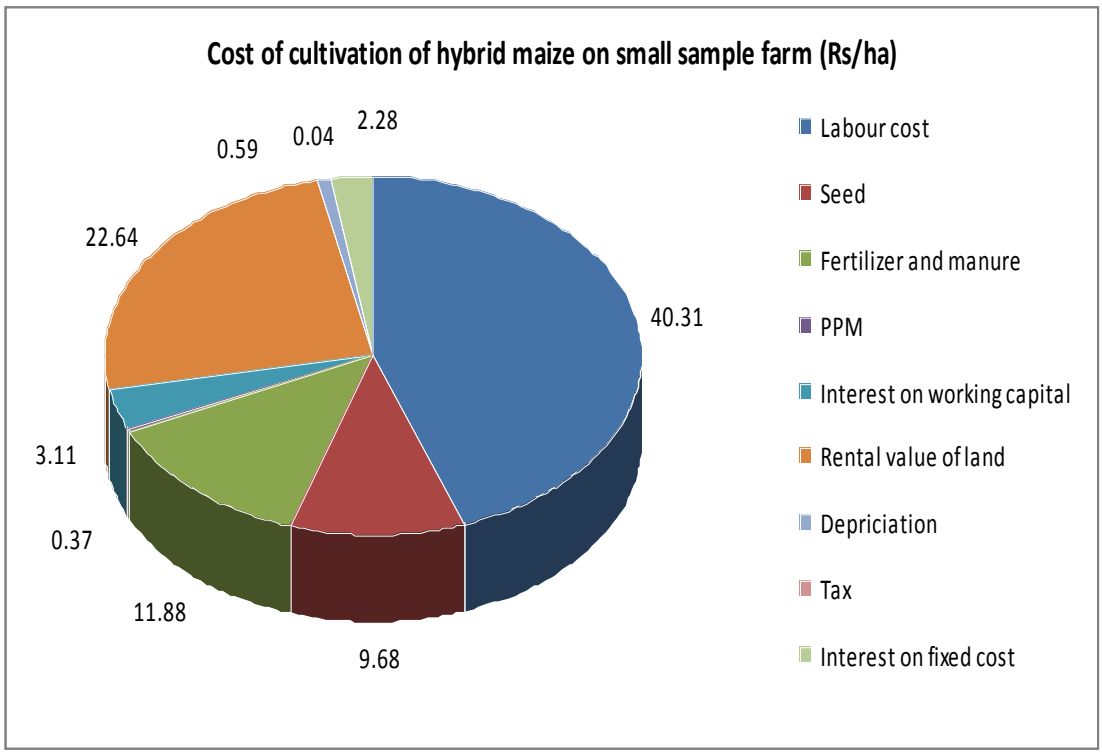


Fig. 5.2: Cropping pattern on large and overall sample farms (in ha)



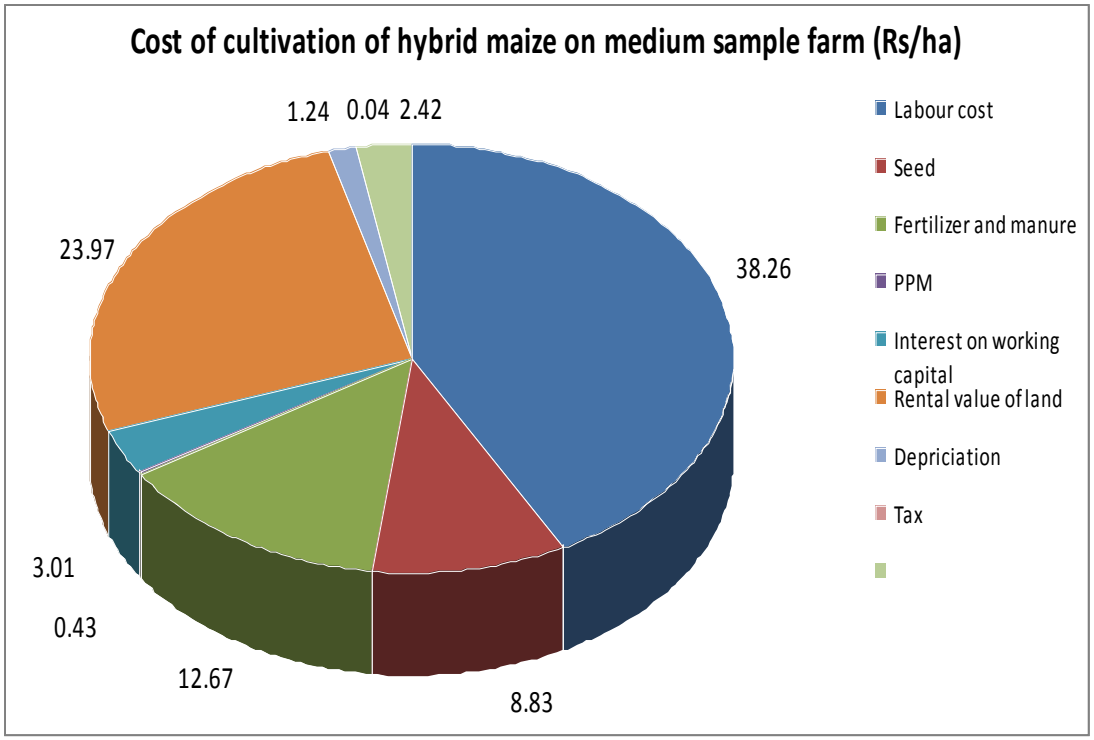
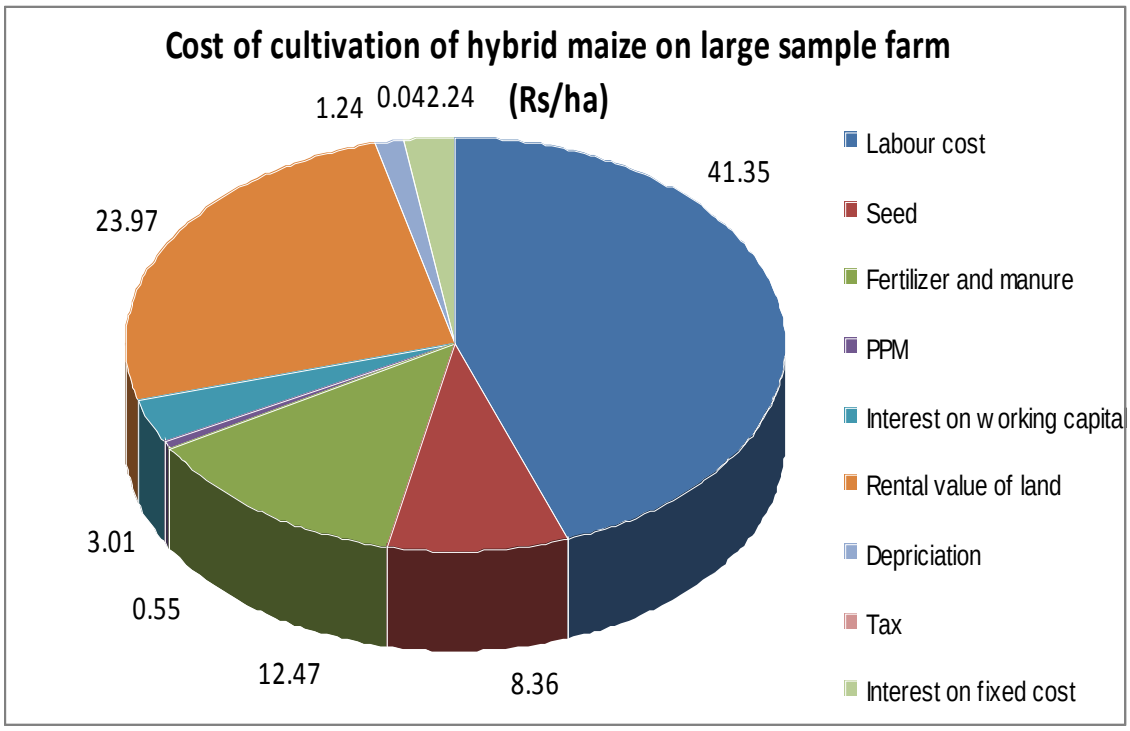


Fig. 5.3 : Cost cultivation of Hybrid Maize on Small and Medium sample farm (Rs /ha)



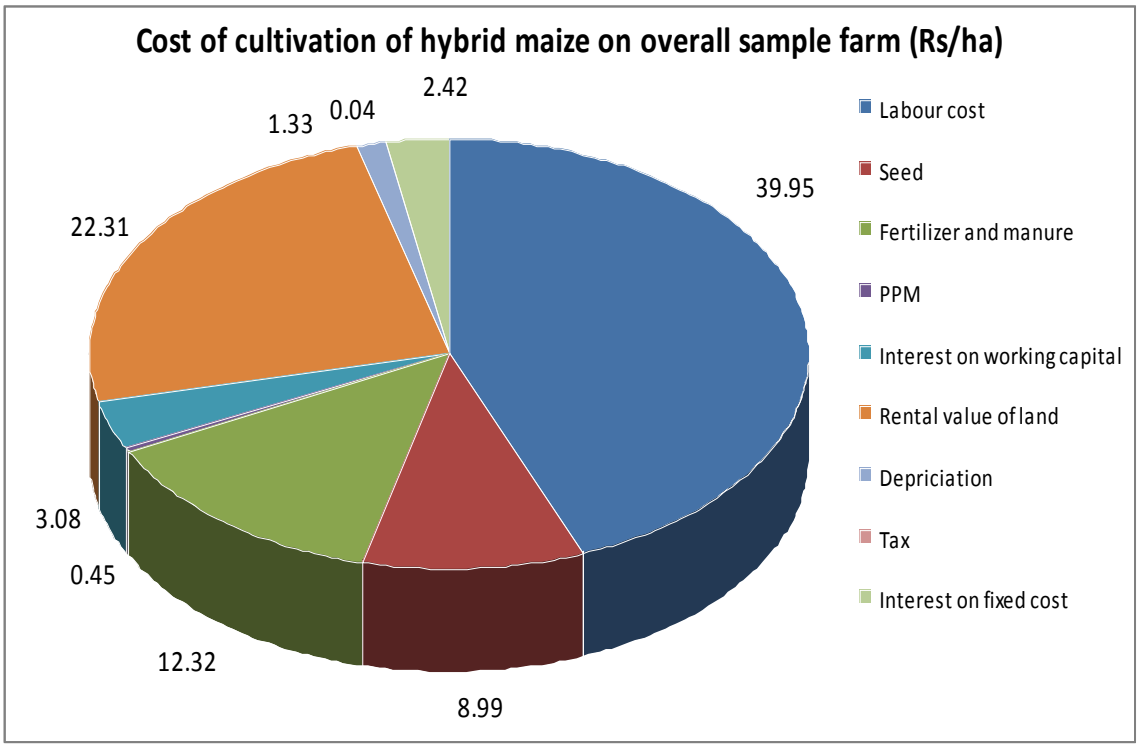


Fig. 5.4: Cost cultivation of Hybrid Maize on Large and Overall sample farm (Rs /ha)

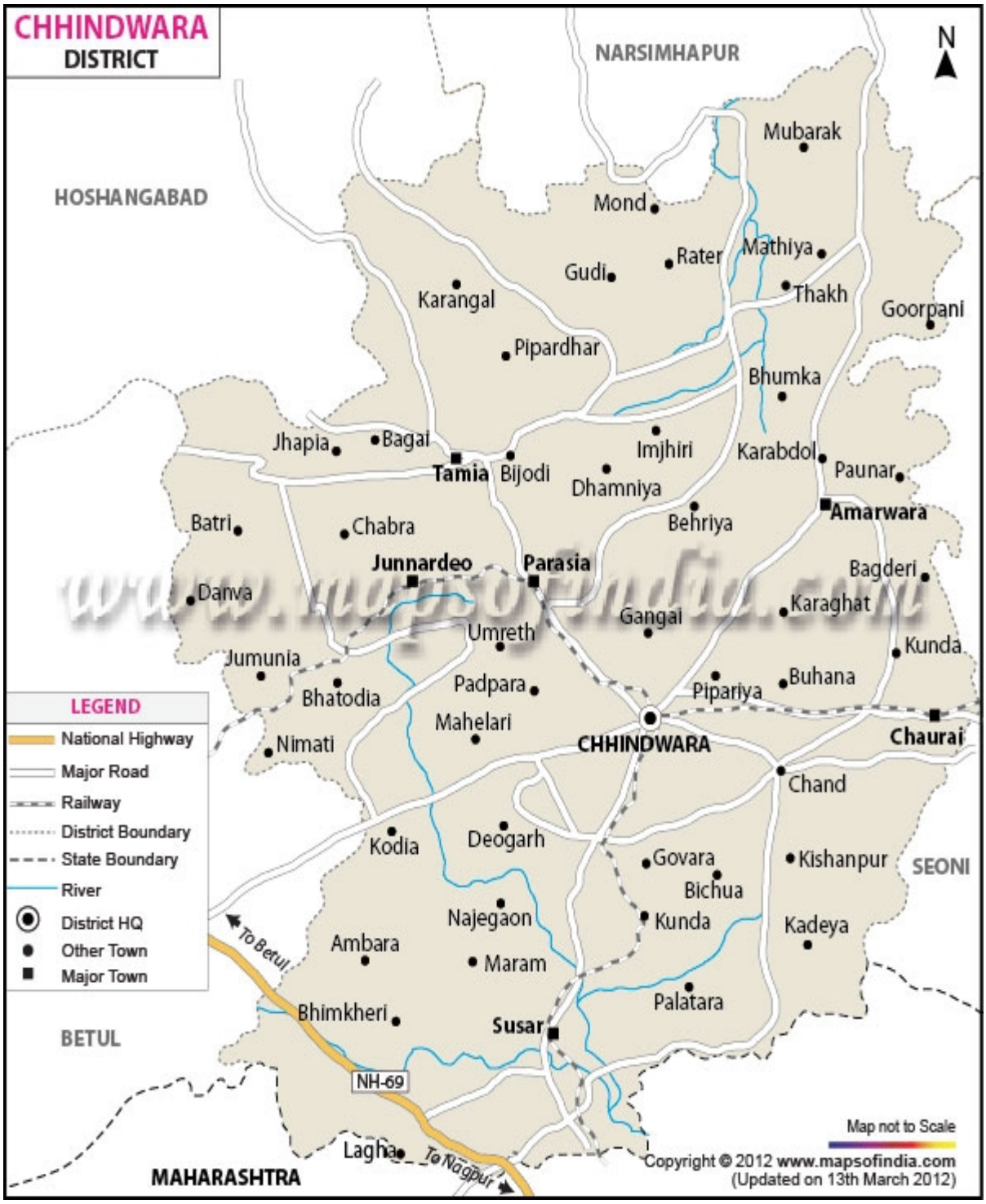


Fig. Map in Chhindwara District

JAWAHARLAL NEHRU KRISHI VISHWA VIDHYALAYA, JABALPUAR (M.P.)

SCHEDULE OF INVESTIGATION

TITAL: "Resource use efficiency of hybrid maize production in Chhindwara district of Madhya Pradesh."

Advisor-
Dr. N.K.RAGHUVANSHI
Dept. of Agril. Econ. and F. M.
JNKVV, JABALPUR

Investigator
DEEPAK KORDE
M.Sc. (Ag.) final year

I. General information

Name of farmer : Shri……

Father's name : Shri……

Caste :……..

Address :……..

Village ..……

Block ……

District ……

II. Family information

S. No.	Name of family member	M/F	Age	Education	occupation

III. Land Use Pattern (in Acres)

S. No.	Particulars	Area (Acres)
1.	Size of holding	
2.	Net cultivation area	
3.	Permanent fellow land	
4.	Old fellow lend	
5.	Current follow land	
6.	Leased in land	
7.	Leased out land	
8.	Irrigated area	
Source of irrigation		
9.	Well	
10.	Tube well	

IV. Cropping pattern (in Acres)

Season	Name of crops	Variety	Area
Kharif			
Rabi			
Others			

V. Agricultural Assets

S. No.	Assets	Total No.	Present Values (Rs.)
1.	Land (Acres)		
2.	Farm house (No.)		
3.	Well (No.)		
4.	Tube well		
5.	Electric pump and pipe		
6.	Plough		
7.	Duffan/Trifan		
8.	Pata		
9.	Bullock cart		
10.	Tractor		
11.	Cultivator		
12.	Seed drill		
13.	Trolley		
14.	Spade		
15.	Khurpi		
16.	Power implements		
17.	Chaff cutter		
18.	Any other specify		

Cost of cultivation of crop

Name of variety (1) :…… (2) :…… (3) :……

Area under crop ……

VI. Operational cost

Operations	Human labour Hrs/Days		Bullock pair/Days		Machine Hrs	
	Family	Hired	Family	Hired	Family	Hired
Land preparation						
Sowing						
Weeding time/intercultural						
Manuring						
Fertilize Plant Protection application						
Harvesting						
Threshing						
Others						

VII. Material cost

S. No.	Particulars	Name	Quantity	Rate
1.	Seed			
2.	Fungicides			
3.	Manure			
4.	Fertilizer			
a.	UREA			
b.	SSP			
c.	DAP			
d.	Grow more			
e.	MOP			
f.	Others			
5.	Bio-fertilizers			
6.	Plant Protection Chemicals			
A	insecticide			
B	Pesticides			
C	Weedicide			
7.	Others			

VIII. Production constraints

S. No.	Constraints related to	Constraints
1.	Field preparation	1…...
		2…...
		3…...
		4…...
2.	Seed and sowing	1…...
		2…...
		3…...
		4…...

3.	Seed treatment	1……..
		2……..
		3……..
		4……..
4.	Manures and fertilizers	1……..
		2……..
		3……..
		4……..
5.	Plant protection	1……..
		2……..
		3……..
		4……..
6.	Irrigation	1……..
		2……..
		3……..
		4……..
7.	Harvesting	1……..
		2……..
		3……..
		4……..
8.	Threshing	1……..
		2……..
		3……..
		4……..
9.	Winnowing	1……..
		2……..
		3……..
		4……..
10.	Cleaning	1……..
		2……..
		3……..
		4……..
11.	Grading	1……..
		2……..
		3……..
		4……..
12.	Packaging	1……..
		2……..
		3……..
		4……..
13.	Packing	1……..
		2……..
		3……..
		4……..
14.	Transportation	1……..
		2……..
		3……..
		4……..
15.	Storage	1……..
		2……..
		3……..
		4……..

16.	Finance	1……..
		2……..
		3……..
		4……..
17.	Credit cards	1……..
		2……..
		3……..
		4……..
18.	Crop insurance	1……..
		2……..
		3……..
		4……..
19.	Warehousing	1……..
		2……..
		3……..
		4……..
20.	MSP	1……..
		2……..
		3……..
		4……..
21.	Others	1……..
		2……..
		3……..
		4……..

ABSTRACT

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ABSTRACT

Maize is considered the third most important cereal crop after rice and wheat in the world. This cereal is referred as Miracle crop and Queen of the Cereals due to its high productivity potential compared to other Graminaceae family members. It is a seasonal crop, annually it can be harvested thrice i.e., in Kharif, Rabi and summer seasons. Maize usually grown as a pure crop but also be grown as an intercrop with different crops like sugar cane, cotton, vegetables, legume crops etc.

In Madhya Pradesh Chhindwara, Dhar, Jhabua, Betul, Rajgarh and Mandsaur are the major maize producing districts. Chhindwara district is the leading district in terms of both area as well as production. The total area under maize in this district is about 94.7 thousand hectares with production of 288.7 thousand tonnes in 2011-12. The climatic conditions of the district are extremely suitable for maize crop. There is a wide scope for increasing area and production in the district. In this situation it is essential to know the reasons of low adoption of improved practices. Thus, present study was canvassed to know the existing knowledge and adoption gap among the farming community of maize growers of the Chhindwara district. Thus, this study was taken with the following specific objectives.

Specific objectives

1. To measures costs and returns of Hybrid maize production on sample farm.
2. To estimate resource use efficiency of important inputs in Hybrid maize production.
3. To identify constraints associated with production of Hybrid maize and measures to minimize constraints.

Chhindwara district of Madhya Pradesh was selected purposively as this district is very potential for Hybrid Maize Production. The district having 11 blocks out of which Chhindwara block was selected as due to investigator is well acquainted with the study area and it was helpful to collect the correct information. After selection of block, a list of hybrid maize growing villages was prepared and 3 villages were selected. From the selected villages a list of hybrid maize growing farmers were prepared. The hybrid maize growing farmers were categorised into three size groups. From each size group 20

farmers were selected by simple random sampling method. Thus total 60 farmers were considered for detail investigation to fulfil the stated objectives.

The primary data pertains to the agricultural year 2012-13 and block wise secondary data on area, production and productivity of hybrid maize from the year 2011-12.

Conclusion

Overall it could be concluded that: The micro level analysis of the data of sample holding characterized by 5.15 hectare of average size of holding ranging from 1.50 ha to 7.50 ha on sample farms. The area under cultivation on sample farm was 89.42 per cent which decreased as the farm size increased. The average family size of the sample respondents was directly associated with farm size and increased with farm size. Cropping pattern of the sample respondents is dominated by Soybean and hybrid maize in Kharif and gram and wheat during Rabi season. Hybrid maize alone shared over 33 per cent of the gross cropped area on sample farm & its relative contribution increased as the farm size increased. Total cost per hectare incurred in hybrid maize production on sample farm was Rs. 34700.76 which decreased as the farm size increased. The proportion of operational cost and fixed cost to total cost on sample farm was 63 and 37 of the total cost was alone contributed by owned and family labours which varied between 38 to 40 per cent on different farm. Cost of cultivation according to various cost concepts (Cost A_1 to Cost C_3) \ in different size of farms decreased as the farm size increased. Net income obtained from hybrid maize production was Rs.13523.23 per hectare with maximum of Rs. 15199.63/ha on medium farm to Rs. 12038.34/ha on large farm revealing inverse relations with the farm size. Input-output ratio was 1:1.3 with marginal variations in different size of holdings. Cost of production of hybrid maize varied from Rs. 682.19 to Rs. 731.32 with an average of Rs. 704.03 per quintal revealing to extra ordinary difference between the different size farms. The sum of regression coefficients of selected variable on different farm was less than unity indicating decreasing return to scale. Regarding resource use productivity of hybrid maize indicated that human labour was found significant in case of large farmer.The coefficient insecticides and pesticides and fertilizer were found significant in case of small farmers while coefficient of machine labour and seed were found significant across all the size of groups and overall level the coefficient

was found highly significant indicated that the above variable contributing in the production of hybrid maize.The marginal value productivity of the resource was found more than 1 for the variables which are found significant.The lack of capital was reported as a main constraint in hybrid maize production irrespective of the size of holdings followed by low plant population, knowledge about seed variety, unfavourable price, high cost of cultivation, low plant population, attack of disease and pest, unfavourable climate condition, unawareness of NPK dosage, shortage of labour and water scarcity.

Suggestions

Based on the findings of the study some suggestions for higher and equitable production of hybrid maize are given below:

1. The socio-economic backwardness of farmers of study area is a higher obstacle in acceptance of the improved technology. It is suggested that frequency of extension visits should be increased to encourage more, wider spread and adoption of farm technology.
2. Improved hybrid maize producers may be cultivated intensively by adopting full package of practices. Provision of cheap credit followed by marketing and processing techniques is an urgent need of the area.
3. The wide gap between productivity level of hybrid maize and attainable yields was observed in the study area. Yield gap can be decreased by augmenting the productivity level of hybrid maize through resource adjustment and recallable resources use under cob-Douglas production function. Thus, sincere efforts be made by the extension personnel to motivate the farmers to adopt non-conventional production technology. Krishi Vigyan Kendra should identify the problems of farmers and feedback and solution of constraints be provided in time to the farmers.
4. The cost of cultivation incurred in hybrid maize production be reduced by curtailing the labour cost and reallocation of available budgets be made in various production factors to raise the benefit.
5. Need to develop the cultivators in which AFLATOXIN is not present for its wider availability at international level.