The study of crop diversification in Jabalpur district of Madhya Pradesh

THESIS

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Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

In partial fulfilment of the requirements for

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In

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(AGRICULTURAL ECONOMICS)

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2020

CERTIFICATE- I

This is to certify that the thesis entitled **"The study of crop diversification in Jabalpur district of Madhya Pradesh"** submitted in partial fulfilment of the requirement for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **Agricultural Economics** of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by **Mr. Deepak Kumar** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.

All the assistance and help received during the course of the investigation has been acknowledged by him.

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Date:

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This is to certify that the thesis entitled **"The study of crop diversification in Jabalpur district of Madhya Pradesh"** submitted by **Mr. Deepak Kumar** to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, in partial fulfilment of the requirements for the degree of **Master of Science (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 on the same.

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Date: **Chairman of the Advisory Committee**

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I, Deepak Kumar S/o Shri Ramdeo Yadav certify that the work embodied in thesis entitled **"The study of crop diversification in Jabalpur district of Madhya Pradesh"** is my own first hand bonafide work carried out by me under the guidance of Dr. N. Khan at Department of Agricultural Economics and Farm Management, College of Agriculture, Jabalpur during 2020.

The matter in the thesis has not been submitted for the award of any other degree/diploma. Due credit has been made to all the assistance and help.

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Place: Jabalpur

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Place: Jabalpur

Date: **Deepak Kumar**

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviations/Symbols	Stand for
HI	Herfindhal Index
SID	Simpson Index of Diversification
Kg/ha	Kilograms per unit hectare
Ha	Hectare
Kg	Kilogram
*	Significant
CV	Co-efficient of Variation
%	Per cent

CHAPTER - I

INTRODUCTION

INTRODUCTION

India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. On the other hand, only 1.6 percent of the farmers have operational land holdings above 10 ha and they utilize 17.4 percent of the total cultivated land. Due to diverse agro-climatic conditions in the country, a large number of agricultural items are produced. Broadly, these can be classified into two groups - food grains crops and commercial crops. Due to the challenge of feeding our vast population and the experience of food shortages in the pre-independence era, 'self-reliance' in food grains has been the corner stone of our policies in the last 50 years. Around 66 percent of the total cultivated area is under food grain crops (cereals and pulses). Concurrently, commercial agriculture developed for whatever reasons in the pre-independent phase also kept flourishing during the post independent period. Commercial agriculture not only catered to the domestic market but has also been one of the major earners of foreign exchange for the country .

Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lesser risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop shift (diversification) also takes place due to governmental policies and thrust on some crops over a given time, for example creation of the Technology Mission on Oilseeds (TMO) to give thrust on oilseeds production as a national need for the country's requirement for less dependency on imports. Market infrastructure development and certain other price related supports also induce crop shift. Often low volume high-value crops like spices also aid in crop diversification. Higher profitability and also the resilience/stability in production also induce crop diversification, for example sugar cane replacing rice and wheat. Crop diversification and also

the growing of large number of crops are practiced in rain fed lands to reduce the risk factor of crop failures due to drought or less rains. Crop substitution and shift are also taking place in the areas with distinct soil problems. For example, the growing of rice in high water table areas replacing oilseeds, pulses and cotton; promotion of soybean in place of sorghum in Vertisols (medium and deep black soils) etc.

Bringing diversity in crops results in strengthening ties between crop culture and livestock. It ensures the availability of rural employment around the year and future of India's agriculture economy. It also results in crop intensification (increase yield per hectare) through the genetic engineering of plants. Crops grow in their required environmental conditions thus removing the barriers of lack of irrigation. On top of it, it brings back the soil's nutrient profile and environmental sustainability.

Crop diversification is not only essential from the farmer's perspective but also the trade balance perspective. Currently, India imports a huge quantity of edible oil from Indonesia and Malaysia. Increase in oil seeds farming in India may help curb the edible oil imports. Similarly, India imports an estimated two million tons of pulses on yearly basis. Government hiked MSP in pulses in order to promote cultivation of pulses in many states in India. This year India also imported huge quantities of b grade maize to meet demands of poultry feed farms. Maize can be a profitable crop for farmers to grow in 2020. Also, to maintain soil fertility, it is essential to grow crops like oil seeds, pulses, cotton and maize.

The incentives provided by the government do not yield the desired results. Government provides high MSP rates for paddy and wheat which leads to many farmers growing the same. The reason for lack of crop diversification in India is the financial overpower of the traditional crop over the new crop. Agricultural planning is necessary to control excessive farming of paddy and wheat and for future of India's agriculture economy. Every year we find reports of stock of wheat and rice being rotten at warehouses of Food Corporation of India. Dead stock of wheat and rice keeps lying at FCI warehouses and we import high quantities of pulses and edible oil to meet the demand.

In conclusion, this loss making habit needs to change with better agricultural planning in India. The launch of schemes to save water and take up production of crops other than paddy in the north-western region of India has not yielded positive results. Government attention and farmer's education are also essential for adopting sustainable farm practices.

Objectives

Considering the importance of crop diversification in Jabalpur district of Madhya Pradesh, the present study is undertaken with the following specific objectives:

1. To study the extent of changes in land utilization pattern.
2. To examine the extent of crop diversification.
3. To study the shift in cropping pattern.
4. To suggest the policy implication based on finding of the study.

Limitation of the study

The present study is based on secondary data obtained from published sources, the analysis is limited to the available stock of the data on the various aspect of the study. The validity of the results of study is therefore based on the degree of reliability of secondary data obtained. However an attempt has been made to have and in depth analysis of the data by adopting suitable analytical technique to arrive at meaningful conclusions.

CHAPTER – II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

An intensive study of available literature is important in gaining familiarity and understanding of the research problem. A deep investigation has been taken up in view of the objectives of the study through acquiring information from various journals, research articles, documents, approved thesis, official websites and other scientific literature. The reviews collected to gain proper understanding of the research problem have been organized chronologically and presented in this chapter.

2.1 Land use Pattern

Pandey and Tewari (1987) made an attempt to study the ecological implications of land use dynamics in Uttar Pradesh. The study revealed that there was a consistent increase in fallow in all the regions despite almost a constant net cultivated area. The cultivated waste was also declining consistently, except in the hills. These changes pointed towards operation of the various in land use dynamics with in the Agricultural sector.

Ramanaiah *et al*.(1990) reported that the importance of forest land use in Andhra Pradesh was second only to Agriculture. The increase in percentage of forest land in the state during the period from 1963-64 to 1978-79 was negligible. The non-cultivable land in the state showed increase from 14.9 per cent of the total area in 1963 -64 to 16.4 per cent in 1978-79, thus showing a net increase of 1.5 per cent. Between 1963- 64 and 1978-79, the percentage of cultivable waste land in the state had decreased by 1.8 per cent and the arable land in the state showed a marginal decrease of 0.1 per cent.

Singh and Kaur (1991) studied the changing pattern of land utilisation in Punjab since the inspection of new farm technology in the mid-sixties i.e. from 1966-67 to 1987-88. The study revealed that the reported area for land utilization remained constant while the area under forests, Area not available for cultivation and net area sown increased during the period. Due to intensification of agriculture, gross cropped area and cropping intensity increased. They have concluded that Punjab agriculture had recorded drastic structural changes since the beginning of the green revolution.

Vaidya and Sikka (1991) studied the land utilization pattern in Himachal Pradesh using secondary data for the period from 1966-67 to 1986-87. They observed that there had been no uniform trend in the changes in the land use classes. The area under forest showed an increasing trend while that of other categories had shown a declining trend. They have projected the land use pattern for the year 2000 on the basis of compound growth rates calculated. The projection revealed that the area under all categories except current fallows would increasing.

Prashant Kumar (2003) studied the land use pattern in the three dry zones of Northern Karnataka. The results showed that there was a decline in the area under non-agricultural uses, cultivable waste, and current fallow land in the case of zone-1 and in the area under non agriculture uses, cultivated waste and net area sown in zone-2. There was a positive growth in the barren and uncultivated land, current fallow land other fallow lands in zone-3. The share of area under cereals increased in the case of zone-2 and zone-3.

Goswami and Challa (2004) Studied the land use pattern in India for the period of 1950-51 to 1997-98. The results indicated that forest area had increased from 40.08 million ha in 1950-51 to 68.65 million ha in 1997-98. There was a significant increase in area under non-agricultural uses showing increase from 9.36 million ha in 1950-51 to 12.3 million ha in 1997-98. It also revealed that the net area sown increased during the study period.

Sreeja (2004) studied the dynamics of land use pattern in Kollam district of Kerala. The results indicated that there was a substantial growth in the current fallow, which was the consequence of year to year rainfall variations. Thus there was an inverse relationship between rainfall and current fallow. Barren and uncultivated land, permanent pastures, land under miscellaneous tree crops and groves and cultivable waste recorded a significant negative growth.

Harish (2006) studied land use dynamics in Mandya district. The study revealed that area under fallow, current fallow, cultivable waste and land under miscellaneous tree crops showed positive growth rate. The land under non-agricultural uses showed a marginal increase in area. This was mainly

because of less infrastructural development. The dynamics of land use pattern showed that majority of the categories of land use showed stability in period (1980-81).

Sharma et al. (2007) conducted a study on changes in land use pattern in Chabri micro watershed for year 1970-71 and 2004-05. They noticed that entire area under forests was under watershed and managed by the government. Forest contributed to about 50 percent of the total geographical area.

Ramappa and Naidu (2009) studied the land utilization pattern in Andhra Pradesh. The study noticed that the possibility for extensive agriculture was very limited since the area under agricultural uses had already reached the maximum level. The area under non-agricultural uses had increased from time to time. This certainly reduces the size of cultivable land. Change in cropping pattern was also necessary to make the most efficient use of land.

2.2 Crop Diversification

Chawla and Chanal (1985) conducted a study on diversification in Punjab Agriculture during 1979-80, compared to 1974-75.The relative significance of different enterprises is revealed that income from crop production to farm sizes, income from dairying, poultry, piggery, forestry, and local transport expanded over the year as well as in relation to farm size. The marginal, small and medium farmers got increasing income from dairy, poultry and miscellaneous sources where the large and big farmers obtained more income from forestry, local transport and miscellaneous source. Therefore, this impact diversification was apparent in all categories of farmers.

Khatkar et al. (1996) worked out the extent of crop diversification in Hisar district of Haryana state using maximum proportion, Herfindhal index and Entropy index. The values of indices ranged from 0.21 to 0.49, from 0.16 to 0.43 and from 0.41 to 0.88 respectively for the above three measures.

Shiyani and Pandey (1998) examined the levels of crop diversification in different agro-climatic zones of Gujarat over a period from 1960-61 to 1995-1996. The district wise time series data on crop acreages was collected from

the Directorate of Agriculture, Gujarat. Analysis was done with the help of five measures namely, Herfindhal index, Ogive index, Entropy index, modified entropy index and composite entropy index. The compound growth model was used to examine trends in acreage under different crops. The results presented in the study concluded that there existed wide spatio – temporal disparity in the acreage allocation under different crops. The study revealed that farmers have shifted their cropping pattern from the subsistence crops to commercials crops. It was also found that the composite entropy index was found to be better suited among five different measures of crop diversification. Relatively more diversification was noticed in the initial years of study as compare to the recent years.

Utpal (2000) examined the levels of crop diversification in different districts of West Bengal from the period of 1970–71 to 1994–95. The time series data on crop acreage was collected from various issues of Economic Review and Statistical abstract of West Bengal. He examined the district wise trends in acreage under different crops and computed crop diversification indices (HI, OI, EI, and MEI) to know the level of concentration or diversification at different point of time and their changes over the years. It was found that there existed wide spatio-temporal variations in the acreage allocation under different crops. Movement towards more commercial crops was observed. The varieties of crops like boro rice, potato and mustard showed an increase in area in most of the districts of West Bengal.

Acharya (2003) analysed the extent and nature of the crop diversification in Indian agriculture at the national and state level. Data related to area under major crops, state wise percentage of gross cropped area, crop value etc. was collected for a period from 1952-53 to 2001-02 from different published sources. An index of crop diversification was worked out at the national as well as state level for assessing the extent of crop diversification in Indian agriculture. The results showed that during last 20 years, the relative area under food grains as a group declined and that under non-food grains has increased. The area under coarse cereals like jowar, bajra, ragi, and small millets had shifted to non-food crops like oil seeds, vegetables, fruits,

sugar cane cotton. However, there was no absolute decline in area under major staple cereals like rice, wheat and even maize.

Joshi *et al*. (2004) in their study found that agriculture sector in South Asia is gradually diversifying in favour of high value commodities namely pulses, oilseeds, vegetables, livestock and fish products. Diversification was more pronounced in rain fed areas, which were by-passed during the green revolution. The rain fed areas were becoming a hub of non-cereals due to their low water requirement and abundant labour supply. Further, the high value crops had substantial potential for generating employment opportunities.

Ravendra Singh (2005) analysed the spatial and temporal changing pattern and level of crop diversification in Indian agriculture between 2002-03 and 2012-13. For measuring the level of crop diversification, Bhatiaˈs method, Herfindahl method, Gibbs and Martins methods have been used. Results of the study have revealed that the level of crop diversification in Indian agriculture has increased during the study period. Karnataka has topped among the most Diversified states in India which is followed by Jammu and Kashmir, Uttarakhand, Rajasthan, Gujarat, Maharashtra, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh and Tamil Nadu. Chattisgarh, Tripura and Odisha have been found among the less cropped diversified states.

Kewda (2006) stated that the value of Herfindahl index was estimated for small, medium and large farmers at 0.177, 0.198 and 0181 respectively. The overall Herfindahl index was 0.182, which was close to the zero and indicated enough crop diversification. There was no direct relationship between holding size and diversification index among the different categories of the farms.

Singh et al. (2006) schematized the pattern and ways of diversification across various states and crops in India. Simpson index was estimated across various states of India for the year 1990-91 and 2000-01. It was observer that the diversification index varied from 0.47 (West Bengal) to 0.9 (Karnataka) in 1990-91 and from 0.40 (Orissa) to 0.92 (Karnataka) in 2000-01. This increased diversification index signified shift towards non-food crops in most

of the states. The study further revealed that in Karnataka, the index had increased. The increase in area under food grains implied shift from coarse cereals to fine cereals.

Suseela and Chandrasekaran (2016) examined the state and regional level pattern of crop diversification Andhra Pradesh during the post liberalization period from 1990-91 to 2014-15 using Herfindahl index of crop diversification. Their study revealed that food grains dominated in the Coastal Andhra region where, paddy is a major crop and oil seeds dominated in the Rayalaseema region where, groundnut is a major crop.

Meena et al. (2016) have measured crop diversification for a uniform data set of 35 year for two districts of Rajasthan state of India namely Kota Jaisalmer. They focussed on status and changing pattern of crop diversification in the districts with a comparative outlook of both Herfindahl Index and Simpson index. This study found complete diversification in the Kota district in all period through all indices and likewise in Jaisalmer district crop specialization was found in first and second period through all indices. Moderate diversification was found in third and fourth period through all indices and finally complete diversification was found in fifth period through all three indices in Jaisalmer district.

2.3 Cropping Pattern

Johl and Kahlan (1963) studied economics of cropping pattern and reported that cropping pattern in any region is the trial and adjustments of farmers with farm enterprises and practices.

Mishra (1980) studied the dynamics of cropping pattern in Madhya Pradesh and found that the state had well responded to the call of the nation for increasing food production. The area under cereals and pulses were increased by 1586 thousand and 743 thousand hectares, respectively. Since 1956-57, increased production at food grains came mainly from extended area, the greater emphasis needs to be given to increase yield per unit of area through the timely supply of improved seeds fertilizers and plant protection measures.

Thomas and Devi (1990) studied the cropping pattern of Kerala state over the period 1973-74 to 1986-87 are analysed by studying the acreage allocated to 16 major crops. Compound growth rates of acreage are calculated for each of the crops and spearman's rank correlation coefficients used in testing for any shift in cropping pattern. The climatic conditions of the state and farmer's high expectations of future prices for crops like cardamom, cashew nuts, coffee and rubber resulted in an increasing trend in the acreage of these crops despite the fact that there was no significant shift in the cropping pattern.

Singh and Singh (1991) examined the changes in cropping and production pattern in Haryana between 1966-67 and 1988-89. The results indicated that area under rice and wheat increased at the rate of 9.28 and 6.34 percent per annum respectively, during the period. The area under coarse cereals like jowar, bajra, maize and barley are declined during the same period. The area under total foodgrains increased at the rate of 0.85 percent per annum. Whereas, area under rapeseed, mustard and sesame increased by 4.07 and 12.02 per annum. Area under groundnut and sugarcane had showed a decreasing trend.

Gupta and Singh (1996) examined the diversification in cropping pattern and changes in production pattern of principal crops in Haryana state since its inception in 1996. The analysis revealed that high value crops like American cotton, paddy, wheat, rapeseed and mustard gradually replaced relatively less remunerative crops bajra, gram and barley in irrigated areas.

Mani and Josh (1997) examine the inter-district, intra-district and inter-temporal shifts in the area, production and yield of rice, coconut and rubber between 1975-76 and 1995-96. Shifts in cropping pattern in favour of cash crops in a majority of the economies in recent years and the consequent reduction in area under food crops weaken the sustainability of food availability.

Hazara (2001) analysed crop diversification across India, it was identified that, after green revolution there was continuous serge of increasing

diversification over several decades in country level. He also indicated the cropping pattern shift over these decades.

Gautam and Sharma (2004) observed that cereal based cropping system involving rice and wheat are predominantly following the Indo-Gangetic plains because of high productivity, profitability and stability. Sustainability of the exhaustive system is threatened owing to several emerging problems necessitating diversification including partial substitution with pulses and oilseeds as well as adoption of other enterprise under specific situations.

Ghosh (2011) studied cropping pattern changes in Indian agriculture during the period 1970-71 to 2006-07. In terms of Herfindahl index and substitution and expansion effects, the concentration and diversification reveals that the cropping pattern in India in terms of allocation of acreage is skewed towards food grains. However, few non-food grain cash crops such as cotton, sugarcane, oilseeds and vegetables have emerged as popular crops among the farmers in recent years.

Mishra and Sinha (2014) focussed on two main issues viz., changing cropping pattern and farmer preference towards high value cash crops. The finding of the study suggest that cropping pattern in Indian agriculture in terms acreage has been skewed towards food grain crops. The production towards high value crops has demonstrated an increasing trend.

Sati and Lalrinpuia (2017) examines the changing in cropping pattern and the major drivers affecting these changes in Mizoram, northeast India based on time series data from 2009 to 2015. The study shows that about 50.8 percent area and 24 percent production of rice have decreased in Jhuming cultivation. Further, a decrease in the area and production of other crops such as tobacco, cotton and potato was observed. In the meantime, the crop area and production in wet rice cultivation have increased by 48 percent and 141 percent respectively. Further, area and production of sugarcane and pulses also increased substantially.

CHAPTER - III

MATERIAL AND METHODS

MATERIAL AND METHODS

The material and methods adopted has been described in to following sub heads

3.1 Profile of the study area
3.2 Selection of study area
3.3 Nature and source of data
3.4 Period of study
3.5 Method of analysis

3.1 Profile of the study area

The knowledge of general characteristics of the study area is essential for understanding the feature of the study area. This will facilitate the discussion with respect to similarities and variation in topography and location, climate and rainfall, etc. This also enlightens the socio economic conditions of the selected for the study.

3.1.1 Geographical Features

Jabalpur district is one of the most important cities of Madhya Pradesh and is located at the centre of the state. The district is situated in the “Mahakaushal“ region. Narmada River flows through the entire district and is also a major source of drinking water for the district. “Bargi Dam“ is a multipurpose project on this river .The city is located between 23 ° 10ˈNorth latitude and 79° 59ˈ East longitude .Jabalpur district is spread over a total area of 10,160 sq. km average elevation of 411 metres above the sea level. The

3.1.2 Demographic features

As per the census 2011 its geographical area is 5,211 sq. kms. it is the 31 st largest district in the state, in respect of area, which is approx. 1.7 per cent of the total area 308,245 sq. kms of the Madhya Pradesh.

3.1.3 Administrative divisions

There are 1424 villages in the district with 543 gram panchayat. The district is divided in to 7 development blocks namely Sihora, Majholi, Patan, Shachpura, Panagar, Jabalpur and Kundam.

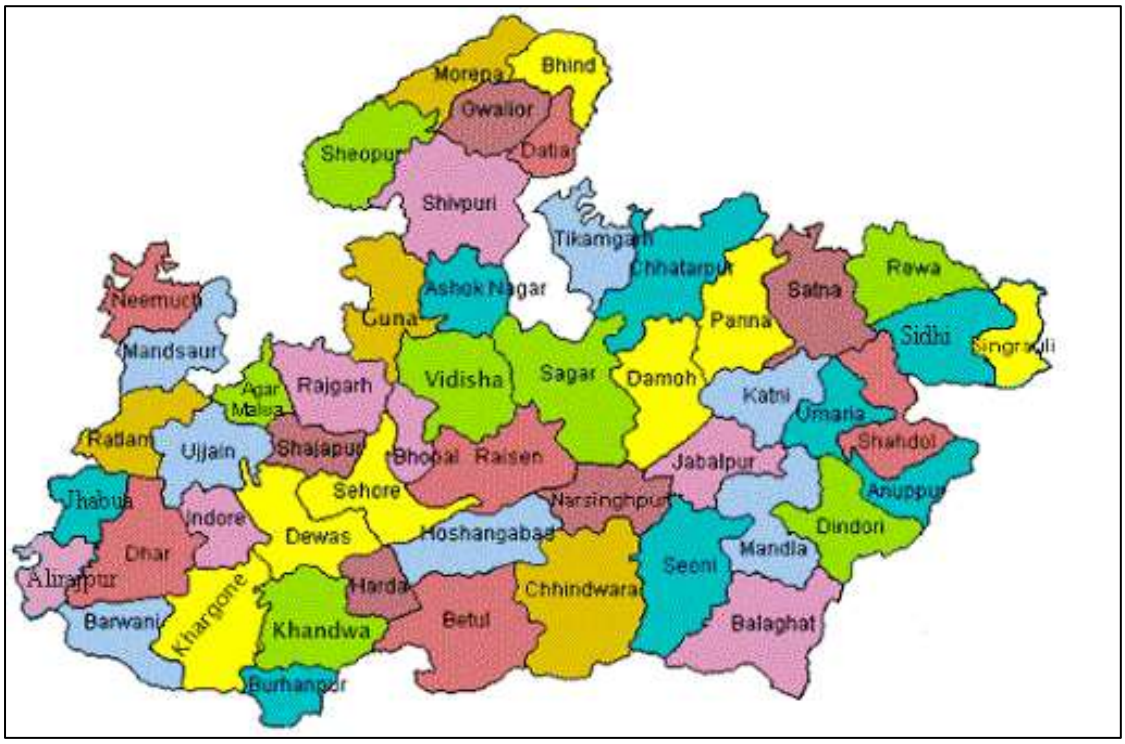

Fig 3.1: Map of Madhya Pradesh

Fig 3.2: Map of Jabalpur district of Madhya Pradesh

Table 3.1: General information of Jabalpur District

Particulars	Value
Area (in sq. Kms)	5211
Latitude	22˚49' to 24˚08'
Longitude	79˚21' to 80˚58'
No. of Tehsils	7
No. of Gram Panchayat	543
N0. of Block	7
Total population (according to 2011 census)	2463289
Population density (per sq. Km)	473
Sex ratio	929
Literacy Rate (per cent)	81.1

(Source: District Census handbook of Jabalpur)

As per Census 2011, the total population of Jabalpur is 2,460,714 with a population density of 472 people per km sq. There are 925 females for every 1000 males. The average literacy rate of the district is 81.1 per cent, which is above the average of the M.P. states 64.76 per cent.

Jabalpur district has three main seasons namely winter, summer and rainy seasons. South-west monsoon generally arrives in mid-June after monsoon season ends in October/November, winter season starts from December to February and then comes summer season which is from March to mid-June. Average rainfall of the district is about 1060.6 mm. Maximum temperature of summer season goes to 45.10 degree Celsius and minimum temperature of winter season is 3.90 degree Celsius.

Table 3.2: Land use pattern in Jabalpur District of Madhya Pradesh

Particulars	Area ("000" ha.)
Geographical area	519.80
Cultivable area	306.10
Forest area	77.70
Land under non-agricultural use	36.70
Permanent pastures	39.70
Cultivable wasteland	22.60
Land under Misc. tree crops and groves	0.10
Barren and uncultivable land	37
Current fallows	16.20
Other fallows	16.10

(Source: Agriculture Statistics 2009, Directorate of Farmer Welfare and Agriculture Development Madhya Pradesh, Bhopal)

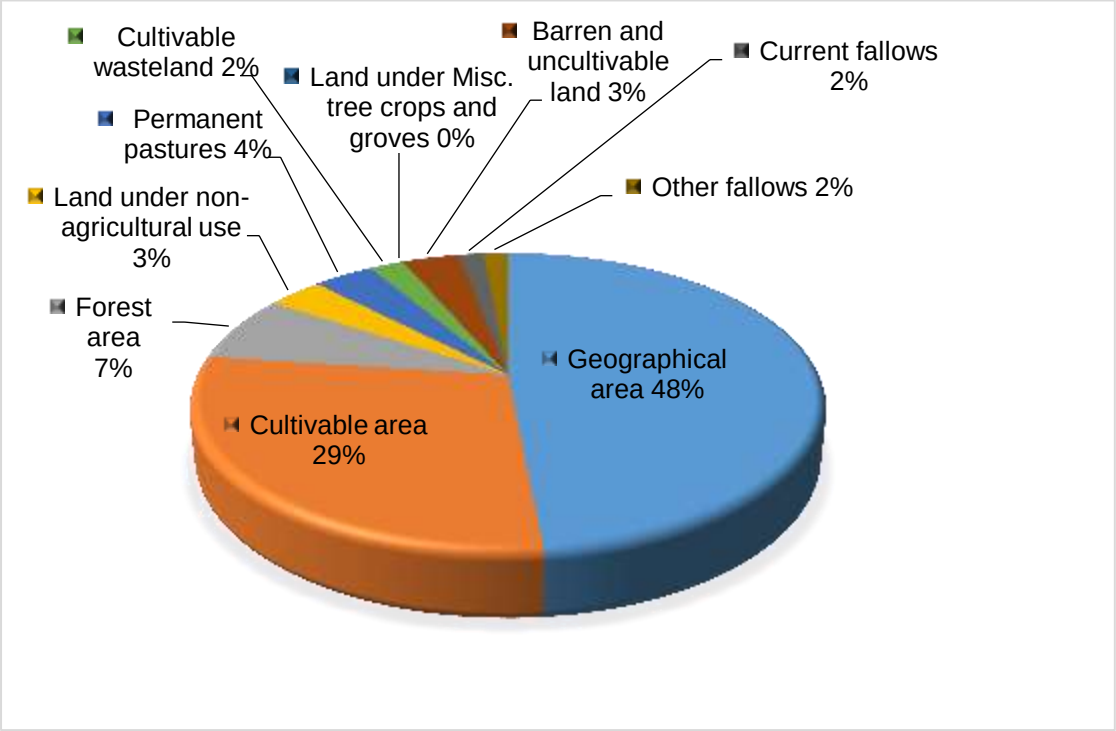

Fig 3.3: Land use pattern in Jabalpur district of Madhya Pradesh

The cropping pattern and area under different crops in Jabalpur district is presented in Table 3.3. The total area under different crops in *Kharif* and rabi season is observed as 34.06 per cent respectively. The value net sown area, grossed cropped area and cropping intensity (%) was 273.80, 371.80 and 136 respectively.

Table 3.3: Cropping pattern of Jabalpur District

S. No.	Season/Crops	Area ("000" ha)	Percentage to total
	Kharif		
1	Rice	60.20	16.19
2	Black gram	28.10	7.56
3	Kodo-Kutki	11.50	3.09
4	Pigeon pea	8.10	2.18
5	Niger	6	1.61
6	Maize	5	1.34
7	Sorghum	4.30	1.16
8	Vegetables	1.59	0.43
9	Other	1.86	0.50
	Sub Total	126.65	34.06
	Rabi		
1	Wheat	88.60	28.83
2	Chickpea	66.20	17.81
3	Lentil	40.10	10.79
4	Pea	36.40	9.79
5	Mustard	3.90	1.05
6	Linseed	2.50	0.67
7	Other	7.45	2.00
	Sub total	245.15	65.94
	Net sown area	273.80	
	Area sown more than once	98	
	Gross cropped area	371.80	
	Cropping Intensity	136	

(Source: Agriculture Statistics 2009, Directorate of Farmer Welfare and Agriculture Development Madhya Pradesh, Bhopal)

3.2 Selection of study area

To conduct the present study, Jabalpur district of Madhya Pradesh. Looking to the significance of crop diversification in the district, nine prominent crops will be selected for study i.e., paddy, soybean, wheat, gram, pea, maize, pigeon pea, sesame, and mustard.

3.3 Nature and source of data

Present study will be based on secondary data and available information will be collected from reliable sources:

1. DDA Office, Jabalpur
2. Directorate of Land records (http://landrecords.mp.gov.in/)
3. Farmers Welfare and Agricultural Development Department, Madhya Pradesh (http://mpkrishi.mp.gov.in/)

3.4 Period of Study

The time series data from 2001-2015 will be used for analysis of absolute change, relative change, variability, trend analysis, growth rate, Simpson Index of Diversification and policy related to crop diversification.

3.5 Method of Analysis

For estimation of given objectives, the science of statistics provides various tools to look into the variables at depth. The tools will be used in this study have been spelled out as follows:

1. Absolute Change = Current year – Base year
2. Relative Change = $\frac{\text{Current year} - \text{Base year}}{\text{Base year}} * 100$
3. Coefficient of Variation (%): CV = $\frac{\text{SD}}{\text{Mean value}} * 100$

$$SD(\sigma) = \sqrt{\frac{\sum Y^2 - \frac{(\sum Y)^2}{N}}{N}}$$

Where,

Y = Area, production and productivity

N = Number of observation (years)

4. Linear trend:

$$Y = a + bx$$

Where,

Y = change in Production

a = intercept

b = Regression coefficient

x = independent variable

5. Simple Growth Rate:

$$SGR = \frac{b}{\bar{Y}} * 100$$

6. Herfindahl Index:

$$HI = \sum_{i=1}^{n} (Pi)2$$

7. Simpson Index of Diversification:

$$SID = 1 - \sum_{i}^{n} Pi^2$$

Where,

P_i = proportionate area of i^{th} crop in the gross cropped area

CHAPTER – IV

RESULTS

RESULTS

The chapter deals with results and discussions cover the analysis and interpretation of secondary data collected for the study with the stated objectives.

Keeping in view the objectives of the study, the data were collected, tabulated, analysed the results are presented in this chapter. It may be recalled that the fact of the study was on the change in land use pattern (under different cropping system) and area, production and productivity of principal crops., their trends and growth rate, extent of variability and different determinants in relationship of different cropping area. Side by side some policy implication measures have also been suggested for the improvement in the out turn of crops in the study area. The results obtained are presented under sub-heads such as:

4.1 Changes in land utilization pattern.

4.2 Extent of Diversification of major selected crops.

4.3 Relative change, variability, trend and growth rate in area, production and productivity of major selected crops.

4.4 Policy implication and suggestions

4.1 Extent of changes in land utilization pattern

Change in cropped area is continuous process based on number of factors including the pressure of population growth, induction of improved farm technology, better management, creation of irrigation potentials, degree of market perfection and acceleration of industrial growth etc. Detail of change in land use under different cropping system is presented in table 4.1

Table 4.1: Changes in Land utilization pattern of Jabalpur district

Particulars	Base year (TE 2003-04)	current year (TE 2015-16)	Absolute change	Relative change (%)
Net sown Area	274.47	273.8	-0.67	-0.24
Area sown more than once	100.05	98	-2.05	-2.05
Total cropped area	374	367.2	-6.8	-1.81
Forest	77.63	77.7	0.07	0.09
Land put to non-agriculture uses	31.99	36.7	4.71	14.72
Barren and uncultivatable land	36.82	37	0.18	0.49
Current fallow	17.51	16.2	-1.31	-7.48
Total Kharif crops	123.13	177.9	54.77	44.48
Total Rabi crops	274.46	253.14	-21.32	-7.76
Total Area	519.75	519.75	0	0

Area in “000” ha

Source: landrecords.mp.gov.in

Net cultivated area

It is cultivated area where crops use to be sown. The volume of production to much extent depends upon this area. During the base year net cultivated area was 274.47 thousand hectare which decreased up to 273.80 thousand hectare area in current year. The absolute and relative change in difference of base and current period was found to -0.67 thousand hectare and -0.24 per cent over a period of time.

Total cropped area

The extent of gross cropped area utilization depends upon favourable rainfall, irrigation potentials and other responsible factors. As per table 4.1 gross cropped area during the base and current period was 374.00 thousand hectare and 367.20 thousand hectare respectively, showed that decrease of 6.80 thousand hectare. This loss of 1.81 per cent decrease in total cropped area was may be due to area increase under urbanisation and construction purposes.

Area sown more than once

The area sown more than once during the base year and current year was 100.05 and 98.00 thousand hectare respectively, showed that decrease of 2.05 thousand hectare which was 2.05 percent lower than base year.

Forest

The forest area during the base year was 77.63 thousand hectare which increased to 77.70 thousand hectare during the current year thus showed an increase of 0.09 thousand hectare which was 0.09 percent higher than base year.

Land put to non-agriculture uses

Land under non agriculture use during the base year was 31.99 thousand hectare which increased to 36.70 thousand hectare during current year. The absolute and relative change were recorded in order of 4.71 thousand hectare and 14.72 percent respectively.

Barren and uncultivated land

The barren and uncultivated land in base year and current year was 36.82 thousand hectare and 37.00 thousand hectare respectively. The absolute change and relative change were recorded in the order of 0.18 thousand hectare and 0.49 percent respectively.

Current fallow

The current fallow land is that part of cultivated area which is kept un-sown for a time being (Kharif and Rabi season). During the base year current fallow was 17.51 thousand hectare which tend to decline to the extent of 16.20 thousand hectare during the current year. The absolute and relative change observed during this period was to the extent of -8.4 thousand hectare and -30.2 percent respectively.

Total *Kharif* crops

The total area under Kharif crops in base year and current year was123.13 thousand hectare and 177.90 thousand hectare respectively. The

absolute change in area was 54.77 thousand hectare and relative change was 44.48 percent.

Total *Rabi* crops

The total area under Rabi crops in base year and current year was 274.46 thousand hectare 253.14 thousand hectare respectively. The absolute change was found to be -21.32 thousand hectare and relative change was -7.76 percent.

Total geographical area

The total geographical area of the Jabalpur district was 519.75 thousand hectare in base year and 519.75 thousand hectare in current year so there is no change in total geographical area of the district.

4.2 To examine the extent of crop diversification

Table 4.2: Extent of crop diversification in Jabalpur district

Year	Herfindahl Index	Simpson Index of Diversification
2001	0.23	0.77
2002	0.24	0.76
2003	0.24	0.76
2004	0.24	0.76
2005	0.24	0.76
2006	0.25	0.75
2007	0.24	0.76
2008	0.25	0.75
2009	0.25	0.75
2010	0.23	0.77
2011	0.23	0.77
2012	0.25	0.75
2013	0.22	0.78
2014	0.24	0.76
2015	0.24	0.76

Calculated by author based on source: mpkrishi.gov.in

Indices of crop diversification are presented in table 4.2 under this proportion of area allocation and diversification index for the 2001-2015 production period are calculated. The year wise variation in values of Herfindahl index (HI), Simpson index of diversification (SID) shows a similar pattern for all the chosen crops. The highest diversification was found in 2013, where value of Herfindahl index was observed (0.22) and Simpson index of diversification was to be found (0.78).

4.3 Variability, trend and growth in major crops in study area

Time series data on area, production and productivity of crops for the period of 2001-02 to 2015-2016 was used to estimate the trend and growth in area, production and productivity of crops growing in the Jabalpur district. In view of this fact understanding growth in area, production and productivity would be meaningful and helpful to call for the policy for benefit of the farmers.

Table 4.3: Trend and growth rate in area, production and productivity of major crops in Jabalpur district

Crops		Base year	Current year	Absolute change	Relative change (%)	b value	SGR	CGR
Paddy	Area	64.53	85.97	21.44	33.23	1.84	2.61	2.53
	Production	58.1	166.41	108.31	186.42	8.41	9.3	8.59
	Productivity	946.13	1948.67	1002.54	105.96	77.64	6.13	5.43
Soybean	Area	2.68	34.13	31.46	1176.01	2.18	21.27	31.01
	Production	2.5	27.4	24.9	995.83	1.9	20.6	29.34
	Productivity	1011.75	689.48	-327.27	-32.35	-12.08	-1.66	-2.68
Wheat	Area	86	130.2	44.2	51.4	3.56	3.61	3.5
	Production	149.08	403.53	254.46	170.69	21.47	9.51	9.35
	Productivity	1899.75	3101.91	1202.16	63.28	103.13	4.64	4.46
Sesame	Area	1.28	1.79	0.52	40.71	0.03	2.48	1.62
	Production	0.38	0.7	0.33	86.95	0.03	5.67	5.95
	Productivity	296	467.36	171.36	57.89	15.59	4.2	3.79
Gram	Area	66.69	59	-7.69	-11.63	-0.62	-0.96	-1.03
	Production	65.18	54.75	-10.42	-15.99	-0.06	-0.09	-0.82
	Productivity	981.75	889.12	-92.63	-9.44	5.26	0.52	0.2
Pea	Area	29.3	33.3	4	13.65	-0.12	-0.41	-0.9
	Production	14.81	31.93	17.12	115.58	0.74	4.41	1.62
	Productivity	500.63	964.33	463.71	92.63	22.63	4.1	2.55
Maize	Area	4.46	6.77	2.3	51.63	0.16	3.14	2.48
	Production	8.04	15.62	7.58	94.34	0.3	3.28	0.96
	Productivity	1800.88	2157.3	356.43	19.79	-23.26	-1.32	-1.26
Mustard	Area	3.18	3.67	-0.14	-3.79	0.01	0.17	0.26
	Production	3.2	4.06	0.86	26.82	0.09	2.55	2.97
	Productivity	843.25	983.33	140.08	16.61	16.31	1.83	2.01
Pigeon pea	Area	6.68	11.98	5.3	79.41	0.63	6.74	7.6
	Production	8.55	15.53	6.98	81.64	0.51	5.04	4.43
	Productivity	1285.88	870.56	-415.32	-32.3	-45.02	-3.29	-3.23

4.3.1 Variability, trend and growth in paddy in study area

Time series data on area, production and productivity of paddy for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.4: Area, production and productivity of paddy in Jabalpur district during 2001-2015

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	64.53	58.1	946.13
Current year	85.97	166.41	1948.67
Absolute Change	21.44	108.31	1002.54
Relative Change (%)	33.23	186.42	105.96
CV%	13.99	62.35	47.35
Coefficient b	1.84***	8.41***	77.64**
Simple growth rate (%)	2.61	9.3	6.13
Compound growth rate	2.53	8.59	5.43
t value	5.43	3.23	2.56

*****Significant at 10%, ******Significant at 5%, *******Significant at 1%

The Area of paddy was found to be increased 33.23 percent from 64.53 thousand hectare (base year) to 85.97 thousand hectare (current year) with the fluctuation of 13.99 percent and annual growth of 2.61 (SGR) and 2.53 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of paddy was found to be increased 186.42 percent from 58.10 M tons (base year) to 166.41 M tons (current year) with the fluctuation of 62.35 percent and annual growth of 9.30 (SGR) and 8.59 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of paddy was found to be increased 105.96 % from 946.13 kg/ha (base year) to 1948.67 kg/ha (current year) with the fluctuation of 47.35 percent and annual growth of 6.13 (SGR) and 5.43 (CGR) per year in Jabalpur district during 2001 to 2015.

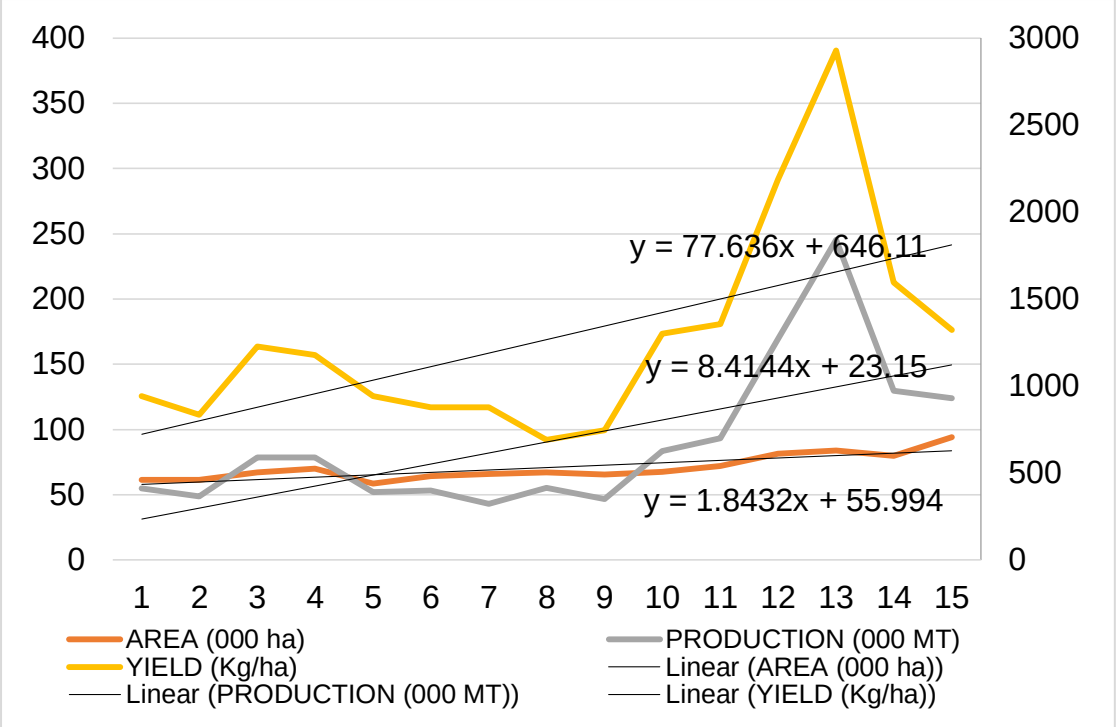

Fig 4.1: Trend in Area, Production and Productivity of paddy

4.3.2 Variability, trend and growth in soybean in study area

Time series data on area, production and productivity of soybean for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.5: Area, Production and productivity of soybean

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	2.68	2.5	1011.75
Current year	34.13	27.4	684.48
Absolute Change	31.46	24.9	-327.27
Relative Change (%)	1176.01	995.83	-32.35
CV%	140.68	145.4	32.28
Coefficient b	2.18***	1.90**	-12.08
Simple growth rate (%)	21.27	20.6	-1.66
Compound growth rate	31.01	29.34	-2.68
t value	3.31	2.952	-0.853

***Significant at 10%, ****Significant at 5%, *****Significant at 1%

The Area of soybean was found to be increased 1176.01 percent from 2.68 thousand hectare (base year) to 34.13 thousand hectare (current year) with the fluctuation of 140.68 percent and annual growth of 21.27 (SGR) and 31.01 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of soybean was found to be increased 995.83 percent from 2.50 M tons (base year) to 27.50 M tons (current year) with the fluctuation of 145.40 percent and annual growth of 20.60 (SGR) and 29.34 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of soybean was found to be decreased -32.35 percent from 1011.75 kg/ha (base year) to 684.48 kg/ha (current year) with the fluctuation of 32.28 percent and annual growth of -1.66 (SGR) and -2.68 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

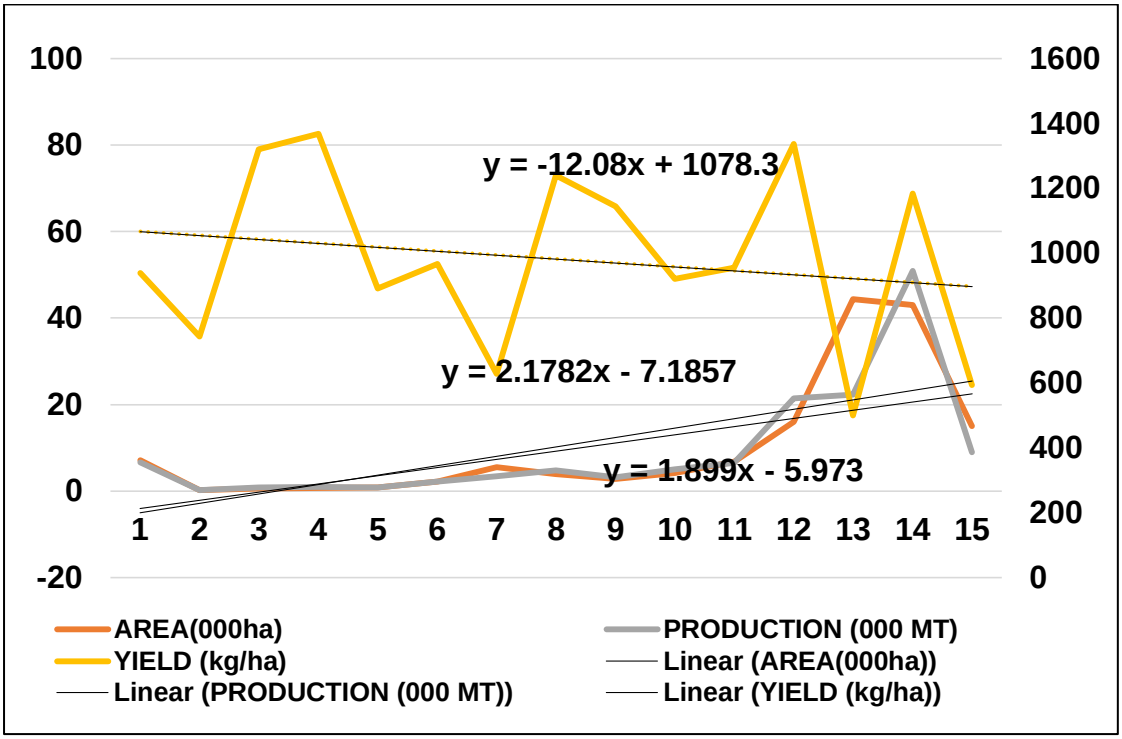

Fig 4.2: Trend in Area, Production and productivity of Soybean

4.3.3 Variability, trend and growth in wheat in study area

Time series data on area, production and productivity of wheat for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.6: Area, Production and productivity of Wheat in Jabalpur District

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	86	149.08	1899.75
Current year	130.2	403.53	3101.91
Absolute Change	44.2	254.46	1202.16
Relative Change (%)	51.4	170.69	63.28
CV%	18.18	48.01	26.13
Coefficient b	3.56***	21.47***	103.13***
Simple growth rate (%)	3.61	9.51	4.64
Compound growth rate	3.5	9.35	4.46
t value	6.957	6.89	4.709

***Significant at 10%, ****Significant at 5%, *****Significant at 1%

The Area of wheat was found to be increased 51.40 percent from 86.00 thousand hectare (base year) to 130.20 thousand hectare (current year) with the fluctuation of 18.18 percent and annual growth of 3.61 (SGR) and 3.50 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of wheat was found to be increased 170.69 percent from 149.08 M tons (base year) to 403.53 M tons (current year) with the fluctuation of 48.01 percent and annual growth of 9.51 (SGR) and 9.35 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of wheat was found to be increased 63.28 percent from 1899.75 kg/ha (base year) to 3101.91 kg/ha (current year) with the fluctuation of 26.13 percent and annual growth of 4.64 (SGR) and 4.46 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

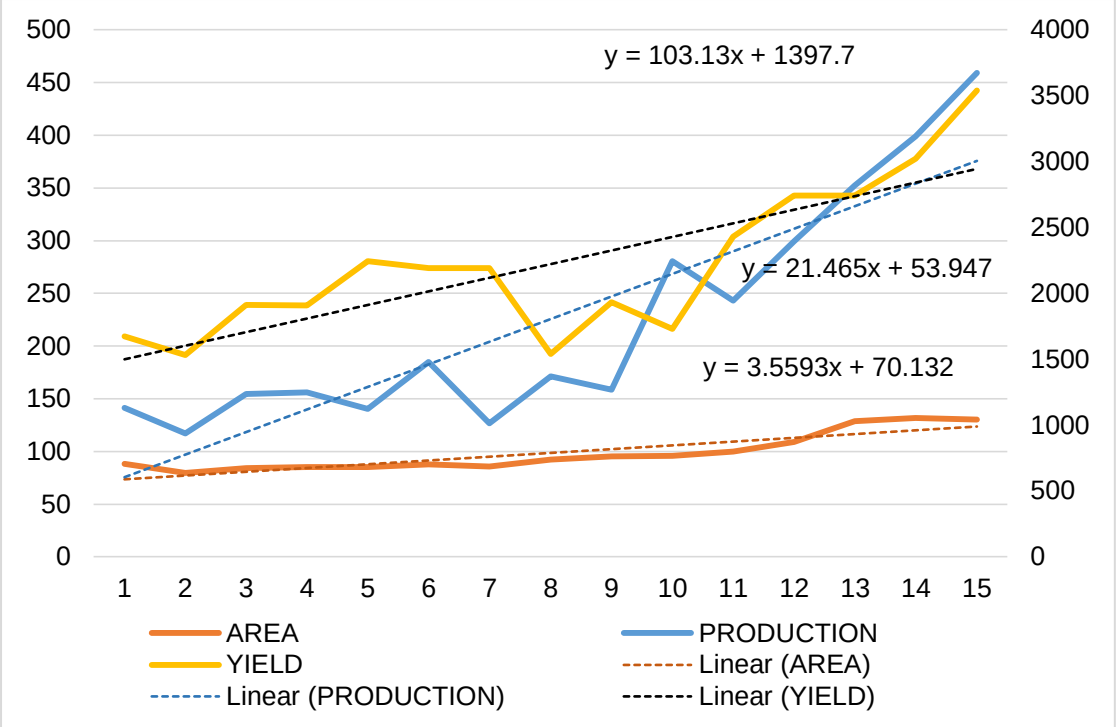

Fig 4.3: Trend in Area, Production and Productivity of Wheat

4.3.4 Variability, trend and growth in sesame in study area

Time series data on area, production and productivity of sesame for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.7: Area, Production and Productivity of sesame

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	1.28	0.38	296
Current year	1.79	0.7	467.36
Absolute Change	0.52	0.33	171.36
Relative Change (%)	40.71	86.95	57.89
CV%	33.19	40.57	38.28
Coefficient b	0.03	0.03**	15.59
Simple growth rate (%)	2.48	5.67	4.2
Compound growth rate	1.62	5.95	3.79
t value	1.277	2.887	2.029

*Significant at 10%, **Significant at 5%, ***Significant at 1%

The Area of sesame was found to be increased 40.71 percent from 1.28 thousand hectare (base year) to 1.79 thousand hectare (current year) with the fluctuation of 33.19 percent and annual growth of 2.48 (SGR) and 1.62 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of sesame was found to be increased 86.95 percent from 0.38 M tons (base year) to 070 M tons (current year) with the fluctuation of 40.57 percent and annual growth of 5.67 (SGR) and 5.95 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of sesame was found to be increased 57.89 percent from 296.00 kg/ha (base year) to 467.36 kg/ha (current year) with the fluctuation of 38.28 percent and annual growth of 4.20 (SGR) and 3.79 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

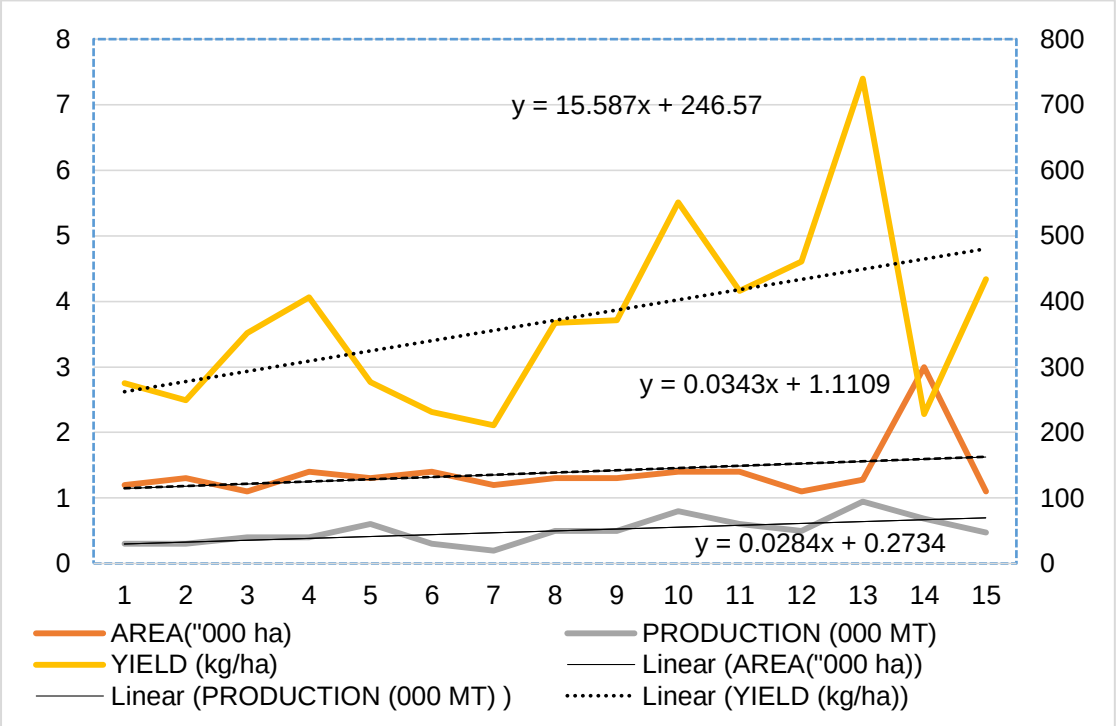

Fig 4.4: Trend in Area, Production and Productivity of sesame

4.3.5 Variability, trend and growth in Gram in study area

Time series data on area, production and productivity of Gram for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.8: Area, Production and Productivity of Gram

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	66.69	65.18	981.75
Current year	59	54.75	889.12
Absolute Change	-7.69	-10.42	-92.63
Relative Change (%)	-11.53	-15.99	-9.44
CV%	8.98	25.47	24.62
Coefficient b	-0.62	-0.06	5.26
Simple growth rate (%)	-0.96	-0.09	0.52
Compound growth rate	-1.03	-0.82	0.2
t value	-1.966	-0.06	0.345

***Significant at 10%, ****Significant at 5%, *****Significant at 1%

The Area of Gram was found to be decreased -11.53 percent from 66.69 thousand hectare (base year) to 59.00 thousand hectare (current year) with the fluctuation of 8.98 percent and annual growth of -0.96 (SGR) and -1.03 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of Gram was found to be decreased -15.99 percent from 65.18 M tons (base year) to 54.75 M tons (current year) with the fluctuation of 25.47 percent and annual growth of -0.09 (SGR) and -0.82 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of Gram was found to be decreased -9.44 percent from 981.75 kg/ha (base year) to 889.12 kg/ha (current year) with the fluctuation of 24.62 percent and annual growth of 0.52 (SGR) and 0.20 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

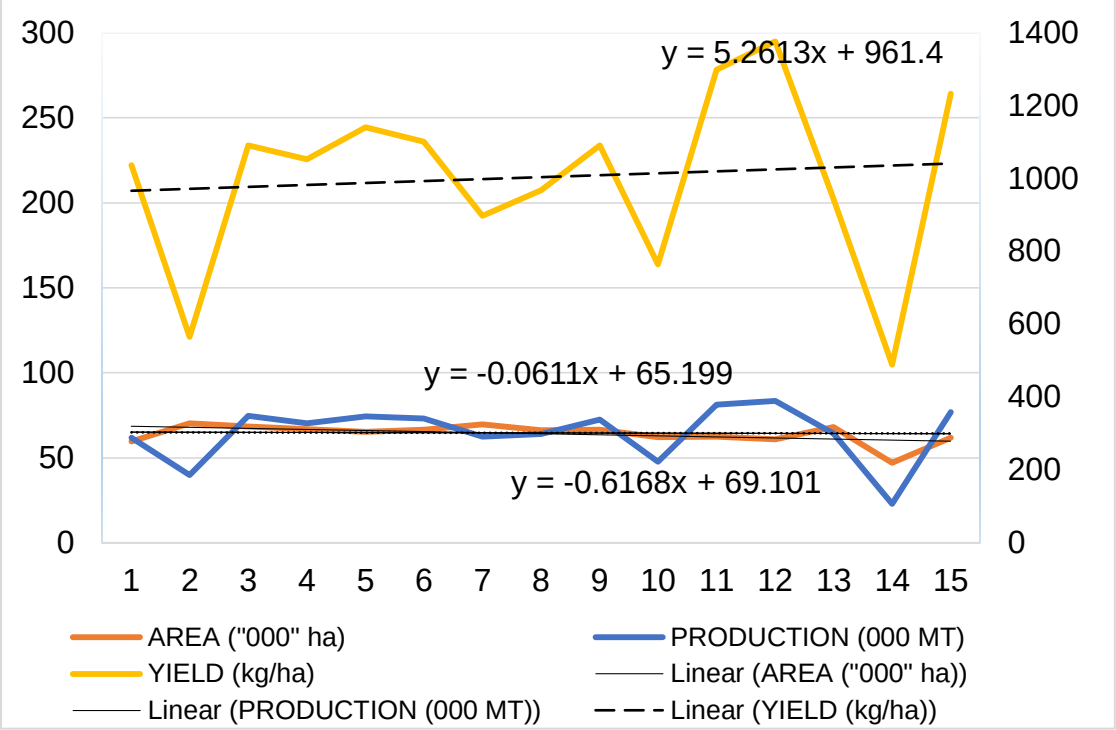

Fig 4.5: Trend in Area, Production and Productivity of Gram

4.3.6 Variability, trend and growth in pea in study area

Time series data on area, production and productivity of pea for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.9: Area, Production and Productivity of Pea

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	29.3	14.81	500.63
Current year	33.3	31.93	964.33
Absolute Change	4	17.12	463.71
Relative Change (%)	13.65	115.58	92.63
CV%	28.57	59.76	42.78
Coefficient b	-0.12	0.74	22.63
Simple growth rate (%)	-0.41	4.41	4.1
Compound growth rate	-0.9	1.62	2.55
t value	-0.234	1.262	1.708

*Significant at 10%, **Significant at 5%, ***Significant at 1%

The Area of pea was found to be increased 13.65 percent from 29.30 thousand hectare (base year) to 33.30 thousand hectare (current year) with the fluctuation of 28.57 percent and annual growth of -0.41 (SGR) and -0.90 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of pea was found to be increased 115.58 percent from 14.81 M tons (base year) to 31.93 M tons (current year) with the fluctuation of 59.76 percent and annual growth of 4.41 (SGR) and 1.62 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of pea was found to be increased 92.63 percent from 500.63 kg/ha (base year) to 964.33 kg/ha (current year) with the fluctuation of 42.78 percent and annual growth of 4.10 (SGR) and 2.55 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

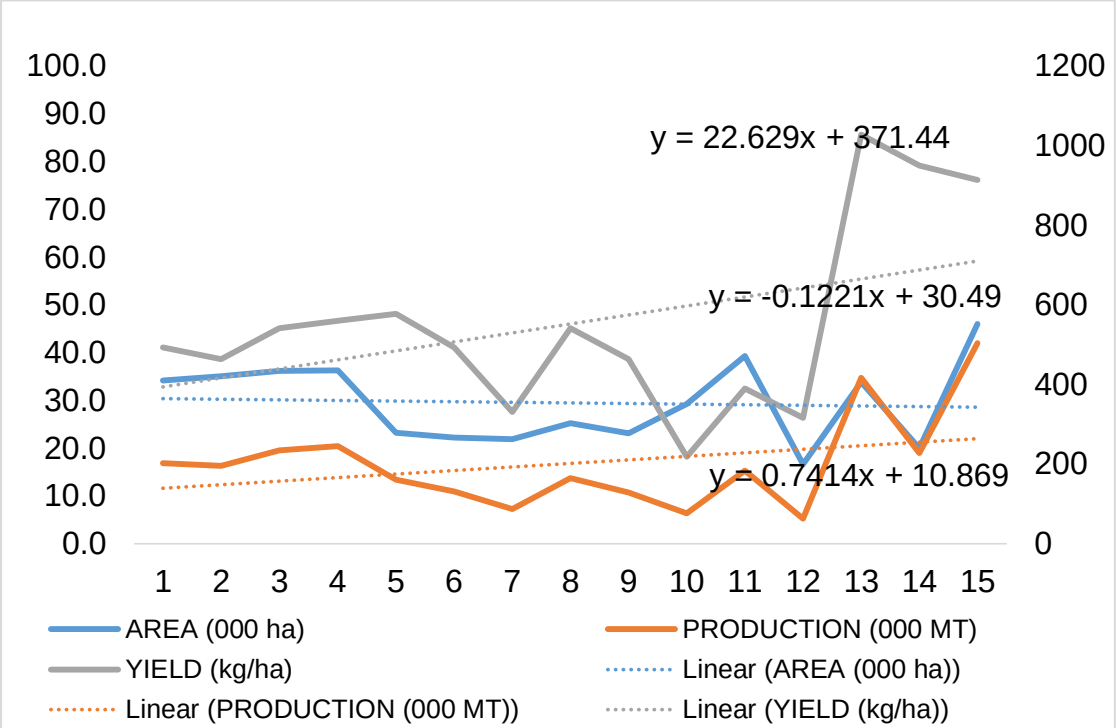

Fig 4.6: Trend in Area, Production and Productivity of Pea

4.3.7 Variability, trend and growth in maize in study area

Time series data on area, production and productivity of maize for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.10: Area Production and Productivity of Maize

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	4.46	8.04	1800.88
Current year	6.77	15.62	2157.3
Absolute Change	2.3	7.58	356.43
Relative Change (%)	51.63	94.34	19.79
CV%	29.95	69.49	35.97
Coefficient b	0.16	0.3	-23.26
Simple growth rate (%)	3.19	3.28	-1.32
Compound growth rate	2.48	0.96	-1.26
t value	1.952	0.779	-0.602

***Significant at 10%, ****Significant at 5%, *****Significant at 1%

The Area of maize was found to be increased 51.63 percent from 4.46 thousand hectare (base year) to 6.77 thousand hectare (current year) with the fluctuation of 29.95 percent and annual growth of 3.19 (SGR) and 2.48 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of maize was found to be increased 94.34 percent from 8.04 M tons (base year) to 15.62 M tons (current year) with the fluctuation of 69.49 percent and annual growth of 3.28 (SGR) and 0.96 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of maize was found to be increased 19.79 percent from 1800.88 kg/ha (base year) to 2157.30 kg/ha (current year) with the fluctuation of 35.97 percent and annual growth of -1.32 (SGR) and -1.26 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

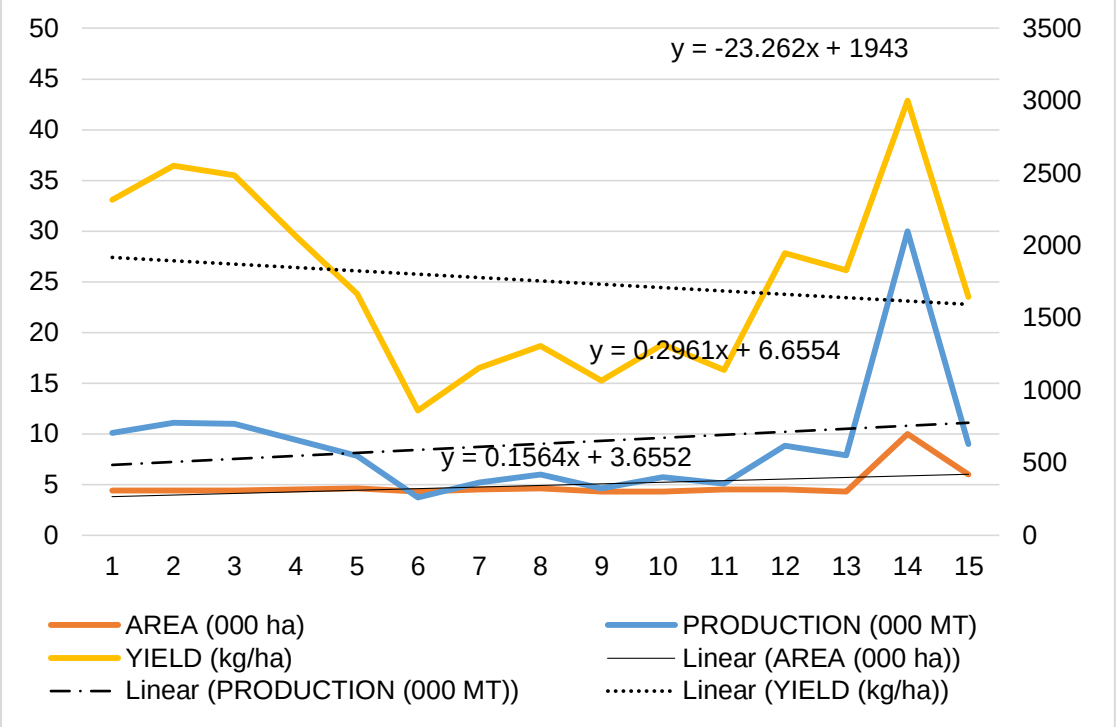

Fig 4.7: Trend in Area, Production and productivity of Maize

4.3.8 Variability, trend and growth in mustard in study area

Time series data on area, production and productivity of mustard for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.11: Area, Production and Productivity of Mustard

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	3.81	3.2	843.25
Current year	3.67	4.06	983.33
Absolute Change	-0.14	0.86	140.08
Relative Change (%)	-3.79	26.82	16.61
CV%	16.01	32.26	21.24
Coefficient b	0.01	0.09	16.31
Simple growth rate (%)	0.17	2.55	1.83
Compound growth rate	0.26	2.97	2.01
t value	0.168	1.361	1.505

*Significant at 10%, **Significant at 5%, ***Significant at 1%

The Area of mustard was found to be decreased -3.79 percent from 3.81 thousand hectare (base year) to 3.67 thousand hectare (current year) with the fluctuation of 16.01 percent and annual growth of 0.17 (SGR) and 0.26 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of mustard was found to be increased 26.82 percent from 3.20 M tons (base year) to 4.06 M tons (current year) with the fluctuation of 32.26 percent and annual growth of 2.55 (SGR) and 2.97 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of mustard was found to be increased 16.61 percent from 843.25 kg/ha (base year) to 983.33 kg/ha (current year) with the fluctuation of 21.24 percent and annual growth of 1.83 (SGR) and 2.01 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

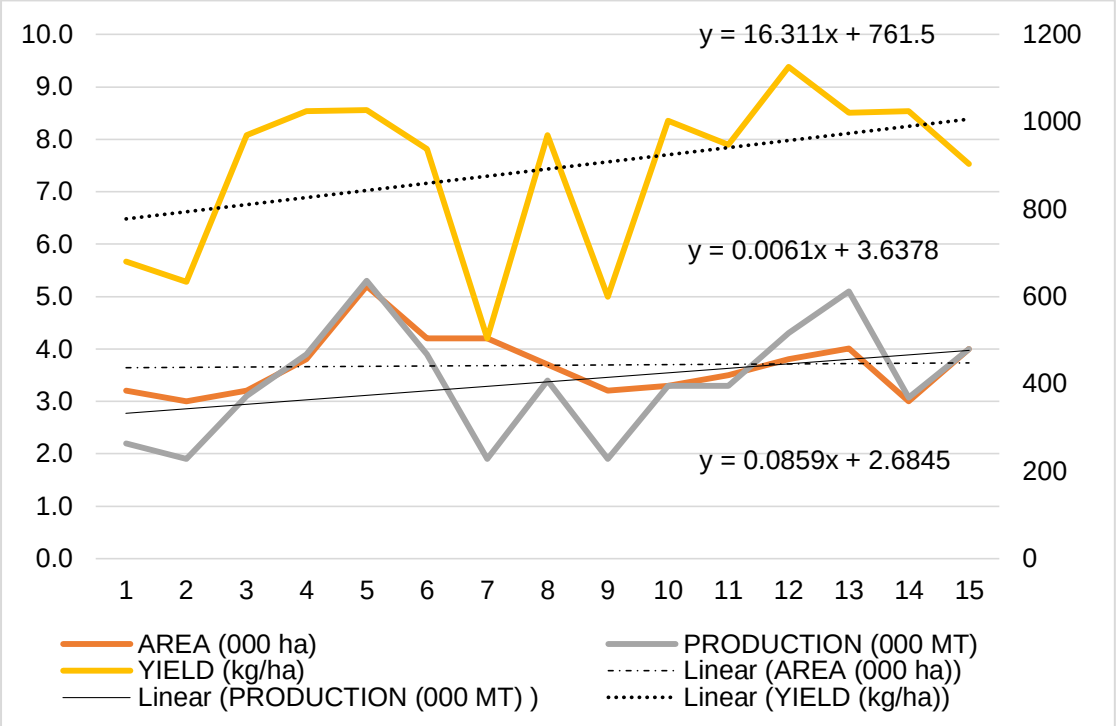

Fig 4.8: Trend in Area, Production and Productivity of Mustard

4.3.9: Variability, trend and growth in Pigeon pea in study area

Time series data on area, production and productivity of Pigeon pea for the period of 2001-02 to 2015-16 are used to estimate the trend and growth.

Table 4.12: Area, Production and Productivity of Pigeon pea

Particulars	Area (000 ha)	Production (M tons)	Productivity (kg/ha)
Base year	6.68	8.55	1285.88
Current year	11.98	15.53	870.56
Absolute Change	5.3	6.98	-415.32
Relative Change (%)	79.41	81.64	-32.3
CV%	42.56	51.55	35.61
Coefficient b	0.63***	0.51	-45.02**
Simple growth rate (%)	6.74	5.04	-3.29
Compound growth rate	7.6	4.43	-3.23
t value	3.61	1.75	-2.6

***Significant at 10%, ****Significant at 5%, *****Significant at 1%

The Area of pigeon pea was found to be increased 79.41 percent from 6.68 thousand hectare (base year) to 11.98 thousand hectare (current year) with the fluctuation of 42.56 percent and annual growth of 6.74 (SGR) and 7.60 (CGR) per cent per year in Jabalpur during 2001 to 2015.

The production of pigeon pea was found to be increased 81.64 percent from 8.55 M tons (base year) to 15.53 M tons (current year) with the fluctuation of 51.55 percent and annual growth of 5.04 (SGR) and 4.43 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

The productivity of pigeon pea was found to be decreased -32.30 percent from 1285.88 kg/ha (base year) to 870.56 kg/ha (current year) with the fluctuation of 35.61 percent and annual growth of -3.29 (SGR) and -3.23 (CGR) per cent per year in Jabalpur district during 2001 to 2015.

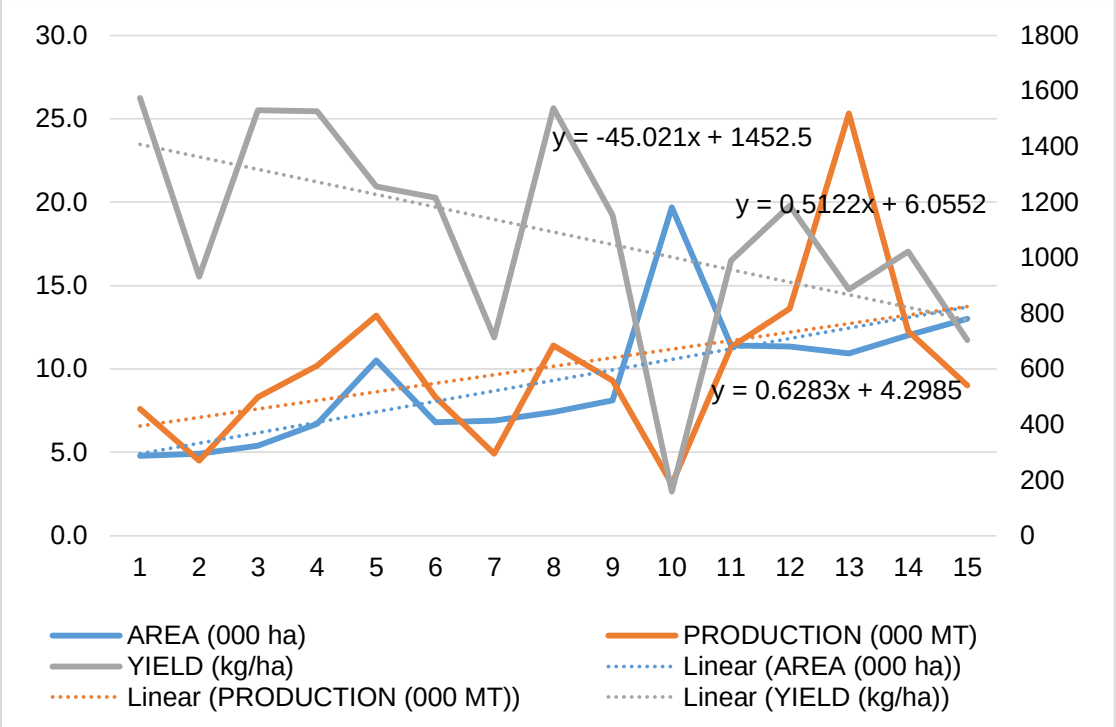

Fig 4.9: Trend in Area, Production and productivity of Pigeon Pea

CHAPTER – V

DISCUSSION

DISCUSSION

The chapter discussion is most important in research process because it appears a statement of findings after analysis of data as per the stated objectives. In other words, the whole chapter deals with interpretation of results found after analysis of basic data as per the stated objectives of the study.

It was revealed from comparative data of acreage under different major use as cropping system in Jabalpur district of Madhya Pradesh, that after lapse of 15 years the land use pattern under different cropping system shows some definite change. The land use are under the head of cropping system found to decreased since base year was net cultivated area decreased by (-0.24 %), followed by area sown more than once (-2.02 %), total cropped area (-1.81%), current fallow (-7.48%), and total Rabi crop crops (-7.76%). On the other hand, the area under Kharif crops shown increase of (44.48%), forest area (0.09%), Land put to non-agricultural uses (14.72%), Barren and uncultivable land (0.49%).

The indices of crop diversification within crops growing in district presented in Table 2.1 from base year (2001-02) to current year (2015-16). This section analyse the extent of crop diversification by using Herfindhal index and Simpson index of diversification, it was recorded here that in year 2013 highest degree of crop diversification was found among the all crops.

The study revealed that among the total crops under study, the relative change in area found to positive for soybean (1176 %), followed by pigeon pea (79.41%), maize (51.63 %), wheat (51.40 %), sesame (40.71 %) paddy (33.23%), , pea (13.65%).

The relative change in production found to be positive for soybean (995.83%) followed by paddy (186.42%), wheat (170.69%), pea (115.58%), maize (94.34 %), sesame (86.95%), pigeon pea (81.64%) and mustard (26.82%).

It is necessary to examine the shifts in acreage of individual crops over a period of time. The data depicted that the total area under Kharif crops

increased during the 15 years of period and among different Kharif crops area shifted to other Kharif crops.

It is due to the lower value crops were shifted towards higher value crops or higher demanding crops respectively.

The shift has been found proportionately in both season as Kharif and Rabi season also.

The study specially reveals that large changes occurred in acreage of specific crop due to shift in cropping pattern as well as due to increase in area under total Kharif crops which increased by 54.77 thousand hectare during the period of time.

So for the discussion was confined to acreage shift of crops in the Jabalpur district in terms of absolute change at the points of time that is base year 2001-02 to current year 2015-16. In the previous sections a detailed discussion on the relative change in area, production and productivity of principal crops in Jabalpur district between successive periods have been synthesized by simple statistical tools based on average and percentage. To continue the synthesis of data of selected crops, an effective and reliable statistical tool had been used in this section. The results of this analysis provided growth trends in linear forms. This function was fitted in this study and compared in the preliminary analysis. The result of linear trend were much reliable in more number of cases therefore, the same have been accepted for discussion in this section.

For the purpose of giving picture of the trends in area, production and productivity for each crop, these function have been fitted on the time series data. The trend equations presented assumed straight line tendencies of crops area, production and productivity.

The slope of the curve is given by the value associated with years. Trend analysis provides the rate of change of particular variable during the period of reference and the direction of change though it fails to provide the appropriate rate of change per annum.

Following crops shows increase in area, in terms of simple growth rate paddy (2.61%), soybean (21.27%), wheat (3.61%), sesame (2.48%), maize (3.19%), mustard (0.17%) and pigeon pea (6.74%), respectively.

Since production is a function of area and productivity therefore, growth of production is depends on growth of these two components.

The following crops found to increase in production growth rate that is soybean (20.60%) followed by wheat (9.51%), paddy (9.30%), sesame (5.67%), pigeon pea (5.04%) pea (4.41%), maize (3.28%), mustard (2.55%) respectively. The productivity found to increase with growth rate in crops of paddy (6.13%), wheat (4.64%), sesame (4.20%), gram (0.42%), pea (4.10%) and mustard (1.83%) respectively.

The study clearly indicated as regards the area under paddy, soybean, wheat, sesame, maize, mustard and pigeon pea show positive “b” value this indicates that these crops have tendency to increase in their acreage assuming the trend to hold good.

As regards the trends in production of paddy, soybean, wheat, sesame, pea, maize, mustard and pigeon pea revealed positive slope. Wheat showed the highest trend “b” value (+21.47X) followed by paddy (+8.41X), soybean (+1.90X), pea (+0.74X), pigeon pea (+0.51X), maize (+0.30X), mustard (+0.09X) and sesame (+0.03X) respectively.

In case of trend in productivity paddy, wheat, sesame, gram, pea, mustard show positive potential of increased productivity per hectare respectively. The highest “b” value was found in case of wheat (+103.13X) followed by paddy (+77.64X), pea (+22.63X), mustard (+16.31X), sesame (+15.59X) and gram (+5.26X) respectively.

It may be noted from the study that in case of paddy field variabilities that is variabilities in production found to highest followed by variabilities in area found to lowest. Soybean revealed highest acreage variabilities but its productivity variabilities found to be lowest. In case of wheat, sesame, pea, mustard crops the production variabilities found highest and area variabilities is lowest. In case of gram, maize, pigeon pea crops the production variabilities found highest and productivity variabilities is lowest.

CHAPTER - VI

SUMMARY, CONCLUSION AND SUGGESTIONS

SUMMARY, CONCLUSION AND SUGGESTIONS

India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. On the other hand, only 1.6 of the farmers have operational land holdings above 10 ha and they utilize 17.4 percent of the total cultivated land.

The green revolution brought about a major breakthrough in agriculture production. But even after passing almost many years the agricultural sector is not developing at the rate at which the country is looking for. The composite picture of agricultural sector is not at all satisfactory even now, there is a regional disparities in the development of agriculture.

Agriculture in Madhya Pradesh made a rapid progress due to variation in cropping pattern, level of resource use etc.., therefore an attempt has been made in this study to examine the magnitude of growth and fluctuations in cropping pattern in Jabalpur district of Madhya Pradesh.

The findings of the study will generate valuable information to the planners and policy makers for initiating proper policy action.

The specific objective of the present study are:

1. To study the extent of changes in land utilization pattern.
2. To examine the extent of crop diversification.
3. To study the shift in cropping pattern.
4. To suggest the policy implication based on finding of the study.

The study was confined to Jabalpur district of Madhya Pradesh. To test the objectives of the study, secondary data regarding land utilization pattern, area, production and productivity of important crops, net and gross cropped area, total kharif area, total rabi crop area etc., were collected from various sources like Directorate of land records Gwalior, Farmers welfare and agricultural development department, Madhya Pradesh, covers period from

2001-02 to 2015-16. The crop included in the study are paddy, wheat, soybean, sesame, gram, pea, mustard, pigeon pea and maize as they shared more than 80 percent of gross cropped area under them and behaved in many ways during this period.

Absolute and relative change in land use pattern, cropping pattern, area, production and productivity of selected crops were worked out by compared mean value of each of these elements for the first and last triennium trend analysis of area, production and productivity of selected crops were carried out with the help of straight line or linear model Y = a + b x. In addition to trend value compound growth rates were also worked out by using exponential function of type Y = ab* in the log linear form Y = log a + log b the exponential trend equation gave directly the geometric or compound growth rate which was as :

Compound growth rate (%) = (b-1) * 100

Extend of variability in area, production and productivity were worked out by calculating their coefficient of variation.

A. The components of land utilization pattern, net sown area, area sown more than once, total cropped area, current fallow, total Rabi crops indicated a decreasing pattern and forest, land put to non-agricultural uses, barren and uncultivated land, total Kharif crops are indicated an increasing pattern.
B. Total cropped area decline from 374 thousand hectare to 367.20 thousand hectare which is resulted in decrease of -1.81 percent from base year.
C. Total Kharif area is increased from 123.13 thousand hectare in base year to 177.90 thousand hectare in current year which is resulted in increase of 44.48 percent from base year.
D. The extent of crop diversification was calculated from base year (2001-02) to current year (2015-16) by using Herfindhal index and Simpson index of diversification the highest diversification was found in year 2013 where HI value was 0.22 and SID value was 0.78 respectively.

E. Paddy, soybean, wheat, sesame, pea, maize and pigeon pea showed increasing rate in their respective area while other crops like gram and mustard showed decline rate in their respective area where soybean recorded highest and spectacular increase in its cultivated area.
F. Except gram, all the crops like paddy, wheat, sesame, soybean, pea, maize, mustard and pigeon pea showed an increasing production rate during the reference period.
G. Except pigeon pea, gram and soybean all other crops showed an increasing rate for their respective productivity.
H. Pea and gram recorded negative “b” value while rest of the crops presented their positive “b” value with their respective cropped area as evident from the linear trend.
I. Linear trend for production was negative “b” value for gram, while rest of the crops showed either highly significant or satisfactory trend values during the same period.
J. Linear trend for productivity was negative “b” value for maize, soybean and pigeon pea, while for rest of the crops recorded normal to higher “b” value.
K. Gram and pea had negative growth rate while rest of the crops was found positive growth rate per annum respectively. Within the crops paddy, soybean, wheat, sesame, maize, mustard and pigeon pea had recorded positive and significant compound growth rate for their respective area. While soybean had recorded very strong and highly significant per annum compound growth rate for its cultivated area.

Significance of the Study

The important findings derived from the above observation will equally be useful to the planners, administrators, subject matter specialists, policy makers, researchers and students involved in the field of agricultural economics and financial institutions associated with the agricultural fields.

Suggestions and policy implication based on study

1. Variability test applied through the crop variability coefficient analysis revealed that high risky crop like soybean should never grow as

specialised enterprise because there was higher production and productivity variation even up to 140.68 percent indicated that soybean may be grown not more than 30 percent kharif cropped area.

2. Crops like paddy, maize, sesame and pigeon pea if possible should be grown simultaneously for sustaining the farm income of the producer farmers in such cases.
3. Paddy and wheat had higher areas under them and had higher association with irrigation, fertilizers and farm harvest price therefore, more attention to be made on such crucial inputs for further increase of their individual productivity directly related with production and farm income.
4. Maize, sesame and pigeon pea having lesser maturity period and provide better return per hectare without having risk should also be taken as shock observing enterprise to cover the additional risk resulted by other crops.
5. Promoting mixed cropping system in the rainfed areas of the district like pulses and oilseeds to ensure sustainable income to the farmers in the event of drought situation.
6. Increasing cropping intensity through seasonal discipline in the district where the farmers can cultivate more crops in a year.
7. Farmers should follow contingency cropping.
8. Results of the study show that paddy and wheat are having highest area in kharif and rabi season. This is due to higher yields, favourable price policy, availability of inputs at affordable prices, etc. in order to reduce area under paddy and wheat, there is an urgent need to ensure parallel facilities for alternative crops. Without firm policy reforms in favour of alternative crops. Crop diversification will remain an elusive goal in Haryana and persist as an issue which will be debated on different for a without any concrete outcome.
9. Earlier, research in rice and wheat got greater attention than other crops from the Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs). There is need to strength technology development programme for other alternative crops.

CHAPTER – VII

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CURRICULUM VITAE

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