CHAPTER 1

INTRODUCTION

“Crop diversification has emerged as an important alternative to attain the objectives of output growth, employment generation and natural resources sustainability in the developing countries. The recent experience in Asia, particularly southeast Asia, Middle East and North Africa indicates that policy makers and planners are increasingly focusing on crop diversification to promote agricultural development”

Petit and Barghouti (1972)

The basic economic problems in India have their roots in food production and agricultural development. Unless supreme efforts are economically directed to these basic problems, the danger implies in the present food crisis will inevitably lead to an acute food shortage and thus stultify all planning for development and better standards of life. It is here that the basic economic problems are really baffling in their variety and content, largely because of their extreme contradictions, enlarging complexities and enormous difficulties. There is a general consensus of opinion that Indian agriculture has not met the challenge of economic development. Ever since independence, increase in agricultural production and self-sufficiency in food have been basic national objectives. Although there is an increase in food grains production, yet our dependence on food grains import occasionally depends upon foreign food import particularly in the years of disaster like either the floods or drought due to the failure of monsoon or above average monsoon. Thus, after years of economic planning the problem of food and
agriculture has been the main source of many economic ills plaguing the nation (Desai, 1969).

Agriculture is one of the oldest and most important occupation of man (Mohammad, 1981). Development of agriculture is important for any country because it is a primary sector of the economy which provides the basic ingredients, necessary for the existence of mankind. Agriculture in India is a major source of economy. It contributes by 50 per cent to national income and gives direct employment to about 68 per cent of total population of rural areas and provides for nearly 35 per cent of country’s exports, besides supplying wage-goods required for the non agricultural sector especially industry. Hence it is not surprising that agriculture in India has been receiving much attention in the sectorial allocation of inputs in the five year plans in India and therefore, crop priority has been assigned to develop agriculture sector in our country (Vidya, 1985).

In addition to supplying food, agriculture provides much of the raw material for industry. The textile industry, the leather goods industry; food processing, etc. will all be dependent on agricultural supplies. In addition, agriculture must generate export surpluses in order to earn the foreign exchange with which to finance the import of capital goods and certain kinds of industrial raw materials. Early theoretical literature on the role of agriculture in economic development can be traced to as far back as the eighteenth century in the writings of the physiocrats. Emphasizing the role of agriculture, the physiocrats were inclined to deny the productivity of other economic activities. It was their view that only agriculture turned out a “net product” over and above its cost of production, with agricultural surplus serving to maintain
the "sterile" class of manufacturers and traders. According to physiocrats, it is only in agriculture that nature labours along with man and by her bounty yields not only what the agricultural labourer or the farmer consumes, but also a surplus which nourishes the other classes of society. On this score they concluded that it was only agriculture which produced an economic surplus over the costs of production and, therefore, this sector played the most strategic role in economic development. Commerce and manufacture were regarded as non-productive as they enhanced the value of the raw materials only enough to pay for the labour and capital used in the process of production (Sadhu and Singh, 1991).

Statement of the Problem

Crop diversification, as a strategy to achieve important development goals, has received increased attention of policy makers in the country during the recent years. The strategy envisages changes in production activities of farm sector, to adjust to changes in economic environment and to face the challenges of persistent unemployment and natural resources degradation. The broad objectives of this strategy are to raise per capita income through opening of avenues for productive employment in farm and non-farm sectors and to make the economic growth broad based and sustainable in the long run. The success of the policy for crop diversification requires crop identification of suitable region-specific diversification alternatives, creation of physical and institutional infrastructure facilities, and implementation of appropriate intervention strategies. Against this backdrop, the study explores the potentials and prospects of crop diversification in the agriculturally advanced green revolution region with focus on Punjab and Haryana plains.
which have attained highest level of agricultural growth and development in the country. Conservation of natural resources, to provide for employment, more income to the marginal farmers, to reduce dependence on outside supply and to promote export possibilities are some basic reasons for the adoption of diversification. Punjab has been the first state in the country to initiate contract farming at government level. The main objective of this programme has been to prepare farmers to cultivate quality and marketable produce based on demand supply chain. Diversification in cropping is possible and essential to save the crumbling agriculture economy and environment of the study area. Crop diversification acquires special significance in this region because of the ecological and environmental problems and strain on natural resources associated with the green revolution technology, and difficulty in sustaining growth in output and income (Chand, 1999).

Crop diversification refers to the competition among the growing crops in a region. The keener the competition, the higher the magnitude of crop diversification, and the lesser the competition, the greater will be the trend towards crop specialization or monoculture farming, where emphasis is on one or two crops. Thus crop diversification is a concept which is opposite to crop specialisation (Singh, 1976).

The farmers all over the world, especially in the developing countries, try to grow several crops in their holdings in an agricultural year. The level of crop diversification largely depends on the geo-climatic/socio-economic conditions and technological development in a region. It is generally considered that higher the level of agricultural technology, the lesser the
degree of diversification. Moreover, rich farmers prefer to specialize in agricultural enterprise while the poor and subsistent farmers are generally more interested in diversification of crops.

**Study Area**

Punjab-Haryana plain is situated in north-west of India. It comprises two states namely Punjab and Haryana. Total geographical area of the study region is 94,572 sq km which accounts for 2.88 per cent of the total geographical area of India. The latitudinal extent of the study area ranges between 32°32’ north to 27°37’ north and longitudinal extent is from 73°55’ east to 77°46’ east. The study region is encircled by Jammu & Kashmir in the north-west, Himachal Pradesh in the north, Uttranchal in the north-east, Uttar Pradesh and Union Territory of Delhi in east and Rajasthan in the south, on the west it forms international boundary with Pakistan. The location of study area is marked by a large number of rivers which makes most of the study area a fertile plain. Most of the land lying in central parts of Punjab-Haryana Plain is fertile. In south and south-east, it varies between semi-arid and desert landscape in the south-west. Punjab-Haryana Plains have Shiwalik hills in the north-east and range of Aravali hills in the south-west which runs through southern Delhi and the Gurgaon district up to Alwar. There are some high ridges running from the north-west to south-east with numerous branches out in all directions in Haryana State. These hills are known as Morni and Tipra ranges which belong to the outer range of Himalayas. A belt of undulating hills of Shiwalik range found in the north-eastern part of the study area. Study region has gifted with four perennial rivers namely Ravi, Beas, Satluj and Yamuna and seasonal rivers like Ghaggar, Tangri, Markanda, etc. Most of the
PUNJAB
HARYANA

Punjab-Haryana Plain

INDIA
Location of Punjab-Haryana Plain

AFGHANISTAN
PAKISTAN
CHINA
NEPAL

ARABIAN SEA
BAY OF BENGAL

Source: Census of India 2001, Series -4, Punjab.
Administrative Division

PUNJAB-HARYANA PLAINS

2005

Fig. 1.2

Sources:
land in the study area is covered by alluvial soils which make the region suitable for agriculture. Punjab-Haryana Plain significantly contributed to green revolution which started in 1960’s. The study region occupies a fertile tract of river plains and is the 'bread basket of the nation'. Climatically, the study area has four major seasons: hot season from mid March to mid June when the temperature rise up to 45°C; rainy season from mid June to mid October and third is retreating monsoons from mid October to mid December and fourth is cold season, from mid December to mid March in which temperature goes down as low as -1°C (Amritsar). The rainfall in the region is low and its nature is erratic. The rainfall is distributed during the year for two well marked seasons. One is the monsoon period lasting from July to the mid of September and other is the winter rains which occur from December to February due to western disturbances. According to 2001 census the population of the study region is 4,55,03,563 persons, out of which 24,4,48,998 are males and 21154565 are females. Most of the population of the Punjab-Haryana plains directly or indirectly depends upon agricultural sector. So agriculture plays a very important role in the economic growth of the study area. It is right to say that agriculture is the backbone of the economy of Punjab-Haryana Plains.

**Review of Literature**

A number of scholars in the field of agricultural geography and allied fields have done work on cropping pattern and crop diversification in India and other countries in the world. Thus, an attempt has been made in the present study to review some of the important works in the following paragraphs:
Ayyar, (1969) in his study "Crop Regions of Madhya Pradesh: A Study in Methodology" has evolved a new technique for measuring crop diversification regions. He has taken all the crops which were having 1 per cent or more than 1 per cent of the total cropped area. Then he divided the sum of crops by the number of crops which are having 1 per cent or more than 1 per cent of the total cropped area. His method is an improvement over Bhatia's and Singh's methods for measuring crop diversification.

Barghouti et. Al (2003) in their study “Poverty and agricultural diversification in developing countries have observed that per capita income is hypothesized to affect the diversification as measured with the presence of non-food crops in either way. The non-food crops more significantly, fruits and vegetables are increasingly recognised as a new source of growth in agricultural income. On the other hand, increase in per capita income is the cause of shift in consumer’s preference from staple food to the items like fruits and vegetables. The above changes in dietary pattern are the cause of diversification of production portfolio.

Bhatia, (1965) in his study on "Patterns of Crop Concentration and Diversification in India" has observed that physical, socio-economic and technological factors have affected the magnitude of crop diversification. Variations in above mentioned factors are responsible for variations in patterns of crop diversification in India. He has also evolved a new technique for measuring crop diversification in India. He has taken all the crops which are having 10 per cent or more than 10 per cent of the cropped area. He summed up the total area under these crops and divided the sum by the
number of crops. According to his method, higher the index, lower is the magnitude of crop diversification and vice-versa.

Bhattacharya, (2002) has studied agricultural land use in Barddhaman block of Barddhaman district. The study reveals that development of irrigation, use of agro-chemicals, service centers, modern technology, development of socio-economic conditions, etc. have enabled the farmers to achieve optimal landuse and crop specialisation in the study area.

Chopra, (1997) in his work analyzed that if agriculture itself grows, it makes product contribution; if it trades with others, it makes a market contribution; and if it transfers resources to other sectors, these resources being productive factors, it makes a factor contribution.

Chinnappa, (1982) in his study concluded that paddy cultivation dating back to the late 1960's in India is generally taken to include use of high yielding varieties, inputs of chemical fertilizers, improve cultural practices and modernisation of agricultural operations which have led to decline in the magnitude of crop diversification which means India's agriculture has become crop specialized.

Dhindsa and Sharma, (1995) have found the aggregate changes in cropping pattern in Punjab during 1965-66 to 1990-91 in terms of expansion and substitution effect. The facts were measured by total cropped area and elasticity of various crops.

Frankel, (1971) observed that no state was more closely identified with profits of new agricultural technology than Punjab and Haryana which is the effect of green revolution technology adopted by the progressive farmers.
Gill, (1976) in his study concluded that Punjab's cropping pattern has changed from diversified to specialised with the introduction of high yielding varieties of seeds of wheat and rice.

Gosal and Krishnan, (1984) in their study titled "Regional Disparities in Socio-economic Development in Punjab" have observed that due to healthy mix of irrigation, chemical fertilizers and high yielding varieties of seeds of wheat and rice, the cropping pattern of Punjab has transformed from diversified to specialized.

Gupta and Shangari, (1980) observed that in the post green revolution period wheat rice crop rotation has emerged in the central parts of Punjab due to the developed agricultural infrastructure and the excellent work done by Punjab Agricultural University, Ludhiana.

Hassan and Inderjeet, (2000) have evaluated the relationship between canal irrigation and land degradation in Haryana. The study found that rapid expansion of irrigation, mainly by canals in the state has led to wheat and rice or wheat and cotton predominant cropping pattern which led to state's crop pattern from diversified to specialised. They further observed that extension in canal irrigation and consequently changes in cropping pattern have resulted in serious amount of ecological destruction through water-logging and accumulation of salts in the soil profile.

Hooda and Turan, (1995) have observed that the influence of powerful new farm technology in modern agriculture led to an achievement called higher crop productivity.

Hussain, (1987) in his study "Consequences of Green Revolution in India" has observed that the state of Punjab and Haryana where green
revolution has ushered, the cropping pattern is largely affected and as a result cropping pattern has transformed from diversified to specialized.

Inderjeet, (1997) in his paper 'Spatial Temporal Analysis of Ground Water Balance in Eastern Haryana' has concluded that in areas where the wheat-rice crop rotation has emerged, the water table is continuously lowering.

Ishtiaq and Kibaemi (2003) have examined the land use pattern and sustainable agricultural development in Nagaland. They found that very recently a section of Naga tribes turned to plantation and horticulture resulting in diversification of agriculture, thus making it sustainable.

Johl, (1996) in his study "Dynamics of Punjab Agriculture" has found that the cropping pattern of Punjab is mainly dominated by wheat-rice crop rotation which shows crop specialization.

Joshi et. al., (2007) have also analyzed that urbanisation is the most important factor behind the growth of high value crop.

Kainth and Mehra, (1985) in their study "Rice Production Potential and Constraints" reveal that the ‘Green Revolution’ may be taken as a turning point for Indian agriculture and especially for the state of Punjab, which with the push given by the new technology has become one of the most developed states of India. The state spearheads the progress of Green Revolution and has rightly been called the ‘grain bowl’ of India. The study also focuses attention towards public investments, infrastructure facilities and agricultural inputs in relatively backward areas to reduce regional imbalances.

Kaur, (1990) in her study relating to "Crop Diversification in Malwa Region of Punjab" has found that there is positive correlation among the
patterns of crop diversification on one hand and physio-socio-economic-technological on the other hand. She has further found that regions' cropping pattern got changed from diversified to specialized with wheat-rice and wheat-cotton crop dominance.

Kaur, (1990) in her work titled, "Crop Diversification Regions in Bist-Doab of Punjab: 1966-68 to 1986-88" has noted that the areas with flat terrain, developed irrigation and developed agricultural infrastructure are having low magnitude of crop diversification as compared to areas lying along the Shiwalik foot hills, which are dissected and have undulating topography, infertile soils, small size of land holdings, low extent of irrigation and poor agricultural infrastructure. She has further found that central areas of Bist-Doab Region during the study period have experienced a drastic change from high crop diversification to low crop diversification, while in areas along the Shiwaliks, the change is noted insignificant.

Kumar, (2001) in his study titled "Technological Change and Rate of Diffusion" has noted that technological advancement in agriculture had accelerated the diffusion of agricultural innovations which has led to crop specialisation.

Maan, et.al (1968) in their study titled, "Estimates of Potential effects of new technology on Agriculture in Punjab" have observed that diffusion of Green Revolution technology has increased acreage under the cultivation of wheat and rice, while there is decline in area under maize, cotton, pulses, grams, fodder, etc.

Mega, (2004) in her study "Towards the Civilization of Sustainable Energy: The European Prospective" has observed that sustainable energy is
imperative for healthy growth of agriculture not only in Europe but also in third World Countries.

Mehta, (2009) has observed in his work that crop diversification is one of the major tools of policy, which drew widespread attention in India in the recent past in the face of stagnant growth; incomplete agricultural transformation and low productivity.

Mohammad, (2000) stated that the strategy for sustainable agriculture must rest on the water conservation and compatibility of agricultural development with the ecosystem and measures of population control on the other hand.

Mohammad, (1981) in his work entitled 'Perspectives in Agricultural Geography' has concluded that resources like land, climate, water, soil, etc. play strategic role in the determination of man's economic, social and cultural progress through reference to economic history.

Morgan & Munton, (1971) have observed that socio-economic factors affect land use patterns considerably and it is unrealistic to regard agricultural cultivation systems as adaptations to different natural conditions and that cultivation system can be more plausibly explained as a result of differences in population density.

Pandey and Muthana, (1980) have concluded that the crux of development of agriculture lies in increasing the productivity of land. For raising the productivity of land, it is invariably suggested that irrigation should be provided to as much of the cultivable land as possible.

Rayamane, (2001) has highlighted the changing landuse profile in Belgaum district of Karnataka. In his study, he has found changes in Landuse
during 1979-80 to 1989-90, 1989-90 to 1999-2000. He has observed that in Belgaum district growing population is one of the main factors for changing landuse pattern and is the major threat to the land. The study has further revealed that dynamics of landuse and land cover differ in different parts of the area.

Singh, (2006) in his study “Crop diversification in Bari-Doab Region of Punjab” has concluded that the patterns of crop diversification and variations in relief are positively correlated. He further observed that areas with unfriendly physiography have high magnitude of crop diversification as compared to featureless central uplands of the study region. He has also found that due to diffusion of agricultural innovations, the magnitude of crop diversification has declined, where as the cropping pattern has become specialised.

Singh and Chawla, (1978) have stated in their study that 91 out of 106 samples taken from the soils where wheat rice crop rotation has emerged were found contaminated with insecticides residues.

Singh and Kareriya, (2003) in their study "Agricultural Technology Transformation, Environmental Change and Rural Development in a Part of Nepal" have observed that rapid growth of population has brought an enormous effect in the developing countries as there crops up the problem of food security and unemployment, which led to more pressure on agricultural land which consequently lead to changes in the cropping pattern.

Singh and Sharma (2003) have studied the variables affecting crop intensity in the Assam plains where land use pattern is not dynamic and pace of agricultural development is slow. With step-wise multiple regression
analysis, they have concluded that crop intensity is still controlled by biotic factors.

Singh Surendra, (2000) in his paper "Modelling Structure and Function of Agricultural Yield Potential" has examined the structural features and functions of crop-yield potential, which affect the crop-yield curve in a specific land environment. The magnitude of yield potential, which is based on the hidden capacity of land, rapidly declines in the initial phases of crop-yield. The most notable feature in yield potential system is that the biotic potential is exhausted with increasing strain on land environment to produce more yield specially in the later phases of crop-yield curve.

Singh, (2000) in his study "Green Revolution in India: Gains and Pains" has concluded that introduction of Green Revolution technology has changed the crop structure in India and has also affected the environment particularly soil and water resources. He has further observed that in areas of Green Revolution, the trend of cropping pattern is from diversified to specialized.

Singh, et. al. (2003) have analysed the effect of the changing landuse on the environment of Nepal. According to them, the changes due to man's activities have led to land degradation, large-scale deforestation and consequent ecological imbalance.

Sipra, (1980) in her work "Class Relations and Technical Changes in Indian Agriculture" has stated that technical changes in agriculture may be expected to bring about desired results, first a rise in agricultural productivity and second, an improvement in the living conditions of the rural population.

Sohal (2003) in his paper "Changes in Crop Diversification in Punjab: 1951-2001" has concluded that before the ushering of Green Revolution in
Punjab, the index value of crop diversification was very high and as well as highly variable in its spatial extent. But with the introduction of green revolution technology, it has witnessed a drastic change in the level of crop diversification. According to Gibbs and Martin technique, it came down significantly from 0.88 to 0.74 during 1951 and 2001 respectively. Magnitude of crop diversification was noted high in major parts of Punjab in 1950-51 but during 2000-01, it was found lowest in about 80 per cent of the area. It is, thus, revealed that Punjab's agriculture has shifted from subsistence and highly diversified to highly intensive, commercialized and specialized nature.

Sohal, (1993) in his study found that if India wants to feed its teeming millions then the present state of affairs in respect of cropping pattern and crop combinations should go on. He has also suggested that both national interest and ecological obligations must work hand in hand in agricultural planning.

Sohal, (1994) in his work "Dynamics of Rice Cultivation and Ecological Consequences in Punjab" has found that the emergence of rice cultivation has led to crop specialization.

Sharma (2005) has found that crop diversification towards selection high value cash crops including fruits and off season vegetables, compatible with the comparative advantage of the region is suggested as a viable solution to stabilize, raise form income and increase in the land productivity.

Vyas, (1966) has argued that the significant changes in cropping pattern in India could be explained in terms of a change in relative prices.
Thus, from the above cited works, it becomes evidently clear that no scholar has ever taken up the work on crop diversification in Punjab-Haryana plains during 1965-66 to 2005-06 periods. Therefore, it is quite useful and significant to undertake the present research problem for the Ph. D. degree. The present researcher feels that this study would be of paramount importance for knowing the nature of crop diversification and its emerging socio-economic and environmental impacts. The deductions of the study in hand would definitely help to solve many upcoming problems of agriculture in the study region.

Objectives

The study in hand has the following objectives:

I. To identify the cropping patterns.

II. To demarcate the crop diversification regions and changes therein.

III. To highlight the factors responsible for changes in crop diversification regions.

IV. To find out the impacts of crop diversification on environment.

V. To make suggestions.

Hypotheses

For achieving the above mentioned objectives, the present study has tested the following hypotheses:

I. Relief affects decisively on the cropping pattern of a region which leads to variations in crop diversification.

II. Development of water resources leads to adoption of new agricultural technology which generally leads to crop specialisation.

III. Introduction of high yielding varieties of seeds leads to changes in cropping patterns and crop diversification regions.
IV. Increase in the magnitude of crop diversification and environmental degradation are positively co-related.

Methodology

The methodology of the present study is consonance with the proposed objectives. District is taken as unit of study. It is based on secondary source of data. Three time periods of 1965-66, 1985-86 and 2005-2006 are taken for revealing the spatio-temporal patterns for crop diversification regions. First time period of 1965-66 is taken because it was the year when Green Revolution Technology is introduced in the study region, while the year 1985-86 is taken when mostly the Green Revolution Technology was adopted by the farmers and it had shown results also. Secondly 1985-86 is also divided the study into two equal time periods i.e. 1965-66 to 1985-86 and 1985-86 to 2005-06. Whereas the year 2005-06 is selected because the present researcher has started her work for to Ph.D. degree in this year. Moreover it is also represent the period of Globalization and Liberalization. Though those were introduced during nineties. To avoid any anomaly in data due to ups and downs in weather conditions, three year average is taken for each time period eg. the figures of 1964-65, 1965-66 and 1966-67 are taken for 1965-66. While the data of 1984-85, 1985-86 and 1986-87 is taken for the period of 1985-86. Whereas, the figures of 2004-05, 2005-06 and 2006-07 are taken for 2005-06.

During the period under present investigation, changes in the boundaries of the districts have occurred. Thus, due to changes in boundaries, the area of some districts is allocated to the new districts in accordance with the geographical area contributed by each district. To know
the accuracy of the adjustment of the new boundaries cross checking at various levels like tehsil, sub-tehsil, community Development block and state is done. A great sincere effort is made for such boundary adjustments, but the being the work is complicated, some shortcomings may be left which is the limitation of the present study. Statistical techniques are used for deriving the results and cartographic methods are used for mapping the results. Tables, graduated circles and maps are used to show the physical, socio-economic parameters and spatio-temporal patterns of land use, crop land use, crop diversification regions, etc.

For calculating the index of crop diversification, the following three techniques, namely Gibbs and Martin (1962), Bhatia (1965) and Singh (1976) are used. The above mentioned techniques are explained below:

1. **Gibbs and Martin's technique:**

   \[
   \text{Index of Crop Diversification} = 1 - \frac{\sum X^2}{(\sum X)^2}
   \]

   Where 'X' stands for the percentage of total cropped area occupied by each individual crop.

2. **Bhatia’s technique:**

   \[
   \text{Index of Crop Diversification} = \frac{\text{Total Cropped Area Under } x \text{ Crops}}{\text{Number of 'x' Crops}}
   \]

   Where 'x' stands for those crops which individually occupy 10 per cent or more of the total cropped area.
3. Singh's technique:

Index of Crop Diversification = \[
\frac{\text{Percentage of total harvested area under 'n' Crops}}{\text{Number of 'n' Crops}}
\]

Where 'n' stands for those crops which individually occupy 5 per cent or more of the total harvested area.

Sources of Data

The present study is based on secondary sources of data which is collected personally by the researcher from various State Offices, Libraries, etc. District is taken as unit of study. Data is collected from the following secondary sources which contain both published and unpublished sources. These are Lal Kitabs of all the districts of the study area; Economic and Statistical Organisation of Punjab, Chandigarh and Haryana, Panchkula; Economic and statistical Adviser Planning Department, Government of Haryana, Chandigarh; Directorate of Agriculture, Punjab, Chandigarh; Directorate of Agriculture, Haryana, Chandigarh; Punjab Agricultural University, Ludhiana; Haryana Agricultural University, Hisar; Land Reclamation, irrigation and power research institute, Amritsar; Punjab Remote Sensing Centre, Ludhiana; Haryana Remote Sensing Centre, Hisar; Regional Meteorological Centre, New Delhi; Central Board of Ground water North west region, Chandigarh. Libraries of various institutions and Other allied departments.
Chapter Scheme

The thesis is divided into the following eight chapters:

First chapter of introduction includes the statement of the problem, geographical setting of the study area, review of literature, objectives, hypotheses, methodology, sources of data and chapter scheme.

Physical environment is discussed in second chapter which deals with relief, landform regions, climate, soils and drainage.

In third chapter, the attributes of socio-economic environment are explained which contains density of rural population, extent of irrigation, agricultural workers, agricultural labourers, cultivators, size of land holdings, land tenure system, consumption of chemical fertilizer, density of tubewells, market, road network, etc.

Fourth chapter examines the spatio-temporal patterns of land use categories.


Delimitation of crop diversification regions for 1965-66, 1985-86 and 2005-06 by using Gibbs and Martin’s technique, Bhatia’s technique and Singh’s technique are made in chapter sixth.

Chapter seventh highlights the impacts of crop diversification on the soil resources, sub soil water resources, air and noise.

In chapter eighth, conclusions are drawn and suggestions are made.