CHAPTER- I
INTRODUCTION

During the last two decades Indian agriculture has been facing major challenges like deceleration in growth rate, degradation of natural resources, inter-sectoral, inter-regional equity, declining input efficiency, etc (Aswale, 2015). Agriculture sector is the mainstay of the Indian economy, contributing about 15 per cent of national Gross Domestic Product (GDP) and more importantly, about half of India’s population is wholly or significantly dependent on agriculture and allied activities for their livelihood (GOI, 2011). Agricultural productivity depends on several factors. These include the availability and quality of agricultural inputs such as land, water, seeds and fertilizers, access to agricultural credit and crop insurance, assurance of remunerative prices for agricultural produce, storage and marketing infrastructure, among others. The agriculture sector employs nearly half of the workforce in the country, However, it contributes to 17.5 per cent of the GDP (at current prices in 2015-16). Over the past few decades, the manufacturing and services sectors have increasingly contributed to the growth of the economy, while the agriculture sector contribution has decreased from more than 50 per cent of GDP in the 1950s to 15.4 per cent in 2015-16 (at constant prices). India’s production of food grains has been increasing every year, and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. It is the highest producer of milk and second highest producer of fruits and vegetables. In 2013, India contributed 25 per cent to the world’s pulses production, the highest for any one country, 22 per cent to the rice production and 13 per cent to the wheat production. It also accounted for about 25 per cent of the total quantity of cotton produced, besides being the second highest exporter of cotton for the past several years. However, the agricultural yield is found to be lower in the case of most crops, as compared to others top producing countries such as China, Brazil and the United States. Although India ranks third in the production of rice, its yield is lower than Brazil, China and the United States. The same trend is observed for pulses, where it is the second highest producer. Agricultural growth has been fairly volatile over the past decade, ranging from 5.8 per cent in 2005-06 to 0.4 per cent in 2009-10 and -0.2 per cent in 2014-15. Such a variance in agricultural growth has an impact on farm income as well as farmer’s
ability to take credit for investing in their land holdings. Key issues affecting agriculture includes the decreasing size of agricultural land holdings, continued dependence on the monsoon, inadequate access to irrigation, imbalanced use of soil nutrients resulting in loss of fertility of soil, uneven access to modern technology in different parts of the country, lack of access to formal agricultural credit, limited procurement of food grains by government agencies and failure to provide remunerative prices to farmers (Deshpande, 2017).

Modern agriculture has many achievements in increasing production, productivity of resources and improving the living standards. Experts believe that agriculture has had a key role in welfare and food security of communities (Alaudin & Tisdell, 1991). However, environment pressures were exerted due to excessive reliance on external inputs, especially fertilizers and increasing use of water and soil (Rahman, 2003; Bylin et al., 2004; Razaei-Moghaddam, 2005). In fact, in recent decades, modern agricultural systems have been severely criticized due to these concerns (Alonge & Martin, 1995; Rodrigues et al., 2003). Meanwhile, there has been an international consensus in support of the environment to develop agriculture capable of increase productivity and making the least damage to the environment (Souza Filho, 1999; Bagheri et al., 2008).

**Statement of the problem**

Crop diversification is known as a 'Silent Revolution' of agricultural diversification. It is also considered as resilience mechanism followed by farmers in different regions. Crop diversification is a concept which is opposite to crop specialization. Singh (1998) also stated that crop diversification is an indicator of multiplication of agricultural activities which obviously involve intensive competition among various activities in space. The degree of crop diversification and cropping pattern are affected by various factors like physical, socio-economic, technological, organizational etc.

Kurosaki (2001) defined that diversification in cropping pattern plays important role in the process of agricultural transformation. Whereas Haque (1995) defines that from national or social point of view, diversified farming can be helpful in protecting the agricultural environment. Crop diversification is the budge word in agricultural scenario at the national and international level.
During the period of green revolution, when there was a need of total food grains production in India, emphasis was given on increasing crop intensity as well as crop productivity but in long term, this approach digressed from the principle of crop production. Thus, the approach of crop diversification has been envisaged as a new strategy towards enhancing and stabilizing productivity making Indian agricultural export competitive and increasing net farm income and economic security. Crop diversification is now almost a normal feature of sustainable cropping pattern and agriculture not only in India but in many parts of the world also emphasized that for increasing progressive farm management (Joshi et al. 2004). Thus, crop diversification manifests the present agricultural scenario. It is further stated by Aksay (2005) and Singh (2006) that green revolution presents fine example of technology induced crop diversification. Green revolution technology has become instrument in creating opportunities for raising agricultural productivity which was possible only through high yielding varieties of seeds, agro-chemicals, irrigation facilities, etc. Moreover, crop diversification is intended to give a wider choice for growing a variety of crops in any area which leads to increase production related activities on various crops and also it helps to lessen economic risk. Crop diversification also helps to shift from subsistence farming to commercial farming, to switch from low value food crops to high value food crops and from indigenous varieties to high yielding varieties of seeds (Goswami, et al. 2004 and Sohal, 2003).

In other words, crop diversification leads from low value to high value crops, hygrophyte crops to water saving crops, single crop to multiple crops, crop cultivation to mixed farming, agricultural production to production with processing and value addition. It can be said that crop diversification works as a risk management strategy and is also instrument in food and nutrition security, increase in the income of farmers, poverty elevation, job opportunity and judicious use of land and water resources, sustainable agriculture and environmental improvement (Saleth, 1995).

**Study area** (Fig.1.2)

Himachal Pradesh lies between 30° 22’ to 33° 12’ North latitude and 75° 47’ to 79° 04’ East longitude. It is bounded by Jammu and Kashmir in north, Punjab in west, Haryana in south-west, Uttarakhand in south-east and China in east. The state has an
area of 55,673 km². It is hilly and mountainous state that represents an intricate mosaic of valleys, hills and mountain ranges. Its altitude varies from below 600 meters to over 4500 meters above the mean sea level. In general, its elevation increases from west to east and from south to north. Himachal Pradesh has five snow fed perennial rivers namely Chenab, Ravi, Beas, Sutlej and Yamuna. There are numerous seasonal torrents also. Its average annual rainfall is 1193 mm which varies from 50 mm in Lahaul and Spiti to over 3400 mm in Dharamshala. The climate varies from subtropical in lower parts to temperate in mid hills and arctic type in higher mountains. According to 2001 census, total population of Himachal Pradesh is 60,77,900 persons, average rural population density of 98 persons per sq. km and literacy rate of 76.5 per cent. There are 81 tehsils and 12 districts for administrative purposes.

**Review of Literature**

The important and relevant work pertaining to agriculture in general and crop diversification in particular done by various scholars have been reviewed in the proceeding pages.

Ajjan and Selvaraj (1996) have studied the impact of crop diversification among the small tea growers in the Nilgiris district of Tamil Nadu. They have deduced that there had been a major shift in cropping pattern and also concluded that crop diversification had a positive effect on soil conservation and ecology. Anosike et al. (1990) have found that land tenures, off-farm work education and environmental variations are important determinant of crop diversification at the farm level. While Bansil (1971) has stated in his work that spatial distribution of crops as well as diverting better lands to high yielding crops is telescopic view of total agricultural economy of the country. Barghouti et al. (2003) from their work have observed that per capita income is hypothesized to affect the diversification as measured with the per cent of non-food crops in either way. The non-food crops like fruits and vegetables are increasingly recognized 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 preferences from staple food items to fruits and vegetables. Thus, changes in the dietary patterns are the result of the diversification of production portfolio. Bhatia (1965) has found that magnitude of crop diversification is governed by physical, socio-economic and technological factors which have led to great variations in patterns of crop diversification in India. Chahal (1999) in his study has observed that mechanical and technical
improvements in agricultural land have led to saving of energy, time and money of the farmers. Chand and Chauhan (2002) have noted in their study that diversification is the process to take the advantage of emerging opportunities created by technology, new markets, changes in policy etc. Chopra (1997) has analyzed that development of agriculture increased the agricultural production, which affect the trade and commerce and as a result all sectors of economy have developed. While Forester (1953) describes agriculture as business and farmer as an entrepreneur. Whereas Gupta et al. (1985) have identified irrigation, farm capital, price mechanism and size of operational land holdings as factors affecting the level of crop diversification. In 1985, Gupta and Tewari have advocated that for getting maximum profit, adoption of crop diversification is the best bet and at the same time it helps to minimize the risk in farming. Haldipur (1979) observed that farmers in subsistence economy always give stress to cultivate various traditional crops which are suitable to the local environment and also for making the risk factor minimized. All this led to crop diversification.

Hooda and Turan (1995) have observed that the adoption of new farm technology in modern agriculture led to higher crop productivity. Husain (1999) in his work entitled 'Systematic Agricultural Geography' has found that agriculture is a dominant economic activity which affects the spatial distribution of agricultural systems and agricultural processes. Joshi et al. (2007) have analyzed that urbanization works as an important force for the growing of high value crops. Kahlon (1984) has found that by adopting crop rotation, the use of chemical fertilizers can be minimized. Kang and kaur (2017) have noted that intensive irrigation with the introduction of green revolution in Bist-Doab region of Punjab has led to high consumption of sub-soil water and as a result ground water resources have been depleted. Lathar et al. (1996) have suggested that there is a dire need to strengthen the agricultural infrastructure, marketing, research and extension services etc for getting the gains of crop diversification. Laxminarayan et al. (1981) has pointed out that the introduction of harvest combines has led to the increase the percent share of wheat and paddy area in the total cropped area.

Mathur (1970) has observed that modern farming requires compulsory vocational training for all the farmers. Mehta (2009) has recognized that crop diversification is one of the major factors of agricultural policy for breaking the stagnant growth of agricultural produce and for increasing the agricultural productivity. He identified four dimensions of diversification i.e,
number of crops, spread of cropping pattern, proportion of high value crops in the cropping pattern and shift in cropping pattern mix. He has also observed great heterogeneity in terms of typology of diversification in the output which is increasing in India. He has also noted that it is important that those high value crops remain remunerative over the period of time through proper technological and market development, otherwise the gains from diversification will become meager. Mamoria (1966) has deduced that in India over time great changes have taken place in both agriculture and non-agricultural sectors. He further emphasized for the need of improved farm techniques in the future, so that problems which the country will face in the times to come should be solved. Mohammad (1981) in his work has concluded that land, climate, water, soil, etc. play decisive role in the cropping pattern of any region. Narain (1965) in his pioneering work has observed that expansion in irrigation technology, price mechanism, etc have affected the shift in cropping pattern and relative profitability of crops in different regions. Narayananmoorthy (1997) in his work entitled, "Crop Diversification and Yield Response to Fertilizers Productivity” has concluded that high relative price and productivity of any crop at the existing state of technology have affected the magnitude of crop diversification. Palanisami et al. (2006) have examined that farmers preferred crop diversification in areas where climatic conditions are vulnerable, because by growing number of crops, they will certainly avoid risk in case of some crop failure. They have further suggested that if linkage between agriculture and industry is strengthened in coastal areas of Tamilnadu, which will certainly affect the crop diversification positively, which will increase farmer’s income and reduce the risk factor. Panda (1991) in his work has observed that judicious use of manures and chemical fertilizers is essential to maintain balance in soil health as well as soil productivity. He has deduced that the private farms and the large family farms have made a better management of soil as compared to government farms. Pandey and Muthana (1980) in their study stated that increase in land productivity will lead to development of agriculture and for increasing productivity of land, irrigation is pre-requisite, because modern farm inputs require developed irrigation. Raina (1997) from his work has observed that besides irrigation, other factors like soil fertility, use of modern agricultural techniques, traditional settlement patterns, crop preferences of local people, caste etc affect the cropping pattern and crop diversification of a region. Ranjana (2012) has observed that relief is one of the most important factor which affects cropping pattern and crop diversification of an area. Raychaudhauri and Sen (1996) in their work have advocated that crop
diversification is actually associated with the spread of new technology. Saini et al. (1996) in their paper entitled "The impact of diversification on small farms economy in Kangra district of Himachal Pradesh" have observed that the diversification of arable farming system is effected with commercial enterprises such as high yielding milk animals, poultry birds, bee-keeping, floriculture, etc. Saleth (1995) has observed that there are several examples which proved that in several instances, cropping systems have been diversified or new cropping systems have been introduced with the major aim to retain or to enhance the value of land and water. He has also found that crop diversification also helps to farm income but it is only possible when the cropping pattern is more rewarding. Sambrani (1974) has found that the subsistence farmer is irrational and will certainly hesitate to adopt new innovations which have proved successful in other areas, because his decision making horizon does not allow him to take such risks. He has further, deduced that owing to his low aspiration, less productive expectations etc have compelled him to avoid risk. Sawant et al. (1999) in their work have concluded that adoption of short duration of HYV’s of seeds, fertilizers, pesticides, irrigation etc. have led to agricultural development in Maharashtra. They have also observed that this new technology has also increased the yield per/hectare of some non-cereal crops like grams oilseeds etc. Sharma (1991) has observed that changing phases of population, its rapid growth, uneven population etc., have affected the land use in general and arable land in particular. Sharma (2005) has suggested that crop diversification towards cash crops like fruits and off season vegetables, provide viable solution to increase both farm income and land productivity. Sharma (2014) in her work has analyzed that for maintaining national food security, the wheat-rice crop dominant cropping pattern with about 60 per cent area under their cultivation should be continued and farmers be educated about judicious use of water and agro-chemical, so that environmental degradation can be minimized and wheat-rice crop rotation can be sustained in Punjab. Sharma and Dak (1989) from their study, “Green Revolution and Social Change" have deduced that green revolution technology led to modernization of Indian agriculture which has further led to intensification, increased use of irrigation, HYV’s of seeds, agro-chemicals etc and resulted into change in cropping pattern, crop diversification and social change. Shenoi (1975) while studying agricultural development in India has observed that the dire need of Indian agriculture is advanced technology for cropping and livestock. Shingi et al. (1982) from their study “management of agricultural extension have evaluated that Indian farming require effective
management of agriculture extension which meets both food requirements and supply of raw materials to the industry. Shiyani and Pandya (1998) in their work have examined the levels of crop diversification in different agro-climatic zones over a period of time. They further observed that the cropping pattern has changed from subsistence to commercial during the study period. They have also suggested that stress should be given on establishment of agro-processing industries and development of infrastructural facilities, increasing irrigation facilities, quality seeds etc. Shukla (1983) in his work entitled, "Agricultural potential and planning in hill regions in India" has stated that 'Land doctoring' will prove positive only with the complete knowledge of physical environment and socio-economic environment. Singh (1993) while studying, "Technological change and agricultural development" has observed that modern technology led to desirable changes in the intensity of land use, cropping pattern and also the mixture of crops. Moreover, modern technology has increased the farm productivity. Singh (2014) in his study of spatio-temporal changes in crop diversification in punjab: 1988-2008 has stated that areas with physical constraints and less developed agricultural infrastructure are having high crop diversification. Whereas, areas with physical constraints and developed agricultural infrastructure or less developed agricultural infrastructure and favorable physical environment have moderate magnitude of crop diversification. But areas with favorable physical environment and developed agricultural infrastructure have low crop diversification. Singh and Sharma (1985) have found that the cropping pattern is a function of physical determinants and socio-economic attributes of a given region. Singh et al. (1985) at micro-level have observed that crop diversification is inversely related to the size of farm. Singh et al. (1997) have concluded that crop diversification along with dairy enterprise can play more significant role in increasing income, of the farmers particularly on marginal farms. Sinha and Mehta (1972) in their study on "Size of land holdings and farmer's achievement, motivation and change proneness" have found that farmers having medium size of land holdings are more receptive to change as compared to both small and marginal land-holders. Prasad (1987) in his study has observed that required supply of farm inputs to small farmers will be helpful for adoption of modern agricultural technology that will certainly lead to low inter-regional disparities in agricultural development. Tyagi (1989) has emphasized that soil and climatic conditions play important role in the cropping pattern and crop diversification of a region. Vaidya (1997) has found that agriculture is the most complex phenomenon, because several factors like geo-climate, biological and socio-
economic are influencing the agricultural production processes. Vyas (1996) has argued that prices of crops affect the changes in cropping pattern in India. Walker et. al. (1983) has observed that crop diversification is influenced by regional agro-climatic and soil conditions. He has also stated that differences in the quantity and quality of the resources are largely responsible for variations in crop diversification.

Thus, the preceding review of literature indicates that none of the above mentioned studies are related to spatio-temporal changes in crop diversification of Himachal Pradesh for the period 1990-2010. Therefore, it is judicious to undertake this study at Ph.D degree level. The present study would certainly help to make the cropping pattern in particular and agriculture in general sustainable of Himachal Pradesh.

Objectives

The major aim of the present study is to achieve the following objectives:

1. To know the spatio-temporal patterns of land use.
2. To study the spatial patterns of crop land use.
3. To find out the changes in cropping patterns.
4. To demarcate the crop diversification regions.
5. To know the changes in crop diversification regions.
6. To find out factors responsible for changes in cropping pattern and crop diversification.
7. To draw conclusions and make suggestions.

Hypotheses

In the light of above objectives, following hypotheses are formulated and tested:

1. Introduction of agricultural innovations often leads to changes in cropping pattern which further affect changes in crop diversification.
2. Higher the development of infrastructure, lower the magnitude of crop diversification and vice versa.
Methodology

The present study is empirical in nature and based on secondary sources of data. Tehsil is taken as unit of study. The time period of the present study is from 1990 to 2010. In order to avoid any anomaly in data due to fluctuations in weather conditions, three years averages are taken for each time period i.e 1989, 1990 and 1991 for 1990 and 2009, 2010 and 2011 for 2010. For making the unit analysis comparable for each selected time period, the administrative boundaries of 2010 are taken as basis. Adjustments are made in data by subtracting the figures of new units from their respective parent units. Statistical methods are used for deriving the results and cartographic techniques are applied for mapping the results. For deriving the index value of crop diversification, methods of Gibbs & Martins, Bhatia and Singh are used which are given below:

i. Gibbs & Martins Technique (1962)

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

ii. Bhatia’s Technique (1965)

\[
\text{Index of Crop Diversification} = \frac{\text{Per cent of Total Cropped Area under ‘x’ Crops}}{\text{Number of ‘x’ Crops}}
\]

iii. Singh’s Technique (1976)

\[
\text{Index of Crop Diversification} = \frac{\text{Per cent of Total Harvested Area under ‘n’ Crops}}{\text{Number of ‘n’ Crops}}
\]
Sources of Data

The present investigation is based on secondary sources of data which has provided full information relating to land use and crop land use from 1990 to 2010. All these are available at various offices of the state like tehsil and district head quarters. These statistics are collected personally by the present researcher from both published and unpublished sources at tehsil/district level, which are given as under:

2. Directorate of Agriculture, Himachal Pradesh, Shimla.
3. Economic and Statistical Organization, Himachal Pradesh, Shimla.
4. Himachal Pradesh Agricultural University, Palampur.
5. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh.
6. Office of Sadar Kanungos of all Tehsils of Himachal Pradesh.
7. Other Allied Departments.
8. Other State Offices.
10. Published and Unpublished Reports of Ph.D Thesis, etc.

These sources have provided vast information of various aspects of agriculture: land use, cropping pattern, land tenure, mechanization, irrigation, fertilizers, marketing, etc.
Chapter Scheme

The study has been organized into following chapters.

Chapter I : Introduction
Chapter II : Physical Environment
Chapter III : Socio-Economic Environment
Chapter IV : Spatio-Temporal Changes in Landuse Patterns: 1990 to 2010
Chapter V : Spatial Distribution of Cropping Patterns: 1990 and 2010
Chapter VI : Changes in Cropping Patterns: 1990 to 2010
Chapter VII : Demarcation of Crop Diversification Regions and changes: 1990 to 2010
Chapter VIII : Conclusions and Suggestions

References