Chapter – 1

- Introduction
- Statement of the Problem
- Agricultural Scenario in Haryana
- Review of Literature
- Research Questions
- Objectives of the Study
- Methodology
- Source of Data
- Chapter Scheme
Introduction

The landscape we see today is a collection of the legacies from the past. It has become what it is and it is usually in the process of becoming different... Let us then not study a static picture but a process that is continuing and seemingly never ending (Darby et al. 2002). The same is true of the agricultural landscape which is vital but limited and constantly changing with time across areas. With growing population, this finite resource is coming under greater stress. For a comprehensive understanding of existing patterns, a look into the past is imperative. It enables the agricultural geographers and policy maker to understand the spatial variation in agricultural development and to find out how it has changed over a period of time.

Agriculture plays an important role in the economy of India and is considered the backbone of the rural Indian economy. It is the main source of livelihood among the rural community; approximately 50 percent of our population is directly dependent upon agriculture. The share of agriculture and allied sectors in India’s GDP is derived to be 13.7 percent in 2012-13. This proportion of GDP has declined from 51.9 percent in 1950-51 and 30 per cent in 1990-91. During the years after Independence, India has made multidimensional progress in the agriculture sector which changed from the traditional form of agriculture gradually to the modern, technically intense form of agriculture.

The decades of the 1950s and the 1960s were marked by institutional reforms in the form of largely land reforms, development of irrigation systems and other related infrastructures. All this in combination played a major role in output and growth. In continuation, the 1970s also witnessed high growth in public investment in agriculture. Technological breakthroughs have been the prime mover during the 1970s and spread of technological changes to wider areas and crops were the main factors during the 1980s. The period since the 1990s as a part of the neo-liberal wave of globalization engulfed rural India as well as it was somewhat suddenly and rather rudely, exposed to the exodus towards integration into the global market economy. This exposure, instead of lifting the rural agrarian economy, added to the growing concerns in this sector. In terms of share in the national income and in the levels of living, there have been growing rural-urban disparities during the 1980s and 1990s (Bhalla, 2005).

Economic reforms have led to creditable growth in the Indian economy. This growth had
been fuelled by industry and the service sector. There is a discernible shift from the traditional agrarian economy towards a service dominated one. The record of the agricultural sector has been lackluster. During the 15 year after economic reforms the agricultural sector has witnessed a deceleration in growth, which is cause for serious concern. During the Ninth (1997-2002) and Tenth Five Year Plans (2002-2007) agricultural sectoral growth rate was 2.44 percent and 2.31 percent respectively as compared to 4.72 percent during the 8th Plan (1992-1997). During the Eleventh Plan (2007-12) agricultural growth was estimated at 3.28 percent against the target of 4 percent. At the same time the performance has varied in different states, each with its own peculiar issues.

The impact of trade liberalization on agriculture works through various channels such as volatile prices, problems in imports and exports, impact on livelihood and other employment opportunities. For farmers, perhaps the single most adverse effect has been the combination of low prices and output volatility for cash crops. Some prices such as those of cotton and oilseeds declined for long periods. With liberalization, we had a situation of lower production with lower prices. This pattern reflected the effect of the growing integration of Indian agriculture with world markets, resulting from trade liberalization (Rao, 2005).

The reforms claimed to eliminate discrimination in agriculture, but the results have been disappointing. Financial sector reforms have affected access of farmers to credit. Reforms also emphasise the role of markets but in some situations markets are not dominant. Income and barter terms of trade have turned unfavourable for agriculture. Employment in agriculture has stagnated and growth rate of wages in agriculture has declined in the post reform period. Thus, there is a felt need for people to move out from agriculture to non-agriculture employment (Srivastav, 2005). The ‘evergreen revolution,’ initiated during the post reform period, is considered responsible not only for resource depletion but also for market rigidities and technological fatigue too. Agriculture in India is facing challenges of sustainability of agricultural growth, which is very important in the context of declining returns from agriculture and the syndrome of working poor. Marginal and small holdings now dominate the agricultural scene. Institutional changes are required to deal with the situation.

**Statement of the Problem**

Studies of agricultural activities have remained a focal area of concern for most agricultural geographers. Agriculture geography is considered essential to fulfil man’s irresistible desire
to know, understand and investigate the arrangement and distribution of agricultural phenomena at spatio-temporal scale (Singh and Dhillion, 2006). Being a leading branch of modern geography, it is becoming a pivotal event in agricultural land use planning and development particularly for sustainability of the rural systems. With the ever increasing population, the need for increasing food production is obvious. However, increase in spatial disparities and instability in agricultural production has also become a matter of great concern for the agricultural geographers.

Indian agriculture has experienced reforms in land, infrastructural support system, green revolution and minimum support price, to name a few. All these reforms have been instrumental in bringing a sea change in the agriculture sector. These reforms have favourably impacted the productivity and production of all the crops but have inadequately affected the crop stability. Only a few crops such as rice and wheat are more stable. The coarse cereals and pulses are unstable in area and production in the country as well as in Haryana.

After initiation of the new economic reforms several challenges surfaced in the Indian agriculture scenario which became all the more severe with the passage of time. The biggest challenge was to reverse the sharp decline in growth rate which the agriculture sector had experienced after 1990s. The growth rate turned out to be lower than the growth in population. Another challenge was to ensure sustainable use of natural resources. While the need for accelerating agricultural growth was obvious, the natural resource base in the country was shrinking steadily.

The steady growth of agriculture decelerated sharply during the post-reform period at the all-India level across all regions. During the same period, the growth rate of agricultural output was recorded as having decelerated from 3.55 percent to 1.58 percent in the north-western region of the country. All states except Gujarat, and to some extent, Maharashtra registered a sharp decline in their growth output rates in the post-reform period. This decline is particularly high in the states of Punjab and Haryana, with the exception being just a few states like Bihar. Even in Uttar Pradesh the situation is not very bad (Bhallam and Singh, 2009).

Statutory bodies and research studies suggest that agriculture in India was passing through a difficult time. The National Agricultural Policy of the Ministry of Agriculture,
Government of India (2000) observed that agriculture has become an “unrewarding profession due to a generally unfavourable price regime and low value addition, causing abandoning of farming and increasing migration from rural areas”. The situation is likely to be exaggerated further in the wake of the integration of agricultural trade in the global system, unless immediate corrective measures are taken.

Economic reforms initiated in the Indian economy in 1991 did not directly target agriculture; instead they had an indirect impact through the reduction in the developmental role of the government and its capacity to generate the requisite resources for investment. The spatial implications of India’s new economic policy had two operating instrumentalities, which were stabilization and structural adjustment.

1. Stabilization was aimed at correcting the balance of payments situation and reducing the deficit in the union government budget, which had had an adverse effect on the social development, employment generation and poverty alleviation.

2. Structural adjustment, through rationalization of trade, industrial, agricultural, human resource development, and power policies had spatial implications of a varying nature. Export orientation in agriculture was to a greater advantage for the rice and cotton producing states. Also reduction in subsidies for agriculture had more serious implications for the agriculturally backward states.

The liberalization of the Indian economy was expected to increase the opportunities for export of agricultural products. It was expected that the agricultural scenario might change from growing subsistence level low value crops to high value crops for export. This advance was envisaged to improve the economic conditions of the farming community, as they will able to get a better price for their produce in the international market. But if one looked at figures of exports of agriculture and its allied sectors, its share in total exports had declined to 12.3 percent during 2011-12 as against 20.5 percent during 1996-97. Consequently imports have been rising and trade balance is going down. The terms of trade have stagnated after 1996-97 and this could be a major factor for decline in agriculture (Indian Trade Bulletin, 2012-13).

Thus, in the context of the policy changes after the economic reforms, the changes in the production patterns in the agricultural sector and its participation in world trade would prove noteworthy enough. The post WTO period has thrown serious challenges to Indian
agriculture while domestic prices of several commodities soared higher than their international prices. This imbalance made imports attractive and adversely affected the exports. Such a situation calls for the improvement of an environment of competitiveness in agriculture which would necessarily entail improved efficiency in agricultural production and marketing. It has been observed that interventions in food markets had benefited only the agriculturally progressive regions while the rain fed and dry land agriculture regions were ignored.

In India more than 80 percent of the farmers cultivate marginal or small landholdings measuring less than two hectares approximately and find it difficult to meet the cost of farm inputs, especially purchased inputs. It is most likely that the benefits of globalization accrued with the large farmers and resulted in further accentuating the existing disparity in the rural sector (Pattanayak, 2004). It was presumed that the new economic policy would increase the efficiency of food production, improve the economic situation of the farmers besides improving the patterns of food consumption. However, studies conducted the world over indicate towards the declining food production, decreased productivity and worsened the already adverse conditions of most of the farmers. Added to this was the massive displacement of farmers which was most likely to lead to a socially and politically explosive situation in the near future. Food growing land was being gradually diverted to non-food crops or for cultivating luxurious commodities like shrimps and this may lead to food insecurity. Further, natural resources were being over-exploited.

During the post reform period, these unfavourable factors like, low growth of farm productivity, low agriculture prices, slowdown of demand for agricultural products due to stagnation of per capita food consumption, and inadequate employment opportunities outside agriculture are resulted in putting at risk the livelihood of the population depending on agriculture for their livelihood. The recent spate in the number of farmer’s suicides is a reflection of the agrarian distress caused by declining profitability and increasing risk of debt and poverty due to growing commercialization of agriculture. An analysis of the farmer’s suicides suggested a deep-rooted crisis in agriculture. The increasing distress of farmers is a serious growth-retarding factor because a sizeable proportion of the farmers had lost the capacity to withstand economic shocks; and was even prepared to leave their traditional occupation of agriculture.
Even though Labour productivity during the 1990s had increased but it was associated with a decline of agricultural employment in Indian agriculture. The real wages for agricultural workers have increased consistently during the 90s, though certain indices of agricultural productivity have not increased significantly. In agriculture the labour market influence of demand decreases while that of supply has increased (Jha, 2003).

Due to new economic policy tremendous changes were also observed in the percent of rural cultivators, which has continuously gone down from 82.7 and 71.9 percent in 1981 to 72.2 and 55 percent in 2011 (Census of India, 1981, 2011). This trend was noticeable because of the fast paced changing scenario of urbanisation. Most people had shifted towards cities and opted for occupations other than agriculture. Another was the transformation of holdings to economically unviable sizes over a period of time. They sought alternative livelihoods elsewhere due to low returns from the agriculture sector. Due to the fast growth of the industrial sector also a large part of the rural population shifted to cities.

In the rural sector, the labour force declined marginally by 6.8 million from 348.7 million in 2004–05 to 341.9 million in 2010–11. The size of the workforce also showed similar trends. The workforce declined from 342.9 million in 2004–05 to 336.4 million in 2010–11, in the rural sector, marking a decrease of 6.5 million (NSS 61st and 66th Rounds), which has given the reflection of an adverse employment scenario. Growth of employment in agriculture is dependent on other sectors also. It has been found that the growth rate was decreasing in fishing, plantation and forestry with marginal growth in the livestock segment. This slow growth is due to higher degree of mechanization and cropping pattern adjustments and the preference of non-farm jobs by young entrants.

The use of rural casual labour was also on the increase in case of both males and females as is seen to be from 22.0 percent and 31.4 percent to 35.1 percent and 35.5 percent during 1972-73 to 2011-12 respectively (NSSO 68th round 2011-12) basically because of high use of farm machinery and weedicides on various crop enterprises. It is essential to know that labour is a seasonal requirement that has a peak period and most of the day to day field jobs like hoeing, irrigation and harvesting operations are decreased from months to days and finally to hours only.

This highlighted the fact that the new economic policy resulted in growing polarization between large and small scale cultivators and casual labourers, which would
imply further impoverishment of the latter. Therefore, if today, Indian agriculture is facing unprecedented exposure to global markets, the small and marginal cultivators, along with agricultural labourers, are the hardest hit by price fluctuations dictated by the global capital. These developments have made survival even more precarious for the rural, poor and peasant households.

With the above discussed problem another major problem is the sustainability of agriculture. As the total cultivable land is limited and land degradation due to depletion of soil fertility, erosion and, water logging had increased. Decline in the surface irrigation expansion rate and reduction in ground water table made for increased risk and vulnerability and disparities in productivity across regions and crops persisted. Long term factors like steeper decline in per capita, land availability and shrinking farm size are collectively responsible for the declining agriculture. Researchers, academician and planners were concerned about these trends and were reflecting seriously about policy measures to increase agriculture economy.

**Agricultural Scenario in Haryana**

Haryana is one of the small yet more prosperous states of India. It accounts for just 1.4 percent of India’s territory and 2 percent of its population but contributes more than 45 percent of the total food-grains to the central pool. From being a food deficit state in 1966, at the time of its inception, Haryana has progressed to become a major contributor to the national pool of food grains. Agricultural production gained great strides largely due to the dynamic political leadership of the state, modern science and technology, agricultural institutions, land reforms, liberal assistance of the Central Government, strong infrastructure, improved grain varieties, production technologies and the people made commendable contributions. The Green Revolution and its attendant agrarian changes showed their effects on the life and living of the people.

Agriculture continued to shape the economy of Haryana while undergoing a number of changes during the last three decades. The biggest change took place during the Green Revolution during the mid-1960s which caused the output to rise substantially and the benefits of this would inevitably ‘trickle down’ to reach all sections of rural society. Almost immediately, however, a powerful critique to this approach had emerged which pointed out that the biochemical even though they were ‘scale-neutral’ were clearly ‘not resource-neutral’
(Rao, 1975). Evidence also pointed towards the fact that the use of biochemical inputs was inextricably linked to mechanization (Dasgupta and Bardhan, 1977) and which being subject to economies of scale, was inevitably favoured for larger landholdings (Byres, 1981).

Agriculture occupied a significant position in the state economy, up to the early 1990s when it experienced high growth; while after that its share in the Gross State Domestic Product declined continuously. The predominance of the agricultural sector was also responsible for the instability in growth rate of the economy due to fluctuations in agricultural production. Natural calamities and erratic rainfall often caused substantial loss in crop production making for a vicious cycle. Moreover, the rapidly increasing services sector was responsible for the decline in the share of agriculture sector.

Haryana’s agrarian economy, with a highly skewed agricultural base, started tottering just three decades after adopting new agriculture strategy. Firstly, the agriculture sector has always been an important contributor to the Gross State Domestic Product (GSDP), although the share of this sector in the Gross State Domestic Product is declining continuously. The composition of Gross State Domestic Product (at constant 1999-2000 prices) reveals that the share of agriculture and allied sector has declined from 32.0 percent during 1999-2000 to 20.5 percent during 2007-08. It came down further to 16.7 percent (at constant 2004-05 prices) and 19.5 percent (at current prices) in the State GDP during 2010-11 (Economic Survey Haryana, 2010-11).

Secondly, it is not merely the deceleration in agriculture’s growth rate which is disturbing, but more important is agriculture’s declining capacity to absorb labour. Recent studies have shown that agriculture employment elasticity with reference to aggregate output was less than 0.2 percent. In the 11th five year plan, the average annual growth of agriculture and allied sector of the state recorded 3.9 percent, which is even slightly higher than that achieved at the all India level of 3.7 percent (Economic Survey Haryana, 2010-11).

During the reform period, production of two major food grain- crops, wheat and rice has increased by 11 and 16 times respectively. This extensive cultivation of rice and wheat led to over-exploitation of aquifers, soil nutrient reserves, multi-nutrient deficiencies and increase in production costs. Over the years, compounded with climate change, depleting fresh water aquifers and labour shortages all posed serious threats to sustainability of crop production systems in Haryana.
According to Haryana Kishan Ayog Report, 2013, the decadal analysis of productivity
growth of major crops of kharif and rabi seasons showed considerably high fluctuation. Most
of the kharif crops showed sharp decline in productivity growth after the decade 1986-96.
Bajra and pulses showed improvement in growth after 1996-06. Similarly, sharp decline in
decadal growth of productivity was also observed in major rabi crops after 1986-96 decade.
However, it is satisfying that during 2006-12, all the rabi crops including wheat, barley and
gram (chickpea) showed increase in decadal growth in productivity whereas there was a
decline in the case of pulses.

Presently, the factors of agriculture production are dominated by purchased inputs
unlike owned human or animal labour in earlier periods. Labour intensive farming, prevalent
earlier, underwent significant changes with the penetration of farm technology (Kumar and
Chamola, 2000). Agrarian distress reached a climax at the turn of the millenium, when the
Government of India sponsored an all - India independent NSSO study (2003), that reported
40 percent of total farmers and 32 percent of Haryana farmers wanted to leave farming as it
was no longer a profitable occupation (NSSO, 2005).

Agrarian distress was further aggravated by marginal and small farmers, who found
it increasingly hard to sustain farming and were being pushed out from agriculture. The
situation worsened due to lack of skills sets among these peasants which made it difficult for
them to be absorbed in the industrial sector (Gill, 1994).

Despite the decline in share of the Agricultural Sector in the Gross State Domestic
Product to 15.3 percent in 2010-11 from 16.7 percent in 2008-09 (Economic Survey of
Haryana, 2010-11), about two-thirds of the population of the State still remained dependent
upon agriculture for their livelihood. The total area of the State under cultivation reached
saturation level and there remained hardly any scope for bringing any more area under
cultivation. Agricultural production could be increased, however, through enhanced cropping
intensity, changes in cropping patterns, improvement in seeds of high yielding varieties,
better cultivation practices and development of post harvest technology etc.

During the post-reform period the major agrarian changes identified in the major
agricultural aspects such as: land use pattern, cropping pattern, productivity, crop
concentration, crop diversification, cropping intensity and agricultural workforce.
The term land use is virtually self-explanatory as the actual and specific use to which the land surface is put to in terms of inherent primary land use namely land under living, infrastructural development, forest, pasture, orchards cultivation, waste lands etc. An analysis of the change in land utilization patterns over the years reveals that the direction of diversification taken by a region. It is essential as it helps in understanding the casual relationship between the physical environment, socio-economic and technological levels of society. It also helps in the decision-making process related to increasing the cultivable area, utilization of cultivable wasteland, introduction of irrigation, increasing crop intensity etc. (Rao, 2001). Cropping Pattern is the central element of agricultural land use. A study of cropping patterns would reveal the proportion of area under different crops, the rotation of crop and the area under double cropping etc. Introduction of new agricultural technology would bring about changes in the traditional cropping patterns.

Cropping Intensity refers mainly to the application of inputs like assured irrigation, high doses of fertilizers including green manuring and application of insecticides and pesticides. In the intensive system of cropping, fallowing is generally not done and double or triple cropping is the rule. The advantages in adopting the intensive system of cropping are that it eliminates the misuse of land when it is kept fallow and virtually eliminates any danger of being exposed to erosion. And it also makes the best use of all available resources.

Crop Concentration refers to the variation in density of an individual crop in a given region at a point of time. The occupancy (high, medium and low) is determined largely by the terrain and climate including temperature, humidity, transport facilities and demand of crop (Shafi, 2006). Crop concentration is immensely useful in agricultural land use planning.

Diversification of agriculture must be considered as an important aspect of agricultural change in the post-reform period. Crop diversification refers to the raising of a number of crops in a given area at a given period. Essentially, diversification is an indicator of the multiplication of agricultural activities, which observably involves intense competition among various activities for space.

Agricultural productivity means the degree to which the economic, cultural, technical and organizational variables are able to exploit resources of the area for agricultural production (Singh, 1979). It refers to agricultural production irrespective of the fact whether it is due to natural factors or through the persistence of human labour. Although production
depends on climate and soil but it is also determined by the farmer’s toil, efficiency, availability of experienced labour, capital and his overall management.

Another significant aspect of Indian agriculture is the agricultural workforce which comprises cultivators, marginal farmers and agricultural labourers. Till 1991, the proportion of agricultural workers in total agricultural workforce was increasing at a slow pace. (Vyas, 2007). But the processes of crop diversification and crop commercialization changed the crop working to such an extent as to manifest a changed labour demand. This dramatically increased the costs of cultivation, and both small and marginal farmers who came under severe income stress entered the labour market as agricultural labourers. The rural areas have borne the brunt of this diversification and crop commercialization process because rural born workers have not been able to find more productive non-farm jobs, either in rural areas, or in the cities (Bhall, 1977).

The present study adopts a comprehensive approach to look into the change in agriculture in the post-reform period in an Indian state. It strives to examine and identify the spatial change in land-use patterns, cropping patterns, productivity, crop concentration, crop diversification, cropping intensity and agricultural workforce in Haryana.

Review of Literature

The agricultural changes in different parts of India have been studied widely by agricultural geographers at different spatial scales—state, district and village level over different periods in time. A review of the past research would help in identifying, reviewing and analyzing the conceptual and methodological issues relevant to the present study. A systematic review of literature has been done keeping in view the objectives of the study. The review is presented under the following broad headings:

I. Land Use
II. Cropping Pattern
III. Crop diversification and Crop Concentration
IV. Agricultural Productivity and Crop Intensity
V. Agricultural Workforce
VI. Agriculture and Development
I. Land Use

Land use has been one of the most researched topics during the last century. Various studies have been conducted on the analysis of land use pattern in different parts of the world. The beginning of land use studies and surveys may be traced to the regional survey where it was purely of general academic interest. The idea of mapping the land use was mooted by Sauer (1919). Tracing the history of land use studies initiated in Great Britain, the first land use survey and mapping was carried out by Geddis (1926). However, practical work on land use was carried out by L. D. Stamp in 1930 and 1931 in the entire Great Britain. The work was titled “The Land Use of Britain: Its Use and Misuse”. The works of Hartshorne (1935), Whittlesey (1936), Weaver (1954), were also focused on land use surveys. Khan (1971) in his study examined the changes in patterns of agricultural land use in southern Ontario during the period 1867-1971. Two factors, namely, physical and socio-economic were examined and the drastic decline in the area of farm land was observed to have occurred during this period. The Ontario farmers also witnessed a very high rate of mechanization during this period. Morgan & Munton (1971) identified the fact that socio-economic factors affected land use patterns considerably and that it was unrealistic to regard agricultural cultivation systems as adaptations to different natural conditions and that cultivation system could be more plausibly explained as a result of differences in population density. Singh, (2003) analyzed the effect of changing land use on the environment of Nepal and observed that man's activities had led to drastic land degradation, large-scale deforestation and consequent ecological imbalance.

As far as India is concerned, Chatterjee (1940) has emphasized the need for a land use survey and Aligarh Muslim University, Uttar Pradesh; Banaras Hindu University, Banaras also conducted land use studies. However, most studies in agricultural land use were done by Indian geographers after 1950.

Chadha (2006) in his presidential address observed that there was a trend of taking away agricultural land for non-agricultural uses in India. The study showed that land under non-agriculture uses had witnessed a continuous increase over time. In many cases it was because of the unwise use of land, mostly due to demographic and economic pressures, usually by the poor and marginal cultivators. Poor rural people also overexploited the land resources mainly by overgrazing or deforestation or by unhealthy cultivation practices. The inadequate or imbalanced use of chemical fertilizers removed soil nutrients and damaged the yield increasing capability of the land. He observed that the expansion of double cropped area
under dry farming conditions had not proved to be an effective mechanism for increasing land productivity, employment and earnings. He suggested that the lands in the upper catchments should be rehabilitated first.

Misra and Kumar (2007) in their work on land-use change and food crop productivity in India, a spatio-temporal analysis captured the changing land use during 1950-51 to 1990-91. A perusal of the land use change in the country revealed that major portions of land devoted to agriculture and the area under agriculture had reached the saturation limit with hardly any chance for further expansion. The waste land, uncultivable land, pasture and groves had already declined.

Several studies have been conducted at the regional and state level in India. (Diddee and Datye, 1980; Kaur, 1991; Sharma and Pandey, 1992; Gill, 1994; Ishtiaq and Kibaemi, 2003; Rayamane, 2001; Ghosh and Khan, 2002; Singh and Kaur, 2007; Singh, 2008). Diddee and Datye (1980) studied regional changes of agricultural land-use to non agricultural uses in Bombay-Poona corridor and presented an analysis of changes in land-use from agricultural to non-agricultural and found that mainly industrial and residential activities had occupied the agricultural land-use.

Kaur (1991) highlighted the changing patterns of land utilization in Punjab since the inception of new farm technology in the mid sixties i.e. from 1966-67 to 1987-88 and revealed that the reported area for land utilization had remained constant. However, the area under forests was not available for cultivation and the net area sown had increased during the period. Due to intensification of agriculture, the gross cropped area and cropping intensity had increased. They concluded that agriculture in Punjab had recorded drastic structural changes since the beginning of the Green Revolution.

Sharma and Pandey (1992) studied the dynamics of land use in different states of India and revealed a general declining trend in the area under permanent pastures, grazing lands, barren and uncultivable lands. The study has found that the area under non-agricultural uses, cultivable wastes and fallow lands showed a positive growth in most states. While for area under forest, negative growth rate was observed in the states of Assam, Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra and Tripura while Jammu and Kashmir and Orissa showed negative growth rate for area put to non-agricultural uses. The annual rate of increase in area under non-agricultural use was very high in Gujarat, Tamil Nadu,
Rajasthan, Uttar Pradesh, Maharashtra, Karnataka and Madhya Pradesh. Increase was observed in areas under permanent pasture and grazing lands in Bihar, Maharashtra, Mizoram and Uttar Pradesh. Similarly declining trend was observed in the areas under miscellaneous tree crops in Andhra Pradesh, Gujarat, Haryana, Kerala, Orissa, Punjab, Tripura and Uttar Pradesh.

Gill (1994) in his work on the changes in land use pattern in Punjab identified inter-regional variations in land use pattern. The author concluded that Punjab’s land had become the most intensively cultivated. As high as 84 percent of land area was under cultivation and the cropping intensity had reached 176 percent.

Rayamane (2001) highlighted the changing land use profile of Belgaum district of Karnataka. He found changes in landuse during 1979-80 to 1989-90 and 1989-90 to 1999-2000. He observed that Belgaum district’s growing population was the main factor for changing landuse pattern and posed a major threat to the land. The study further revealed that the dynamics of landuse and land cover differed in different parts of the area.

Ghosh and Khan (2002) presented an analysis of the land-utilization patterns in Bankura District using factor analysis and found two economic activities, viz. forestry and farming to be competitive and substitutive.

Ishtiaq and Kibaemi (2003) have studied land use patterns and sustainable agricultural development in Nagaland. They have observed that Naga tribes had turned to plantation and horticulture resulting in diversification of agriculture, making it sustainable.

Singh and Kaur (2007) in their study pointed out that land-use change and status of agricultural production in interstate Chandigarh region the major factor in influencing use of land was the constant expansion of urban areas there and focused encroachments on fertile agricultural lands.

Singh (2008) in his study on land use change, diversification of agriculture and agro forestry in north west India has analyzed the land use for the previous 10 years and suggested that Punjab and Haryana had recorded absolute expansion of areas and cultivation with almost 84 percent of the area being cultivated. The cropping pattern in the region underwent a substantial change, with wheat and rice emerging as major crops in Punjab and half of
Haryana and the cropping pattern had unnecessarily become energy-intensive while affecting the static balance of underground water resource in the plains of Punjab and Haryana.

Studies on land use pattern analysis have been undertaken at district level in India such as Krishna and Balakrishnan (2014) have examined spatial change in the area of cultivation, production and yield of selected crops in Madurai District, using data from 1998-99 to 2008-2009. And the study concluded that the existing traditional pattern may not be viable in the coming years because of continuous ground water depletion, the deterioration in soil health, changing rainfall pattern, high cost of cultivation, implication of WTO etc.

Kaushik, Saroj, Sharma and Hooda (2015) in their study have made an attempt to study the changes in land use and land cover of Hisar city of Hisar district of Haryana state. The study was carried out through Geo-Spatial techniques using SOI toposheets, LISS III imagery of 1999 and 2014 and concluded that though there are some changes detected in land use/land cover analysis for the period 1999-2014 but it does not indicate any significant environmental impact on the study area. The urban change detection is happening in Hisar city due to the good trade links with the adjoining areas and its dominance in the field of medical care, education, seed production, horticulture and automobile repair and because of spare parts market. It has been identified as a counter magnet city of NCR to attract migrants and develop as an alternative centre of growth to Delhi. The rapid growth of population has created an extraordinary rise in the built-up area of the city. The total residential and commercial area which comes in developed area has changed from 13.32 sq. kms. to 17.31 sq. kms. and developing area has changed from 7.49 sq. kms. to 12.90 sq. kms.

There have some village level studies on land use analysis have been conducted by scholars. Shafi (1951) has used the systematic sampling method when he carried out the sample study of land use in twelve villages and published his findings in ‘The Geographer’ and also completed ‘Pattern of Cropland Use in Ganga-Yamuna Doab.’ Shinde and Pawar (1978) dealt with agricultural land use of Bhatanwadi village.

The following studies on land use mainly focused on the spatial changes of agricultural land use to non agricultural use during 20th century and after that at different levels; state, districts and village level. These studies concluded that the changes were mainly governed by industrial and residential activities which occupied the agricultural land use.
II. Cropping Pattern

In India various studies have been conducted on the changing cropping pattern on different levels; state, district and village, such as Gupta and Amiya, (1963); Vyas, (1966); Sohal, (1993); Hazra, (2001); Goswami and Challa, (2004); Rao and Shahid, (2005); Gyan Prakash, (2006); Toor, et al. (2006); Sihmar, (2014). Gupta and Amiya (1963) has measured the changes in cropping patterns in all the states by taking their average percentage over the period of 10 years from 1949-50 to 1958-59. The study stressed the importance of irrigation and fertilizers, which induced desirable changes in cropping patterns. The analysis has indicated that the relative importance of the area devoted to cereals had declined whereas that of cash crops had increased.

Vyas (1966) has argued that the significant changes in cropping pattern in India could be explained in terms of a change in relative prices. Sohal (1993) in his study has 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 suggested that both national interest and ecological obligations must work hand in hand in agricultural planning.

Hazra (2001) has studied the changes in cropping patterns at the all India level by considering the area share of crops and crop groups at four time points respectively, the triennium ending average of areas at 1966-67, 1976-77, 1986-87 and 1996-97. The study revealed a shift from the traditionally grown less remunerative crops to more remunerative crops. The crop shift took place due to government policies and thrust on some crops in a given time. Market infrastructure development and certain other price related support also induced the changes in cropping pattern.

Goswami and Challa (2004) have studied the changes in cropping pattern in India for the period 1951 to 1998. The results showed a gradual shift in area from food crops to non-food crops indicating more diversification in recent times. The proportion of area under total cereals to total cropped area reduced from 61.1 percent in 1950-51 to 53.08 percent in 1997-98. Reverse scenario was noticed in the case of total oil seeds where there was almost three-folds increase in area during the period under study.

Rao and Shahid (2005) highlighted the dynamics of cropping patterns in sorghum growing states of India. They revealed that at the district level, Dharwad had set up
competing crops like groundnut and cotton to sorghum while the Belgaum district had another set of competing crops like pearl millet and maize to sorghum. The Transition Probability Matrix clearly demonstrated that Karnataka had sorghum area retention of 31 percent in 1970-73.

The study of Gyan Prakash et.al (2006) reflected that there was in fact, some deceleration from Pre-Green Revolution period to Green Revolution period in the production of food grains in India, but further it has deteriorated more in the post economic reforms period and the area shrinks four times from pre-Green Revolution period.

Several studies on changing cropping pattern have been conducted in the northern and western states of India like (Shah, 1963; Parmer et al. 1995; Singh and Mohammed 1992; Dhindsa and Sharma, 1995; Singh, 1997; Chand and Haque, 1997; Kumar and Singh, 1998; Virender Kumar et al. 2002; Hassan et al., 2005; Chaukar and Mittal 2007). Shah (1963) has studied cropping patterns in Punjab and the study observed shift in cropping pattern. Food crops were replaced by non-food crops and inferior crops by superior and commercial crops. This led to higher agricultural production through large use and increased productivity of variable resources.

Parmer et al. (1995) had examined the degree of change in cropping pattern in four districts of south Gujarat during the period 1960-61 to 1989-90. The period of study was divided into three sub-periods as 1960-61 to 1969-70, 1970-71 to 1979-80 and 1980-81 to 1989-90. The changes in cropping pattern were measured by rank correlation coefficient. The fluctuation in cropping pattern was found to be severe in Bharuch district, moderate in Surat and Valsad and least in Danya. In the Bharuch district, the acreage under ‘tur’ increased tremendously while that of other crops decreased. Singh and Mohammed (1992) have studied the dynamics of cropping pattern in Northern India and revealed that the total cropped area and area under cereals and vegetables had increased while it had decreased in the case of millets and cash crops. As far as the special organization of land use was concerned, despite the subsistence economy prevalent in the area, the predictions of Van-Thunen’s theory appear validated.

Dhindsa and Sharma, (1995) found that the aggregate changes in cropping pattern in Punjab during 1965-66 to 1990-91 in terms of expansion and substitution effect were measurable by total cropped area and elasticity of various crops.
Singh (1997) studied the cropping pattern during the pre (1959-60 to 1968-69) and post (1969-70 to 1990-91) Green Revolution period in the three agro-climatic zones of the plateau region of Bihar. He found that rice was the most important crop of all the zones contributing to more than 70 percent of the total cropped area and its share remained unchanged in all zones of the region. There had been a marginal change in the share of maize in total cropped area in pre-Green Revolution period whereas wheat and maize showed marked changes during the Post-Green revolution period. The area under pulses declined considerably but after the introduction of high yielding varieties program, the cropping pattern shifted in favour of wheat, potato and other vegetable crops in the region.

Chand and Haque (1997) in their study have examined the sustainability of rice-wheat crop system in the Indo-Gangetic Region and have worked out the growth trends and discussed the problems and issues related to the crop system especially in the Gangetic and Trans-Gangetic plains, where rice-wheat farming was widely practiced. Kumar and Singh (1998) have made an attempt to analyze the cropping patterns in North Bihar during the post-Green Revolution period (1970-71 to 1993-94). The study revealed that the cropping patterns of North Bihar were still predominated by cereal crops. The predominance of cereal crops in the cropping pattern was attributed to the food grains scarcity in the project area and biochemical and genetic innovations in the principal cereal crops during the post-Green Revolution period.

Kumar et al. (2002) have examined the changing cropping pattern in Himachal Pradesh and reported that total cropped area increased by about 21 thousand hectares from 16.69 percent to 17.06 percent of the total geographical area during the period 1972-96. The area under wheat, as percent of total cropped area, increased from 34.27 percent to 37.66 percent and that of maize went up from 28.11 percent to 32.58 percent. The magnitude of decline in percentage share in area in ‘ragi’ and other millets was much higher than that of barley. Hassan et al. (2005) in their study have mentioned that, irrigated areas of Punjab province was selected for determining optimum cropping pattern under various price options. LP model was applied to calculate the optimal crop acreage, production and income of the irrigated Punjab. Crops included in the models were wheat, basmati rice, IRRI rice, cotton, sugarcane, maize, potato, gram and moong. The results showed that irrigated agriculture in the Punjab was more or less operating at the optimal level.
Meanwhile, Chaukar and Mittal (2007) have studied ‘Changing patterns of crop land use in Dadri tehsil, Haryana and analyzed the total, overall cropped area. Shift in cropping area was calculated and it revealed that the major shift was from coarse food-grain crops like pearl millet and gram to wheat and oilseeds. The other crops which gained were paddy and black mustard. While crop area under green fodder recorded a decrease, it could adversely impact upon an agricultural economy dependent on live stocks.

Tingre et al. (2008) made an attempt to study the cropping pattern changes and crop diversification in Akola district of Vidarbha. The study revealed that a majority of the cereal crops showed negative and low growth rates of area during the study period. Soybean had attained important position in the cropping pattern. The trend of crop diversification and cropping intensity increased significantly. Koshal (2012) in his divisional based study of Uttar Pradesh has found that the cropping systems level is useful to understand to overall sustainability of agricultural system. The changes in cropping pattern have been worked out on the basis of secondary data. The major cropping systems change analyses were found Rice-wheat, Sugarcane/ratoon-wheat, Maize-wheat, and Pearl millet-wheat and sorghum-wheat system. The dominant cropping systems are Rice-wheat system, maximum positive change observed in Aligarh division.

Sihmar (2014), in his study growth and Instability in agriculture production in Haryana a district level analysis has highlighted the growth rate of agricultural production shows changes in spatial pattern of different crops. On the one hand two crops, wheat and rice show a very satisfactory performance in their production in all the three periods (1980-81, 1989-90 to 1990-91 and 2000-01 to 2006-07. on the other hand crops like Gram, Masar, Mize etc showed unsatisfactory performance in their production. Gram shows highest declining trend. The study finds out that there is a very positive impact of green revolution and new economic reforms on total food grain production. But it has created a wide gap between superior crops such as wheat, rice, sugarcane and coarse cereals such as Bajara, Jowar, Maize and Pulses crops.

The above mentioned studies highlighted the changes in cropping pattern that have been occurred in most parts of the country during 20th century and after that. Most of the studies revealed that with the push given by the new technology, there was a very positive impact of green revolution and new economic reforms on total food grain production. But it
has created big gap between coarse cereals and more remunerative crops like wheat, rice, oilseed and fruits and vegetables etc.

III. Crop Diversification and Crop Concentration

Studies in different parts of the world have examined the changing pattern of crop concentration and crop diversification. 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 had brought an enormous effect in the developing countries because of the problems of food security and unemployment, which led to more pressure on agricultural land which consequently lead to changes in the cropping pattern. Joshi, Gulati, Birthal and Tewari (2004) have evaluated the impact of unfolding globalization on agriculture in South Asian countries and found that agricultural diversification was strongly influenced by the price policy, infrastructure development, urbanization and technological improvements as also contributed towards employment opportunity.

In India, spatial pattern of crop concentration and crop diversification have been examined by many scholars like Bhatia, (1965); Hussain, (1987); Kumar, (2001); Singh, (2000); Barghouti et al., (2003); Bathla, (2008); Verma, Datta, Mandal, and Tripathi, (2008); Amarnath Tripathi and Brajesh Jha, (2009); Mehta, 2010. 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. He also evolved a new technique for measuring crop diversification in India. He had taken all the crops which are having 10 percent or more than 10 percent 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 was the magnitude of crop diversification and vice-versa.

Hussain (1987) has highlighted the consequences of the green revolution in India and found that states of Punjab and Haryana where the Green Revolution had been ushered, the cropping pattern were largely affected and as a result cropping patterns had transformed from diversified to specialized. Kumar (2001) found, that technological advancement in agriculture had accelerated the diffusion of agricultural innovations which has led to crop specialization. Singh (2000) has found that introduction of Green Revolution technology changed the crop structure in India and 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 specialize.

Barghouti et al. (2003) in their study on poverty and agricultural diversification in developing countries like India have observed that per capita income was 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 were increasingly recognized as a new source of growth in agricultural income. On the other hand, increase in per capita income caused a shift in consumer’s preference from staple food to the items like fruits and vegetables. The above changes in dietary pattern were causative of diversification of production portfolio.

Bathla (2008) has studied the regional dimensions of inter-crop diversification in India and observed that inter-crop area shifted in favour of high yielding crops like wheat, paddy, oilseeds, cotton and sugarcane, up to eighties and towards paddy, sugarcane, fruits, vegetables, fibres, plantations, condiments and spices during the nineties and early 2000. The area under wheat and paddy had expanded solely at the cost of low yield growth crops like coarse cereals and pulses due to price support and HYV programme. The high value commercial crops have benefited both from area shifts as well as fresh land brought under cultivation.

Verma, et al. (2008) in their study have examined that Agricultural diversification in India that was steadily accelerating towards high value crops and livestock activities to augment farm income. Some of the factors that influenced the nature and pace of agricultural diversification from staple food to high value crops were technological change in crop production, improved rural infrastructure and diversification in food demand. The nature of agricultural diversification differs across regions due to wide heterogeneity in agro-climatic and socio-economic conditions. Generally, the pattern of agricultural diversification showed a shift from crop production to livestock production during the 1980s to 1990s. With rising incomes, the patterns of diet normally changed from a basic cereal-based diet to non-cereal items. Analyses of expenditure patterns of Indian households in urban and rural areas based on National Sample Survey data provide evidence that the income elasticity of demand for cereals was very low or zero for the population as whole, even though households at low income levels may still have a positive income elasticity of demand for cereals. A varied diet was likely to include protein, fats and other non-cereal items such as fruits and vegetables.
Tripathi and Jha (2009) in their study have discussed factors responsible for agricultural diversification at different levels: country (India), state (Haryana) and farms of Kurukshetra district in Haryana. The study regressed alternate measures of diversification namely, the Simpson index and concentration of non-food crops, on several possible factors such as income, land distribution, irrigation intensity, institutional credit, road density, urbanization and market penetration. The regression analysis pointed out that increased road density, urbanization encouraged commercialization of agriculture and with commercialization farms in a region were increasingly specialized under certain crops and crop-groups as per the resource, infrastructure and institutions of the region. Mehta, (2010) has observed that crop diversification was one of the major tools of policy, which drew widespread attention in the face of stagnant growth; incomplete agricultural transformation and low productivity in India.

Various studies have been conducted on the changing pattern of crop concentration and crop diversification on the level of states and regions of India (Ayyar, 1969; Sohal, 1994, Johl, 1996; Kebebe et al., 2000; Hassan and Inderjeet, 2000; Bhattacharya, 2002; Malik and Singh, 2002; Sohal, 2003; Sharma, 2005; Singh, 2006, Puran, Shiv, Amit and Geeta, 2006; Pattanayak and Nayak, 2006; Sau and Pathak, 2007; Dinesh et al., 2007; Ratnam, Mohan and Narayana, 2008; Singha and Chakravarty, 2013).

Ayyar (1969) in his study has evolved a new technique for measuring crop diversification regions. He took all the crops which were having 1 percent or more than 1 percent of the total cropped area. Then he divided the sum of crops by the number of crops which were having 1 percent or more than 1 percent of the total cropped area. His method was an improvement over Bhatia's and Singh's methods for measuring crop diversification.

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. Johl (1996) in his work on dynamics of Punjab agriculture found that the cropping patterns of Punjab were mainly dominated by wheat-rice crop rotation which showed crop specialization.

Kebebe et al. (2000) have studied the diversification of agriculture in Haryana and revealed that cereals, commercial crops, vegetables and fruits were found to be relatively more diversified as compared to pulses and oilseeds among the crop groups. Diversification towards high-tech innovative enterprises within the agricultural sector such as vegetables,
fruits and towards agro-food processing and rural non-farm sector had been gaining momentum in the State.

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 had led to wheat and rice or wheat and cotton predominant cropping patterns which led to the state's crop pattern from diversified to specialization. They further observed that extension in canal irrigation and consequently changes in cropping pattern had resulted in serious amounts of ecological destruction through water-logging and accumulation of salts in the soil profile.

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

Malik and Singh (2002) in their study have measured the extent of crop diversification at district level in Haryana using diversification measures viz. Crop Diversification and Entropy Indices. The analysis concluded that more diversion of area towards vegetables, fruits and flowers in Sonepat, Rohtak and Gurgaon districts due to availability of market increased demand of products and export facilities due to proximity of metropolitan city, Delhi. Crops were diversified in Bhiwani district with introduction of sprinkler-irrigation system. The other districts observed specialization in crops due to absence of proper markets, amount of risks involved, availability of irrigation facilities etc.

Sohal (2003) has concluded that before the ushering of the 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 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 notably high in major parts of Punjab in 1950-51 but during 2000-01, it was found to be lowest in about 80 percent of the area. Punjab's agriculture had shifted from subsistence and highly diversified to highly intensive, commercialized and specialized nature.
Sharma (2005) in his study has found that crop diversification in Himachal Pradesh towards selection of 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 from income and increase in the land productivity. Singh (2006) has identified that the patterns of crop diversification and variations in relief were positively correlated. He further observed that areas with unfriendly physiography had high magnitude of crop diversification as compared to featureless central uplands of the study region. He also found that due to diffusion of agricultural innovations, the magnitude of crop diversification had declined, while the cropping pattern had become specialized.

Puran et al. (2006) in their study have observed that the economy of Haryana had diversified from agricultural-dominated economy to the non-agricultural sector. The share of the primary sector decreased during the study period during 1965–66 to 1999–2000, but in value terms, it had registered a four-time increase. The contribution of livestock income had increased while income from crops decreased to the agricultural sector. The value of index of diversification of area under various crop groups showed concentration in favour of cereal crops (i.e. specialization had taken place). The area under fine cereals had increased at the expense of area under coarse cereals. They also suggested that these results emanated important policy implications. Due to inelastic supply of land, area and yield of food-grains could not increase in the long-run with the present technology. They suggested that some fundamental and radical changes were required at the genetic molecular level (i.e. biotechnology) and marketing level. Investment on agricultural research and development is required to enhance yields of high-yielding varieties of crops and diversifying the genetic base of crops.

Pattanayak and Nayak (2006) in their study have examined the nature of crop-diversification and crop concentration in Orissa during the previous one and half decade. The findings showed that in almost all districts crop specialization was taking place. He also figured out the major determinants of crop diversification.

Sau and Pathak (2007) in their study have estimated the level of diversification in West Bengal by using Hart’s Entrophy Index and Berr’s Index and revealed that while diversification of agriculture stagnated in India, whereas, West Bengal recorded increasing diversification. Relatively high rate of industrial growth and overall economic growth gave particularly the demand side boost to the growth of diversification of agriculture away from
the coarse cereals into high value crop. The linkages between agriculture and industry included manufacturing as well as infrastructure play a crucial role in the diversification process. Dinesh et al. (2007) have studied the crop diversification in Chattisgarh and observed that the pattern of land use and cropping pattern has changed during pre-reform, reform and post-reform periods. The area under forest had increased in Chattisgarh plains and northern hills, while it had decreased in Bastar plateau. Land put to non-agricultural use and cultivable waste land had increased in the Chattisgarh plains while it had decreased in the northern hills. The permanent pastures in plains and plateau were depleting very fast. On the other hand, paddy area had been continuously increasing in the last three decades. The increase occurred at the expense of coarse cereals and minor millets area. Wheat area was diverted to gram in the post-rainy season.

Ratnam, et al. (2008) has analyzed the agricultural resource base and the institutional framework of Andhra Pardesh. They found that the shifts in cropping patterns were leading to crop diversification or crop concentration. They also concluded that for promoting rural development in general, mitigating farmer’s distress in particular, diversification of agriculture as a strategy had received increased attention of the policymakers in recent times. Singha and Chakravarty (2013) in their study have found that in India with growing population, need of agricultural production also increase. Crop diversification within the agriculture sector has also been noticed but to a great extent. Using one way Least Squares Dummy Variable (LSDV) for twenty-seven districts over twelve years, the study explored that the introduction of new hybrid seed (HYV) was one of the most important factors for significant growth of maize crop in the state. Further, though the crop is suitable in the drier region, the role of timely rainfall was also significant on the yield level.

The above mentioned studies highlighted the regional changes in crop concentration and crop diversification during the Green revolution and period and after that by using different diversification methods at different levels like state, districts. The studies identified that agriculturally developed regions were having less crop diversification as compared to the regions having dissected, undulated topography, infertile soil and less developed agricultural areas. It has also been pointed out that increased urbanization and road density encouraged commercialization of agriculture which results in specialization under certain crops in the region.
IV. Agricultural Productivity and Cropping Intensity

Several studies in different parts of the world have attempted to identify the level of agricultural productivity and intensity which was essential for better planning, management and development of any agricultural region, such as Kendall (1939) treated it as a mathematical problem and pointed out that the productivity coefficient was concerned only with the yield per acre but not in any way weight according to the volume of production. Stamp (1958) have applied Kendall’s ranking coefficient technique on an international level in order to determine agricultural efficiency of a number of countries as well as some major crops.

As far as India is concerned, several studies have been conducted on agricultural productivity and cropping intensity like Shafi M., (1960); Enyedi, (1964); Garg, (1964); Deshpande, (1964); Sharma, (1965); Tambad, (1965); Sipra, (1980); Pandey, (1980); Dayal, (1984); Rao, (2001); Chauhan and Sangwan, (2007); Vanitha, (2008); Ghatak, (2010); Ramachandra, Anand, and Manjuprasad, (2014); Kumar, Sharma, and Ambrammal, (2014).

Shafi M. (1960) has worked on measurement of agricultural efficiency in Uttar Pradesh by applying the ranking coefficient method of Kendall tooling eight food crops grown in each of the forty eight tehsils of the state. Enyedi (1964) has studied geographical types of agriculture in India. He applied new methods of crop productivity. Garg (1964) has worked out the trends in agricultural development with respect to total cropped area, gross irrigated area and food grain production in two districts of Uttar Pradesh.

Sapre and Deshpande (1964) had attempted to further refine Kendalls ranking coefficient method. Sharma (1965), while defining the concept of agricultural productivity, suggested various parameters on which it could be measured. Tambad (1965) has calculated the Spatio-temporal variation of agricultural productivity of Mysore state. Sipra, (1980) 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. Pandey (1980) has concluded that in India the crux of development of agriculture lay in increasing the productivity of land. For raising the productivity of land, it was suggested that irrigation should be provided to as much of the cultivable land as possible. Dayal (1984) has worked on agricultural productivity of India in his work he divided India into different zones on the basis of productivity.
Rao, (2001) has presented the analysis of how globalization affected agricultural productivity and its opportunities and threats to agriculture and future implications to meet the challenges of accelerating India’s agricultural growth as an impact of WTO. The study compared the fluctuations in the growth rate of productivity across crops in India, during the period 1950-51 to 2003-04. The analysis showed the rate of growth in productivity per hectare of all crops increased from 2.07 percent to 2.51 percent during 1985-1994 as a consequence of implementation of various pro-agricultural policies of the government. Sharma (2006) has estimated variability in production and yield by choosing a smaller set of year, viz., 1981-82 to 1990-91 and 1991-92 to 2000-01. This would be helpful if the instability changed over time. The author found that the production of individual crops and food-grains had become more stable in the 1990s as compared with the 1980s.

Chauhan and Sangwan (2007) have found that there has been multi-dimensional progress which had collectively improved the socio-economic conditions particularly in rural areas of India during the Green Revolution. A unique phenomenon was observed in those areas in which the agricultural productivity was high especially in Punjab and Haryana, but in recent years the productivity had declined in the eastern region except West Bengal the productivity was observed to be low mainly due to weak infrastructure.

Vanitha (2008) has stated that intensive cropping system is often based on manual labour such as in traditional paddy rice and raised – bed agriculture, or on highly mechanized systems based on purchased inputs. High productivity is obtained in mechanized monoculture which in turn is dependent on chemicals which may inadvertently destroy desirable flora and fauna. Intensive cropping systems are suited to those environments where high yielding varieties, chemical inputs, fertile soils and irrigation can be guaranteed.

Ghatak (2010) in his study has provided an overall assessment of Indian agriculture over the Five Year Plan. He concluded that during the last three five year plans, growth rate of agricultural sector has gone down, that affected India’s food security in terms of self-sufficiency in food production. Falling growth in productivity increase is bothering the nation at the time when agrarian distress is observed in many of the states.

Ramachandra, et al. (2014) in their secondary data based study have examined the performance of trends of agriculture growth and production in India. And the study has shown that agricultural production has significantly increased from during the last three
decades. It also revealed that the major cereals crop have increased over the period of time. An average of 94.49 million tonnes of rice is produced annually which is higher than production of wheat, coarse cereals and pulses taken individually. However, it is less than annually average production of all food grain (227.48 million tonnes). Kumar, Sharma, and Ambrammal (2014), have estimated the impact of climatic and non climatic factors on major food grain crops in India. Cobb-Douglas production function for a panel of 13 states during 1980-2009 has been employed. Empirical results based on Prais Winsten models with panels corrected standard errors (PCSEs) estimation shows that productivity of major crop like, rice, maize, sorghum, and ragi negatively influences with increase in actual average maximum temperature. And predict that a 10 degree Centigrade increment in actual average maximum temperature reduces the productivity of rice, maize, sorghum, and ragi crops.

Many studies have been undertaken in different regions and states on spatial change of agricultural productivity and cropping intensity in India such as Singh, (1972); Shaban and Bhole; (1997); Godara and Poonia, (2011); Saha, (2014); Singh (1972) on the assessment circles based data, has assessed spatio-temporal variations in land efficiency in Haryana and revealed that the geography of land use of efficiency is complex because the spatial divergences in the physio-socio-economic variants. Shaban and Bhole (1997) have attempted to identify pattern and determinants of land utilization in districts of Maharashtra and found that physiographic, socio-economic factors and extent of irrigation played an important role in determining cropping intensity.

Godara and Poonia (2011) have made an attempt to study impact of prices on acreage and income from gram in Haryana during 1978-80 to 2008-09. The important findings emerged from the study indicated that the growth rates of area and production during all the study periods have been negatively highly significant. Saha (2014) in his secondary data based study has made an attempt to identify the disparity in agricultural production of Assam. The study concluded that the agricultural production of the state is much below the expectation as compared to the many other states in the country like Madhya Pradesh, Punjab and Haryana etc. Consequently, a disparity in the agricultural productivity of the state with the rest of India arises. Many agricultural inputs as well as government machineries are responsible for it. The study found a regional disparity in the production almost all the crops between the state of Assam and India.
The above mentioned studies have assessed the spatio-temporal variations of agricultural productivity and cropping intensity at different levels during 20th century and after that by using different methods. The studies have shown that after green revolution the growth and production has significantly increased but during 21st century because of the government policies and climatic change the falling growth in productivity has increase the agrarian distress in many of the state of the country.

V. Agricultural Workforce

In India several studies have been conducted on agricultural workforce change Scholars like Jha, (1992); Reddy and Reddy, (2007); Deshpande and Shah, (2007); Reddy and Mishra, (2008); Jayashula and Vishwanath, (2008); Mehta and Lochan, (2008), and Antony and Saravanan, (2014). Jha (1992) identified the push and pull factors responsible for the mixed trend in agricultural employment during the study periods 1983-99. The study also discussed the opportunities for increasing employment in agriculture. They have found that there is hardly any increase in of agricultural employment during the 90s. Labour productivity in agriculture has increased but this increase is associated with almost a complete decline of agricultural employment in the 1990s.

Reddy and Reddy (2007) have examined the viability of agriculture and the relative share of farmers and labourers over the last three decades in order to understand the critical factors contributing to the crisis. By using the cost of cultivation data for major state, they examined the change in profitability and factor share for important crops. And found that while increasing labour costs hurt the interest of the farmers, the promotion of labour-saving technologies would adversely affect the laborers.

Deshpande and Shah (2007) have examined the agrarian crises in the Indian agriculture during last decade and traced its impact on the agricultural labour and found that the share of Gross Domestic Production of agricultural sector has been going down but the workforce in this sector is not declining with the same rate. As a result the density of agricultural labour is increasing and consequently the surfacing agricultural labourers are the worst sufferers in the process. Reddy, and Mishra, (2008) have highlighted the structural, environmental and technological dimensions of the current agrarian crisis. The most important structural problem is the diminishing share of agriculture in GDP and the continued dependence of a majority of the workforce on agriculture. The number and share of marginal
and small holding are growing rapidly. The authors also emphasized that the agrarian crisis has been exacerbated because of the post 1991 policy regime which has neglected investment in agriculture.

Singh (2008) has examined globalization as a process of opening of the economy leads to external liberalization which does not imply farmer’s liberation. It is creating new forms of slavery. Jayashula and Vishwanath (2008) have discussed the growth and trends of institutional credit for agriculture and allied activities during the period, 1980-81 to 1999-2000 and concluded that agricultural credit has a significant positive relationship with agricultural output. But the flow of institutional credit for agriculture was not positive, which may not help the farming communities at large, particularly the marginal and small farmer’s community. Mehta and Lochan (2008) have analyzed the current situation of Indian agriculture and suggested that if small farms were provided the requisite knowledge inputs could well be the key to an economic upturn in the fortune of the farmer. They also suggested that given the present institutional constraints, policy makers in India need to look at concrete options to enable small holders to survive not only with dignity but also as constructive units in the economy.

Antony and Saravanan (2014) have made attempts into some of the crucial dimensions of the changing employment scenario in rural India at the national as well as the state level. They figure out the challenges and threats, as well as the potential for employment expansion that lies ahead. Occupational distribution of workforce showed that labour absorption in self cultivation is saturated and declining. The study also highlighted that the increase in the size of agricultural labourers was more than the size decline in cultivators indicating farmers those who are leaving farming activity and those who enter newly into agriculture are becoming agricultural labourers. Moreover, relatively high growth of female workforce engaged in non-agriculture appears to be a welcome feature but one needs to be prudent in interpreting it so, especially in the context of increasing informalisation of labour market.

Scholar like Sidhu, (2002); Wilson, (2002); Devi, (2006); Sah, (2007); Singh, (2008); Singh and Kaur, (2008); Singh, et al., (2009) have examined the status of agricultural workforce in different region and states of India. Sidhu (2002) has found that agricultural production and crop yields in Punjab have nearly stagnant. Land and water, the two most critical resources on which Punjab’s rural economy is built have sharply deteriorated over
time. Profit margins of the farmers have come down drastically. Wilson (2002) has pointed out the effect of 1991s; new economic policy on the small producers of Bihar and her finding suggested that in a scenario of unequal distribution of land and resources, the embrace of new technology by small cultivators, far from leading to greater income diffusion efforts and also through ensured input supply mechanism.

Devi (2006) has found that in India, the factors which has mattered most in the determination of farm wages are the availability of alternative, nonfarm jobs of secondary and service sector employment. Whereas, in Haryana in the 1990s, the absolute number of workforce in farm sector went down and employment in the tertiary sector expanded until, by the middle 1990s, it absorbs 35 percent of all usual principal status workers. No other state recorded figures like this. Sah (2007) has argued that instability and indifferent growth in Madhya Pradesh agriculture since 2001-02 had created severe stresses in the rural economy. The worst affected are the small and marginal farmers and landless laborers in the day region including tribal areas. The secondary data based study also reviewed the patterns of growth in the well-being of its masses.

Singh (2008) has focused on the causes of agrarian distress in Punjab. Apart from explaining the concepts required in the agrarian studies, he opined that cultivation is becoming an unrewarding occupation along with the increasing debt in the agrarian Punjab. The nature of exploitation of agriculture by the capitalist market has worsened the social relations with the landed peasantry. Over the years, the withdrawal of the stake in agriculture has created the agrarian crisis. Singh and Kaur (2008) has a primary data based study conducted in Amritsar, Jalandhar and Sangrur district revealed that materialism is on the rise in rural Punjab as most farmers have adopted new housing pattern coupled with all the facilities previously found in urban areas only. Areas under wheat and paddy have shown a significant increase. While other after crops such as groundnut, sugarcane, gram and oilseed have indicated a decline trend. The introduction of new technology and the use of agrochemicals have brought about change in agriculture and this in turn has also affected the traditional social-relationships of farmers.

Singh et al. (2009) examined multiple factors responsible for the economic viability of small and marginal farmers in Punjab. Broadly these factors are: farm size, off-farm income, income from dairy, rational domestic expenditure, and productivity of crops. The study concluding that the rationalization of household expenditure and farm investment
are also a source of enhancing the possibilities of financial viability of both the categories of farming families. Therefore, they suggested that on the policy front, all efforts should be made to create off-farm employment opportunities for these farmers. The public investments should be made to remove the regional productivity gaps, as it will enhance income of these farmers. Assuring remunerative prices and up-scaling of the marketing and input supply facilities are the need of the hour to promote dairying and other allied activities among these farmers. All these measures will go a long way in easing the financial stress on marginal and small farmers of the area. They also pointed out that in the prevailing economic scenario, it is difficult to pull out or push out these farmers out of agriculture in a short-run and hence the solution lies in making them part-time farmers having access to diversified sources of income as has happened in some of the South-East Asian countries.

The above mentioned studies highlighted the multiple factors responsible for the changing employment scenario in rural India at national as well as the state level during post reform period. The studies pointed out that occupational structure of the agricultural workforce shows that labour absorption in self cultivation is saturated and declining. The introduction of new technology and use of agrochemicals have brought about change in agriculture and this turn has also affected the social and economic status of the farmers.

VI. Agriculture and Development

In India many studies have been conducted on the theme of agriculture development in different parts of India such as: Gupta and Shangari, (1980); Kainth and Mehra, (1985); Sharma, (1990); Krishnan, (1991); Bhalla and Singh, (1997); Singh, (1998); Chand, (1998); Virender Kumar et al., (2002); Alagh, (2007); Mythili, (2008); Tingre et al., (2008); Koshal, (2012).

Gupta and Shangari, (1980) has observed that in the post Green Revolution period wheat-rice crop rotation had emerged in central parts of Punjab due to the developed agricultural infrastructure and the excellent services of the Punjab Agricultural University, Ludhiana. Kainth and Mehra, (1985) in their study on rice production potential and constraints have revealed that the Green Revolution may be taken as a turning point for Indian agriculture and especially for Punjab, which with the push given by the new technology had become one of the most developed states of India. The state spearheads the progress of the Green Revolution and has rightly been called the ‘grain bowl’ of India.
Sharma (1990) attempted to study the inter-state disparities in growth of agriculture in India from 1966-67 to 1987-88 and observed that four agriculturally developed states viz., Punjab, Haryana, Uttar Pradesh and Maharashtra had a growth rate of food grains production higher than the national average of 2.72 percent. Increased production was statistically non-significant in Gujarat, Tamil Nadu and Rajasthan states. The remaining states witnessed lower growth rate than the national average. The study also found that cropping pattern change also accompanied with development of the states. He suggested that inter-state disparities minimized by bringing the farmer within the ambit of efficient extension education and training activities, sound government policies and efficient supply network of various inputs.

Krishnan (1991) studied the growth and instability of agriculture in Kerala and observed that the cropping pattern had shifted in favour of plantations and commercial crops. He concluded that though the shift in cropping pattern was welcome in terms of the theories of economic development, it was at the cost of making the state deficient in rice, which was the staple crop of the state. The shift in cropping pattern was attributed to exorbitant wage levels.

Bhalla and Singh (1997) in their state level analysis of recent developments in Indian agriculture have made a brief review of the regional patterns of level and development of agricultural output in India since mid-1960s, in general during 1980-83 to 1992-95, in particular. Singh (1998) has analyzed the post Green Revolution developments in agriculture in Haryana. The study revealed that with the onset of the Green Revolution in mid-sixties Haryana witnessed a transformation of the traditional, largely subsistence agriculture into a modern commercial one. This is attributed primarily to the development and intensification of agricultural infrastructure base. The state has experienced impressive changes in its cropping pattern with low yield and value coarse cereals being replaced by more remunerative oilseed, fiber rice and wheat.

Chand (1998) studied the effect of trade liberalization on selected crops like rice, maize, chickpea rapeseed and mustard. Estimating the impact on the wholesale and farm level prices studied the effect at national level by estimating the consumer and producer surpluses. The study showed a sharp positive impact on net return following free trade from production of exportable such as maize and rice. The impact was negative for importable
such as rapeseeds, mustard etc. Thus, impact of grade liberalization would vary from commodity to commodity.

Kumar et al. (2002) have also examined the factor responsible for change in agricultural development in Himachal Pradesh. The analysis revealed that because of large-scale import of certain commodities in post WTO period Indian agriculture faced decline in growth rate of production and yield of selected commodities like oilseed, cotton, and pulses. Toor et al. (2006) have also made attempt to examine the changing scenario of Indian agriculture in the wake of globalization. They highlighted the changes in cropping pattern, food-grain production, rural workforce, change in yield and changes in capital formation in agriculture and allied sectors.

Alagh, (2007) has studied growth and changes in Indian agriculture since the eighties. The study revealed that agricultural sector was traditionally regarded as having low price responses. Cropping patterns were different in different areas because of economic reasons or technological reasons but the change was slower.

Mythili, (2008) has reported on acreage and yield response for major crops in the pre- and post-reform periods in India estimates supply response for major crops during the pre- and post-reform periods. Estimations were based on dynamic panel data technique using pooled cross-sectional time-series data across the states of India for the period 1970-71 to 2004-05. As expected, the food grains revealed less response than non-food grains. With proper specifications of the price variable, the acreage elasticity increased by about 20 percent to 40 percent post reforms as compared to pre-reforms for all crops, except cotton and groundnut. Yield responses were higher than acreage response for the main cereals, rice and wheat. Treating yield variable as a proxy for non-acreage inputs, the results confirmed that farmers respond to price incentives increasingly by adjusting non-acreage inputs than acreage for main cereal crops.

The above mentioned studies highlighted the agriculture development that has been occurred in most parts of the country during 20th century and after that. Most of the studies revealed that with the push given by the new technology, with green revolution and new economic reforms also enhance pace of agricultural development in India.

Changing patterns of agricultural landscape have been the most staggering feature of the agricultural situation in India as well as Haryana in post-reform period. Many systematic
studies are available on the nature of changing agrarian pattern in the Green Revolution region of India. But no attempt has been made to depict a collective agricultural change in terms of various attributes namely land-use, cropping pattern, productivity, crop concentration, crop diversification, cropping intensity and agricultural workforce. Hence the present study had made a humble attempt to fill this gap to some extent by studying the agricultural change in terms of various attributes as mentioned above in the post reform period by taking Haryana as an example.

**Research Questions**

The main aim of the study is to gain insights into the magnitude of efforts needed to achieve balanced agricultural growth in Haryana. The present study seeks to answer the following questions:

1. How did the economic reforms influence the agricultural situation in the state of Haryana?
2. Which aspects of agriculture were influenced to a greater degree, in particular, how has land use, cropping pattern, crop diversification and crop productivity responded to the reforms?
3. What have been the trends and spatial variations in different aspects of the agricultural sector?
4. What is the process of change in the status of workforce dependent on agriculture?
5. What has been the impact of reforms on agricultural farmers who left farming?

The present study purports to go into these questions with geographic curiosity and intensity. It tries to identify, describe and explain the spatial changes in agriculture in post-reform period.

**Objectives of the study**

The present study focuses on the research questions pertaining to spatial and temporal change in:

1. Land Use Pattern
2. Cropping Pattern
3. Crop Concentration
4. Crop Diversification  
5. Agricultural Productivity  
6. Crop Intensity  
7. Status of the Farmers (who left farming).

**Methodology**

In conforming with the focus of study on the spatial and temporal dimensions of changes in agriculture of the state were examined in terms of (i) Land-use, (ii) Cropping pattern (iii) Cropping intensity (iv) Crop concentration, (v) Crop Diversification, (vi) Crop Productivity and (vii) Socio- economic life of agricultural workforce of the state. The main focus of the study was on the years 1990-92 and 2010-12. It was in 1991 that the new economic reforms were introduced in the country which created new incentives in agricultural sector of India. The initiation of economic reforms in India in 1991 brought about major changes in Indian economy by changing the macroeconomic policy framework that existed in India during 1950-51 to 1990-91. Although, there was no direct reference made to agriculture in particular but change in trade policy, devaluation of currency, gradual dismantling of industrial licensing system and reduction in industrial protection, would benefit tradable agriculture by turning the terms of trade in its favour. This, in turn, was supposed to promote exports leading to rapid agricultural growth. But despite these changes the agricultural sector in India neither experienced any significant growth subsequent to the initiation of economic reforms in 1991 nor did it derive the expected benefits from trade liberalization. As revealed by research studies during the reform period, agricultural growth in India recorded a visible deceleration during the post-reform period as compared to Pre –reform period.

**Agro Climatic Regions**

Soil and climate conditions of a region largely determine the cropping pattern and crop yield. The purpose of zoning, as carried out for land-use planning, is to separate areas with similar sets of potentials and constraints for development. Specific programs can then be formulated to provide the most effective support to each zone. A geographical region can be divided into two types of zones:

1. Agro-climatic zones.  
2. Agro-ecological zones.
1. An agro-climatic zone is a land unit uniform in respect of climate and length of growing period which is climatically suitable for a certain range of crops and cultivators (FAO, 1983). It refers to a land unit in terms of its major climate, superimposed on the length of growing period of crops or moisture availability period of soil.

2. Agro-ecological region is the land unit carved out of agro-climatic region when superimposed on land form and soil condition that acts as modifier of the length of growing period (FAO, 1983). Therefore, within an agro-climatic region there may be a few agro-ecological regions depending on soil condition. This approach has been used in delineating agro-ecological regions of India.

The Planning Commission of India, (1989) has categorized India into 15 agro climatic zones (Annexure-1.) taking into account the physical attributes and socio-economic conditions prevailing in the regions. Haryana lies in the Trans-Gangetic Plain Zone which is the VI zone.

The Trans-Gangetic Plain Zone

It consists of areas included in the States of Punjab, Haryana, Plain region of Rajasthan as well as the Union Territories of Chandigarh and Delhi. The climate is arid, semi-arid and sub-humid in different districts. In summer months temperatures rise up to 43°C radiating heat waves with occasional dust storms. Rainfall varies from 190 mm to 1,150 mm. The rivers Beas, Ravi, Sutlej, Yamuna and Ghaggar are important sources for irrigation in the zone. Agricultural development in this region has witnessed a phenomenal increase in agricultural productivity ranging from 2 to 4 fold in most areas.

The sub-zones cut across state boundaries:

Sub- Agro Climatic Zones with their characteristics

1.1 Plains

This sub-zone, which is placed in the basin of the Indus and the Ganga, is bound in the north by the Shiwalik hills and in the east by the Yamuna river. The soil is almost entirely alluvial, particularly in the Punjab areas. In Haryana, the sub-zone runs over sand dunes. The districts
from Haryana include Kurukshetra, Karnal, Jind, Sonipat, Rohtak, Faridabad and Gurgaon. The normal annual rainfall is 720 mm. The climate is semi-arid to dry and sub-humid and the soil is alluvial. Over 80 percent of the land is sown and over 80 percent of the sown area is irrigated.

Table 1.1

Haryana: Characteristics of Agro Climatic Sub Zone of Trans-Gangetic Zone.

<table>
<thead>
<tr>
<th>Sub Zone</th>
<th>District Falling in the Sub Zone</th>
<th>Rainfall (in mm.)</th>
<th>Climate</th>
<th>Soil</th>
<th>Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain</td>
<td>Kurukshetra, Karnal, Jind, Sonipat, Rohtak, Faridabad and Gurgaon</td>
<td>720</td>
<td>Semi-arid to Dry sub-humid</td>
<td>Alluvial (Recent)</td>
<td>Wheat, Rice, Maize, Sugarcane</td>
</tr>
<tr>
<td>Foothills of Shiwalik &amp; Himalayas</td>
<td>Ambala, Yamunanagar</td>
<td>1000</td>
<td>Semi-arid to Dry sub Humid</td>
<td>Calcareous</td>
<td>Wheat, Rice, Maize, Sugarcane</td>
</tr>
<tr>
<td>Scarce Rainfall Arid Region</td>
<td>Hisar, Sirsa, Bhiwani, Rewari, Mahendragarh</td>
<td>360</td>
<td>Arid and Extreme arid</td>
<td>Calcareous, Sierozemic, Alluvial (Recent) Desert</td>
<td>Wheat, Cotton, Gram, Bajra, Rice</td>
</tr>
</tbody>
</table>


1.2 Foot Hills of Shiwalik

This is a relatively small sub-zone, covering the districts of Gurdaspur, Hoshiarpur and Rupnagar in Punjab and Ambala in Haryana. It also includes Chandigarh. The region receives about 1000 mm rainfall and the climate is sub humid. Nearly 16 percent of the land is under forests and about 65 percent is cultivated. About 60 percent of the net sown area is irrigated. Three-fourths of the irrigation is through ground water resources.

1.3 Arid

This region comprised Hisar, Sirsa, Bhiwani, Mahendragarh and Rewari districts of Haryana. The advent of the Indira Gandhi Canal and the new irrigation facilities available to the region, have transformed this region significantly. Over 80 percent of the land is available for cultivation. However, only about 70 percent of the net sown area is irrigated.
Further, Economic and Statistical Organization, Planning Department Haryana, (2007) has divided the state into four agro climatic zones which are conducive for a different variety of crops. The administrative division is considered an aerial unit to show crop land use pattern in general and also their changes within the agro climatic zones. To facilitate the analysis of data and to make the study more useful in planning and research for agricultural development, Haryana has been divided into four homogeneous agro climatic zones which are as under:
Agro climatic Zones  Districts included

1. Northern  Panchkula, Ambala, Yamunanagar, Kurukshetra, Karnal, Panipat
2. Central  Kaithal, Jind, Sonipat, Rohtak, Jhajjar
3. Western  Bhiwani, Hisar, Fatehabad, Sirsa
4. Southern  Faridabad, Gurgaon, Rewari, Mahendragarh

An average of data for three successive years at any point of time has been used to avoid anomalies created by year to year fluctuations in weather. Appropriate techniques have been used for data processing. The data has been examined for the state at the level of districts. It has been represented through tables and maps. The distribution pattern has been displayed using appropriate cartographic techniques. Suitable indicators have been selected to examine the agricultural changes in Haryana. To glean the impact of various conditions of small and marginal farmers and agricultural labourers, a household based field survey has been carried out in selected sample villages in the state.

For measuring crop concentration, method has been adopted from Singh (1976) the crop concentration index (C) or location quotient has been determined with the following equation:

$$C = \frac{P_{ac}}{P_{at}} \times 100$$

Where

‘P_{ac}’ is percentage of the area of crop ‘a’ in the unit area to the total cropped area of the unit area

‘P_{at}’ is the percentage of area of crop ‘a’ in the entire region to the total cropped area of the entire region.

The higher crop concentration index indicates higher level of interest in the production of that crop.

Statistical Technique Herfindahl Index has been adopted from Rahman (2009). It is computed by taking the sum of squares of acreage proportion of each crop to the total cropped area.
Mathematically, the index is as follows:

\[ H_0 = \sum_{j=1}^{J} \left( \frac{Y_j}{\sum_{j=1}^{J} Y_j} \right)^2 \quad 0 \leq H_0 \leq 1 \]

Where

- \( Y_j \) represents the area share occupied by the \( j \)th crop in total area \( Y \)
- \( J \) is the total number of crops

**Crop Diversification Index (CDI) = 1 - H_0**

In order to observe the trend of Crop Diversification and to facilitate the overtime comparison, the Crop diversification index (CDI) was calculated as one minus the value of Herfindahl Index. Thus, the value of CDI closer to 1 indicated complete diversification (i.e., an infinite number of crops in equal proportion), to zero, reflecting complete specialization (i.e., just one crop).

The index of land productivity (\( P_l \)) (agricultural productivity per hectares) is defined as the market value of output of 10 crops per unit of area occupied by the crops and is given by the formula. Not that the crop price is used as ‘converter’ of crop production to put all crops on their uniform scale considering them at their market importance (Singh and Chauhan, 1977). Base year’s crop prices are used as constant to observe the changes in physical production of agriculture over time. Method of agriculture productivity (Land and Labour Productivity) have been adopted from Dayal (1984) and computed as

\[ P_l = \sum_{i=1}^{N} \left( \frac{O_i P_i}{A_i} \right) \]

Where

- \( N \) = number of crops.
- \( O_i \) = output of crop \( I \) in a district
- \( P_i \) = regional average harvest price of crop \( I \) per unit weight
- \( A_i \) = Area occupied by the \( i \)th crop in the district
Labour Productivity-

The index of labour productivity (Lb) agricultural productivity per worker) is similarly obtained, and is given by the formula.

\[
\text{Labour productivity} : \quad L_b = \sum_{i=1}^{n} \left( \frac{O_i P_i}{W_i} \right)
\]

Where

\( N \) = number of crops.
\( O_i \) = output of crop i in a district
\( P_i \) = regional average harvest price of crop i per unit weight
\( W_i \) = is the labour input in agriculture in a district, in terms of number of agricultural workers.

The formula for calculating the cropping intensity adopted from Singh (1979) is as under

\[
\text{Cropping Intensity} = \frac{\text{GCA}}{\text{NSA}} \times 100
\]

Where,

\( \text{GCA} \) = Gross Cropped Area,
\( \text{NSA} \) = Net Shown Area

However, in case of level of change to maintain comparability between different dimensions of time, the class limits have been adjusted to some extent.

\textbf{Source of Data}

The data used in the study are secondary and primary in nature. It has been collected from:

(i) Directorate of Agriculture, Haryana, and Chandigarh.
(ii) Statistical Abstract of Haryana, Various issues by Economic and Statistical Adviser, Planning Department, Government of Haryana.
(iii) Primary data have been obtained through field survey in selected sample village of the State.
Chapter Scheme

The present work has been organized into following seven chapters:

Chapter 1-Introduction

This chapter provides introduction of the topic, statement of the problem, review of the previous works done in this field, objectives of the study, research questions, and research methodology, period of the study, data sources, and organisation of the material.

Chapter 2 – Land, People and Economy

Chapter file of the Land, People and Economy under following headings: physiography, climate, soil, groundwater resources, natural vegetation, minerals, population and settlement, polity, economy and planning of the state are dealt with in the chapter.

Chapter 3- Spatial Pattern of Land Use and Cropping Pattern

This chapter highlights the changing spatial pattern of Agricultural Land-Use and Cropping pattern and areas of high change have been identified.

Chapter 4- Spatial Pattern of Crop Concentration and Crop Diversification

This Chapter deals with the changing spatial pattern of crop concentration and crop diversification in the study area.

Chapter 5- Spatial Pattern of Agricultural Productivity and Cropping Intensity

This Chapter five dealt with the changing spatial pattern of land and labour productivity and cropping intensity in the state. Their explanatory variables are also analyzed.

Chapter 6- Change in the Status of Farmers (who left farming)

This chapter identifies the changes in the economic status of the farmers who left farming in the state. It also suggests some policy measures to overcome the problems identified in the study.

Chapter 7- Summary and Suggestions

Major findings of the study are summarized in this chapter. Suggestions have been made to
overcome the existing problems and existing imbalances in the state agriculture.

References and Bibliography

Appendix