CHAPTER

2

STUDY AREA: AN INTRODUCTION
2.1 INTRODUCTION

The Punjab-Haryana plain is a fertile alluvial lowland situated in the west of the river Yamuna and is bounded by the arid desert in the south. Between the stony and highly broken slopes of the Himalayan mountains in the north and the waterless desert tract in the south, this plain stretches like a corridor and merges in the east into the rich Ganga plain (Singh, 1979: 407). The plain may be classified mainly on the basis of watersheds of its major rivers. The Punjab-Haryana plain consists of the Manjha plain bordered by the Ravi on the west and Beas on the east. Their tributaries serve as gathering streams, which emerge from the foothill zones of the Hoshiarpur cho lands. The Bisht doab lies between the Beas and the Satluj. Their tributaries are also gathering streams. Between the Satluj and Yamuna are the Malwa, Sirhind, Saraswati and Kurukshetra plains in the north. Towards south, these progressively merge into the drier sandy stretches and low hills of the Katwali Rohi and Bhawani Bagar (Deshpande, 1992: 19). The central drainage is that of the Ghaggar which disappears in the arid bagad. The elevation of the region varies between 200 and 300 metres. The rivers have made the plain very fertile and it now possesses one of the densest networks of canals for irrigation.
It may be noted here that the present study relates to the administrative divisions of Punjab and Haryana. The forthcoming discussion on the geographical background pertains to the area formed by the two states of Punjab and Haryana.

2.2 LOCATION

The Punjab-Haryana plain is one of the major regions of India. On the basis of language, two states Punjab and Haryana came into existence on November 1, 1966 after the reorganisation of the composite Punjab state. Geographically, Punjab-Haryana plain is situated in the north-west of India. The plain extends from 27°39' N to 32°30' N latitudes and from 73°51' E to 77°36' E longitudes. The north-west frontiers of Punjab-Haryana plain are situated along the boundaries of Pakistan. These are international borders. Jammu & Kashmir is located to the north of the plain, while Himachal Pradesh is situated in its north-east. Similarly national capital Delhi is situated in the east, Uttar Pradesh is situated in the south-east of the plain and Rajasthan is located on its south-western borders. In shape, it is irregular oval with its long axis lying from the north-west south-east.

According to the surveyor General of India, the total area of the Punjab-Haryana plain (Punjab and Haryana states only) is 94574 Square
Kilometres. This amounts to 2.9 per cent of the total geographical area of the Indian union.

In terms of administrative divisions, the plain comprises of 2 states Punjab and Haryana, 8 divisions, 36 districts, 139 tahsils, 263 towns (223 statutory towns and 40 census towns), 5 municipal corporations, 19,684 villages and 252 C.D. blocks as per 2001 Census.

As already mentioned earlier, the present study deals with growth and spread of rice cultivation in Punjab-Haryana plain as a result of the spread of new farming technology in the mid sixties. Therefore, an account of the geographical background of the study area in terms of its terrain, drainage, soil types, weather conditions etc. which have direct impacts on agricultural practices, are being presented in the forthcoming sections. In addition, some of the basic features of agricultural operations in the region have also been outlined.

2.3 PHYSICAL ASPECTS

2.3.1 Relief:

Excepting some hills of the Sivaliks in the north-east and the outliers of the Aravali system in the south, the study area is basically a plain area. The northern part generally slopes imperceptibly from the north-east to the south-west. But the south-western section is undulating
due to a number of small hills of the Aravali system and sand dunes. Physiographically the study area can be divided into the following four regions.

I. Siwalik Hills and the Piedmont Plains: Stretching in north-west to south-east, this region or belt runs along the border of Himachal Pradesh. The average width of the Siwalik range varies between 6 to 10 km. Siwalik hills are about 400 to 700 metres high above the mean sea level. The ranges of Siwalik hills include Gurdaspur, Hoshiarpur and Roop Nagar districts of Punjab state and Panchkula, Ambala and Yamuna Nagar districts of Haryana state. The Siwalik ranges, low lying as they are, serve as a border to the long plain skirt only in patches. It is only the north-eastern parts of Gurdaspur, Hoshiarpur, Roop Nagar, Panchkula, Ambala and Yamuna Nagar districts that have undulation in the name of Siwalik ranges. As such these districts have steeper slopes towards the south-west.

The Siwalik ranges are made, for the most part, of barely coherent sandrock, gravels and conglomerates an ideal formation for gullying. A large number of rainy season torrents come down the slopes of Siwaliks and spread a lot of gravel, boulders, pebbles and sand in their beds.
The Siwalik ranges are broken near Roop Nagar where Satluj makes its entry into the plain, and near Talwara, where Beas enters the plain. There is still another breaking in the east of Gurdaspur through which the Nangal Gorshankar Road passes. Morni and Tipra hills are found in the sub-mountainous region of Ambala district. The height of the Morni hill is 1,514 metres above mean the sea level.

Dissected Piedmont plains of Punjab and Haryana states are known as Kandi by the local inhabitants. The piedmont plains are found in the south-west of the Siwalik hill ranges. These plains roughly lie between contours of 300 to 400 metres in the form of a narrow long belt (25 km) along the entire extent of the Siwalik hill ranges. The surface of the piedmont plain is replete with “choe” (stream). There is at least one “choe” available after every few kilometres. Piedmont plains were formed by the assimilation of alluvial fans in the foothills of Siwalik hill ranges. These plains have convex slope and low underground water table because these are dry uplands.

II Great Alluvial Plain (Khaddar or Bet and Naili and Flood Plain): Leaving aside the Siwalik hill ranges in the north-east sand-dunes and Aravalli outliers in the south and south-west, the entire region is extensive lands of great alluvial plains. This plain is formed by the
same materials, by which the Siwalik hill ranges are composed of. This plain is an integral part of the Great Indo-Gangetic plain, which is a synclinal basin formed by the elevations of the Himalayas.

The rivers of the region indicate that this plain is the result of a recent deposition and these very rivers have formed it. These rivers have been raising their beds and then breaking through the banks at the time of severe floods to adopt new courses. With the historical times the Satluj had a very different course from its present one. River Yamuna too has changed its course.

The alluvial plain of Punjab and Haryana lies between 200 to 300 metres above sea level. Districts Amritsar, Kapurthala, Jalandhar, Ludhiana, Fatehagarh Sahib, Patiala, Sangrur, Mansa, Moga and north-eastern Firozpur of Punjab and south-western Ambala and Yamuna Nagar, whole of Kurukshetra, Panipat, Kaithal, Jind, Sonipat, Rohtak, Faridabad and north-eastern parts of Fatehabad, Hisar, Bhiwani and Jhajjar of Haryana lie in the alluvial plain.

It is here in the plains that one comes across areas which get flooded during rainy seasons, locally known as Beds and Khadars. Besides one also finds old flooded plains which remain abandoned due to the shift of courses of the streams and are termed as Bangars. These
plains generally are the aftermath of the alluvium comprising unconsolidated clay, silts and gravel deposited by Ravi, Satluj, Yamuna and many others sub-mountainous torrents, ‘Khads’ and ‘chos’. Almost the whole of alluvial plain is among the most fertile lands in the country.

III The Plain with Sand Dunes: Sand dunes form an integral part of the landscape all along the south-western border of Punjab and Haryana plain. To the other side lies the state of Rajasthan. Semi arid type of climate and variation in relief contribute a lot in the origin of these sand dunes. These sand dunes break the continuity of the great alluvial plain of the region. The sand dunes are found in the most of the parts of districts Bhatinda, Mansa, Sangrur, Muktsar, Moga, Faridkot and Firozpur in Punjab and in the districts of Sirsa, Fatehabad, Hisar, Bhiwani and Mahendargarh in Haryana. Sand dunes here are found in the shape of undulating ridges. These sand dunes have symmetrical shape and during the dry seasons these have their slope to the windward direction. It ranges in height from 200 to 220 metres above the sea level. Many of these sand dunes have been levelled so as to use the land for agricultural purpose in the region.

IV The Aravalli Hills with sand Dunes: It is located in the southern-most part of the region and includes almost the whole of the
Mahendargarh, Rewari, Gurgaon and parts of Bhiwani and Faridabad in Haryana. The Aravalli ranges are narrow ridges that span into Punjab-Haryana plain for 90 kilometres in the north-east-south-west direction up to Delhi state. It is very much undulating in characters, due to the presence of a number of hills and ridges of the Aravalli system and some sand dunes of varying size. It varies in height from 225 to 518 metres and slopes, in general, from the south to the north. At places, the hill slopes are steep, bare and rocky overgrown with thorny bushes and thickets. Generally, the soil is sandy. However, in depressions there are also heavier alluvial soils covered here and there with reh and kankar.

2.3.2 Drainage:

Geographically, the drainage system of Punjab-Haryana plain is quite complicated. At present four main rivers namely Ravi, Beas, Satluj, and Yamuna flows through the plain. Along with these rivers, Ghaggar, Saraswati, Markanda, Sahibi, Indora, White Bein, Black Bein, Kiran Nala, Chakki Nala, Sakki Nala and numerous seasonal streams called "choes" flow through this plain.

River Ravi, Beas and Satluj drain only one fourth of the area of this plain in the north. The Yamuna drains only a narrow strip of land lying on its right bank. A large number of seasonal hill torrents leave the
Siwalik range and flow in the south-west direction. Except for the Ghaggar (and its tributaries), Markanda and Saraswati which leave the foot-hills between Satluj and Yamuna, all other torrents dwindle soon after they have traversed a few kilometres on the plain.

A brief description of the main river channels of the plain are as follows:

The Ravi: River Ravi has its origin in Himachal Pradesh on the northern side of Rohtang pass-situated on the hills of Kullu, at an elevation of about 4,116 metres. Ravi traverses from head to the Dhaula Dhar and Pir Panjal ranges by forming a number of depressions. And after passing through Chamba and Dalhousie hills, near Madhopur it steps into the Punjab-Haryana plain. Ravi forms the boundary between Punjab and Jammu & Kashmir up to Kathlor.

Starting from Madhopur, Ravi passes through the districts of Gurdaspur and Amritsar in Punjab and forms the international border between India and Pakistan and enters into Pakistan at Kakar Manj. At last it falls into river Chenab in Sidhani near Multan in Pakistan. The total length of river Ravi from its source to Kakar Manj turns out to be about 725 kilometres. Its total catchment area is about 5957 square kilometres. Ujh is the main tributary of Ravi. It is also known as “Gurdaspur Nala”.
The Beas: River Beas also has its origin in the Beas Kund in the Peer Panjal hills of Himachal Pradesh on the southern side of Rohtang pass at an altitude of about 4060 metres above sea level. After passing through the valleys of Manali, Kullu and Kangra in Himachal Pradesh it reaches Siwalik hill ranges. Beas steps into Hoshiarpur district near Talwara in Punjab through Siwalik hills.

Beas river joins Satluj near Hari-Ke-Pattan. Here the river forms large ‘Mand’ Region, a lake and riverine island is also formed. The total length of Beas turns out to be about 470 kilometres. The Beas has a number of tributaries. The major among them being the Parbati, Suketri, Uhl, Lambading, Guz, Chakki, Soahan and Black Bein.

The Satluj: River Satluj is the most significant of all the rivers of Indus system. Satluj rises in the south-west of lakes Rakashthal and Mansarover in Tibet at an elevation of about 4630 metres. Satluj covers a long and narrow path starting from its origin to the southern slopes of the Kailash mountains. After gushing through Himachal Pradesh and after establishing world fame gorge at Bhakra, river enters Punjab near Nangal. Its valley is known as the Dooni in Anandpur Sahib tehsil. At Roop Nagar, it is joined by Nadi Soan, Nadi Sirsa and many seasonal choes.
From the meeting point of river Satluj and Sirsa Nadi onwards, it takes a sharp south-west turn and enters the plains at Roop Nagar.

After the construction of Bhakra dam, Satluj acts as a canal upto Harike Patten. Near Firozpur, Satluj forms international border between India and Pakistan. It steps into the territory of Pakistan from Suleimanki and joins river Chenab at Punjnad in Pakistan. The total length of the river Satluj is about 1050 kilometres and its catchments area upto Nangal is about 55000 square kilometres. Satluj has a number of tributaries. The important among them are Namgia, Baspa, Beas, white Bein, Soan Nadi and Sirsa Nadi.

**The Yamuna:** The hot water spring located at about 13 kilometres west of 6330 metres high Bandar Poonch (Kalindgiri) in Tehri Garhwal is the source of river Yamuna. Flowing by the side of Jamnotri where hot and cold waters get mingled and passing through Siwaliks, the Yamuna touches the boundaries of Himachal Pradesh. After passing through mountainous region of Uttranchal it reaches the plain near Tajewala in Haryana.

River Yamuna follows a southern course and works as a boundary for about 320 Kilometres between Uttar Pradesh and Haryana. It is one of the main tributaries of the river Ganga.
The Ghaggar: River Ghaggar originates from the mountains of Sirmaur in the east of Kalka lying in between river Yamuna and Satluj. After running through Morni hills, it leaves behind mountainous course and steps into the plains of Punjab and Haryana near Mubarkpur. River Ghaggar is a seasonal stream.

Meandering southwards the river crosses into Punjab and moves through the eastern parts of the Patiala district with the exception of small distances where it touches Ambala and Kaithal district of Haryana. It is joined by Patialewali stream on its right bank and the Saraswati on its left bank. Then it moves into Sangrur district of Punjab. Again it enters Hisar district of Haryana. Finally it enters Sirsa and breaks up into a number of branches and loses itself in the desert near Hanumangarh in Rajasthan. The Sukhna, Jhajra, Sirsala, Saraswati, Umla and Patiala Nadi are the main tributaries of the river Ghaggar.

The Saraswati: The Saraswati is the river par excellence of the Rig Vedic era. All kinds of mythical stories have been woven around this river, now flowing through Ambala and Yamuna Nagar districts. It originates from the Sirmaur district of Himachal Pradesh. It has sufficient water during three to four months of rainy season and is dry
during the rest of the year. It ultimately joins the Ghaggar in the district of Patiala in Punjab.

The Markanda: River Markanda originates in the lower Siwalik hills. It is also a seasonal stream. It flows across the Ambala and Kurukshetra districts of Haryana. The surplus water of this stream flows into the Sanisa Jheel where it joins the Saraswati. Tangri is the tributary of river Markanda.

The Sahibi: This river rises in Arawali Hills in Mewat area near Mahendargarh of Haryana. It flows northwards through Rewari, Gurgaon and Jhajjar districts. It flows to the north again and after a few miles enters in to Delhi. It falls into the Yamuna through Nazafgarh drain.

The Indori: This river rises near the old fort Indora in the Mewat hills. After flowing for a few miles, it is divided into two branches. The main branch goes off north-west and joins the Sahibi. The other branch gets water from many other rivulets and spread over the plain tract near Bhora. Finally this branch also joins Sahibi near Pataudi.

Thus there are number of streams (locally called ‘choes’) and rivulets in Punjab-Haryana plain. Although most of these are seasonal in nature, they cause much havoc during the rainy season. Some of these streams originate in Siwalik hills, traverse through the foot hills and there
after merge with the main stream. While other have their origin in the Aravallis in the south.

Choes play a vital role in the drainage system of the plain. These are excessively found in the drainage system of the Bist-Jalandhar Doab region in Punjab. At the time of heavy rains particularly when it is sudden, these streams are in spate and cause untold destruction.

2.3.3 Climate:

The climatic conditions in Punjab and Haryana plain vary from semi arid type in the south-west to the Gungetic type in the rest of the plain. The region is located on the outer margins of the monsoon region between the Thar desert and the Himalyas in the north-west of the Indian sub-continent. Climate of Punjab-Haryana plain is a part of the entire system of the climate of India. In other words the climate of the Punjab-Haryana plain is very much similar to the climate of India. According to H.F. Blanford, “Like the rest of India, the Punjab plain has really but three seasons, the summer or hot season, the rainy, and the winter or cold season.”

The location of Punjab and Haryana plain helps to bring a metamorphic change in the temperature. During summers in the months of May and June, the maximum temperature may rise upto 48°C. For
example on May 18, 2002 the maximum temperature in Bhatinda in Punjab touched the mark of 48°C. During winters in the months of December and January, temperature at many places of the plain reaches near 0°C. Frost is common in winter season, when the plains are filled in with a cold air mass coming down the northern mountains.

Generally, temperature starts rising slowly from the months of February. The temperature increases rapidly from February to June. The maximum number of hottest days of the year is in June. In July, when the rains starts the temperature subsides and keep falling till January. There is, however, no lack of sunshine in any part of the year except for a brief period in December and January.

It is the south-easterly current of the summer monsoon that brings here the much needed rains from July to September. The amount of rainfall in Punjab-Haryana plain varies from 25 centimetres to more than 110 centimetres, the maximum near the Siwalik range and the minimum in the south-western extreme of the plain. In the districts of Gurdaspur, Hoshiarpur, Roop Nagar, Panchkula, Ambala and Yamuna Nagar along the Siwaliks the average annual amount of rainfall is over 80 centimetres. In the central parts of the plain in districts like Amritsar, Kapurthala, Jalandhar, Ludhiana, Patiala in Punjab and Kurukshetra, Kaithal, Panipat
and Sonipat in Haryana, report an average rainfall between 50 to 80 centimetres. In the districts of Firozpur, Muktsar, Bhatinda, Mansa, Sirsa, Hisar, Bhiwani, Mahendargarh and Rewari, located in the extreme south-western margin of the plain, the amount of rainfall is only between 25 to 50 centimetres.

Over 70 per cent of the rainfall in the plain is received during the period from July to September. From some time in the middle of September, monsoon begins a retreat and while withdrawing causes showers here and there.

2.3.4. Climatic Zones:

If all the climatic elements of an region namely rainfall, temperature, winds, air pressure, humidity etc. are homogenous, that region is called a climatic zone. We are aware that the climate of Punjab-Haryana plain is broadly similar to that of the Indian sub-continent. Punjab-Haryana plain is quite small in size and almost a uniform climatic condition prevails in the plain. Under such conditions, it becomes very difficult to divide the plain into different climatic zones.

Based on the various bio-climatic conditions, however, the Punjab-Haryana plain can be divided into the following three climatic zones:
REFERENCES

- Warm & Wet Mountainous Zone
- Hot & Humid Siwaliks
- Hot & Less Dry Foot-Hill Zone
- Hot but Less Dry Zone Adjoining the Hills
- Less Hot & Semi-Dry West-Central Zone
- Hot & Semi-Dry East Central Zone
- Hot & Semi-Dry South-Eastern Zone
- Hot & Semi-Dry South-Western Zone
- Hot & Arid Zone

Source: Agricultural Atlas of Punjab, 1960-61
Map - 2.4
I. **Less Hot and Humid North-Eastern Zone:** This Zone is spread over Gurdaspur, Hoshiarpur and Roop Nagar districts in Punjab and Panchkula, north-eastern part of Ambala and Yamuna Nagar in Haryana. This region is not very hot and for eight months of the year mean monthly temperature remains below 20°C. Being located in the Siwalik ranges, this climatic region enjoy more than 80 centimetres of average annual rainfall.

II. **Hot and Semi-dry Central Zone:** This zone is quite vast and spreads over much of Punjab and Haryana plains. It accounts for more than 75 per cent of the total geographical area of the two states. It is spread over the districts of Amritsar, Kapurthala, Moga, Ludhiana, Fatehgarh Sahib, Sangrur and Patiala in Punjab and districts of Kurukshetra, Kaithal, Karnal, Panipat, Jind, Rohtak, Sonipat and Faridabad in Haryana.

Annual average temperature of this zone is higher than that in the Less-hot and humid north-eastern climatic zone. Ground frost and mist are the common features of the zone in the months of December and January. Average amount of annual rainfall of this Zone ranges from 40 to 80 centimetres. The amount of rainfall received gradually increases as one moves towards the north eastern parts.

III. **Hot and Dry South-Western Zone:** This zone is spread over the districts of Muktsar, Mansa, Bhatinda and the southern parts of Firozpur
in Punjab, and Sirsa, Fathabad, Hisar, Bhiwani, Mahendargarh, Rewari and parts of Jhajjar and Gurgaon in Haryana. This zone is extremely hot because their average annual temperature is more than 20°c. Average rainfall is quite low in this zone. Total amount of rainfall received is not sufficient for the agricultural activities. Average annual amount of rainfall of this zone is below 40 centimetres. Sometime, the entire zone is devoid of even a single drop of rain water.

2.3.5 Soils:

The Punjab and Haryana plain are located in the drainage system of the Ganges and the Indus. The soils of this plain are primarily formed of alluvial debris brought from the mountains by the Ganges and the Indus river system. In other words, soils of Punjab-Haryana plain are mainly alluvial soils and climatic conditions have their own significance on their composition and formation.

The soils in the plains were earlier grouped into Barani, Nehri, Bhangar, Khader, Chachhra, Rehi, Naili, Rego, Bagar, Tal, Tibba, Bet etc. Later on scientific classification of soils was under taken by the National Bureau of Soil Survey and Land-Use Planning, Nagpur. Based on the recent United State’s system of soil classification most of the soils
PUNJAB-HARYANA PLAIN
SOIL TYPES

CATEGORIES

NO. SUB-ORDER ASSOCIATIONS
9 Ustalfs - Ochrepts
10 Ustalfs - Fluvents
20 Ustalfs
32 Orthids - Fluvents
33 Aquents - Fluvents
35 Psammants
36 Psammants - Fluvents
37 Psammants - Fluvents - Orthids
38 Psammants - Fluvents - Aquents
44 Fluvents - Ochrepts
64 Aquents - Ochrepts
70 Ochrepts
72 Ochrepts - Orthents
73 Ochrepts - Psammants
76 Ochrepts - Ustents - Ustalfs

Map - 2.5
in the plains are medium textured. Degree of salinity seems to be a great hazard than alkalinity in the soils of the plains.

Broadly the soils of Punjab-Haryana plains could be categorised in three groups viz. soils of sub-mountainous areas, alluvial soils and desert soils.

I. Soils of Sub-Mountainous Areas: Soils of Sub-Mountainous areas are found in the north-eastern parts of the plain along the borders with Himachal Pradesh. These areas include north-eastern parts of Gurdaspur, Hoshiarpur, Roop Nagar in Punjab and Panchkula Ambala and Yamuna Nagar in Haryana.

The soils of the mountainous areas are devoid of lime and are laden with alluvial soils. On the slopes of the Siwalik hills soils are affected by the process of erosion by water and as a result have become medium and thin texture. Soils of the flood plains are young and sedimentary, so these soils are included in the class of alluvial soils. These soils are quite fertile.

II. Alluvial Soils: Alluvial soils are found mainly in the central parts of the plain. These areas include of Amritsar, Kapurthala, Jalandhar, Ludhiana, Patiala, Sangrur and parts of Firozpur and Gurdaspur in Punjab
and Kurukshetra, Kaithal, Karnal, Panipat, Sonipat and parts of Rohtak, Jhajjar, Jind, Faridabad, Bhiwani in Haryana.

These soils are highly fertile and suitable enough to have any type of farming. These soils have an average depth of 10 inches and contain 10-15 per cent clay. These soils are deficient in nitrogen and organic matter and are alkaline in reaction owing to the presence of sodium. In the alluvial tract salinity and alkalinity are the major problems. These soils are further such divided into five groups namely:- Brown soils, chestnut soils, Salty soils, Fluvial soils and undulating hills and Piedmont plains soils.

III. Desert Soils: The desert soils are found generally in the south-western parts of the plains. They are found in Firozpur, Faridkot, Bhatinda, Mansa and Muktsar in Punjab and Sirsa, Fatehabad, Hisar, Bhiwani, Mahendargarh and Rewari in Haryana situated along the borders of Rajasthan.

Wind erosion is a serious problem here. Soils are deficient in nitrogen, Phosphorus and potassium. Such types of soils are quite deep and these are formed from calcareous alluvium or the depositional process of winds. Desert soils can further be sub divided into three sub-groups namely :- Gray and Red desert soils, calcareous soils and Rego soils.
2.4 DEMOGRAPHIC CHARACTERISTICS:

As per 2001 census, the total population of Punjab and Haryana states is 4,53,72,285 which accounts for 4.42 per cent of the total population of the country. With a rural-urban break-up of 3,10,12,580 and 1,43,59,705 persons respectively, the region reports an urbanisation level of 31.48 per cent as against 27.78 per cent for the country as a whole.

The economy of the region is predominantly based on agriculture. The factors explaining the distributional pattern of rural population relate mostly to the productivity of soils. In the central part of the region (plain)*, population is concentrated along the rivers streams where small patches of cultivable land and water are available. In western parts where dune topography is dominant (Bagar area) the concentration of population is sparse. In the southern parts also where Aravalli offshoots and semiarid climate are dominant, population is sparsely distributed except in the industrial belts of Faridabad and Gurgaon. In the Bet Bhanger areas of eastern plain, concentration of population is thick.

The states of Punjab and Haryana individually rank 15th and 16th respectively in terms of the size of population amongst 28 states in the country. The density of population in the region is 480 persons per square

*Note: In the present study the term 'plain' and 'region' have been used interchangeably
kilometres as against 324 for India. Though, the number of cities, towns and urban population has increased considerably during the last few decades, 68.52 per cent of the total population of the plain is still rural based.

The rate of growth in population during 1991-2001 was 23.91 per cent as against 24.11 per cent during 1981-91. It is a region with a deficit of females in the population as reflected by the sex ratio of 868 (females per 1000 males) as against 933 for the country as a whole according to 2001 census. Sex ratio is slightly higher in rural than in the urban areas, the figures being 877 and 848 respectively. It becomes clear from the figures that the sex ratio in Punjab-Haryana plain is lower than the average sex ratio in the country, with a tendency to fall further. This situation is quite alarming. If this trend continuous the plain is bound to face certain social and cultural problems.

Literacy rate in the plain is 69.27 per cent in comparison to 65.38 per cent of the country. The male literacy rate is 77.44 per cent and female literacy rate is 59.93 per cent. The percentage of literates in the total population is 79.51 in the urban areas and 64.49 in the rural areas. Further in the rural areas the literacy rate among males is 73.92 per cent
as compared to only 53.84 per cent among females. On the other hand, in the urban areas 84.78 per cent of males and 73.34 per cent of females are literates.

The work participation rate i.e. proportion of workers to total population in Punjab-Haryana plain is 38.7 per cent. This is somewhat lower than the all India work participation rate of 39.26 per cent. The male and female work participation rate in the plain is 28 per cent and 10.68 per cent respectively. Of the total workers in the plain according to 2001 census, 29.65 per cent are returned as cultivators while another, 15.80 per cent are agricultural labourers, thus over 45 per cent of the work force is involved in agricultural activities/practice. Among the workers involved in non-agricultural activities 2.92 per cent engaged in household industry and 51.63 per cent engaged in other profession.

2.5 ECONOMY

In terms of the share of NSDP coming from different sectors, the economy of the region appears to be balancedly poised. The primary sector contributed 35.42 per cent in the net domestic product at factor cost in 2001-02. With a weight of about 34.59 per cent in the gross income at current prices, agricultural growth has influenced greatly the pattern of income. The secondary sector contributes 24.59 per cent to the
income which affects the growth of backward and forward linkages in the economy of the plain. The tertiary sector generates 39.99 per cent of income.

Punjab-Haryana plain has taken a big lead in increasing industrial production in urban and rural centres. A systematic planning of its industrial activity and sustained promotion of new enterprise in an atmosphere of harmonious industrial relations, coupled with calm and peaceful atmosphere have contributed significantly to the achievement of the present high level of industrialisation in the plain.

Agriculture, too, in the region has undergone a rapid transformation. There has been a significant increase in agricultural production and improvement in farm practices. The breakthrough achieved in agricultural production is probably due to a vastly improved and sophisticated irrigation system and optimum utilization of its water resources. The land once howing with milk and honey, as the saying goes, is again on the threshold of a white revolution.

2.5.1 Industries:

Though young in age and small in size Punjab and Haryana states have, in a very short span of time, developed an excellent infrastructure for the growth of industries. The region is located in a close proximity to
the national capital, which has a big market for raw materials, finished goods and trading etc. National Capital (Delhi) has indeed proved to be a boon for the industrial progress of the region. Many important national highways including Grant Trunk Road and Railway networks pass through this region.

The Punjab-Haryana plain now rightly boasts of a sound industrial base. It is aiming at rapid industrialisation and is definitely destined to remain in the forefront of industrial activity in the country.

There are 22,588 registered working factories in the region. The growth of working industrial units in small, medium/large sectors has been heartening. There are 200603 small and 629 medium/large scale units in Punjab (Statistical Abstract of Punjab – 2002). It may please be noted that scale-wise industrial unit data of Haryana is not available. These units turn out a wide range of consumer and industrial goods like bicycles, motor cycles, sewing machines, tractors, automobiles, auto parts, earth moving machinery, refrigerators, sanitary wares, air conditioners, hosiery goods, sports and leather goods, food products, textiles, textile machinery, machine tools, agriculture implements, electronic and other important engineering items.
Today Punjab-Haryana plain occupies an enviable position on the industrial map of India. The region has been able to attract many national and multinational industries. Many leading companies have collaborated in the industrial ventures in this region.

**Clustering of Industries at a few centres:** Industrial clustering in this region matches with the patterns of industrial clustering of the country. Nearly 65 per cent of the total industries of this region are clustered at Amritsar, Jalandhar, Ludhiana, Roop Nagar, Faridabad, Gurgaon, Sonipat, Panipat and Yamuna Nagar. These cities employ about 56 per cent of the total industrial workers of the region (Statistical Abstract of Punjab, 2002 and Haryana, 2001-02).

Maximum industries of this region are located along the G.T. Road. If we see the industrial map (No.2.6) of this region, we will find only a numbered few industries located away from G.T. Road. Industrial units located away from G.T. Road are either developed in those places which have been declared industrially backward and are enjoying certain concessions and facilities for industrial development or located at national capital region or located at industrial focal points set up by the state government.
Agro-Based Industries: Punjab-Haryana plain is predominantly an agricultural region with its economy centred around agriculture and its allied activities. So, the main industries working in this region are chiefly based on agriculture. These industries are cotton textile, sugar mill, oil refinery, biscuit, milk and milk products, manufacturing bakery items, rice mills, machines grinding wheat flour, jams and pickles, pulses, canning of fruit juices, industries based on potatoes and tomatoes, to manufacture agricultural implements starting from axespade to tractor-trolleys, other agricultural implements and industries related with electric motors of tube-wells and diesel engines etc.

However, agro-based industries in this region are still undeveloped. These industries do not make full use of raw materials like sugarcane, cotton, hides, skins and leachers. Undeveloped agro-based industries stand as an obstacle in the industrialisation of the region. Because of poor linkage between agriculture and industry, agricultural input supplying and output using industries have not come up as fast as required in Haryana. It is therefore, necessary to establish agro-industries to correct the imbalance in the economy. A variety of agro-industries can be set up in Haryana. Some indicative areas, which may be highly useful in developing agro-based industries are – plant tissue culture, herbal
products, mushroom products, flowers processed, fruits and vegetables, durum wheat, rice aging, barley malt, biofertilizer, animals products/feed and hybrid seed etc. (Singh et. al., 1971: 1).

2.5.2 Agriculture:

Modern day world comprises of developed and developing regions. Developed regions are mainly industrialized and developing regions are agrarian. The economy of the developing regions overwhelmingly depends upon agriculture.

Agriculture plays a vital role in the economy and development of Punjab and Haryana states. Since, 1966, these states have made a lot of progress in agriculture sector. With the introduction of high yielding varieties of crops, improved irrigation facilities, use of chemical fertilisers and pesticides, the production of various crops have increased manifold. These states are rightly considered the 'food basket' of the country.

On a total geographic area of about 3 per cent of the region accommodates nearly 4 per cent of the total population in the country. More than eight % of the total geographic area of the region has already been brought under farming. About 69 per cent of its population live in rural areas and depend directly or indirectly upon agriculture as against the national figure of about 65 per cent. This clearly shows the
predominance of agriculture in the economy of the region. About 58 per cent of its workforce is involved in agricultural activities. In the year 2000-01, the net sown area was about 7790 thousand hectares out of which about 6260 thousand hectares were sown more than once (Statistical Abstract). This high input user region is going through the third phase of agriculture development.

Punjab-Haryana plain has already attained the distinction of being one of the most progressive and dynamic regions in the field of agriculture. Scientific farming techniques, improved variety of seeds, balanced use of fertilizers have joined together to make the soil yield rich dividends. The farmer is no more captive of the weather conditions. Scientific storage and marketing facilities have also contributed towards improving the lot of the farming community.

Endowed with a vast alluvial plain and supplemental irrigation, this region is agriculturally far advanced and ahead of other regions in the marketable surplus of foodgrains (Singh, 1979: 474). The agricultural universities and the Government corporations provided an important input in the development by providing seeds and fertilizers together with scientific advances in applying these to the soil of this region.
The cropping pattern in the region is, however, determined by the availability of water for crop cultivation. Fifty centimetres isohyets divides this region into further two agricultural sub-regions. To the west of this isohyets irrigated areas grow cotton and wheat and un-irrigated areas mainly rely on bajra, gram and barley. To the east of the isohyets, wheat, rice, maize, ground nut, rapeseed, mustard and sugarcane, which heavily dependent on irrigation, are the important crops (Singh, 1979: 413). In Punjab and the eastern part of Haryana where almost three-fourth of the net area sown is irrigated either by canals or tubewells, the winter season is more important for raising crops than the summer monsoon rainy season.

Net sown area has already reached its farthest limit. Now there is very limited scope for improving the cultivable area in the region. The percentage of net area sown to total geographical area of the region has been fluctuating between 81 per cent and 84 per cent since 1990-91.

Trends in Cropping Pattern: “Crop Pattern” means the proportion of area under different crops at a particular period of time. The choice for growing a particular crop in a particular region is an outcome of these factors: (i) the general agricultural conditions, particularly the soil, climate, water supply, sub-soil water table, etc. (ii) aim of agricultural production, scale of production, size of holdings, techniques of agriculture and change in market prices (Mamoria, 1995: 94).
Table 2.1

Trends of Area Under Different Crops in Punjab and Haryana
(In Thousand Hectares)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>659(6.2)</td>
<td>1667(13.6)</td>
<td>2776(20.7)</td>
<td>3666(26.0)</td>
</tr>
<tr>
<td>Jowar</td>
<td>213(2.0)</td>
<td>138(1.1)</td>
<td>129(0.1)</td>
<td>110(0.7)</td>
</tr>
<tr>
<td>Bajra</td>
<td>1087(10.2)</td>
<td>939(7.7)</td>
<td>621(4.6)</td>
<td>614(4.4)</td>
</tr>
<tr>
<td>Maize</td>
<td>670(6.3)</td>
<td>454(3.7)</td>
<td>223(1.7)</td>
<td>180(1.3)</td>
</tr>
<tr>
<td>Wheat</td>
<td>3428(32.2)</td>
<td>4291(35.1)</td>
<td>5123(38.2)</td>
<td>5763(41.0)</td>
</tr>
<tr>
<td>Barley</td>
<td>166(1.5)</td>
<td>190(1.5)</td>
<td>87(0.6)</td>
<td>76(0.5)</td>
</tr>
<tr>
<td>Others</td>
<td>0.4(-)</td>
<td>1.8(-)</td>
<td>2.7(-)</td>
<td>0.2(-)</td>
</tr>
<tr>
<td>Total Cereals</td>
<td>6223(58.5)</td>
<td>7681(62.8)</td>
<td>8962(66.0)</td>
<td>10409(74.0)</td>
</tr>
<tr>
<td>Pulses</td>
<td>1573(14.8)</td>
<td>1136(9.3)</td>
<td>885(6.6)</td>
<td>212(1.5)</td>
</tr>
<tr>
<td>Total Foodgrains</td>
<td>7796(73.3)</td>
<td>8817(72.1)</td>
<td>9847(72.6)</td>
<td>10621(75.6)</td>
</tr>
<tr>
<td>Oil seeds</td>
<td>438(4.1)</td>
<td>549(4.5)</td>
<td>593(4.4)</td>
<td>500(3.5)</td>
</tr>
<tr>
<td>Cotton</td>
<td>590(5.5)</td>
<td>965(7.9)</td>
<td>1192(8.9)</td>
<td>1028(7.3)</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>284(2.7)</td>
<td>184(1.5)</td>
<td>249(1.8)</td>
<td>264(1.9)</td>
</tr>
<tr>
<td>Potatoes</td>
<td>22(0.2)</td>
<td>51(0.4)</td>
<td>34(0.2)</td>
<td>73(0.5)</td>
</tr>
<tr>
<td>Chillies Dry</td>
<td>27(0.2)</td>
<td>23(0.2)</td>
<td>7(-)</td>
<td>5(-)</td>
</tr>
<tr>
<td>Tobacco</td>
<td>124(1.2)</td>
<td>70(0.6)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total cropped area</td>
<td>10635</td>
<td>12225</td>
<td>13421</td>
<td>14050</td>
</tr>
</tbody>
</table>

Source: Statistical Abstract of Punjab and Haryana, for Various Years.

Note:

I. Figures of total cropped area is not tally to the total area under all crops because some crops which have negligible area, is not taken in this table.

II. Figures in brackets are the percentage share of different crops to total cropped area of the region.

III. (-) Negligible.
There are a variety of crops grown in the Punjab and Haryana plain. These crops are rice, jowar, bajra, maize, wheat, barley, pulses, oilseeds, cotton, sugarcane etc. These crops are grown in Kharif (June-July to September-October) and Rabi (October-November to April-May) seasons mainly. The major kharif crops are rice, cotton, sugarcane, bajra, jowar and maize and the Rabi crops are wheat, gram, oilseeds and barley.

Agriculture of this region is based on two cereal crops namely wheat and rice. Wheat is a traditional crop of Punjab and Haryana while rice is the outcome of Green Revolution. Area under cultivation in the case of both the crops is on the increase at the cost of other crops. Total cropped area in the region under all crops during 2000-01 was 14050 thousand hectares of which 10621 thousand hectares (75.6 per cent) was under foodgrains. During the same period area under cereals was 10409 thousand hectares which was 74 per cent to total cropped area. Therefore share of area under pulses was negligible during this period, which was only 1.5 per cent to total cropped area of the region.

The most important among all the crops is wheat which accounts for 41 per cent of the total cropped area during 2000-01. The area under wheat increased from 3428 thousand hectares in 1970-71 to 5763 thousand hectares in 2000-01. Wheat is an important crop in Ludhiana,
Jalandhar, Amritsar, Kapurthala, Firozpur, Bhatinda, Patiala and Sangrur districts in Punjab and Hisar, Sirsa, Jind, Kaithal, Karnal, Rohtak, Faridabad and Gurgaon in Haryana. Area under rice cultivation has also increased rapidly. In 1970-71 total area under rice cultivation was 659 thousand hectares, which was only 6.2 per cent of the total cropped area of the region. This has grown to about 3666 thousand hectares (26 per cent) in 2000-01. In other words area under rice cultivation has recorded a six-fold increase over a period of thirty years. Rice is an important crop in Hoshiarpur, Gurdaspur, Jalandhar, Amritsar, Roop Nagar, Ludhiana and Kapurthala in Punjab and Karnal, Kurukshetra, Kaithal, Panipat and Ambala in Haryana.

Among non-foodgrains, cotton is the outstanding one and covers 1028 thousand hectares in 2000-01. Seventy to eighty per cent of the total acreage under this crop is in the districts of Hisar, Sirsa, Jind, Bhiwani in Haryana and Firozpur, Bhatinda, Ludhiana, Amritsar and Sangrur in Punjab. Bajra is completely localized in the south-western parts of the region and 80 per cent of the area under this crop is in the districts of Bhatinda, Sangrur, Firozpur, Hisar, Sirsa, Bhiwani and Mahendargarh. Sugarcane covers 264 thousand hectares of the cropped area and is mainly grown in the eastern half of the region. Oilseeds covers 500
thousand hectares area of the total cropped area. Among oil seeds, the dominance is that of rapeseed, mustard and sesamum. Oilseeds are grown in the drier south-western parts of Punjab and Haryana plain.

An analysis of the area under different crops grown shows that foodgrains (mainly cereals) crops have a complete monopoly in the cropping pattern.

**Change in Cropping Pattern:** A suitable and rational change in cropping pattern, specially in favour of high-yielding crops, brings about an increase in agricultural output. Cropping pattern in Punjab and Haryana region has also undergone a change in this direction. There are a number of factors which are responsible for this change. Both physical and economic factors as well as some government policies are collectively responsible to bring this change in cropping pattern. Although cropping pattern has been changing but it has remained favourable to some major crops such as wheat, rice, cotton etc.

The total cropped area during 1970-71 was 10635 thousand hectares which increased to 14050 thousand hectares in 2000-01. During this thirty years period the total cropped area has increased by 32 per cent. During the same period area under foodgrains increased from 73.3 per cent in 1970-71 to 75.6 per cent in 2000-01. Area under cereals
increased from 58.5 per cent in 1970-71 to 74 per cent in 2000-01. During the same time, area under pulses declined from 14.8 per cent in 1970-71 to 6.6 per cent in 1990-91 and reached on all time low level of 1.5 per cent in 2000-01.

Within the cereals, the superior cereals, viz. rice and wheat have shown the maximum increase both in terms of proportion share as well as absolute area. For these two cereals HYV seed was introduced in 1966-67. Jowar, bajra, maize and barley showed a decline over the entire period under review. In 1967-68, area in Punjab under total cereals, pulses, foodgrains and oilseeds was 2945, 597, 3542 and 399 thousand hectares whereas in 1990-91 the state had 5522, 143, 5665 and 104 thousand hectares area under these respective crops. During the same period area under rice and wheat has increased tremendously. In 1990-91 the increase in area under rice and wheat was 6.4 and 1.8 times respectively as compared to 1967-68 (Singh and Singh, 1994: 588).

In the case of non-foodgrains, sugarcane, chillies and tobacco have registered a decline in absolute as well as proportionate area, whereas cotton and potatoes have shown an increase. In case of oilseeds, there has been decline in proportion but increase in absolute area. The overall position in non-foodgrains shows a decline in its proportionate area but increased in its absolute area.
From 1966-67 onwards, there has been change in cropping patterns with a major thrust of food crops, mainly rice and wheat, for commercial purpose. Wheat commands the largest area with a marked concentration in the central plain, rice is gaining in area as a commercial crop in the irrigated areas of plain land. Jowar and bajra are mainly grown in the dry land of south-western parts of the region. Maize is a rainfed crop and is grown mainly in the hilly region of the north, central and southern parts with the help of irrigation. Cotton leads in the south-western dry land area. It is gaining in area as irrigated crop to the central plain land. Next to cotton, sugarcane is a cash crop and grown mainly in northern and eastern Yamuna belt. Pulses, potatoes and oilseeds enter into crop association in almost all the cultivated areas.

2.5.3 General Land-Use

Land use is the surface utilization of all developed and vacant land, at a given time and space (Mandal, 1990). The primary uses of land are for agriculture, forest, pasture, transportation, mining, residential, gardening, industrial, recreational, commercial, and uncultivated waste, barren and follow land etc. Use of land is not a static phenomenon. It changes to meet the variable demands of the land by the society. Now uses of land are inspired by technological change or by a change in the size, composition and requirement of a community.
Information on land use for any region is conventionally given under nine different categories. They are:

I. Reporting area,
II. Land under forest,
III. Land not available for cultivation,
IV. Other uncultivated land excluding fallow,
V. Fallow land,
VI. Net sown area,
VII. Gross cropped area,
VIII. Area under food grains,
IX. Area under non-food grains.

Table 2.2
General Land-use in Punjab and Haryana
(In thousand hectares)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Reporting area</td>
<td>9433</td>
<td>9438</td>
<td>9411</td>
<td>9435</td>
</tr>
<tr>
<td>II</td>
<td>Land under forests</td>
<td>222(2.4)</td>
<td>348(3.7)</td>
<td>391(4.2)</td>
<td>394(4.2)</td>
</tr>
<tr>
<td>III</td>
<td>Land not available for cultivation</td>
<td>1114(11.8)</td>
<td>966(10.2)</td>
<td>843(9.0)</td>
<td>903(9.6)</td>
</tr>
<tr>
<td>IV</td>
<td>Other uncultivated land excluding fallow</td>
<td>190(2.0)</td>
<td>109(1.2)</td>
<td>105(1.1)</td>
<td>82(0.9)</td>
</tr>
<tr>
<td>V</td>
<td>Fallow Land</td>
<td>289(3.0)</td>
<td>222(2.4)</td>
<td>279(3.0)</td>
<td>266(2.8)</td>
</tr>
<tr>
<td>VI</td>
<td>Net sown area</td>
<td>7618(80.8)</td>
<td>7793(82.6)</td>
<td>7793(82.8)</td>
<td>7790(82.6)</td>
</tr>
<tr>
<td>VII</td>
<td>Gross cropped area</td>
<td>10635</td>
<td>12225</td>
<td>13421</td>
<td>14050</td>
</tr>
<tr>
<td>VIII</td>
<td>Area under foodgrains</td>
<td>7997(75.2)</td>
<td>8994(73.6)</td>
<td>9957(74.2)</td>
<td>10907(77.6)</td>
</tr>
<tr>
<td>IX</td>
<td>Area under non-foodgrains</td>
<td>2055(19.3)</td>
<td>2495(20.4)</td>
<td>2766(20.6)</td>
<td>2496(17.8)</td>
</tr>
</tbody>
</table>

Note: Figures in brackets from rows no. 2 to 6 are percentage to Reporting area and in rows No. 8 and 9 are percentage to gross cropped area.
Source: Statistical Abstract of Punjab and Haryana for various years.
The total reporting area according to village papers of Punjab and Haryana states was reported to be 9435 thousand hectares in 2000-01. The distribution of area under different land use categories in the region is presented in Table No. 2.2. The table shows that an exceptionally higher proportion of the total reporting area in the region has already been brought under cultivation. This will perhaps be one of the highest percentage of geographical area under cultivation in the world. The area classified as land not available for cultivation and other uncultivated land excluding fallow has gradually declined over the period. It was 11.8 per cent and 2 per cent to total reporting area respectively in 1970-71. The corresponding figures for 2000-01 were 9.6 per cent and 0.9 per cent. As against this, the area under forests had been continuously increasing. The increase in area under forests has really been impressive. In 1970-71 land under forests was 222 thousand hectares which increased to 394 thousand hectares in 2000-01 recording a growth of 77 per cent. From 1970-71 to 2000-01 fallow land has also been on the decline. The resultant increase in gross cropped area over the entire period has been of the order of 32 per cent. In 1970-71 area under foodgrains was 75.2 per cent to gross cropped area and in 2000-01 it was 77.6 per cent. In 1970-71 area under non-foodgrains was 2055 thousand hectares, which formed 19.3 per cent
of gross cropped area. In 2000-01 area under non-foodgrains was 2496 thousand hectares. Therefore, during the entire period, area under non-foodgrains has increased by over 21 per cent. But percentage share of area under non-foodgrains to gross cropped area has declined from 19.3 per cent in 1970-71 to 17.8 per cent in 2000-01.

A very high proportion of the reporting area under cultivation in the region can be attributed to the fact that the plain is free from all physical handicaps and the deficiency of rainfall has been made up by growth in irrigation facilities. It is only in the districts of Panchkula in Haryana and Roop Nagar in Punjab that the cultivated area forms less than 60 per cent of the total reporting area. The percentage shares in the two districts were 37 per cent and 59 per cent respectively in 2000-01. It is so because considerable land of these districts are covered by Siwalik Hills and the beds of seasonal streams which cannot be brought under cultivation. Elsewhere in the region, more than three-fourths of the reporting area is already under cultivation. In Mansa, a district in Punjab, this figure is as high as 95 per cent in 2000-01.

Forests account for only 4 per cent of the reporting area. The reason for the small acreage of forests is that Punjab-Haryana region is mostly a fertile and plain land. This land is more beneficial for
cultivation. Further, forest cover is very unevenly distributed over space. More than 47 per cent of the forest area of the region is in three districts viz. Hoshiarpur and Roop Nagar in Punjab and Panchkula in Haryana. Importantly, all these districts are located in the Siwalik region in the north.

Hoshiarpur alone accounts for 27.7 per cent of the total forests land. On the other hand, the districts of Kapurthala, Nawan Shehar, Faridkot, Moga, Fatehgarh Sahib in Punjab and Mahendargarh in Haryana have only 2.5 per cent of the forests land of the region.

Next to net sown area, the category showing the largest percentage is that of 'non-agricultural uses'. As per the latest record over 9 per cent of the total reporting area in the region is under 'not available for cultivation'. This land covers all such land which is under human settlement, industries, roads, railway lines, canals, and other economic activities. The highest percentage of this category of land is in the district of Gurgaon in Haryana, where as much as 17.7 per cent of the total reporting area is under 'non-agricultural uses'. This is followed by Faridabad with a figure of 16.8 per cent. The smallest share of land covered under this category is in the district of Jind in Haryana where it is only 1.4 per cent of the total reporting area.
The land classified as 'other uncultivated excluding fallow' forms a very small portion of the total reporting area in the region. Nevertheless, districts like Karnal, Panipat, Sonipat, Rohtak and Jhajjar report a reasonably higher share of total area under this category. The land classified as 'fallow' is in significant proportion the districts of Hisar, Sirsa, Gurgaon and Panchkula in Haryana. These districts accounts for 59 per cent of the fallow land in the region. Hisar alone has 27.8 per cent of the fallow land in the region.

As noted earlier, currently, over three-fourth of the gross cropped area in the region is devoted to foodgrains. However, there is a marked regional variation in the dominance of food crops in the farming operation in the region. Patiala in Punjab, with 91.7 per cent of gross cropped area ranks first in the region. This district is followed by Kapurthala in Punjab with 91.6 per cent and Kaithal in Haryana with 89 per cent. On the other hand, district Sirsa in Haryana reports only 48.6 per cent of the gross cropped area under foodgrains.

With greater emphasis on the intensive use of land, the pattern of land utilization is rapidly changing and there have been conspicuous changes during the period from 1970-71 to 2000-01.
2.6 GREEN REVOLUTION:

Although seeds of the Green Revolution were sown in early fifties in Mexico, but the term Green Revolution was first used by then Administrator of the U.S. AID, William S. Gand on 8 March, 1968 in Washington D.C. when he addressed the society for International Development on the subject of Green Revolution Accomplishments and Apprehensions (Khullar, 2002: 340).

The Green Revolution model of agrarian transformation was born out of the food shortage of the 1960s when a nation lacking the resources to buy foodgrains abroad had to ask for food aid from the U.S. Around the same time India had an unexpected war with China in 1962, has had two consecutive droughts in 1964-65 and 1965-66 and another war with Pakistan in 1965. The major donor of foodgrains, U.S., was threatening India to withdraw the food aid unless the country accepted the policies suggested by western powers (Alavi quoted in Sidhu, 2002: 3132)).

In India, the seeds of Green Revolution were first field tested in the drought years of 1964-65. India received 100 kg. seeds each of four dwarf and semi dwarf varieties. The seeds were planted in different soils in Delhi, Ludhiana, Pusa and Kanpur. The yield was over 4000 kg. per hectare which was about four times the yield of local varieties.
In 1966, about 16000 tonnes of seeds were imported for cultivating about 4 lakh hectares of land. High Yielding Varieties Programme (HYVP) was introduced in the Kharif season of 1966. The production of foodgrains in 1967-68 was 25 per cent higher than that of 1966-67. This unprecedented increase in production was nothing less than a revolution and it was termed as Green Revolution (Khullar, 2002: 340).

Green Revolution is a process to grow more food by the regular use of mechanized means of farming, improved seeds, chemical fertilizers and pesticides. When these methods of farming were introduced in Punjab-Haryana plain, it took no time to witness Green Revolution within the five years of its completion. Punjab-Haryana plain became not only self-sufficient in foodgrains, but their production increased by five-folds. Green Revolution was so quick in this plain that it even surpassed Mexico. This region achieved a progress within 5 years which Mexico attained in 15 years. Punjab and Haryana states of India are among the few parts of the world where the “Green Revolution” has achieved phenomenal success within a few years of its introduction (Bagi, 1981:15).

2.6.1 Impact of Green Revolution on Agriculture in the Region: Green Revolution in this region was introduced quite earlier than the
other regions of the country. Per hectare yield increased all of a sudden. This region which used to face scarcity of foodgrains became a 'food bowl' of India. The advent of Green Revolution in terms of the introduction of high yielding varieties of seeds in 1966-67 gave a further boost to agricultural production in the region.

The total foodgrains production which was 5830 thousand tonnes in 1960-61, showed a marked increase throughout the period and was 11961 thousand tonnes in 1970-71, showing an increase of about 105 per cent. Production of wheat in the region has increased from 2516 thousand tonnes in 1960-61 to about 7406 thousand tonnes in 1970-71 an increase of over 194 per cent. During the same period, the production of rice in the region has increased from 398 thousand tonnes to about 1137 thousand tonnes - an increase of 186 per cent (Statistical Abstract of Haryana - 1966-67, 2001-02 and Punjab – 2002). With the likely release of short duration varieties in the next two to three years, the area under rice and yield are likely to increase rapidly as it will not only be possible to obtain heavy yields from the crop but also to fit into the multiple cropping pattern. Cotton and sugarcane outputs also showed a significant increase but it was only marginal in the case of oilseeds.
The main reason for the happening of Green Revolution in Punjab-Haryana plain was the increase in irrigational facilities. Earlier agriculture of this plain depended on manpower, but after mid-sixties, it started using machines on a large scale. This initial step taken towards machines kept moving onwards. Today agriculture of this region is totally mechanized. Right from cultivation to harvesting and thrashing all the works are done by machines.

The main aim of Green Revolution was to supplement wheat production. So wheat producing areas with irrigational facilities were selected to acquire the object, while other areas ignored. Same was the case with other crops like rice, cotton, sugarcane, maize etc. The use of different yardstick in different areas caused intra-regional inequalities. It proved fatal to the peaceful atmosphere of the region.

Only the rich and big landlords benefited from Green Revolution. Small and medium farmers could not gain anything. It resulted in growing inequalities among the farming communities in the region.

With the advent of Green Revolution, the condition of the small farmers and tenants deteriorated. Due to high yield the landlords started demanding higher rent and it affected the economic condition of tenants tilling their lands.
The disparity between the rich and the poor farmers bred social 
tensions. The small farmers and big landlords started bickering at 
different places in the region.

Green Revolution has made the region wheat-rice oriented. Pulses 
(mainly gram) are no longer grown in this plain now. Same is the case 
with oilseeds.

Green Revolution, doubtlessly has introduced shift in the cropping 
pattern. But the damages because of this shift to rice cultivation will have 
to be controlled in the coming years. If we do not put a check on this shift 
then in the coming 20-30 years more than half of the area of the region 
would be badly affected by ecological problems.

It can thus be concluded that Green Revolution has bred social 
tensions and undesired shift in cropping pattern, yet it has made Punjab 
and Haryana plain march on the path of prosperity.

2.7 MODERN INPUTS IN AGRICULTURE

2.7.1 Irrigation:

Punjab-Haryana plain was never so much prosperous region. Its 
prosperity is owing to the availability of irrigational facilities. Now this 
region is a proud possessor of irrigated area more than that of other 
regions or states of the country. Agriculture of this region is no longer a
PUNJAB-HARYANA PLAIN CANALS

Map - 2.7
gambles to the monsoons. Irrigation has a vital role to play in the agricultural development in Punjab and Haryana states. In Haryana, the net irrigated area recorded an appreciable increase from 1.29 mha in 1966-67 to 2.72 mha in 1994-95. This accounts for more than 75 per cent of the net area sown in the state (Hassan, 2000: 55). With increase in the irrigation facilities in Punjab during 1967-68 to 1990-91, total irrigated area increased from 2289 to 3910 thousand hectares (Singh and Singh, 1994: 589).

Table 2.3
Net Irrigated Area in Punjab and Haryana
(In thousand Hectares)

<table>
<thead>
<tr>
<th>Year</th>
<th>Canals</th>
<th>Tubewells and wells</th>
<th>Other Sources</th>
<th>Total</th>
<th>Percentage to net area sown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>2244</td>
<td>2165</td>
<td>11</td>
<td>4420</td>
<td>57</td>
</tr>
<tr>
<td>1980-81</td>
<td>2591</td>
<td>2906</td>
<td>19</td>
<td>5516</td>
<td>70</td>
</tr>
<tr>
<td>1990-91</td>
<td>3006</td>
<td>3481</td>
<td>22</td>
<td>6509</td>
<td>83</td>
</tr>
<tr>
<td>2000-01</td>
<td>2478</td>
<td>4484</td>
<td>17</td>
<td>6979</td>
<td>89</td>
</tr>
</tbody>
</table>

Source: i) Statistical Abstract of Punjab, 2002
ii) Statistical Abstract of Haryana, 2001-02

Table No. 2.3 shows that net area irrigated has been continuously increasing. It increased from 4420 thousand hectares in 1970-71 to 6979 thousand hectares in 2000-01 an increase of about 58 per cent. During
this period percentage of net area under irrigation to net area sown increased from 57 per cent to 89 per cent.

Major sources of irrigation are canal, wells and tubewells. Other sources like tanks etc. have very little contribution. The area irrigated by canals has increased from 2244 thousand hectares in 1970-71 to 3006 thousand hectares in 1990-91. There was an increase of about 34 per cent in the area irrigated by canals during this period. The 1990s have shown a decline to 2478 thousand hectares. Thus there was an decrease of about 18 per cent in area irrigated by canals during the last decade, because of an increase in area irrigated by tubewells. The area irrigated by tubewells and wells continuously increased from 2165 thousand hectares in 1970-71 to 4484 thousand hectares in 2000-01 i.e. an increase of about 107 per cent. Thus, tubewells have played a major role in development of irrigation facilities in the region. At the inception stage of Haryana in 1966, there were hardly 28000 private tubewells. The area irrigated from tubewells was 3 lakh hectares. By 1991-92, the number of tubewells and the area irrigated from tubewells increased to 5.10 lakh and 13.4 lakh hectares respectively. (Tanwar quoted in Dutta and Jong, 1997: 216). In Punjab, out of the total net irrigated area of 3.9 million hectares about 60 per cent (2.38 million hectare) is irrigated by tubewells (Sidhu and

In 1970-71, about 51 per cent area was irrigated by canals to total irrigated area of the region but in 2000-01 it was about 36 per cent. During the same time period, area irrigated by tubewells and wells increased by about 49 per cent to about 64 per cent. Because tubewells have a convenient mode of irrigation in Punjab and Haryana plains from structure of the soils and underground water level point of view. There is a network of tubewells in the region. Irrigation done with the help of tubewells bears better results than the canals, because whenever desired, tubewells are operated by the farmers themselves and they do not have to depend on the administration of the canal irrigation department. In 1970-71, the number of tubewells in the region was only 2.96 lakh which grew to about 15.24 lakh in 2000-01 (Statistical Abstract of Punjab-2002 and Haryana – 2001-02). But the distribution of tubewells is not the uniform everywhere in the region.

Canal irrigation is found in almost all the districts of Punjab and Haryana states but there is a network of canals in the central and north-
east districts namely Amritsar, Faridkot, Mansa and Bhatinda in Punjab and Kaithal, Sonipat, Rohtak, Hisar, Sirsa and Fatehabad in Haryana.

Following are some of the important canals of this region. The Western Yamuna Canal, Bhakra Canal, Jui Canal, Gurgaon Canal, Upper Bari Doab Canal, Sirhind canal and Bist Doab Canal. Bikaner and Beas are the other Canals which provide irrigation to parts of Punjab and Haryana.

District Kapurthala, Ludhiana and Fatehgarh Sahib in Punjab and Sonipat in Haryana have hundred per cent net area sown under irrigation. As against this district Gurgaon in Haryana have lowest area (only 42.6 per cent) under irrigation followed by Panchkula with 45.5 per cent.

2.7.2 Fertilizers Consumption:

Modern agriculture is based on chemical fertilizers. Use of chemical fertilizers have increased in the agriculture of Punjab and Haryana states. Today, Punjab is a leading state in consumption of fertilizers in India, followed by Haryana. It has been estimated that about 70 per cent of growth in agricultural production can be attributed to increased fertilizer application. Thus increase in the consumption of fertilizers is a barometer of agricultural prosperity.
Table 2.4

Fertilizer Consumption in Punjab and Haryana
(In Thousand Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Nitrogenous</th>
<th>Phosphatic</th>
<th>Potassic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>236</td>
<td>38</td>
<td>9</td>
<td>283</td>
</tr>
<tr>
<td>1980-81</td>
<td>714</td>
<td>238</td>
<td>41</td>
<td>993</td>
</tr>
<tr>
<td>1990-91</td>
<td>1320</td>
<td>466</td>
<td>20</td>
<td>1806</td>
</tr>
<tr>
<td>2000-01</td>
<td>1722</td>
<td>488</td>
<td>34</td>
<td>2244</td>
</tr>
</tbody>
</table>

Source: As in Table 2.3.

Before Green Revolution, fertilizers consumption was insignificant, touching about some thousand tonnes only. Figures for the total fertilizers consumption in terms of different nutrients from 1970-71 onwards are given in Table 2.4. As per the policy of the states and centre governments, the improved seeds were put to use in 1966-67 which resulted in high yield combined with the use of chemical fertilizers. About 283 thousands tonnes of fertilizers was used in 1970-71. In 1990-91 it increased to about 1806 thousand tonnes and in 2001-01 it was about 2244 thousand tonnes. Thus during a period of 30 years, i.e. from 1970-71 to 2000-01, fertilizer consumption has increased by almost 7 times, showing an average annual increase of about 23 per cent. Fertilizer
consumption in Haryana has increased by 47 times from 13.35 thousand tonnes (2.90 kgs per cropped hectare) in 1966-67 to 637.16 thousand tonnes (104.40 kgs per cropped hectare) in 1991-92 (Ram and Nandal, 1994: 29).

The regional variations came in sharp focus when we look at the per hectare consumption of fertilizers. In Punjab and Haryana region about 238 kilograms fertilizers per hectare are used as compared to an average of 73 kilograms per hectare in the entire country. Majority of the states have consumed much below this average. But it is very high in north-western states like Punjab and Haryana as discussed above.

2.7.3 Use of Pesticides:

Improved seeds yielding high produce are prone to insects and weeds. In order to check their growth pesticides are put to use. Therefore pesticides are used to save the crops and to avoid losses. According to annual report of ministry of Agriculture, over 30 million hectares of cropped area in India was affected by various pests and diseases in 1983-84, taking an annual toll of 5 to 25 per cent of the agricultural production. So pest surveillance should be an integral part of crop production.
Table 2.5
Consumption of Pesticides in Haryana

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity in Thousand Tonnes</th>
<th>Area covered in Thousand Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>41</td>
<td>3206</td>
</tr>
<tr>
<td>1980-81</td>
<td>215</td>
<td>5058</td>
</tr>
<tr>
<td>1990-91</td>
<td>516</td>
<td>6420</td>
</tr>
<tr>
<td>2000-01</td>
<td>502</td>
<td>8798</td>
</tr>
</tbody>
</table>

Source: Statistical Abstract of Haryana, 2001-02
Note: Figures of pesticides consumption in Punjab is not available

The quantity and area under pesticides has been increasing year by year. In Haryana consumption of pesticides increased from 41 thousand tonnes in 1970-71 to 502 thousand tonnes in 2000-01. Likewise the area covered by pesticides has also been increasing very significantly. The cropped area under pesticides protection increased from 3206 thousand hectares in 1970-71 to 8798 thousand hectares in 2000-01. During this period, area under pesticides protection has increased about 174 per cent, showing an average annual increase of about 6 per cent.

The use of pesticides has saved lot of crops, mainly the food crops from various diseases. But indiscriminate use of pesticides has resulted in widespread environmental pollution. According to a study, 99 per cent of total applied pesticides goes into various environmental systems, and only one per cent is effective in controlling pests (Sekhon and Kour, 1996:716).
2.7.4 High Yielding Varieties (HYV) of Seeds:

The era of Green Revolution in Punjab and Haryana plain ushered in with the introduction of high yielding varieties of seeds of some major crops. The earlier developments in irrigation and use of fertilizers provided the necessary base (Gosal and Krishna, 1984). Cropwise details of area under high yielding variety are shown in Table 2.6.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rice</th>
<th>Maize</th>
<th>Bajra</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>22.2</td>
<td>10.5</td>
<td>44.0</td>
<td>62.4</td>
</tr>
<tr>
<td>1980-81</td>
<td>89.0</td>
<td>36.2</td>
<td>43.8</td>
<td>95.0</td>
</tr>
<tr>
<td>1990-91</td>
<td>83.4</td>
<td>65.5</td>
<td>79.5</td>
<td>99.4</td>
</tr>
<tr>
<td>2000-01</td>
<td>79.1</td>
<td>72.9</td>
<td>84.0</td>
<td>98.7</td>
</tr>
</tbody>
</table>

Source: As in Table No. 2.3

Only the area under H.Y.V. seed is reported separately for the four foodgrains crops for which these seeds have been adopted. The area under H.Y.V. seed had been continuously increasing. The biggest achievement has been in the case of wheat where more than 95 per cent of the total area under wheat was reported to be under H.Y.V. seed in 1980-81, 1990-91 and 2000-01. In case of rice, 22.2 per cent area was under H.Y.V. seeds in 1970-71, in 1980-81 it increased to 89 per cent. Corresponding proportions of the area under H.Y.V. seeds to total crop
area were about 73 per cent and 84 per cent respectively for maize and Bajra in 2000-01.

2.7.5 Farm Mechanization:

Much success in agriculture depends upon farm mechanization. Mechanization saves a lot of human labour and quickens the farm operations, thereby adding to the productivity and efficiency. Mechanization has also led to the proper utilization of inputs, like fertilizers, pesticides, H.Y.V. seeds and irrigated water.

After mid-sixties, agriculture in Punjab and Haryana which earlier depended on man power started banking upon machines. All the farmers of this region know the value of farm mechanization. Man power is used only for the plantation and picking of cotton flowers etc. The poor farmers who can not afford to buy these costly machines use man power in agriculture mainly in harvesting.

The adoption of mechanical technology has increased in these two states at a rate higher than that in the rest of the country. In 1997 about 4.5 lakh ploughs, 7 lakh tube wells and 19 thousand combine harvester were used for farming in Haryana. During 2001-02, there were about 2.2 lakh tractors in Haryana, which were only 4.8 thousand in 1966-67.
The Punjab state has made huge investments in mechanization of agriculture. The state has 4.34 lakh tractors, 1.45 lakh seed drills, 3.25 lakh threshers, 7300 combine harvesters and more than 9 lakh tube wells. The total investment in farm machinery is at least worth Rs 8000 crores. This state has about 25 per cent tractors of the country. Each tractor is being used for about 400 hours whereas to be economical it must be used for at least 1000 hours (Singh and Kalar quoted in Sidhu, 2002: 3134).

The state has highest number of tractors (28 per-thousand acres of land) in the country. In fact every third farming house hold in the state have a tractor, and a third of the tractors in India are owned by farmers of Punjab. In a village of district Bhatinda there were 110 tractors for 960 hectares of land (Sharma and GOP quoted in Singh, 2000: 1989).