CHAPTER 6

ECOLOGICAL CONSEQUENCES
6.1 INTRODUCTION

Land and water are two basis natural resources, which have a direct impact on agriculture production. Land resource is non-renewable and is subjected to erosion and degradation through various means. Similarly water resources are limited and highly variable. During the last three decades these resources have been over exploited in the wake growing demand of foodgrains. Over exploitation of these resources has led to deterioration of soil health, created nutritional imbalance and disturbed the natural hydrology, particularly in intensively irrigated areas.

Punjab-Haryana plain has been in forefront where green revolution has been a great success. But now, agriculture of this plain is facing great problems of water depletion, water logging and soil salinity / alkalinity. The agricultural production in this plain would have been much more than what it is now. Moreover, irrigation has caused adverse impact on productivity of crops over a long period of time. Land use changes also have had their own effects on ecological balance.

Rice has maximum water requirement as compared to other crops. Rice cultivation has thus, led to an imbalance in underground water situation in Punjab-Haryana plain. It is true that rice, having expanded much more beyond the limits of sustainability, has created many issues of
environmental and ecological concern (Singh and Kalra, 2002: 3146). The underground water of northern and central parts of the plain is, on an average, of good quality for irrigation and its excess exploitation has resulted in receding of water table from year to year. The available ground water is being over-exploited in the Punjab. If such a situation is allowed to continue, it may lead to hydrological drought like situation in the near future, which is not desirable for the socio-economic development of the state. The existing evidences show that water table in the state is receding annually on an average by one to one-and-half feet in most of the intensively cultivated 'development blocks' (Sharma, 1994: 19).

Contrary to it, the water table in the southeastern and southwestern parts of the plain has risen gradually because of its poor quality and non-judicious use for irrigation. Underground water in these parts is brackish and therefore, is not used for irrigation. Farmers depend mainly on canal irrigation. Excess irrigation and seepage of water have resulted in a gradual rise in the water table. In some areas, the water table has reached the critical level because of which land is going out of cultivation due to water logging. Spread of rice cultivation in this non-traditional region became possible due to massive strides made in the irrigation sector. Canal and tube-well irrigation is not only a blessing where it has helped
to increase productivity levels, but it has also created problems of rise of water table leading to water logging in some areas and water depletion in other areas.

Salinity is also a serious problem in the irrigated lands. There exists a marked correspondence between the incidence of salinity and extent of irrigation. Of the 230 million hectares of irrigated land in the world, 45 million hectares (19.5 per cent) is salt affected soils to varying degrees by human-induced processes (Oldeman et al. quoted in Sengupta, 2002: 1247). In contrast, of almost 1.500 million hectares of dry land (non-irrigated) agriculture, only 32 million (2.1 per cent) is salt affected.

It is undesirable to over-exploit the ground water resources. Over exploitation of non-renewable resources of a country has caused several maladies and degradation of resources. In Punjab, over 80 per cent area is irrigated out of which tubewells contribute about 60 per cent (Sekhon and Kaur, 1996: 713). The intensive cultivation of rice-wheat system for the last couple of decades has generated the problem of lowering of water table in areas where ground water is of good quality because rice has very high water requirement. Since tubewell is the main source of irrigation in these areas, widespread cultivation of water intensive crops e.g. rice has resulted in excessive use of underground water. Thus, it has depleted the
water table continuously to a level from where pumping out of water has become very difficult.

Over-dependence on ground water and simultaneously neglecting its recharging mechanism has led to fall in the water table on an average by 20 cm per year in as many as 216 districts of the country and overall there is decline in water table by as much as 4 metres over the past two decades. Out of 7063 blocks/ mandals/ talukas/ watersheds 249 fall under over-exploited category (C.G.W.B., 2000). The maximum number of over-exploited blocks is concentrated in 62 in Punjab and 45 in Haryana after Tamil Nadu.

The net draft of ground water is increasing with time but the exploitation of ground water is becoming very high and more than annual recharge. In the north, north-east and central districts namely Amritsar, Ludhiana, Jalandhar, Kapurthala, Sangrur, Ambala, Kurukshehra, Kaithal, Karnal and Panipat where tubewell is the main source of irrigation for rice cultivation, underground water has gone down very rapidly.

In Punjab-Haryana plain rice cultivation is not favourable from the point of view of underground water, mainly in north, north-east and central parts where groundwater is fresh and easily available for irrigation by tubewells.
Rice cultivation requires irrigation at each and every step. It is badly affecting the level of underground water. It is estimated that if rice cultivation goes on at the present rate by tubewells irrigation in the coming 35 to 40 years groundwater in the region will dry up completely, rendering this region of the plain as a semi-desert.

Concerned with the adverse consequences of rice cultivation, Haryana Agriculture University, Hisar and Punjab Agriculture University Ludhiana are suggesting the farmers to replace rice cultivation with other crops, which are less water demanding. Punjab Agriculture University, Ludhiana has recently suggested that at least 20 per cent area under paddy must be diverted to other crops if the deterioration in the underground water balance of the state is to be checked and if the state’s land is to be prevented from becoming barren (Singh and Kalra quoted in Sidhu, 2002: 3135). Punjab and Haryana governments too have laid emphasis on the cultivation of crops other than rice. Keeping in mind the future of underground water table in this region, some researchers including Randhawa (1989) have sounded a warning to the extent that Punjab would become desert again if present level of exploitation of groundwater in semi-arid area is not stopped (Sekhon and Kaur, 1996: 714).

Deserts come into existence not only through natural processes but
also by human action. In recent times land degradation by human action creating desert like barrenness, has become an alarming phenomenon (Sen Gupta, 2002: 1247).

In the south and southwestern parts of the plain canal irrigation is one such case, which is viewed as a major cause of water logging and salinity. The critical issues India faces in the irrigation sector are the poor management of irrigation water. This has created many dire consequences, which call for urgent attention. Poor maintenance of most of the surface irrigation and drainage infrastructure has seriously reduced the irrigation efficiency and has also led to excessive irrigation in head reaches (Sekhon et al. 2003: 456). In the absence of proper drainage outlet coupled with poor water management, excessive irrigation results in the rise of groundwater table leading to water-logging and salinity (Hassan and Inderjeet, 2000: 51). In Haryana, according to a rough estimate about 4.5 lakh hectares of area are saline/alkaline mainly due to the lack of a proper management of irrigation water (Chamola et al., 1988: 23). In part quality of underground water is very poor and unfit for irrigation, therefore canal are the main source of irrigation. The irrigation water seeps into sub soil and water table has been rising from year to year. In Haryana about 70 per cent of the geographical area is facing the problem
of rising water table due to dominance of canal irrigation, lack of adequate drainage, low extraction of groundwater, etc. (Sharma et al., 1997: 357).

Unusual heavy rainfall, which fall over large area after short intervals has further aggravated the water-logging problem. In this inland basin water table has been rising since 1941 at the rate ranging from 8 cm. to 31 cm. every year in the canal irrigated areas and elsewhere, where a large number of streams enter the plain (Singh, 1979: 473). In the belt running along the Siwalik Hills Range, problems of water-logging and salinity are rising. Salinity can also occur independent of water-logging in part accentuated by over use of chemical fertilizers and pesticides. The high temperature particularly in summer has hastened the process of bringing salts to the subsurface soils and resulted in soil salinity. The worst affected districts of the plain are Rohtak, Jhajjar, Bhiwani, Hisar, Fatehabad, and Jind in Haryana, and Mansa, Bhatinda, Muktsar and Firozpur in Punjab, lying mostly in the inland basin. In these districts more than 70 per cent area have poor quality of underground water, which is not fit for irrigation. It has been reported that 10.3 per cent of the total geographical area of Haryana (4.4 million hectare) is salt affected (Bhandari et al., 1995:4).
In Punjab and Haryana states, irrigation facilities have been extended from 57 per cent of net cropped area in 1970-71 to 89 per cent in 2000-01 (Statistical Abstracts of Punjab and Haryana, 2002). But not much attention has been paid to a proper water management. Many canals are old and still unlined. As nearly one-third of the water which flows in the unlined canals seeps into the sub soil, in Haryana water table has shown a rising trend in sizeable canal command areas in the districts of Sirsa, Hisar, Bhiwani, Rohtak, Jind and Kaithal. In some of these areas, water table has come within the critical limits (<2m) where significant amount of groundwater may keep on entering into the root zone due to capillary action (Sangwan et al., 1995: 7).

In this region, the natural drainage outlets have been blocked over time because of the construction of roads, buildings etc. This has resulted in gradual increase of water table through water-logging and seepage. During 1974-1993 water table has risen (0.021 m to 0.317 m annually) in arid and semi-arid tract of Haryana. It has been reported that the water table has almost reached the land surface in about 4000 sq. km. If counter measures are not taken to arrest the present rise in water table, an additional 15-20 thousand sq. km. area will be affected by water-logging and soil salinization during the next 25 years (Singh and Agarwal, 1995: 5).
In the present chapter, an account of the problems of water depletion, water logging, soil salinity and alkalinity is being presented. But before that let us look into the underground water flow and its quality, which have some significant bearing on the problem of land degradation through water depletion, water logging and salinity.

6.2 FLOW OF UNDERGROUND WATER

The water table contour map of Punjab-Haryana plain shows that water table contours follow the surface topography. In the north-western region of the plain lying mainly in Punjab, the altitude of water table varies from 173 m amsl in the southern most part of Firozpur district to 483 m amsl in the north-east along the Himalayas (C.G.W.B., 2002). The master slope of this region is towards south-west with local variations due to rivers and dense canal network. Most of the rivers of this region are effluent and the canals are influent. The hydraulic gradients are steep in the foothill zones of Hoshiarpur and Roop Nagar districts. In most part of the Punjab region, the gradients are gentle, indicating a low topography relief and high hydraulic conductivity (Map No. 6.1).

In the south-eastern parts of the plain the altitude of the water table varies between 165 m amsl in the extreme southern part of Gurgaon and Faridabad and 174 m amsl in western of Sirsa district to 536 m amsl
Map 6.1

Source: A note on water level behaviour of Haryana and Punjab during May 2002, Central Ground Water Board North-West Region, Chandigarh
in the northern of Panchkula district. The flow of the underground water in the northern part of Haryana region is towards north-west, in the south-western part groundwater flow is towards north, in the western part it is towards north-west, and in the eastern and south-eastern parts of the plain the flow of groundwater is towards Yamuna river or parallel to it. A groundwater mound is seen in the north-east of Gurgaon district of Haryana. There is a groundwater trough in the Central part around Rohtak district.

In the Haryana region the groundwater table contours are highly modified due to the dense network of canals as also the large and random rate of groundwater extraction. Hence the groundwater table does not follow a smooth and well defined pattern. The hydraulic gradients are steep in the north-eastern part of Haryana underlain by the Kandi formations, in the south-western part covered by hard rock areas of Mahendargarh district, and in the hilly tract of Delhi ridge around Gurgaon district. This indicates a steep topography and low hydraulic conductivity of the underlying geological formations.

The hydraulic gradient becomes gentle in the entire central part of the Haryana region from east to west as also in the north-western part, covering a major portion of the Haryana region. This indicates a high
hydraulic conductivity and low topography relief.

6.3 QUALITY OF UNDERGROUND WATER

The Isocon map of Punjab-Haryana plain shows that there is a wide variation in specific conductance of groundwater in the plain. The quality of groundwater in the plain is fresh in almost 65 per cent of the plain (C.G.W.B, 1993). The occurrence of fresh water can be seen along the rivers, central part and in patches in south-western part of the plain. The major districts having fresh water area are Gurdaspur, Amritsar, Hoshiarpur, Kapurthala, Jalandhar, Ludhiana, Roop Nagar, Firozpur, Patiala of Punjab and Ambala, Panchkula, Yamuna Nagar, Kaithal, Kurukshetra, Karnal, Panipat and some part of Sonipat districts of Haryana (Map No. 6.2).

Sub-marginal and marginal ground water occurs in patches in all over the plain more so in the south-western part of the plain (about 25 per cent) falling in the districts of Ferozpur, Faridkot, Bhatinda, Muktsar, Mansa, Hisar, Bhiwani, Jind, Sonipat, Rohtak, Rewari, Gurgaon, Faridabad etc.

Saline groundwater patches cover about 10 per cent area of the plain and are found in districts of Kaithal, Rohtak, Jhajjar, Faridabad, Gurgaon, Fatehabad and Hisar.
6.4 PROBLEMS OF WATER DEPLETION AND WATER LOGGING

Punjab and Haryana have emerged as the main rice cultivating states of India. In these states rice cultivation is totally dependent on artificial irrigation facilities, because of insufficient rain and semi-arid conditions of the plain. Therefore, in these states rice cultivation is dependent on tubewell and canal irrigation.

In the north-eastern parts and in some patches in its central part, underground water is fresh and fit for irrigation. Therefore, in this part of the plain tubewell irrigation is the main source of irrigation of rice fields. From the very beginning, rice cultivation in this region has traditionally been dependent on groundwater for irrigation. Therefore, over the last four decades an excess use of underground water has led to water depletion in the north-eastern and patches in central part of the plain. In Punjab out of 138 blocks, 84 blocks have been declared 'black hall' which means, a stage of complete depletion of groundwater. Other 16 blocks have been declared as 'gray hall' which means, water table is at alarming stage. Thus, only 38 blocks in the state are found to be in a safe position with regard to underground water (Dainik Jagran, June 22, 2003:2).
In Haryana, availability of fresh water is very limited. It is only in the northern and eastern margins of the state that one comes across fresh underground water. These areas heavily depend on tubewell irrigation. Here 20 feet-deep open wells had dried up two decades ago and shallow tube-wells (70-150 feet deep) are also now drying up due to the continuous decline in the water table. Tubewells are not able to draw adequate groundwater due to the decline in water table (The Tribune, July 7, 2003: 14).

As against this, in the south-eastern and south-western part of the plain groundwater is saline and unfit for irrigation. Therefore, canals are the main source of irrigation. Water from irrigated land seeps into the subsoil leading to a continuous rise in water table during the recent past. So, problem of water-logging has gradually assumed a serious proportion in the region.

In extreme south-western parts of the plain, along the border with Rajasthan, also water table has been declining rapidly due to excessive extraction and inadequate recharge. Both surface and underground water flow away from this area. Extremely hot and arid climate coupled with the presence of sandy soil make the agricultural practices even more
difficult. Remarkably, ground water is available only in small patches in these areas.

From the above discussion it can be said that Punjab-Haryana plain is caught in a peculiar situation with regard to the utilisation of ground water resources. The problem of ground water depletion exists side by side with the problem of rising water table leading to water logging. A greater part of Punjab has been witnessing decline in water table due to over-exploitation of ground water. In the south-western parts of the state, however, water table is rising leading to the problem of water logging and salinity. Ground water in this part is very poor in quality and is unfit for irrigation. Farmers, thus, heavily depend on canal irrigation. In 1970-71 about 0.7 million hectares of area was estimated to be salt affected. The problem of water logging has already assumed serious proportion in districts like Faridkot, Firozpur and Bhatinda. The rise in the water table has been found to be more than 7 meters during 1973-83, and more than 4 metres during 1983-93 alone (Sidhu and Dhillon, 1997: 511).

According to the data for the last 26 years pertaining to underground water situations in north-eastern parts of Haryana, water table has declined by 1.36 metres in Sonipat, 5.02 metres in Panipat, 2.85 metres in Karnal, 6.62 metres in Kurukshetra, 2.61 metres in Kaithal,
3.89 metres in Panchkula and 1.27 metres in Yamuna Nagar. During the same period in south-western parts of the state groundwater level has risen, by 4.58 metres in Bhiwani, 2.5 metres in Fatehabad, 9.09 metres in Hisar, 4.95 metres in Jind, 1.35 metres in Jhajjar, 2.15 metres in Rohtak and 8.18 metres in Sirsa (Denik Jagran, Aug. 1, 2003: 5).

6.4.1 Change in Water Table During 1982-92:

During this period of 10 years, the water table in the plain is reported to have declined in a large part of the plain by the rate of nearly 0.9 metre per year. To be more precise, on the whole during 1982-92 the water table declined by 9.15 metres in the plain. The water table has declined in whole of Sangrar, Patiala, Amritsar, Fatehgarh Sahib, Faridabad, Gurgaon, Rewari, Mahendargarh, Rohtak, Sonipat, Kurukshetra, Karnal, Kaithal, Yamuna Nagar, Ambala, large part of Jind, major portions of Kapurthala, Gurdaspur, Ludhiana, Jalandhar, Ferozpur and Faridkot.

The expansion of area under paddy crop has been significantly associated with the lowering down of water table in Punjab. The fall in the water table during 1984-94 has been estimated to be about 5.1 metres in Sangrur district, 4.8 metres in Patiala, around 4.5 metres in paddy growing areas of Firozpur and Faridkot and 2.5 metres in Jalandhar.
During the same period in some parts of the plain there has been a rise in the ground water table. During this decade the water table rise 8.65 metres by the rate of 0.87 metres (C.G.W.B., 1992). The rise of water table was mainly in the western part of the plain lying in the districts of Firozpur, Faridkot, Bhatinda and in the north-eastern districts like Hoshiarpur, Jalandhar and Kapurthala. With this rise in water table absolute area under critical water table has increased drastically. In June 1985, the area under critical water table depth was about 931 sq. km. which increased to 1350 sq. km. in June 1991. The worst affected districts were Rohtak, Jind, Hisar and Sirsa (Datta and Jong, 1997: 261).

6.4.2 Water Table Depth in May 1992:

Map of water depth (Map No. 6.3) shows that the groundwater depth varies from less than one metre to 40 metres below surface (C.G.W.B, 1992). The level of groundwater is deep in the foothill zones of Hoshiarpur, Panchkula and Yamuna Nagar districts in the north-eastern boundary of the plain and south and south-western parts of the plain covering large parts of Rewari, Mahendargarh, Bhiwani, Hisar, Sirsa, and south-eastern part of Firozpur district. In these areas the depth of groundwater lies within 10m below land surface. The water-logged
PUNJAB-HARYANA PLAIN
DEPTH TO WATER LEVEL
May 1992

DEPTH RANGE IN METRES
(Below ground level)
- 0 - 3
- 3 - 5
- 5 - 10
- 10 - 15
- above 15

Map - 6.3

areas are found in small patches in Gurdaspur, Bhatinda, Faridkot, Firozpur, Sirsa, Hisar, Jind, Kaithal, Faridabad, Gurgaon, Rohtak and Jhajjar districts. There are several areas where water table rests within 5 metres below the ground surface. These areas lie in large parts of Hoshiarpur, Kapurthala, Firozpur, Faridkot and almost all the districts of Haryana except Rewari, Mahendargarh and Bhiwani. The deepest water level recorded 47.5 metres below ground level at Sodi was in Bhiwani district in May 1992, and the shallowest water level was recorded at 0.7 metre below ground level at Ladhewala in Firozpur district.

6.4.3 Change in water table during 1994 to 2003:

The fluctuation of groundwater level in the plain during the past 10 years indicate a general decline of water level in 69 per cent area of the plain. This is concentrated mainly in northwestern, central and southeastern parts of the plain (C.G.W.B., 2004). In this region the main cause of declining the water table is an intensive tube well irrigation. Farmers use excess water in their rice fields, therefore the water table is declining in this region.

Water table declining in the range of 0-2 and 2-4 metres have been reported in all over the central plain and patches, in other south and southwestern districts. Decline in the range of above 4 metres occurs in
PUNJAB-HARYANA PLAIN
WATER LEVEL FLUCTUATION
1994 to 2003

FLUCTUATION IN METRES
RISE FALL
0 - 2 0 - 2
2 - 4 2 - 4
above 4 above 4
Hilly area Hilly area

Map - 6.4

Amritsar, Bhatinda, Mansa, Sangur, Kaithal and Mahendargarh (Map. 6.4).

The area showing rise in water table are mainly in Hisar, Sirsa, Panchkula, a large patch in Rohtak and Jhajjar. In Rohtak district alone as per agriculture department records, about 2000 hectares of land has been out of cultivation due to rise in water table beyond critical level (Hindustan Times, Feb. 28, 1999). Small patches can also be seen in Rewari, Bhiwani, Patiala, Firozpur, Muktsar, Bhatinda, Mansa, and in area parallel to Kandi region in Gurdaspur, Hoshiarpur, Nawan Shaher and Roop Nagar districts.

In Haryana, a paradoxical situation is developing over the years. It is observed that nearly 52 per cent of the state is experiencing rising water table while the remaining 48 per cent area is experiencing decline in the water table due to overexploitation of groundwater (C.S.S.R.I, 2000:11).

6.4.4 Water table depth in Jan-2004:

In Jan-2004 the depth of ground water level in Punjab-Haryana plain varies from 0.01 metres below ground level in Hisar district to 48.29 metres below ground level in Bhiwani district. Both the district of Hisar and Bhiwani are located in the south western parts of the plain. In
the north-eastern parts of the plain the deepest water level (35.41 metres below ground level) is seen in Hoshiarpur district (C.G.W.B. 2004).

Water logged areas (very shallow water levels less than 2 metres) have been observed in a large patch in western part of the plain lying the district Firozpur, Muktsar and Hisar. Water logged areas are also observed in central and southern parts of the plain in Rohtak and Jhajjar districts. Small patches also occur in Sonipat, Jind, Bhiwani and Gurdaspur districts (Map. No. 6.5).

Deep water level (depth 10-20 metres) are reported from parts of Hoshiarpur, Ludhiana, Roop Nagar, Bhatinda, Sangrur, Fatehgarh Sahib, Kurukshetra, Kaithal, Hisar, Bhiwani, Mahendargarh, Rewari, Gurgaon and Faridabad districts in a large continuous patch from north west to southeast and southwest part of the plain.

The very deep water level (depth above 20 metres) occur in the area bordering to Rajasthan state lying the district Sirsa, Bhiwani, Mahendargarh, Rewari and Gurgaon districts in south west of the plain. Very deep water level also occurs in the Kandi areas in the north eastern parts of the plain in the districts Gurdaspur, Hoshiarpur and Roop Nagar.

The water table conditions in the plain vary in the pre and post monsoon periods, as it occurs elsewhere in the country. The depth of
water table generally rises in the post monsoon period particularly when there is sufficient rainfall. Therefore, in order to have a better picture of incidence of water depletion and water-logging in the Punjab-Haryana plain a brief inquiry into the pre and post monsoon periods have also been attempted in the present chapter.

6.4.5 Seasonal fluctuation in ground water table (May 03 to Jan 04):
Seasonal groundwater level fluctuation indicate a general rise in about 76 per cent area of the plain and remaining 24 per cent area indicate decline in water level. Maximum areas have shown a rise in the range of 0-2 metres. Rise in the range of 2-4 metres occurs in patches in the districts of Faridabad, Gurgaon, Bhiwani, Jind, Yamuna Nagar, Firozpur and Gurdaspur.

Decline in the range of 0-2 metres have been reported mainly in central and eastern part covering the districts of Faridkot, Moga, Bhatinda, Sangrur, Ludhiana, Patiala, Kaithal, Kurukshtera, Karnal, Mahendargaon and Rewari. Patches with a decline in water table up to 2 metres also occur in Amritsar, Hoshiarpur and Nawan Shaher. This is also the core area of rice cultivation dependent mainly on tubewell irrigation. Declines in the range of 2-4 metres have been reported in small patches in Bhatinda and Mahendargarh (Map. No. 6.6)
PUNJAB - HARYANA PLAIN
SEASONAL WATER LEVEL FLUCTUATION
May-03 to Jan-04

Map - 6.6

FLUCTUATION IN METRES
RISE          FALL
0 - 2         0 - 2
2 - 4         2 - 4
above 4       above 4
Hilly area    Hilly area

Source: As in the Map No. 6.4
6.5 THE SOIL SALINITY-ALKALINITY

Accompanied with the incidence of water-logging in the plain is the problem of accumulation of soluble salts in the soil profile. Soils become saline as a result of concentration of salts due to evaporation of ground water moving upwards.

Salt affected soils differ from arable soil with respect to two important properties viz. the soluble salts and the soils reaction. The accumulation of soluble salts in the soil may influence its behaviour for sustainable crop production through changes in the properties of exchangeable cations, soil reaction, the physical properties and the effects of osmotic and specification toxicity. The salt affected soils are mainly grouped as saline, Sodic/Alkali and saline-sodic soils.

The most widely accepted definition of salt affected soils is the one propounded by the United States Department of Agriculture. The definition is based on PH$_5$ (PH of the saturated soil paste), EC$_e$ (electrical conductivity of the saturation extract of soil, dS m$^{-1}$) and ESP (exchangeable sodium percentage of the soil) (C.S.S.R.I., 2000).

The term ‘salinity’ is often used as a generic term to cover both Salinity and Alkalinity. Soil salinity/alkalinity can be identified easily. Normally, water remains clear and does not stagnate for a longer period.
on the normal and saline soils, while it will be muddy, soapy and continue to stagnate on alkaline soils. Moreover, saline soils are covered with white efflorescence and alkali soils are covered with dark brown or ash coloured clay crust. Saline and sodic soils are known by a local name ‘Kallar or Reh’. Such soils usually occur in the vicinity of the canals or rivers where obstruction to natural drainage occurs and consequently water table remains near the surface.

Alkali or Sodic soils are hard and compact with clay to clay loam texture. Wet alkali soils are gummy and show cracks after drying. A thick and highly cemented bed of big sized Kankar is found in the sub-soil. In these soils water percolation is almost nil and water stagnation is a common land feature. On evaporation and drying such condition may leave black reddish brown residue on the surface caused by the dissolution of humus in the alkaline soil. These types of soils are found completely barren. During rainy season only salt tolerant grasses can be seen on such soils.

The problem of salt affected soils is a colossal one and has increased in many countries of the world particularly in arid and semiarid regions. From various available data it is estimated that the world is losing at least three hectares of arable land every minute because of soil
salinity (Sengupta, 2002:1247). In India, the area under salt-affected soil was estimated to be 7 million hectares (M.ha.) (Abrol and Bhumbla, 1971) (Yadav et al., 1990:14) estimates that 8 m. ha. of land is under saline and sodic soils in India. However during the last decade several agencies have given divergent estimates. The data from various sources were critically evaluated at Central Soil Salinity Research Institute, Karnal (Haryana) in 1996 and figure has new modified to 7.4 M. ha.

6.5.1 Status of Salt Affected Soil in Punjab-Haryana plain:

Experience in Punjab and Haryana shows that with the introduction of canal irrigation, when large doses of irrigation are applied at varying intervals, these salts are likely to diffuse upward and seriously interfere with crop growth. Alternatively, with intensification in canal irrigation water-table rises significantly, and once the water table is within 2 metres it is likely to act as a continuous source of soluble salts in the soil profile.

The salt-affected soils exist in almost all the districts of the plain in large or small patches. Their net area is around 1.03 million hectare. In the south eastern parts of the plain more than 0.55 million hectare of land is, out of which 1.6 lakh hectares is lying barren on account of severe salt infestation. In Haryana more than 0.52 million hectares area has salinity/alkalinity problem (Dhanda and Yunus, 1988:5). Basing their
estimates on the interpretation of LANSAT imageries, Sharma and Bhargava, (1993) have suggested that nearly 164 thousand hectares of land in Haryana alone is affected by salinity problems (Sharma et al., 1997: 357).

The high water table with soil salinity is already a serious problem in the plain mainly in Bhatinda, Firozpur, Sirsa, Hisar, Fatehabad, Rohtak, Kaithal, Narwana, Hansi and Dabwali blocks (Sharma, 1998). There is no natural outlet for drainage because the general hydrological contours are in the south-westerly direction. According to one study, alkali soils are found in Karnal, Kurukshetra, Rohtak, and in some parts of Jind and Gurgaon districts in Haryana (Yadav et al., 1990: 14). Another study indicated that saline-alkali soils are found (in patches) in Karnal, Panipat, Sonipat, Rohtak and Jhajjar districts (Goyal and Kuhad, 2000:3).

Some of the salinity affected villages in the Jhajjar district (on Rohtak-Jhajjar Road) are Dighal (my own village), Gochhi, Lakaria, Seria, Madana and Dhandhlan. Out of a total area of 52 thousand acre in Dighal and neighbouring villages, one forth is affected by salinity, because this is low land area and the level of salty ground water is high (Dainik Bhaskar, Feb. 23, 2004).
In Punjab the net area affected by salt is around 0.48 million hectare, although about more than half of the alkali soils has already been reclaimed (C.G.S.H.A.U, 2002). It must be remembered that reclamation, however, displaces the salts from the surface to the lower layers, which can again move to the surface layers under favourable conditions.

Reclamation of saline soil and disposal of saline drainage water may pose problem in future. Rice is an ideal crop to grow while reclaiming alkali soils. Rice tolerates high exchangeable sodium because it grows well in standing water, and infiltration rates usually are sufficient to leach out toxic substance, resulting from the reaction of applied amendments with exchangeable sodium. Also rice has a shallow root system and can grow well if sodicity is lessened in only the upper few centimetres of soil whereas other crops need deeper layer of low exchangeable sodium percentage soil to yield satisfactorily (Mangat Ram et. al., 1994:17).

The soil salinity and alkalinity are causing great harm to agriculture in the region. A heavy investment will be required for its reclamation, if it is not checked at this stage. The response of productivity to irrigation has been declining with every increase in irrigation.
Salinity increases as a result of rising water table from over irrigation and lack of drainage. Reclamation of waterlogged areas would, however, succeed only when steps are taken simultaneously to put an end to the seepage, which has been responsible for their present conditions. At least major irrigation projects have to be modernised and completed by appropriate drainage system in order to avoid further water logging and increase in soil salinity.