CHAPTER VI

SUMMARY AND CONCLUSIONS

Human interactions with the land have created imbalances in the global ecosystem. One does not have to search too far to determine that many lands are stressed. Our large mono-clonal farms, the network of roads and concrete buildings which seal the soil surface, the large-scale irrigation systems that alter the hydrology of the catchments, the drainage of swamps, and the emission of green house gases by industries and their products, have cumulatively made this a different world. A healthy, functioning society requires all of these; the difference is that human society has proceeded recklessly and without an understanding of environmental impacts.

The identification and analysis of social factors that contribute to land degradation deserve particular attention, because they often set the stage for corrective actions and policies. In recent decades a number of human factors associated with land degradation have been identified, including poor land management, inadequate technology, overpopulation, poverty, and decisions of social and political structures.

Land Degradation and Wastelands

Wastelands are generally associated with the land degradation process. Land degradation as dealt in the present study means deterioration of the biological potential of the land due to human activities. The land for the purpose of analysis includes vegetative cover, soils, and slopes, geomorphic surfaces and, hydrological systems.

Broadly the word wasteland is used to connote different aspects of land. In the national perspective the concept of wasteland can be narrowed to the optimum use of all available land (since land is finite) that derives maximum benefit from it. This is in principle accepting the dictum of Dudley Stamp that no land is a wasteland (1957).

However, Stamp defined wastelands as that land which has been abandoned and for which no further use has been found.

Wasteland, therefore, is **degraded land which can be brought under vegetative cover with reasonable effort, and which is currently under utilized. It also includes the land, which is deteriorating for lack of appropriate water and soil management practises or on account of natural causes. Wastelands can result from inherent/imposed disabilities such as by location, environment, chemical and physical properties of the soil or financial or management constraints.** Thus, the main objective of wasteland development is to bring more area under agriculture, afforestation, pastoral development and increasing the biomass.

Sri Ganganagar district of Rajasthan was selected to identify and monitor the wastelands, where it has developed more due to human interference rather than natural causes. The district was selected mainly, because it is one of the very productive areas of Rajasthan, which has been famous for high yield s of wheat, rice and cotton after the inception of Indira Gandhi Nahar Project (IGNP), which converted most of these vast desertic tracts into fertile areas.

However, in recent years, some parts of the district, especially the areas which are closer to canal, have been facing the problem of waterlogging and secondary salinity due to the seepage from the canal, and unlined Ghaggar depression channels due to high water allowance on one hand and the existence of high duny area and the associated scrub lands suffering from wind erosion due to water scarcity on the other.

Sri Ganganagar district, in general, and Indira Gandhi Nahar Pariyojna (IGNP) in particular, has twin problems of temporary / stabilized sand dune erosion and associated scrubland and waterlogging and secondary salinity. In fact, it is a characteristic feature of arid regions. Especially, after the introduction of irrigation, waterlogging and consequent salinity problems have started appearing in this region. Solution of the problem depends upon the quality of construction maintenance and management of the entire irrigation system.

The problem of waterlogging has been a cause of concern in IGNP. Vast tracts of cultivable lands have over the years been rendered unfit for cultivation due to waterlogging which has also brought along with it, the concomitant problem of increase in salinity resulting in the decrease of crop yield. Waterlogging has occurred due to various reasons inter – alia over application of irrigation water, high water allowances, minimum use of ground water, seepage from the canal system, seepage from the Ghaggar depression, lack of natural drainage out fall, presence of clay lenses close to ground level etc.

Major portion of water available in the canal system is utilized as irrigation water and, therefore, the importance of irrigation water management is further enhanced specially in the light of waterlogging problem. The choice of irrigation method depends on the topography of the area. In IGNP command, there is a great scope of improvement of water application and use of proficient methods of irrigation .The methods being followed in almost all the irrigation commands are highly inefficient. Unless the effectiveness of water application is raised, total utilization of irrigation potential may not be realized.

The scope of the present study is limited to wasteland mapping, accuracy assessment, and management at the village level based primarily on the primary data sources. Land is always in the constant flux due to transformation resulting from natural processes and human activities. The change in human activities is very dynamic and rapid.

There are two factors behind the formation of wastelands, viz: natural and anthropogenic. In case of Sri Ganganagar district, we find four different types of wastelands, such as, waterlogged area, areas affected with salinity; land with or without scrubs and sandy areas. The main purpose is first to identify and map these areas and find out their causes of formation and to suggest action plans for reclamation.

This is assumed that the development projects providing irrigation cannot be neutral to land degradation; rather these have lead to certain level of environmental degradation in general and land degradation in particular. Further, in the sandy terrain of

Sri Ganganagar districts much of the wasteland could be put under productive use through proper management strategy. Therefore implementation of proper management practices along with contemporary technology will stimulate positive changes in physical/natural characters of wastelands. This would further enhance more economic return of land.

Remotely sensed data by satellites provide reliable and accurate information on the landuse/land cover including wastelands. The minimum delineation unit selected is 3mmx3mm on the scale of 1:50,000, which represent 150mx150m or 2.25 ha. area on the ground.

Digital analysis of IRS IC/ID LISS III was performed using Max. Likelihood algorithm. Data for two seasons were used to avoid any misclassification and aggregation. Extensive ground truth checking was carried out first to take training sets for supervised classification and then to interpret false color composite (FCC's) and classified images in relation to ground features

Wastelands study requires an accurate assessment of how severe the damage is and whether or not it is practically controllable or reversible. In the present study four wasteland category viz., scrub land, waterlogged, saline / alkaline, and sand areas could be identified and delineated with fair degree of accuracy with the help of images.

Land with or without scrub

This category of wasteland is mainly prone to degradation due to sheet and rill erosion. It is mainly observed in the southern part of the district and associated with low dunes. Due to the loose structure of the soils on these lands, they are quite vulnerable during summer and starts moving due to aeoline action and engulf the adjoining agricultural lands. Due to lack of moisture, these dunes cannot be cultivated except where irrigation is available and low water intensive crops like gram or jowar are grown. There is a need to stabilize these lands and protect them from biotic interference. Natural regeneration of grasses and stall-feeding of animals have to be encouraged. Gradually these lands are being leveled for cultivation with the availability of canal water. This category occupies 91256.84 ha. or 8.32% of the total area of the district area, which is the highest

proportion of the total wastelands and account for 51.83 percent of total wasteland of the district.

Waterlogged and marshy land

Waterlogging defined as congestion of drainage and a soil is considered as waterlogged, if the water table rises to an extent that root zone becomes saturated, diffusion of air is curtailed and amount of oxygen is reduced, with increase in carbon dioxide.

Waterlogged areas were delineated on the basis of indicators such as high soil moisture, standing water and perennial vegetation. The presence of high soil moisture and shallow standing water on the surface is indicated by bluish tone on FCC. Perennial vegetation could be identified from its characteristics pink or red tones. Major reason for waterlogging in the area is due to the canal irrigation system and unlined depression channels of Ghaggar River. There is a need to develop water application system like drip and sprinkler, which will deliver less water. This will not only save water but also 30% increase in yield is possible without endangering the land. Water can be re-used for irrigating crop of adjacent fields depending upon the tolerance of crops for salinity. In the district, an area of 12498.42 ha. (1.14 percent) of Ghaggar depression and inter dunal valleys have also been under waterlogged category.

Land affected by Salinity

The soil salinity / alkalinity has become a serious a problem for the irrigated agriculture in arid and semi arid climates. High salinity and alkalinity in soil and ground water usually lead to soil degradation. Large stretches of natural saline areas occur along the tanks, canals, and ephemeral streams and in micro depression. Redistribution of salts within the area through the run off water to agricultural lands causes soil degradation. Irrigation with saline / sodic ground water over last 20 – 25 years has turned the soils saline / sodic. High salinity in surface soil and ground water in the area is the major problem for cropping. This wasteland class constituted only 426 ha. covering an insignificant area i.e., 0.002 percent of the district and accounting for 0.01 percent of the total wastelands.

Sands

The soils over large tract are highly sandy, and sand accumulations are found in the form of dunes and hummocks. These soils are loose and structureless. The permanent vegetation cover is very sparse. Moreover, households carry out frequent cultivation even during fallow period in order to eliminate weeds and conserve soil moisture. This is particularly so for gram crop, the success of which to a great extent depends on the quantity of stored moisture. But this management without the necessary control measures promotes wind erosion, even though the wind regime in the study area is not as strong as in the rest of the district , considerable evidence of wind erosion and drift sands exists.

Sri Ganganagar district receives irrigation water from one of the country's most important projects i.e., Indira Gandhi Nahar Project (IGNP) that envisaged irrigating 1.5 million-hectares in western Rajasthan. Primarily, the project command area is characterized by limitations of prevailing arid environment, undulating sandy terrain with unstable sand dunes of varying heights, high infiltration rate, low water holding capacity, saline ground water, the presence of hydro geological sub strata with restricted permeability and low fillable porosity. Wherever the project land is not managed properly it has witnesseed various types of degradation processes such as wind erosion, waterlogging, salt infestation, and other related problems. This fact has been clearly brought out by the change detection analysis attempted for 1970-71 and 1996-97.

Sandy and scrublands in the study area also present a common feature of desert environment, but the problem of waterlogging and secondary salinity started only after the inception of Indira Gandhi Canal. At the same time, we find that there has been a considerable decline in the first two categories of wastelands (aggregate of sand and scrubland) in the last 27 years in all the three sample regions, where the decline has been to the tune of 75 %, 45 % and 71 % in sample I, II and III respectively. At the same time these three sample areas have witnessed the increase in their cropland, which has been 1688% in sample I, 79 % in sample II and 27 % in sample III during the same period. Hence, the importance of Indira Gandhi canal cannot be undermined.

However, it is clear, that sample II and III did not register any substantial increase in area under cropland. Appearance of waterlogging and secondary salinity due to the seepage from the Ghaggar depression channels and Indira Gandhi canal and its tributaries is the main reason, which has contaminated the cropland. This problem has been further aggravated due to the faulty management practices, especially, over irrigation of the fields and sowing of water intensive crops, such as wheat, paddy, cotton, which have now, assumed the status of main crops grown in this entire tract.

Hence, repair of the canal bed, which is almost 44 years old, and lining of the Ghaggar depression channels, is very important. Water intensive crops practices should be replaced by less water intensive crops, such as gram, guar (cluster beans), *jowar* etc. Further, over irrigation practices may be restricted by the reduction in water allowance to the fields. Lastly, use of drip and sprinkler irrigation by using tubewells or from the canal would not only cause efficient water management on the farms near the canal, but this can also supplement the irrigational needs of *barani* lands.

Considering the above-mentioned reasons of human induced development of wastelands, there is an urgent need of reappraisal of the entire planning and policies to check further deterioration, since the present problem is the cumulative results of so many factors.

As we look at the socio - economic profile of the sample households of the eight villages, we find that farming is their occupation, although a small proportion if the members of are engaged in the other non farm activities Further, major proportion (61%) of the head of the households were illiterate. Low literacy rate may be one of the reasons that are aggravating land degradation such as over irrigation, choice of water intensive crops, non-awareness about latest government policies and so on.

Given the same situation as in these eight-sample villages no relationship was found to exist between soil depth and its Ec and pH. However, there are two villages (Bareka and Rangmahal in Suratgarh district) where both salinity and alkalinity were very high. In these villages farms of 62% sample households suffer from the problem of

alkalinity and salinity. Most of the lands farms lie outside the canal command area and the households have no access to IGNP water, rather their irrigation needs are met by tube well irrigation or by the Bhakhra Canal water. The water collected in the depressions due to spill out from the Ghaggar river during rainy season is also used for irrigation depending upon its availability. These depressions are natural and are not lined which causes the problem of waterlogging and secondary salinity due to the large-scale seepage. This water contaminates the soil as the sodium found in the soil is mixed with water resulting in soil efflorescence. Hence, it is essential to either to do the lining or discontinuing the water discharge into the depression.

The problem of waterlogging in the command of IGNP surfaced after 15 to 20 years of introduction of canal irrigation. Recent studies conducted by Ground Water Department indicate that water table in IGNP is rising at an alarming rate of 0.8 m per year. This aspect gets clearer once we look at the distribution and growth pattern of wastelands and land holding sizes in villages of Bhopalpura, Surajansar, Rangmahal and Kishanpura of Suratgarh block during the period of 1970-71 and 1996-97. These villages are the worst affected areas due to the waterlogging and secondary salinity caused by the seepage of IGNP and it's branches.

The positive effect of inception of canal and tubewell irrigation was seen in the form of change in the cropping patter. Prior to IGNP, major crops of this area were *bajara* during *kharif* and gram during *rabi*. However, with the irrigation facilities introduced, the water intensive crops like cotton and wheat became the main crop during *kharif* and *rabi* respectively in this area. The major crops grown in these eight sample villages are cotton, groundnut, guar (cluster beans) and paddy during *kharif* and wheat, gram, mustard and *taramira* during *rabi*. Further, it was observed that double cropping is practised invariably by small and large households in order to get maximum returns from the land since the irrigational facilities have been introduced in this region.

Canal and tube wells are the main source of irrigation in eight sample villages. Canal is the main source of irrigation, especially IGNP main canal in the villages of Bhopalpura and Surjansar in Suratgarh block, Anupgarh branch in Sangeeta, (Suratgarh)

2MLD, 3MLD etc. in Gharsana blocks. Tube well is another important source of irrigation to supplement the water requirement of crops and at the time of its shortage in the canals. In some of the villages both tube well as well as canal are used for irrigation purposes, whereas rain fed faming is important in non-command areas (*barani* land).

The practice of over irrigation has aggravated the problem of waterlogging in this region, along with other reasons such as seepage from the canals and depressions and it was observed that over irrigation is done mostly where canal water irrigation is practised as the households believe that use of large quantity of water for irrigation may bring high production, hence, shortage of water from canal is further supplemented by tube wells. It was inferred that over irrigation is one of the reasons of waterlogging that ultimately leads to secondary salinity, at the same time under irrigation Gharsana block have also caused salinity / alkalinity.

It has been observed after studying the effects of increasing number of waterings on wheat and cotton that number of watering is one of the reasons of waterlogging as in 138 cases out of 248 (56 percent), households irrigate the wheat crop 4 to 7 and in 63 (46 percent) cases the farms were waterlogged. Whereas out of total 93 cases of waterlogging (water standing on the surface to 1m deep), 61 percent (57) cases the households irrigated their wheat crops 4 to 7 times or more in one season. Thus, the practice of over irrigation has further aggravated the problem of waterlogging in this region, along with other reasons such as seepage from the canals and depressions.

It was observed that out of 168 cases of moderate to high salinity, there are122 (73 percent) households providing 4 to 7 watering or more to wheat crop, that is one of the reasons of waterlogging and the salinity varies from moderate to high. On the other hand, there are 46 households (88 percent) out of 53, applying less than 3 watering which suffer from moderate to high salinity, are in the villages of Gharsana block. Here, the soil is alkaline in nature, which requires lots of irrigation water; especially canal water, so that soil can be leached down. However, due to dearth of water in the Anupgarh branch of IGNP, which meets the irrigation requirement in this block, white salt efflorescence makes the land barren and is not suitable for any crop. The only

solution for this kind of problem, that is locally called "*kallar*", is canal water irrigation followed by gypsum application. Even tube well irrigation, which is drawn from depths beyond 12 to 14meters, is not suggested. However, the canal water can be mixed with the tube well water for irrigation purpose.

A significant positive correlation was observed between waterlogging and salinity, which means salinity increases with an increase in waterlogging and vice versa. In other words, there are fairly high chances of high salinity where there is waterlogging.

As far as the quality of stagnant water is concerned, the ten samples of stagnant water at soil surface were tested for their salt content in Rangmahal, Bareka, Kishanpura, Sangeeta, and Bhopalpura and Surjansar villages of Suratgarh block. The electrical conductivity of these water samples varied from 15.17to 33.602 dS/m, which is very high and detrimental

It was also observed after the analysis that wastelands (waterlogged saline and barani lands) occur mostly in the farms of small to medium households. Basically most of the problems are related with the economic condition of a farmer. If a farmer has large share of land he also possess the proper means to increase the fertility of his farm, as well as uses proper reclamation method to reclaim his lands, whereas small households cannot afford the required investment.

Not many households made efforts for reclaiming their wastelands. It was found that out of 248 households 200 (81%) did not make any effort for wasteland reclamation due to their poor economic condition, only remaining 14 percent of the households adopted the reclamation measures by adding gypsum to get the fertility back or added soil or sand to raise the height of the farm to avoid waterlogging. The remaining 5 percent constructed furrows to discharge the excess water of their farms, since it was the cheapest method they could afford using their family labour.

Hence, it was clear that households having large land holdings can afford to reclaim their wasted lands or they can even afford to leave it fallow. On the other hand, the small and medium households cannot leave their land nor they have the capacity to

reclaim, so they keep cultivating their land until it completely goes out of production. This further aggravates the problems.

In order to avoid problems of waterlogging and land degradation, a comprehensive and sustainable plan need to be worked out that includes, plantation of deep rooted trees, maximization of net returns of field crops including cereals, pulses oilseeds, fiber and fodder, orchards and social forestry species of dry deciduous plants, pastoral development, reduction of water allowance in the commands of Suratgarh branch, encouragement of water efficient irrigation techniques such as drip and sprinkler, lining of the Ghaggar depression and provision of seepage drains considering the nature of the soil in this region which is light textured.

Lastly, there is an immediate need of community participation in the direction of wasteland reclamation. Most of the problems, as we have seen in the study area, have been caused due to the non-awareness of the households as a result of illiteracy. Therefore, an initiation of awareness program is very important to teach the ill effects of over irrigation, water intensive cropping practises etc. at the same time government to ensure subsidy to the households for installation of tube well and sprinkler irrigation. This will not only stop the problem of waterlogging and salinity, but would boost up irrigational facilities in the non-command areas.