Chapter 1

INTRODUCTION

Land is a limited non-renewable resource required by all living species. The use of this resource is highly dynamic and is controlled by a complex mix of various inter-related, interdependent and interexchangeable phenomena affecting the overall geo-environment.

Economically, the concept of ‘land use/land cover’ denotes not only the surface of soil but also all those resources which are gifts of nature. Socially, land cover is a tradition, a way of life, which for centuries has shaped the thought, outlook and culture of a community. Ecologically, land cover is not only a visible surface, but also an interaction and interdependence of all living organisms together with their physical environment. Environmentally, it is not merely a study of particular environmental set up associated with specific land cover status, but also a study of overall impact of land use/land cover on the physical as well as socio-cultural environment on the surface of the earth.

Geographically, the concept is not only a study of spatial distribution of particular attributes of land use/land cover but a systematic study of changing pattern of land use/land cover in spatio-temporal manner and its impact on society, economy and physical set up of an area or region.

Thus in this era of technological innovation the concern is not only to study the status-quo of land use/land cover but also to study the degradation status. By doing this we will be able to know how the prime gift of nature is losing its original land cover and how it is affecting the living conditions on the surface of the earth. For this purpose different nations despite their ethnic, cultural and political diversities congregated at the first Earth Summit of Stockholm in 1972 and stressed the need for sustainable development. India was also a signatory to this summit.

The sustainable land use requires preserving the original land cover not only for the present generation but also for the future generations. It is more emphasized these days to study the degradation status of actual land use/land cover from its original cover.
India is the first country which has made provisions for the protection and improvement of natural environment in its constitution. In directive principles of the State policy, Article 48A was inserted which enjoins the state to make endeavor for protection and improvement of natural environment and for safeguarding the forest and wild life of the country. The same also includes another provision in Article 51-A [g] of the constitution that it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes and wildlife and to have compassion for the living creatures. These provisions can be achieved by paying attention to protect the original land cover of the area, because this land cover is the outcome of thousands of year’s systematic evolutionary process and is best suited to the geographical set up of the area.

Though, on regional scale, human highland interaction systems have led to a critical impact on the overall quality of natural environments but on a micro scales, these interactive systems have faced rigorous change with a strong shift towards deterioration of original land use/land cover. This is true for the mountainous highlands of which the study area is a part. The consequence of this impact is also faced by low land plain areas in the form of floods and oversiltation in the river valleys because these low land areas are the recipients of displaced materials from highlands. So, the study of highland human-environmental interactive systems becomes pertinent to understand the deteriorative tendency operating in spatio-temporal context. All these can be understood by studying the deterioration that has taken place in original land use/land cover status.

The environmental system in a mountain area is described as topographically extremely undulating, geologically unstable and ecologically fragile. The soil cover is generally poor with marginal availability of nutrients and rigorous down slope movement due to steep slopes. These areas are also economically backward.

In this type of environmental setup, our emphasis should be to distinguish between what is natural and what is accelerated through the anthropogenic activities. Though the natural factors like physiography, slope, and drainage affects the land in their own way but the overall effects and tendency of these natural factors is very slow in deteriorating the land
quality. Anthropogenic activities both mismanagement of land resource and unscientific methods of development lead to dramatic deterioration of land quality, which further leads to the genesis of degraded or waste lands. Thus land in a mountain area is an important shrinking natural resource, which has been neglected too long with little protection from the vagaries of natural and excessive human interference. The geomorphic situation, climatic factors, human interference and unscientific exploitation of lands are the chief causes of degradation of lands leading to the creation of degraded lands / wastelands.

The term wasteland indicates little used common land usually a less fertile soil. It fails to yield a return to the cultivators and has a serious environment problem. This land area is a result of inherent or imposed disabilities or both, such as location, environment, chemical and physical properties and even suffers from management conditions. Thus within its broader term of definition, the wasteland includes all such areas showing serious ailment of physical limitation either natural or human induced, rendering it useless or uneconomic because of low productivity. It develops as a separate feature of landscape with the deterioration of its environment quality. Wasteland thus is a marginal feature of landscape with the potential to support economy and maintain environmental quality.

In recent years, rapid growth of population has resulted in intensive exploitation of the available natural resources than ever before. Consequently, many a pristine forestland has been cleared to meet human requirements. Vast tracts of agricultural land have turned sterile or degraded due to overuse. Extensive areas have been dug up for extracting more minerals of various kind and more industries have been set up for production of consumer goods. All these land based activities are responsible for generation of different kinds of wastelands. In the world as a whole only 28 percent of the total land area is the actual habitat of man. As much as 72 percent falls in the category of land not suitable for human use due to one reason or another.

In India, the condition is not better. According to Central Water Commission, out of total geographical area of 329 million hectares in the country, land use data of 300 million hectares is accounted for, and data are not available for the balance, largely consisting of
mountains, deserts, forests and other inaccessible areas. From the available accounts, it seems that a little more than 67 million hectares area is under forests and 142 million hectares is subjected to active cultivation practices. A little more than 40 million hectares is not available for cultivation either due to non-agricultural use like settlements, industrial activities, etc. or due to their barrenness or lack of land capability. Fallow land totals about 23 million hectares. An area of little more than 15 million hectares is considered culturable waste and an equal amount of area is reported to be as under permanent pastures, grazing land or miscellaneous tree crops and groves.

It has been estimated that out of 329 million hectares of geographic area of the country, some 167 million hectares have been suffering from different kinds of degradations, such as water erosion (90 million hectares), wind erosion (50 million hectares), salinity and alkalinity (7 million hectares) and flooding (20 million hectares). Another 20 million hectares in the canal-irrigated area is under the risk of becoming degraded (Bali and Kanwar, 1977). The Food and Agriculture Organization (FAO, 1986b) has also estimated that nearly half of the total geographical area in India is under various degradation hazards. About 2.1 million hectares of land is reported to be degraded and deforested annually. On the whole between 0.5-1.0 percent of the country’s area is turning into wasteland every year. According to National Remote Sensing Agency, Hyderabad (2000), out of total geographic area of the country 20.17 percent is lying as various types of degraded or wastelands in different states.

The indiscriminate application of high production technology, without having any inbuilt mechanism for restoring the natural ecological balance leads to inappropriate or misuse of our land resources causing land degradation. This is more prevalent in the areas of Haryana, Punjab and Indo-Gangetic Plains. The hilly and mountainous areas of the country are also facing the problem of tackling the menace of growing wasteland and rapid deterioration of environment due to over exploitation of forestland, overgrazing of pastures, and unscientific methods of cultivation. These factors lead to excess soil erosion, landslides and debris fall. This is especially the case of mountainous and hilly areas of the country of which Himachal Pradesh forms a part. This state has reached a critical level of land utilization. Its environment is ecologically fragile in nature. The geology is weak and unstable. The
monsoon type of climate has its own role to play towards land degradation through erosion and generation of wastelands in the state. Out of total geographical area of Himachal Pradesh, 56.87 percent is reported as wasteland of various kinds by National Remote Sensing Agency, Hyderabad (NRSA, 2000) against 20.17 percent for the country as a whole. The different types of wastelands which have been identified in the state include degraded forest (8.25 percent), degraded pasture (7.69 percent), barren rocky land (6.93 percent), degraded non forest land (4.42 percent), land without scrub (3.69 percent), steep slopyp (2.79 percent), snow covered (2.56 percent), gullied/ravine (0.02 percent), saline and alkali wasteland (0.002 percent) (Table 1.1)

These types are distributed highly unevenly over different parts of the state. It has been noted that the position of wasteland is very peculiar in Sirmaur district. The district, no doubt, ranks third after Kinnaur and Lahaul-Spiti, in terms of total area under degraded land/wastelands (77.05 percent), but the first two districts contains high proportion of such wasteland types as snow covered, steep sloppy and barren rocky wasteland, which can hardly be reclaimed for any use. In Sirmaur district, the degraded forest is the most predominant form of wasteland, as it constitutes 54.09 percent of the total area of the district (a little more than 70 percent of the total wasteland area.) In addition, value of degraded forestland is highest in Sirmaur amongst all districts of state. This is because of over exploitation of forests and illegal encroachment of forestland by the local people. The district has also the distinction of having highest area under mining wasteland. Area under the above mentioned two major kinds of wasteland is therefore a matter of concern. The other important types of wastelands found in the district include degraded pastures, steep sloppy and land without scrub. Therefore, there is lot of variety in terms of types of wastelands/ degraded lands in the district. It stands second with the presence of ten types of wastelands, after Lahaul-Spiti where eleven types are found. It may be mentioned that the NRSA has identified thirteen types for Himachal Pradesh.

The district Sirmaur is predominantly rural with agriculture as the main occupation of its inhabitants. A noteworthy feature is that only a limited area, out of the total geographical area is available for cultivation. According to latest land revenue records, net area sown is
### Table 1.1
Himachal Pradesh: District Wise and Category-Wise Wastelands (sq. kms.)

<table>
<thead>
<tr>
<th>District</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tr>
<td></td>
<td>Gullied</td>
<td>Land</td>
<td>Water-</td>
<td>Saline/Alkaline</td>
<td>Shifting</td>
<td>Degraded Forest Land</td>
<td>Degraded Pastures Land</td>
<td>Degraded Plantation Land</td>
<td>Sands</td>
<td>Mining</td>
<td>Bareen</td>
<td>Rocky</td>
<td>Steep</td>
<td>Slopy</td>
<td>Snow/ Glacial Area</td>
<td>Total Wasteland Area</td>
</tr>
<tr>
<td>Bilaspur</td>
<td>33.41</td>
<td>58.03</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>134.74</td>
<td>278.13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.64</td>
<td>59.46</td>
<td>0</td>
<td>564.41</td>
<td>1167</td>
<td>48.36</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>254.97</td>
<td>2450.94</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>68.44</td>
<td>231.6</td>
<td>368</td>
<td>3399.95</td>
<td>6528</td>
<td>52.08</td>
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<tr>
<td>Hamirpur</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>4.87</td>
<td>83.85</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>1.26</td>
<td>50.49</td>
<td>0</td>
<td>164.07</td>
<td>1115</td>
<td>14.68</td>
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<td>93.06</td>
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<td>0</td>
<td>6.28</td>
<td>11.92</td>
<td>284.19</td>
<td>1003.07</td>
<td>1486.54</td>
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<tr>
<td>Kinnaur</td>
<td>0</td>
<td>552.85</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>45.18</td>
<td>1410.45</td>
<td>0</td>
<td>1.31</td>
<td>0</td>
<td>1699.63</td>
<td>117.6</td>
<td>1438.76</td>
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<td>173.83</td>
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<td>1.31</td>
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<td>275.36</td>
<td>427.49</td>
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<td>0</td>
<td>0</td>
<td>66.46</td>
<td>45.13</td>
<td>1744.63</td>
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<td>49.7</td>
</tr>
<tr>
<td>Lahul &amp; Spiti</td>
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<td>443.5</td>
<td>0.99</td>
<td>0.05</td>
<td>0</td>
<td>68.88</td>
<td>703.81</td>
<td>0.01</td>
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<td>11117.24</td>
<td>13835</td>
<td>80.79</td>
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<td>Mandi</td>
<td>8.3</td>
<td>229.57</td>
<td>0.92</td>
<td>0</td>
<td>0</td>
<td>1407.35</td>
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<td>0.09</td>
<td>0</td>
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<td>330</td>
<td>231.91</td>
<td>0</td>
<td>0.08</td>
<td>0</td>
<td>60.9</td>
<td>19.76</td>
<td>252.97</td>
<td>1069.32</td>
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<tr>
<td>Sirmaur</td>
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<td>87.42</td>
<td>0.65</td>
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<td>1528.25</td>
<td>302.53</td>
<td>0.64</td>
<td>19.71</td>
<td>85.66</td>
<td>19.79</td>
<td>131.36</td>
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<td>2176.53</td>
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</tr>
<tr>
<td>Solan</td>
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<td>123.45</td>
<td>0.09</td>
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<td>266.29</td>
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<tr>
<td>Una</td>
<td>36.83</td>
<td>126.44</td>
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<td>0</td>
<td>0</td>
<td>220.68</td>
<td>33.92</td>
<td>0</td>
<td>59.92</td>
<td>7.25</td>
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<td>0</td>
<td>493.74</td>
<td>1540</td>
<td>32.06</td>
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</tr>
</tbody>
</table>

**Total**: 121.98 2056.5 15.69 1.36 0 4889.98 4278.17 2457.59 105.04 85.66 3858.04 1529.87 12559.42 31659 55673 56.87

424.55 sq. km. which is only 15.03 per cent of the total geographical area. Per-capita availability of cultivated land is only 0.12 hectare and cropping intensity is 183.2 per cent. Very limited availability of agricultural land has resulted in intensive cultivation and increased dependence on natural resources, leading to the emergence of degraded land/wastelands in the districts.

It needs to be stressed here that the revenue department shows only 9.49 per cent of total area as wasteland as against 77.05 per cent as per the estimates of National Remote Sensing Agency. This low percent vis-à-vis the NRSA figure is because of two reasons:

- Out of the total geographical area of 2825 sq.kms. about 80 per cent is cadastrally surveyed and finds place in village papers. The rest more than 20 per cent area is still not reported for use. This primarily is unsurveyed forest, pasture and wasteland of different types.

- The revenue department does not follow the standard classification as adopted by the NRSA. They do not record data on many types of wasteland especially on gullied, steep sloppy, land without scrub, degraded plantation land, waterlogged land, river sand and mining wasteland.

**Statement of the Problem:**

As stated before, degraded land/wasteland in Sirmaur district constitutes more than three fourth of the total geographical area. Major part of this wasteland is comprised of the degraded forest and degraded pastures. Infact, Sirmaur ranks at the top amongst all districts of Himachal Pradesh as far as presence of degraded forest and mining wasteland is concerned (Table 1.1). This clearly reflects the high level of human interference into the natural ecosystem of the district. Also the proportion of net sown area in the district is limited (15 percent), the cropping intensity is high (183 percent) and per capita availability of cultivated area is just 0.12 hectares. The pressure of population has increased notably with increase in its population from 2, 45,033 persons in 1971 to 3, 79,695 persons in 1991 and then to 4,58,593 persons in 2001.
The demand of land and related resources has therefore increased over time. To fulfill this, people have used practices suited to them rather than to their environment. As a result, once ecologically useful land cover has been turned into wastelands (degraded lands). This process is continuing and under these conditions, it becomes important to evaluate the wastelands of the district in respect of their extent, distribution, utilization and conservation towards better management. The present study thus is a modest attempt in this regard.

**Review of Literature**

The land use is a major area of academic and professional interest among scholars of different disciplines across the world. Land resource is a gift of nature to man, which is being utilized for different purposes in different parts of the world, giving birth to different kinds of land use patterns, spatially as well as temporally. It is a well known fact that due to adverse environmental conditions and unscientific exploitation of land by human beings, the quality of land is degrading and productive land is turning into unproductive land i.e. wasteland.

Huge volume of literature on land use has been produced and is difficult to be comprehended. The literature consulted for the present work on wastelands was carefully reviewed. It is classified into four groups: **a**, **b**, **c** and **d**. The first group covers studies on the genesis, problems and utilization of wastelands while the second takes into account those studies which deal with the typology, distribution and changing pattern of wastelands. The third group reviews the ones which concern with the distribution and reclamation of wastelands while the fourth group examines the research attempts which focus on the strategies for restoration, development and management of wastelands.

***(a)*** Studies which are related to the genesis, problems and utilization of wasteland, are few in number. The genesis, problems and utilization of different kinds of wasteland in Koli tehsil of Aligarh district of Uttar Pradesh was studied in detail by Singh Abha Luxmi in 1978. She extended her work to cover the entire state of Uttar Pradesh during the year 1985. Besides this work the studies done by Aggarwal(1959),Hadimani(1960),Sharma(1968),Shafi Mohamand (1968), Bali and Kanwar(1977) have suggested some reclamation measures for
the restoration of wastelands in the state. Studies conducted by Vohra (1982), Murthy (1982), National Wasteland Development Board (1985), Dev Roy (1986), Yadav (1986), A.K.Saha and Pramod Singh (1990), Singh (1990), and Sharma (2000), highlighted the problem of wastelands in India and suggested reclamation strategies. These studies however, could not assess the newly adopted nomenclature of different wasteland types as given by NRSA. The reasons for the formation of degraded lands are mainly confined to the few old wastelands types. It is observed that these studies could augment only few determinants of wastelands formation and therefore could not explain adequately the problems of wastelands as has been recently classified by NRSA.


These studies not only analysed the spatial distribution of wastelands but also focussed on the changing pattern of different types of wastelands in different parts of India, spatially as well as temporally. These studies are however, limited in extent as they cover only one aspect of wasteland i.e. distribution and changing pattern, in one way or the other. These studies could not correlate typology with the distributional pattern of wastelands according to small scale terrain units. The present study aims at the explanation of wasteland formation and relationship between typology and spatial distribution up to small scale terrain units.

(c) There is a sizeable volume of literature on distribution and reclamation of wastelands. The works of Reh Committee (1886), Leather (1893), United Province of Agra and Oudh, the User land Reclamation Committee (1908-1909), Barnes (1931), Dhar(1938), Tailor(1940), Audin (1942), Dec Greger (1947), Khan (1950), Khan (1951), Raj (1951), Aggarwal (1957), U.S.A.Salinity Laboratory (1954), Pilat (1956), Nigam (1956), Academy of the Science of U.S.S.R (1958), Indian Council of Agriculture Research(1958), Yadav and

Most of these studies have been found to be related with the problem of wasteland in plain areas. The focus in these studies is on the reclamation of alkali, saline and waterlogged wastelands. Many of these have been carried out by the government agencies and fail to paint a total picture in the sense that they are highly selective and deal with the chosen problems. The study area is hilly and differs from plain areas in terms of wasteland types, problems and reclamation practices. Therefore, a complete scenario of wasteland in this region is important to be analysed.

(d) Another group of studies is comprised of the works which are focused on the management of wastelands. The works of Kaul(1961), Raheja (1962),Chakravarty and Verma (1968),Gupta (1979), Datiya (1982), Roy (1986), Kumar and Pandey (1989), Ghosh (1990), All India Soil And Landuse Survey (1990), Vohra (1990), Singh (1991), Banerjee Bireswar (1992), and National Remote Sensing Agency (2000)are important in this regard. Although various methods of wasteland management are suggested in these studies yet the management of degraded lands according to different geomorphic units up to meso-level having geomorphological, hydrological and pedological diversities is completely lacking.

The above review shows that most of the studies are concerned with the reclamation of wasteland for agricultural purpose and no adequate attention is put on the eco-friendly land use pattern. The above studies have mostly been carried out in case of the plain areas and there is no study concerned with the problem of wastelands in a hilly area where the terrain is rugged, strata is geologically unstable, carrying capacity of the land is low and environment
is ecologically fragile. Under these conditions, the nature, characteristics and problems of wastelands are different.

The present work has been taken for Sirmaur district and is going to be a study of its own kind. It is different from works done so far in the following respects:

1. It analyses the presence of wasteland in a hilly tract, based upon environmental set up of the area.
2. It takes into account the distribution of different types of wastelands and their association with terrain types.
3. It suggests measures for the restoration, management and conservation of degraded lands / wastelands by identifying eco-friendly land use practices suitable to the terrain nature of the area.

Objectives of the Study

The present research has the following main objectives:

1. To analyse the distribution and determinants of different types of wasteland in Sirmaur district.
2. To identify the association of different types of wasteland with the terrain units (geomorphic units) of the district.
3. To provide site specific natural resource information through case study of a Community Development Block.
4. To suggest suitable measures for reclamation, conservation and management of different wasteland types for better policy formulation.

On these objectives the present research work is planned and its major aim is to analyse the degraded/wastelands in a hilly and mountainous part of the Himalayas that is Sirmaur District from the viewpoints of their existence, distribution, reclamation and management according to geomorphological, hydrological, and pedological characteristics of the district.
Hypotheses

The present study proposes the following hypotheses:
1. The extent and the intensity of degraded land (wasteland) is high at higher altitudes in the district.
2. Proportion of degraded pasture and degraded forestland types of wasteland varies directly with population pressure.

Data Base

A proper and dependable database is essential for the successful completion of any research which can be utilized for the formulation of a comprehensive policy document. This database varies from one theme to the other depending on the nature of the problem under research. The present study, is based mainly on secondary data which was collected from different sources such as from village records, statistical abstracts, topographical sheets and satellite imageries of NRSA from State Council for Science Technology and Environment, Shimla. The data pertaining to soil has been collected from the National Bureau of Soil Survey and Land use Planning, Nagpur; Department of Agriculture, Government of Himachal Pradesh, Shimla; and Deputy Director, Agriculture and Soil Conservation of district Sirmaur. The data for water quality and behavior of water table was collected from the Executive Engineer (Irrigation); the Ground Water Survey Division of the Sirmaur district; State Geological Wing; Department of Industry, Government of Himachal Pradesh; State Pollution Control Board and State Council for Science, Technology and Environment, Government of Himachal Pradesh, Shimla. The rainfall data was gathered from different rain gauge stations situated at Pachhad, Renuka and Kiar-da-dun valley. However, the overall climatic data used in the research work is based upon Kiar-da-dun station.

The different Topo-maps and Imageries used are as follows:-
Topo- maps:
1. Survey of India Topo-sheets
53F/1,2,3,5,6,7,9,10,11,14,15 and 53E/8 (Scale: -1:50,000)
2 Satellite Imageries of National Remote Sensing Agency, Department of Space, Government of India, Balanagar, Hyderabad:-


Besides the above mentioned secondary sources, observation method was also used to get a picture of ground reality through a large number of visits to different parts of the district. The local people, village level officials, and staff of various government departments were consulted to gather information on many qualitative aspects.

Methodology

The adoption of a suitable methodology provides an incentive to analyze and represent the data. The methodology adopted in the present study is based on secondary and primary database. It includes the identification of wasteland types and calculation of average slope, relative relief, drainage density and ruggedness number. Besides, collection of data on rainfall, water quality, water table, soil type, soil texture, drainage, soil erosion, soil reaction etc., the identification of causal relationship amongst different determining variables is also included. The various techniques and data sources used in this regard are as follows:

1. Identification of Wastelands/Degraded Lands: In Sirmaur District, ten types of wastelands are found. These wasteland types were traced from the Satellite Imageries of National Remote Sensing Agency available at Remote Sensing cell of State Council of Science Technology and Environment, Government of Himachal Pradesh, Shimla. Field visits were conducted to verify the existence of identified wasteland in the district.
2. **Average Slope:** The topo-sheets of Survey of India have been used to calculate the slope of the entire district using Wentworth’s C.K. (1930) formula viz:

\[
\text{Average Slope} = \frac{\text{Average numbers of contours crossing per sq. km} \times \text{Contour interval}}{636.6}
\]

where 636.6 is a constant.

3. **Relative Relief:** Relative relief is the difference in height between the highest and the lowest points in a unit area. The relative relief of the study area has been calculated based upon 1:50,000 topo-sheets of Survey of India.

4. **Drainage Density:** Drainage density is ratio of total length of all stream segments and total area in a given areal unit. For the present study it has been calculated by using Horton R.E. (1945) method as follows-

\[
\text{Drainage Density} = \frac{\text{Total drainage length in an areal unit}}{\text{Total area of the areal unit}}
\]

5. **Ruggedness Number:** Ruggedness number was computed by applying H.R. Yadavs(1986) formula viz:

\[
\text{Ruggedness No.} = \frac{\text{Drainage density} \times \text{Relative relief}}{1000}
\]

6. **Rainfall Data:** The rainfall data was collected mainly from Kiar-da-dun rain gauge station, Pachhad and Renuka rain gauge station for the relevant years.

7. **Quality of Water (in pH):** The information for the quality of water was obtained from the Hydrological wing of Irrigation and Public Health Department, Sirmaur; State Geological Wing of Department of Industry Shimla; Cement Corporation of India and State Pollution Control Board, Shimla.

8. **Behavior of Water Table:** This data was collected from Department of Irrigation (Ground Water Survey Division), State Geological Wing, Department of Industry and State Pollution Control Board Shimla. The ground water potential map was also prepared from the satellite imageries.

9. **Pedogenic Data:** The data for soil type, nitrogen, potash, phosphorous, soil depth, soil texture, soil drainage, soil reaction, soil erosion and other properties of soil were collected from National Bureau of Soil Survey and Land use Planning, Nagpur; Directorate of Agriculture Shimla; Deputy Director of Agriculture of Sirmaur (soil testing laboratory
10. Quantitative Techniques:
The identification of causal relationship between wasteland types and various environmental variables such as morphometric, climatic, hydrologic and pedogenic variables was essential for explaining the scientific bases of existence of different wasteland types. This has been done by using Karl-Pearson’s product moment method. A correlation matrix has also been prepared to test the significance of correlation coefficient.

Stepwise regression analysis has also been used for analyzing the effect of different independent variables (environmental and anthropogenic) on the dependent variable (wasteland types). Coefficient of Multiple Determination ($R^2$) and Adjusted Coefficient of Multiple Determination have also been calculated for assessing the explanatory power of the model.

The significance of the regression coefficients has been studied through $t$-test at 1 percent, 5 percent and 10 percent levels of significance. F-test has been used for studying the significance of the adjusted $R^2$.

Cartographic Techniques

The cartographic representation in the form of maps and diagrams has been made to depict the data in a suitable graphic form.

Format of the Study

The present study has been organized into eight chapters, keeping in view the nature of the problem.

1. Introduction: This chapter covers the nature of problem, literature review, objectives, hypotheses, database and methodology.
2. **Geographic Personality of Sirmaur District:** This chapter deals with the location and introducing the district in terms of its physical, biological, demographic and economic environment.

3. **Typology and Distribution of Wastelands:** In this chapter, classification and distribution of various types of wasteland in Sirmaur is analysed.

4. **Determinants of Wastelands:** This chapter discusses the various environmental, anthropogenic and geomorphic factors impacting upon the wastelands in the district.

5. **Wastelands Terrain Association:** This chapter deals with the terrain association of different types of wastelands in the study area.

6. **Case Study: Shallai Community Development Block:** The Block has been brought under exclusive focus as a case study in order to analyse the relationship of wastelands with different physical and demographic attributes and to provide site specific information of natural resource base in the Block.

7. **Strategies for Reclamation, Conservation and Management of Wastelands:** This chapter has been devoted to study the various reclamation, management and conservation methods for wastelands restoration. It also hints at the influence of wasteland area on the social, economic and ecological life in the area.

8. **Summary and Conclusions:** The whole study is summarized and concluded in this chapter. It is followed by a comprehensive bibliography.