CHAPTER FIVE

LAND AND SOIL

5.1 Introduction

5.1.1 In India, on the basis of nine-fold land-use classification, the land use statistics is available for roughly 306 million hectares (mha) of land out of the 329 million hectares of the total geographic area which accounts for 93% of the total land. **The land use classification of India over the years is presented in table 5.1.1 and pictorial representation (Charts 5.1.1 a-d) of the changes is at annexure 5.**

5.1.2 The data shows that land use in the country, over the last five decades, has undergone drastic change. Land under agriculture has almost doubled, forest cover has dwindled to less than half, large tracts of fertile agriculture and forest land have been diverted for urbanization and settlements. Deforestation contributes to loss of precious top soil which amounts to about 35 percent of the global sediment load going to oceans even though water flowing through our rivers is only about five percent of the flow of rivers in the world.

5.1.3 The area under barren and uncultivable land is generally unsuitable for agriculture either because of topography or its inaccessibility. Instances are the desert areas in Rajasthan, the saline land in part of the Rann of Kutch in Gujarat, and the weed infected and ravine land in Madhya Pradesh. Recently, the area under non-agricultural land has increased due to increase in developmental activities; e.g. housing, transport system, irrigation, etc. About 24 mha are occupied by the housing, the industry and for other non-agricultural uses, 19.2 mha are snowbound and remote, leaving only 263 million hectare for agriculture, forestry, pasture and other biomass production. The net sown area increased from 119 mha in 1950-51 to 140 mha in 1970-71, mostly through reclamation of old fallow and cultivable wastelands and diversion of groves. Since 1970-71, the net area sown has remained almost the same at around 141 mha levels. However, there is an increase of 48.48% in the gross sown area, which indicates areas sown more than once have increased considerably. The net irrigated area showed a three fold increase. **Table 5.1.2 at annexure 5 depicts the selected categories of land use classification.**

5.1.4 The **table 5.1.3 at annexure 5 gives the details of waste lands** in India which accounts for 17.45% of the total geographic area of the Country.

5.2 Soil Survey

5.2.1 Soil survey constitutes a valuable resource inventory linked with the survival of life on the earth. The technological advancements in the field of remote sensing and Geographical Information System have been a boon for such surveys. **The State wise coverage of detailed soil survey in India is in table 5.2.1, the State wise coverage of**

soil resource mapping is in table 5.2.2, the reporting under Rapid Reconnaissance Survey in table 5.2.3 are at annexure 5.

5.2.2 Alkali, or alkaline, soils are clay soils with high pH (> 9), a poor soil structure and a low infiltration capacity. Often they have a hard calcareous layer at 0.5 to 1 meter depth. Alkali soils owe their unfavorable physico-chemical properties mainly to the dominating presence of sodium carbonate which causes the soil to *swell.* Alkaline soils are difficult to take into agricultural production.

The State wise extent of alkali area in India and the physical progress in its reclamation are depicted in table 5.2.4.

TABLE 5.2.4 : STATE-WISE EXTENT OF ALKALI AREA, PHYSICAL PROGRESS OF RECLAMATION

(Phy. In thousand ha.)

S.No	Name of State	Alkali Area	Reclamation up to IX Plan	Progress during 3 years of X Plan (2002-05)	Reclamation upto (2004-05)	Target for 2005-06
1	**2**	**3**	4	5	6	7
1	Andhra Pradesh	64.00	0.00	0.00	0.00	0.00
2	Bihar	4.00	0.00	0.00	0.00	0.00
3	Gujarat	610.00	4.72	25.00	29.80	8.00
4	Haryana	450.00	166.95	32.00	198.90	10.00
5	Karnataka	76.00	0.00	2.34	2.30	5.00
6	Madhya Pradesh	164.00	0.09	0.00	0.10	0.00
7	Maharashtra	59.00	0.00	0.00	0.00	0.50
8	Punjab	718.00	275.20	1.33	276.50	5.00
9	Rajasthan	332.00	5.87	13.40	19.30	12.00
10	Tamilnadu	4.00	0.00	2.10	2.10	5.00
11	Uttar Pradesh	1100.00	128.23	1.54	**129.70**	0.00
	Total	**3581.00**	**581.06**	**77.71**	**658.70**	**45.50**

Source: Ministry of Agriculture

5.3 Land Degradation

5.3.1 Land is degraded when it suffers a loss of intrinsic qualities, decline in its capabilities or loss in its productive capacity. Land degradation may be due to natural causes or human causes or it may be due to combination of both. **The State wise information of degraded land of the Districts is in table 5.3.1 at annexure 5.**

5.3.2 Land degradation is a global problem, largely related to agricultural use. The major causes include:

- Land clearance, such as deforestation
- Agricultural depletion of soil nutrients through poor farming practices
- Livestock including overgrazing
- Inappropriate Irrigation
- Urban sprawl and commercial development
- Land pollution including industrial waste
- Vehicle off-roading
- Quarrying of stone, sand, ore and minerals

The following sections discuss in detail the major causes of land degradation and the related Statistics.

5.3.3 The **table 5.3.2 at annexure 5 exhibits the trends in usage of agricultural inputs in India.**

5.3.4 The crop yields have increased greatly in India over the past 20-25 years. Most of these increases have been due to the development of crop varieties which respond to fertilizers. The different types of cropping systems practised in traditional agriculture have given way to systems involving only a few crops which are highly nutrient depleting but high yielding. The legumes, grasses, and millets which were regular components of cropping systems in Indian agriculture have largely been phased out in highly productive areas due to poor economic returns and replaced by high yielding rice, wheat, sugarcane, etc. As a result, the water level is receding at an alarming rate. This has created the problems of soil erosion and the destruction and disturbances to wild life habitats. **Tables 5.3.3 & 5.3.4 at annexure 5 depicts the changing pattern of crop production in India.**

5.3.5 The pesticides and insecticides used in agriculture have a negative impact on the productivity conditions of the soil. **Tables 5.3.5 and Table 5.3.6 at annexure 5 shows the capacity and production of chemical industry for insecticides, fungicides, herbicides, weedicides, roddenticides and fumigents. The table 5.3.7 in annexure 5 shows the details of the enormous consumption of pesticides in India.**

5.3.6 The use of pesticides above permissible limits enters the food chain, causing health hazards. A major concern particularly about chlorinated hydrocarbons like DDT is their persistence in soil.

5.3.7 Among fertilizers, the conversion of fertilizer-N to gaseous forms-ammonia (NH_3) and various oxides of Nitrogen lead to atmospheric pollution. Escape of fertilizer-N as ammonia gas is called ammonia volatilization. The presence of ammonia and sulphur dioxide may lead to acid rains which ultimately degrade the soil. Atmospheric ammonia contaminates water bodies, impairs visibility and causes corrosion. Nitrous oxide also contributes to global warming.

5.4 Soil Erosion

5.4.1 Soil is the non-renewable natural resource which supports life on earth. It is estimated that one-sixth of the world's soils have already been degraded by water and wind erosion. This has two important consequences: the reduced ability of society to produce sufficient food due to loss of quality and depth of soils; and resulted in off-site pollution associated with erosion. These include siltation of dams, pollution of water-courses by agricultural chemicals and damage to property by soil-laden runoff. On-site issues of declining soil quality tend to be spatially dispersed occurring on many different soil types whereas off-site pollution issues tend to be locally concentrated.

5.4.2 Soil erosion problems are not confined to the Developing World. In the last two decades, there has been a growing appreciation of the threat to European soils as a result of intensification of agriculture, overgrazing and climate change. The threat is most apparent in the Mediterranean Region where the term "desertification" has been used to describe a series of inter-related changes which include soil erosion. The EU-funded Mediterranean Desertification and Land Use (MEDALUS) project is currently addressing these latter issues for much of Southern Europe.

5.4.3 In India, about 130 mha of land (45% of total geographical area) is affected by serious soil erosion through ravine and gully, shifting cultivation, cultivated wastelands, sandy areas, deserts and water logging (Govt. of India, 1989).

5.4.4 Soil erosion by rain and river that takes place in hilly areas causes landslides and floods, while cutting trees for firewood, agricultural implements and timber, grazing by a large number of livestock, over and above, the carrying capacity of grass lands, traditional agricultural practices, construction of roads, indiscriminate (limestone) quarrying and other activities, have all led to the opening of hill-faces to heavy soil erosion. Wind erosion causes expansion of deserts, dust, storms, whirlwinds and destruction of crops, while moving sand covers the land and makes it sterile. Excessive soil erosion with consequent high rate of sedimentation in the reservoirs and decreased fertility has become serious environmental problems with disastrous economic consequences. Of the 16 rivers of world, which experience severe erosion and carry heavy sediment load, 3 rivers, namely; Ganges, Brahmaputra and Kosy occupy the 2nd, 3rd and 12th position, respectively.

5.4.5 Soil erosion results in huge loss of nutrients in suspension or solution, which are removed away from one place to another, thus causing depletion or enrichment of nutrients. Besides the loss of nutrients from the topsoil, there is also degradation through

the creation of gullies and ravines, which makes the land unsuitable for agricultural production. Subsidence of the land in some areas and landslides in the hilly tracts are problems affecting highways, habitations and irrigation dams.

5.5 Mining

5.5.1 The activity of mining and quarrying covers underground and surface mines, quarries and wells and includes extraction of minerals and also all the supplemental activities such as dressing and benefaction of ores, crushing, screening, washing, cleaning, grading, milling floatation, melting floatation and other preparations carried out at the mine site which are needed to render the material marketable.

TABLE 5.5.1 : MINING LEASES (By Principal States) (as on 31-3-2009)*

Sl. No.	State	No. of Mining Leases Granted/Executed	Percentage to Total Leases	Area ('000 Hect.)	Percentage of Total Area
1	**2**	**3**	**4**	**5**	**6**
1	Andhra Pradesh	1578	17	54	11
2	Chhattisgarh	312	3	18	4
3	Goa	422	5	31	6
4	Gujarat	1228	13	28	6
5	Jharkhand	323	3	37	7
6	Karnataka	693	7	57	12
7	Madhya Pradesh	948	10	28	6
8	Maharashtra	280	3	18	4
9	Orissa	387	4	67	13
10	Rajasthan	2068	23	107	22
11	Tamilnadu	482	5	7	1
12	Others	595	7	41	8
	All States	**9416**	**100**	**493**	**100**

Source : Indian Bureau of Mines (IBM), Nagpur
* :Excuding coal & lignite, fuel atomic and minor minerals.

5.5.2 The mining activities in the country are governed by the Mineral Conservation Development Rules (MCDR), 1988. Every license holder of mining lease shall take all possible precautions for protection of environment and control of pollution while conducting prospecting, mining beneficiation or metallurgical operations in the area. Specific provisions for proper removal and utilization of top soil, storage of over burden and waste rocks, reclamation and rehabilitation of lands, precautions against air pollution, noise and ground vibrations, restoration of flora, discharge of toxic liquid, control of surface subsidence have been provided under the MCDR. The Indian Bureau of Mines collects the statistics on all these aspects under the above rules.

The industry wise mines reported (1999- 2008) in India is presented below in table 5.5.2.

TABLE 5.5.2 Number of Reporting Mines (1999 -99 to 2007-08)

Year	Total*	Coal & Lignite	Metalic Minerals	Non-Metallic Minerals
1	2	3	4	5
1998-99	3283	567	621	2095
1999-00	3209	611	572	2026
2000-01	3191	596	565	2030
2001-02	3193	570	574	2049
2002-03	3145	562	591	1992
2003-04	3131	562	612	1957
2004-05	3214	571	625	2018
2005-06	2995	556	636	1803
2006-07	3005	570	639	1796
2007-08	3023	570	691	1762
2008-09 (P)	2991	570	691	1730

Source : Indian Bureau of Mines (IBM), Nagpur

* : Includes iron & steel

Reporting mine: A mine reporting production or reporting 'Nil' production during a year but engaged in developmental work such as overburden removal;, underground driving, winzing, sinking work; exploration by pitting, trenching or drilling as evident from the MCDR returns. P : Provisional

The detail of underground mines in India is exhibited in table 5.5.3 below:

TABLE 5.5.3 NUMBER OF UNDERGROUND MINES
(By Principal Minerals)

Mineral	2007-08 (R)			2008-09 (P)		
	Total	A' Category	B' Category (Other than 'A')	Total	A' Category	B' Category (Other than 'B')
1	2	3	4	5	6	7
Apatite	1	0	1	1	0	1
Asbestos	3	1	2	3	1	2
Ball Clay	1	0	1	1	0	1
Barytes	1	0	1	1	0	1
Chalk	1	0	1	1	0	1
Chromite	5	5	0	5	5	0
Copper Ore	3	3	0	3	3	0
Gold	4	3	1	4	3	1
Lead & Zinc Ore	6	6	0	6	6	0
Limestone	9	4	5	10	4	6
Manganese Ore	12	8	4	12	8	4
Mica	24	3	21	28	3	25
Ochre	1	0	1	0	0	0
Salt (Rock)	1	0	1	1	0	1
Sand (Others)	6	0	6	7	0	7
Steatite	23	1	22	22	1	21
Total	**101**	**34**	**67**	**105**	**34**	**71**

Source : Indian Bureau of Mines (IBM), Nagpur
Category 'A' : Mechanised Mines, > 150 labour in all and > 75 labour in workings below ground. Category 'B' : Other than Category 'A'
P : Provisional

The number of Mines in various States and production of minerals are presented in tables 5.5.4, 5.5.5 at annexure 5.

5.5.3 **The details of machinery and explosives used in Mining Industry is exhibited in tables 5.5.6, 5.5.7 at annexure 5.**

5.5.4 The details of production of coal and lignite, consumption of minerals in various industry are elaborated in tables 5.5.8 to 5.5.12 at annexure 5.

5.5.5 The condition of reserves and resources for various minerals in the Country is presented in table 5.5.13 at annexure 5.

5.5.6 Environmental issues associated with mining can include erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to increase the available room for the storage of the created debris and soil. Contamination resulting from leakage of chemicals can also affect the health of the local population if not properly controlled. Mining companies in most countries are required to follow stringent environmental and rehabilitation codes in order to minimize environmental impact and avoid impacts on human health. These codes and regulations all require the common steps of Environmental impact assessment, development of Environmental management plans, Mine closure planning (which must be done before the start of mining operations), and Environmental monitoring during operation and after closure. However, in some areas, particularly in the developing world, regulation may not be well enforced by governments.

The data on rehabilitation of mining land and reclamation of abandoned mines in India shown in table 5.5.14 indicates the progress made in these areas.

TABLE 5.5.14 : INFORMATION ON REHABILITATION OF MINING LAND/RECLAIMATION OF ABANDONED MINES

Sl. No.	Item	For the Year	Cumulative
		2008-09	2008-09
1	2	3	4
1	No. of abandoned mines	0	102
2	No. of abandoned mines reclaimed	0	53
3	Total area reclaimed in abandoned mines (in hect.)	0	660
4	No. of mines (working) where reclamation / rehabilitation is carried out	37	1202
5	Area of such reclaimed / rehabilitation in working mines(in hect.)	524	11771

Source : Indian Bureau of Mines

5.5.7 Status of afforestation and trees survived in mining areas in India is presented in table 5.5.15 at annexure 5.

5.6 Natural disasters in India

5.6.1 Many of the natural disasters occuring in India are related to the climate of the country. They cause massive losses of Indian life and property. Droughts, flash floods, cyclones, avalanches, landslides brought on by torrential rains, and snowstorms pose the greatest threats. Other dangers include frequent summer dust storms, which usually track from north to south; they cause extensive property damage in North India and deposit large amounts of dust from arid regions. Hail is also common in parts of India, causing severe damage to standing crops such as rice and wheat.

TABLE 5.6.1 : FREQUENTLY OCCURRING NATURAL DISASTERS IN INDIA

Sl. No.	Type	Location/ Area	Affected Population (in Million)
1	2	3	4
1	Cyclones	Entire 5700 km long coastline of Southern, Peninsular India covering 9 States viz Gujarat, Maharashtra,Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal and Union Territory of Pondicherry besides Islands of Lakshadweep and Andaman and Nicobar	10
2	Floods	8 major river valleys spread over 40 million hectares of area in the entire country	260
3	Drought	About 68% of total sown area and 16% of total area of the country spread in 14 States of Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal & Himachal Pradesh covering a total of 116 districts and 746 blocks	86
4	Earthquake	56% of the total area of the country susceptible to seismic disturbances	400
5	Landslide	Entire sub Himalayan region and Western Ghats	10
6	Avalanche	Many parts of the Himalaya	
7	Fires	States of Bihar, West Bengal, Orissa and north eastern States	140
Source : India: State of the Environment, 2001, Ministry of Environment & Forests			

The details of the natural disasters occurred in India as depicted in table 5.6.2.at annexure 5 indicates the frequency and impact of major natural disasters.

5.6.2 The two thirds of India lies in the Seismic zones of moderate to severe intensity. The Himalayan Range, the Indo-gangetic plains and the Kuthch and Kathaiwar region of Western India are geologically the most unstable parts, and are most prone to earthquakes. The Himalayan frontal arc flanked by the chaman fault in the west constitutes one of the most seismically active intra-continental regions in the world. In a span of 53 years, four earthquakes, exceeding magnitude 8 on the Richter scale, occurred in this region. These are the Assam earthquakes of 1897 and 1950, the Kangra earthquake of 1905 and the Bihar-Nepal earthquake of 1934. Besides the Himalayan regions, the Union Territories of Andaman and Nicobar Islands are also quite vulnerable to earthquakes. Peninsular India comprises stable continental crust regions, which are considered stable since they are away from tectonic activity of the boundaries. These regions are considered seismically the least active but the Latur earthquake in Maharashtra on September 30, 1993 of magnitude 6.3 in the Richter scale showed that this region, too, is unstable and earthquake prone. **Table 5.6.3 at annexure 5 presents the major earthquakes in earth quakes in India.**

5.6.3 Landslides are common in the Lower Himalayas. The young age of the region's hills result in labile rock formations, which are susceptible to slippages. Rising population and development pressures, particularly from logging and tourism, cause deforestation. The result is denuded hillsides which exacerbate the severity of landslides; since tree cover impedes the downhill flow of water. Parts of the Western Ghats also suffer from low-intensity landslides. Avalanches occurrences are common in Kashmir, Himachal Pradesh, and Sikkim.

5.6.4 Floods are the most common natural disaster in India. The heavy southwest monsoon rains cause the Brahmaputra and other rivers to distend their banks, often flooding surrounding areas. Though they provide rice paddy farmers with a largely dependable source of natural irrigation and fertilisation, the floods can kill thousands and displace millions. Excess, erratic, or untimely monsoon rainfall may also wash away or otherwise ruin crops. Almost all of India is flood-prone, and extreme precipitation events, such as flash floods and torrential rains, have become increasingly common in central India over the past several decades, coinciding with rising temperatures. Mean annual precipitation totals have remained steady due to the declining frequency of weather systems that generate moderate amounts of rain. **Table 5.6.4 at annexure 5 presents a record of damages due to floods in India.**

5.6.5 **The State wise details of damage to human lives and property due to heavy rains/ floods, cyclonic storms and landslides during 2005 in India is in table 5.6.5 and the details of extent of damage in various States due to disasters during South – West monsoon- 2009 is in table 5.6.6 at annexure 5.**

5.6.6 **The extent of relief operations done during South West monsoon during 2009 in table 5.6.7 at annexure 5 is an indicator of impact of the calamities occurred during that period.**

5.6.7 Drought is a perennial and recurring feature in many parts of India. Drought leads to large-scale migration in search of alternative livelihoods, loss of human life due to stress, suicide, starvation or unhygienic conditions, and increased social conflict. **Table 5.6.8 at annexure 5 elaborates the details of drought prone areas in India.**

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