

# Desertification in India: Challenges and Remedial Measures

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**Abstract**—Desertification is a universal phenomenon and a persistent danger to mankind. The human activities for his subsistence and endurance lead to overloading the land resources and ultimately destruction of delicate ecological balance. The overuse of soil resource and imbalance in ecosystem enhances denudation, erosion soil salinization, deforestation and ultimately transformation into a desert. India is a huge country covering 3.28 million square km with varied surface features. A semi-arid belt in the peninsular region extends in the area between the humid west coast and the central and eastern parts of the country. This segment is very prone to desertification. The aim of this paper is to find the causes of rapid desertification and to suggest some possible measures to combat it

**Key words**—Land degradation, Desertification, arid and semi-arid climate zone, ecological balance, industrialization, urbanization

## I. INTRODUCTION

Land degradation as described by the Global Land Degradation Information System (GLADIS) is the reduction in the capacity of the land to provide ecosystem goods and services over a period of time (Nachtergaele and Petri, 2008; Nachtergaele et al., 2010, 2011) is happening globally and influenced by on the associations between several natural and socioeconomic elements. Surprisingly, humid areas seem to have a higher share of the global land degradation than primarily assumed (Bai and Dent, 2007). Consistent with the Global Land Degradation Assessment (GLADA), land degradation is growing, with almost one-quarter of the global land area being degraded between 1981 and 2003. The most severely affected areas are Africa south of the Equator, Indochina, Myanmar, and Indonesia. Land degradation happening in drylands is described as Desertification. Aridity of a region is categorised by the ratio of  $P = \text{Mean Annual Precipitation}$  to  $PE = \text{Mean Annual Potential Evapotranspiration}$ . As per this, the aridity zones are classified as given in Table. The “drylands” are defined as those regions where the ratio of the mean annual precipitation to the mean annual evapotranspiration is in the range of 0.05-0.65. Classification of regions on the basis of aridity index is given in Table 1

Table 1: Classification of regions on the basis of aridity index

Climate Zone	P/PE ratio	% of world covered
Hyper-arid	<0.05	7.5
Arid	0.05-0.20	12.5
Semi-arid	0.21-0.50	17.5
Dry sub-humid	0.51-0.65	9.9
Humid	>0.65	39.2
Cold	>0.65	13.6

Source of Inf.: WMO-UNEP Report (1996): Interactions of Desertification and Climate

According to International Convention to Combat Desertification (CCD) adopted by United Nations (UN, 1994), desertification is “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climate variations and human activities”. The anthropologic processes like unplanned developments, human and livestock population stress, industrialization, urbanization and mining may accelerate the desertification process. The adversely changing rainfall pattern and rising trends in temperature are making this desertification scenario more severe. The Drylands cover about 41 percent of Earth’s land surface and inhabited by more than 38 percent of the global population (Reynolds et al., 2007). Land degradation harms ecosystem functions and services, thereby jeopardizing livelihoods, economies and societies. Despite the significance of the issue and its close relation to economic survival of the poorest populations, land degradation does not get adequate attention often because of the complex challenges it poses and the need for a better consideration of the issue.

India has 2.4 percent of the total world’s land of which about 69.5 percent (i.e. 228.3 million hectares - mha) is dryland. The National Bureau of Soil Science and Land Use Planning classified dryland regions of India as arid (50.8 mha), semi arid (123.4 mha) and dry sub humid regions (54.1 mha) (cf. Table 2)

*Table 2: Dry lands in India*

Dry land	Mha
Arid	50.8
Semi-arid	123.4
Dry sub humid	54.1

Overpopulation causes abuse of land resources in dry lands (UNCCD, 2011). Human population pressure is most critical indicator for desertification in a country like India (MoEF, 2001). In India 32.75 percent of the total geographical area is affected by various forms and degree of desertification (MoEF, 2006, 2008).

The general climate of the country is tropical monsoon, with an annual precipitation estimated at 1,200 mm. The distribution of the rainfall across the country varies from less than 100 mm in extreme arid areas of Western Rajasthan to greater than 3,600 mm in north-eastern States and 1,000 mm from east coast to 3,000 mm in the west coast. Shifting in precipitation patterns leading to aridity or hyper-aridity over certain locations, especially over semi-arid regions that suffer from obstinately negative trends in precipitation is one of the grave and possible consequences of global warming and climate change. Even though global warming is generally related with a wetter climate owing to a general escalation in tropospheric moisture, local effects of climate change could be reduced rainfall. Linear trends in both rainfall and surface temperature show significant spatial variability with negative trend over many places, even though the large-scale area-averaged rainfall may be stable. Further, approximately 93 percent of the accessible water resources are used for agriculture and only 4 percent for industrial purposes. The total water requirement by 2050 is expected to go to 1,180 billion cubic meters. The national average of annual per capita availability of water is about 1,829 cubic meters, which may decline to 1,557 cubic meters by 2015 due to projected increase in population. In addition to this, as a result of heavy extraction of groundwater and its limited recharge, groundwater is getting depleted in the drylands in Punjab, Haryana, Uttar Pradesh, Rajasthan, Andhra Pradesh, Karnataka, Orissa and Maharashtra. The rainfall and monsoon patterns in India are summarized in Table 3

*Table 3: The rainfall and monsoon patterns in India*

SEASON	RAINFALL (%)	RAINWATER AVAILABLE
Winter and pre-monsoon	16	64
South-West monsoon (June-September)	74	296
North-East monsoon (Oct- Dec)	10	40
Total for the year	100	400

Agriculture is the backbone of Indian economy which in turn is mainly dependent on monsoon. While India is required to increase land based productivity to ensure food security for its rapidly growing populace, both farm based activities (agriculture) and non-farm but allied activities (livestock) that are dependent on natural resources are suffering because of land degradation and desertification. The gauge and bearing of land degradation and desertification is severe in India, affecting about 32% and 25% respectively of India's total land area. Not only it undesirably affects the country's ecosystem health and farm productivity, it further leads to fewer job opportunities and local migrations. Sidelined farmers with small land assets are most affected. Funds are prerequisite to maintain and/or increase land based productivity and prevent land degradation and desertification that has to be looked up on at the policy level more emphatically.

Forestry is a vital share of land use. Forests occupy a recorded range of about 77.47 million ha thereby constituting 23.6% of the total geographical area of the country. However, the actual forest cover is just 67.84 million ha out of which 28.78 million ha are open forests. 4.03 million ha of land areas is under scrub vegetation. Thus about 32.81 million ha of forest in the country are degraded or open. The forests range from tropical rainforest to dry thorn forests and to mountain temperate and alpine forests. The land use pattern of India is presented in Table 4.

*Table 4: Land use pattern in India*

Land Use Area	(mha)
Total Land Area	328.73
Forests	67.84
Area under Non-Agricultural Use	21.8
Barren and Un-Culturable Land	19.4
Permanent Pastures and Grazing Lands	12
Fallow Lands	24
Cropped Area	142.5
Area under Food Grain Cultivation	123.5
Area under Rainfed Farming Systems	89

## II. CAUSES OF DESERTIFICATION IN INDIA

### 1. Unsustainable Agrarian Practices:

Untenable agrarian practices comprise of unnecessary and excessive use of fertilisers, pesticides, recurrent cropping patterns, inapt technologies, or choice of crops/ plants, etc.

2. ***Unsustainable Water Management Practices:***

Meagre & inefficient irrigation practices, over abstraction of ground water, particularly in the coastal regions resulting in saline incursion into aquifers, etc. are some of major unsustainable water management practices which has led to problems of desertification in such regions. Over abstraction of groundwater without compensatory rejuvenation has led to depletion of groundwater table.

3. ***Land Use variation:***

With the rapid urbanization and industrialization, alteration of land from forestry and agriculture to other land uses has been one of the primary causes of land degradation this practice was curtailed with the enactment of Forest (Conservation) Act, 1980 with the objective of arresting diversion of forest land for non-forestry purposes. Wherever diversion of forest land is inevitable, for instance for developmental projects (energy, infrastructure, transportation, etc.) compensatory afforestation on non-forest land is mandatory. However, loss of major forests could have an influence in the long-term stability of the forests. The other land use change is due to infringements, through violation of forest boundaries, illegal farming in forests. As a consequence of the illegal status, people involved are unable to receive extension services and improve their farming schemes, thereby accelerating land degradation further. The encroachment of forest land, and the socioeconomic pressure to regularize them, is still the most spiteful problem of forest protection.

4. ***Deforestation:***

It is hard to separate the causes from the effects of deforestation and forest degradation. Some direct causes of deforestation are land permissions for agriculture (including shifting cultivation), other land use changes including unplanned urbanisation, land transfers, different forms of encroachments, over-grazing, uncontrolled and wasteful logging, illegal felling, and excessive fuel wood collection.

5. ***Unchecked discharge of Industrial effluents into water bodies and soil:***

Industrial effluents and mining are also gradually emerging as important causes of desertification. In most cases in the core of the problem is the mismanagement by land users and poor execution of pollution control regulations. Industrial effluents and their discharge into nearby water bodies and irrigation with poor quality water in many parts of the country are rendering stretches of land getting degraded. Industrial effluents from textile, printing and dyeing industry and their discharge into streams and rivers, which are non-perennial with no flow during the lean season severely pollutes them. Use of such waters for irrigation has affected agricultural land as well. Besides decline in productivity, progressive degeneration of bio-diversity is yet another major consequence of land degradation.

6. ***Population Pressure:***

The general problem of arid areas with large populations is essentially one of human ecology. The intrinsically limited resources within arid and semi-arid regions set the critical limit of production are finally dependent. The situation aggravates with erratic rainfall results in

extensively fluctuating production leading to scarcity, which levies stress on these populations. In general, the population density of both human and livestock in the arid region is much higher than the national average. The decennial growth rate of population during the decade 1981-91 in the desert region was 29% as against 23% for the country (MOEF, 1996). The livestock population also increased from 9.4. million in 1951 to 14.4. million in 1961 (53% increase ) and to 15.52 million in 1971 (8% increase). This has led to increase in the density of livestock on grazing lands. As population increases, the demand on natural resources is further magnified.

#### 7. *Lack of knowledge and awareness*

There is inadequate quantitative data on current land use in arid and semi-arid regions of the country. Whatever information is available is scattered across many agencies and institutions and is not readily accessible to researchers, planners, and policy makers, hampering the full assessment of land degradation and desertification problems and the quantification of economic losses to the region. There is need to develop suitable data basis and geographical information systems to encourage integrated planning at the desertified areas at regional level. Communities in dry land areas are now generally aware of land degradation issues and have information of the resources existing in their vicinity. They are, however, unaware of the full magnitude of land degradation and desertification. Similarly, there is very little knowledge of land degradation and desertification issues among the general public, planners and policy makers and even among those who are directly responsible for the management of land resources.

### III. REMEDIAL MEASURES

Following initiatives have been suggested by Ministry of Environment and Forest under Government of India.

1. Encourage adoption of science based and traditional sustainable land use practices, through research and development, extension of knowledge, pilot scale demonstrations, large scale dissemination and access to institutional finance;
2. Promote reclamation of wasteland and degraded forestland, through formulation and adoption of multi-stakeholder partnerships;
3. Prepare and implement thematic action plans incorporating watershed management strategies, for arresting and reversing desertification and expanding green cover;
4. Promote sustainable alternatives to shifting cultivation, where it is no longer ecologically viable, ensuring that the culture and social organization of the local people are not disrupted; and,
5. Encourage agro-forestry, organic farming, environmentally sustainable cropping patterns and adoption of efficient irrigation techniques.

### IV. FUTURE PERSPECTIVES

Just as human activities are foremost in triggering land degradation or desertification, timely action by local communities based on socio-scientific database can change the drivers of degradation. In the areas affected by desertification there is often more need of access to external resources to protect their livelihoods

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