DEGREE, EXTENT AND TREATMENT OF DESERTIFICATION HAZARDS IN INDIA

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INTRODUCTION

Land degradation is a dynamic process. It is the result of both- natural and biotic forces operating on the earth. Natural calamities, viz, earthquakes, floods and droughts etc, over-exploitation of land resources, unwise land use and the consequences of high inputs agriculture on soil and environment are of great concern that sensitized the international bodies to combat land degradation and desertification in both developed and developing countries. Development of degraded lands in India is one of the options available to enhance food production and to restore the fragile eco-system. The scientific information and spatial distribution of various kinds of degraded lands is thus essential for formulation of strategic plan to arrest the menace of land degradation. The statistics on degraded lands published by different and non- governmental agencies not only vary widely but the nomenclature of degraded lands also differs considerably. It thus, necessitates rapid inventorying of degraded lands to generate realistic database on degraded lands using remote sensing techniques in the country as a first step of strategic planning.. Subsequently, detailed information on soil and land characteristics are required to be generated, which is vital for development of location specific plan for reclamation of degraded lands.

All India Soil and Land Use Survey (AISLUS) has undertaken the task of land degradation mapping using remotely sensed data and developed a methodology accordingly. The mapping has been conceptualized as a four tier approach comprising kind of degradation, severity and degradation, degradation under major land form and land-use. Visual mode of interpretation technique based on image characteristics has been employed for mapping of degraded lands, image interpretation key has been formulated based on the spectral signatures of various causative factors of different kinds of degraded lands. The mapping legend has been made very systematic and commutative. The extent and spatial distribution of different

kinds of degraded lands with degree of severity under major landform and major land use in a district could be derived easily.

Generation of realistic information on degraded lands of the country is utmost necessary. Visual mode of interpretation technique based on image characteristics has been employed for mapping of the degraded lands. Image interpretation key has been formulated based on the mapping legend. The degree and extent of desertification hazard of different kinds with degree of severity under major landform could be derived.

Review of Literature

A significant work has been done in the field of desertification by eminent world personalities. Worth mentioning are Biswas[1], where causes and process of desertification – abiotic and biotic factors and measures to combat desertification are analyzed. Sehgal and Abrol[2] has described that about 50.5% of the area under desertification through various factors. Jain[3] has described the adverse geo-hydrological and geo-morphological conditions and pedogenic limitations of desertification. .Shankarnarayan[4] has described major problems of desertification in Indian sub-continent. Rao, et al[5] have dealt with the role of space technology in assessment, monitoring and combating desertification. Kaul[6] – has suggested measures for long term sustainability. Chouhan[7] has focused in his study on introduction of desertification situations, its indicators, process and causes, Satellite remote sensing and Measures for combating desertification.

Above literature lack on focusing the pinpointed issue of extent and degree of desertification hazard, whereas the present attempt addresses the area and its location on the map as well as through narration to reveal the present extent and degree of desertification helpful for the planners and decision makers to take suitable measures.

METHODOLOGY

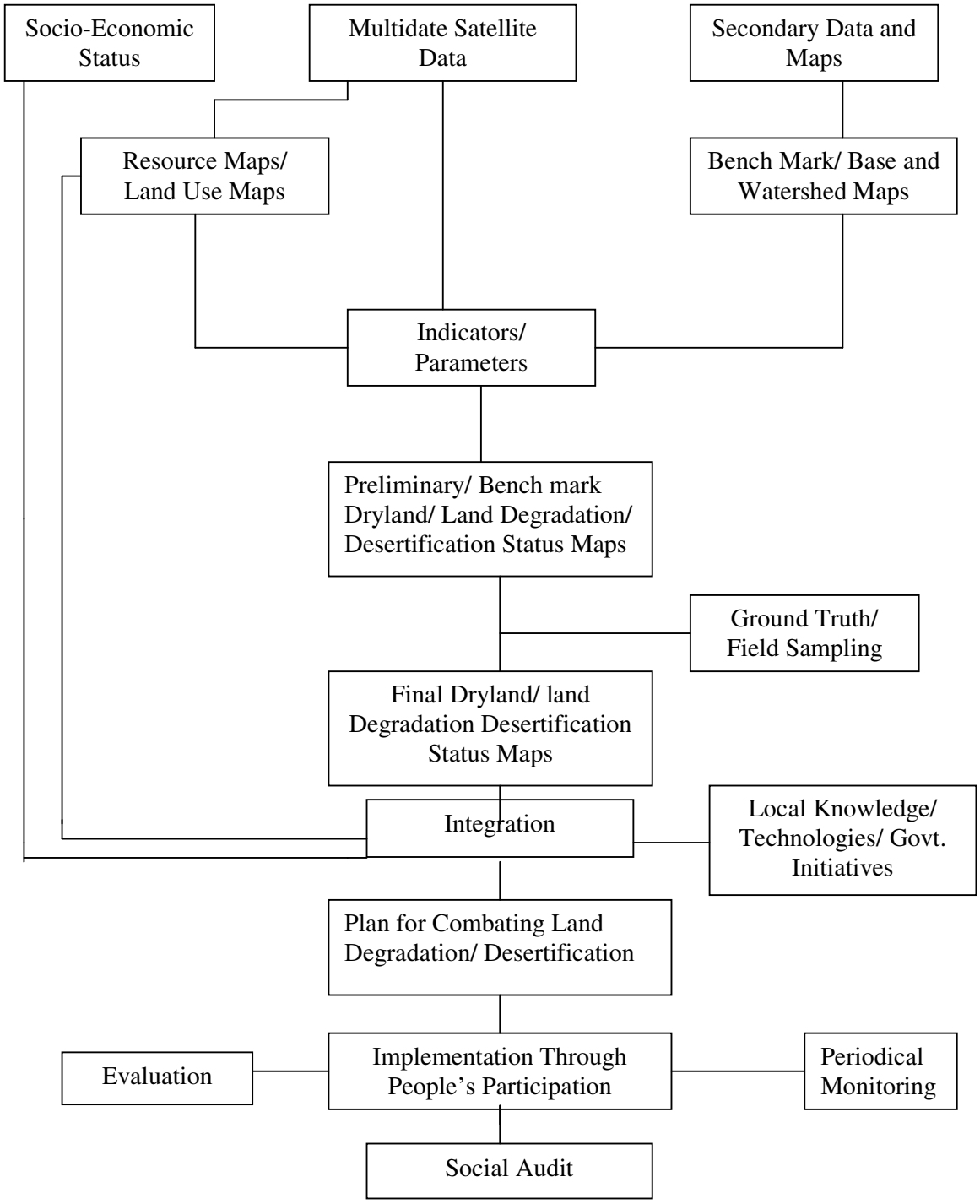
The present paper has been substantiated by extensive fieldwork. The essential data have been collected from a wide range of sources. The remote sensing data available in black and white and false colour composites of IRS-LISS-III of different seasons on 1: 1 million and 1: 250,000 scale have been used. Survey of India topo-sheets (old and new) for the entire region both 1:4 miles or a: 250,000 scale, 1: 1 mile or 1: 50,000 scale and a bioclimatic map, have been used as base maps.

India has a geographical area of 329 million hectare, but land use statistics are available for 304 million hectare. Out of the total reporting area, 30 million hectare is classified as other uncultivated area and 41 million hectare is under non-agricultural use, making a total of 71 million hectare, which is not available for cultivation. The area under non-agricultural purposes is reportedly increasing at the rate of 0.3 million hectare per annum. The area classified as forests is reported to be 67 million hectare. Out of the total forest area, actual area with more than 10 percent canopy is about 64 million hectare and out of this, only 38 million hectare has a canopy cover of 40 percent or more. Thus about half of the forest area is in advanced stage of deterioration.

The area under arid, semi arid and sub-humid zones has been calculated as no such information was available to stress the areas of different bio-climatic zones to communicate the intensity and magnitude of problem through various methods by super-imposing over one map. The methodology has been transcribed in flow chart.

Flow Chart

RESEARCH DESIGN FOR COMBATING DESERTIFICATION/ LAND DEGRATION IN DRYLANDS USING SATELLITE DATA & GIS



Degree and Extent of Desertification Hazard

In the absence of scientific measurements and monitoring of soil degradation/ land degradation for most of the world's land surface, the data that did exist for each unit were supplemented by expert opinions from the participants, who were selected for their intimate knowledge of local conditions. Using a standardized set of guidelines to ensure uniformity in reporting, soil degradation was assessed over the recent past, ideally averaged over the previous 5 or 10 years, but in some cases the time period extended over recent decades.

The involvement of a large number of scientists with personal experience of regional conditions is an important strength of GLASOD. The complex interplay of soil degradation/ land degradation processes and their spatial variability needs to be assessed according to local conditions and forms of land use. This point is well illustrated in the case of off-site effects of soil erosion. Soil is often lost from steep highland slopes and deposited in lower, move level sites. If the lower site contains a reservoir, the accumulation of sediment is a problem; it causes a loss of storage capacity requiring expensive remedial efforts.

This spatial variability in the operation of degradation processes also illustrates an important point concerning the scale of analysis. Scoones[8] noted that despite indications of increased degradation in his study areas, livestock production had not declined, although this could have been because negative effects on production lagged the initial degradation. The scale of the GLASOD mapping polygons of large areas on the ground are coloured according to an average severity of degradation.

Areas identified as non-degraded in the GLASOD survey are designed wither 'stable' or 'non-used' by human populations. Stable areas are either those regions, where human intervention is minimal due to very low population densities, or regions where soil improvement or protection programmes have been successfully implemented. Non-used areas are those not used for agricultural purposes, permanent pasture or covered by forest or woodland. This category includes land with little value for agricultural use, but land in this category may also be potentially productive, but has been put to other land use e.g. build on areas and roads.

Severity is calculated according to a combination of the degree of soil degradation and the percentage of the area affected. The degree to which soil is degraded has been estimated in relation to changes in agricultural suitability, in relation to reduced productivity and in some cases in relation to its biotic functions. The degree of degradation is classified according to the following scheme:

(a) **None** : There is no sign of present degradation from water or wind erosion, from chemical or physical deterioration; all original biotic functions are intact. Such land is considered stable.

(b) **Light:** The terrain is suitable for use in local farming systems, but with somewhat reduced agricultural productivity. Restoration to full productivity is possible by modifications of the management system. The original biotic functions are still largely intact.

(c) **Moderate**: The terrain is still suitable for use in local farming systems, but with greatly reduced agricultural productivity. Major improvements are required to restore productivity, such as draining for water-logged or salinized land or counter banks for eroded land. The original biotic functions are partially destroyed.

(d) **High:** The terrain is not reclaimable at the farm level. Major engineering works are required for terrain restoration. The original biotic functions are largely destroyed.

(e) **Very High**: The terrain is not reclaimable and impossible to restore. The original biotic functions are completely destroyed.

The importance of the land use in question should be noted here. While a moderately degraded soil for example may require major structural alterations to restore productivity under one particular land use, for a less demanding land use the alterations required may be less intensive. The relative extent of degradation was expressed using five categories:

(i) **Infrequen**t: Up to 5 % of the unit is affected.

(ii) **Common:** 6-10 % of the unit is affected

(iii) **Frequent**: 11-25 % of the unit is affected.

(iv) **Very Frequent**: 26-50 % of the unit is affected.

(v) **Dominan**t: More than 50% of the unit is affected.

The degree and extent of desertification hazard has been depicted on the Fig. 1. The map contains multi-facet aspects of desertification from various angles as per existence of problem and extent of the existence of the problem. It can be witnessed from the map that out of 29 states, 12 states have been affected with the desertification problem covering of an area of 531870.48 sq. kms which is about 16.18 percent of the total geographical area spread over in 12 states., viz, Andhra Pradesh, Gujarat, Haryana, Jammu and Kashmir, Karnataka,

Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. Areas classified as arid, semi-arid and dry sub-humid with state-wise position of affected area are given in Table 1. It would be seen from the table that highest area under desertification exist in Rajasthan. Arid area of Rajasthan State is almost half of total similar category, whereas semi-arid area is maximum in Maharashatra. .Madhya Pradesh possesses maximum sub-humid area and that is the only category of desertification area in the state.

TABLE 1
DEGREE AND EXTENT OF DESERTIFICATION HAZARD

(Area in Sq. Kms)

State	Total Geog. Area	Arid	Semi-arid	Dry Sub-humid	Total Dryland
Andhra Pradesh	275045.00	--	35754.12	48199.15	83953.27
Gujarat	196024.00	16561.24	18800.34	--	35361.58
Haryana	44212.00	--	4415.55	8811.99	13227.54
Jammu & Kashmir	222236.00	30862.17	--	9118.29	39980.46
Karnataka	191791.00	--	29115.08	31002.58	60117.66
Madhya Pradesh	443446.00	--	--	50032.76	50032.76
Maharashtra	307713.00	--	47468.09	23409.89	70877.98
Orissa	155707.00	--	--	801.38	801.38
Punjab	50362.00	--	6273.79	--	6273.79
Rajasthan	342239.00	47986.78	23556.08	34583.84	106126.70
Uttar Pradesh	294411.00	--	--	34803.94	34803.94
Tamil Nadu	130058.00	--	--	30313.42	30313.42
Total	2653244.00	95410.19	165383.05	271077.24	531870.48
India (Total Area)	3287263.00	95410.19	165383.05	271077.24	531870.48

Source: Area calculated by the author on the basis of fig. 1.

The information given in above table reveals that the states facing the problem of desertification cover 80.71% of the total geographical area of the country. However, the present level of desertification in these state is 20.15 percent of the total geographical area of the affected states. Table 2 gives the percentage distribution of position of desertification in each category in comparison to total geographical area of each state to understand severity of the problem. The percentage distribution of 12 states has been indicated out of the total geographical areas of these states. Similarly, the percentage distribution in the country has been shown to total geographical area of the country to stress the desertification problem.

The information given in Table 2 reveals that under arid areas the desertification situation prevail in Gujarat, Jammu & Kashmir and Rajasthan with maximum area in Rajasthan. The semi-arid area prone to desertification is in 7 states of the country with maximum percentage coverage in Maharashtra. Dry sub-humid area covers 10 states out of

total 12, where Tamil Nadu has highest percentage area under the only this category. Though Madhya Pradesh has maximum area under dry sub-humid category, but it is lesser in percentage terms to its total geographical area.

TABLE 2
PERCENTAGE DISTRIBUTION OF DESERTIFICATION HAZARD TO TOTAL GEOGRAPHICAL AREA OF RESPECTIVE STATE.

State	Total Geog. Area	Per cent of Total Dryland to state	Per cent arid area to State area	Per cent semi-arid area to state area	Per cent dry sub-humid area to total state area
Andhra Pradesh	275045.00	30.52	--	13.00	17.52
Gujarat	196024.00	18.04	8.45	9.59	--
Haryana	44212.00	29.92	--	9.99	19.93
Jammu & Kashmir	222236.00	17.99	13.89	--	4.10
Karnataka	191791.00	31.35	--	15.18	16.17
Madhya Pradesh	443446.00	11.28	--	--	11.28
Maharashtra	307713.00	23.03	--	15.43	7.60
Orissa	155707.00	0.51	--	--	0.51
Punjab	50362.00	12.46	--	12.46	--
Rajasthan	342239.00	31.01	14.02	6.88	10.11
Uttar Pradesh	294411.00	11.82	--	--	11.82
Tamil Nadu	130058.00	23.31	--	--	23.31
Total 12 States	2653244.00	20.05	3.60	6.23	10.22
India (Total Area)	3287263.00	16.18	2.90	5.03	8.25

Source: Area calculated by the author on the basis of fig. 1.

A. Degree of Desertification Hazard

The degree of desertification has been classified under three categories as Moderate desertification, High desertification and Very High desertification. These areas have been demarcated as 3, 2 and 1 respectively in the map. The analysis of desertification in terms of geographical position reveals that the western part of the country from north to south is prone to desertification. The peninsular area is completely covered with exception to western coastal area and except some part f eastern peninsular of Tamil Nadu. Total eastern part of the country from north to south is completely free from desertification hazard Areas prone to very high desertification belong to semi arid areas of Rajasthan and Gujarat.

Information given in the figure is evident that the areas of various desertification categories have created significantly larger zones, where, rainfall deficiency has intensified

the problem further. According to this classification, the position of each affected state has been described in table 3.

TABLE 3

DEGREE OF DESERTIFICATION IN AFFECTED STATES

State	Degree of Desertification
Andhra Pradesh	Areas under the categories of semi arid and dry sub-humid zones are presently under the moderate category of desertification.
Gujarat	Northern part adjoining to Pakistan under arid zone and middle part under semi arid zone is high desertification prone, whereas the north-western part situated in between is very high desertification category.
Haryana	The state is high prone to desertification
Jammu and Kashmir	The northern and middle part of the state is cold arid area with moderate desertification category.
Karnataka	Barring the western coastal area of the state the total state is prone to desertification but presently in moderate desertification process.
Madhya Pradesh	Western part adjoining to Rajasthan and Gujarat is prone to desertification of moderate category.
Maharashtra	Most part of the state is under semi-arid and sub-humid zone but presently under the moderate process of desertification.
Orissa	Very small pocket of coastal region adjoining to Andhra Pradesh is sub-humid zone category with moderate process of desertification.
Punjab	Total state is under semi arid zone prone to high process of desertification.
Rajasthan	The western part of the adjoining to Pakistan is under arid zone and some eastern part of sub-humid zone are prone to high desertification, whereas the middle part of semi arid zone is very high prone to desertification.
Uttar Pradesh	Western part of the state adjoining to Rajasthan falling under the category of sub-humid zone is moderate prone to desertification.
Tamil Nadu	Barring east coastal and some parts adjoining to Kerala are under sub-humid zone and moderate category of desertification process.

B. Vulnerability of Land to Desertification Processes

The desertification is the outcome of various factors relating to natural and human efforts. The desertification is constant impact of all these factors but the prime factor responsible for land degradation and desertification conditions have been classified into five following categories:

1. Surfaces subject to sand movement marked as "**W**" in the figure. This is significantly hazard disrupting the total process of development as sand movement disturb the transportation of all categories, communication network, problematic in view of sudden movement with the wind pressure.

2. Alluvial or residual surfaces subject to stripping of top-soil and accelerated run-off, gully erosion on slopes and / or sheet erosion or deposition of flat lands. Such problematic conditions have been demarcated as **"V**" on the figure.
3. Surfaces subject to salinization / alkalinization due to high human and animal pressure. Areas prone to such problems have been marked as "**S**" on the figure.
4. Human pressure including mechanization impacts responsible for desertification have been shown as "**H**" on the figure.
5. Animal pressure responsible for desertification conditions have been indicated through the sign **"A**" on the figure.

The above category of vulnerability of land subject to desertification are basically the prime and most acute factors causing desertification hazard, which indicates that other factors also play their role to deteriorate the productivity of land on regular basis. The occurrence of drought due to failure of monsoon further intensify the deterioration. Poverty, drought, land degradation and desertification are inter-related to each other specially in dryland areas of the country. When more than one factor play key role in degradation, the area becomes severely deteriorated and the main sufferers are the local residents, who are helpless, but to remain in the degraded areas for their livelihood. The social and economic factors of such degradation are far reaching in terms of resultant impact of their problems. Details of the factors vulnerable to land degradation and desertification are narrated in Table 4 along with the locations in the problematic states and causes playing important role for the process of desertification conditions. It would be revealed from the analysis that the causes of desertification are diverse in terms of intensity, impact and incidence.

TABLE 4
VULNERABILITY OF LAND TO DESERTIFICATION PROCESS

States	Factors Causing Land Degradation Process.
Andhra Pradesh	The primary factor responsible for land degradation is alluvial or residual surfaces subject to stripping or topsoil and accelerated run-off, gully erosion on slopes and /or sheet erosion or deposition on flat lands. Northern and southern parts of the state are most vulnerable to the problem.
Gujarat	Northern part adjoining to Pakistan under arid zone is most vulnerable to surface sand movement. Whereas the middle part under semi arid zone marked as **"SH"** is prone to salinity and alkalinity through high human and animal pressure and human pressure which include the mechanization impact..
Haryana	The state is high prone to desertification and canal cultivated area is mostly affected by water-logging. Other well irrigated is prone to salinity and alkalinity.
Jammu and Kashmir	The cold desert zone is generally disturbed area due to international boundary with Pakistan. Soil erosion on slopes and deposition on flat lands are responsible for severity of the problem.
Karnataka	Various factors of category **"V"** exist in the state, which is very severe in the central part of the state..
Madhya Pradesh	Salinity and alkalinity is the severe problem due to uninterrupted drawl of ground water. .
Maharashtra	Over-exploitation of cultivated land is the severe problem in rain-fed areas. Deficiency of water has further intensified the problem. Monsoon failure is common phenomena in dryland areas.
Orissa	Coastal area of more than 800 sq.km. is prone to desertification. With mixed impact of various factors.
Punjab	Water logging and salinity are severe problem factors since most of the state is canal irrigated and fertility loss due to these factors have severe affected the state.
Rajasthan	The western part of the adjoining to Pakistan is prone sand movement marked as **"W".** The adjoining semi arid land is mostly affected by sand movement and human pressure marked as **"WH**". The south eastern part of the state is prone to various factors of "**VHA".** The multiple impact of these factors followed by water deficiency and salinity/ alkalinity are the most problematic conditions of the area.
Uttar Pradesh	Western part of the state adjoining to Rajasthan is prone to desertification due to salinity and water logging in canal cultivated areas and salinity/ alkalinity in ground water irrigated areas. The ultimate impact is deficiency in productivity.
Tamil Nadu	The sub-humid areas prone to desertification face water deficiency in view of erratic monsoon and excessive use of ground water.

C. Bio-climatic Zones of the Problematic States

Bio-climatic zones of the country in the process of desertification have been classified into arid, semi- arid sub-humid according to biological and climatic conditions.

The north-west arid region prone to desertification is spread over in 95410.19 sq. kms of area of Jammu and Kashmir, Gujarat and Rajasthan. With 13.89%, 8.45% and 14.02 % of total geographical area of respective state. This is 2.90% of the total country area. There are intra-regional variations but major problem are wind and water erosion. In some pockets, recently brought under irrigation, problems of salinization and water logging are causing concern. Frequent droughts occur in this region- three times in five years on average. Serious problems include decreasing water availability and receding water table, brackish ground water, depleting forest cover, deteriorating grazing grounds and pastures, decreasing availability of fodder and drinking water, declining land productivity and yield of important crops, livestock suffering from scarcity of drinking water. In western parts of Rajasthan, shifting sand dunes is major problem.

Semi arid regions under the process of desertification cover geographical area of 13% of Andhra Pradesh, 9.59% of Gujarat, 9.99% of Haryana, 15.18% of Karnataka, 15.43% of Maharashtra, 12.46% of Punjab, 6.88 % of Rajasthan which is 5.43 % of the total geographical area of the country. The region is characterized by undulating topography, low to medium rainfall, high-density rainstorms, high volume and speed of surface flow, severe water erosion and very low level of rainfall utilization. Occurrence of intense drought and crop losses are frequent. Farmers are living in poverty. There have been reports of helpless farmers committing suicides due to crop failures. Low and fluctuating crop yields, over cultivation and shrinking pasturelands due to biotic pressures, receding ground water and depleting vegetative cover are assuming alarming proportions.

Sub-humid zones prone to desertification are spread over in 271077.24 sq. kms are in the states of Andhra Pradesh, 17.52% Haryana, 19.93 % , Jammu and Kashmir 4.10% , Karnataka 16.17%, Madhya Pradesh 11.28%, Maharashtra 7.60%, Orissa 0.51%, Rajasthan 10.11%, Tamil Nadu 23.31% and Uttar Pradesh 11.82% of their respective geographical area.. The north-western and central sub-humid regions are prone to saline and sodic and water logged areas. The underground water is brackish with soluble salts. The north-western and north eastern sub humid regions suffer due to poor irrigation practices in the command areas. Ground water is sweet and sodification has taken place damaging physical conditions and chemical properties of the soil. Considerable areas have been rendered uncultivated.

Areas under sub-humid zones are spread over from Jammu and Kashmir to Tamil Nadu and of varying nature where the climatic conditions are different and similarly the topography and soil conditions differ. There cannot be one yard stick for measuring the situation prone to desertification in terms of degree and extent. Efforts have been made to

analyze the situation of all the twelve states of the country prone to desertification at different stages of degree from very high to moderate desertification. Therefore, the area specific situations have been narrated to give the content and nature of the degradation situation.

Location of sub-humid given in the figure have also been described in the table 5, with the location of area in the state, situation of desertification in kms and the nature of the problem.

TABLE 5 : SUB-HUMID ZONES IN THE PROCESS OF DESERTIFICATION

State	Bio-Climatic Zones
Andhra Pradesh	North, eastern coastal region and western parts of the state of 48199.15 sq. km area is in the process of desertification
Gujarat	Eastern part of the state from north to south is prone to sub-humid desertification.
Haryana	Eastern part of the state spread over in 8811.99 sq.kms is in the hub-humid desertification category.
Jammu and Kashmir	The sub-humid area of the stte spread over in 9118.29 sq. kms is in the process of desertification.
Karnataka	Barring the western coastal area of the state, the adjoining area of west and southern parts spread over in 31002.58 sq. km is sub-humid desertification prone.
Madhya Pradesh	Western part adjoining to Rajasthan and Gujarat spread over in 50032.76 sq. kms is sub-humid area prone to desertification.
Maharashtra	North eastern sub-humid region of the state spread over23409.89 sq. kms is prone to desertification..
Orissa	Very small pocket 801.38 sq. kms of coastal region adjoining to Andhra Pradesh is sub-humid zone is in the process of desertification.
Rajasthan	The sub-humid area of 34583.84 sq. kms situated in eastern part of the state from north to south is in the process of desertification.
Uttar Pradesh	Western part of the state adjoining to Rajasthan falling under the category of sub-humid zone spread over in 34803.94 is prone to desertification.
Tamil Nadu	Barring east coastal and some parts adjoining to Kerala are under sub-humid zone spread over in 30313. 42 sq. kms is in the process of desertification.

D. Magnitude of the Problem and its Treatment

The above analysis of various factors of desertification have been analyzed to stress the magnitude of the problem existing in the country. It is evident that total area affected with the problem of desertification is 531870.48 sq. kms comprising of 95410.19 sq. kms arid zone, 165383.05 sq. kms of semi arid zones and 271077.24 sq. kms of sub-humid zone. Therefore the problem is not so simple, but necessary to be treated to make the total area free

from the problem. There are different opinions amongst the specialists of various discipline, who have their authoritative approach. But the Ministry of Environment , Government of India has worked out estimates for treatment of areas at different levels of desertification process. While the norms calculated for construction of watersheds of 5000 hectare area each and the cost norms, the watershed approach is not the only feasible mode of treatment of the area. While learning the lessons from the past decade while construction of various watersheds in different climatic zones, it is difficult to select even a dozen watershed, which have succeeded in treatment of the area. However, our objective to adhere to the norms is to work out the cost of treatment of total area in the process of desertification According to the norms suggested, the cost of treatment has been worked out in Table 6 :

TABLE 6
COST ESTIMATES FOR TREATMENT OF DESERTIFICATION
(Cost in Rs. per hectare)

Cost Component	In arid areas	In semi-arid areas	In sub-humid areas
1. Creation of awareness and capacity building of PRIs including entry point activities	1000	1000	2000*
2. Conservation measures – 70% for water resource development and 30% for soil conservation	5000	5000	5000
3. Production system	3000	3000	4000 **
4. Alternative livelihood systems	2000	2000	1000 ***
Total cost per hectare	11,000	11000	12000

* Includes EPA
** Includes cultivation of medicinal plants
*** Includes processing and marketing of minor forest produce.

On the basis of above norms the treatment cost of arid, semi-arid and sub-humid areas as given in Table 1 is as follows:

(a) Treatment cost of arid zones spread over in 95410.19 sq. kms or say 9541019 hectares @ Rs. 11,000 is Rs. 10495.12 crores.

(b) Treatment of semi-arid zones of 165383.05 sq. kms or 16538305 hectares @ Rs. 11000 is Rs. 18192.14 crores.

(c) Treatment of sub-humid zones of 271077.24 sq. kms or 27107724 hectares @ Rs. 12000 is Rs. 29818.50 crores.

(d) Total cost of treatment of 53187048 hectares land i.e., total of a+b+c = Rs.58505.76 crores or say Rs. 585 billion

CONCLUSION

The approach suggested and amount required is quite significant, which need to be managed in a time bound phase to cover all the degraded areas within a span of 10-15 years. Treatment of area in the process of desertification is necessary to meet the demand of growing population, employment generation, livestock development and environment development. However, the total programme require peoples participation in the decision-making process including empowerment in mode of execution and their cost sharing. Presently, treatment of individual land is generally avoided in view of personal benefit, but this ideology need to be changed as every land belong to the country and individual cultivator is unable to share the burden of total cost of the programme. However an indicative approach is necessary to identify the areas like those suggested for sub-humid regions.

The intervention approach suggested for programme execution starts from learning lessons from past efforts with rectification to unsuccessful efforts of watershed, irrigation practices and withdrawal of excess water from underground sources. The approach should associate the cultivators, understanding their problems and conventional approach for treatment of area with latest technological devices, adhering following measures:

1. Approach for Arid Regions

(i). Entry Point Activities and Capacity Building of PRIs

In most villages, farmers demand water sources for human and livestock drinking. Social capital building need to be promoted. In addition, sheds for schools, village link roads and culverts, community health centers, etc, need to be provided/ strengthened. Entry point activities need to be part of the programme and decided in consultation with local communities. The capacity building of the Panchayati Raj Institutions need to be developed to handle technical matters and financial management including group dynamics. Involvement of PRIs is essential for working out programme of common interest as the community land development, activities on common property resources, social forestry programme etc. require common understanding.

(ii). Conservation Measures

Water conservation measures based on indigenous systems like Nadi (Ponds), Tankas (covered dug-well), Khadins and nala ponding in small rivers or drainage systems with

tunnel recharge wells need to be promoted. Farmers confidence increases with increasing availability of water. In addition a rationale pattern of water use need to be decided by the village community to benefit the maximum number of cultivators. The cultivators deprived from the benefit need to be acknowledged with the situation befitted to their interest. Appropriate low cost soil conservation measures based on local systems of trench and furrows, vegetative hedges of local grasses and shrubs. Kanabandi, a unique indigenous system of fixing brush wood barriers across the prevailing directions of wind to stabilize the sand dunes and save the crop from sand blows. Shelterbelt, wind breaks and strip plantation as per local requirement and feasibility.

(iii). Production System- Crop + Livestock Rearing

Mixed farming to minimize risk of erratic rainfall and diversified production system, mixed cropping producing millets, pulses and oilseeds, Agro-forestry and dryland horticulture, Strip and block plantation on desert front areas, grazing grounds, silvi-pasture systems.

(iv) Alternative Livelihood Systems of Rural Poor

Land based and non-land based activities like manufacturing of ethnic dresses, weaving of carpets etc. Livelihood for typically encompasses water, food, fodder and feed security with income generation through cash flows.

2. Semi- Arid Regions

(i) Entry Level Activities and Capacity Building of PRIs

Panchayati Raj Institutions and their community based organizations have to play a central role at field level. Their capacity building in to be built in technical, financial and institutional matters. NGOs and Government field functionaries to create awareness about the dangers of land degradation, help in organizing self help groups and other village institutions. The potential entry point activities can be creation of life saving irrigation during long dry spells in the cropping season.

(ii) Conservation Measures

Water conservation through life saving irrigation is the greatest need of the area. Collection of surplus surface flow in a network of small percolation ponds to recharge dug-

wells, continuous contour trenches for enhancing the recharge should also be taken up. The utilization of harvested water during rainy season cropping and during the period of early withdrawal of monsoon and if possible, provision of pre-sowing irrigation for the next crops to be given priority. Thus water conservation would start the process of regeneration of eco-system.

(iii) Soil Conservation

Simple soil conservation measures in tune with traditional systems like small mud pebble bunds, boulder bunds, vegetative hedges and dead furrows in inter bunded areas need to be promoted.

(iv) Production System

Mixed farming with reliance on organic farming, LEISA (Low External Input Sustainable Agriculture) including Integrated Pest Management (IPM) and Integrated Nutrient Management. Agro-forestry and dryland horticulture.

(v) Alternative Livelihood system of Poor Households

Activities based on local resources, agriculture produce based activities and small scale industries will little technical input for using improved design and quality to make the produce marketable. Livestock rearing for supplemental source of livelihood.

3. Sub-Humid Regions

(i) Capacity Building of PRIs and CBOs and Entry Level Activities

In view of low literacy level in rural areas, the capacity build need to be addressed with patience as tribals residing in these areas have tradition of community based behaviour. A well structured awareness programme is needed to organize to bring them into self help groups in village institutions. The local population has good Indigenous Technical Know-hows (ITKs)The project need to build upon its systems and practices where voice of the local beneficiaries need to addressed properly. The capacity of PRIs and Community Based Organizations have to be nurtured and build in organizational, financial, record, book-keeping etc. slowly in tune with their absorption capacity.

(ii) Conservation Measures

Rain-water harvesting in village ponds, desilting of existing ones and construction of new ponds at hydrologically strategic points to enhance water availability for human beings and livestock be given highest priority. For life saving irrigation, the upgradation of traditional low cost Chuas (seepage wells) should be promoted and upgraded. Such wells save the crops during drought, provide pre-sowing irrigation for second crop and allow vegetable cultivation. Thus availability of water is helpful to build the confidence of local population and inspire them to move towards sustainable development.

(iii) Soil Conservation Measures

Soil erosion is serious problem in view of topographic reasons and as such continuous contour trenches, vegetative hedges across the slope, loose boulders, gully checks reinforced with vegetation and loose bolder checks in drainage lines to control soil erosion and loss of top soil.

(iv) Conservation of Bio-diversity

The tribal areas of this region are very rich in bio-diversity- land races and indigenous genes in cultivated and medicinal plants. Efforts need to be made to preserve bio-diversity to enable tribals to utilize genetic material for their benefit.

(v) Production System

Mixed farming- crop + livestock particularly small ruminants- goat, sheep rearing, poultry etc. for which the tribals have long traditions and local skills. Mixed cropping, coarse cereals, pulses, oilseeds adopted to ecological conditions. Low External Input Sustainable Agriculture with higher reliance on organic manures, IPM, INM etc. In addition promotion for cultivation of medicinal and herbal plants can be helpful in raising their income level substantially.

(vi) Alternative Livelihood System

Traditionally, the tribals have been supplementing their food, nutrition and income by collection of medicinal plants and minor forest produce, which need to be promoted. The processing and marketing is to be organized to save tribals from exploitation by middlemen. Other cottage industries including basket making and similar bamboo based decorative

products need to be patronized. Sericulture, bee-keeping and lac cultivation can help tribals for traditional rearing useful insects through skill upgradation.

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