

India's Efforts towards Land Degradation and Desertification

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Abstract: Natural resources of the country like land, water and forests are threatened due to demographic pressure, developmental activities and impacts of climate change. Intensive agriculture, particularly on fragile dryland ecosystems, may further aggravate land degradation. An unprecedented magnitude of degraded and waste lands in the country (120.72 Mha) is a cause of concern. It is broadly understood that about 50% of these lands can easily be afforested, while only one-third can be reclaimed and brought under cultivation with adoption of soil and water conservation measures.

Key words: Desertification, land degradation and drought (DLDD), sustainable land management (SLM), ecosystem management.

Large number of programs and schemes were launched in area of land management by the Govt. of India. Some of the important programs are: Drought Prone Area Development Program, Desert Development Program, Integrated Watershed Management Program, National Afforestation Program, River Valley Projects, Flood Prone Area Program, National Watershed Development Project for Rainfed Areas, Shifting Cultivation and, foreign aided projects. Eight National Missions, of which six deal with land issues, signify importance of sustainable land management in larger interest of the country and to fulfill global commitments

Since Rio Convention 1994, to which India is a signatory, United Nations Convention to Combating Desertification (UNCCD) has been making frantic efforts for sustainable land management. UNCCD strategies zero net land degradation by 2020. Besides, United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biodiversity (CBD) are other mega conventions dealing with climate change impacts and biodiversity. An integration and synergy is required between these conventions to attain national as well as global objectives. Various acts and policies are in existence in India in the field of forestry, which have helped forest conservation to some extent. Such policies are also required in the area of land and water use to arrest/revert the process of degradation. Policies are required to

cover entire spectrum of sustainable land and ecosystem management. Efficient coordination and governance is critical for synergistic outputs.

Background

India supports about 16.8% of the world's population, 11% livestock merely on 2.3% of land and 4.2% global fresh water resources. Since independence the population of the country has increased from 363 to 1210 million and is likely to become 1475 million by 2030. Natural resources of the country like land, water, forests, biodiversity, mineral deposits, rivers, wetlands, surface water bodies as well as ground water reserves are threatened due to demographic pressure, developmental activities, industrialization and impacts of climate change. A quantum jump in food production from 51 to 245 Mt, on account of irrigation, green revolution and associated agricultural developments in the country, may still befall insufficient to feed the population of 1.48 billion by 2030 needing at least 350 Mt of food grains from an unchanging 141 Mha net cultivated area. Even at the current nutritional level, 100 Mt of additional food grains are needed by 2020 for food security in the country. On the other hand the per capita agricultural land has decreased from 0.48 ha in 1951 to 0.13 ha and is likely to shrink to 0.07 ha 2030. More than 50% of the Indian farm families comprising of 4-6 members cultivate less than one hectare land, making a reasonable livelihood difficult, despite 51% of the geographical area under cultivation as

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compared to only 11% of the world average. The disproportionate area under cultivation is reflected in excessive pressure on natural resources such as land, water and forests. The over exploitation of natural resources is resulting in land degradation, siltation of reservoirs, pollutions of river systems and declining ground water resources, which will have serious implications in long run.

Cropping intensity of 139%, registered an increase of 25% since independence mostly on irrigated land. The total contribution of irrigated agriculture to food grain production from both area expansion and yield improvement put together is likely to be around 64 Mt by 2020, leaving a shortfall of 36 Mt. Therefore, the expanded food needs of the future can only be met through intensive agriculture and added productivity from drylands, spread over 177 districts in 13 states, constituting 68% of the total net sown area in India. Intensive agriculture and excessive pressure on fragile dryland ecosystems may further aggravate land degradation unless adequate conservation measures are adopted. Hence sustainable land and water management seems to be vital when an increased productivity is envisaged from rainfed dryland ecosystem.

Desertification, Land Degradation and Drought (DLDD)

An unprecedented magnitude of degraded and waste lands in the country is a cause of concern and warrants a caution against further abuse of land, water and vegetation resources. DLDD and the combating strategies to overcome their impacts shall remain high on international agenda in the 21st century also to meet challenges of food security and environmental concerns. India is no exception to the menace of land degradation owing to anthropogenic as well as demographic reasons resulting in decline in soil quality adversely affecting the land productivity. Land degradation is the major cause of low productivity in rainfed drylands as well as on irrigated lands due to secondary degradation issues such as soil salinity and water logging, declining ground water, which is a serious issue of dry areas, and lowering of carbon status, soil fertility and imbalance of nutrients. The productivity losses to the tune of 13.4 Mt equivalent to INR 111.3 billion (Sharda *et al.*, 2010) have been

estimated due to soil erosion from rainfed areas under major cereals, oilseeds and pulses. It is therefore of paramount importance to monitor extent of land degradation more frequently than what has been practiced so far, and adopt policies to ameliorate degraded lands, revert land degradation and make efforts to zero land degradation as envisaged for a lasting food security by United Nations Convention to Combat Degradation (UNCCD) under Sustainable Land Management. India has made several efforts in this direction, which are overviewed and discussed in this paper.

Assessment of extent of degraded lands

Understanding and assessment of the problem of declining natural resources is the first step in the direction of their sustainable management. Different agencies have estimated/assessed land degradation using variable methodology. These agencies are: National Commission on Agriculture (1976), Society for Promotion of Wasteland Developments (1984), National Remote Sensing Agency (1985), Ministry of Agriculture (1985), Space Application Centre (2004) and National Bureau of Soil Survey & Land Use Planning (1984, 2005 and 2010) and National Remote Sensing Centre (2011) and a few R&D institutions for specialized areas like CAZRI for arid areas and CSSRI for salt affected lands. The assessment of degraded and waste lands by different agencies has varied widely from 55.5 Mha of waste lands (NRSC, Hyderabad, 1997) to 187.7 Mha human induced land degradation (Sehgal and Abrol, 1994) due to varied reasons. The figures were not consistent and reproducible due to limitations of methodology, source of data, ground surveys and big extrapolation of information.

Space Application Centre, Ahmadabad, in collaboration with several R&D institutes developed a classification system utilizing Driving Force-Pressure-State-Impact-Response (DPSIR) framework of UNCCD with few indicators and published desertification map of India at 1:500,000 (Ajai *et al.*, 2009). Land degradation was assessed to cover 105.48 Mha (32% of geographical area) and desertification 81.45 Mha (25% of TGA). The water erosion was the most dominant process of desertification accounting for 65 Mha, followed by vegetal degradation covering wind erosion in hot desert

Table 1. Degraded and wastelands of India (Harmonized statistics; Mha)

Degradation type	Arable land (Mha)	Open forest (<40% canopy; Mha)	Data source
Degradation due to erosion			
Water erosion ($>10 \text{ t ha}^{-1} \text{ yr}^{-1}$)	73.27	9.3	Soil Loss Map of India-CSWCR&TI
Wind erosion (Aeolian)	12.4	-	Wind Erosion Map of India-CAZRI
Sub-total	85.67	9.3	
Chemical degradation			
Exclusively salt-affected soils	5.44	-	Salt affected Soil Map of India, CSSRI, NBSS&LUP, NRSA and others
Salt affected and water eroded soils	1.2	0.1	
Exclusively acidic soils (pH<5.5)	5.09	-	Acid Soil Map of India NBSS&LUP
Acidic (pH < 5.5) and water eroded soils	5.72	7.13	
Sub-total	17.45	7.23	
Physical degradation			
Mining and industrial waste	0.19		Wasteland Map of India-NRSA
Water-logging (permanent surface inundation)	0.88		
Sub-total	1.07		
Total	104.19	16.53	
Grand total (Arable land and open forest)	120.72		

Source: NBSS&LUP, 2010.

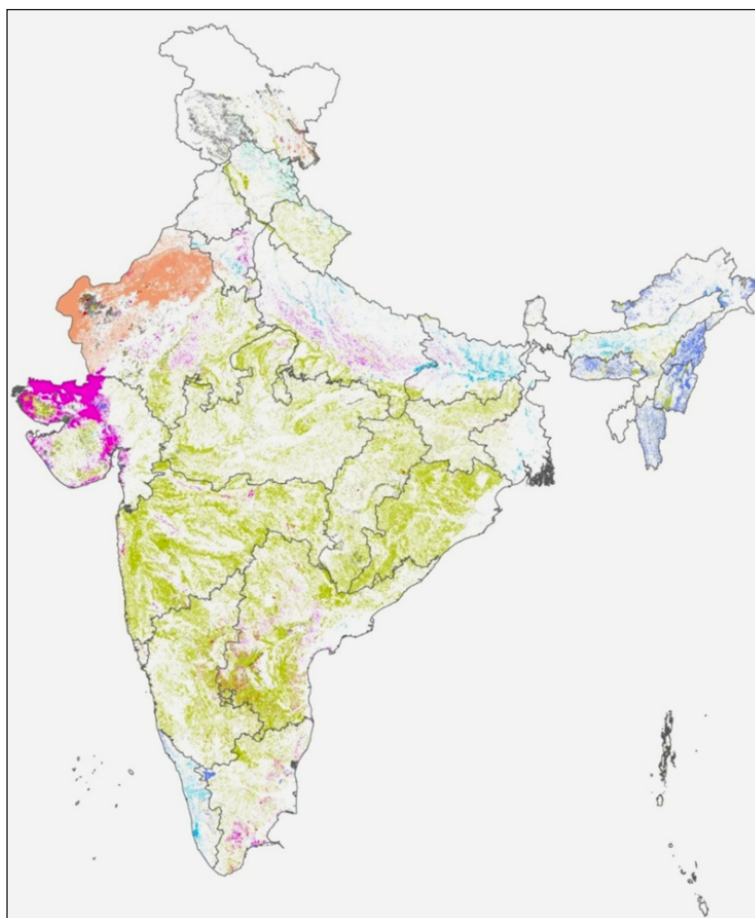


Fig. 1. Land degradation in India (1:50,000).

Table 2. Land degradation in India (1:50,000 scale)

Form of land degradation	Million hectares	% of geographical area
Water erosion	504468	15.93
Wind erosion	86649	2.74
Water logging	21383	0.68
Salinization/alkalization	65454	2.07
Acidification	34467	1.09
Glacial	10903	0.34
Anthropogenic	4633	0.15
Others	63518	2.01
Total	791475	25.00

Source: NRSC, 2011.

and frost shattering in cold deserts. Recently, NBSS&LUP (Majhi *et al.*, 2010) has reported harmonized statistics of land degradation, wherein 120.72 Mha degraded and waste lands have been reported at 1:250,000 scale (Table 1). This is arrived at by integrating different thematic layers such as forest cover, soil erosion as computed by Universal Soil Loss Equation, saline and water logged soils, and soil acidity in GIS environment. Several R&D institutions working in this field have concurred with harmonized land degradation values.

National Land Use/Land Cover Mapping on 1:50,000 scale with multi-temporal IRS LISS III Data has been used to generate LULC data base

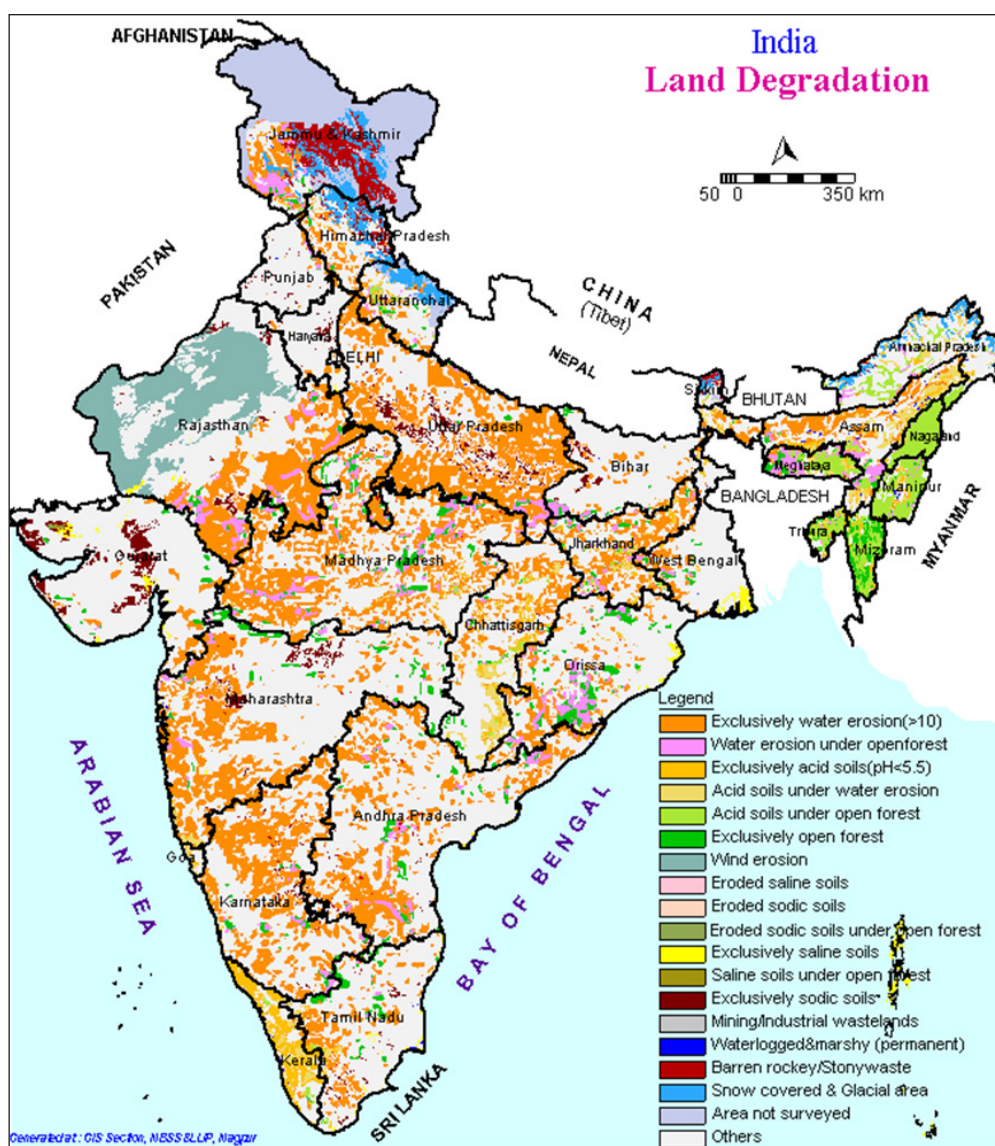


Fig. 2. Degraded and Wastelands of India (NBSS&LUP, 2010).

on 1:50,000 scale utilizing three seasons kharif, rabi and zaid (Fig. 1). LULC information system has been prepared for easy query and retrieval of data base. For this purpose multi-temporal geo-rectified LISS-III data covering kharif, rabi and zaid seasons of 2005-06 have been utilized for creation of LULC:50 K L-III layer based on screen interpretation. Use of limited ground truth, consultation and legacy data have been utilized for this purpose. National Remote Sensing Centre assesses 79.15 Mha degraded land at 1:50,000 scale (Table 2; unpublished). In this remote sensing technology there is always a possibility that the assessment captures synoptic view of various forms of waste lands/degraded lands leaving some slightly degraded lands, where productivity decline is smaller. The degraded lands due to lowering of soil quality can only be estimated by soil survey and extensive ground truth at a narrow grid.

Such anomalies are required to be reconciled for creation of a robust database and generation of harmonized map at 1:50,000 scale, which is more precise and reproducible allowing the change detection on a time scale and help developing commensurable strategies for management of degraded and waste lands.

Degraded and waste lands (Fig. 2), which constitute about one-third of geographical area of the country, offer great potential to enhance production of food grains, fuel and fodder, and reduce pressure on the forests considerably with added benefits of improving environment. As these lands are hungry and unsaturated with respect to organic carbon, their carbon sequestration capacity is much more than the saturated forest soils. These degraded lands are therefore ideal for utilization under Green India Mission, which is very important from the point of view of mitigation of climate change impacts. It is further understood that about 50% of these lands can easily be afforested, while only one-third can be reclaimed and brought under cultivation adopting soil and water conservation measures. Their reclamation, management and sustainable utilization have to be undertaken simultaneously.

Policy initiatives

Government of India has taken several initiatives by way of enactments, policies and welfare schemes/subsidies through different five year plans to deal with various sectors of

land resources that is forest, water/irrigation and agriculture governing land management (Table 3). Developing the canal command was one of the major decisions to make agriculture more remunerative and attracting people thus bringing more area under plough. This was followed by use of fertilizers and improved cultivars and enhancing land productivity through green revolution. However, intensive agriculture has led to land degradation due to second generation problems in command areas due to which crop yields are plateauing and have started declining. These secondary degradation issues have to be treated on priority. Besides, the focus seems to be shifting on rainfed dry areas in order to ensure food security, which requires land management issues to be addressed.

Forestry sector

In the field of forestry, the Indian Forest Act, 1927 existed even before the independence, however, Forest Conservation Act, 1980 and Environment Protection Act 1986 were enacted upon primarily for forest conservation, which have proved very effective instruments to prevent change of forest land use and thus contained land degradation. National Forest Policy, 1988 envisages that at least 33% area of the country should remain under forest cover. Several efforts are being made to achieve this target by way of plantation of degraded and waste lands and stocking degraded forests, which have bearing on the forest biodiversity. Under changing scenario several forest acts have been enacted upon to fulfill commitments of UN Conventions. Biological Diversity Act, 2002, National Environmental Policy, 2006, and National Green Tribunal Act, 2010, are the recent enactments to safe guard biodiversity and improve quality of environment. These acts and policies help conserving forests and make it difficult conversion of forest land use, which act as preventive measures for land degradation.

National Agricultural Policy, 2000, National Water Policy, 2002, and National Policy for Farmers, 2007, relate to land and water resources. These are relatively young policies with few loose ends. These have been framed to safeguard agricultural land use, integrated management of water resources and help farmers who have been a weaker section of

society due to poverty. It is reported that in the recently created small state of Uttarakhand nearly 56,000 hectares of land has gone out of cultivation. Land is the state subject and therefore states have to play proactive role in reinforcing and execution of these policies and safeguard agricultural land. It is much easier to acquire agricultural land and change its use for miscellaneous purposes. Weak compliance of these measures for the want of enactment has not proved so effective. Hence large areas of good agriculture land are being converted to non-agricultural uses like infrastructure and development, etc. Avoidance of conversion of fertile land to non-agricultural uses (Section 3f) of the Land Acquisition Act needs modification to save good agricultural land for non agricultural uses. Alternatively the degraded and waste lands could be utilized for industries, infrastructures and other non agricultural uses.

Table 3. Enabling acts and policies having provisions to address Desertification Land Degradation and Drought (DLDD) issues in India

• Indian Forest Act, 1927
• Forest (Conservation) Act, 1980
• Environment (Protection) Act, 1986
• National Forest Policy, 1988
• National Agricultural Policy, 2000
• Biological Diversity Act, 2002
• National Water Policy, 2002
• National Environmental Policy, 2006
• National Policy for Farmers, 2007
• National Green Tribunal Act, 2010

National missions

In view of recent developments and addressing emerging national and global issues such as emission of green house gases and climate change, Govt. of India has launched eight National Missions, of which six missions deal with land-based issues signifying importance of sustainable land and ecosystem management in larger interest of the country and global commitments.

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission for Sustainable Habitat

- National Water Mission
- National Mission for Sustaining the Himalayan Eco-System
- National Mission for the Green India
- National Mission for Sustainable Agriculture
- National Mission for Strategic Knowledge for Climate Change

These national missions would address carbon sequestration, sustainable use of land, water, energy and ecosystem to ensure land care, good soil health and environmental quality. There has to be synergy and complementarities between different national missions for greater output. A greater inter-ministerial coordination is therefore required as sustainability issue is common to many ministries. Great importance has been attached for effective coordination and integration to ensure synergy between these Missions. Prime minister of India is the chair person of these missions to ensure smooth functioning and synergistic outputs.

Green India Mission: In the forestry sector, Green India Mission aims at addressing climate change by enhancing carbon sink and biodiversity conservation through sustainable management of forests and ecosystems, enhancing the resilience and ability of vulnerable species/ecosystems to adapt to the changing climate and enabling adaptation of forest dependent local communities in the face of climatic variability. The objectives of Green India Mission are doubling the area under afforestation/eco-restoration in India in the next 10 years by afforestation/eco-restoration of 20 Mha area, increasing removal of the green house gases (GHG) by India's forests to 6.35% of India's annual GHG emissions by the year 2020, and enhancing the resilience of forests/ecosystems. The program can also include stocking of degraded open forest, where the canopy cover is less than 40%, which is also taken care under forest development plans through Joint Forest Management. The major areas available for afforestation under the Green India Mission are the degraded and waste lands, which cover one-third of geographical area, social forestry on community lands and agroforestry on private lands, which is the most successful due to personal care and involvement of

the stakeholder. This requires a liberalized policy for utilization of the trees on private land as stringent rules and regulations to get permission of felling a tree on private land is likely to deter the people for undertaking planting of trees in and around private lands under green India mission.

Programs/Schemes Agriculture Sector: Indian economy has been agriculture-based until past few decades when perceptible growth in industrialization took place. Agriculture policies envisage attaining a growth rate of over 4% per annum through efficient land management. Vehicle of this growth encompass Integrated Watershed Management Program (IWMP), National Afforestation Program (NAP), Soil Conservation in the Catchment of River Valley Project and Flood Prone River, National Watershed Development Project for Rainfed Areas (NWDPA), Fodder and Feed Development Scheme component of Grassland Development including development of ranges and pastures.

Large number of programs and schemes has been launched since independence in the agriculture sector with great emphasis on watershed management since 1990's. This was fallout of one of the most severe and widespread drought of 1987, when it was visualized that the impact of drought could be reduced in a well managed watershed than outside. The watershed management offered excellent coping mechanism against drought. Integrated Watershed Management Program aims to restore ecological balance by harnessing, conserving and developing degraded natural resources such as land, water and vegetation. National Watershed Development Project for Rainfed Areas (NWDPA) addressed sustainable management of natural resources, enhancement of agricultural production, restoration of ecological balance on degraded and fragile rainfed ecosystem, reduction in regional disparity between irrigated and rainfed areas and creation of sustained employment opportunities for landless rural communities and finally combating desertification, land degradation and drought (DLDD) through crop diversification, agroforestry and plantation of fodder and useful multipurpose tree species in and around crop land, particularly in dry areas of arid, semi-arid and dry sub-humid regions.

Ministry of Agriculture has undertaken mega programs on National Watershed Development Project for Rainfed Areas (NWDPA), River Valley Project (RVP) and Flood Prone Rivers (FPR), Watershed Development Project in Shifting Cultivation Areas (WSDCA) and Alkali Soils. Ministry of Rural Development undertook Drought Prone Areas Program (DPAP), Desert Development Program (DDP) and Integrated Watershed Development Program (IWDP) launched during 2009-10. Consolidation of erstwhile DPAP, DDP and Integrated Wastelands Development Program (IWDP) paved way for optimum utilization of resources, integrated planning and sustainable outcome. Ministry of Environment and Forests launched Integrated Afforestation and Eco-Development Projects Scheme (IAEPS) and National Green India Mission for this purpose.

Rashtriya Krishi Vikas Yojana (RKVY): The RKVY scheme was launched to assist states in the development and implementation of district-level agricultural plans based on agro-climatic conditions and bring about quantifiable changes in the production and productivity of agriculture and allied sectors under different agro-climatic conditions. Swarnjayanti Gram Swarajgar Yojna (SGSY)/National Rural Livelihood Mission (NRLM) were also under taken with similar objectives.

The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS): The MGNREGS is essentially an employment scheme for rural communities to provide 100 days employment in a year. Though objectives of this mega scheme are livelihood improvements, however, the manpower could be utilized for soil and water conservation, creation and rejuvenation of water resources development in rainfed areas, development for agriculture and enhancing productivity along with livelihood of the weaker section. This scheme can be gainfully integrated for land management and rural livelihood generation.

Development of water resources

Water is becoming one of the scarcest commodities the world over. It is projected that half of the global population is going to suffer due to water scarcity by the end of 2050. With rapid rise in population and standard of living, the pressure on water resources is mounting

and per capita availability of water is reducing drastically in rural as well as in urban areas of India. The per capita availability of water in the country (1902 m³ in 2001) is projected to decline to 1401 m³ in 2025 and to 1191 m³ by 2050 making the country at water stress level.

Utilizable water in India is 1123 BCM comprising of 690 surface and 433 ground water, which is a very precious commodity particularly in dry areas. About 44% of the net cultivated area in the country is irrigated, where productivity is plateauing or somewhat declining on account of secondary land degradation issues. Agriculture consumes more than 80% of the available water. An increase of more than 60% demand in domestic and industrial sectors by 2025 will leave less water available for agriculture. A shift towards ground water irrigation in dry as well as canal command is a matter of concern.

Ground water is the mainstay for drinking as well as watering trees and crops in dry regions. Ground water development has reached 145% in Punjab, 138% in Rajasthan, 109% in Haryana against 53% for rest of the country. The situation may turn worst to scarce level in drought stricken States like Rajasthan, Gujarat, Andhra Pradesh and Karnataka. Fast declining precious ground water in cosmopolitans, water scarce and high water using states is a serious matter needing immediate attention and action.

The rainfed agriculture covers nearly 56% of the net cultivated area in India contributing to about 45% of the food grains. Uncertainty of water availability, low fertility and fragility of rainfed ecosystem are major constraints, which need to be addressed. There is tremendous pressure on ground water, which is being over exploited for drinking as well as for agriculture. Rational and sustainable use of surface and ground water is required in urban as well as rural areas. In the view of urgent needs Govt. of India undertook Command Area Development and Water Management (CADWM) programs, National Rural Drinking Water Program (NRDWP), and National Project for Repair, Renovation and Restoration (RRR) of Water Bodies. The issues of water can be possibly addressed by economy in water use, rain water harvesting and augmentation of water resources. A Mission approach is required to mobilize public for this cause.

Sustainable Land and Ecosystem Management (World Bank, UNDP and FAO Projects through GEF)

Large number of donor agencies has been involved in supporting the watershed management program of the Government and NGO's. Ministry of Environment and Forest has under taken following projects in collaboration with Global Environmental Funding through World Bank, FAO and UNDP funding for policy and institutional reforms. In this context, mainstreaming and up-scaling sustainable land and ecosystem through known best practices is crucial.

1. Sustainable Rural Livelihoods Security and Institutional reform through Innovations in Land and Ecosystem Management, ICAR, Ministry of Agriculture
2. Sustainable Land, Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand
3. Sustainable Land and ecosystem Management in Shifting Cultivation areas of Nagaland for Ecological and Livelihood Security
4. Integrated Land and Ecosystem Management to Combat Land Degradation and Deforestation in Madhya Pradesh
5. Reversing land degradation and Rural poverty through adaptation to climate change in drought stricken areas of Andhra Pradesh
6. Sustainable Participatory Management of Natural Resources to Control Land Degradation in Thar Desert Ecosystem

Zero net land degradation (rehabilitation and prevention)

Since the Rio Convention, also signed by India in 1994, United Nations Convention to Combating Desertification (UNCCD) has been making frantic efforts for sustainable land management. Six Thematic Program Network (TPNs) were launched in the beginning of the century for this purpose and National Action Plan (NAP) was also developed under UNCCD. In next ten year strategy, UNCCD envisages zero net land degradation by 2020, which is possible to be achieved through zero net forest degradation

by 2020 and implementation of drought proofing policies and drought preparedness in the affected regions by the time. Natural resources have to be utilized rationally on sustainable basis. Now there is more emphasis on United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biodiversity (CBD), which are considered to have serious implications for climate change impacts. As the land is beholder of biodiversity, a sink as well as source for green house gases therefore sustainable land management should be equally important in this context. An integration and synergy is therefore required between these mega conventions and UNCCD as well as between the ministries handling these thematic areas to attain national as well as global objectives in stipulated time frame.

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