



National Action Plan to Combat Desertification and Land Degradation Through Forestry Interventions



**Ministry of Environment Forest and Climate Change
2023**



INDIA'S NATIONAL PLAN (NAP) TO COMBAT DESERTIFICATION AND LAND DEGRADATION THROUGH FORESTRY INTERVENTIONS

2023

Ministry of Environment Forest and Climate Change
Government of India



“Friends I would like to make further commitment to the global land agenda..... From this forum I would like to announce that India would raise its ambition of the total area that would be restored from its land degradation status from 21 Million Hectares to 26 Million Hectares between now and 2030. This will support India’s large commitment to achieve an additional Carbon Sink between 2.5 Bn MT to 3 Bn MT through tree cover.”

Hon’ble Prime Minister Shri Narendra Modi at UNCCD COP 14

(Source: narendramodi.in/pm-modi-addresses-14th_coference-of-parties-to-unccd-546376)



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पर्यावरण, वन एवं जलवायु परिवर्तन
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MINISTER
ENVIRONMENT, FOREST AND CLIMATE CHANGE
AND
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GOVERNMENT OF INDIA



भूपेन्द्र यादव
BHUPENDER YADAV



FOREWARD

We all are aware that land is an important natural resource and the sustenance of the ecosystem is under immense pressure from a combination of climatic, developmental, social and anthropogenic reasons. As a key provider of food, water, shelter and employment, the land areas outside the conventional protected/notified areas, especially the unutilized productive land is also subjected to coerce with tremendous pressure making it turn into wastelands.

Land degradation, depleting land productivity, impending desertification and consequent drought is affecting all countries, all types of topography, without any priorities and discrimination. Land degradation negatively impacting global food systems, health, economic and social opportunities, and its effect is becoming even more magnified and pronounced in the context of our country when over 70% of the population is directly and rest 30% is indirectly dependent on the productivity of land for their sustenance.

Desertification is the degradation of land in arid, semi-arid and dry sub-humid areas and does not mean the expansion of deserts. It occurs because dryland ecosystems, which cover over one third of the world's land area, are extremely vulnerable to overexploitation and inappropriate land use. Globally, desertification is threatening the livelihoods of 1 billion people in over 100 countries, and each year 12 million hectares of arable land are lost due to drought. The economic costs of desertification and land degradation are estimated at USD 490 billion per year. With a population of over 1.3 billion, India holds 18% of the world's population on 2.4% of the world's total land. It also holds 15% of the world's livestock population.

Land in India suffers from unsustainable use and inappropriate management practices, deforestation, grazing and other anthropogenic pressures. Approximately 30% of its geographical area is affected by land degradation and therefore India stands committed to implementing the goals of the UNCCD. Avoiding land degradation through sustainable land management can generate up to USD 1.4 trillion of economic benefits.

We now stand at the threshold where it has become imperative to counter this impending threat of land degradation and consequent depletion of land productivity leading to desertification and drought like conditions. India has emerged as a global leader in planning, and implementing actions targeted towards combating, mitigating and adapting adverse effects of climate change and impending related ecological, social and economic atrocities. India is among the few countries, making continuous efforts to address the problem of desertification and land degradation. First in the World, Government of India has prepared the National Action Programme to Combat Desertification in India in 2001, and has also taken various policy measures at national level to combat land degradation and desertification.

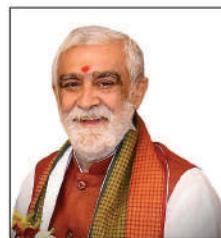
With the introduction of several national policies and Missions that not only address land degradation but also take in hand the crises of biodiversity loss and climate change, the National Action Plan for Combating Desertification is being revised with an aim to achieve the Land Degradation Neutrality Targets of 26 million ha by 2030. This action plan provides the thematic strategies at National and sub-national level and also collate them with the objective to neutralize the land degradation and desertification in long term.

(Bhupender Yadav)

Date: 25 .02.2023



अश्विनी कुमार चौबे
Ashwini Kumar Choubey



राज्य मंत्री
पर्यावरण, बन एवं जलवायु परिवर्तन
उपभोक्ता मामले, खाद्य और सार्वजनिक वितरण
भारत सरकार
MINISTER OF STATE
ENVIRONMENT, FOREST AND CLIMATE CHANGE
CONSUMER AFFAIRS, FOOD & PUBLIC DISTRIBUTION
GOVERNMENT OF INDIA

Message

Most societies are now experiencing the pressure of balancing environmental conservation with satisfying the needs of growing human populations. With over 7 billion people living on the planet, demands for food, fuel and fibre continues to grow. The United Nations estimates that food production will have to increase by 60 per cent to meet the needs of 9.3 billion people by the middle of the century. Meanwhile, the unsustainable land practices of past and present generations mean that there is, simultaneously, significant restorative and conservation work to be prioritized.

Indeed, agriculture, conservation, development and other land uses all compete for space and for resources. Management approaches that consider agriculture, forestry, biodiversity and poverty alleviation in "silos" do not suffice. The scale of the global challenges we face is too great; there is a need for genuinely integrated and cohesive approaches. In this context, landscape restoration approach provides a framework to integrate policy and practice for multiple land uses, within a given area, to ensure equitable and sustainable use of land while strengthening measures to mitigate and adapt to climate change, besides reducing negative effects of land degradation and consequent desertification. Landscape approach further capacitates forest managers for enabling and inclusive decision-making processes.

In ardent pursuance of the concept of LiFE, advocated by our Hon'ble Prime Minister Shri Narendra Modi, there is an urgency to imbibe sustainable planning in all our approaches. This a global concept and must be followed globally. Sustainable Production intertwined with Sustainable Consumption will enhance the productivity of our natural resources but can also enable socio-economic development, increased land productivity and diversified livelihood opportunities. Ecological restoration, rejuvenation and reclamation of the degraded natural resources must be prioritized besides taking corollary preventive measures.

The National Action Plan to Combat Land Degradation and Desertification is one of the sincere steps of the nation towards its commitment to ensure the sustainable, and optimum utilization of its natural resources adopting an integrated approach where effectively and sustainably implemented ecological restoration, contributes to protecting biodiversity; improving human health and wellbeing; increasing food and water security; delivering goods, services, and economic prosperity; and supporting climate change mitigation, resilience, and adaptation. The Plan provides a time bound solutions-based approach that engages communities, scientists, policymakers, and land managers to repair ecological damage and rebuild a healthier relationship between people and the rest of nature.

(Ashwini Kumar Choubey)

कार्यालय: 5वां तल, आकाश विंग, इंदिरा पर्यावरण भवन, जौर बाग रोड, नई दिल्ली-110003, दूरभाष: 011-20819418, 011-20819421, फैक्स: 011-20819207, ई-मेल: mos.akc@gov.in
Office: 5th Floor, Aakash Wing, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi-110003, Tel.: 011-20819418, 011-20819421, Fax: 011-20819207, E-mail: mos.akc@gov.in

कार्यालय: कमरा नं. 173, कृषि भवन, नई दिल्ली-110001, दूरभाष: 011-23380630, फैक्स: 011-23380632

Office: Room No. 173, Krishi Bhawan, New Delhi-110001, Tel.: 011-23380630, Fax: 011-23380632

निवास: 30, डॉ. एपीजे अब्दुल कलाम रोड, नई दिल्ली-110003, दूरभाष: 011-23794971, 23017049

Residence: 30, Dr. APJ Kalam Road, New Delhi-110003, Tel.: 011-23794971, 23017049



लीना नन्दन
LEENA NANDAN



PREFACE



सचिव
भारत सरकार
पर्यावरण, वन और जलवायु परिवर्तन
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST
& CLIMATE CHANGE

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet. Out of the 17 Sustainable Development Goals (SDGs), SDG 15 urges countries to inter-alia protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests and combat desertification.

UNCCD has endorsed the concept of Land Degradation Neutrality (LDN) as a strong vehicle and driving force to mitigate and combat land degradation and invited all country Parties to formulate voluntary targets to achieve LDN. Achieving land degradation neutrality - by preventing land degradation and rehabilitating already degraded land, scaling up sustainable land management and accelerating restoration initiatives - is a pathway to greater resilience and security for all. Restoring the soils of degraded ecosystems for instance, has the potential to store upto 3 billion tonnes of carbon annually.

Desertification and Drought Day was officially declared by the UN General Assembly as "World Day to Combat Desertification and Drought" in 1997 with three objectives, namely, to promote public awareness about desertification and drought; advocacy that these problems can be effectively tackled; and solutions that are rooted in community participation and cooperation.

India has pledged its commitment to restore 26 million hectares by 2030, laying emphasis on a landscape-based restoration approach, which would also contribute to addressing water scarcity, enhancing water recharge in forests and retaining soil moisture.

The revised and updated National Action Programme to Combat Land Degradation and Desertification through forestry Interventions provides a global, regional and India specific overview of the status of land resources in the country, the status and impacts of desertification, the large number of measures under implementation, and in particular, the recent initiatives taken for combating desertification. The Plan strives to address issues in an integrated manner on a long-term basis, with the proactive participation of all stakeholders, and its proper implementation of the Plan will undoubtedly result in achievement of the country's goals.

(Leena Nandan)

Dated: March 7, 2023.



चन्द्र प्रकाश गोयल
CHANDRA PRAKASH GOYAL



वन महानिदेशक एवं विशेष सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
DIRECTOR GENERAL OF FOREST & SPL. SECY.
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND
CLIMATE CHANGE



Message

Conservation, protection and restoration of its natural resources have always been a priority for India, and which is significantly reflected in its national policies, programs and schemes and its international commitments as distinguished part of various international treaties and Agreements. India, being a diverse and resource rich nation has enshrined the values of conservation and the sustainable development of our natural resources in its national and regional policies which are implemented through unified and a multi-stakeholder proactive involvement.

India acknowledges that holistic eco-restoration measures are important for the natural forests to adapt in the changing climate pattern. Sustainable forest management, diversification of tree species to build resilience, and reducing the risk from pests, disease and forest fires are the option available to increase the adaptive capacity of the forest in response to projected climate change impacts. Implementation of the adaptation in response to climate change depends immensely on the capacity and effectiveness of the stakeholder especially the local and tribal communities who are dependent on the adjoining forests for their sustenance and livelihood.

India is committed to achieve Land Degradation Neutrality by 2030 and is diligently working towards comprehensive eco-restoration measures through adoption of 'Landscape approach' for ameliorating climate change, enhance food & water security and diversification of livelihoods and augmenting livelihoods and household incomes of the communities dependent on the natural resources.

India's leadership in combating land degradation is reflected in its proactive steps to introduce policies and programmatic interventions to tackle the issue in the country. In 2001, India developed its National Action Plan to Combat Desertification, a first globally. With the introduction of several national policies and missions that not only address land degradation but also take in hand the crises of biodiversity loss and climate change, the National Action Plan for Combating Desertification is now under revision. The objective is to revise regional and thematic strategies and to collate them at the national level with the sole objective to neutralize the land degradation and desertification in long term.



इंदिरा पर्यावरण भवन, जोर बाग रोड, नई दिल्ली-110 003
फोन: (011) 20819239, 20819209 फैक्स: (011) 20819195

INDIRA PARYAVARAN BHAWAN, JOR BAGH ROAD, NEW DELHI-110 003
Ph.: 011-20819239, 20819209, Fax: 011-20819195, E-mail : dgfindia@nic.in

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The revised Action plan focus on the landscape approach of restoration through adopting holistic ecological forestry-based interventions. The plan also makes an effort to further the restoration efforts through suggesting region-wise and site wise treatment models which through are indicative yet highlights some of the best practice models.

Numerous eco-restoration schemes catering to the comprehensive development and restoration of the degraded landscapes and those on the threshold of degradation given the continued ecological and anthropogenic pressures, are being implemented under the different initiatives of the Central Government and the respective State governments emphasizing on intensive afforestation and reforestation, soil and moisture conservation, adopting integrated approach for the holistic socio-economic and ecological recovery and restoration of the vulnerable and degraded landscapes. All these schemes running parallelly in the same landscape have separate implementation and monitoring mechanisms.

The Plan highlights the need for a synergistic, efficient planning and implementation of the eco-restoration initiatives in the country, and puts the spotlight on the need for a synergistic convergent Approach to address the sustainable management of forest and natural resources available in the specific landscape and an effective planning and a wider selection of vulnerable and potentially vulnerable sites capable of supporting progressive and sustainable eco-restoration interventions.

The National Action Plan to Combat Desertification, 2022 presents the coherent and the updated version of the NAP 2001 taking due consideration with the country's commitments for Restoration of 26 million hectares of degraded land by 2030, initiative for enhanced South-South Cooperation that aims to share experiences on sustainable land management strategies, and generating an additional carbon sink of 2.5 - 3 billion tonnes of CO₂ equivalent by 2030 through additional forest and tree cover

The urgent restoration of degraded forests and landscapes in drylands is essential if the global community is to meet the challenges posed by desertification, food insecurity, climate change and biodiversity loss, among other negative trends. The many efforts that have already been made provide lessons that underpin this Action Plan. This plan is tailored to suit regional and local contexts but are intended to be globally replicable in its scope.



(Chandra Prakash Goyal)

10.03.2023

Place: New Delhi
Date: 10th March, 2023



बिश्वजीत कुमार सिंह Bishwajit Kumar Singh



अपर वन महानिदेशक
भारत सरकार
पर्यावरण, वन एवं जलवाय परिवर्तन मंत्रालय
ADDITIONAL DIRECTOR GENERAL OF FOREST
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND
CLIMATE CHANGE

Message

Land degradation is among India's most pressing environmental problems with almost all Indian states recording an increase in degraded land in the past 15 years. Even Policy-wise it is a major challenge to establish concordance between the multiple priorities of poverty eradication, food security and sustainable land management.

Ecosystem degradation resulting from the combination of climatic, developmental, social and anthropogenic pressures is one of the biggest environmental threats facing the world and has caused considerable damage to almost all types of ecosystems. Almost two-third of India's terrestrial forests present outside protected areas have been degraded due to high human pressure and a relatively lower conservation priority and consequently reduced intensity of restoration efforts. An estimated 40-50% of our forests could be facing degradation to varying degrees.

As a key provider of food, water, shelter and employment, the land areas outside the conventional protected/notified areas, especially the unutilized productive land are subjected to coerce with tremendous pressure turning them into wastelands. India is facing an acute crisis of land degradation and desertification. India witnessed an increase in the level of desertification in 28 of 31 states and Union territories between 2011-13 and 2018-19. Some 97.85 million hectares (mha) of India's total geographical area (TGA) of 328.72 mha underwent land degradation during 2018-19, according to the Desertification and Land Degradation Atlas of India, June 2021. This implies 29.7 per cent of the country's land in that year became degraded.

Importantly, restoration provides the unique potential for generating rural livelihoods based on activities aimed at building ecological resilience, thus making local communities active partners in the overall conservation effort. At an economic level, given the scale of effort required, the GDP generation potential is substantial. These social benefits should indeed strengthen the political will needed for this thrust. Restoration ecology and conservation biology are two arms of ecological conservation that complement each other. The latter focuses on conservation of an individual or a related group of faunal species. Restoration focuses on reviving biotic and abiotic components of an ecosystem and one of the objectives is improvement of the habitat for diverse species of fauna. In fact, the success of a restoration project is often measured by the comprehensiveness of revival of the food chain. Restoration makes the conservation of flagship or threatened fauna more effective and sustainable.



जे-305, जल विंग, इंदिरा पर्यावरण भवन, जोर बाग रोड, नई दिल्ली-110 003
फोन: 011-20819290, फैक्स: 011-20819372 .
J-305, JAL WING, INDIRA PARYAVARAN BHAWAN, JOR BAGH ROAD, NEW DELHI-110 003,
Ph.: 011-20819290, Fax: 011-20819372 E-mail: jk036.ifc@nic.in



आजादी का
अमृत महोत्सव

India is committed to achieve Land Degradation Neutrality by demonstrating leadership in addressing land degradation, and pledging to restore 26 million hectares of degraded and deforested land by 2030 as India chaired the COP 14 of the United Nations Convention to Combat Desertification (UNCCD) in 2019. Under the Paris Agreement, India outlined the creation of an additional carbon sink of 2.5-3 billion tonnes of CO₂e through additional forest and tree cover (increase of about 680-817 million tonnes of carbon stock).

Achieving Land Degradation Neutrality also forms an important component of the Sustainable Development Goal 15 (SDG 15) of the United Nations urging countries to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt & reverse land degradation and halt biodiversity loss. Target 15.3 of SDG 15 targets combating desertification, restore degraded land and soil including land affected by desertification, drought and floods and strive to achieve a land degradation-neutral world by 2030.

A Centre of Excellence (CoE) on Sustainable Land Management is also being established at the Indian Council of Forestry Research and Education, Dehradun to foster a strong and long-lasting partnership with institutes of repute both within and outside India working in the field of LDN and SLM, besides integrating key concerns in the development process in India through a multi-stakeholder approach.

The Kunming Montreal Protocol adopted recently in December 2022 by 190 party nations and to restore 30% degraded ecosystems globally (on land and sea) by 2030, Conserve and manage 30% areas (terrestrial, inland water, coastal and marine) by 2030, has been historic and further strengthens and catalyses the India's prior commitment to restoration of degraded landscapes.

The updated version of the National Action Plan to Combat Desertification and Land Degradation adopts a targeted approach to identify priority landscapes and take holistic site conducive actions to restore the degraded lands. Initially, fifteen states of India have been selected based on the extent of degradation, geographical as well as ecological conditions, for taking up the interventions towards achieving the LDN targets. The total area under desertification in the selected 15 states is more than 25% of the country's geographical area.

The National Action Plan with an actionable and integrated plan enables us to foresee an adoptable and an implementable plan towards India's commitments at different global platforms and further leading to the long-term sustainability of the "Life on Earth" and ensuring its overall wellbeing.



(B. K. Singh)



डॉ. संजय कुमार शुक्ला, आई.एफ.एस.
Dr. SANJAY KUMAR SHUKLA, IFS



वन महानीरीक्षक
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
INSPECTOR GENERAL OF FORESTS
Government of India
Ministry of Environment, Forest &
Climate Change

Acknowledgements

India does not have a specific policy or legislative framework for combating desertification as such, however the concern for arresting and reversing land degradation and desertification gets reflected in many of our national policies e.g., National Water Policy 2012; National Forest Policy 1988; National Agricultural Policy 2000; Forest (Conservation) Act 1980; Environment (Protection) Act 1986; National Environmental Policy 2006; National Policy for Farmers 2007; and institutions like National Rainfed Area Authority (NRAA) which have the mandate and enabling provisions for addressing these problems. The National Action Plan to Combat Desertification 2001 was a step taken in earnest and in the right direction. However, given the changes in the problem statement, the magnitude and the plethora of schemes being implemented across the country and the national and international commitments, the revision of the 2001 Plan was due.

The need to converge the underlying principles of sustainable forest management (SFM), sustainable agriculture, sustainable land management (SLM) and the overarching goal of sustainable development which the country has been prioritising has further prompted the Desertification Cell of the Ministry of Environment Forests and Climate Change to take the responsibility to update and revise the 2001 Plan incorporating the new commitments and technologies. The Desertification Cell functions as the Nodal Agency for UNCCD in India, and undertakes activities to help strengthen inter-ministerial coordination, build scientific and technical capacities, and facilitate knowledge sharing by bringing together diverse stakeholder groups to strengthen the foundation for undertaking activities for combating desertification and mitigating the negative effects of droughts.

The preparation of the National Action Plan was initiated under the motivation and able leadership of Shri Bhupender Yadav, Hon'ble Minister for Environment, Forests and Climate Change and with the encouragement provided by Shri. Ashwini Choubey, Hon'ble Minister of State, MoEF&CC and Mrs. Leena Nandan, Secretary, Ministry of Environment, Forests and

Climate Change. The name of Shri C.P. Goyal, Director General of Forests and Special Secretary, MoEF&CC deserves a special mention, in being a driving force and a motivation to undertake this exercise in-house. Without his expert guidance and suggestions, the current shape of the Plan would not have been possible. The contributions of Shri. Bivash Ranjan, Additional Director General of Forests (Wildlife) and Shri B. K. Singh, Additional Director General of Forests (Forestry) in their continued patronage, support, inputs and leadership to the entire initiative, were the key enabling factors for undertaking this challenging task of updating the Plan.

The updation and the revision of the National Action Plan was a magnified exercise which though was undertaken in-house yet involved detailed discussions with various stakeholders, collection, integration and analysis of a voluminous information and data from the Reports of the Working Groups, the final draft report of the consultants, various reports of the Government of India R&D institutions and other organizations. The documents of the UNCCD and a number of national and international organizations were also consulted. The Ministry acknowledges all those who have contributed in the exercise of the formulation of the National Action Plan.

The role and contributions of Directorate of National Mission for Green India (GIM) and National Afforestation and Eco-development Board (NAEB) in drafting, collating, coordinating and consolidating the Plan facilitated the entire exercise. The Ministry and the Desertification Cell duly acknowledges their contribution. The contributions made by the following personnel deserve special mention- Mr. Mayank Trivedi, Consultant Green India Mission for assuming the responsibility and the lead in the drafting of the National Action Plan, Dr. Nemit Verma, Consultant Green India Mission for his untiring thematic and technical contributions, Mr. Nikunj Pathak, National Afforestation and Ecodevelopment Board for his specific inputs on the selected chapters of draft are specifically acknowledged. We also acknowledge the efforts of Dr. Sanjay Singh, Scientist 'E' ICFRE for enriching and vetting the document, Mr. Dinesh Kumar Dalei, Consultant, Desertification Cell towards overall coordination and technical referencing of the document and Dr. Rama Bharti, Consultant, Desertification Cell for her overall contribution in enabling the compilation of the draft.

The Ministry further acknowledges the contributions of all the line ministries including Ministry of Rural Development and Department of Land Resources, Ministry of Jal Shakti, Ministry of Agriculture and Farmers Welfare, Ministry of Road Transport and Highways, Ministry of Fisheries, Animal husbandry and Dairying, Ministry of Coal, Ministry of Housing and Urban Affairs, and National Remote Sensing Centre in the formulation of the draft. In



addition, the Ministry would also like to appreciate and acknowledge the proactive support and inputs provided by a number of knowledge partners and institutions including United Nations Development Program (UNDP), United Nations Environment Program (UNEP), International Union for Conservation of Nature and Natural Resources (IUCN), Indian Council of Forestry Research and Education (ICFRE) in the effort.

We continue to strive to achieve the objectives and the mandate of the Plan and look forward to the persistent involvement of all the stakeholders towards meeting the national and international commitments of the nation towards achieving Land Degradation Neutrality.

Dr. Sanjay Kumar Shukla
Inspector General of Forests, NAEB

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Executive Summary

Desertification, acknowledged to be a complex phenomenon requiring an integrated application of disciplines such as climatology, soil science, meteorology, hydrology, range science, agronomy, veterinary medicine, geography, political science, economics and anthropology, is one of the most serious environmental issues at global, national, regional and local scales affecting the ecological sustainability as well as endangering the sustenance of the communities dependent on the natural resources. The problem of land degradation corollary of desertification has come up to acquire prominence in recent times given the vulnerabilities of natural resources and livelihoods of the dependent communities.

The restoration needs and opportunities are huge. Land degradation affects almost 2 billion hectares of land worldwide, and is home to 1.5 billion people. The Space Applications Centre has estimated India to have about 96.4 million hectares under desertification and land degradation. According to the economics of desertification, the annual cost of degradation comes to Rs.3177 billion which is equal to 2.5% of India's GDP and about 15.9% of the gross value added from the agriculture, forestry and fisheries sectors. Recent studies have alarmed the urgency to restore these areas to cope with the effects of drought, desertification and land degradation.

Restoration interventions involve a mosaic of land uses such as agroforestry systems, parklands, agro-silvo-pastoral and other pastoral systems, forests, rangelands, riparian systems, barren or abandoned agricultural land, protected areas, ecological corridors, public, communal and private land, and rural, urban and peri-urban areas. These actions range from on-the-ground activities such as habitat protection, assisted natural regeneration (ANR), sand-dune stabilization and tree-planting to policy improvements, the provision of financial incentives, and continuous monitoring and learning.

For India, addressing land degradation and promoting restoration at a national scale assumes importance because of its impact on the economy and the well-being of millions. With a population of over 1.3 billion people, India holds 18% of the world's population on 2.4% of the world's total land. It also holds 15% of the world's livestock population. Given the pressure of sustenance, land resources in India are suffering in varying degrees and types, predominantly due to unsustainable use and inappropriate management practices, deforestation, grazing and other anthropogenic impacts. **Approximately 30% of its geographical area is affected by land degradation.** For restoring this, India stands strongly committed by implementing the goals of the UNCCD.

The Desertification and Land Degradation Atlas of India (SAC 2021) indicates the current extent of land degradation to be 97.85 million hectares covering 29.77% of the geographical area of the country during 2018-19. Furthermore, the land area undergoing Desertification and Land Degradation has shown a cumulative increase of 1.45 million ha area (0.44% of the total geographical area) from 2011-13 to 2018-19 (SAC 2021). Around 23.79% of the area undergoing desertification/land degradation with respect to total geographical area of the country is present in Rajasthan, followed by Maharashtra, Gujarat, Karnataka, Ladakh UT, Jharkhand, Odisha, Madhya Pradesh and Telangana in descending order. Amongst the process water erosion has emerged as the most significant process of desertification/ land degradation in the country followed by vegetation degradation and wind erosion.

The Wasteland Atlas of India, 2019 however, highlights the positive change in the country with respect to the reduction of total area in the wastelands category which has been converted to non-wastelands. The total wasteland area of the country was observed to be 5,57,665.51 sq. km. in 2015-16, which was



5,66,070.36 sq. km. in 2008-09. **This indicates a conversion of 8,404.86 sq. km. of different wastelands categories in the country to non-wastelands during 2008- 09 to 2015-16.** Comparison of wastelands statistics of all the states indicates a decrease in wastelands in 18 states and an increase in wastelands in 11 states of the country.

India's leadership in combating land degradation is reflected in its proactive steps to introduce policies and programmatic interventions to tackle the issue of land degradation in the country. In 2001, India developed its National Action Plan to Combat Desertification, a first of its kind globally. With the introduction of several national policies and missions that not only address land degradation but also take in hand the crises of biodiversity loss and climate change, the National Action Plan for Combating Desertification is now being updated and revised. The objective is to integrate regional and thematic strategies and to collate them at the national level with the sole objective to neutralize the land degradation and desertification in long term.

The revised Action Plan focuses on the landscape approach of restoration through adopting holistic ecological 'forestry-based' interventions. The plan also makes an effort to further the restoration efforts through suggesting region-wise and site wise treatment models, which though are indicative, yet highlight some of the best practice models documented by agencies like FAO, World Bank and IUCN.

Numerous eco-restoration schemes catering to the comprehensive development and restoration of the degraded landscapes and those on the threshold of degradation given the continued ecological and anthropogenic pressures, are being implemented under the different initiatives of the Central Government and the respective State governments. These schemes emphasize on intensive afforestation and reforestation, soil and moisture conservation, adopting an integrated approach for the holistic socio-economic and ecological recovery and restoration of the vulnerable and degraded landscapes. However, all these schemes running parallelly in the same landscape have separate implementation and monitoring mechanisms.

The revised Plan highlights the need for a synergistic, efficient planning and implementation of the eco-restoration initiatives in the country. It puts the spotlight on the Guidelines of Convergent Approach for Greening India formulated by the Ministry of Environment, Forests and Climate Change, which emphasizes on converging all afforestation schemes in the country to provide the much-needed impetus and focus on addressing the sustainable management of forest and natural resources available in the specific landscape, and an effective planning and a wider selection of vulnerable and potentially vulnerable sites capable of supporting progressive and sustainable eco-restoration interventions.

The Plan strives to realize participatory landscape designing and visioning process for a proactive and a multistakeholder involvement in the identification of the landscapes and the eco-restoration interventions governed by the landscape mosaic of habitat types and land uses that are best suited to prevalent environmental and socioeconomic conditions. Landscape approaches are people-centered. However, promoting integration among institutions is always challenging, but the best "integrators" are often rural people – who instinctively adopt landscape approaches to their land management. Adoption of a micro-ecosystem¹ approach enables working with a localized approach and involving the smallest working units within the larger landscape with their impacts being magnified and collated at the macro or the landscape level. The Micro-ecosystem approach would thus enable formulation and adoption of site conducive, established, identified and demonstrable models which will be highly beneficial for the holistic eco-restoration of the identified intervention areas within the larger landscapes.

1. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microecosystem>

The **National Action Plan to Combat Desertification, 2022** presents the coherent and the updated version of the NAP 2001 taking due consideration with the country's commitments through forestry interventions for:

- **Restoration of 26 million hectares of degraded land by 2030**
- **Initiative for enhanced South-South Cooperation that aims to share experiences on SLM strategies, and**
- **Generating an additional carbon sink of 2.5 - 3 billion tonnes of CO₂ equivalent by 2030 through additional forest and tree cover**

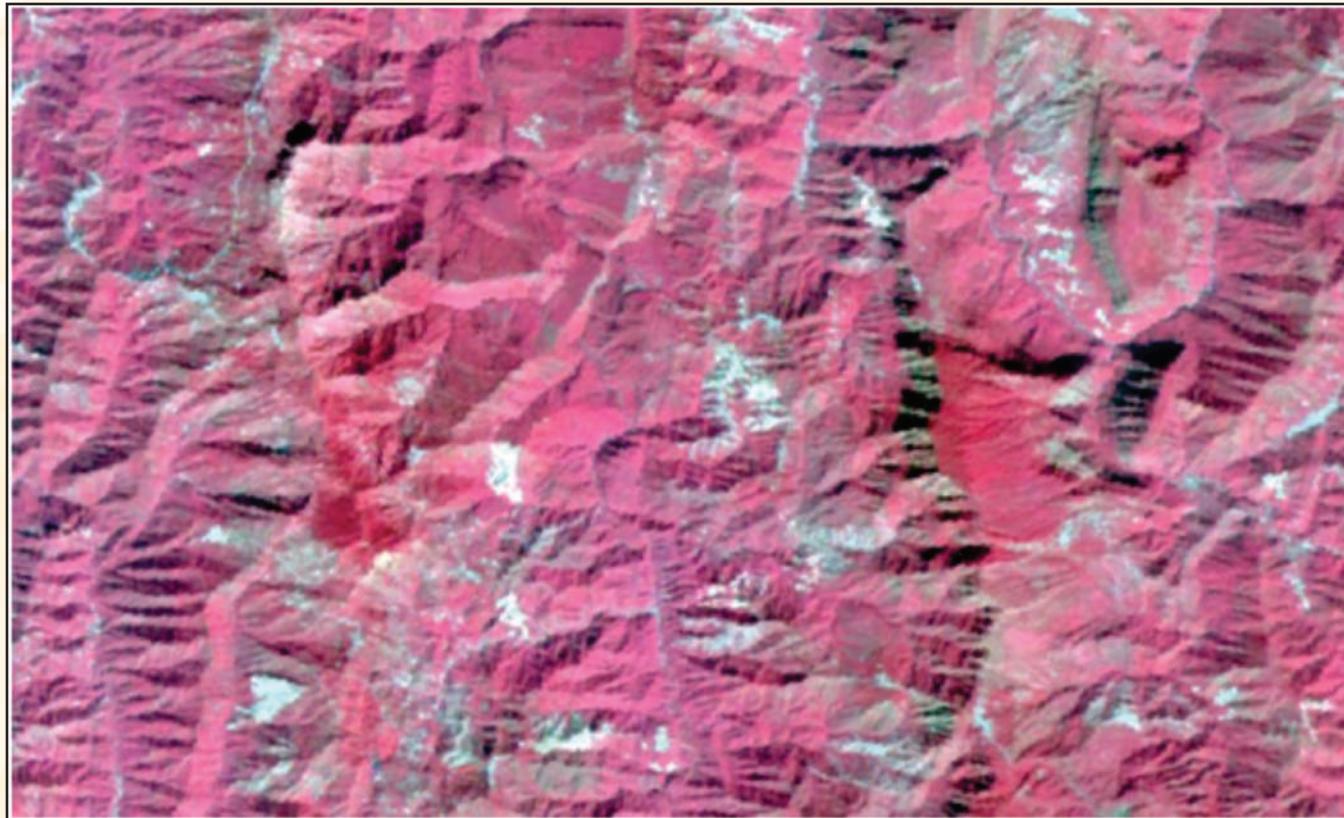
An estimation of the Forest Survey of India establishes that the largest potential of creating additional carbon sinks lies in the restoration of open forest areas included degraded lands, afforestation on wastelands and agroforestry. These activities of eco-restoration through forestry interventions can contribute up to 60% of the total carbon sink that may be achieved by 2030. It may be further emphasized that afforestation on a total of 18.94 mha area has been undertaken since 2011-12 till 2021-22 by the different implementing agencies and under the different schemes/components of schemes under the National and the State plans. The country is thence progressing at a commendable rate to achieve the targets under various commitments and moreover to achieve 33% of forest and tree cover of its geographical area as enshrined under the National Forest Policy of the country.

Based on the extent of degradation, existing vulnerabilities and prioritizing the potential degraded landscapes on the geographical as well as ecological conditions, fifteen states namely Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Odisha, Rajasthan, Telangana, Uttar Pradesh, Uttarakhand, Tamil Nadu, Himachal Pradesh, West Bengal and Maharashtra have been identified for taking up the interventions towards achieving the committed LDN targets and to meet the shortfall of 7 million hectares by 2030. The total area under desertification in the selected 15 states is 83.78 million Ha which is more than 25% of the country's geographical area. In the open forest areas, only 30% of the land is culturable that can be taken up for treatment towards achieving the Land Degradation Neutrality.

Moreover, overall projected allocations of targets under the Revised Plan are proposed under the recently adopted Convergence Approach to achieve the shortfall in the targets to achieve land degradation towards the Land Degradation Neutrality.

The Action plan reiterates that restoration needs to be considered across the entire market value chain, from seed to end-product. Regional collaboration in establishing a network of regional seed-supply centers is essential for developing value chains for native species suitable for building resilient forests and landscapes in drylands.

The urgent restoration of degraded forests and landscapes in drylands is hence essential, if the global community is to meet the challenges posed by desertification, food insecurity, climate change and biodiversity loss, among other negative trends. The many efforts that have already been made provide lessons that underpin this Action Plan. This plan is tailored to suit regional and local contexts but are intended to be replicable globally in scope.



Vegetation degradation inside forests visible in AWiFS image covering parts of Mizoram with corresponding field photograph

Source Desertification and Land Degradation Atlas of India



Chapter 1

THE CONTEXT

1.1 The Concept of Desertification and Criteria for identification of lands as Drought/ Desertification Prone

The issue of degrading lands and the progressive desertification has come up to acquire a prominent importance in recent times, given the vulnerability of natural resources and livelihoods of the dependent communities. The drought in the West African Sahel in the early 1970s caused unforeseen loss of human lives and livestock and widespread environmental deterioration. In recognition of this assigned importance to desertification and mainly as a result of the impact of extended drought in the West African Sahel, United Nations Conference on Desertification in Nairobi was created in 1977. This was however, neither the first manifestation of the desertification phenomenon nor the only reason for scientific interest in the concept of desertification.

Desertification, a series of natural processes leading to gradual land degradation, is one of the most serious environmental issues at global, national, regional and local scales (UNEP, 1992; Imeson, 1996). The evolution of the term desertification is originally attributed to A. Aubreville, a French scientist, who popularized it as early as 1949. Land degradation means the reduction or loss of the biological and economic productivity and complexity of irrigated and non-irrigated agricultural lands, pastures, rangelands, forests and forested lands. Desertification is acknowledged to be a complex phenomenon requiring an integrated application of disciplines such as climatology, soil science, meteorology, hydrology, range science, agronomy, veterinary medicine, geography, political science, economics and anthropology. It has been defined in many different ways by researchers in their disciplines, and also from many national and bureaucratic (institutional) perspectives, each emphasizing different aspects of the phenomenon. Desertification, is thus the consequence of a series of important degradation processes in semi-arid and arid regions, where water is the main limiting factor of land use performance.

Definitions of Desertification

Desertification, as a process has generally been viewed as a series of incremental (sometimes step-wise) negative changes in biological productivity of arid, semi-arid, and subhumid ecosystems. It can encompass such changes as a decline in yield of the same crop or more drastically, the replacement of one vegetative species by another which maybe equally productive or equally useful, or even a decrease in the density of the existing vegetative cover. Desertification as an event is the creation of desert-like conditions (where perhaps none had existed in the recent past)

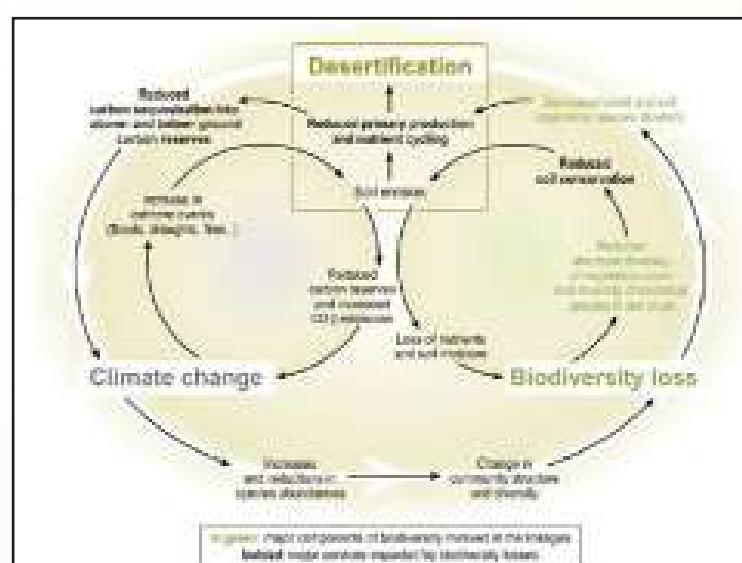


Figure 1 Processes of Desertification

as the end result of a process of change. Some researchers consider desertification to be a process of change, while others view it as the end result of a process of change. This distinction underlies one of the main disagreements about what constitutes desertification. These two views represent different aspects



of a broader concept of desertification. Thus, seemingly different statements such as “the creation of desert-like conditions in areas once green”, “encroachment by desert-like conditions”, “the intensification of desert-like conditions”, as well as less drastic projections like “changes in soils and in climate” or “the land becoming less fit for range and crops”, can be encompassed in the concept of desertification.

Different definitions focus on changes in soil (e.g. salinization), or vegetation (e.g. reduced density of biomass), or water (e.g. waterlogging), or air (e.g. increased albedo). Most of them, regardless of primary emphasis, also describe changes in biological productivity, with comments related to the type, density, and value of vegetation. Within the dozens of existing definitions of desertification, many words are used to describe the phenomenon, some of which complement each other while others appear to be contradictory. There however exists a consensus that desertification is an adverse environmental process. The negative descriptors used in these definitions of desertification include: deterioration of ecosystems (e.g. Reining, 1981), degradation of various forms of vegetation (e.g. Le Houerou, 1975), destruction of biological potential (e.g. UNCOD, 1978), diminution of biological potential (*ibid.*), decay of a productive ecosystem (e.g. Hare, 1977), reduction of productivity (e.g. Kassas, 1977), decrease of biological productivity (e.g. Kovda, 1980), alteration in the biomass (e.g. UN Secretariat, 1977), intensification of desert conditions (e.g. Mecklein, 1980; WHO, 1980), and impoverishment of ecosystems (e.g. Dregne, 1976).

The 1977 Nairobi Conference did serve to draw attention to the phenomenon of desertification (UN Secretariat, 1977), and described in detail the phenomenon as:

“...the diminution or destruction of the biological potential of the land, (which) can lead ultimately to desert-like conditions. It is an aspect of the widespread deterioration of ecosystems, and has diminished or destroyed the biological potential, i.e. plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development. Important factors in contemporary society--the struggle for development and the effort to increase food production, and to adapt and apply modern technologies, set against a background of population growth and demographic changes--interlock in a network of cause and effect. Progress in development, planned populations growth and improvements in all types of biological production and relevant technologies must therefore be integrated. The deterioration of productive ecosystems is an obvious and serious threat to human progress. In general, the quest for ever greater productivity has intensified exploitation and has carried disturbance by man into less productive and more fragile lands. Overexploitation gives rise to degradation of vegetation, soil and water, the three elements which serve as the natural foundation for human existence. In exceptionally fragile ecosystems, such as those on the desert margins, the loss of biological productivity through the degradation of plant, animal, soil and water resources can easily become irreversible, and permanently reduce their capacity to support human life. Desertification is a self-accelerating process, feeding on itself, and as it advances, rehabilitation costs rise exponentially. Action to combat desertification is required urgently before the costs of rehabilitation rise beyond practical possibility or before the opportunity to act is lost forever (UN Conference to Combat Desertification, 1978)”

Changes in the density of the vegetative cover also constitute an important factor acknowledged by many authors in their definitions of desertification. As density decreases, the risks of wind erosion, water

erosion and the adverse effect of increased solar radiation on bare soils are increased dramatically. Surface albedo (reflectivity) is also enhanced by a reduction in the vegetative cover, is also a major contributor to desertification process.

Each of these terms suggests a change from a favored or preferred state (with respect to quality, societal value, or ecological stability) to a less favored one and each has been used to describe the condition of vegetation, or moisture availability, or soils, or atmospheric phenomena, depending on the particular definition. A movement or a transfer of the characteristics of a desert landscape into an area where such characteristics had not existed; through an extension, encroachment, acceleration, spread, and transformation forms the essence of all the definitions. Desertification, thus encompasses most kinds of environmental changes related to biological productivity (see Rozanov, 1981).

1.2 Criteria for Identification of Lands as Drought/ Desertification Prone

Land degradation and desertification constitute as among the most serious environmental issues at global, regional, and local scales (UNEP 1992; Imeson 1996). Both are global processes that are especially active in arid, semi-arid, and dry sub-humid areas, and that have been enhanced in recent decades by factors including climatic variations and human activities.

Desertification of an area will proceed if certain land components are degraded beyond specific thresholds, leading to irreversible change. Indicators of desertification may demonstrate that desertification has already proceeded to its end point of irreversibly unproductive soil. The necessity of elaborating indicators is one of the priorities identified by the United Nations Convention to Combat Desertification (UNCCD) (COP9 2009). Indicators generally simplify reality to make complex processes quantifiable so that the information obtained can be communicated (EEA 2005). There is always a possibility for inaccuracy associated with indicators but this can be taken into account sometimes as degree of risk.

- **Environmental indicators**, facilitate the assessment and monitoring of desertification by providing synthetic information on the status and trends of environmental processes leading to desertification. Simple indicators related to the physical environment such as soil depth, slope gradient, slope exposure, parent material, rock fragment content, annual rainfall, aridity index, type of vegetation, plant cover, etc., and land management characteristics such as tillage operations, tillage depth, controlled grazing, period of existing land use type, erosion control measures, etc., can be easily used for defining desertification risk.
- **Socio-economic indicators**, based on the characteristics of an area such as family size, farmer age, farm size, farmer income, land tenure, etc., should be treated very cautiously and analyzed at local conditions, but may not be generalized for other areas. These indicators become more effective when they are applied on the basis of land use type.

The main processes or causes of land degradation and desertification are identified as soil erosion including water and tillage erosion, soil salinization, water stress, forest fires, and overgrazing, and may be further categorized as under-

- (a) **State indicators** that allow monitoring of the success of mitigation measures; these need to be tailored for maximum sensitivity to each particular technique,
- (b) **Driver and pressure indicators** focusing on conditions where remedial intervention may be needed to prevent land degradation and desertification, and



(c) **Response indicators** characterizing actions undertaken for land protection. Furthermore, the analysis included indicators related to local (farm) level, such as land use type, farm size, tillage operations, or regional conditions (municipality, watershed) such as farm subsidies allocated, or rainfall seasonality

Salinization is another important process that promotes desertification. In many cases, the rapid development results in the overexploitation of the aquifer systems for a variety of uses such as agricultural, industrial and domestic, causing gradual intrusion of sea water in the aquifers. Irrigation using water with high salt concentrations increases the salinity of soil, causing an unproductive land. Soil salinization is a potential desertification threat for lands characterized by high xerothermic climatic indices (Kosmas, 1999). Moreover, as tourism continuously grows along coastal areas, water allocation is shifted towards domestic consumption. The increasing water consumption combined with the substantial increase in water requirements associated with high input agriculture, is likely to create significant water allocation problem bringing about further degradation of the plains through salinization.

1.3 The Impacts of Desertification Process

Desertification and land degradation are very serious challenges. They lead to hunger and poverty, drive unemployment, forced migration and conflict, while increasing the risk of extreme weather related to climate change. It is estimated that desertification is affecting around 1.5 billion people globally. Each year an estimated 24 billion tonnes of fertile soil are lost in drylands, as drought and desertification turn 12 million hectares of land into man-made deserts.

A study produced in 2007 by the United Nations University suggested climate change is making desertification "the greatest environmental challenge of our times". Around one third of the world's surface is now suffering the effects of desertification (© Giulio Napolitano/FAO). It has also been estimated that about 24 billion tons of fertile soils are lost due to erosion annually and this becomes all the more consequential in tropical and sub-tropical countries having most of its population practicing subsistence agriculture, and dependent on natural phenomena for agricultural production. Desertification can reduce agricultural yields and make them much more unpredictable. Often communities affected by desertification develop survival strategies to attend to urgent requirements, which in turn worsen the desertification in the area. Besides, exaggerating the threat to food supplies, desertification also heightens climatic crises including drought, famine and political crises that can lead to migration.

The restoration needs and opportunities are huge. Land degradation affects almost 2 billion hectares of land worldwide, home to 1.5 billion people. An estimated 2 billion people, 90 percent of whom are in developing countries, live on drylands. The Space Applications Centre has estimated India to have about 96.4 million hectares under desertification and land degradation. According to the economics of desertification, the annual cost of degradation as Rs.3177 billion which is equal to 2.5% of India's GDP and about 15.9% of the gross value added from the agriculture, forestry and fishing sectors. Recent studies have indicated the need to restore these areas to cope with the effects of drought, desertification and land degradation.

1.4 Need for Combating Vulnerability to Desertification

Drylands cover 41 percent of the earth's land surface and are home to 2 billion people. In many regions, dryland forests and landscapes are under unprecedented pressure, brought about by changing and competing land uses and practices, wasteful and unsustainable water use, inappropriate cultivation and grazing practices, and overharvesting. Up to 20 percent of the world's drylands are degraded, and people

living there are often locked in a vicious circle of poverty, destructive practices and environmental degradation.

It is clear that urgent efforts are needed to arrest dryland degradation and restore degraded lands. At the same time, macro-level concerns about the degrading natural resource base has overlooked the many micro-level gains that have been made towards sustainable management and restoration practices and efforts led by governments, local communities, non-governmental organizations and other stakeholders. These gains and successes, if identified and analyzed, can inspire others and lead to their scaling up – nationally, regionally and globally. A closer observation would reveal valuable management and restoration practices being implemented by national and local institutions and by thousands of farmers and their families. Such practices have generally had positive impacts in reducing climatic risks, raising yields and lowering yield variability, protecting soils, strengthening natural buffers against disasters, recharging aquifers, protecting biodiversity, reducing sedimentation, storing carbon and generating benefits, livelihoods and employment opportunities for the rural poor.

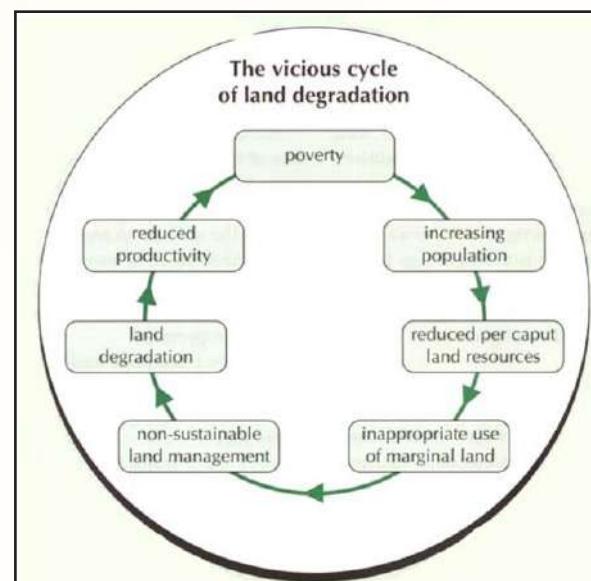


Figure 2 Vicious Cycle of Land Degradation

Restoration actions may involve a mosaic of land uses such as agroforestry systems, parklands, agro-silvo-pastoral and other pastoral systems, forests, rangelands, riparian systems, barren or abandoned agricultural land, protected areas, ecological corridors, public, communal and private land, and rural, urban and peri-urban areas. These actions may range from on-the-ground activities such as habitat protection, assisted natural regeneration (ANR), sand-dune stabilization and tree-planting to policy improvements, the provision of financial incentives, and continuous monitoring and learning.

Recent achievements in restoration and sustainable land management show that the problems posed by desertification are not insurmountable. Bold action and investments are needed to boost food security, improve livelihoods and help people adapt to a changing climate. It thus, gives us an urgent reason to devise a holistic National Action Plan collating comprehensive regional micro-plans and incorporating the best practices to restore drylands and degraded lands in order to tackle the detrimental social, economic and environmental impact of land degradation and desertification using an imbricate mix of community based land restoration, promotion of Non-timber forest products, capacity building and skill enhancement, monitoring and evaluation and through information sharing: knowledge exchange and raising awareness about land degradation and desertification.

1.5 The Convention to Combat Desertification, Objectives and Obligations

Established in 1994, the United Nations Convention to Combat Desertification (UNCCD) is the sole legally binding international agreement linking environment and development to sustainable land management. It is the driving force behind Sustainable Development Goal 15 and Land Degradation Neutrality (LDN).





UNCCD's history can be traced back to the first United Nations Conference on Desertification (UNCOD) in 1977, which adopted a Plan of Action to Combat Desertification (PACD). Tackling desertification took center stage at the seminal 1992 United Nations Conference on Environment and Development (UNCED) – also known the Earth Summit – held in Rio de Janeiro. The Rio Conference called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee (INCD) to prepare, by June 1994, a Convention to Combat Desertification. In December 1992, the General Assembly agreed and adopted resolution 47/188 on this matter, and the UNCCD was established in 1994. 197 countries and the European Union are now Parties to the Convention. The UNCCD is the global voice for land, championing land stewardship to avoid, reduce and reverse land degradation and ensure the ongoing availability of land-based resources vital to human survival. Much has been done, but much more remains to be done.

The 1st Strategic Plan and Framework for 2008-2018 outlined a clear vision to forge global partnerships to reverse and prevent desertification and land degradation, besides providing a global framework to support the development and implementation of national and regional policies for poverty alleviation. At UNCCD COP13 in September 2017 in Ordos, China, member States agreed on a new global roadmap to address land degradation. The UNCCD 2018-2030 Strategic Framework evolved as the most comprehensive global commitment to achieve LDN, with the aim of restoring the productivity of vast swathes of degraded land, improving the livelihoods of more than 1.3 billion people, and reducing the impact of drought on vulnerable populations. The role of the UNCCD would be to play a central role in addressing these issues through capacity-building, the sharing of successful experiences, technology transfer, the provision of scientific support, awareness-raising, mobilization of resources and the provision of assistance to countries in implementing policies at national, subregional, regional and international levels.

Besides recognizing Desertification / Land Degradation and Drought (DLDD) as the challenges of a global dimension which contribute to and aggravate economic, social and environmental problems such as poverty, poor health, lack of food security, biodiversity loss, water scarcity, reduced resilience to climate change and forced migration. The Framework emphasizes that DLDD is a serious impediment to the sustainable development of all countries, particularly affected countries. It realizes that formulation of long-term integrated strategies simultaneously focus on the improved productivity of land and the rehabilitation, conservation and sustainable management of land and water resources would be an imperative necessity.

Key Objectives of the UNCCD 2018-2030 Strategic Framework

- to improve the condition of affected ecosystems, combat desertification/land degradation, promote sustainable land management and contribute to land degradation neutrality
- To improve the living conditions of affected populations
- To mitigate, adapt to, and manage the effects of drought in order to enhance resilience of vulnerable populations and ecosystems
- To generate global environmental benefits through effective implementation of the UNCCD
- To mobilize substantial and additional financial and non-financial resources to support the implementation of the Convention by building effective partnerships at global and national level.

restoration for future prosperity was taken. The UNCCD COP15 adopted 38 decisions on multiple issues including land tenure, migration and gender, that highlight the role of land in addressing multiple crises. An Intergovernmental Working Group on Drought for 2022-2024 shall also be established to look into possible options, including global policy instruments and regional policy frameworks, to support a shift from reactive to proactive drought management. The “Drought in Numbers, 2022” called upon the world to prioritize drought preparedness and resilience.

Another milestone global consensus emerged on boosting drought resilience by identifying the expansion of drylands, improving national policies and early warning. For this, mobilizing drought finance was considered a critical tool. Other significant outcomes of the COP 15 included three key declarations: **Abidjan Call** issued by the Heads of State and Government to boost long-term environmental sustainability, **Abidjan Declaration** on achieving gender equality for successful land restoration and the **COP15 “Land, Life and Legacy” Declaration**, which responds to the findings of the UNCCD’s flagship report, Global Land Outlook 2.

UNCCD’s COP15 is the first Conference of the Parties of the three Rio Conventions taking place in 2022, ahead of the UN Framework Convention on Climate Change COP27 and the UN Convention on Biological Diversity COP15. The Conference called upon the need to ensure greater synergies among the three Rio Conventions, including complementarities in the implementation of these treaties through nature-based solutions and target-setting at the national level, said the leaders representing the UN member states.

The UNCCD’s goal of Land Degradation Neutrality (LDN) can halt, and then reverse this alarming picture of the future. More than 100 countries are a party to the Changwon Initiative, which supports national voluntary target setting processes to achieve land degradation neutrality (LDN). LDN is “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services to enhance food security remain stable, or increase within specified temporal and spatial scales and ecosystems” and involves three concurrent actions:

- firstly, avoiding new degradation of land by maintaining existing healthy land;
- secondly, reducing existing degradation by adopting sustainable land management practices that can slow degradation while increasing biodiversity, soil health, and food production; and
- thirdly, ramping up efforts to restore and return degraded lands to a natural or more productive state.

Recognizing that the droughts are one of the most feared natural phenomena in the world, a ‘Drought Initiative’ was established in 2018, on the premise that the impact of a drought is not determined solely by the severity of the drought, but by the ability of communities and countries to anticipate and prepare for it.

The Drought Initiative focuses on:

- setting up drought preparedness systems, particularly national drought plans
- working together at the regional level to reduce drought vulnerability and risk, and
- providing a toolbox that stakeholders can use to boost the drought resilience of both people and ecosystems

A central part of the Drought Initiative is the Drought Toolbox which countries can use to develop and strengthen their national drought plans. The Toolbox developed by the UNCCD, together with its partners (including the Food and Agriculture Organization of the United Nations, Global Water



Partnership and World Meteorological Organization), features a number of technical and policy options. The tools can be used to assess drought vulnerability and risk and prioritize feasible drought mitigation intervention measures. It contains case studies and other resources, such as 14 validated national drought plans that stakeholders can use to design and implement their own national drought plans.

Leading up to 2030, UNCCD focuses on improving the resilience of vulnerable populations and ecosystems by assisting socially vulnerable and poverty-stricken communities to recover from natural and human-made disasters. The Convention's 197 parties (countries) work together to improve the living conditions for people in drylands, to maintain and restore land and soil productivity, and to mitigate the effects of drought.

1.6 Need to revise the strategies for Combating Desertification

Covering about 41 percent of the Earth's land surface – more than 6 billion hectares distributed among all continents – drylands are home to an estimated 2 billion people, with about 90 percent of them in developing countries. These ecosystems are vulnerable to water shortage, drought, desertification, land-use change and degradation and climate change impacts, with dangerous ramifications for the food security, livelihood and well-being of their populations. Trees and forests in these lands help mitigate the challenges through provision of economic products and vital environmental services such as habitat for biodiversity, prevention of erosion and desertification, and regulation of water, microclimate and soil fertility.

Urgent action is needed to improve the management and restoration of drylands. To this end, a comprehensive understanding of the global and regional threats to drylands and their populations is required, to pinpoint what interventions are needed and where. Unfortunately, the monitoring of dryland ecosystems has not attracted as much attention as that of other ecosystems such as humid tropical forests.

For India, addressing land degradation and promoting restoration at a national scale assumes importance because of its impact on the economy and the well-being of millions. With a population of over 1.3 billion people, India holds 18% of the world's population on 2.4% of the world's total land. It also holds 15% of the world's livestock population. Land in India suffers from varying degrees and types of challenges caused by unsustainable use and inappropriate management practices, deforestation, grazing and other anthropogenic pressures. Approximately 30% of its geographical area is affected by land degradation and therefore India stands strongly committed to implementing the goals of the UNCCD².

Agriculture plays a vital role in India's economy. Of the total workforce 42.6%³ are engaged in agricultural and allied sector activities. The share of agricultural and allied sector activities in the economy's total Gross Value Added (GVA) at current prices is 18% and 17%, respectively, for years 2017-18 and 2018-19. As per the latest statistics published by Ministry of Agriculture & Farmers Welfare, Government of India in 2020, the net sown area in the country stands at 139.42 million ha; of which 68.65 million ha (49.24 %) is the net irrigated and the remaining approx. 70.77 million ha. (50.76%) is rainfed. The rainfed area is typically characterized by resource-deficiency, land degradation and suffering vagaries of nature resulting in poor productivity. The forest and tree cover in India is estimated at 809,537 sq. km (80.95 mha), accounting for 24.62% of the geographical area of the country. Forest cover extends to approximately 713,789 sq. km (71.38 mha), 21.71% and the tree cover accounts for 95,748 sq. km (9.57 mha), 2.91% of the geographical area⁴.

2. ISRO 2019

3. Statista 2019

4. ISFR 2019

The most recent mapping (2018-2019) of degraded lands in India by the Space Applications Centre (ISRO) reveals an area of 97.85 million ha (29.77% of the Total Geographic Area) of the country as undergoing land degradation. Compared to previous assessments (2011-13; 96.40 mha) and (2003-05; 94.53 mha), India has seen to a marginal increase in its degraded land. The assessment shows that the most significant process of desertification and land degradation as Water Erosion (11.01% in 2018-19), followed by Vegetation Degradation (9.15% in 2018-19) and Wind Erosion (5.46% in 2018-19).

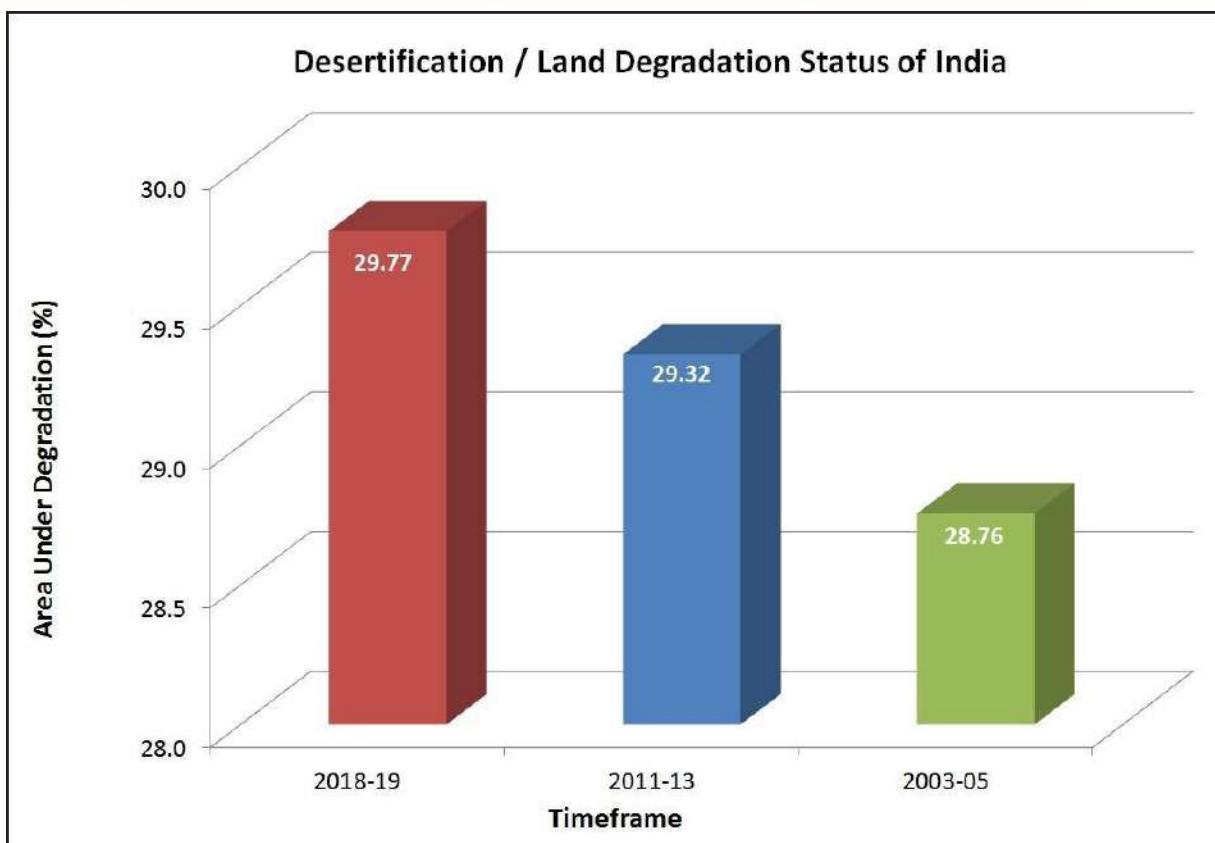


Figure 3 Land Degradation In India

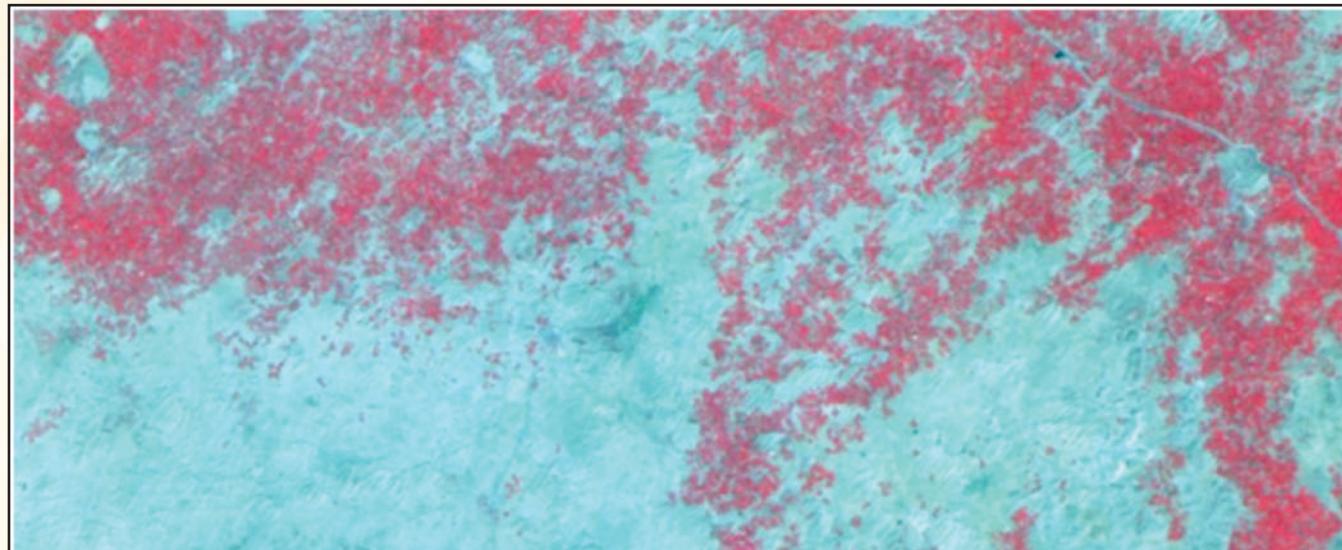
Source: ISRO, Desertification and Land Degradation Atlas 2021

India has demonstrated leadership in addressing land degradation, initially pledging to restore 13 million hectares of degraded and deforested land by 2020 and an additional 8 million hectares by 2030 at the 21st meeting of the Conference of Parties (CoP) of the United Nations Framework Convention on Climate Change (UNFCCC). Under the Paris Agreement, India outlined the creation of an additional carbon sink of 2.5-3 billion tonnes of CO₂e through additional forest and tree cover (increase of about 680-817 million tonnes of carbon stock). The earlier target to achieve 21 million hectares of land restoration by 2030, was also revised to 26 million hectares, as India chaired the COP 14 of the United Nations Convention to Combat Desertification (UNCDD) in 2019.

India's leadership in combating land degradation is reflected in its proactive steps to introduce policies and programmatic interventions to tackle the issue of land degradation in the country. In 2001, India developed its National Action Plan to Combat Desertification, a first globally. With the introduction of several national policies and missions that not only address land degradation but also take in hand the crises of biodiversity loss and climate change, the National Action Plan for Combating Desertification is now under revision. The objective is to revise regional and thematic strategies and to collate them at the national level with the sole objective to neutralize the land degradation and desertification in long term.

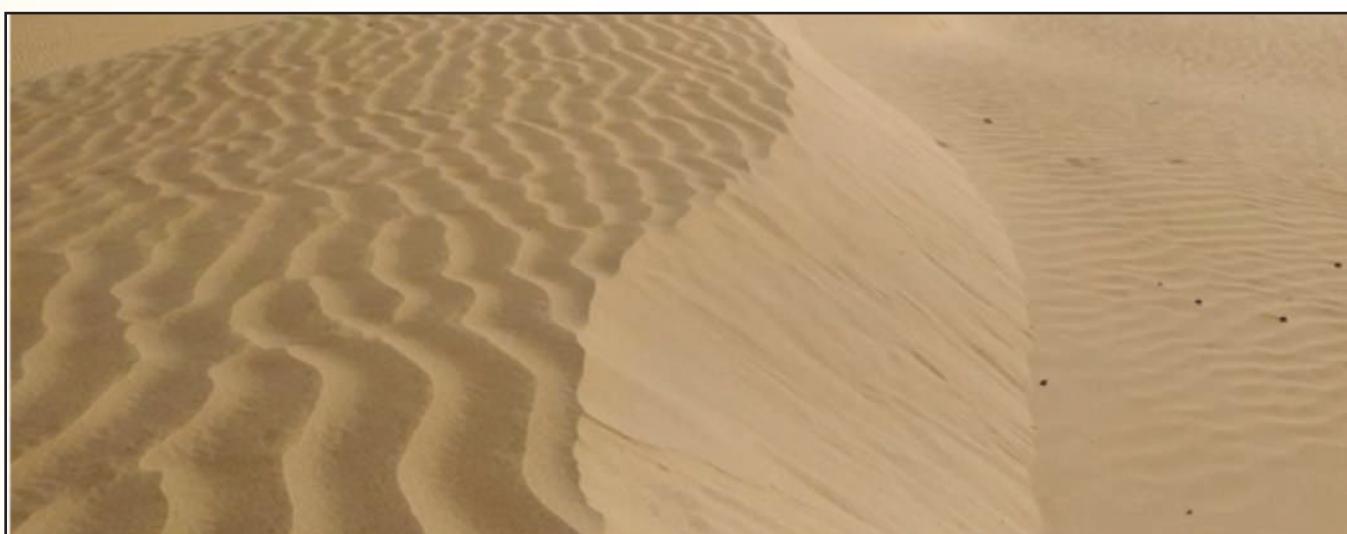


Figure 4: Representational image



Wind erosion/deposition as visible in AWiFS image covering parts of Jodhpur, Rajasthan with corresponding field photograph

Source Desertification and Land Degradation Atlas of India



Chapter 2

SITUATIONAL ANALYSIS

The arid, semi-arid, and dry sub-humid areas, are collectively known as drylands. The geographic classification of drylands based on the aridity index (AI) – the ratio of average annual precipitation amount (P) to potential evapotranspiration amount is shown in Fig.5. The classification of AI is:

- Humid $AI > 0.65$,
- Dry sub-humid $0.50 < AI \leq 0.65$,
- Semi-arid $0.20 < AI \leq 0.50$,
- Arid $0.05 < AI \leq 0.20$,
- Hyper-arid $AI < 0.05$.

Desertification in drylands is due to climatic variations and/or human activities.

2.1 Situation of Drylands and Desertification in the World

At present, Drylands cover about 46.2% ($\pm 0.8\%$) of the global land area and are home to 3 billion people (IPCC 2019). Approximately 70% of dryland areas are located in Africa and Asia. The highest number of people live in the drylands of South Asia, followed by Sub-Saharan Africa and Latin America. Over 70 percent of people living in drylands derive their livelihoods from natural resources (FAO). The status and extent of desertification globally and regionally still show substantial variations..

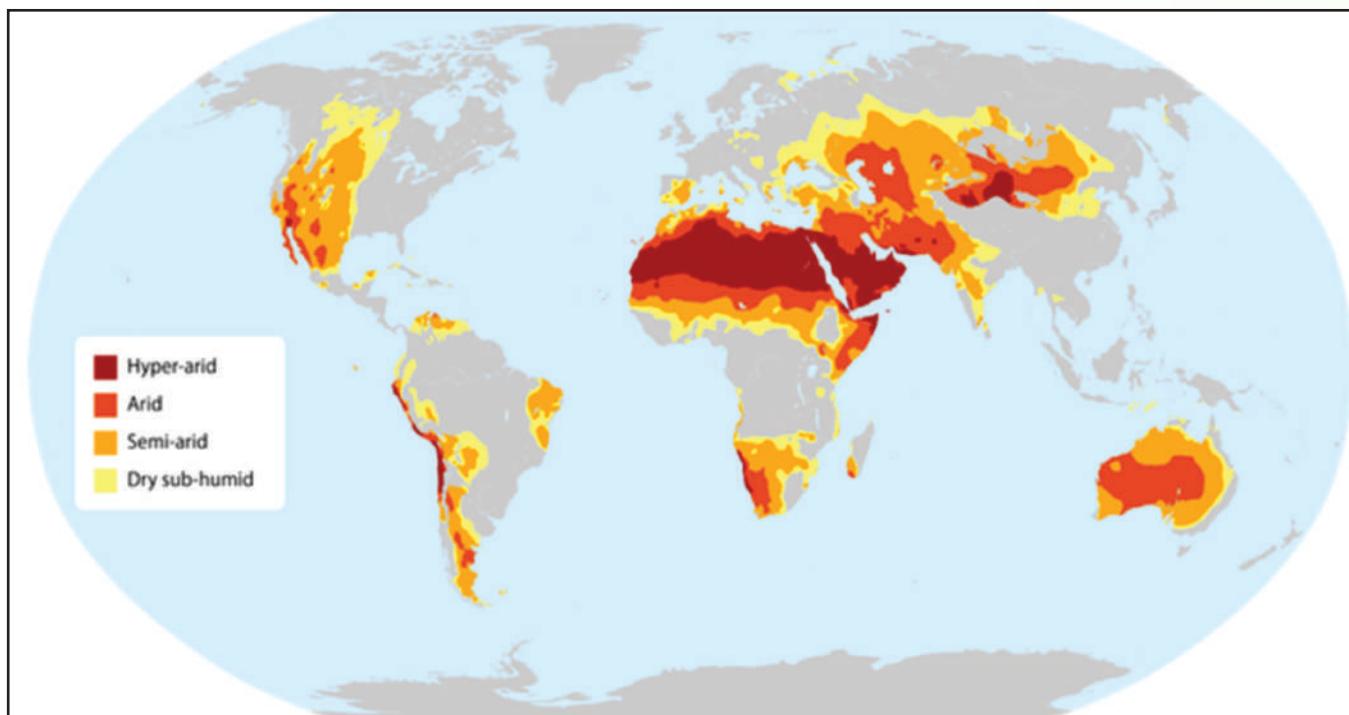


Figure 5 Global Status of Drylands

The IPCC special report on climate change and land degradation suggest with high confidence that the range and intensity of desertification has increased in some dryland areas over the past several decades. Furthermore, between the 1980s and 2000s, about 9.2% of drylands ($\pm 0.5\%$) has reported decline in productivity affecting about 500 (± 120) million people in 2015 (IPCC 2019).

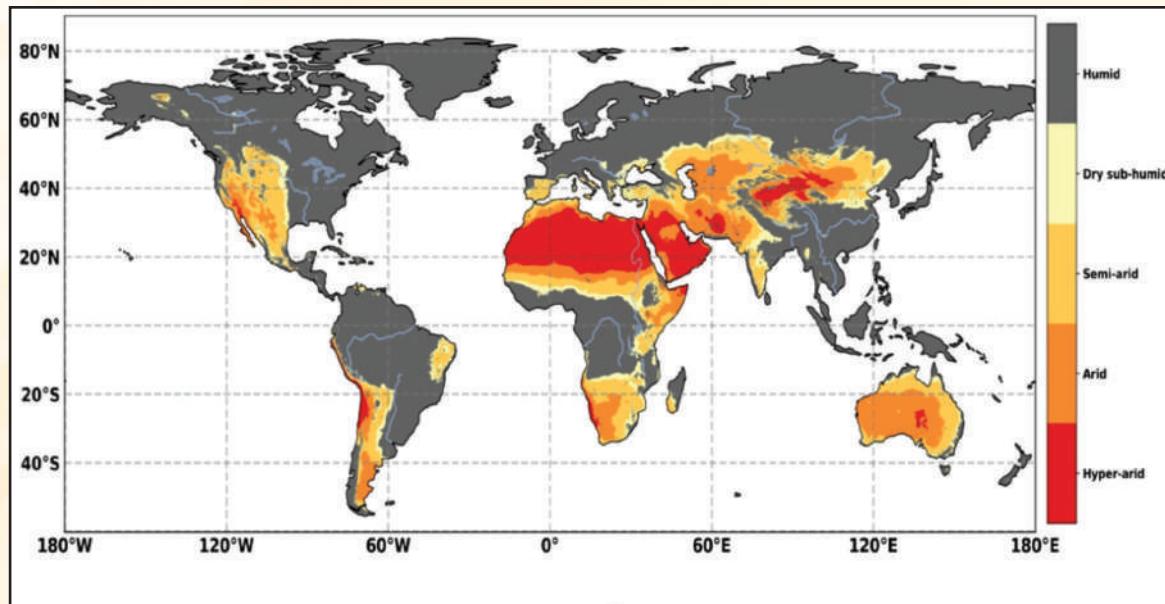


Figure 6 Geographical Distribution of Drylands based on the Aridity Index (AI)

Source: IPCC, 2019

Moreover, according to 'World Atlas of Desertification' the drylands have expanded considerably over the past 60 years and are expected to expand by 10 to 23 percent by the end of the 21st century (Cherlet et. al. 2018). In addition, arid regions are expected to expand in southwestern North America, the northern fringe of Africa, Southern Africa and Australia, while the semi-arid regions are expected to expand in the northern Mediterranean, Southern Africa and North and South America (FAO 2019). It has been reported that land degradation affects almost 2 billion hectares of land worldwide, home to 1.5 billion people. Every year, 24 billion tons of fertile soils are lost due to erosion and 12 million hectares of land are degraded each year meaning 23 hectares per minute (FAO).

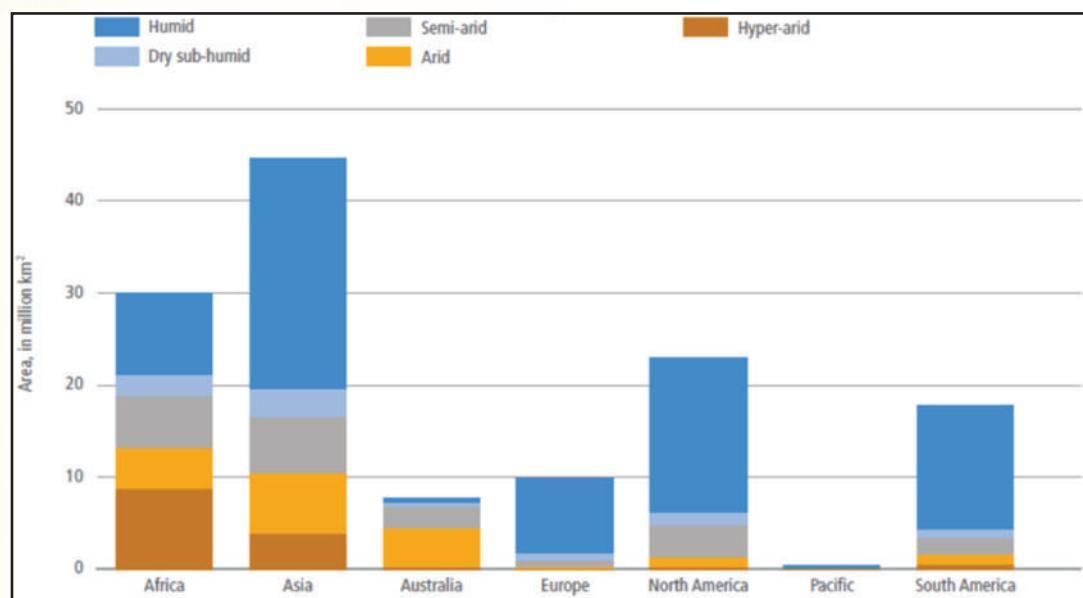


Figure 7 Dryland categories across Geographical Areas

Source: IPCC, 2019

2.1.1 Drylands in Southern Asia

The drylands of Southern Asia cover a total area of 479 million hectares, including almost all of Afghanistan, the Islamic Republic of Iran and Pakistan, as well as most of India, representing 71 percent of the region's total land area and 8 percent of the global drylands. The arid and semi-arid zones each make up 40 percent of the drylands, with the dry sub humid zone occupying another 18 percent and the hyper arid zone covering 2 percent (FAO 2019). The semi-arid and dry sub humid zones are mainly located in India and Nepal, while the arid zone is predominant in Afghanistan, the Islamic Republic of Iran and Pakistan, with pockets of hyper arid zone in the latter two countries.

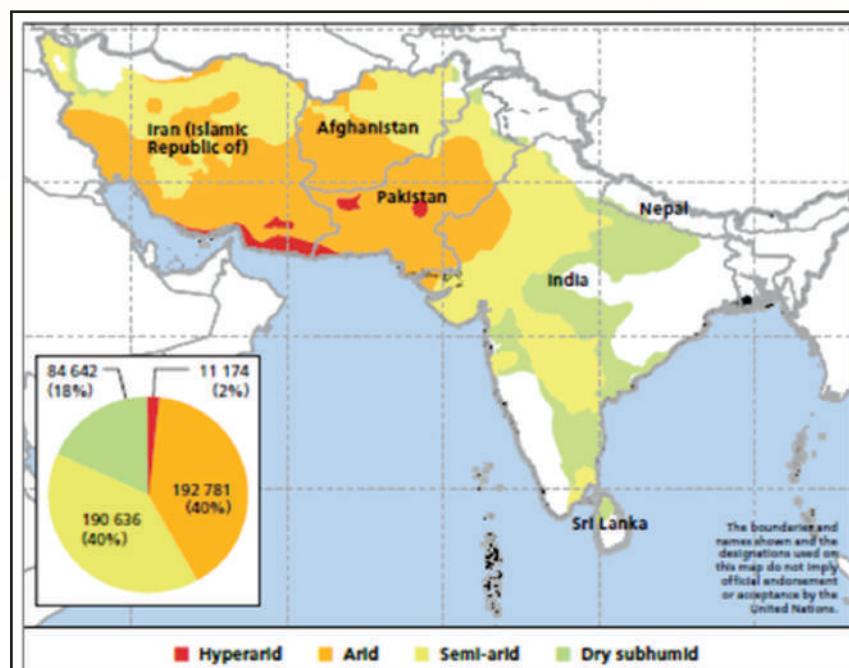


Figure 8 Distribution of Drylands in Southern Asia by Aridity Zone

(Source: FAO 2019)

While studying the changes in drylands in Asia between 1982–2011, it was found that some areas experienced vegetation improvement while others showed reduced vegetation (Miao et al. 2015a). However, according to Damberg and AghaKouchak (2014), parts of South Asia experienced drying over the last three decades. More than 75% of the area of northern, western and southern Afghanistan is affected by overgrazing. Desertification is also a serious problem in Pakistan (UNEP-GEF 2008; Irshad et al. 2007; Lal 2018). Desertification in Iran has also increased substantially during the 1930s and despite numerous efforts to rehabilitate degraded areas, it still poses a major threat to agricultural livelihoods in the country (Amiraslani and Dragovich 2011). According to Pravlie (2016) desertification is currently affecting 38 of 48 countries in Asia. Climate change is further threatening the natural ecosystems in the drylands of Southern Asia, as drier and warmer conditions are exacerbating the risks of fire, increasing risks posed by invasive species, and endangering the survival of plants adapted to specific climatic conditions, particularly in alpine areas (FAO 2019).

2.2 Indian Scenario

India too is facing an acute crisis of land degradation and desertification. A cumulative increase of 1.45 million ha area (0.44% of the TGA) undergoing DLD is observed during the timeframe 2011-13 to 2018-19. Whereas, from 2003-05 to 2011-13, a cumulative increase of 1.87 million ha area (0.57% of the TGA)

was observed. According to a report-cum-atlas by ISRO's Space Applications Centre, almost 90 percent of the states experienced a rise in land degradation in 2018-2019 compared with 2011-2013 – notably in Delhi and in the northeastern states – while four states showed a slight decrease in land area affected by degradation.

Soil erosion due to water and wind, and degradation of vegetation cover were the main processes that has led to land degradation in India. India, being a sub-tropical country and practices subsistence farming, land degradation can exacerbate climate change and threaten agricultural productivity, water quality, biodiversity, sustainable development, and the living conditions of humans and wildlife, among other effects.

India is on its path to achieve its commitment to achieve land degradation neutral status by 2030 whereby increases in land degradation would be offset by gains in land reclamation, which needs effective and efficient inventory and subsequent monitoring. ISRO's Space Applications Centre (SAC) in Ahmedabad had released the results of a project in 2019 in the form of an Atlas, mapping the extent of land degradation and desertification across the country, including the processes involved, the severity, and the changes in degradation. This Atlas also facilitates India's reporting to the UNCCD, and highlights vulnerable areas for mitigation to policy makers, managers, planners, and researchers.

The SAC report-cum-atlas showed that during 2018-2019, the most recent time period to be quantified, 29.77 percent of the country was undergoing land degradation. Compared with 2011-2013, the country experienced a 0.44 percent increase in land degradation and more land has been degraded than reclaimed. A few states were afflicted with more than 50 percent of their area under desertification. The increase in degradation compared with 2011-2013, was high for Delhi, Jammu and Kashmir, and the northeastern states while four states showed a drop in degradation.

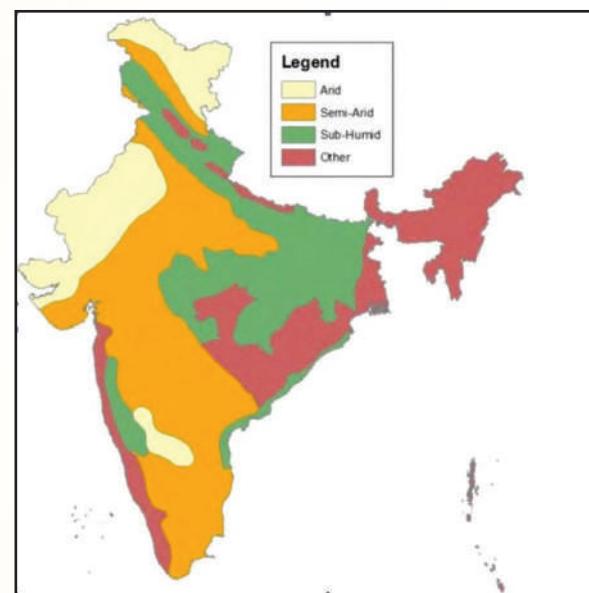


Figure 9 Extent of Desertification and Land Degradation in India

According to the UNCCD, around 69 percent of India falls under drylands. Land degradation within dryland regions is known as desertification. The map shows the dryland regions of India, which comprise 69 percent.⁵

5. Original source: National Bureau of Soil Survey and Land Use Planning, Bangalore. Map extracted from Desertification and Land Degradation Atlas of India.

“The basic definition of land degradation in the Indian context is the deterioration of the original quality of land and deterioration or total loss of the production capacity of the soil.”

The cost of land degradation can be substantial for India where agriculture is a large contributor to the country’s Gross Domestic Product. As a result, lost productivity can weigh heavily on the economy of the country. A study by Delhi-based The Energy and Resources Institute (TERI) estimated that the economic losses from land degradation and change of land use in 2014-15 stood at 2.54 percent of India’s GDP or Rs. 3,177.39 billion (Rs. 317,739 crore or US\$ 46.9 billion) for that year. Land degradation alone accounted for 82 percent of those costs.



Figure 10 Desert in Ananthapur District, Karnataka

Mapping Degradation

ISRO’s ‘Desertification and Land Degradation Atlas of India, 2021’ maps degradation and desertification from Indian Remote Sensing Satellite (IRS) Advanced Wide Field Sensor (AWiFS) data at a scale of 1:500,000 during 2011-2013 and 2018-19 for all Indian states including the processes of degradation (i.e. water erosion, wind erosion, etc), their severity levels, and the changes between the two time frames (a period of eight years). The type of land cover is classified which includes forest or plantation, agriculture, grassland, scrubland, barren, rocky area, sandy area, glacial, periglacial, and others. In addition, ground truthing or field observations were performed to ascertain that the satellite images were consistent with features on the ground.

The study identifies the processes of degradation/desertification in India as vegetation degradation from deforestation, forest-blanks, shifting cultivation and grazing or grassland; water erosion resulting in the loss of soil cover mainly due to rainfall and surface runoff water; wind erosion causing the spread of sand which can erode soil; salinity of soils in cultivated areas due to excess evapotranspiration, drought, excess irrigation, and overuse of fertilizers; waterlogging or the accumulation of standing water for long periods caused by floods, excess irrigation, and incorrect planning of drainage; frost shattering referring to the breakdown of rocks because of differences in temperature; frost heaving where ice lenses form under the soil; mass movement delineating the movement of masses of soil and rock due to gravity; and manmade causes such as mining, quarrying, brick kilns, industrial effluents, city waste, and urban agglomeration. These are further classified into their level of severity, either high or low.

The most significant process of desertification/ land degradation in the country is Water Erosion (11.01% in 2018-19, 10.98% in 2011-13 and 10.83% in 2003- 05), followed by Vegetation Degradation (9.15% in 2018-19, 8.91% in 2011-13 and 8.60% in 2003-05) and Wind Erosion (5.46% in 2018-19, 5.55 % in 2011-13 and 5.58 % in 2003-05)

83.69 million ha area is observed as undergoing desertification for 2018-19 timeframe. Whereas, area undergoing desertification during 2011-13 and 2003-05 is 82.64 million ha and 81.48 million ha respectively. There is a cumulative increase of 1.05 million ha area under desertification from timeframe 2011-13 to 2018-19. The increase in area under desertification from 2003-05 to 2011-13 is 1.16 million ha. The most significant process of desertification in arid region is wind erosion. Whereas, water erosion and vegetation degradation processes are prominent in semi-arid and dry sub-humid regions.

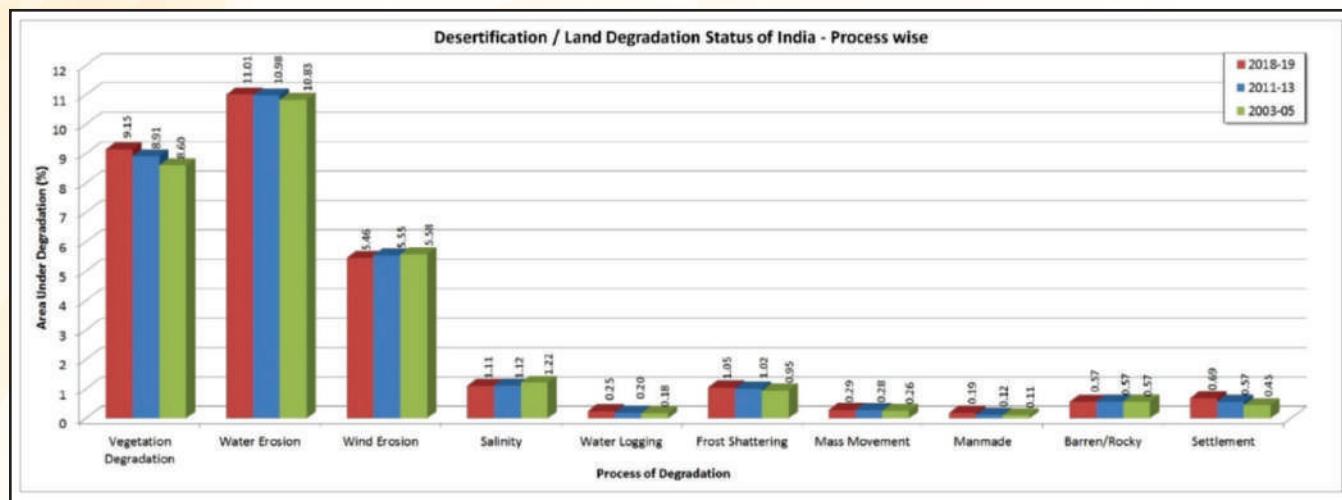


Figure 11 Changes in the Processes leading to Desertification/Land Degradation between 2003-2005, 2011-2013 and 2018-19.

Land degradation increased in most states

Analysis shows that around 23.79% (2018-19), 23.63% (2011-13) and 23.34% (2003-05) of the area undergoing desertification/land degradation with respect to TGA of the country is contributed by Rajasthan, Maharashtra, Gujarat, Karnataka, Ladakh UT, Jharkhand, Odisha, Madhya Pradesh and Telangana (in descending order). All other remaining states are contributing less than 1% (individually) wrt country's TGA. However, the analysis with respect to TGA of the individual states show that Jharkhand, Rajasthan, Delhi, Gujarat and Goa are showing more than 50% area under desertification/ land degradation, whereas states with less than 10% area under desertification/land degradation are Kerala, Assam, Mizoram, Haryana, Bihar, Uttar Pradesh, Punjab and Arunachal Pradesh.

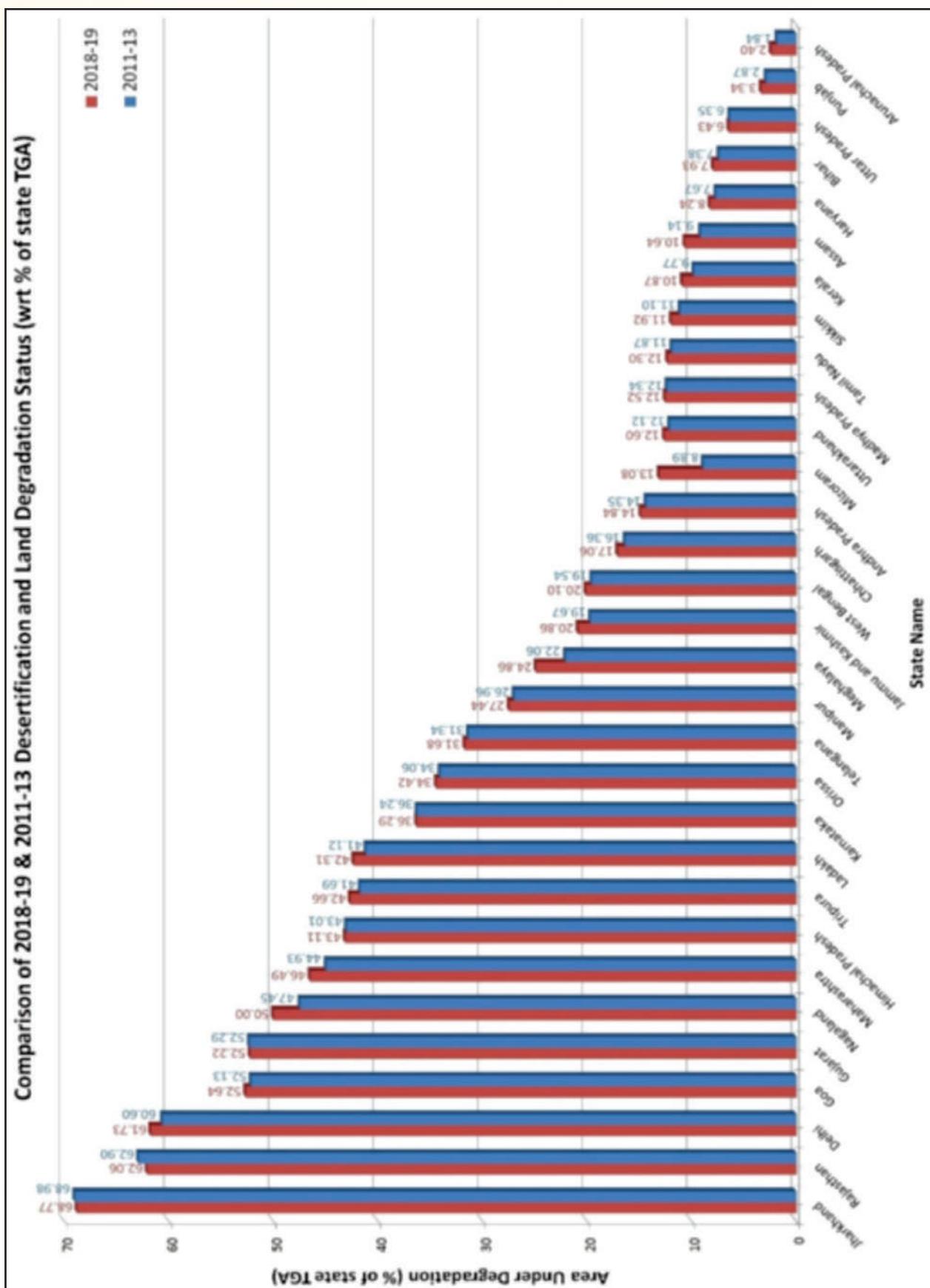


Figure 12 Comparison of the changes in desertification/land degradation status between 2011-2013 and 2018-19 as a percentage of the country area.

The impact of land degradation varies with time and space. It depends on the intensity and amount of rains which cause soil erosion by water. The increase/decrease in area under land degradation does not matter anymore because of the severity of various components of land degradation. There is a need to initiate watershed interventions which include afforestation and other programmes aimed at conserving soil and water, to combat soil loss by water erosion to restore degraded lands.

2.3. Synergies between LDN and other international commitments

Land degradation has been a focus of the three Rio Conventions for more than 20 years and restoration programmes. Each convention has its own goals and commitments, yet they're interconnected. UNCCD envisions to attain LDN by 2030. This complements and accelerates land-use-related UNFCCC and CBD aims. Land management and restoration are vital to the CBD and are addressed in Aichi Targets 5, 7, and 14. (restore ecosystems). Land management and restoration promote climate change adaptation by reducing emissions and improving carbon sequestration.

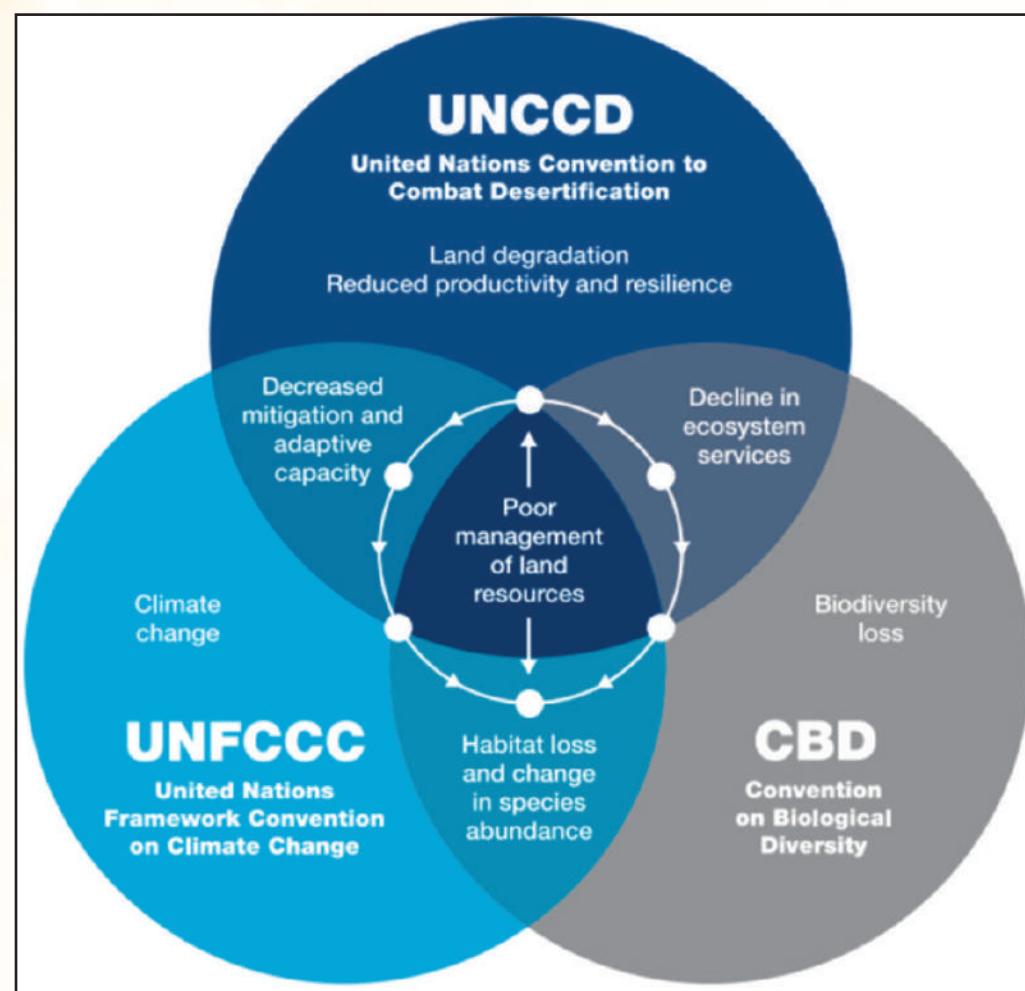


Figure 13 Interwoven challenges and objectives of the Rio Conventions

Source: DOI: 10.2305/iucn.ch.2019.11.en, IUCN, 2019

UNCCD and LDN: UNCCD focuses on desertification, land degradation, and drought. Improve ecosystem health, stop desertification and land degradation, promote sustainable land management, and support LDN. LDN has led convention implementation and SDG advancement since 2015. UNCCD helps countries set voluntary national targets and LDN goals. It promotes LDN locally.

UNFCCC and LDN: Under REDD+, governments use Forest Landscape Restoration (FLR) to establish activities that deliver result-based payments for forest and land-use mitigation actions. FLR addresses degradation drivers to develop optimal landscape-scale solutions for sustainable land-use goals. REDD+ activities include reforestation, afforestation, and silviculture, as well as natural regeneration and enhanced land management.

CBD and LDN: The CBD promotes biological diversity conservation, sustainable use of its components, and fair and equitable sharing of genetic resource benefits. FLR and LDN support process-related activities (including mainstreaming and capacity development) and activity-based restoration interventions (management, rehabilitation, and conservation). LDN and FLR contributions are linked to Aichi Targets 2, 5, 7, 11, 12, 13, 14, and 152, and incorporating them into the CBD Post-2020 Biodiversity Framework could strengthen CBD implementation at the country level.

Bonn Challenge and LDN: The Bonn Challenge was created to voluntarily implement the three Rio Conventions, as well as satisfy LDN and CBD Aichi Biodiversity Targets. The FLR methodology that underpins the Bonn Challenge can serve as a base for achieving national targets and agreements in a cooperative way.

SDG Goal 15.3 aims at combatting desertification, restoration of degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. Achieving this goal through sustainable land management (SLM) practises supports several other SDGs. SDG target



Figure 14 SDG related to Target 15.3. “By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world”

Source: DOI: 10.2305/iucn.ch.2019.11.e

There is a need to align and harmonize reporting under the National Action Plan with the targets outlined under Rio Conventions as well as global restoration initiatives like the UN Decade on Ecosystem Restoration (2021-2030), the Bonn Challenge, UNFCCC, UNCBD, and UNCCD. Land degradation neutrality is central to achieving India's commitments to the three Rio conventions, i.e. UNFCCC, UNCBD, and UNCCD.

2.4 Comparative Analysis and Importance of National Action Plan (NAP) in the Indian Context

In the arid areas of Southern Asia, rangelands or grasslands and shrubs are the dominant vegetation type. In Afghanistan, the Islamic Republic of Iran and Pakistan, forests cover only 2 to 6 percent of the land area (FAO 2019). In addition, dryland forests provide local communities with timber for building and fuelwood to meet their daily needs. Moreover, drylands in Southern Asia contain several biodiversity hotspots, including the Irano-Anatolian region, Western Ghats and the Himalayas, and the forests and trees play a critical role in supporting this rich biodiversity.

India is recognized as one of the world's megadiverse countries. Land degradation and desertification have adversely affected the lives of millions of people. Loss of soil productivity has not only affected lives of the people but also led to the mass migration and socio-economic conflicts. In the year 2014-15, the economic loss faced due to land degradation and change in land use pattern was 2.54 % of India's GDP, which was about 3,177.39 billion rupees (TERI, 2018).

Responding to the threat of Desertification, India has made a target to restore 26 million hectares of degraded land by 2030 and committed to achieve Land Degradation Neutrality by 2030 (Country Position Paper). Desertification is embedded in SDG 15 (Target 15.3) and climate change is under SDG 13. The high confidence and high magnitude impacts depicted for these SDGs (Figure 2.3) indicate that the interactions between desertification and climate change strongly affect the achievement of the targets of SDGs 13 and 15.3, pointing at the need for the coordination of policy actions on land degradation neutrality and mitigation and adaptation to climate change (IPCC 2019). India is party to all the major global conventions and agreements related to forests, biological diversity and environment such as United Nations Framework Convention on Climate Change, Convention on Biological Diversity, United Nations Convention to Combat Desertification, United Nation Forum on Forest, Paris Agreement, Bonn Challenge, etc.

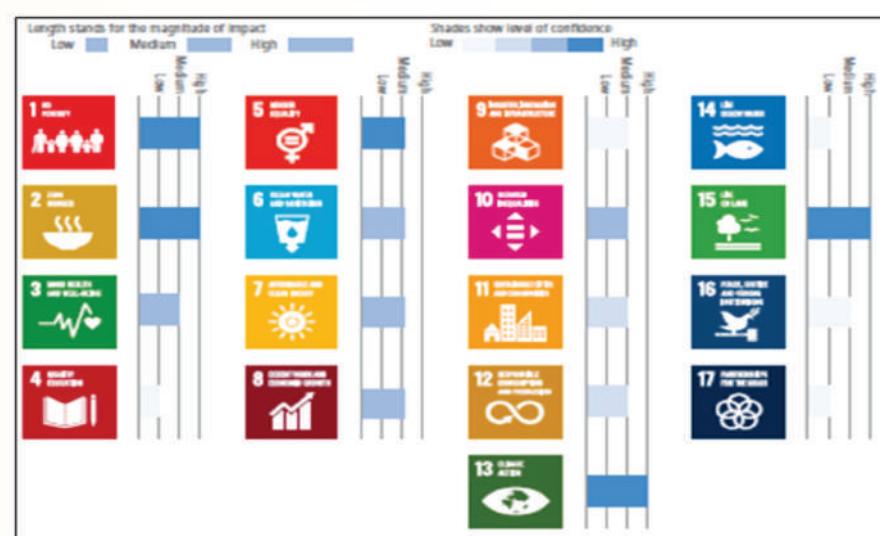


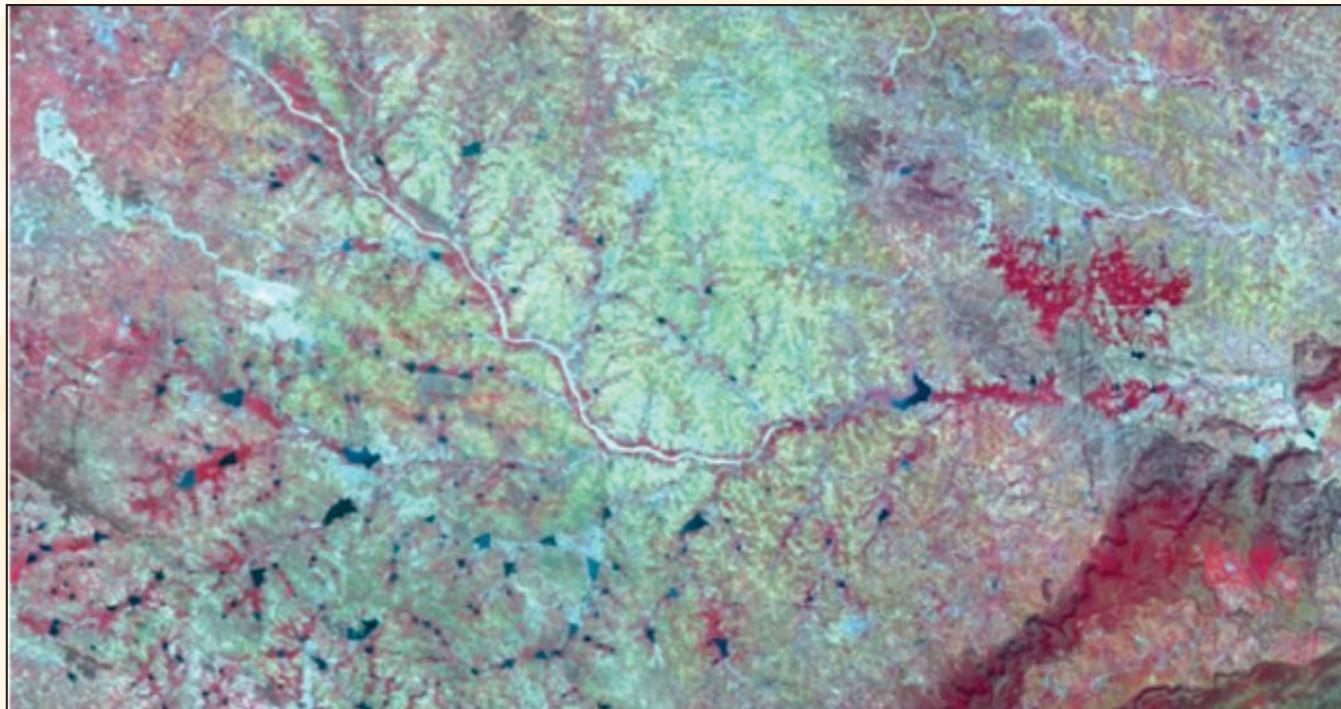
Figure 15 Socio-economic Impacts of Desertification and Climate Change with the SDG Framework (IPCC 2019)

In addition, India has also agreed on integrating SDG 15 and related target 15.3 for the implementation of the Convention and Land Degradation Neutrality. For effective implementation of the Convention at national, sub-regional and regional levels Integration of Sustainable Development Goal 15 and related target 15.3 into the implementation of the Convention and land degradation neutrality, India has set up a Centre of Excellence in the Indian Council of Forestry Research and Education (ICFRE), Dehradun to promote scientific approach towards Land Degradation Neutrality issues.

Urgent action is needed to improve the management and restoration of drylands. And such action requires a comprehensive understanding of the complexity, status and roles of drylands, as well as context-specific approaches tailored to the unique conditions of drylands. Therefore, a comprehensive National Action Plan for combating desertification is ‘the’ need of the hour. As per the experts, better regulation of lands and stepping up watershed management initiatives will help to combat the rising trend of degradation.



Figure 16 Soils are eroding faster than its formation – Area affected by water erosion in Chamarajanagar district, Karnataka



**Water (Sheet) erosion as visible in AWiFS image covering parts of
Telangana with corresponding field photograph**

Source Desertification and Land Degradation Atlas of India



Chapter 3

INDIA: CURRENT PROFILE AND LAND USE

3.1 General Desertification and Land Degradation Profile of India

India is the seventh largest country in the world having a total geographic area of 328.73 million hectare, and occupying only 2.4% of the world's geographical area. However, it supports over 18% of the world's human population and over 18% of the world's cattle population. India is one of the top ten forested countries of the world and its forest and tree cover has increased in recent years transforming country's forests into a net sink of carbon owing to national policies aimed at conservation and sustainable management of forests. As per National Forest Policy 1988, India should have a forest and tree cover on 33% of its geographical area. Degradation of land is the result of both biotic and abiotic factors. Human and animal pressure on land, over-exploitation of soil and water resources, unscientific land use and natural calamities like drought & floods are the main drivers responsible for land degradation. Dry lands areas in India are about 228.3 million hectare which is 69.6% of the total geographical area. According to various estimates, about 29 to 35% of the total geographical area of India is subjected to land degradation.

As per the Desertification and Land Degradation Atlas of India (SAC 2021), the current extent of land degradation is estimated to be 97.85 million hectares covering 29.77% of the geographical area of the country during 2018-19. Furthermore, a cumulative increase of 1.45 million ha area (0.44% of the total geographical area) is observed in areas undergoing Desertification and Land Degradation during the period 2011-13 to 2018-19 (SAC 2021). Around 23.79% of the area undergoing desertification/land degradation with respect to total geographical area of the country is contributed by Rajasthan, followed by Maharashtra, Gujarat, Karnataka, Ladakh UT, Jharkhand, Odisha, Madhya Pradesh and Telangana in descending order.

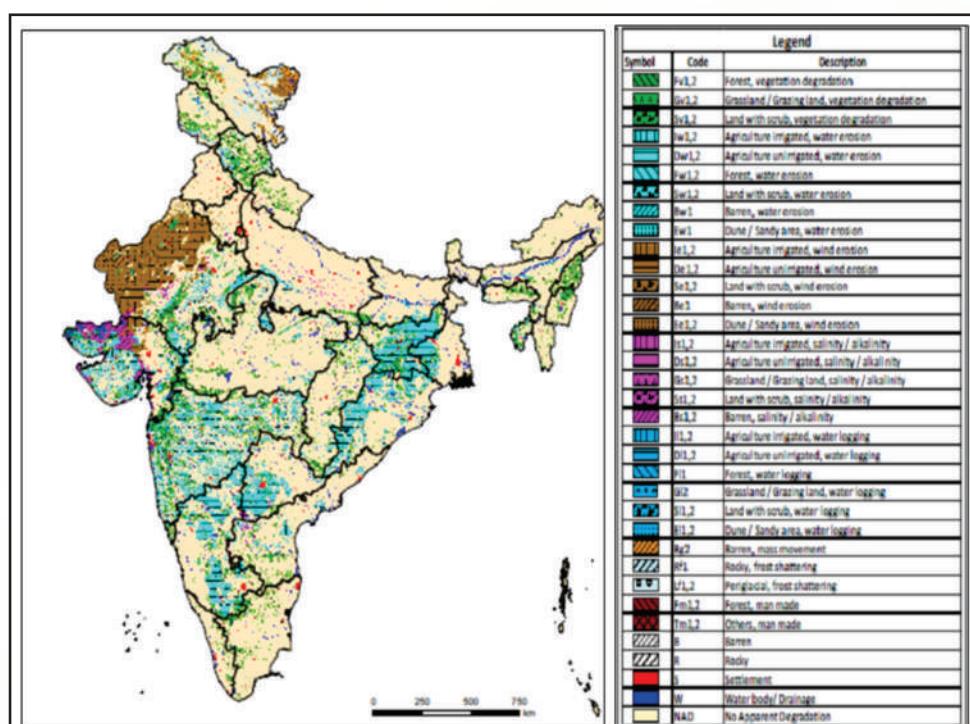


Figure 17 Process of Desertification and Land Degradation in India



The Wasteland Atlas of India, 2019 however highlights the positive change in the reduction of total area in the wastelands category to non-wastelands. The total wastelands area of the country was observed to be 5,57,665.51 sq. km. in 2015-16, while it was 5,66,070.36 sq. km. in 2008-09. This indicates a conversion of 8,404.86 sq. km. of different wastelands categories in the country to non-wastelands during 2008- 09 to 2015-16. Comparison of wastelands statistics of all the states indicates a decrease in wastelands in 18 states and an increase in wastelands in 11 states of the country. A major positive change is observed in the state of Rajasthan with a conversion of 4,803.56 sq. km. of sandy wastelands area to non-wastelands. This was followed by Uttar Pradesh and Bihar states where a respective change of 1,082.29 sq. km. and 1,130.07 sq. km. wastelands area has been restored.

However conversely, increase in wastelands was observed in some of the states of Odisha (465.82sq. km.) followed by Assam (406.69sq. km.), Telangana (377.79 sq. km.) and Chhattisgarh states (373.54 sq. km.). which may be taken up as priority areas for treatment under the current Action plan. A reduction in wastelands was observed in the category of 'Land with Dense Scrub' followed by 'Snow/Glacial Cover' and 'Sands-Semi Stabilized - 15- 40m'. 'Barren Rocky/Stony waste' and 'Land with Open Scrub' followed by 'Under-utilised/Degraded Forest (Agriculture domain)' are the wastelands categories that indicated a marked increase from 2008-09 to 2015-16. Statistics indicate that highest change from wastelands to non-wastelands area is recorded under 'Cropland' class in 2015-16. A considerable change has also been observed in Forest (Open/Dense) and Fallow Land classes from 2008-09 to 2015-16.

Land Use Patterns in India

India is predominantly an agricultural economy having the major portion of its land under the agricultural production and contributing to about 20.2 % of India's GDP (Economic Survey 2022). As such the vulnerabilities of the desertification and drought get much more magnified in indirectly impacting the entire country, in addition to the direct impacts in the specified region. The detailed Land Use Statistics may be seen in the table below which clearly depicts that the Wastelands including the agricultural fallows is affecting about 5,58,21900 hectares which constitutes about 17% of the total land area of the country.

Table 1: Land Use Statistics in India

S. No.	Level 1	Level 2	Area (Sq. Kms.)		
			1985	1995	2005
1	Agriculture	Crop land	15,58,712	15,56,346	16,14,921
		Fallow	2,52,073	2,66,671	2,21,136
		Plantation	77,493	77,956	78,560
		Sub Total -1	18,88,278	19,00,973	19,14,617
2	Barren/Unculturable/ Wastelands	Barren Rocky	65,484	71,250	69,855
		Gullied / Ravinous Land	84,414	78,649	74,355
		Scrub Land	1,82,860	1,88,342	1,92,873
		Sub Total-2	3,32,758	3,38,241	3,37,083
3	Builtup	Built up & Urban	34,019	40,090	47,239
		Sub Total-3	34,019	40,090	47,239

S. No.	Level 1	Level 2	Area (Sq. Kms.)		
			1985	1995	2005
4	Forest	Deciduous	3,17,429	2,94,777	2,80,684
		Evergreen/Semi evergreen	2,08,063	2,05,160	1,97,992
		Forest Plantation	1,50,163	1,49,523	1,47,284
		Scrub Forest	84,368	91,188	98,723
		Swamp / Mangroves	4120	4525	4579
		Sub Total-4	7,64,143	7,45,173	7,29,262
5	Grass / Grazing	Grass / Grazing	54,553	56,604	61,595
		Sub Total-5	54,553	56,604	61,595
6	Snow and Glacier	Snow and Glacier	97,152	91,636	92,522
		Sub Total-6	97,152	91,636	92,522
7	Wet lands / Water bodies1	Water bodies	1,16,119	1,21,148	1,14,856
		Sub Total-7	1,16,119	1,21,148	1,14,856

(Source: EnviStats 2022, MoSPI, Government of India)

3.2 Associated Impacts and Vulnerabilities to Desertification and Land Degradation in the Indian context

Drylands face numerous challenges linked to desertification, population pressure, climate change, and overharvesting and mismanagement which make them highly vulnerable to degradation. These vulnerabilities are the root causes and require careful inventory to ensure effective planning and subsequent redressal.

The **vulnerabilities** may further be segregated for better understanding as

Ecological

- Water scarcity may have natural or anthropogenic causes (Falkenmark et al., 2007), which increases soil erosion and decreases groundwater recharge. This destabilizes the hydrological balance and can lead to recurrent water shortages and sometimes flooding. Water scarcity exacerbates the effects of desertification through direct, long-term impacts on land and soil quality, soil structure, organic matter and soil moisture. In turn, the physical effects of land degradation have negative impacts on the availability, quality and quantity of water resources by inducing the drying up of freshwater bodies; increasing the frequency of drought and of sandstorms and dust storms; intensifying floods; and inducing decline in soil nutrients and vegetation cover. Further land and water degradation can also trigger indirect effects, such as surface and groundwater pollution, siltation and the salinization and alkalization of soils.
- The challenges and threats posed by water scarcity in drylands are expected to increase in the future. Climate change is leading to increased climate variability, such as more frequent droughts, and is likely to intensify water scarcity and exacerbate stresses and desertification in dryland ecosystems.



- Environmental degradation, especially desertification, is a frequent cause of migration, forcing people to move away from unproductive lands.

Climatic

- Drylands are among the most vulnerable ecosystems to extreme weather events. The main challenge posed by climate change in drylands is likely to be an increase in the frequency, magnitude and severity of such events, including prolonged droughts, intense heat waves, heavy precipitation and strong winds. Some consequences of this increase like uncontrolled largescale forest fires; massive forest dieback and pest attacks; major reductions in soil water storage capacity; and large-scale floods that accelerate and intensify soil degradation processes are already apparent.
- Climate change can also magnify the effects of socioeconomic change, and vice versa, potentially triggering faster rates of degradation and landscape-scale impoverishment. There is evidence of prehistoric local and regional disappearances of forest species and ecosystems in drylands caused by combinations of climate change (e.g. an increase in temperature) and intense or rapid anthropogenic changes in land cover or management practices (e.g. the extensive use of fire for land clearance).



Anthropogenic

- Changing land uses and practices such as the transformation of rangelands and other silvo-pastoral systems to cultivated croplands, wasteful and unsustainable water use, inappropriate cultivation and grazing practices, and the overharvesting of wood fuel are leading to land degradation, water shortages and major losses of environmental services. An estimated 10–20 percent of the world's drylands suffer from one or more forms of land degradation (MEA, 2005).
- Sedentism among formerly nomadic people can lead to the overstocking of grazing lands, accelerated deforestation, and intensive cultivation, which are key factors in inducing water scarcity through reduction in vegetation cover.
- A high dependency on wood fuel (firewood and charcoal) coupled with its low availability and overexploitation
- There is a direct relationship between human well-being and the availability of provisioning environmental services (such as food, forage, water and bioenergy), which is characteristically low in most drylands.
- Many people living in drylands are locked in a vicious circle of poverty, irrational practices and environmental degradation. Moreover, climate change is expected to increase the incidence of extreme weather events such as droughts which exacerbate desertification and lead to decline in land productivity.



- Population pressure, the weakening of traditional controls over the use of range resources, increasing land-use conflicts, the general trend towards sedentism among former transhumant communities, and environmental stresses (including those caused by climate change and increased climate variability) are affecting the sustainability of land use and in some cases causing conflicts. The migration of dryland-dwellers in response to societal and climatic changes is another critical issue.

Economic

- Many known drivers of biodiversity loss are present in drylands, including: rapid demographic shifts and urbanization; agricultural expansion (especially intensive farming practices focusing on specific commodities); land-use change; the weakening of governance arrangements that previously regulated resource use effectively; and the introduction and spread of alien invasive species (Davies et al., 2012). Poverty and food insecurity, often coupled with unclear tenure rights over natural resources, drive people to over-exploit remaining natural resources, which accelerates land degradation, leading to even greater poverty and malnutrition.
- On the other hand, many human communities in drylands carry a wealth of ancestral knowledge, skills and other assets, and they have survived and prospered in drylands for millennia. In favourable conditions and with sufficient incentives, these communities have the capacity to achieve sustainable livelihoods, cope with natural disasters, and escape poverty (Dobie, 2003).



Impacts of Drought

Drought produces wide-ranging impacts that span across many sectors of the country's economy. The reverberations are felt by the society and economy much beyond the areas actually experiencing the onslaughts of physical drought because agricultural production and water resources are integral to our ability to produce goods and services. Drought affects the overall economy of the country at macro and micro economic levels, both directly and indirectly. Direct impacts are usually visible in falling agricultural production and heightened food insecurity among poor and vulnerable sections; depleted water levels; higher livestock and wildlife mortality; cattle and animal migration; damage to ecosystem from indiscriminate exploitation; increased fire hazards etc. Indirect impacts of drought can be gauged from the reduction in incomes for farmers and agribusinesses, increased prices for food and fodder, reduction in purchasing capacity and slump in consumption, default on agricultural loans, distress sale of agricultural land & livestock, rural unrest, shrinkage in avenues for agricultural employment etc. These deleterious impulses have huge negative multiplier effects in the economy and society.

The impacts of drought are generally categorized as economic, environmental, and social.

Economic impacts refer to production losses in agriculture and related sectors, especially animal husbandry, dairy, poultry, horticulture and fisheries. It affects livelihoods and quality of life for the majority of farmers, share croppers, farm labourers, artisans, small rural businesses and rural population in general that is dependent on agriculture. All industries dependent upon the primary sector for raw materials suffer on account of reduced supplies and hardening prices. Drought thus causes a dampening impact on the economy by squeezing profit margins, drying up income and revenue streams and constricting employment avenues through disruption caused to supply chain managements, slowing down flow of credit and tax collections, depressing industrial and consumer demand, increased dependence on imports, and lowering of overall market sentiments.



Environmental impacts can be gauged from low water levels in ground water and surface reservoirs, lakes and ponds, reduced flows in springs, streams and rivers, loss of forest cover, migration of wildlife and escalating man-animal conflicts and general stress on biodiversity. Reduced stream flow and loss of wetlands may affect levels of salinity. Increased groundwater depletion rates, and reduced recharge may damage aquifers and adversely affect the quality of water (e.g., salt concentration, acidity, dissolved oxygen, turbidity) which in turn may lead to a permanent loss of biological productivity of soils.

Social impacts manifest in widespread disruption in rural society on account of outmigration of the population from drought affected areas, rise in school dropout rates, greater immiseration and indebtedness, alienation of land and livestock assets, malnutrition, starvation and loss of social status among the most vulnerable sections. The situation of scarcity in some cases may exacerbate social tensions and lead to erosion of social capital. Besides, generation of hydroelectricity is adversely impacted by drought which indirectly accentuates the detrimental economic impacts of drought on both agriculture and industry.



3.3 Assessment and Monitoring

Drought is a complex phenomenon characterized by slow onset. Careful monitoring of the symptoms of desertification eventually leading to drought and the issuance of early warnings are the key to effective management of the landscape level management of the desertification, increasing aridity and the consequent drought as the superlative eventuality. It is essential that along with a drought monitoring system, medium- and long-term area specific plans be prepared for drought proofing of susceptible areas. In addition, contingency and suitable Crisis Management Plans need to be formulated with short term, medium- and long-term perspective. Such well-conceived plans, when executed promptly, can go a long way in mitigating distress and disruption to the rural economy and society.

The objectives behind an effective monitoring system are to:

1. Provide accurate and timely information on desertification and drought indicators like rainfall, crop sown area, data on soil moisture (wherever possible), stream flow, groundwater, lake and reservoir storage at the relevant spatial scale at the State / district / sub-district levels, collating at a larger landscape level.
2. Detection of drought conditions as early as possible in order to accordingly formulate and implement District level Contingency Plans and the Crisis Management Plan.

The development of such a system and its success depends on the coordinated efforts on the part of all affected parties viz. Government of India, State Governments, Scientific Institutions and farmers.

Scientific & Support Organizations involved in Monitoring

1. India Meteorological Department (IMD) provides, inter alia, national weather-based services for weather-sensitive activities like agricultural and is the principal government agency in all matters related to meteorology, seismology and allied subjects. IMD provides All India Weather Forecasts, including meteorological forecasts, monsoon Forecasts, and warnings for severe weather conditions. In addition to these forecasts, IMD also issues other specialized forecasts for tourism, highway, mountain weather, etc. Under Agro-Advisory Services, the Pune based Agricultural Meteorology Division of IMD provides district level 5-day forecasts and crop wise agro-advisories. These advisories are prepared in collaboration with Agro-Met Field Units (AMFU), located in State Agricultural Universities (SAUs) and ICAR centres.

2. Mahalanobis National Crop Forecast Centre (MNCFC) established as an attached office of DAC&FW in 2012 use space technology for agricultural assessment. MNCFC, operationally, carries out drought assessment and monitoring under the National Agricultural Drought Assessment and Monitoring System (NADAMS) after the technology was transferred from the National Remote Sensing Centre in the Department of Space (Government of India). District/sub-district level monthly drought assessments are carried out for 14 major drought-prone agricultural States of India under the NADAMS project. The drought assessment is carried out in the MNCFC using long-term satellite data (NOAA-AVHRR, MODIS, RESOURCESAT 2 AWIFS) on multiple vegetation indices, Rainfall Deficiency (or SPI) using meteorological data, Soil Moisture Index (from agro-meteorological modeling and satellite data), irrigation statistics and sown area figures. The monthly reports are made available in the public domain (www.ncfc.gov.in) for use of all concerned .

3. ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad and the All India Coordinated Research Projects on Agro-meteorology and Dryland Agriculture (AICRPAM and AICRPDA), each with 25 centres under SAUs across the country take part in drought studies pertaining to assessment, mitigation, risk transfer, and development of decision support software for drought-prone States. CRIDA has prepared comprehensive District Agriculture Contingency Plans for about 650 districts in the country, which State Governments and district level authorities can use as guidance documents to deal with drought.

4. The Central Water Commission (CWC) and the Central Ground Water Board (CGWB) under the Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR) are the two lead organizations in the country which monitor reservoir and ground water status. The data on river flows, reservoir storage levels and groundwater status can prove to be extremely useful in making a realistic assessment of water availability for agricultural crops in the event of drought like developments.

5. Indian Space Research Organisation (ISRO) is a premium organization of the country with the mission to harness space technology for national development. Two major centres of ISRO viz., Space Applications Centre, Ahmedabad and National Remote Sensing Centre, Hyderabad carry out applications related to remote sensing, including those in agriculture. These Centres, along with 4 Regional Remote Sensing Centres, located in Bengaluru, Kolkata, Jodhpur and Nagpur provide R&D and technical support for drought assessment/monitoring activities through satellite data products available on Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC) and Bhuvan platforms. The satellite derived products available on Bhuvan (<http://bhuvan.nrsc.gov.in/>) can be useful for drought assessment, including the computation of Normalized Difference Vegetation Index, Soil moisture etc.



Space Applications Centre (SAC), Indian Space Research Organisation (ISRO), Ahmedabad using its more than two decades of experience in monitoring and assessment of land degradation in the country is implementing a Department of Space (DOS) funded project “Desertification and Land Degradation: Monitoring, Vulnerability Assessment and Combating Plans”, and have prepared “Desertification and Land Degradation Atlas of India (Assessment and analysis of changes over 15 years based on remote sensing)”, for the mapping of Country level Desertification/Land Degradation (DLD) for the timeframe 2018-19. The analysis of changes on the status of DLD has also been carried out with previously available inventories of DLD of timeframes 2011-13 and 2003-05.



6. State Remote Sensing Application Centres (SRSACs) carry out remote sensing applications including those critical for agriculture. These centres have developed valuable State level geospatial database and help the State Governments in satellite data analysis for agricultural drought assessment.

7. State Agricultural Universities (SAUs) have the mandate for education, research and extension in agriculture and allied sectors with wide network of research stations, colleges and KVKS and play a crucial role in compilation and analysis of data on rainfall, dry spells etc in their domain districts Manual for Drought Management 24 and have a specific role in studies on Moisture Adequacy Index (MAI) and Standardized Precipitation Index (SPI) at mesoscale and Plant Available Soil Moisture (PASM) at microlevel, to undertake further research in drought management and in field level verification or ground truthing for drought assessment.

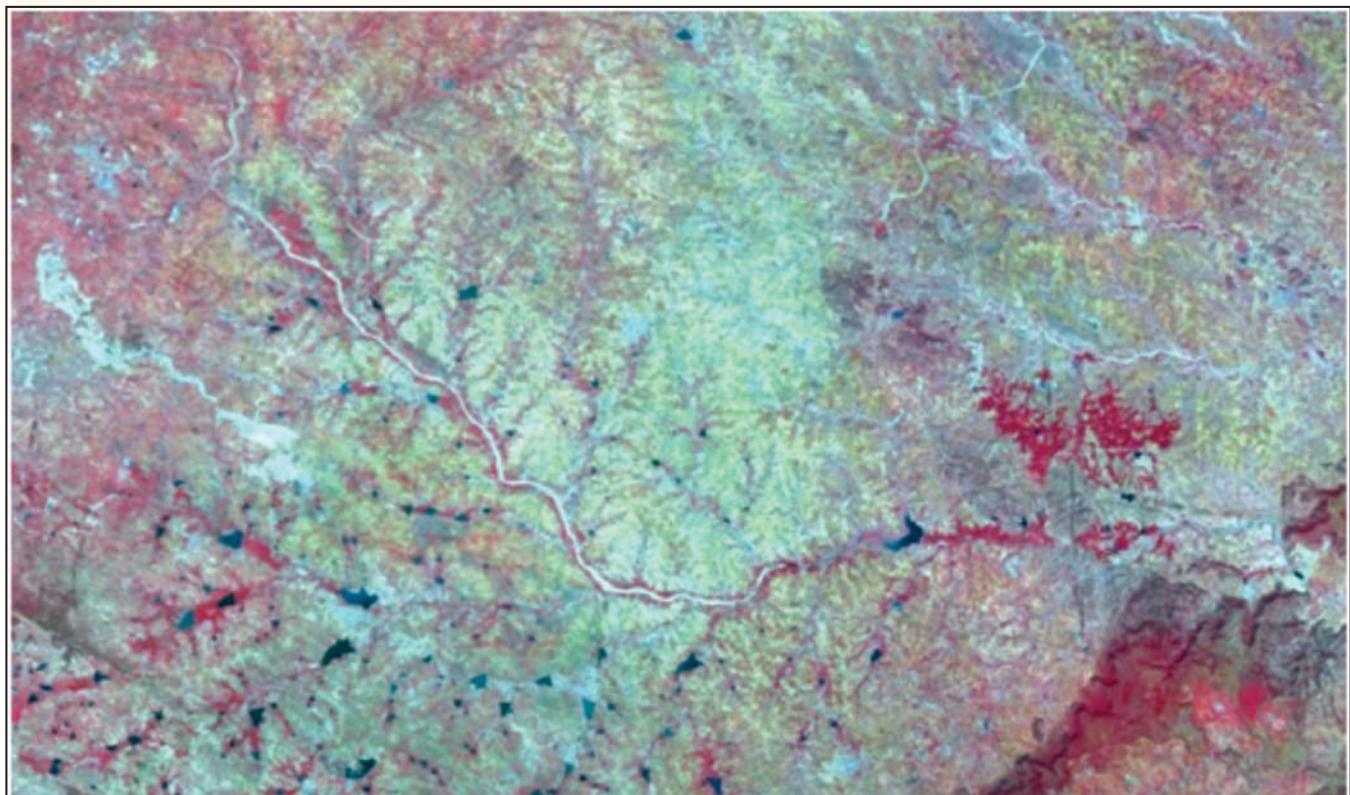
8. Department of Land Resources, Ministry of Rural Development in association with the National Remote Sensing Centre (NRSC) undertakes periodic assessment of wastelands since 1986 to assess the spatial spread and changes happening in the spatial extent of wastelands in the country. The Wastelands Atlas 2019 is the fifth in the series and provides useful inputs to identify specific areas for further reducing their extent, besides helping identifying areas for different schemes and programs on efficient management and qualitative and quantitative enhancement of natural resources in the country, which includes productive use / greening, new infrastructure projects and potential solar farms for renewable energy etc.

Key Variables for Monitoring

State Governments monitor drought by obtaining information from various sources on key variables for drought assessment which include rainfall, reservoir / lake water levels, surface water / groundwater, soil moisture and sowing / crop conditions etc, and listed as-

- Meteorological Data – Rainfall and other parameters like Temperature, Wind speed and Relative Humidity
- Weather forecast - Short, medium, extended range
- Soil Moisture
- Sown Area / Crop Health / Stress
- Satellite based Vegetation Index
- Stream Flow - Discharge
- Groundwater Levels
- Reservoir and Lake Storage / Level

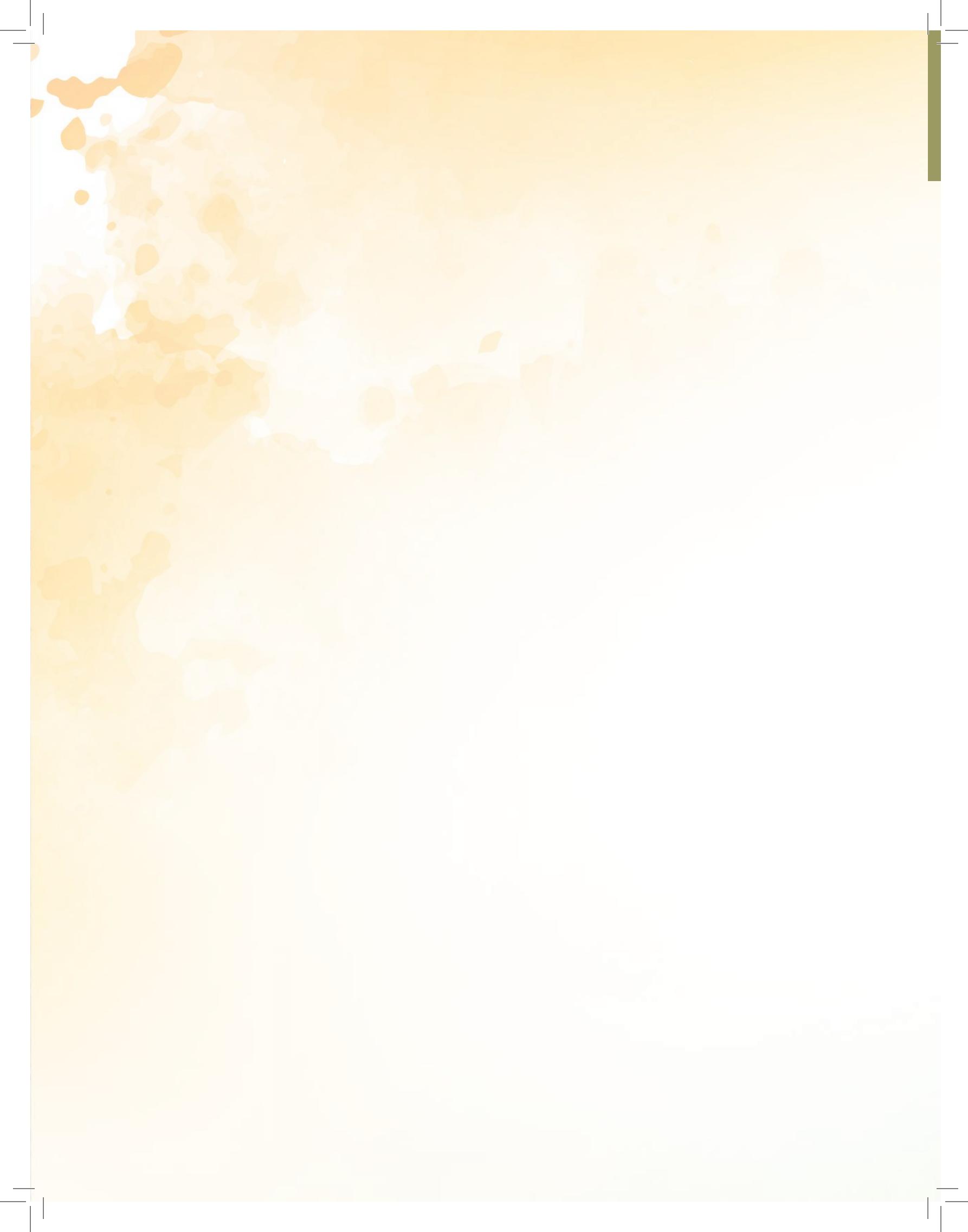
The impact areas of these variables cover distress sale and migration of cattle, human migration, fodder availability, drinking water, animal health, employment opportunities in agriculture sector.



Water logging as visible in AWiFS image covering parts of Bihar with representative field photograph

Source Desertification and Land Degradation Atlas of India





Chapter 4

ADAPTATION AND MITIGATION MEASURES FOR DESERTIFICATION AND DROUGHT

India's national policies have always had a strong focus on environment and wildlife, and are some of the oldest and most comprehensive in the world. India's leadership in combating land degradation is reflected in its proactive steps to introduce policies and programmatic interventions to tackle the issue in the country. Since the 1952 National Forest Policy (NFP), there has been a strong advocacy to have minimum of one-third of the total land area of the country under forest or tree cover, while maintaining two-third of the area under green cover in mountainous and hilly regions. As per the latest Forest Survey of India report, present forest and tree cover is 24.16% of the country's total geographical area. Therefore, to bring a minimum of one third of the total land area of the country under forest and tree cover, an additional 28.58 million hectares of land area would be needed to brought under green cover. This means that we need to start looking beyond designated forest lands and business as usual scenarios.

The Government of India has been diligently undertaking efforts for achieving Eco-restoration and Land Degradation Neutrality through its many flagship schemes and programmes. Among these notable are the National Afforestation Programme (NAP), which is now merged with the Green India Mission, the National Mission for a Green India (GIM), National Green Highways Mission, National Mission for Clean Ganga, and National Agroforestry Policy among others. The Central Government has channeled funds to the States for conservation, protection, improvement and expansion of forest and wildlife resources of the country under the CAMPA Act 2016.

In 2001, India developed National Action Plan to Combat Desertification, globally it is known to be first such plan developed. With the introduction of several national policies and missions that not only address land degradation but also take in hand the crises of biodiversity loss and climate change, the National Action Plan for Combating Desertification is now being revised.

Eco-restoration efforts in India involves different agencies. Prominent among them are the State Forest departments. They work to revive forest landscapes, often through engagement and involvement of the local communities. There are several non-governmental organizations who work in the field of forestry, biodiversity conservation and social upliftment and have specific restoration programmes and activities as part of their mandate. Additionally, there are many private companies in India that also engage in restoration programmes. The environmental, social and economic benefits that come with the restoration of degraded lands have prompted several stakeholders to become part of the restoration process. Government schemes are often implemented with a bottom-up joint forest management approach, with local communities playing a key role. Private companies and non-governmental organizations may operate at smaller scales, yet have the expertise at their disposal that can influence the success of these restoration efforts. Many successful restoration efforts are also being carried out by NGOs and private sector companies.

Over the last two decades, India has introduced and strengthened several policies and programmes in sectors that are relevant to meeting the LDN targets (agriculture, environment and forest, rural development, social welfare, poverty alleviation and women's upliftment). Listed below are some of the key policy and programmatic interventions to address land degradation.



4.1 Policy level

The country already has a slew of policies and laws in keeping with the principles of restoration. Notable among them are the National Forest Policy, 1988 and the recent National Agroforestry Policy, 2014.

The **National Forest Policy (NFP)** aims to substantially increase tree cover in the country through afforestation and social forestry programmes, especially on denuded, degraded and unproductive land. It strives to restore forested landscapes to a state where it can provide benefits such as biodiversity conservation, disaster mitigation and livelihood enhancement. The policy advocates to have minimum of one-third of the total land area of the country under forest or tree cover, while maintaining two-third of the area under green cover in mountainous and hilly regions. Forest and tree cover of India is estimated as 71.38 million hectares which is 21.71 % of the country's geographical area.

Given that 60% of land in India is utilised for agriculture, the **National Agroforestry Policy (NAP)**, launched in 2014, is directed at promoting sustainable and resilient agricultural practices that generate income and improve livelihoods. At the same time, it aims to promote ecological stability in these agricultural landscapes by increasing forest cover. This is of particular significance in a densely populated country like India where habitat connectivity is especially under threat.

India is also a party to various international commitments and forums such as Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD), United Nations Forum on Forests (UNFF), and Bonn Challenge among others.

4.2 Legislative

1. The **Wildlife Protection Act, 1972** is one of the oldest and most comprehensive wildlife laws in the world. This Act provides for the protection of the country's wild animals, birds, and plant species, in order to ensure environmental and ecological security. Among other things, the Act lays down restrictions on hunting many animal species.

2. The **Wild Life (Protection) Amendment Bill, 2021** was introduced in Lok Sabha by the Minister of Environment, Forest and Climate Change on December 17, 2021. The Bill amends the Wild Life (Protection) Act, 1972. The Act regulates the protection of wild animals, birds and plants. The Bill seeks to increase the species protected under the law, and implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

3. **The Forest (Conservation) Act, 1980** regulates diversion of forest land for non-forestry purposes and provides for compensatory afforestation. On the issue of forest use, a historic step was taken in 2006 with the enactment of the Forest Rights Act (FRA). This landmark Act recognises both individual rights to cultivated land in forestland and community rights over common property resources. The act enables forest communities to secure livelihoods and allows for governance of forests and natural resources to be strengthened. These laws guide protection of forest lands and encourage sustainable use by forest-dependent communities. The restoration efforts in India extend beyond national policies and programmes.

4. **Compensatory Afforestation Act (CAMPA) 2016** provided for the constitution of Compensatory Afforestation Fund Management and Planning Authorities both at the National and at the respective State level to oversee the establishment and the management of the funds received from the user

agencies towards compensatory afforestation, additional compensatory afforestation, penal compensatory afforestation, net present value and all other amounts recovered from such agencies under the Forest (Conservation) Act, 1980.

5. Disaster Management Act, 2005 is the primary law at the national level that provisions for management of disasters in the country. Section 11 of the Disaster Management Act, 2005 mandates that there shall be a National Disaster Management Plan for the whole country. As per Section 37 of the Disaster Management Act, every ministry and department of the Government of India, including the hazard specific nodal ministries, shall prepare comprehensive disaster management plans detailing how each of them will contribute to the national efforts in the domains of disaster prevention, preparedness, response, and recovery.

4.3 Programs, Plans and Schemes

Interventions/Schemes/Programs on Afforestation/Restoration, MoEF&CC

Green India Mission:

The National Mission for Green India (GIM) is one of the eight Missions outlined under the National Action Plan on Climate Change (NAPCC). It aims at protecting, restoring and enhancing India's diminishing forest cover and responding to climate change by a combination of adaptation and mitigation measures. The programme takes on a holistic approach of greening and focuses on multiple ecosystem services, especially biodiversity, water, biomass, preserving mangroves, wetlands, and critical habitats. The goals of the mission include:

- To increase forest/tree cover to the extent of 5 million hectares (mha) and improve quality of forest/tree cover on another 5 mha of forest/non-forest lands;
- To improve/enhance eco-system services like carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity; along with provisioning services like fuel, fodder, and timber and non-timber forest produces (NTFPs); and
- To increase forest-based livelihood income of about 3 million households.

Eco-Task Force (ETF) (earlier Eco-Development Forces (EDF): Established in 1980s and implemented through the Ministry of Defence for ecological restoration of terrains rendered difficult either due to severe degradation and/or the remoteness of the location. The Eco Task Force (ETF) Battalions raised by Ministry of Defence is supported by MoEFCCand State Forest Departments in raising and maintaining these plantations.

Nagar Van Scheme

Launched on World Environment Day 2020, the Nagar Van (Urban Forests) aims to develop 400 Urban Forests across the country in the next five years. The scheme is implemented by the National Afforestation and Eco-development Board envisaging the development of 400 Nagar Vans (Urban Forests) and 200 Nagar Vatikas (Urban Groves) in the country during the period of 2020-21 to 2024-25 with an objective to significantly enhance the tree outside forests and green cover, enhancement of biodiversity and ecological benefits to the urban and peri-urban areas apart from improving quality of life of city dwellers. The programmatic intervention includes the cost of fencing, soil-moisture conservation measures, administrative activities, plantation and maintenance.



Compensatory Afforestation Fund (CAF)

India constituted the Compensatory Afforestation Management and Planning Authority (CAMPA) at the national level to coordinate, monitor and evaluate the progress of afforestation efforts apart from supporting Compensatory Afforestation at the sub-national level. The Compensatory Afforestation Fund (CAF) under CAMPA is utilized to promote afforestation and regeneration activities as a means to compensate diverted forest land for non-forest purposes. The funds collected is spent on the following interventions:

- Assisted natural regeneration
- Artificial regeneration
- Silviculture operations in forests
- Protection of plantations and forests
- Pest and disease control in forest
- Forest fire prevention and control operations
- Soil and moisture conservation works in the forest
- Voluntary relocation of villages from protected areas
- Improvement of wildlife habitat as provided in the approved wildlife management plan or working plan
- Planting and rejuvenation of forest cover on non-forest land falling in wildlife corridors
- Establishment, operation and maintenance of animal rescue centre and veterinary treatment facilities for wild animals
- Supply of wood-saving cooking appliances and other forest produce saving devices in forest fringe villages as specified by the National Authority from time to time
- Management of biological diversity and biological resource.

Intensification of Forest Management Scheme (IFMS) to reduce the threats to forests including encroachments, forest fires, illicit felling for timber and firewood, grazing, diseases and incursion of weeds and other invasive species, etc. The components of the scheme included forest fire control and management, survey, demarcation and preparation of working plans, strengthening of infrastructure such as roads, camp offices, watch towers, improved mobility, providing fire arms and use of modern information and communication technology etc.

Green Skill Development Programme (GSDP), an initiative for skill development in the environment and forest sector has been taken up by the Ministry of Environment, Forests & Climate Change (MoEF&CC) to enable India's youth to get gainful employment and/or self-employment, utilizing the vast network and expertise of ENVIS Hubs/RPs.

National Coastal Mission: The Government has taken steps to protect sustain, conserve and augment mangrove forests in the country through promotional as well as regulatory measures. The promotional measures are being implemented through a Central Sector Scheme under National Coastal Mission Programme on '**Conservation and Management of Mangroves and Coral Reefs**'. Under this programme, annual Management Action Plan (MAP) for conservation and management of mangroves are formulated and implemented in all the coastal States and Union Territories. Regulatory measures are implemented through Coastal Regulation Zone (CRZ) Notification (2019) under the Environment (Protection) Act, 1986; the Wild Life (Protection) Act, 1972; the Indian Forest Act, 1927; the Biological Diversity Act,

2002; and rules under these acts as amended from time to time.

The Government under Centrally sponsored scheme for Conservation & Management of Mangroves, extends assistance to Coastal State/UTs for implementation of action plans including survey and demarcation, alternation and supplementary livelihood, protection measures and education and awareness activities.

The Forest Survey of India (FSI) assessed Mangrove Cover of the country in three density classes i.e. very Dense, Moderately Dense and Open Mangrove Cover on biennial basis and publishes the findings in the India State of Forest Report (ISFR). As per the ISFR 2021, the mangrove cover in the country has increased by 17 sq. km. in year 2021 as compared to the mangrove cover assessed in year 2019.

Interventions on Restoration of Agricultural Lands (Ministry of Agriculture and Farmers' Welfare)

National Mission on Sustainable Agriculture

The National Mission for Sustainable Agriculture (NMSA), is also one of the eight Missions under the National Action Plan on Climate Change (NAPCC) and seeks to address issues regarding ‘Sustainable Agriculture’ in the context of risks associated with climate change by devising appropriate adaptation and mitigation strategies for ensuring food security, equitable access to food resources, enhancing livelihood opportunities and contributing to economic stability at the national level. NAPCC’s clarion call is to “devise strategies to make Indian agriculture more resilient to climate change” focusing on “improving productivity of rain-fed agriculture.” This National Mission covers both adaptation and mitigation measures in the domain of crops and animal husbandry, including research and includes the following sub-missions relevant to meeting India’s LDN target:

National Bamboo Mission (NBM)

India is the world’s second largest cultivator of bamboo after China, with 136 species and 23 genera spread over 13.96 million hectares. To increase the area under bamboo plantation in non-forest areas and private lands, and supplement farm income and availability of raw material, thereby contributing towards climate change resilience, the mission has the following goals:

- Promoted predominantly in farmers’ fields, homesteads, community lands, arable wastelands, and along irrigation canals and water bodies.
- Improving post-harvest management through establishment of innovative primary processing units near the source of production, primary treatment and seasoning plants, preservation technologies and market infrastructure.
- Promotion of product development keeping in view market demand, by assisting R&D, entrepreneurship & business models at micro, small and medium levels and feed bigger industry.
- Rejuvenation of the under developed bamboo industry in India.

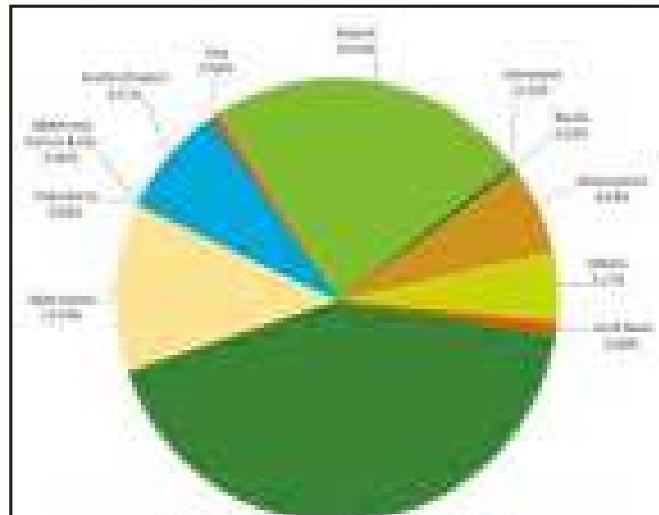


Figure 18 Mangrove Status 2020-21



- Promotion of skill development, capacity building, and awareness generation for development of bamboo sector from production to market demand.
- Realignment of efforts so as to reduce dependency on import of bamboo and bamboo products by way of improved productivity and suitability of domestic raw material for industry and enhance income of the primary producers.

Soil Health Cards:

Launched in 2015, the Soil Health Card programme is a tool for the Government of India to monitor and evaluate soil fertility across India, thereby aiding in the design of appropriate interventions to maintain and restore soil fertility. Twelve parameters provide crop-specific fertilizer recommendations and is assisting farmers improve productivity by maintaining soil health. Over 229 million Soil Health Cards have been issued to farmers over two project cycles, i.e. 2015-2017 and 2017-2019. In order to motivate farmers to regularly conduct soil testing and adopt the recommendations of the soil tests, over 60,000 demonstrations and 47,000 trainings have been carried out through Krishi Vikas Kendras (Agricultural Extension Centres) and State Agricultural Universities. According to an assessment carried out by the National Productivity Council (NPC), the Soil Health Card scheme has led to a decline of 8-10% in the use of chemical fertilizers and also raised productivity by 5-6%.

This programme is supported by the participation of NGOs, research institutes, startups and farmer associations. Many fertilizer companies have also enabled this movement through provisions and educating the farmers on the Soil Health Cards.

Interventions on Watershed Management (Ministry of Rural Development - Department of Land Resources)

Integrated Watershed Management Programme (under PMKSY)

Since 2009-10, the Department of Land Resources (DoLR) has been implementing the 'Integrated Watershed Management Program' (IWMP) for development of rainfed and degraded areas. In 2015-16, IWMP was amalgamated as the Watershed Development Component of the umbrella scheme of Pradhan Mantri Krishi Sinchayee Yojana. Activities undertaken, inter alia, include ridge area treatment, drainage line treatment, soil and moisture conservation, rainwater harvesting, nursery raising, afforestation, horticulture, pasture development, livelihoods for assetless persons, etc. WDC-PMKSY, through these interventions seeks to ensure sustainable development through improved natural resource management and better resilience of farmers against the vagaries of climate change.

Watershed development programmes have proved to be a suitable solution to address land degradation, soil erosion, water scarcity and climatic uncertainties. The programme contributes substantially towards enhancing agricultural production & productivity, reducing poverty and improving livelihoods especially in rural areas. With the successful implementation of the first phase of IWMP and the ongoing second phase, the Department of Land Resources is expecting to treat an approximate 34.52 million ha of degraded land in the country by 2021-26. As such, IWMP through its interventions significantly contributes towards ensuring LDN by developing degraded lands, sequestration of carbon dioxide (afforestation/ horticulture/ plantations etc.) and Sustainable Land Management (agriculture, Forests, soils, other ecosystems).

Some notable initiatives taken by State Governments under IWMP:

Hariyali is a watershed development project sponsored by the Central Government which aims to enable the rural population in conserving water for drinking, irrigation, fisheries and afforestation. The project is executed by Gram Panchayats with people's participation. Other schemes include the Neeru-Meeru (Water and You) programme in the state of Andhra Pradesh, and the Arvary Pani Sansad in the state of Rajasthan, where construction of various water-harvesting structures such as percolation tanks, dug out ponds (Jihad), check dams, etc., through people's participation has been carried out.

Interventions on Feed and Fodder Development (Ministry of Fisheries, Animal Husbandry and Dairying)

National Livestock Mission: Sub-Mission on Feed and Fodder Development

The National Livestock Mission (NLM) was launched in 2014-15, designed to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders. The following are the components of the sub-mission which also contributes towards LDN:

- Forage production from non-forest wasteland /rangeland/ grassland /non-arable land(ha)
- Forage production from Forest Land (ha)
- Fodder seed production/ procurement and distribution (MT)
- Conservation of fodder through post-harvest technologies

Interventions on Greening of Highways (Ministry of Road Transport and Highways)

National Green Highways Mission

The Green Highways Policy launched in 2015 aims to promote the greening of highway corridors through the participation of community, farmers, private sector, NGOs, and government institutions. The mission targets the development of a 1,40,000 km long 'tree line' with plantation along both sides of the national highway in five years. The goals of the mission contribute towards LDN targets and include the following components:

- Development of a systematic framework for integrated green corridor development
- Build resilient ecosystems in form of green corridors along national highway
- Develop green corridors with aesthetic appeal
- Reduce the impact of dust, air and noise pollution
- Reduce soil erosion at embankment slopes
- Reduce effect of wind and incoming UV rays

Interventions on Watershed Management and Development (Ministry of Jal Shakti)

Namami Gange:

In 2015, the mission was launched by the Government of India to ramp up efforts in cleaning the River Ganga. Plantation on 8.39 mha by 2030 is targeted under the Namami Gange mission. The following are the components of the mission that are relevant to afforestation:

- Review and assess the existing situation of Ganga River Basin, past river management and implications and lessons learned.
- Identify and involve stakeholders and build consensus for design and development of strategies.



- Assess ongoing forestry activities of the states engaged in the Ganga rejuvenation program.
- Identify and prioritize critical areas/ field sites in the catchment for regeneration and improvement.
- Assess the condition of riparian forests and potential of biological filters. Examine the possibilities of allied and other alternate income generation activities
- Assess the potential of cultivation of medicinal plants and restoration of 'Bhoj' (Betula utilis) forests and identify appropriate species
- Identify research and monitoring needs and develop strategy for future research

Atal Bhujal Yojana

Atal Bhujal Yojana (Atal Jal) is a programme of the Government of India which focuses on community participation and demand side interventions for sustainable ground water management in identified water stressed areas of seven states including Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. The scheme is partly funded by the World Bank and was launched by the Prime Minister in 2019 and is under implementation for a period of 5 years.

This unique scheme aims at increasing the capacity of States to manage their ground water resources and for ensuring their long-term sustainability with active participation of the local communities through a mix of top-down and bottom-up approaches. It also envisages convergence of various ongoing schemes for implementation of interventions for improving ground water availability with emphasis on demand management and also to inculcate behavioural changes in the community to ensure optimal use of available water resources.

Command Area Development and Water Management (CADWM) Programme (under PMKSY)

The main objective of CAD&WM Programme is to enhance utilisation of irrigation potential created and improve agriculture productivity and production on a sustainable basis through integrated and coordinated approach involving multidisciplinary team. Components of Command Area Development and Water Management include:

Structural Interventions:

- On-Farm Development (OFD) works: comprise of construction of field channels, land leveling, and realignment of field boundaries
- Construction of field, intermediate & link drains;
- Correction of system deficiencies;
- Reclamation of waterlogged areas.

Non-Structural Interventions (activities directed at strengthening of Participatory Irrigation Management)

- One-time Functional Grant to the registered Water Users' Associations (WUAs);
- One time Infrastructure Grant to the registered WUAs;
- Trainings, demonstration, and adaptive trials with respect to water use efficiency, increased productivity, and sustainable irrigation in participatory environment.

Rejuvenation of 13 Major Indian Rivers:

Depleting freshwater resources, especially the shrinking and degradation of river ecosystems pose a threat to achieving national goals pertaining to environment, land degradation, conservation, climate change

and sustainable development. In March 2022, the Government of India announced the programme to rejuvenate thirteen rivers of India which collectively cover a total basin area of 18,90,110 sq. km (189.01 mha), representing 57.45% of the geographical area of the country. The rivers include Jhelum, Chenab, Ravi, Beas, Sutlej, Yamuna, Brahmaputra, Luni, Narmada, Godavari, Mahanadi, Krishna, and Cauvery collectively traversing a distance of 42,830 km.

The ambitious programme for the rejuvenation of the identified 13 major Indian rivers primarily through forestry interventions is proposed at a cost of Rs. 19,342 Crores (US\$ 2.55 Billion). The project aims to increase forest cover by 7417.36 sq. km (0.74 mha) along the river channels. The proposed interventions are estimated to sequester 50.21 million tons of CO₂ equivalent in 10-year-old plantations and 74.76 million tons of CO₂ equivalent in 20-year-old plantations.

Government of India's Flagship Programmes on Land Resources and Livelihood Security (MNREGS & NRLM)

The Mahatma Gandhi National Rural Guarantee Scheme (MGNREGS) and the National Rural Livelihood Mission (NRLM) are the key schemes of the Government of India that inter alia provide financial resources for combating land degradation. MGNREGS guarantees 100 days of wage employment to atleast one member of every household. Under MGNREGS, the sub-component on plantations has significantly contributed to afforestation, tree plantation and horticulture works in rural India. Forest-based livelihoods under NRLM provide for plantations such as host trees for Tasar (kosa silk), Lac (resin), medicinal plants, tamarind, and amla among other NTFPs. Its potential has been illustrated in the the plantation of 1623 hectares of Tasar in Jharkhand, involving 40,000 households.

Restoration Flagships

Following a proposal for action by over 70 countries, the United Nations General Assembly (UNGA) proclaimed the decade 2021-2030 as the UN Decade on Ecosystem Restoration. Launched on June 5, 2021, the UN Decade is building a strong, broad-based global movement to ramp up restoration; it aims to halt the degradation of ecosystems and restore them to achieve global goals. The UN Environment Programme (UNEP) and the Food and Agriculture Organization of the United Nations (FAO) called for countries to nominate World Restoration Flagships in a quest to give prominence to the world's most significant restoration efforts.

India submitted 6 nominations against the call for World Restoration Flagship nominations that have strong elements of people's participation, inclusion of local knowledge and are projects of significant scale and learning potential. These projects include:

Madhya Pradesh Community-Based Forest Restoration

The state of Madhya Pradesh has a notified forest area of 94689 sq.km constituting 30.72% of the geographical area of the state and 12.30% of the forest area of India. Of the total forest area in the notified forest area, 79,704 sq.km of the forest area (84%) has been assigned to 15,608 village communities to ensure participation in the management of the forest. This Joint Forest Management approach has assisted in harmonizing the relationship between forest and communities where microplans are prepared with active participation of local communities. The needs and aspirations of the local communities are accommodated in the microplans.



As per assessments made by the Madhya Pradesh State Forest Department 37,420 sq.km (3.74 mha) of forest area in the state currently stands degraded. An area of 0.3 million ha of forest has been restored through the programme and aims to completely halt degradation in the medium term by restoring 2.83 million ha degraded forest by 2030.

Banni Grassland Restoration

The Banni Grassland in Kachchh district of Gujarat is a natural, unique and complex grassland ecosystem. It is one of the largest grasslands in the Asian region spanning an area of 2497 sq. km and is acknowledged for its high biodiversity. It is a source of sustenance not only to the people in the 48 villages inside Banni and also serves as an important livelihood support system. Over the years, the landscape of Banni has seen deterioration through drivers such as heavy uncontrolled grazing, wide spread ingress of *Prosopis juliflora*, diversion of water, periodical occurrence of droughts, and continuous increase in soil salinity among others. With a livestock population of over 2.085 million there are significant pressures on the grassland.

The State Government of Gujarat under the Grass Development Project has invested Rs. 24.38 Crores in the last 5 years to address the long-term conservation and restoration of the ecosystem. There are plans to restore 76,000 hectares of grasslands, *Prosopis juliflora* management in 24,500 hectares with biodiversity conservation across the entire Banni landscape.

Gujarat Social Forestry

Gujarat is one of the leading industrialized states in India and has simultaneously taken several initiatives including enhancement of tree cover, improving human environment, health of the people and ecological enrichment of desert, coastal, dry scrub and degraded farmlands. In past one decade, with participatory approach, Gujarat has covered an area of 2.16 lakh hectares of land and has planted over 21.63 Crore saplings with the participation of 224,975 farmers, including small and marginal farmers as well as women on a large scale. This eco-restoration activity has worked towards doubling the income of farmers and generation of employment which contributes in achieving SDG goals of “No Poverty”, “Good health and Wellbeing”, “Gender Equality”, “Climate Action” and “Life on Land” with emphasis on land degradation neutrality and carbon sequestration.

In the last decade the project has covered extensive area across the length and breadth of the state of Gujarat. The project has covered an area of 0.216 million hectares of farmland with the plantation of over 210 million saplings. In the next 10 years the project is expected to cover an area of around 500,000 hectares of farmland with plantation of approximately 50 Crore saplings and an active participation of more than 5 Lakh farmers.

4.4 Assessments and Monitoring of the Interventions

The Ministry of Environment, Forests and Climate Change, is in the process of developing a **National Afforestation Dashboard** as part of its convergence initiative of all the afforestation/reforestation interventions being implemented in the country. The National Afforestation Dashboard would also serve as a tool for effectively capturing and reporting on the tree plantation and regeneration activities undertaken across the country under the Central Govt. schemes and State plans including the activities by the private players, NGOs, Civil societies, and individuals. The other levels of monitoring would include on-ground self-monitoring by the implementing agencies, social audit by the members of Gram Sabha and the

remote-sensing based monitoring by the Forest Survey of India and other specialized agencies. Periodic monitoring of the identified intervention areas by third-party will be one of the components under the mechanism.

A Web based Integrated Management Information System platform powered by GIS application on real time basis will be developed for ensuring convergence of various afforestation schemes for robust financial planning, timely funding, mobilization of adequate resources and prudent utilization of funds. Web based portal will generate state wise progress report of numerous plantation activities undertaken under different Central and State sponsored schemes being implemented in the states and will generate information on cumulative nursery, soil and moisture conservation measures, their respective Annual plan of Operations, beneficiary details etc.

Desertification Cell

The Ministry has a dedicated Desertification Cell which has the responsibility of the Nodal Cell for reporting to UNCCD. The Desertification Cell is mandated to undertake activities to help strengthen inter-ministerial coordination, build scientific and technical capacity, and facilitate knowledge sharing by bringing diverse stakeholder groups together that will lay the foundation for undertaking activities for combating desertification and mitigating the effects of droughts.

Given the evolving priorities and new challenges, in light of the India's national and international commitments, the organizational composition and hierarchy of the Desertification Cell is also being modified. The Cell would now be headed by the Additional Director General of Forests, Forestry (ADGF) and supported by the Joint Chief Executive Officer of the CAMPA National Authority (equivalent to IGF) and Inspector General of Forests, NAEB, Government of India. The Scientists from the Climate Change Division and the Biodiversity Division of the Ministry of Environment, Forests and Climate Change and the representatives from the Forest Survey of India, Zoological Survey of India and Botanical Survey of India have also been included as the functionaries under the Desertification Cell.

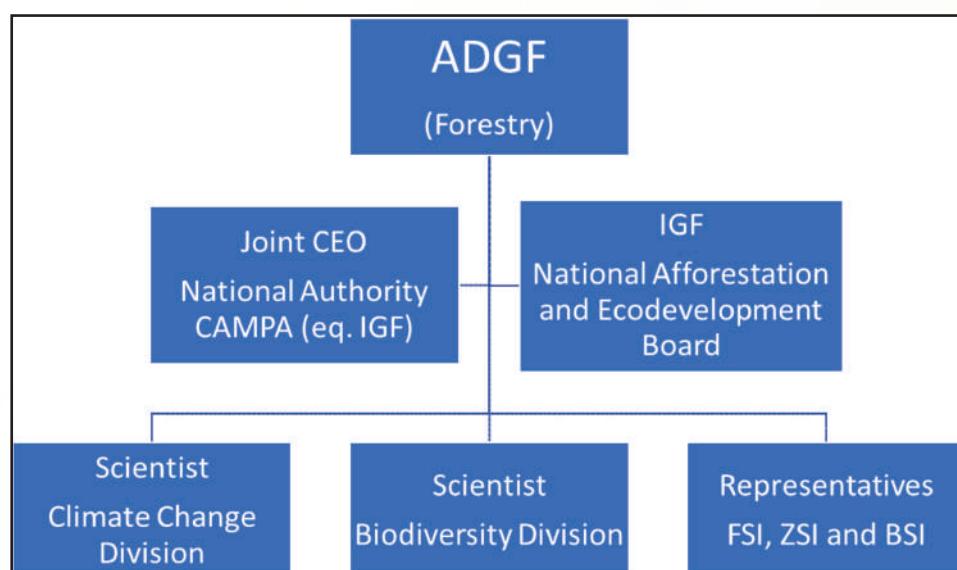


Figure 19 Structure and Composition of Desertification Cell



Centre of Excellence (CoE), Indian Council of Forestry Research and Education

The Country is also establishing a Centre of Excellence for Sustainable Land management and South-South Cooperation at ICFRE, in order to further develop a scientific approach and facilitate induction of technology to land degradation issues, through actively engaging all the stakeholders, promote South-South cooperation with those who wish to access knowledge, technology and training of manpower to address land degradation related issues. The main role of the proposed Centre of Excellence (CoE) would be to share knowledge, technology & training of manpower of developing countries Parties of UNCCD and to promote scientific approach to arrest further land degradation and restoration of degraded lands.

Key Functions include- Ground Mapping and LIDAR Survey under operation,

- Emphasis on including agricultural landscapes,
- Space based monitoring of wetlands, and
- Coordination with SAC, ISRO on use of VEDAS
- Creating repository of UNCCD

Combating desertification and land degradation is one of the thrust areas identified by the Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India, New Delhi. Space Applications Centre (SAC), ISRO, Ahmedabad along with 19 concerned partner institutes carries out an inventory and monitoring of desertification of the entire country using Indian Remote Sensing Satellites (IRS) data in Geographical Information System (GIS) environment. The findings and the maps are produced in the form of '**Desertification and Land Degradation Atlas of India**'. This Atlas presents state-wise desertification and land degradation status maps depicting land use, process of degradation and severity level. Area under desertification / land degradation for the specified time frames and changes are reported state-wise as well as for the entire country. The outputs are helpful in prioritizing areas to be taken up for minimizing the impact of desertification and land degradation.

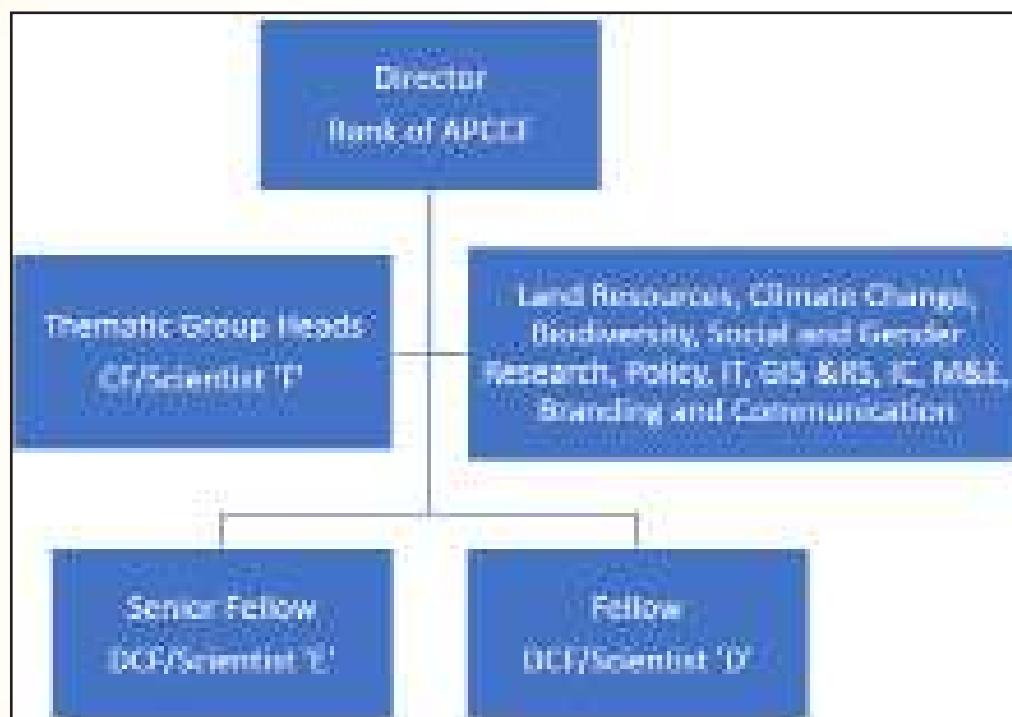


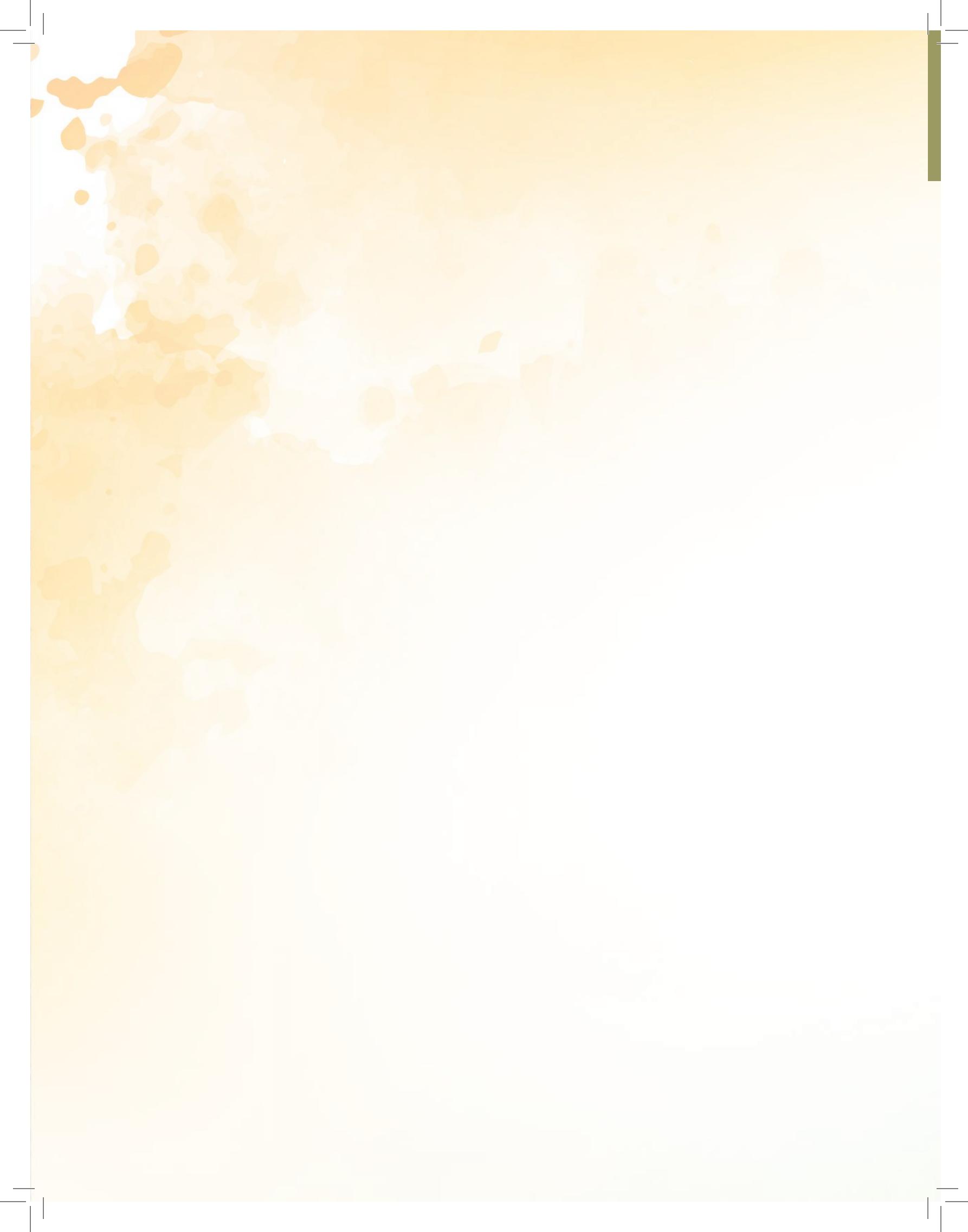
Figure 20 Proposed Structure and Composition of Centre of Excellence



Salinity in agricultural field as visible in AWiFS image covering parts of Uttar Pradesh with corresponding field photograph

Source Desertification and Land Degradation Atlas of India





Chapter 5

MODELS FOR COMBATING LAND DEGRADATION AND DESERTIFICATION

“Preventing environmental degradation, conserving and sustainably using and restoring biodiversity, preserving our oceans and associated biodiversity, promoting clean air and water, responding to natural disasters and extreme weather events and tackling climate change are among the most pressing challenges at present”.

Ecosystem degradation resulting from the combination of climatic, developmental, social and anthropogenic pressures is one of the biggest environmental threats that world is facing and has caused considerable damage to almost all types of ecosystems. Almost two-thirds of India's terrestrial forests are outside of protected areas (Protected areas are those areas in which human occupation or at least the exploitation of resources is limited. (IUCN)). Many of these forest areas are degraded due to high human and livestock pressure and a relatively lower conservation priority and consequently reduced intensity of restoration efforts. At a ballpark estimate around 40-50% of our forests and their fringe areas could be facing degradation of varying degrees. This presents a huge opportunity to improve biodiversity, restore precious habitats for our wild fauna and improve quality of human lives.

As a key provider of food, water, shelter and employment, the land areas outside the conventional protected/notified areas, especially the unutilized productive land is also subjected to coerce with tremendous pressure turning them into wastelands. The total wasteland area of the country was observed to be 5,57,665.51 sq. km. (16.96 % to TGA) in 2015-16. During the period 2008-09 -2015-16 14536 sq. km. of wastelands are converted in to non-wastelands categories, with a net conversion of 8,404.86 sq. km. (0.26 %) of different wasteland categories in the country during 2008-09 to 2015-16. A reduction in wastelands area was observed in the categories of Land with Dense Scrub, Waterlogged and Marshy land, Sandy areas, Degraded pastures/grazing land and gullied and/or ravinous land.

In order to increase the biomass production and to restore the environmental health, preventive and curative measures need to be employed for rehabilitation of wastelands/ degraded lands. The wastelands which are unutilized and have potential to produce food grain and provide vegetation cover, may significantly contribute in this endeavour. Information on the nature, extent, severity and dynamics of degradation is vital in this endeavour.

Importantly, restoration provides the unique potential for generating rural livelihoods based on activities aimed at building ecological resilience, thus making local communities active partners in the overall conservation effort. At an economic level, given the scale of effort required, the GDP generation potential is substantial. These social benefits should indeed strengthen the political will needed for this thrust. Restoration ecology and conservation biology are two arms of ecological conservation that complement each other. The latter focuses on conservation of an individual or a related group of faunal species. Restoration focuses on reviving biotic and abiotic components of an ecosystem, and one of the objectives is improvement of the habitat for diverse species of fauna. In fact, the success of a restoration project is often measured by the comprehensiveness of revival of the food chain. Restoration makes the conservation of flagship or threatened fauna more effective and sustainable.



Suggestive Models for Restoration

5.1 Remedial Models

The activities will be undertaken with the prime objective to ensure ecological restoration of degraded landscapes and subsequently leading to enhanced livelihoods of the forest dependent communities dwelling in those landscapes through skill enhancement, building of capacities and the diversification of livelihood options.

The afforestation models have been formulated in alignment with principles of ecological restoration, protection, production and livelihood diversification:

Reclamation and Protection Forestry Models

Locally conducive revegetation models would be developed and implemented for the degraded landscapes, especially with respect to the choice of species, the flow of benefits and the restoration and enhancement of the ecosystem services. For example, in the arid areas of north-west India with sand-sheet/dunes with groundwater level at more than 4 m, combined with rapidly degrading original sand-sheet with dark topsoil, moving sand dunes or where moving sand dunes are invading, the models are composed of shrubs and trees. The single most important management tool is the fencing-off of the areas, with a combination of mechanical and living fences. The prime objectives and benefits of these models would be Environmental protection, restoration of natural woodland or natural grassland with eventually some wood, fruit, crop, or fodder production.

As the main purpose of these models is revegetation rather than timber or cash crop production and the revenue from trees and crops is extremely low because of the advanced degradation of the land, the model rotation is identified mainly based on the time needed for the establishment of the revegetation cover. Over the remainder of time after establishment, it is assumed that the annual maintenance cost is equal to the benefits obtained from possible fodder or fuel wood production and medicinal herbs recollection.

Productive Forestry Models

The productive forestry plantation models are proposed for timber and fuelwood production as well as providing environmental protection through permanent forest cover, with additional fodder and fuelwood production from the shrubs.

Agroforestry Models

India has been experimenting with various models of agroforestry and forest management with its suitably placed institutional and policy frameworks. The country has been innovative and is one of the first in the world to bring out a national policy of agroforestry in 2014. The potential of agro-forestry to meet its focus on increasing green area of the country and increasing wood productivity through agroforestry will play a major role.

Various agroforestry models are being implemented in India with the prime objective of environmental protection resulting in improved crops and fruits production, as well as timber and fuel wood production and additional fodder production from the belts and the hedges besides livelihoods diversification and enhancement.

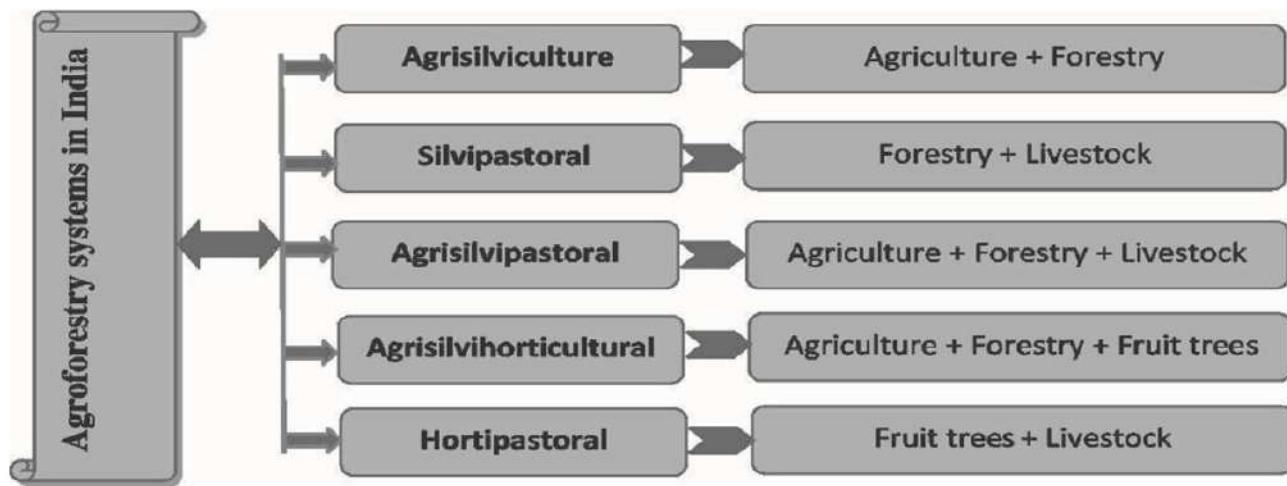


Figure 21 : Agroforestry Models

Bamboo based Agroforestry Model

Bamboo based agroforestry systems can provide a major boost to the agroforestry sector in India given the adaptability to various climate zones, and relatively high growth rates as compared to the popular fast-growing exotic species. Bamboos thus can play an important role in enhancing productivity, sustainability and resource conservation in the degraded landscapes of India. In addition, bamboo has the ability to provide building materials and edible products for many years or even decades.

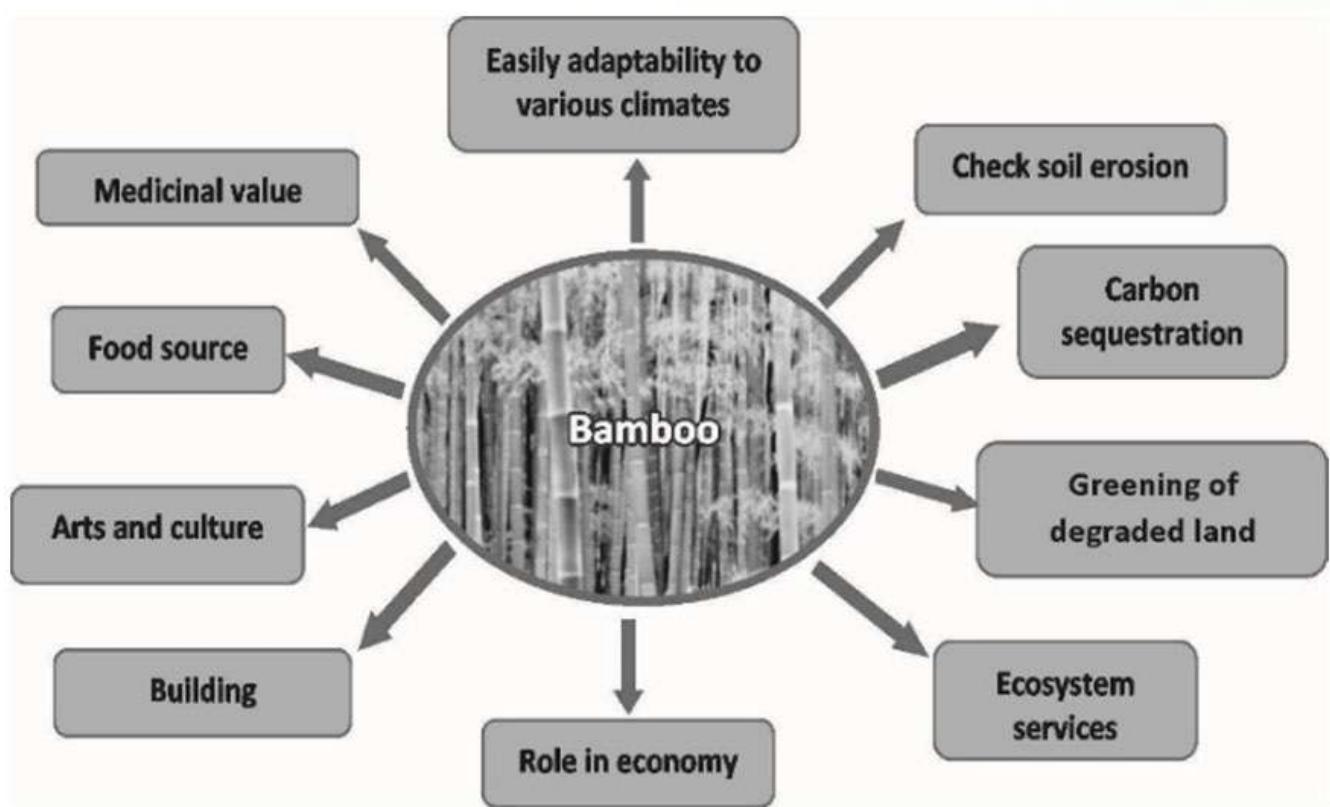


Figure 22 : Importance of Bamboo Agroforestry

Bamboos require four to five years to yield first harvest, if grown from offsets, which is much earlier than any other woody species. If raised from seedlings, first harvest is obtained after seven years. This initial period can be sustainably utilized for raising intercrops and enhancing sustainability and income of the



growers. Under agroforestry system, bamboos are also benefited due to sharing of resources like irrigation, fertilizers, weeding, etc. with intercrops, as a result the quantity and quality of bamboos are expected to be much higher as compared with monoculture and unmanaged plantations .

Bamboos, if properly managed, can be grown in agri-silviculture, silvi-pastoral, agri-silvi-pastoral and agri-silvi-horticultural systems. They can be suitably grown for intercropping for enhancing productivity and conservation of natural resources using monoculture plantations, wind breaks, riparian filter, permaculture, etc. Bamboos of different heights and growth characters may be used for integrating them with agriculture crops.

The species to be selected for agroforestry models should have light crowns such as *Dendrocalamus*, *Phyllostachys* and *Thyrsostachys* species (Banik, 2000).

NTFP Based Agroforestry Model

Non-Timber Forest Products (NTFPs) are biological resources of plant and animal origin, obtained from natural forests, woodlands, plantations and trees and can be categorized under Fibres and Flosses, Bamboo and Canes, Essential Oils, non-edible oilseeds, tans and dyes, gums and resins, lac, silk, drugs and medicinal plants etc . Domestication of NTFP species grown in agroforestry systems offer significant opportunity for livelihood improvement through the food and economic security of poor people in the degraded areas, simultaneously reducing effective pressure on the adjoining forests.

The efforts to undertake holistic eco-restoration measures, will establish a sustainable community-based agro-forestry model for the cultivation of the NTFPs outside the conventional forest areas. To achieve the targets, the emphasis will be given on the plantation of suitable native and economically conducive species, having a high carbon sequestration potential. The core strategy would be on plantation of quality seedlings and ensuring the high survival rate of these species.

Multifunctional agroforestry systems protect the social wellbeing of the rural people in addition to providing goods and services. Suitable programs that design the plantations of NTFP trees can serve dual purpose of conserving the useful species at the same time improving the livelihoods of local people.

Some SLEM Best Practice Models

WADI System

Wadi is a kind of tree-based farming to promote agroforestry and has been practiced traditionally in India.

A 'Wadi plot' is a piece of family-owned land that is developed for agro-horti-forestry system along with soil and water conservation measures. Planting of fruit trees which are efficient enough in providing higher economic return even under stress growing conditions, intercropping with agriculture crops, can provide income from the very 1st year to the participating farm families. In addition, opportunities for post-harvest processing, marketing and employment generation can be opened up thereby reducing the occurrence of frequent migration.

Steps in Building Wadi Plot-

Selection of site:

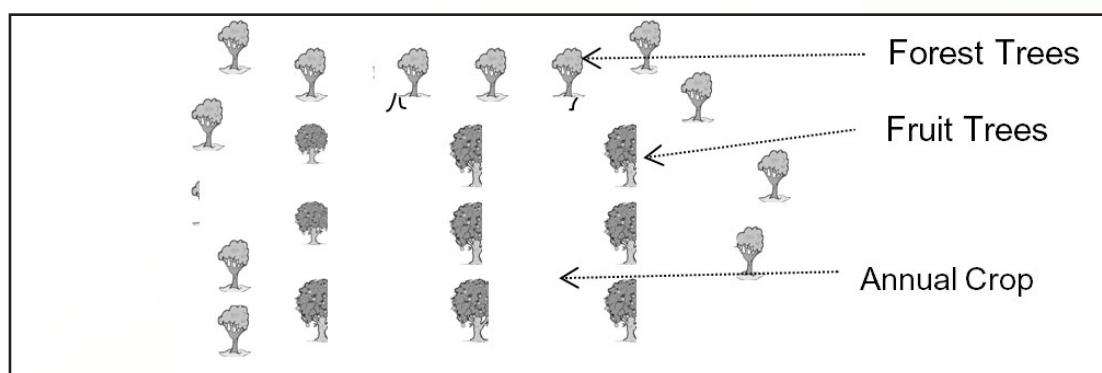
- a) Places with good drainage
- b) Site has a sloping aspect
- c) The site must not be very close to the road

Important points to be kept in mind while building a Wadi plot:

- a) Species -wise distance between the plants (most popular being 5 X 5 meters)
- b) Adequate space is there to go for inter-cultivation of remunerative crops like vegetables
- c) Maintaining suitable distance between the fence and the plants
- d) Region specific selection of manure and soil layers, and
- e) Suitable arrangement for protection of planted material
- f) Cooperative Model, Farmer's cooperative is ideally suited for effective implementation of Wadi model

Wadi- A Traditional tree-based farming Practice to Promote Agroforestry

The concept of Wadi includes an integrated approach of agriculture, horticulture and forestry systems and aims at promoting socio-economic empowerment of the communities and the conservation of land and water resources through practicing sustainable agriculture. A typical wadi is developed as a 1 acre mini orchard with around 100 trees of fruit species appropriate to the region. The space between the fruit trees is used for growing seasonal crops and the periphery is bio-fenced with forestry, fuel or timber species. The Wadi is sometimes surrounded by a cattle protection trench that serves to keep grazing animals at bay and also to harvest rainwater. Wadi system has been traditionally to promote comprehensive economic development through enhancing agricultural productivity, efficient management of natural resources and developing social awareness and also to enhance financial security of the small and marginal farmers through integrating concepts of agriculture, horticulture and silviculture and animal husbandry at the local/micro level.



CHAUKA System

Rainwater conservation, runoff harvesting and storage in village pond are traditional practices for managing water for drinking, ground water recharge and agriculture purpose in the arid regions of the country. Chauka is a runoff harvesting and water conservation practice primarily undertaken on community pasture lands for utilization by the communities. Chauka system is mainly practiced to enhance fodder availability for sustenance of livestock.



A Chauka is a rectangular structure (a pit) surrounded on three sides by soil bunds and constructed across the slope to check the runoff. A mild slope of 1.5 to 2% is considered as ideal. The bunds of Chauka are made from the soil made available from making small pits inside the Chauka. These small pits made inside the Chauka serve as additional resources and contributing to enhanced water conservation.

'Chauka System'- A water conservation practice done primarily on pasturelands

Under Chauka system rainwater runoff is collected through making small rectangular pits (chaukas) on pasture as well as community lands to enhance groundwater availability and to judiciously utilise the collected rain water.

The adoption of Chauka increases the availability of fodder, besides the local grass species, drought and water scarcity has been prevented through conservation of rain water, biodiversity conservation and judicious usage of natural resources.

Benefits of Chauka system:

- Channelizing and regulating runoff
- Recharge of soil water
- Improving the availability of water in the community ponds
- Conservation and recharge of groundwater resources.
- Enhancing land productivity

Following important considerations are required to be kept in mind while making effective Chaukas-

- Slope of the land
- Drainage channels available in the area
- Features of the adjoining areas, and
- Availability of roads etc.

Practice

- Any kind of land including degraded lands can be utilized for Chauka system.
- A chain of Chaukas is constructed on a checker-board pattern on the whole area available for pastureland. There is no set criterion for the quantity of land required as it can be adopted on the any land being currently used as pastureland.
- The size of a Chauka should be such as to allow only up to 9 inches of standing water, so as to prevent any negative effect on the growth of grasses.
- All the Chaukas and their chains remain interconnected through small drains.
- All these small drains join together to form a large drain which falls into the community pond available in the area, and where the water is conserved and can be used for irrigation, pisciculture and for drinking of livestock.

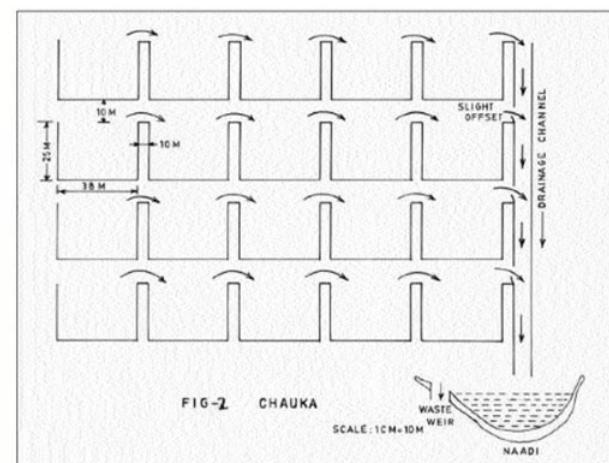


Figure 23 : Chauka System

- The bunds of the Chaukas obstruct the flowing water which gets collected in the lower parts inside the Chauka
- The water thus collected during the heavy rains, passes through the chain of Chaukas through the interconnecting drains and feeds the community pond.
- There are 3 systems of constructing Chaukas and is based on the slope of the land.
- Judicious selection of the system is absolute must for the success of the Chauka.

Technologies for Reclamation of Waterlogged Saline Soils

Saline soils are often associated with water logged areas due to the rise in the water table. Surface stagnation of water in these soils is a serious problem during monsoon. Cost effective measures for managing surface and sub-surface drainage are the key to minimise the adverse effects of water logging/ soil salinity. It is estimated that in India, area with high water table is about 2.6 mha, while about 3.4 mha suffers from water stagnation. Following are some of the measures for reclaiming water-logged saline soils:

- Drainage management:** Based on 10-year field study of sub-surface drainage in Haryana, design criteria for sub-surface drainage for water logged saline soil representing alluvial plains have been standardised. Field studies further indicated that desalinisation of the soils under sub-surface drainage was achieved through the rainwater that was conserved in the field by providing strong bunds (Singh and Pandey, 1991).
- Irrigation system improvement:** Drip and sprinkler irrigation can increase the water use efficiency by 70-80% in contrast to conventional system of surface irrigation with unlined field channels which have an efficiency of 20-30% only. Improvement in the conventional methods by borders/furrow irrigation and brick lined water courses had an efficiency of 40-60%. These improvements can bring down the rate of secondary salinisation by irrigation water.
- Disposal of drainage effluent:** Sub-surface drainage systems produce poor quality drainage water which needs to be disposed off carefully. This problem is imposing restrictions on the reclamation plans using sub-surface drainage system on about 0.4m ha in Haryana which is potentially productive but for water logging and salinity. Feasible alternatives for use of high salinity drainage water by blending it with canal water need to be worked out as a strategy for managing saline drainage effluents.
- Agronomic practices for managing salinity/alkalinity:** About 25% higher seed rate over the normal is recommended to account for mortality of young seedlings and poor tillering of crops in salt affected soils. Heavy irrigation is recommended before sowing to leach down the accumulated salts so as to improve germination and initial growth of the crops in such

Assisted Natural Regeneration Model

Assisted Natural Regeneration (ANR) can also be a component of forest and landscape restoration, among other interventions. In addition to enhancing resilience and supplying multiple forest products and ecosystem services, ANR can be highly effective for recovering biodiversity, species interactions and movement within landscapes. It involves natural establishment of trees and shrubs from seeds, root sprouts, stumps or coppices through a set of interventions that aim to enhance and accelerate the natural regeneration of native forests. It is a simple, inexpensive and effective technique for restoring forests by removing or reducing barriers to natural succession (Shono et al., 2007), in which degraded and denuded

lands that are not burned or otherwise disturbed. ANR accelerates the natural successional process by protecting against disturbances (from fire, stray domestic animals and humans) and by reducing competition from grasses, bushes and vines that hinders the growth of naturally regenerated trees. With adequate rain and good implementation, impressive ANR results are usually evident in less than three years.

Table 2 Indicative ANR Model under Karnataka's Bije Bitne Utsav

INDICATIVE LANDSCAPE APPROACH WITH ANR (Karnataka Model)		
YEAR	WORK PHASE	ACTIVITIES
ZERO	Protection and Planning phase	Fencing to close Formation of Patrolling Road Planning for SMC Works
FIRST	Preparatory Phase	Seed Collection/Cleaning/Weeding SMC Works
SECOND	Assessment Phase	Seed Sowing Assess for Natural Regeneration Decide whether supplementary Planting is required
THIRD	Advance Work Phase (in case of Planting) / Augmentation Phase 1	Singling Operations/Tending/Soil Working/Weeding
FOURTH	Planting Phase / Augmentation Phase 2	Soil Working and Weeding
FIFTH YEAR onwards	Maintenance Phase	



Figure 24 ANR Model (Protective Regeneration through Root Suckers)

In Karnataka, closing of about 35000 ha in different locations for Protected Regeneration through root suckers.

5.2 Preventive Models

1. Management of pastures and range lands:

Among the different land use units in the rainfed agro-eco-system, the permanent pastures are the most degraded and neglected. In many instances these are devoid of even the basal vegetation cover. These lands fall mostly under the common category hence the reason for any dedicated conservation activities and no claim and concern for restoration of these lands. Overgrazing and other forms of destruction of natural vegetation, as well as encroachment, have increased so much that other poor communities have largely replaced the original plant communities. In order to reverse the process, a serious and sustained effort (perhaps even legislation) is warranted. In the arid areas, pelleted seeds of grasses such as *Lasiurus indicus*, *Cenchrus ciliaris* and *Cenchrus setigerus* may be planted.

Regulated Grazing interventions can increase the carrying capacity of an average permanent pasture from 2.5 sheep per hectare to 4.5-6.9 per hectare in sandy soils and 9.0-13.8 per hectare in loamy sand soils (Abrol and Venkateswarlu 1995). Multipurpose trees and shrubs such as *Prosopis cineraria*, *Ziziphus nummularia*, *Capparis decidua*, and *Acacia nilotica* are suitable for silvipasture. The areas marked for development need to be protected from grazing for at least two years.

Course of Action

- Community mobilisation forms the pivot.
- Farmers may be encouraged to establish pastures on part of their holdings (short and long-term/ degraded fallow lands) to decrease the pressure on village commons. The size of pasture may depend on the individual requirement and holding size.
- Adoption of an integrated approach supplemented by effective research and development interventions in complimentary sectors.
- Improvement in livestock productivity, through replacing the large herds of poor-quality animals with improved quality livestock of smaller number, which can be sustained in arid and semi-arid rainfed environments,
- Introduction and promotion of stall feeding
- Development of site-specific dynamic models for identifying the appropriate balance between the resilience of vegetation to short-term overgrazing, the variability in the weather overtime, the indebtedness of herdsmen and their attitude to risk.

2. Soil and Moisture Conservation Measures – The main objective of soil moisture conservation is to minimize the amount of water lost from the soils through evaporation (water loss directly from the soil) and transpiration (water loss occurring through the plants) – or combined, the evapotranspiration. Preserving soil moisture is important means to maintain the necessary water for agricultural production, and also helps minimize irrigation needs of the crops. This is especially important in areas where rainwater and/or groundwater resources for irrigation are scarce or decreasing due to climate change or other causes.

The unsustainable human activities have resulted into acute problems of soil erosion and sedimentation. Thus, extensive bio-engineering as well as mechanical measures have been proposed for the purpose of soil and water conservation. Proposed soil and water conservation activities are an important aspect of forestry interventions. Bioengineering measures for land slope management, drainage line treatment (e.g., live check dams, brush wood check dams, contour wattling, contour live hedges, etc.), stream bank protection, slope stabilization etc.



Soil Moisture Conservation Techniques Implementation

There are a variety of methods that can be used to conserve soil moisture. Most of these **soil moisture conservation techniques** are relatively low cost and primarily relying on the presence of required materials and technical capacity locally. Many of the methods rely on providing some kind of cover for the soil to minimize evapotranspiration and direct soil exposure to heat and sun. Generally, most methods used for soil quality improvement and conservation, will also yield benefits to soil moisture conservation. Examples of methods for reducing excess soil moisture loss include following:

Trending Approaches for Soil and Water Conservation

The topsoil layer contains mostly organic matter and nutrients which are very useful for plant growth. In order to get better plant growth, the topsoil must be protected from wind and water erosion. Measures taken for protecting the topsoil layer are called soil conservation measures. These measures protect topsoil either through reducing the impact of erosive agents (water and wind) or by improving the soil aggregate stability or surface roughness.

The soil conservation measures can be broadly grouped into three categories namely, biological, mechanical, and bio engineering measures etc.

Biological Control of Soil Erosion

In this, erosion is controlled through crops or vegetation - that is by nature's way of doing things. It means that cultivation should be done in suitable way by adopting measures, which shall minimize erosion. Improper cultivation leads to severe soil erosion. A permanent vegetative cover is the best protection for soil. Studies have shown that bare ground allows four times more soil erosion compared to permanent plant covered ground. Therefore, vegetation plays an important role in controlling soil erosion and can be used as an effective erosion control measure. In this method, we try to plant such species, which are capable of holding soil strongly and can survive in very adverse soil condition. The main principle of biological control is to prevent high velocity of water and conserve water within the soil. In biological control following method can be adopted.

Mulching

Mulching is the covering of the soil with crop residues such as straw, maize, stalks etc. This cover protects the soil from the rain drop impact and reduces the velocity of runoff and wind. It is also useful as an alternative to cover crop in dry areas where a cover crop should compete for moisture with the main crop. Fig. 3.1 shows application of mulch in agriculture.



Figure 25 : Mulching

Agro Forestry

Trees can be incorporated within a farming system by planting them on terraces, contour bounds and as ornamental around the homestead. This reduces soil erosion and provides additional needs to the farmers. Fig. 3.2 shows agroforestry system in which poplars are in cultivated along with, turmeric, mango and litchi.

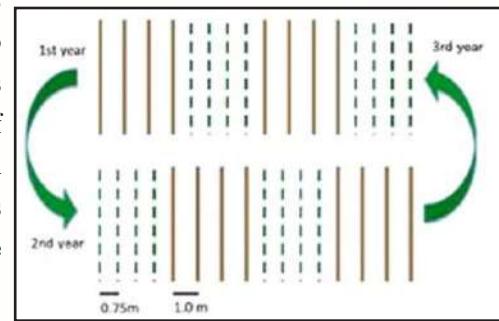
Reforestation/Afforestation

Reforestation is a process of restocking the existing depleted forests and woodlands either naturally or intentionally. Reforestation can be used to improve air quality, mitigate global warming and rebuilt ecosystem by controlling soil erosion. Forestation/plantation plays the major role in erosion control on gullies areas and landslides.



Figure 26 : Agroforestry

It may be defined as a more or less regular succession of different crops being grown on the same piece of land. Rotation of crop reduces erosion and increases the fertility of soil by different crops being grown on the same patch of land so as to enable intake of plant food from different layers of soil. In addition crop rotation increases crop yield and net profit while it reduces use of chemicals as well as water pollution. For example, leguminous crops like pulses are grown alternately with wheat, barley or mustard. Fig. 3.3 shows typical layout for crop rotation system.



Mixed Cropping

In this system two or more than two crops are raised on the same land simultaneously. Mixed cropping is also known as inter cropping or co-cultivation. Mixed cropping system offers several benefits which include better utilization of soil nutrients, low weeds and insect pests, resistance to climate extremes, increase in overall productivity and use of limited resources to the fullest extent.

Cover Cropping

Cover crops are grown as a conservation measure either during off-season or for ground protection under trees. These also add organic matter to soil. All these provide good cover from erosion control point of view and at the same time furnish hay or fodder and serve as soil building crops. These cover crops are also grown under trees to protect the soil from the impact of water drops falling from the canopy particularly important for tall trees like rubber where height of fall is more.



Figure 27 : Cover cropping

Contouring

Contouring refers to applying all tillage practices, such as, ploughing, planting, cultivation & harvesting on the contour i.e. across the slope rather than up and downhill. In regions of low rainfall, this helps in conservation of moisture and in humid areas reduces erosion by reducing surface runoff. The furrows between the ridges developed by contour tillage operations catch and hold the water, thereby, checking the high-water velocity, which erodes soil and causes sheet, rill or gully erosion. On steep slopes or under conditions of high rainfall intensity and soil erodibility, contour farming alone will increase gullying because row breaks may release stored water. Under such conditions they are supplemented by strip cropping.



Strip Cropping

It is the practice of growing alternate strips of row crops and inter-tilled crops in the same field. In this method, the crops are grown in strips at right angles to the slope of land. Erosion is largely limited to row - crop strips and soil removed from these is trapped in the next strip, which is generally planted with a leguminous or grass crop. Strip cropping reduces soil erosion due to both water and wind erosions, and water borne contamination. Strip cropping is generally of three types, namely, contour strip cropping, field strip cropping and buffer strip cropping.



(a) Buffer strip cropping



(b) Contour strip cropping



(c) Field strip cropping

Conservation Tillage

Conservation tillage is any method of soil cultivation that leaves previous crops residue on field before and after planting the next crop. It decreases soil erosion, runoff, water pollution, and CO₂ emissions. Conservation tillage methods include **no-till**, **strip-till**, **ridge-till** and **mulch-till**. **No-till** involves planting crops directly into residue, whereas in strip-till narrow strips are tilled and the rest of the field left untilled (strip-till). In Ridge-till row crops are planted directly on permanent ridges of 10-15 cm by clearing previous year's crop residues from ridge tops only. **Mulch-till** is any other reduced tillage system that leaves at least one third of the soil surface covered with crop residue.



Figure 28 : Conservation Tillage System

Mechanical Methods

Mechanical practices are engineering measures used to control soil erosion from sloping land surface. The purpose of constructing the mechanical structures is to (1) to increase the time of stay of runoff water to increase the infiltration time for the water, (2) to break the land slope, thus reducing the velocity of the runoff water. Bunds and terraces are mechanical structures used to control the soil erosion.

A terrace is an earth embankment, constructed across the slope to control runoff and thus reduces the soil erosion. Terraces are act as a slope divider. The terraces can be classified in to two groups. Bench terrace reduces land slope whereas broad base terrace removes or retains water on sloping land. The original bench terrace system consists of a series of flat shelf-like areas that convert a steep slope of 20 to 30 percent to a series of level, or nearly level benches. Broad base terrace is broad surface channel or embankment constructed across the slope of rolling land. On the basis of primary function, the broad base terrace is further classified as Graded or Channel Type and Level or Ridge Type. The primary function of graded terrace is to remove excess water in such a way as to minimize erosion. Erosion is controlled by reducing the slope length and conducting the intercepted runoff to a safe outlet at a non-erosive velocity. The primary function of level terrace is moisture conservation. In low to moderate rainfall regions, they trap and hold rainfall for infiltration into the soil profile. They can be used even in high rainfall areas if the soil is permeable. Based on the functional requirements, they can be divided in to two types: Contour bunds - storage of water and Graded bunds - safe disposal of excess water.

Bunds are similar to the terraces which have narrow base. Generally, two types of bunds are practiced namely graded bunds and contour bunds. Graded bunds are used where rainfall is very high and contour bunds are used where rainfall is low. The choice of the type of the bunds depends on the slope, rainfall, soil type and the purpose of making the bund in the area. Contour bunds are constructed following the contour as closely as possible. A series of such bunds divide the area into strips and acts as barriers to the flow of water, thus reducing the amount and velocity of the runoff. Graded bunds are used for safe disposal of excess runoff in high rainfall areas and regions where the soil is relatively impervious. They may have uniform grade or variable grade.

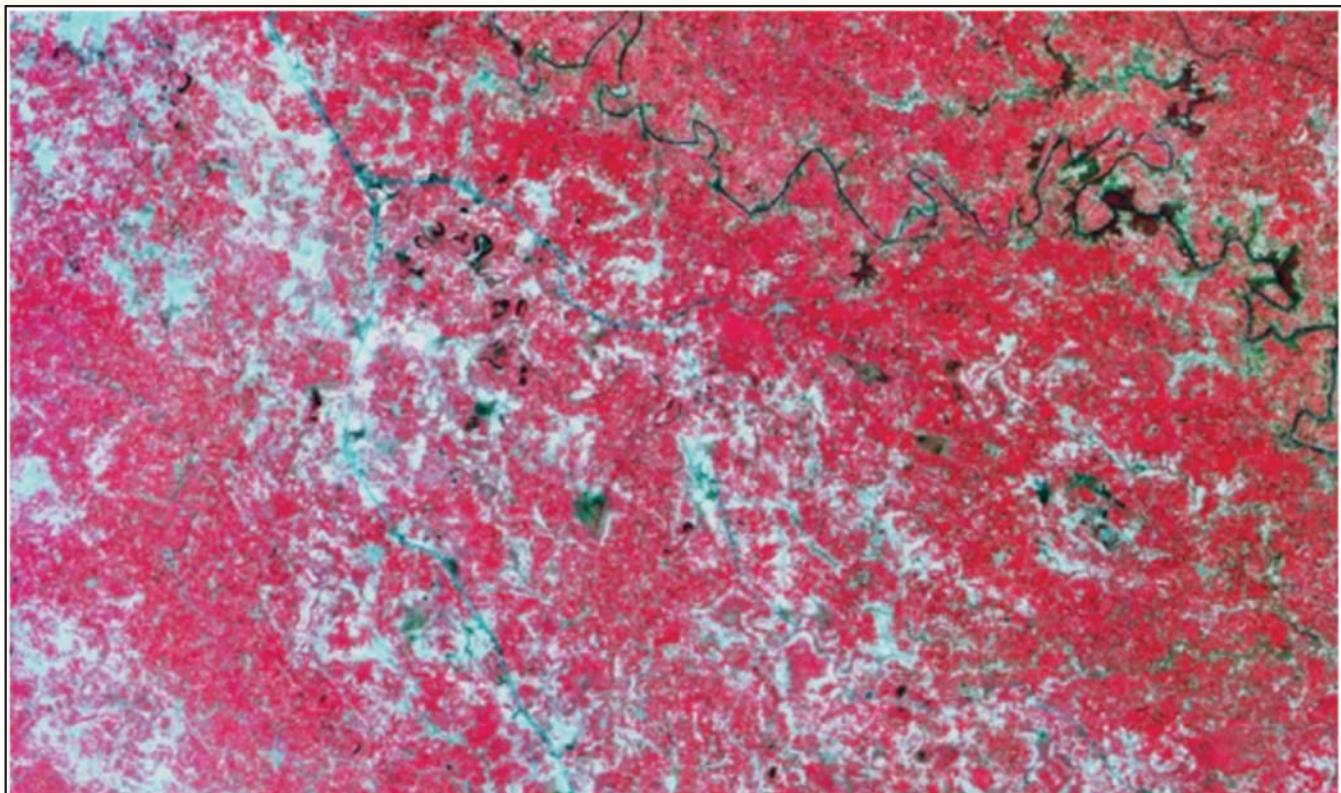
Bio-Engineering Method

Biotechnical engineering techniques are combined with biological knowledge to build geotechnical and hydraulic structures and to secure unstable slopes and banks. Whole plants or their parts are used as construction materials to secure unstable sites, in combination with other (dead) construction material. Biotechnical methods using willows and other woody plants are especially appropriate for constructing several soil conservation structures. This structure stabilizes the soil, reduce the movement speed of running water, and thus reduce the surface erosion. Maintenance of these structures is a very important aspect as compared with other methods of soil conservation. The maintenance cost of bioengineering structures is somewhat high in initial period and later on it becomes very less.

Spreading manure or compost over the soil – this minimizes evapotranspiration and also provides valuable nutrients to the soil through processes of decomposition.



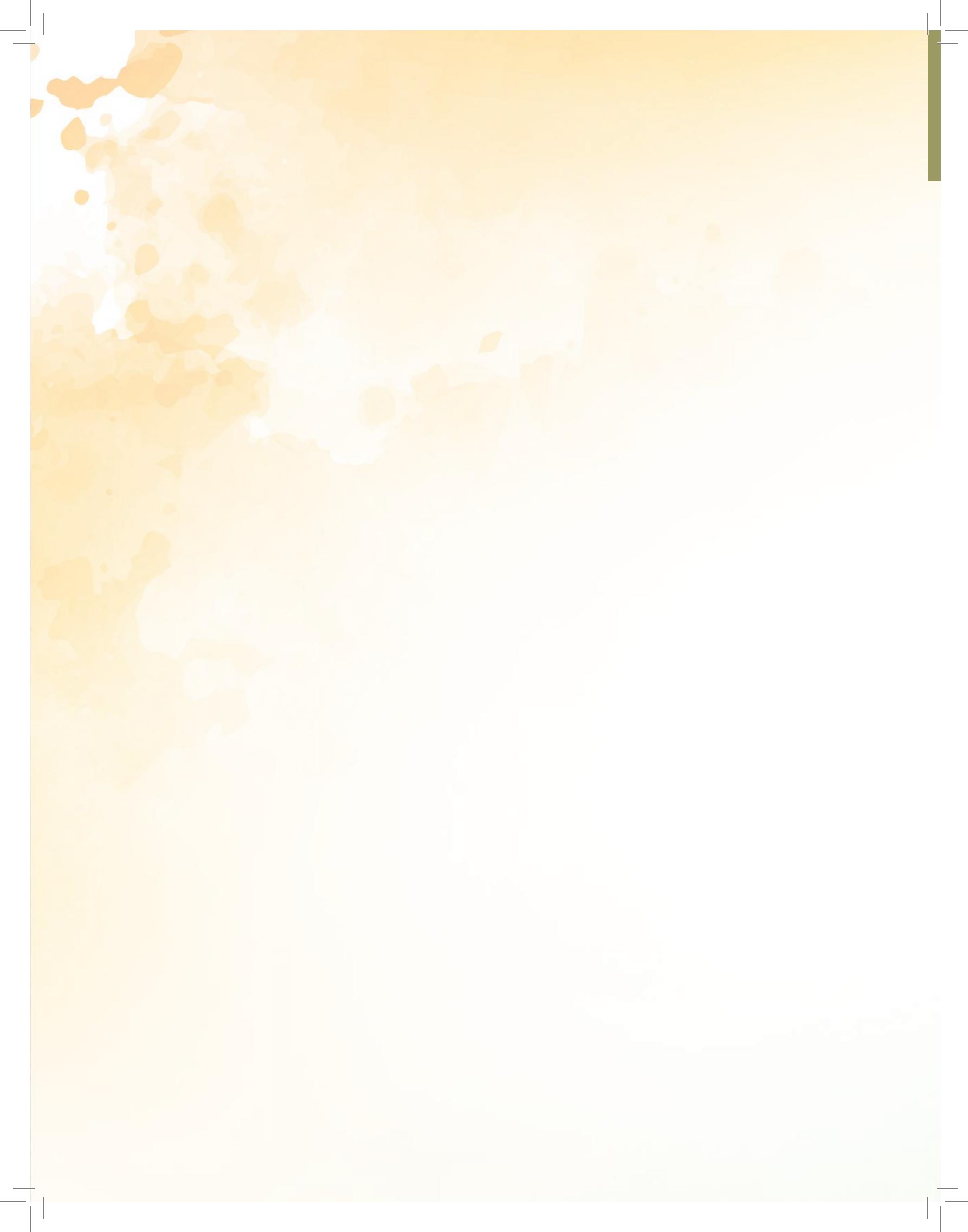
Figure 29: Stunted crop growth due to high salinity in Chamarajanagar district



Mass movement as visible in AWiFS image covering parts of Jammu & Kashmir with representative field photograph

Source Desertification and Land Degradation Atlas of India





Chapter 6

NEW APPROACHES FOR ECO-RESTORATION TOWARDS LAND DEGRADATION NEUTRALITY

The Ministry of Environment, Forest and Climate Change is the nodal agency for the implementation of the UNCCD commitments and all the other national and international commitments and agreements of which India is a part. Along with MoEF&CC, different line ministries work in tandem to ensure eco-restoration and the mitigation of vulnerabilities through the landscape approach. However, to achieve long term objectives, a focused but regional and thematic approach of all the interventions being undertaken is required. Accordingly, current approaches are being revised and new approaches are being devised working in tandem with the different line Ministries for adaptation and consequent formulating and revising new initiatives, plans, guidelines etc. to enable effective conservation, governance and management of natural resources.

Some of the new approaches adopted by the Government of India are-

6.1 Convergent Approach

Numerous eco-restoration schemes, catering to the comprehensive development and restoration of the degraded landscapes and those on the threshold of degradation, are being implemented under the different initiatives of the Central Government and the respective State governments. These initiatives emphasize on intensive afforestation and reforestation, soil and moisture conservation and adopting integrated approach for the holistic socio-economic and ecological recovery, and restoration of the vulnerable landscapes. All these schemes, though running parallelly in the same landscape, have separate implementation and monitoring mechanisms.

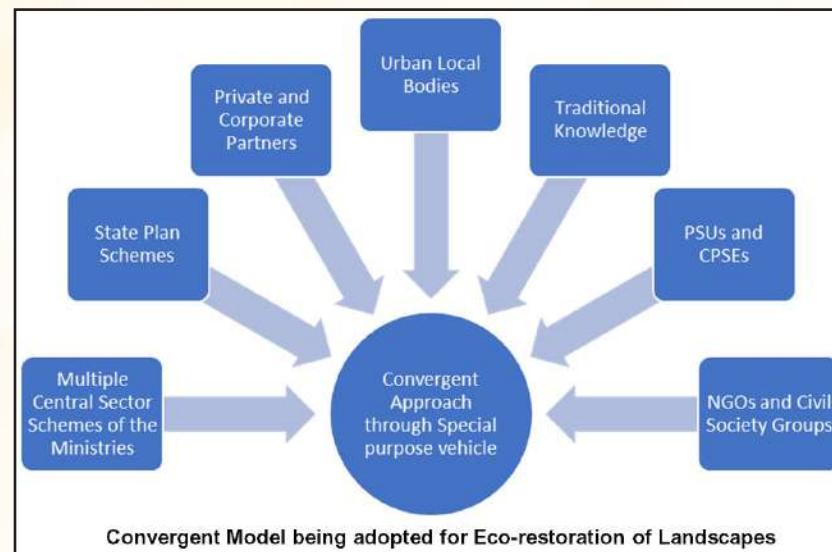
A Convergent and Integrated Approach would thus enable:

- **Efficient Mapping of Forest and Non-Forest areas** for identification of vulnerable and potentially vulnerable sites for undertaking Plantation and Soil and Water Conservation Activities.
- **Adoption of an Integrated National Framework for Collative APOs, enabling to identify priority landscapes and develop focused workplans** for rejuvenation of rivers and wetlands, biodiversity conservation, combating desertification and the enrichment of wildlife corridors. The collative annual plans shall provide a clear roadmap for implementation of afforestation activities for addressing the vulnerable/priority areas by incorporating the targets and achievements of all eco-restoration/afforestation schemes/component being implemented in the State.
- **Adoption of Single Portal approach** for the formulation of State Annual Plan of Operations (APOs) and their implementation as well as reporting of State and District wise achievements. A consolidated Collative Annual Plan of Operation (APO) will be prepared by the States/UTs Nodal Officer in consultation with all line Ministries/Department for carrying out plantation activities under different schemes in their respective State/UT.
- **Effective Monitoring, Reporting and Evaluation** through technological and other scientific applications/inputs

Recognizing the challenges and to enable efficient planning and implementation of the eco-restoration initiatives in the country, the Ministry of Environment, Forests and Climate Change has brought out



the Guidelines for Convergent Approach for Greening India, to converge all afforestation schemes to provide the much-needed impetus and focus in addressing the sustainable management of forest and natural resources available in the specific landscape and an effective planning and a wider selection of vulnerable and potentially vulnerable sites capable of supporting progressive and sustainable eco-restoration interventions.



The Ministry of Environment, Forests and Climate Change has also constituted a working group involving the different line Ministries to provide scientific and technical inputs and establishing necessary linkages for preparing and the effective implementation of the roadmap for achieving Land Degradation Neutrality (LDN) targets of India and combating desertification.

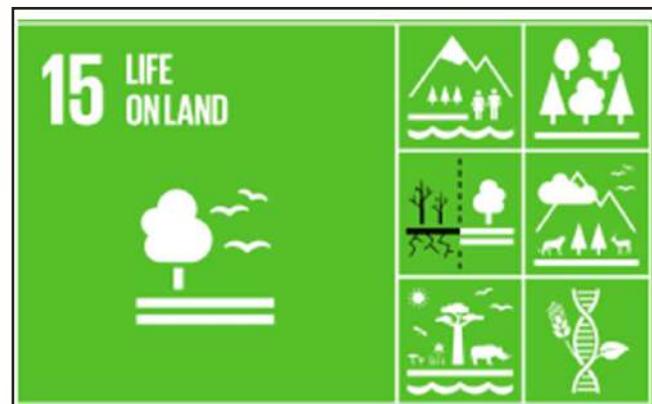
Table 3 Composition of the Inter-Ministerial Working Group

S. No	Designation/Rank	Affiliation	Designation in the IMWG
1.	Additional Director General of Forests, Forestry	Ministry of Environment, Forests and Climate Change	Chairperson
2.	Advisor (Forestry)	NITI Aayog	Member
3.	Joint Secretary	Ministry of Agriculture and Farmers' Welfare	Member
4.	Joint Secretary	Ministry of Road Transport and Highways	Member
5.	Joint Secretary	Ministry of Jal Shakti	Member
6.	Joint Secretary	Ministry of Fisheries, Animal Husbandry and Dairying	Member
7.	Joint Secretary	Ministry of Housing and Urban Affairs	Member

8.	Joint Secretary	Department of Land Resources, Ministry of Rural Development	Member
9.	Joint Secretary	Ministry of Coal	Member
10.	Director	National Remote Sensing Centre	Member
11.	IGF, NAEB/DC	Ministry of Environment, Forests and Climate Change	Member-Secretary

6.2 Multi-tier Landscape Level planning and Implementation

The Sustainable Development Goals have an explicit influence over the global development policies in the current decade, prompting a need for ever greater financial support and political will to achieve the 17 goals. Among these, SDG 15 on the sustainable use and management of land resources embodies a major shift in the way the international community responds and manages land degradation. Four years after its adoption, Goal 15 continues to inspire positive change in global land and landscape restoration efforts, now embodied by the UN Decade on Ecosystem



Restoration 2021–2030 as declared by the United Nations General Assembly in March 2019. This is expected to accelerate and further mobilise action and resources to scale up restoration, build resilience and reduce vulnerabilities, while responding to the ever-pressing challenges of sustainable development.

The Rio Conventions (the United Nations Convention to Combat Desertification, UNCCD; the United Nations Framework Convention on Climate Change, UNFCCC; and the Convention on Biological Diversity, CBD) have together championed the political impetus for restoration. Countries have already begun taking steps towards protecting, sustainably managing and restoring their degraded lands, by committing to national, regional and global initiatives.

NDCs have become the bedrock of India's climate actions post-2020 and are also indicative of the country's "best-efforts" while balancing the developmental imperatives, with sustainable development and poverty eradication . Several proactive eco-restoration interventions are being implemented to fulfil the inherent obligations as per the principles of common but differentiated

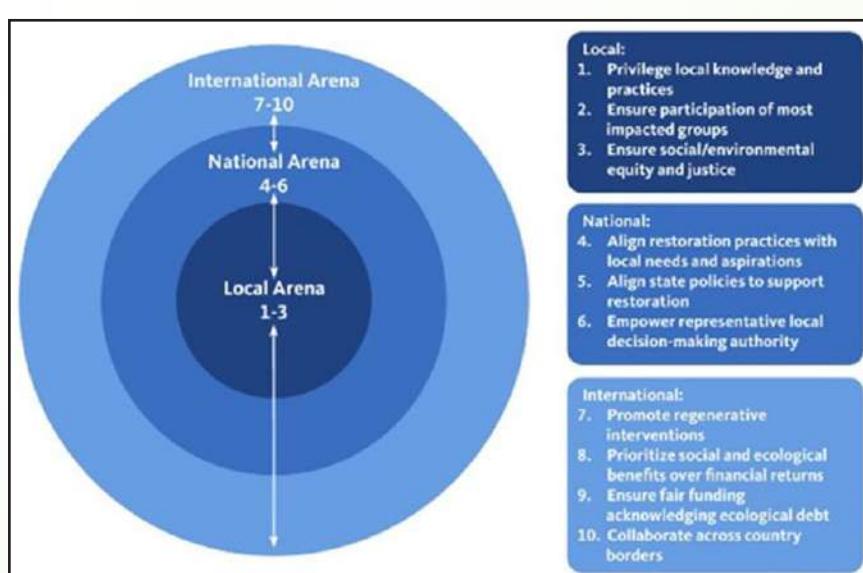


Figure 30 : Multi-tier landscape Planning



responsibilities and respective capabilities and equity. Among the various interventions' priority is being accorded to Ecosystem Based Approaches (EbA) to increase the sink capacity and enhancing resilience within and across forestry, agriculture, oceans and food systems, through biodiversity conservation, leveraging supply chains and technology; strengthening and motivating local action and resilience, and consequent adaptation and mitigation to manage the impacts and risks of climate change amongst the vulnerable communities.

The term "landscape" is used to refer to relatively large areas of land containing mosaics of land uses and abiotic, biotic and human elements. Agriculture, forestry, soil protection, water supply and distribution, biodiversity conservation, pasture and other land uses are interlinked but often dealt with in relative isolation of each other. However, Natural resources are better managed when viewed from a broader perspective. A landscape approach is thus an integrated approach that considers and involves the perspectives, needs and interests of all stakeholders, including local communities and individual land users. Its purpose is not to force a unified approach but to reinforce them by enhancing interlinkages with other sectors for conserving the integrity of landscape components. Landscape approaches are increasingly seen as indispensable in developing sustainable land-use and livelihood strategies in rural areas (FAO, 2012a).

The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. This approach is based on the application of appropriate scientific methodologies focused on different levels of inter-relationship between various biological factors and involving essential processes, functions and interactions among organisms and their environment. The approach recognizes that humans, with their cultural diversity, are an integral component of ecosystems.

Restoration efforts should be planned as an integrated part of the mosaic of land uses in a landscape with the aim of re-establishing ecological integrity and supporting human well-being. In forest landscapes, planning should "focus on restoring forest functionality: that is the goods, services and ecological processes that forests can provide at the broader landscape level as opposed to solely promoting increased tree cover at a particular location" (Maginnis and Jackson, 2005).

Participatory landscape designing and visioning processes should be undertaken to obtain – through an equitable process of negotiation and dialogue – stakeholder agreement on the landscape mosaic of habitat types and land uses that are best suited to environmental and socio-economic conditions. Landscape approaches are people-centric. Promoting integration among institutions is always challenging, but the best "integrators" are often rural people – who instinctively adopt landscape approaches to their land management.

Elements of Successful Landscape Level Restoration

- 1. Integrated and Inter-sectoral Land-use planning
- 2. Community-based landscape planning and decision-making;
- 3. Effective intersectoral cooperation and coordination among government agencies at the national, subnational and local levels;
- 4. Strengthening of local institutions to better manage conflicts over land use and tenure; and
- 5. Improved policies for integrated management (e.g. agroforestry).

Adoption of a micro-ecosystem⁹ approach would enable working with a localized approach and involving the smallest working units within the larger landscape with their impacts being magnified and collating at the macro or the landscape level. The Micro-ecosystem approach would thus enable formulation and adoption of regionally conducive and established, identified and demonstrable models which will be highly beneficial for the holistic eco-restoration of the identified intervention areas within the larger landscapes.

The Landscape approach would thus emphasize upon the adoption of-

- 1. Reclamation/Restoration Forestry**
- 2. Best practices of Ecosystem Based Approach (EbA),**
- 3. Decentralized models of implementation for a proactive multi-stakeholder involvement and to effect synergies with the relevant ongoing afforestation schemes, and**
- 4. Promoting Self-reliance among the forest dependent communities through skill enhancement and enabling diversification of livelihoods.**

This approach would in principle align the Plan with the three major United Nations Sustainable Development Goals SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), SDG 6 (Ensure availability and sustainable management of water and sanitation for all), and SDG 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss). This approach shall contribute to the success of the vision that all existing schemes together will contribute to fulfilling the NDC targets.

6.3 Identification of Priority Landscapes

The focus of restoration ecology has greatly evolved from aiming at reconstructing pristine and reference sites to an objective-oriented strategy aiming at maximizing ecological functions and services. This change in focus is due to a virtual lack of undisturbed reference sites and because ecological restoration projects need to integrate society values in the restoration process. In parallel, restoration ecology moved from targeting relatively small areas to planning ecological restoration at scales more meaningful for ecosystem functioning, such as the landscape or the watershed scale. This larger scale approach entails the challenge of coordinating restoration actions across a variety of habitats, degradation levels, restoration needs, decision-makers and resources' availability.

Ecosystem Services (ES) are increasingly used as a tool to integrate both ecological and social values in ecological restoration at large scales and promote an efficient and effective approach enabling integrating the valuation of multiple ecosystem services.

⁹ <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microecosystem>



Figure 31 : Components of Landscape Approach



Given the scarcity of adequate availability and access to the economic resources to undertake ecological restoration at large scales, developing a tool to effectively prioritize sites for ecological restoration and enhance multiple ecosystems services and their interlinkages with the human well-being is critical.

The Government of India is prioritizing landscape approach under its various flagship eco-restoration schemes and programs including the National Mission for Green India. Intervention areas within the designated larger landscape category are proposed to be identified on the basis of both bio-physical and socio-economic parameters. As contiguous area, the operational units/intervention areas within larger landscapes would have a magnified and extended impact on the landscape ecologically as well as socio-economically. The criteria for identification of these areas may include projected vulnerability of forests to climate change, status of forest cover, significant biodiversity and other ecosystem values and services, critical habitats, corridors, and carbon sequestration potential of area. Overlays of socio-economic criteria like deprivation index and ethnicity (tribal/non-tribal) will further help in the prioritization of project areas within the landscapes. Priority shall be accorded for the treatment of eco-sensitive and disaster-prone areas, such as coastal areas, mangroves, ravines, shifting cultivation areas, cold and hot arid areas, river and tank catchments, strips along public infrastructure, etc.

Vulnerable landscapes which will be a mix of degraded forest lands and non-forest lands including forest fire affected areas and abandoned mined areas shall be identified using the satellite imagery for undertaking comprehensive afforestation and eco-restoration interventions. The details of the land resources available in each state for the Plan interventions shall be made available on the proposed online portal on a real-time basis. The repository shall further enable undertaking of suitable R&D to develop additional combinations of trees and agricultural crops suitable to the climatic condition, soil profile, socio-cultural acceptability and with a favorable cost-benefit analysis with regards to the available land areas.

The Project Implementing Agencies (PIAs) which may be JFMCs, community-based institutions, NGOs, CBOs etc. would have the *prima-facie* responsibility to devise and propose the detailed interventions based on the vulnerability of the micro-landscape and its consequent potential for being reclaimed. The identification of potential intervention areas/sites shall be a participatory process as it necessitates a detailed inventory of the landscapes in conjunction with the Forest and the other line departments along with the local/regional NGOs/CBOs as an indispensable prerequisite. Detailed resource inventory also needs to be prepared to assess the availability of the resources and to further estimate the deputation of further resources in the area for the effective and efficient delivery of the Plan's interventions.

Key Components of Micro-ecosystem level planning-

1. 1. Describe the attributes of the landscape in totality including bio-physical, socio- cultural and economic parameters; highlighting key values and attributes that the landscape houses (some of such values could include ecosystem service like water, carbon, biomass, NTFP, biodiversity etc.),
2. Assessment of the institutional diversity, ethnic/demographic dimension
3. Key challenges /threats that the landscape has vis-à-vis the values/attributes (there could be time series data for different elements like forest degradation etc. to corroborate this).
4. Details of the ongoing afforestation and eco-restoration schemes and programs of multiple agencies being implemented in the region along with their respective strengths and gaps.

5. Identification of the additional priority pockets within the selected landscape as per identified priority landscapes under its different interventions.
6. Identification and estimation of the additional activities in the selected landscape not supported under the other schemes and considered as important for furthering the States' efforts (urban, peri-urban, Agro-forestry, eco-restoration and soil and moisture conservation activities).

An indicative list of various data/information/indicators required for the identification and planning maybe as below.

1. Bio-physical Information – including

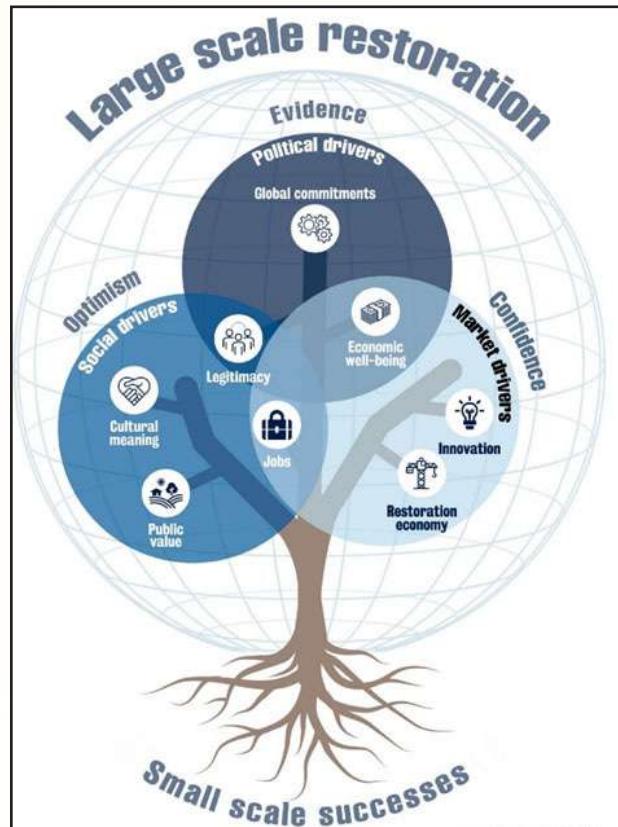
- Land use
- Area of forest/non-forest
- Flora & fauna and Biodiversity
- Watershed classification and catchment area
- Types of forests & regeneration status
- NTFP resources
- Surface water and ground water resources
- Biomass and Carbon stock
- Degraded forest and waste lands
- Areas needing special attention, and
- Fire/erosion prone areas/incidences

2. Bio-cultural Information:

- Areas of incomparable values, indigenous ecological knowledge

3. Socio-economic information – including

- Administrative
- Population
- Landholding pattern
- Cropping pattern and Livestock
- Drinking water
- Domestic Energy
- Occupation
- Infrastructure
- Sources of income
- Forest- based livelihood enterprises and Recreation/eco-tourism





4. Dependency on forests – for

- Food
- Firewood
- Fodder and grazing
- NTFP for consumption and trade
- Timber/small timber
- Drinking water/irrigation
- Other forest-based Livelihoods

Ecological restoration aims to treat degraded ecosystems, often with external interventions, to return to a state where one or more of its original functions are revived. These measures could be diverse and span along a continuum. While some places could be revived by natural recovery, concerted human intervention is needed for others, such as mining sites. It could involve influencing abiotic factors such as reshaping the landform to capture rainwater or minimize soil erosion or facilitating biotic factors like assisted colonization by native vegetation. These measures can therefore vary depending on the motivation behind restoration, the time period of restoration as well as availability of resources. Integration of socio-economic aspects into ecological restoration can however be a complex process.

At a landscape level, multiple stakeholders should be involved to reach consensus and to alleviate differences if any. For e.g., parts of the landscape can be productive forests that could be harvested sustainably while other parts can be left intact for biodiversity conservation and regulation of ecosystem services. It cannot be over-ruled that the implementation of a landscape restoration programme is a labour-intensive process. Ecologically, the abiotic and biotic factors of a degraded site may also need to be altered to facilitate restoration.

Restoration, when taken up at a larger scale, is fraught with many challenges, like cost escalations, management and governance issues, lack of self-recuperative ability of the degraded ecosystems, etc. which envisages that a scientific approach be adopted to undertake such efforts on the micro-landscape level. However, under a forest landscape restoration approach, implementers also have to keep in mind the economic aspirations of the people and the cultural significance of the landscape. Forests also have economic and social significance and different communities can be dependent on them in a variety of ways.

Ecological restoration opportunities also exist in other land use activities such as agricultural and pastoral lands. Human land use activities (agriculture, urbanization etc.) now dominate the global ecosystems (covering almost 40% of the land surface) and interact across multiple scales. Given that there is severe pressure on our protected areas, restoration efforts should strive to make these agricultural landscapes ecologically viable. Agricultural landscapes can act as corridors connecting habitat patches. Besides, they can also offer refuge to wildlife population that can spill over from such protected areas. Similarly, in an agricultural landscape, not just ecological integrity, but productivity and sustainability should also be promoted. Biodiversity has a positive effect on productivity and it is now generally agreed upon that increasing biodiversity promotes enhanced productivity in agriculture landscapes as well. Thus, forest landscape restoration is dynamic and forward-looking. It is a long-term process where activities are carried out over multiple years, in a way that adapts to the local conditions and results in multiple benefits to various stakeholders.

Ecological restoration, when implemented effectively and sustainably, contributes to protecting

biodiversity; improving human health and wellbeing; increasing food and water security; delivering goods, services, and economic prosperity; and supporting climate change mitigation, resilience, and adaptation. It is a solutions-based approach that engages communities, scientists, policymakers, and land managers to repair ecological damage and rebuild a healthier relationship between people and the rest of nature. When combined with conservation and sustainable use, ecological restoration is the link needed to move local, regional, and global environmental conditions from a state of continued degradation, to one of net positive improvement.

6.4 Strategizing for Increasing Green Cover Outside Recorded Forest Areas

In recent time, due to increasing demands and scarcity of forest produce, promoting Trees Outside Forests (TOF) has assumed a significant importance in national economy. India is not an exception of it. The trees outside forests serve as buffer for the pressure on our declining forest resources and cater to the burgeoning need of domestic biomass and also instill the need for the establishment of value chains given the escalating demands for industrial wood. According to the report of FAO, 93% of industrial wood demand is met from TOF. It has been corroborated from the successive biannual State of Forest Reports which show increase in the Forest Cover and Tree Cover ever since 2005. India has an immense potential to increase its TOF area, particularly through expansion of agro-forestry, social forestry and community forestry. India, primarily being an agrarian economy needs to focus on climate resilient farming in a big way on the face of uncertainty of monsoon rains besides enhancing diversification of farming practices through establishing concordance with other land-based activities like agro-forestry, dairy, livestock rearing, api-culture, pisci-culture and other ancillary livelihood alternatives, which will enable the farming community to enhance their family income. Common lands/ Panchayat lands provide a unique opportunity to develop the green cover providing ample scope to experiment with agroforestry as an innovative option for both farming and forestry. This provides a win-win situation for both agriculture sector and forestry sector.

India has been unique in pursuing a visionary goal of having 33% of its geographical area under forest and tree cover (FTC) despite incessant pressure to part away with forest lands in the interest of developmental activities and projects. Nationally Determined Contributions (NDCs) provide an opportunity to fast-track the much-needed momentum to move towards the goal of 33% of FTC. Actions to achieve the NDC would require action on both forest lands and non-forest lands. Where on the forest lands, it relates to rehabilitating the degraded forests and improving other forest areas, in respect of non-forest lands it focuses on creating additional tree cover through agroforestry, farm forestry, urban and peri-urban forests, roadside avenues, etc. Most of the experts agree that achievement of NDC will require more action on non-forest lands than the forest lands. However, to create the targeted additional CO₂ sink, actions on forest and non-forest lands will be equally important.

Action on non-forest lands will have many spin-off benefits including improving the income of the farmers. This may provide an opportunity to create viable business models for farmers to get more income from tree cropping and cultivation of NTFP species and marketing the produce to get additional income and simultaneously meeting the requirement of the industry and the community. This is expected to give an unprecedented boost to the expansion of TOF, which may result in large scale changes in cropping practices associated with emerging markets across the country. Such fast changes in the socio-cultural and economic fabric of the rural landscape will require a close watch by the government and other relevant agencies to ensure that the spirit of TOF is maintained. This can be ensured by continuous evaluation of the trend of production from agroforestry landscapes, and of the associated emerging markets.



In addition, provision of finance is essential for upscaling the relevant existing activities and undertaking new initiatives to promote TOF on non-forest lands. A large number of government and banking sector schemes are available to give a boost to the concept. These business models may be developed on a pilot basis to take tree cultivation out of the domain of routine project funding and make it self-sustainable like any other business model. This will in turn necessitate ensuring of the Quality Planting Material (QPM) through certified nurseries.

Most importantly, selection of most suitable tree species to be planted on non-forest lands as a component of agroforestry, farm forestry, avenue plantation and even of city forest is most important and may be chosen to be as a part of the crop combinations for the different agro-ecological zones, soil types, annual precipitation, availability of irrigation etc. suiting different tree species.



Frost heaving as visible in LISS3 image covering parts of Ladakh with representative field photograph

Source Desertification and Land Degradation Atlas of India





Chapter 7

CAPACITY BUILDING AND OUTREACH

Amongst one of its several objectives the National Action Plan (NAP) seeks to establish and implement a multi-sectoral approach for land management, biodiversity conservation, and climate change mitigation/adaptation issues in the country with specific focus on the prioritized landscapes. The NAP is hence envisioned as a multi-stakeholder platform for the adoption and implementation of sustainable land and ecosystem management practices, that will not only help to enhance land productivity but will also facilitate to achieve the Land Degradation Neutrality targets. The program's complexity necessitates significant efforts at multiple institutional levels to achieve the desired results and secures the scaling-up of successful outcomes.

7.1 Capacity Building

United Nations defines “Capacity-building is defined as the process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in a fast-changing world. An essential ingredient in capacity-building is the transformation that is generated and sustained over time from within; transformation of this kind goes beyond performing tasks to changing mindsets and attitudes”. Basically, capacity building helps to increase knowledge and awareness, encourage collaborative action which encourages sustained long-term commitment.

Capacity building helps to:

- Synergize all stakeholders for operating from a common base of knowledge.
- Provide stakeholders with the knowledge and skills to appropriately and effectively implement planned interventions.
- Combat misperceptions that stakeholders may have.
- Foster a sense of collective ownership of the project, and
- Strengthen local capacity to ensure sustainability of the interventions at the community level.

Capacity building enables developing a common vision, building a sense of collective ownership and commitment to any action plan or the project, which in turn ensures the success and the sustainability of the plan as per desired outcomes. Engagement of multi-stakeholders in capacity building with the use of the standard procedure can strengthen the local institutions and foster coordinated action. It will help to establish a link between ecosystem based decision-making and existing administrative structures and processes. Capacitybuilding and technology transfer are essential for the preparation of integrated assessments so as to translate the science from the assessments into policy in a way that positively contributes to sustainable development.

In order to gain the necessary understanding of the land resources and to address degradation, there is an imperative need of a technical instrument for their inventory and their subsequent analysis in an integrated manner. This analysis must include socio economic perspective to assess the impacts of various activities and pressures on the land resources.

The Centre of Excellence on Sustainable Land Management (CoE-SLM) established at the ICFRE is a nodal body dealing with issues of sustainable land management at the national and international levels and has mandate of providing trainings, capacity building, outreach and dissemination activities. The CoE adopts the multi-dimensional and multi-hierarchical approach for building the capacities of the stakeholders through a proactive involvement of diverse knowledge partners and premier institutes. The approach of CoE is depicted in the Figure 32 below.

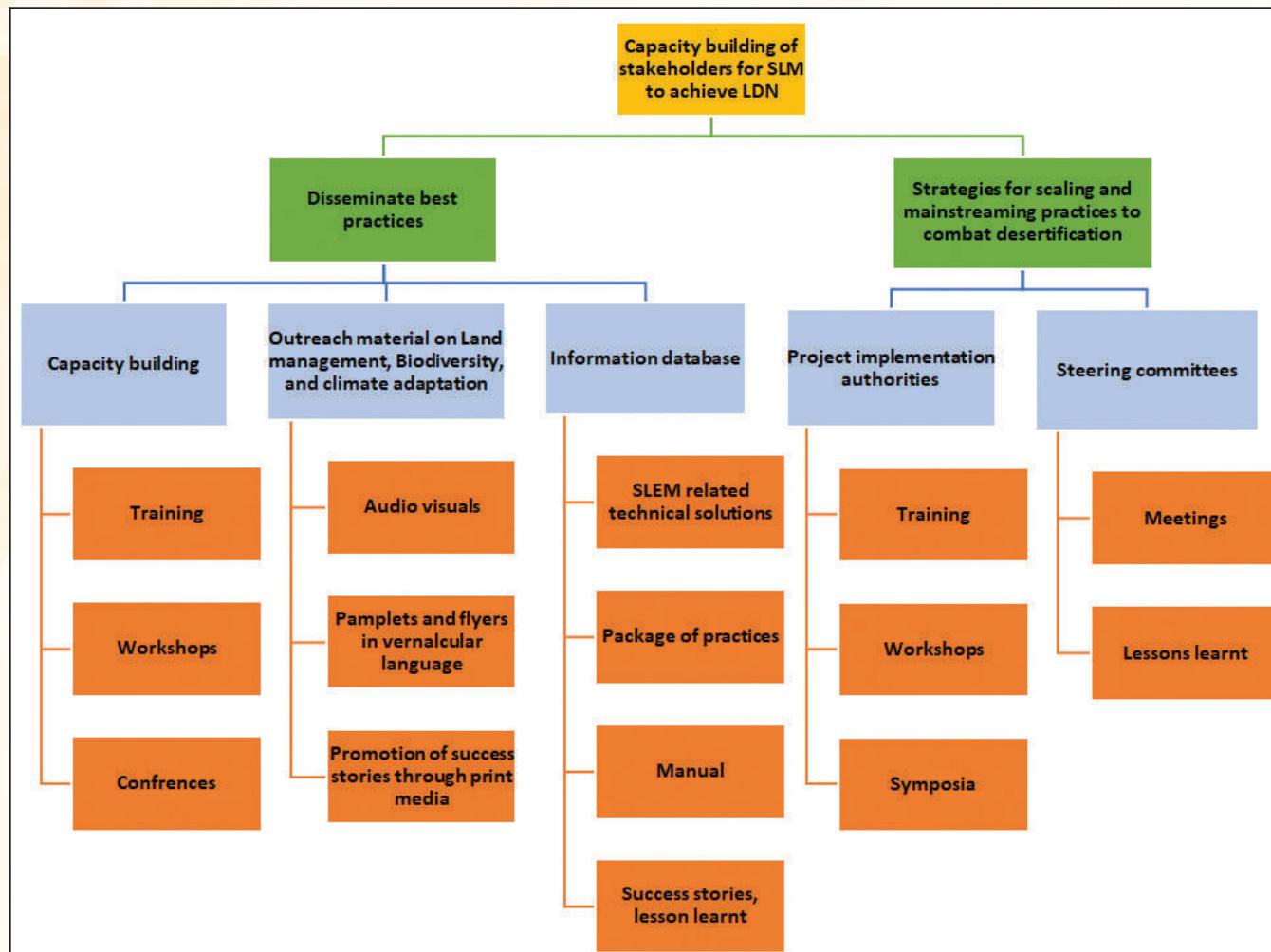


Figure 32 Components of Capacity Building

7.2 Outreach and Dissemination

The implementation of communications and outreach activities, which is aninbuilt component of Plan's operational strategy, will be governed by a framework that specifies objectives and anticipated outcomes. The Communication Strategy is an integrated component of the plan and will help to facilitate knowledge sharing, learn from experiences, disseminate success stories, and replicate best practices pertaining to Land Degradation Neutrality (LDN). The success of the Communication Strategy will play a crucial role in achieving greater acceptance of the sustainable land management approach for achieving LDN, throughout the country.

Objectives of the Communication Strategy

"To enhance the impact of LDN approaches in fulfilling its mandate by equipping stakeholders with technical know-how andengaging them through enhanced information andknowledge with transparency".

Objective 1: Increasing understanding of the SLM approach for achieving LDN

Objective 2: Transferring Knowledge on SLM for LDN: Capacities Build Capacities and enable stakeholders by facilitating access to information and knowledge available on SLM for achieving LDN.

Objective 3: Promoting SLM Mainstreaming for achieving LDN: Generating and disseminating information to substantiate the role of Sustainable Land Management (SLM) for achieving LDN.

Principles of the Communication Strategy

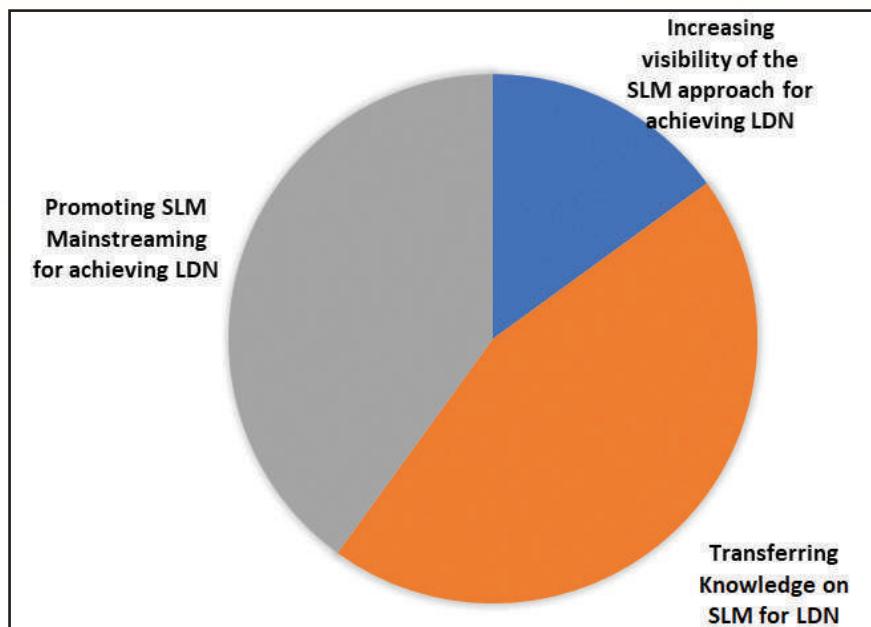


Figure 33 : Relative weightage of respective objective

To ensure that communication work is consistent of high quality, all relevant activities will be expected to adopt the following principles and be monitored against them:

- Messages are consistent among all the relevant stakeholders and project proponents' at all levels
- Communication initiatives are demand-driven, i.e. responsive to the needs arising from the SLM operating environment;
- Communications activities are practical, timely, and constructed in accordance with the available budget;
- Communications build on, add value to, and strategically complement existing communications;

Message Development

Key communication messages will be developed to address the need to

- Engage with cross-sectoral stakeholders and institutions,
- Mainstream SLEM within sectoral policies and strategies, and
- Leverage existing networks (including civil society organisations).

Key Elements of the Outreach Strategy

Based on the information gathered through the M&E framework, as well as field visits to project areas and other relevant sites, appropriate outreach material on land management, biodiversity conservation, and



climate change adaptation will be developed for decision-makers and practitioners. This outreach material will include written, audio/visual material, e-learning tools, field visits of the thematic experts, semi-annual best practice notes in the vernacular language, models for mainstreaming, and so on. Training, workshops, conferences, and other dissemination tools shall be the prima-facie of the achievement of the Plan objectives to disseminate best practices, lessons learned, and strategies for scaling and mainstreaming practices to combat land degradation.

Promoting the SLM for LDN approach as a mechanism for advancing the SLEM Approach within the nation	Dissemination of the SLEM Approach and its products to specific target audiences	Evaluating stakeholder feedback
<ul style="list-style-type: none"><input type="checkbox"/> A website that is regularly updated;<input type="checkbox"/> Brochures geared toward a variety of target demographics<input type="checkbox"/> Newsletter<input type="checkbox"/> Briefing notes and updates on the status of NAP for achieving LDN<input type="checkbox"/> Presentations<input type="checkbox"/> Outreach sessions (primarily involving project partners and stakeholders)<input type="checkbox"/> Regularly updated press releases<input type="checkbox"/> Commissioning of opinion/editorial pieces by team members/experts for media release	<ul style="list-style-type: none"><input type="checkbox"/> Website containing online downloads of reports/best practices/success stories and links to data sets<input type="checkbox"/> Mailing relevant information in hard copy<input type="checkbox"/> Distribution and mailing of Outreach kits/Training Manuals to project partners, relevant sectoral institutions and ministries, research & scientific communities, academia, and civil society	<ul style="list-style-type: none"><input type="checkbox"/> Analyses of the content of documents created by stakeholder organisations<input type="checkbox"/> Survey of SLEM-CPP media coverage

Figure 34 Elements of outreach strategy and proposed activities

In addition to discussing these issues at regular steering committee meetings, technical workshops will be held for project implementation authorities and staff. This will strengthen their capacities and lead to more focused project-related activities. An information database containing SLEM-related technical solutions will be established. The technical solutions will be distributed to all Indian states, including those that are not implementing LDN projects. This information will also be distributed to leading non-governmental organizations involved in SLEM-related activities. A Package of Practices and Manual will be prepared containing tools, guidelines, and approaches for scaling and replicating success models and lessons learned in land management, biodiversity conservation, and climate change adaptation.

7.3 Target Audience

Landscape wise priorities based on the respective vulnerabilities shall be taken into consideration for the identification of the interventions and subsequently the specific focus groups from amongst the wide audience base in the landscape to undertake effective communication with them in various ways and within varying timeframes. The target audience is comprised of the following demographics:

- The project proponents and stakeholders from the area where the project for Land degradation neutrality is being undertaken.
- Ministries and departments related to Land Management issues.
- Partners in thematic and strategic areas of Sustainable Land management interventions (universities, relevant institutions, civil society, etc.);

- National and State level policymaking bodies

The SLEM audience is diverse and includes individuals/institutions from across the country and a variety of industries. The following are the most important segments to target.

Project proponents

- Realisation of the objectives of the SLM for LDN will be increased through greater cooperation
- Project proponents enhance cooperation and realise greater synergies in their activities

Relevant ministries of government of India

- Land as a subject falls under the purview of the Ministry of Agriculture and Cooperation, Ministry of Rural Development and the Ministry of Environment and Forests
- Endorsement of the SLEM Approach by the concerned Ministries in their communications, research and policy briefings over the duration of the project cycle

Scientists and Researchers involved in issues in land management, conservation, sustainable use, and equitable sharing of the benefits of, biological diversity and genetic resources

- Encourage researchers to advocate the SLEM Approach and its underlying source material
- Number of mentions of SLEM in scientific journals

Specialized groups of experts who were consulted or contributed to the articulation of the SLEM Approach

- The objective is to ensure coherence among the message in the communication strategy as well as in their own communications within and outside of their organizations regarding SLEM Approach
- Group of experts and contributors communicate consistent and coherent messages; provide follow-up actions as the basis of the key messages conveyed by the SLEM-CPP/TFO

Members of Civil society, with an interest in SLEM issues

- Provide channels for the use of SLEM Approach and its data by NGOs
- Information products from the SLEM Approach are used by local groups, are translated into local languages, and are cited in policy proposals and documents at the local level

The media, including print, radio and television media, and online correspondents

- To promote broad, positive and accurate coverage of SLEM Approach and its use by the mass media; to engage and effectively use the mass media to disseminate information and news regarding SLEM Approach
- This group will assist in reaching out to all of the above groups.



Rockoutcropsvisible in AwIFS imagecovering parts of Gujarat with corresponding field photograph

Source Desertification and Land Degradation Atlas of India



Chapter 8

MONITORING AND EVALUATION

Ministry of Environment, Forests, and Climate Change (MoEF&CC), using Indian Remote Sensing Satellites (IRS) data in a Geographical Information System (GIS) context, the Space Applications Centre (SAC), ISRO, Ahmedabad, along with 19 concerned partner institutes, conducts an inventory and monitoring of desertification across the country. The results and maps are published as the “Desertification and Land Degradation Atlas of India.” This atlas provides state-by-state desertification and land degradation status maps that reflect land use, land degradation processes, and severity levels. Changes in desertification/land degradation for the chosen time periods are reported for each state and for the entire nation. The findings aid in identifying locations to be addressed in order to reduce the effects of desertification and land degradation.

For monitoring of the progress on LDN activities a thorough monitoring structure at four different level is proposed to be established at CoE-SLM. In addition to the on-the-ground self-monitoring by implementing agencies and communities, the Ministry will also use Geographic Information System-based real-time monitoring, and remote sensing with GPS mapping of the project areas under various schemes and satellite imageries for monitoring at the output/outcome level.

Gram-Sabha will conduct a social audit of the village-level activities. This information will be published in the public domain. Third-party monitoring and long-term monitoring of UNCCD indicators for positive land cover changes, increased land productivity, and increased carbon stocks through GIS tools will be undertaken. A third party will periodically monitor the designated intervention regions as one of the components of the monitoring mechanism

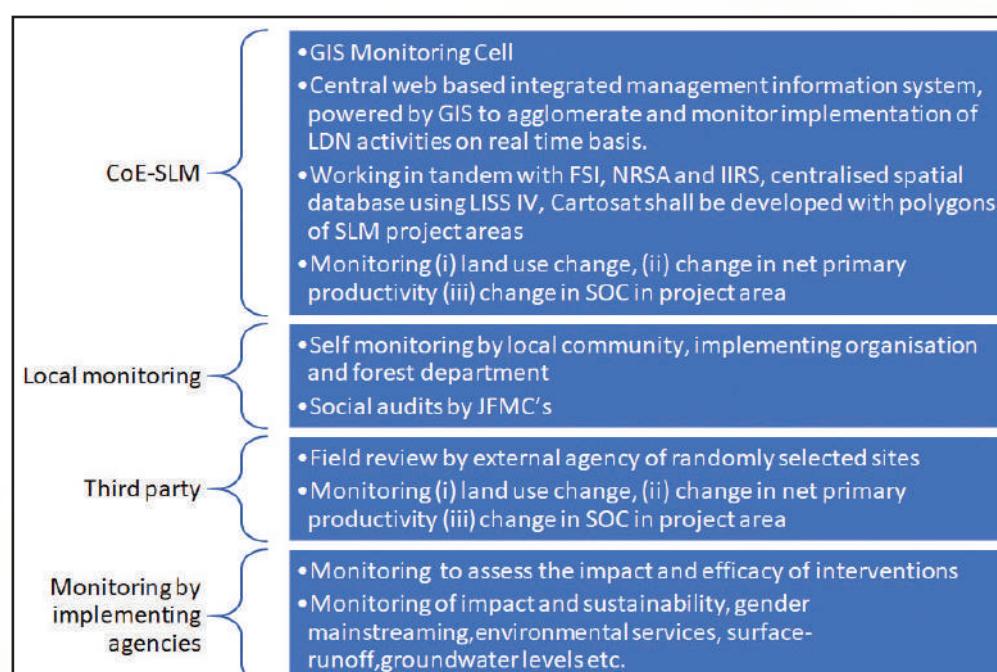


Figure 35 Strata of Monitoring and Evaluation



To provide convergence of diverse programs for achieving LDN, for strong financial planning, timely funding, mobilization of necessary resources and judicious use of financial resources, a web-based Integrated Management Information System Platform driven by GIS application in real-time will be developed at CoE-SLM. This web-based portal will generate state-wise progress reports of various activities undertaken in various public/private funded schemes being implemented in the states.

In addition, a dedicated monitoring cum GIS cell would be established at the Directorate Level in the Ministry. The projects being implemented by various agencies at state level will be monitored for relevance and coherence, efficacy and effectiveness, impact and sustainability, and gender mainstreaming based on the criteria, Evaluation Questions and Indicators enlisted in the table 4.

Table 4: Criteria and Indicators for Monitoring and Evaluation of LDN activities

Criteria	Evaluation Questions	Indicators
Relevance and Coherence	How well is the project responding to the needs and priorities of the state, participating communities and global commitments	Compliance on implementation of international conventions/agreements
	To what extent the project support, and aligned with existing national policies and international commitments	Existing National Action Plan for Achieving LDN Existing policies supporting LDN activities Directives to the state for undertaking LDN activities as per National Action Plan for achieving LDN The directives of the National Action Plan are as per National commitments and policies. Compliance on implementation of international conventions/agreements Existing MEA to which India is a party and their compliance
Efficiency and effectiveness	How efficient is the project delivery	Availability of approved planning documents, identifying the drivers of land degradation, and an approved plan for achieving LDN with a defined timeline Existing organisational structure, task, and functions of the entity responsible for implementing LDN activity
	If the project is delivering its planned results	Projected vs actual (i) land use change, (ii) change in net primary productivity (iii) change in SOC in the project area Conservation and maintenance of Soil and Water resources. LDN activities contribute to ecosystem function and vitality

Criteria	Evaluation Questions	Indicators
Impact and sustainability	Potential impacts delivered by the initiatives supported by the project	<p>Provisions enabling the participation of the community, NGO's civil society, and other relevant stakeholders.</p> <p>Capacity building of forest staff and stakeholders</p> <p>Maintenance and enhancement of forest (resource) productivity</p> <p>LDN activities increase the groundwater level</p> <p>LDN activities result in the improved cropping-pattern and cropping-system</p> <p>LDN activities increase the productivity of land through eco-friendly means</p> <p>LDN activities have increased access to clean and safe drinking water for the population</p> <p>LDN activities ensure the maintenance, conservation, and enhancement of Biodiversity</p> <p>LDN activities encourage optimization of forest resource utilization</p>
	To what extent are the project results likely to be sustained	<p>Potential drivers for risk of reversal identified (fire, encroachment, grazing, etc.)</p> <p>Management measures to address mitigate the risk of reversal</p> <p>Participation of the community in forest protection and incentive measures</p>
Gender mainstreaming	How the project supports gender mainstreaming within LDN initiatives	<p>Status of information dissemination and utilisation</p> <p>Engagement of JFM/VFC communities for planning and implementation of LDN activities</p> <p>Provisions enabling the participation of the community, NGO's civil society, and other relevant stakeholders.</p> <p>Capacity building of forest staff and stakeholders</p> <p>Equitable benefit sharing</p> <p>Adequacy of rules and regulation and their compliance</p>



Frost shattering as visible in AWiFS image covering parts of Himachal Pradesh with representative field photograph

Source Desertificationand Land Degradation Atlas of India



Chapter 9

ROAD MAP AND THE NATIONAL ACTION PLAN RESTORATION OF DRYLANDS FOR COMBATING DESERTIFICATION

Many countries and communities worldwide are battling to overcome the challenges posed by poverty, food insecurity, drought, natural disasters and war. Dryland regions have been highly vulnerable to such challenges for centuries. Many struggle to produce sufficient food for their growing populations and face daunting physical and demographic challenges like high rates of poverty and unemployment, rapid urbanization, severe water scarcity, and land degradation. Such problems and constraints are expected to worsen as a result of climate change. India is no exception, and the impacts of progressive desertification get exacerbated in the Indian context given the preponderance of subsistence agriculture and the quotient of population directly dependent on the natural resources for their subsistence and sustenance.

Drylands, which cover 41 percent of the earth's land surface and are home to 2 billion people, are widely affected by desertification, biodiversity loss, poverty and food insecurity. Restoration of drylands thus offers ample opportunities for environmental and socioeconomic development as it helps increase the natural capital on which rural livelihoods depend, besides enhancing the resilience of the landscapes, ecosystems and social systems to global change.

The importance of drylands for the provision of goods and environmental services is generally undervalued, which restricts the policy attention they receive, the funds available for their restoration and management, and the extent of scientific research, to those suited to humid forests. There is a clear and urgent need for dryland management, conservation and restoration

Restoration is recognized as the most effective tool to reverse degradation processes and increase the contributions of ecosystems and landscapes to livelihoods, land productivity, environmental services and the resilience of human and natural systems. The term "restoration" thus entails a wide range of conservation, sustainable management and active restoration practices that increase the quality and diversity of land resources, thus enhancing ecological integrity and human well-being.

Restoration may involve a mosaic of agroforestry systems, parklands, agro-silvo-pastoral and other pastoral systems, forests, rangelands, riparian systems, barren or abandoned agricultural land, protected areas, ecological corridors, public, communal and private land, and rural, urban and peri-urban areas. Restoration in dryland ecosystems can comprise actions ranging from habitat protection, assisted natural regeneration, sand-dune stabilization and tree-planting to policy improvements, the provision of financial incentives, capacity development, and continuous monitoring and learning. To be effective and sustainable, dryland restoration should be approached at the landscape scale through coordinated, integrated and streamlined efforts. The management of drylands thus requires differing approaches converging for effective management. Other Effective Area-Based Conservation Measures (OECMs) can also be an effective conservation tool where effective in-situ conservation of biodiversity is achieved mainly through effective landscape management lying outside forests and protected areas.

Building and enhancing resilience of the ecological and socio-economic systems is the prime objective of the restoration actions. In drylands, resilience is the capacity of socioecological systems to endure major and uncertain disturbances, such as drought, without severe, long-term consequences for livelihoods



and the environment. The development of rural societies in drylands has been both guided and limited by environmental constraints, and traditional socioecological systems. These traditional systems have simultaneously shown better economic viability than “modern” land management practices while also providing conservation benefits (Davies et al., 2012) by being able to adapt to complex, unstable and adverse conditions and by making efficient use of limited resources and biodiversity.

The efficient management of surface water and groundwater is another way of promoting resilience in drylands. The re-establishment of trees and other vegetation can help restore the protective and productive functions of dryland ecosystems. Plantation of native multi-purpose tree species (MPTs) can be used as shelterbelts and windbreaks can also play important roles in protecting against landslides and floods, stabilizing riverbanks and mitigating soil erosion besides producing fuelwood, timber and NWFPs.

The approaches guiding the restoration efforts to enhance resilience may thus be categorized into three approaches and systems-

- a.) Ecosystem approaches (in terms of species and genetic diversity),
- b.) Socioeconomic systems (in terms of traditional knowledge and practices, livelihood options, foods and other products), and
- c.) Institutions (in terms of land-use options, governance, and adaptive management including innovations and application of new and improved researches).

This road map and action plan aims to enhance restoration efforts in the country’s drylands, and to initiate an effective and efficient implementation of the nation’s efforts to meet its national and international commitments. A two-level approach is recommended for undertaking restoration actions-

- a. Policy level, and
- b. Implementation level

9.1 General Recommendations for Policymakers and other Decision-makers

Well-informed policymakers and other higher-level decision-makers can be the enablers in the design and implementation of effective restoration efforts by providing appropriate policies, governance mechanisms along with financial and other incentives. Following policy level measures are recommended for an integrated restoration mechanism-

- 1. Effective strategies against the identified drivers of land degradation** by engaging in cross-sectoral dialogue and planning at the landscape level through promoting intersectoral and interdepartmental and inter-ministerial level coordination for formulating implementation patterns and designs. Multisectoral platforms can be used to raise awareness of the extent and negative impacts of dryland degradation, encourage intersectoral approaches for addressing dryland degradation, and demonstrate restoration benefits and returns on investment.
- 2. Improve the supply of, and access to, Quality and Certified Planting material** – through establishment of streamlined and accountable certification mechanisms and the strengthening of national and regional seed centres and programmes to ensure the availability of genetically superior seeds in the quantities and of the quality needed for restoration.
- 3. Enabling and investing in assessment and monitoring** – for identifying priority areas for restoration, and estimating the required level of investment.

- 4. Create the right conditions for investment and resource mobilization to initiate and sustain restoration activities** – through enabling equitable and productive company–community partnerships based on the (Public-Private Partnership) PPP model, and facilitating small-scale, locally driven tree and forest product enterprises by improving access to credit for such enterprises.
- 5. Enable and invest in capacity assessment and development** – through developing networks of communicators and opinion leaders to influence policymakers.
- 6. Improve the governance and policy framework** – for securing land tenures, strengthening local and national-level institutions to support local-level processes by providing technical and financial assistance and encouraging equitable participation of stakeholders.
- 7. Encourage knowledge, research, learning and experimenting** – through collaborative and adaptive learning and experimenting processes based on traditional knowledge and innovative research, and promoting the sharing of knowledge among land users.

9.2 General Recommendations for Practitioners for Effective Implementation

An efficient and diligent Implementation of any plan is a must for the success of the plan, program or initiative. Following may be the broad guiding points for the practitioners on the actions they should consider in any restoration initiative -

- 1. Plan and choose the most cost-effective restoration strategies** – for undertaking site specific restoration efforts and involving communities in the planning of restoration strategies.
- 2. Prioritization of Interventions Sites and Areas** – on Micro-ecosystem basis through Landscape-scale planning considering the mosaic of land uses and the diversity of needs of all stakeholders. Diverse and site-conducive restoration strategies should be promoted.
- 3. Promote natural regeneration** – through assisted natural regeneration on forest lands and, on farms, farmer-managed natural regeneration requires little investment, and have the potential to be scaled up quickly in areas where tree and shrub species can re-sprout after harvest and where rights to resource use are appropriate.
- 4. Plant where and when necessary** – through appropriate selection of species based on site suitability and local preferences. Special attention should be given to ensuring the quality of genetic material and giving preference to the native species. Planting multi-purpose trees species should be preferred as an effective tool to enhance resilience. Plantation activities should be scrupulously planned to ensure optimal use of limited water resources.
- 5. Protect and manage** – improvements in protection and management are potentially more cost-effective than planting in restoration initiatives, and can be effected through checking soil-erosion using cost efficient water-harvesting techniques, and minimizing anthropogenic threats and pressures.
- 6. Monitoring and Evaluation:** Monitoring and evaluation must be integrated in restoration initiatives by developing an effective monitoring plan, promoting the participation of all stakeholders in the design and implementation of monitoring, and undertaking consistent monitoring and evaluation and sharing for the benefit of ongoing and future initiatives.



9.3 Action Plan

India is a party to the UN Convention to Combat Desertification (UNCCD) and MoEF&CC is the National Coordinating Agency for the implementation of the UNCCD in the country. As an affected party, a 20 years comprehensive National Action Plan (NAP) to Combat Desertification in the country was prepared in 2001 with the objective to promote community-based approach to development, and development of activities to improve the quality of life of the locals, awareness raising, their preparedness and resilience to drought, undertaking R&D initiatives and interventions which are locally suited, and strengthening self-governance leading to empowerment of local communities.

The **National Action Plan to Combat Desertification, 2022** presents the coherent and the updated version of the NAP 2001 taking due consideration of the country's commitments for-

- Restoration of 26 million hectares of degraded land by 2030
- Initiative for enhanced South-South Cooperation that aims to share experiences on SLM strategies
- Additional carbon sink of 2.5 - 3 billion tonnes of CO₂ equivalent by 2030 through additional forest and tree cover

As corroborated under the latest estimates of the Space Applications Centre, ISRO presented in the Desertification and Land Degradation Atlas of India 2021, the area under Desertification and land degradation has increased to 97.85 million hectares (29.77% of the total geographic area) of the country.

9.4 Extent of Intervention

India is committed to achieve its target of Land Degradation Neutrality by 2030, which indicates that no more land would be degraded as compared to the degraded land of baseline year, that is 96.40 mha.

Status of Land Degradation in country

Desertification and land degradation are major threats to agricultural productivity in our country. Combating desertification and land degradation is one of the thrust areas identified by the Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India, New Delhi. As per the latest Desertification and Land Degradation Atlas released by Space Application Center, ISRO, Ahmedabad, India has around 30% of its total geographical area under drylands undergoing the process of desertification i.e., land degradation as a result of climatic and anthropogenic factors. The population pressure has resulted in over exploitation of land for cultivation, grazing, water resources, deforestation etc., leading to degradation of drylands.

At the 2019 Conference of Parties for the UNCCD, India announced an increase in the country's ambition for land restoration from 21 million ha to 26 million hectares by 2030. This ambitious task will involve restoring land productivity and ecosystem services on degraded agricultural and forest landscapes including wetlands through adopting a landscape restoration approach. India has also announced its intention to set up a global technical support for member countries of the UNCCD member countries, for capacity building and support in order to help them achieve the LDN goals and to further develop a scientific approach and to facilitate the use of technology to address land degradation issues.

The State wise details of Desertification and Land Degradation - 2018-19 and 2011-13 is given in Table5.

Table 5 State wise Status of Desertification and Land Degradation - 2018-19 and 2011-13

State Name	Total Area under Desertification (ha)		% Total Area under Desertification w.r.t. GA	
	2018-19	2011-13	2018-19	2011-13
Andhra Pradesh	2378042	2298758	14.84	14.35
Arunachal Pradesh	200683	153933	2.40	1.84
Assam	834530	716596	10.64	9.14
Bihar	746586	694809	7.93	7.38
Chhattisgarh	2306531	2211153	17.06	16.36
Delhi	91543	89868	61.73	60.60
Goa	194877	192973	52.64	52.13
Gujarat	10248057	10261641	52.22	52.29
Haryana	364154	338964	8.24	7.67
Himachal Pradesh	2400300	2394240	43.11	43.01
Jammu and Kashmir	1136013	1070856	20.86	19.67
Jharkhand	5482260	5498726	68.77	68.98
Karnataka	6959847	6951000	36.29	36.24
Kerala	422299	379587	10.87	9.77
Ladakh	7098768	6898745	42.31	41.12
Madhya Pradesh	3859735	3804315	12.52	12.34
Maharashtra	14306029	13825935	46.49	44.93
Manipur	612566	601959	27.44	26.96
Meghalaya	557576	494880	24.86	22.06
Mizoram	275827	187453	13.08	8.89
Nagaland	828943	786678	50.00	47.45
Orissa	5359014	5304114	34.42	34.06
Punjab	167989	144653	3.34	2.87
Rajasthan	21237665	21526512	62.06	62.90
Sikkim	84610	78749	11.92	11.10
Tamil Nadu	1599981	1543898	12.30	11.87
Telangana	3638508	3598856	31.68	31.34
Tripura	447378	437128	42.66	41.69
Uttar Pradesh	1549608	1528997	6.43	6.35
Uttarakhand	673894	648253	12.60	12.12
West Bengal	1784345	1733931	20.10	19.54
Total	97848160	96398161	29.77	29.32

**Table 6: Status of desertification and available Open forest Area as per Desertification and Land Degradation Atlas 2021 and ISFR 2021**

S. No	Name of the State	Total Area under Desertification (ha)	% Total Area under Desertification w.r.t. GA	Open Forest Area
1	Uttar Pradesh	1549608	6.43	816200
2	Tamil Nadu	1599981	12.3	1179200
3	West Bengal	1784345	20.1	958700
4	Chhattisgarh	2306531	17.06	1637000
5	Andhra Pradesh	2378042	14.84	1386100
6	Telangana	3638508	31.68	1047100
7	Madhya Pradesh	3859735	12.52	3661900
8	Odisha	5359014	34.42	2394800
9	Jharkhand	5482260	68.77	1143100
10	Karnataka	6959847	36.29	1321200
11	Gujarat	10248057	52.22	951600
12	Maharashtra	14306029	46.49	2147500
13	Rajasthan	21237665	62.06	1220800
14	Uttarakhand	673894	12.6	648200
15	Himachal Pradesh	2400300	43.11	518000
Total		83783816		21031400

(Source DLDA 2021 & ISFR 2021)

Table 7: Status of desertification and available Open Forest Area in the identified North-Eastern States

S. No	Name of the State	Total Area under Desertification (ha)	% Total Area under Desertification w.r.t. GA	Open Forest Area
1	Arunachal Pradesh	200683	2.4	1519700
2	Manipur	612566	27.44	946500
3	Meghalaya	557576	24.86	732600
4	Mizoram	275827	13.08	1194800
5	Nagaland	828943	50	653000
6	Sikkim	84610	11.92	68800
7	Tripura	447378	42.66	186300
Total		3007583	172.36	5301700

(Source DLDA 2021 & ISFR 2021)

It may be observed that the 9.34 % of the total forest area falls under the degraded or the open forest category (43% of the total forest cover of the country) and offers an ample scope along with the 76.87% of non-forest area to undertake not only the restoration measures to neutralize the ongoing land degradation but also to eco-restore and judiciously undertake landscape specific measures to increase the overall tree cover outside the conventional forest areas.

Ten categories of activities have been considered by the FSI for the potential increase in carbon sink and forest cover in the country and include restoration of impaired forests, restoration of open forests, afforestation on wastelands, agroforestry, setting up of green corridors, undertaking plantations along roads and railways, undertaking plantation on railway sidings, along rivers and canals and the creation of urban green spaces.

The estimation establishes that the largest potential of creating additional carbon sinks lies in the restoration of forests which have impaired in the last 15 to 20 years, along with the activities like restoration of open forests, afforestation on wastelands and Agroforestry. These two activities of restoration of natural forests contribute up to 60% of the total carbon sink which can be achieved by 2030.

It may be emphasized that due to the high priority accorded to conservation and restoration of forest and enhancing biodiversity and green cover under the policies, Acts, Rules and programmes, and an efficient collaborative implementation of the afforestation efforts of both National and State Governments under various plans and schemes of the Central and the State governments, afforestation on a total of 18.94 mha area has been undertaken since 2011-12 till 2021-22 by the different implementing agencies as detailed below

Table 8: Afforestation Achievements (2011-12 to 2021-22)

Area covered (in million ha)		
Year	Target	Achievement
2011-12	1.74	1.6
2012-13	1.54	1.63
2013-14	1.48	1.62
2014-15	1.53	1.35
2015-16	1.16	1.38
2016-17	1.09	1.99
2017-18	1.45	1.68
2018-19	1.72	1.63
2019-20	1.88	2.07
2020-21	2.23	2.21
2021-22	2.69	1.78
Total	20.74	18.94

The country is progressing at a commendable rate to achieve the targets under various commitments and moreover to achieve 33% of forest and tree cover of its geographical area as enshrined under the National Forest Policy of the country. Yet the efforts will be continued to achieve the commitments beyond by adopting efficient social, community and agro-forestry practices. It will reduce the vulnerabilities of the landscapes and the forest dependent communities through the interventions on the micro-ecosystem basis and effecting convergence with the other related schemes.

Based on the extent of degradation, geographical as well as ecological conditions, fifteen states namely Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Odisha, Rajasthan, Telangana, Uttar Pradesh, Uttarakhand, Tamil Nadu, Himachal Pradesh, West Bengal and Maharashtra have been identified for taking up the interventions towards achieving the LDN targets. The total area



under desertification in the selected 15 states is more than 25% of the country's geographical area. In the open forest areas, only 30% of the land is cultivable that can be taken up for treatment towards achieving the Land Degradation Neutrality.

Further, guided by the assessment on the total area available under the Open Forest category and the recommendations of the FSI, 15 states are identified for undertaking the comprehensive land restoration measures as high potential areas and accorded high priority for the interventions planned under the National Action Plan to Combat Desertification and Land Degradation.

In general, to reduce the severity of the desertification process, the prominent focus of the Plan shall be on

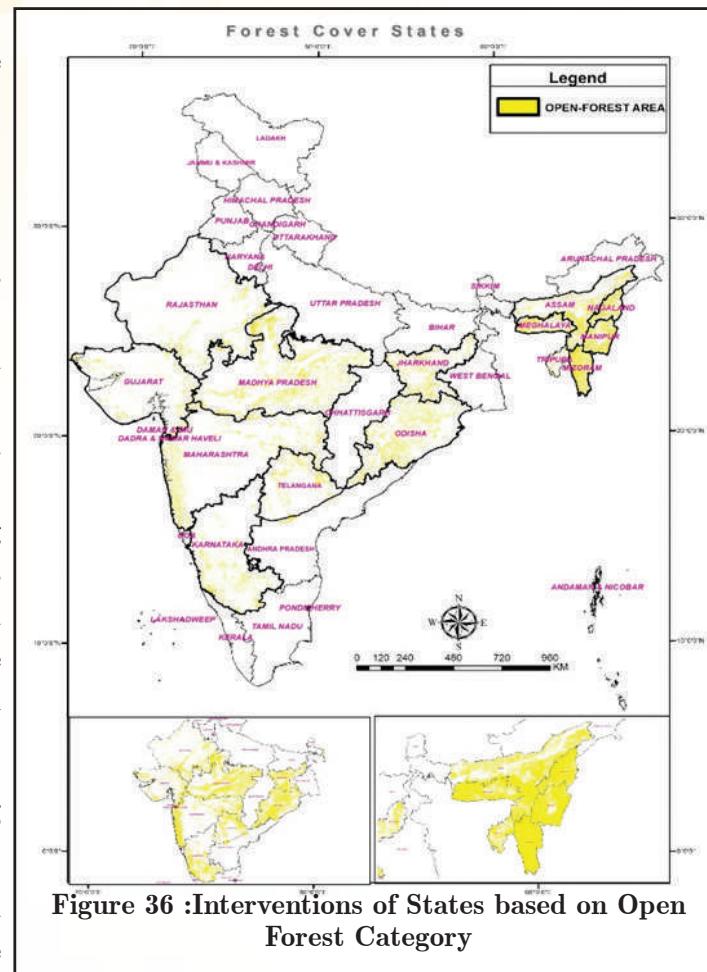
- Identifying suitable areas for eco-restoration/ afforestation with the selection of suitable climate-resilient multipurpose tree species, perennial forage and fodder species.
- Managing soil erosion by adopting location-specific soil and water conservation practices.
- Dealing with soil salinity in agricultural lands through proper irrigation water management, development and maintenance of surface and subsurface drainage systems.
- Adopting proper agriculture and land management practices.
- Converging these activities with the ongoing national and state government programmes like Joint Forest Management, Integrated Watershed Management Programme and Mahatma Gandhi National Rural Employment Guarantee Act, etc.

9.5 Action Plan for Combating Desertification: A Holistic Approach

The Ministry of Environment, Forests and Climate Change has released 'Convergence Guidelines for Integrated Greening Interventions' for all afforestation activities on Pan India Basis, to introduce the convergence of all afforestation schemes for providing impetus and a concerted effort in addressing the sustainable management of forest resources required for the mitigation of climate change but will also lead to better quality planning and broader selection of degraded sites capable of generating progressively sustainable eco-restoration/afforestation interventions. The interventions are proposed to be taken up for holistic land treatment measures till 2030 through the convergence with various schemes/programs to achieve the country's targets to restore degraded areas till 2030.

1. National Mission for a Green India

The National Mission for a Green India (GIM) is one of the eight Missions under NAPCC and aims towards



protecting, restoring and enhancing India's forest cover and responding to climate change. It envisages a holistic view of greening and focuses on multiple ecosystem services along with carbon sequestration and emission reduction as co-benefit. The Mission recognizes the impacts of climate change phenomena on the distribution, type and quality of natural resources of the country and further acknowledges the influences that the forestry sector has on environmental amelioration through climate mitigation, food security, water security, biodiversity conservation and livelihood security of forest dependent communities. Under GIM focus will be given for innovative and demonstrative afforestation model to saturate the vulnerable landscapes, which would include focus on establishing NTFP and Socio-Agro-forestry based Sustainable Plantation Models with multi-stakeholder pro-active involvement and an enhanced engagement of Private Players on non-forest lands. The Mission's interventions would be undertaken under three submissions:

- Enhanced Quality of Forest cover and Improved Ecosystem Services;
- Increase in Forest and Tree cover and Ecosystem Restoration;
- Enhancement of household incomes and diversification of livelihoods for forest dependent communities.

The total Mission cost is Rs.12,190 Crore for ten years (2021-30) which include Rs.7190 crores from CAMPA and Rs. 5000 crores budgeted under Green India Mission. Accordingly, based on workable area and objectives of the National Mission for a Green India i.e., open forest in the eight states, the State wise targets allocated under GIM in the selected states given in table 5. The interventions under GIM through CSS Component will emphasize on series of interventions focusing on Reclamation/ Restoration Forestry to treat Open Forest and Non- Forest areas through focus on Soil and Moisture Conservation activities, Micro-ecosystems approach with prioritized intervention areas under the landscape, adoption of regionally conducive best practice models, and to achieve saturation of the landscape.

The total area proposed to be undertaken under Green India Mission is **0.20 million hectares** during the period 2022-2030.

In addition, the Mission also has a second component to be implemented in the project mode and funded under the National CAMPA, and governed by the CAF Act 2016. Through CAMPA support under GIM, Innovative and demonstrative eco-restoration projects will be developed with active participation of the States in their priority vulnerable landscapes which have the greatest potential to mitigate the impacts of climate change and include holistic eco-restoration measures for restoration of degraded landscapes, grasslands and scrublands. In total 0.30 ha area in the selected states will be taken up through National CAMPA for treatment of degraded and deserted landscapes through a set of interventions including afforestation, soil moisture conservation, agro-forestry, etc.

Keeping in view of the international commitments and targets, Ministry will announce a special package for the vulnerable states with the financial assistance and set of intervention to treat the degraded lands with innovative models. The States will be consulted to develop certain projects under the special package for addressing the land degradation in India. Under this component special projects may be undertaken for implementing interventions under the Landscape Approach. One such innovative model may be a case study of Karnataka, where landscape specific interventions are being implemented in following specified phases –

- **Protection and Planning phase in the Zero year**, where the primary activities are closure of the area through fencing and planning and undertaking Soil and Moisture Conservation Works to enable regeneration in the area from the available root stocks. Though this may be effective in the forest areas,



it shall also be equally helpful in the grasslands following the principles of rotation for restoration.

- **Preparatory Phase in the First year** focusing on the SMC works, seed sowing and Fire Tracing,
- **Assessment Phase in the Second year** where seed sowing is done, assessment of natural regeneration, and to undertake planting if required and accordingly prepare the treatment plan.
- **Advance Work Phase** in the Third year
- **Planting Phase** in the Fourth year and
- **Maintenance Phases** in the fifth, sixth, seventh, eighth, and ninth year.

The Model may prove highly effective in restoring degraded areas and thus may be adopted for undertaking 20000 ha per State per year in all the 10 priority states. The target area to be covered through this package will be **1.6 million ha**.

2. Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

Under the Forest (Conservation) Act, 1980, whenever forest land is converted to non-forest land use for residential, commercial, mining and industrial purposes, an equivalent area of non-forest land has to be taken up for compensatory afforestation. In addition, following the ‘polluter pays’ principle, funds for raising the compensatory forest are also to be imposed on the entity responsible for such diversion.

In 2002, the Supreme Court (SC) ordered that a Compensatory Afforestation Fund (CAF) be created in which all the contributions towards compensatory afforestation and the net present value (NPV) of land had to be deposited.

Following the order, in 2004, Ministry of Environment, Forest and Climate Change (MoEF&CC) constituted the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) to overlook and manage the CAF as directed by the SC. Between 2006 and 2012, the CAF grew from INR 1,200 crore to INR 23,607 crores. For better regulatory oversight and institutional management of the fund, the Compensatory Afforestation Fund Act, 2016, which legalized the status of CAMPA at the national as well as state level, came into force on 30 September 2018. The act established a National Compensatory Afforestation Fund under the Public Accounts of India and State Compensatory Afforestation Fund under the Public Account of each state to be managed by the national and state CAMPAs. The state funds receive 90% of the payments (of the NPV), while the national fund receives the remaining 10%.

CAMPA aims to promote afforestation and regeneration activities as a means of compensating for forest lands that have been taken over for non-forest use due to the developmental needs of an area. It covers a wide range of activities, including compensatory afforestation, catchment area treatment, assisted natural regeneration, forest fire prevention and control, soil and moisture conservation in forests, wildlife management, improvement of wildlife habitat, management of biological diversity and biological resources, research and innovation in forestry, and monitoring and evaluation of CAMPA works.

CAMPA promotes sustainable forest management practices through undertaking the following measures:-

- encouraging natural regeneration of forests by limiting extraction of wood, charcoal and fodder from forest areas for daily household use
- generating awareness on the use of wood waste for household purposes and minimizing the use of felled trees
- ensuring that CAMPA funds are not used to set up monoculture and commercial species as they aggravate the impact of climate change in terms of soil erosion and groundwater depletion

- ensuring that species selection criteria include adaptive capacity of plants with local climatic conditions and potential additional benefits for the communities – for example, the cultivation of fruits and tubers that can be used as food or sold in local markets and to the larger value chain (provided capacity-building support is made available under CAMPA)
- assessing location-specific climate risk and vulnerabilities, socio-economic conditions, and cultural nuances before investing in specific activities listed under CAMPA. (For example, catchment area treatment by constructing new ponds or recharging old ponds will yield more tangible benefits to the local community in terms of incremental agricultural and forest-based production only when these activities are conducted in an area that has a historical trend.

Based on the ongoing trends of undertaking plantation measures, it may be projected that a total plantation of 1.0 million hectares may be undertaken during the period till 2030 as detailed in the table provided below-

Table 9 States wise Achievements (2010-11 to 2021-22)

Sr.	State	CAMPA	NPV	Interest Component	Total Area (in thousand ha)
		Achievement	Achievement	Achievement	
		Area (in thousand ha)	Area (in thousand ha)	Area (in thousand ha)	
1	Andhra Pradesh	12.24	52.77	0	65.01
2	Chhattisgarh	31.55	29.12	0	60.67
3	Gujarat	22.94	4.71	0	27.65
4	Jharkhand	39	90.12	0	129.12
5	Karnataka	10.62	63.87	0	74.49
6	Madhya Pradesh	35.83	74.22	0	110.05
7	Maharashtra	17.68	24.5	0.53	42.71
8	Odisha	52.03	362.34	0	414.37
9	Rajasthan	28.06	66.44	0	94.5
10	Telangana	20.19	51.22	0	71.41
	Total	270.14	819.31	0.53	1089.98

Accordingly, the target of **1.5 million hectares** in the selected states can be taken under CAMPA to contribute in achieving the land degradation neutrality targets.

3. Restoration of Aravalli Landscape

Aravalli's form the skyline of northwest India extending from southwest in Gujarat and Rajasthan to Northeast in Delhi through Haryana. It runs diagonally across Rajasthan starting from Champaner in Gujarat to Delhi in the northeast covering a distance of about 700 km. The width of Aravalli varies from <10 km to over 100 km. Aravalli is the oldest mountain system and is the main water divide of the north Indian drainage system between the Indus and Ganga basins. Aravalli's with its forests used to act as a green barrier and an effective shield against desertification by checking spread of the Indian Desert (Thar) towards eastern region.

It is also the origin of many rivers including Chambal, tributaries of the Yamuna, and Mahi, Sabarmati, Luni and Banas rivers and other seasonal streams. Aravalli's help in enhancing the precipitation and



checking drought as the rainfall in north-west India depends heavily on the preservation of forest cover and resultant normal evapotranspiration process over the Aravalli hills. It also provides numerous resources to its inhabitants including fuel wood, fodder, fruits, vegetables and important commercial products like rubber, raisins and a range of economically viable products.

Preparation of a Detailed Project Report

A Detailed Project Report on restoration of Aravalli region is under preparation incorporating

- a.) Identification and Restoration of Priority Intervention Areas (PIAs) in the region
- b.) Restoration and Enhancement of Water Resources including augmentation of ground water and conservation of surface water and shall include constructing site specific water harvesting structures, restoration of existing water bodies/lakes and improved drainage management through detailed hydrology / water mapping, and
- c.) Development of Aravali Van Diwar/Green Wall

Aravalli Van Diwar/ Green Wall Initiative

The proposed initiative for restoring about 1.50 million hectares of land in the Aravalli region will prove to be a landmark in the land restoration leadership of India. This initiative will also prove to be a boon in terms of the overall flourishing of the environment not only of Aravalli but north-western regions of India as a whole. This would also be a prestigious attempt to showcase the resolve and capabilities of the country and position itself as a leader in eco-restoration among the world community. Restoration of this hill region will not only lead to curtailing the growth of the desert area but will also curb the air pollution occurring in the form of dust storms originating from the high-pressure areas of Rajasthan during summer months.

Direct benefits:

- The project is likely to create wage employment to 20 lakh person days per year in the three districts.
- In the medium term there would be increased production of biomass from the area which will aid in dairy and animal husbandry, improved output from horticulture, enhanced production of firewood which would directly benefit the poor in the area.
- In the long run, the project will positively impact soil fertility by reduction of soil erosion from water and wind, increase in soil moisture and organic matter.

Indirect benefits:

- The project will improve the ecology of the area and help in reducing desertification and aid in halting spread of the desert from the western boundary of the project area. The wall will act as a barrier to the sand blown onto agriculture land potentially protecting lakhs of hectare of agriculture land from desert sand.
- The significant increase in tree cover will help to

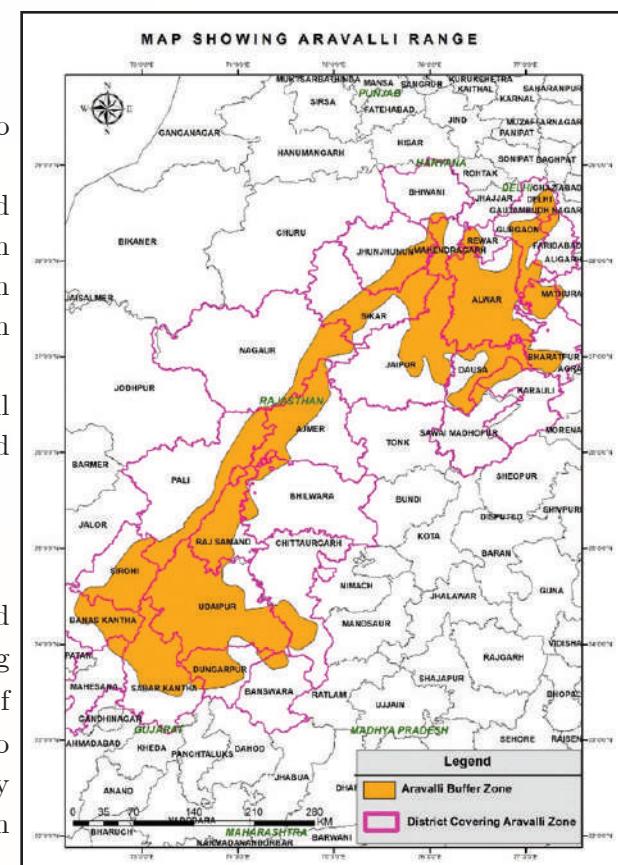


Figure 37 Map showing Aravalli range

sequester additional carbon.

- The project will usher in a culture of tree planting and sustainable livelihoods.
- The project will enhance ecological value by supporting rejuvenation of endemic and indigenous plants, many of which have medicinal value.
- The project will also help in rejuvenation of water bodies and catchment of the local streams and help in stream rejuvenation, improving soil moisture regime and drought resilience.

The project envisages creating a contiguous patch of greenery and tree cover straddling the Aravalli region from Gujarat to the southern borders of Delhi in a 5 Km buffer zone encompassing various types of existing land uses.

While the initial stretch of the green wall would start from the boundary of the southern part of Aravalli in Gujarat, it would generally run first in the easterly and then in the north easterly direction towards the boundary between Delhi and Haryana. The green wall landscape will be spread over the agro-climatic zones namely Gujarat Plains and Hills, Central Plateau and Hills, and Trans Gangetic Plains. A rough estimate of the possible path of the green suggests that about 70% of the area would fall in Rajasthan while 25% in Gujarat and 5 % area would fall in Haryana and Delhi respectively. About 70% of the area would fall in Rajasthan while 25% in Gujarat, and 5 % area would fall in Haryana and Delhi respectively. Accordingly, the area to be covered for intervention in the State of Gujarat and Rajasthan under development of Van Diwar is given in table below.

Table 10 Area to be taken up under Van Diwar Initiative in the Three States

S. No	State	Proposed target till 2030 (in mha)
1	Rajasthan	0.3
2	Gujarat	0.2
3	Haryana	0.1
Total		0.6

4. Rejuvenation of Riverine Landscapes and Restoration of Degraded Coastal Areas

MoEF&CC has prepared the detailed report on the rejuvenation programme for 13 major Indian rivers, with the objective to introduce forestry interventions to ensure that rivers have a continuous clean flow, with cleaner banks to improve aquatic biomes and livelihoods. Over Rs 19,000 crore will be spent over the next five years on various forest interventions to help these rivers. The 13 rivers chosen for rejuvenation are the Jhelum, Chenab, Ravi, Beas, Sutlej, Yamuna, Brahmaputra, Narmada, Godavari, Mahanadi, Krishna, Cauvery, and Luni. Forestry interventions will be spread across different catchment areas of natural, agricultural or urban landscapes. A total of 667 treatments and plantation models have been planned for the 13 rivers. The project expects to observe a noticeable increase of forest cover by 741736 ha and an increase of ground water recharge of 1,889.89 million cubic meters annually. i.e., in next 7 years it will treat 5192152 ha i.e., 5.1mha.

In the selected states, the DPR constitute an area of 0.21 mha for treatment through various interventions including afforestation, soil moisture conservation work etc. which will help to reduce

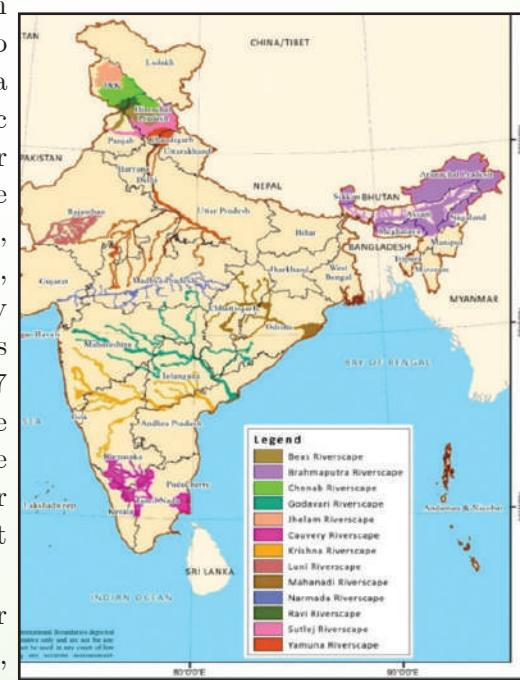


Figure 38 : Riverscape of India



the extent of land degradation and enhance land productivity in the States. The Proposed intervention under the River Rejuvenation in the selected states is given in Table 11.

Table 11 Proposed intervention under the River Rejuvenation in the selected states

S. No.	States	Area (target in ha)
1	Uttar Pradesh	15884
2	Odisha	7452
3	Maharashtra	13645
4	Madhya Pradesh	38065
5	Gujarat	7975
6	Karnataka	32246
7	Telangana	22379
8	Rajasthan	74999
9	Haryana	261
	Total	212906
	Total (mha)	0.21

Accordingly, the target of 0.4 mha in the selected states can be taken under CAMPA to contribute in achieving the eco-restoration of riverine landscapes land degradation neutrality targets.

In addition to the riverine landscapes, degraded coastal areas up to a width of 10 km may also be considered for inclusion under the National Coastal Mission.

5. Watershed Development Component of Pradhan Mantri Krishi Sinchayee Yojana (erstwhile IWMP)

Government of India is committed to accord high priority to water conservation and its management. To this effect Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation ‘Har Khet ko Pani’ and improving water use efficiency ‘More Crop per Drop’ in a focused manner with end-to-end solution on source creation, distribution, management, field application and extension activities. The Cabinet Committee on Economic Affairs chaired by Hon’ble Prime Minister has accorded approval of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) in its meeting held on 1st July 2015.

The PMKSY encompasses 4 schemes viz. the Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR, RD&GR), Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC). PMKSY has been approved for implementation across the country with an outlay of Rs. 50,000 crore in five years. For 2015-16, an outlay of Rs. 5300 crore has been made which includes Rs. 1800 crore for DAC; Rs. 1500 crore for DoLR; Rs. 2000 crore for MoWR (Rs. 1000 crore for AIBP; Rs. 1000 crores for PMKSY).

As per the current scale of activities an estimated 191000 ha is being taken up under the component of the PMKSY, as may be seen in the table below -

Table 12 Achievements and Projections under Watershed Component of PMKSY

Categories	2018-19	2019-20
Plantation	71000	56000
Culturable wastelands	178000	77000
Total	249000	133000
Average in 1 year	191000	
Area to be covered in 8 years	1337000 or 1.52mha	

On the basis of the current trend, estimated target of **1.52 million hectares** can be achieved by 2030.

6. Externally Aided Projects

MoEF&CC is also exploring possibilities to collaborate and associate with the multi-lateral agencies to attract funding and knowledge of best practices at the national and international level for further replication as the demonstrable models in the country. Under this initiative, Ministry is intending to take a World Bank funded project in the states of Uttar Pradesh, Maharashtra, Rajasthan, Madhya Pradesh, Karnataka, Gujarat, Haryana & Odisha.

World Bank will support with technical assistance for capacity building of forest sector institutions including forest service (in line with civil services reforms), communication and extension strategies for people's and stakeholders' participation and creation of green jobs in India to diversify rural employment opportunities and additionally contribute to farmers' incomes. World Bank's engagement will also help in introducing the much-needed policy and institutional reforms in the forestry sector, uplifting the NTFP value chains to next level, establishing backward-forward market linkages and developing forest-based entrepreneurship approach for transforming the rural economy.

Under this proposed engagement, a multi-sectoral integrated landscape management approach will be adopted to address:

- Avoiding Land Degradation through Tree outside Forests: Enhancing tree cover outside forest areas to reduce pressure on the conventional forest resources by bringing existing forest fringe landscapes under better protection and management will significantly contribute to reducing GHG emissions.
- Forest Restoration: With about 30.4 million Ha of open forest (canopy cover between 10-40%) and about 4 million Ha scrub (canopy cover less than 10%), there is significant opportunity and potential for expanding carbon sinks through forest restoration and for creating additional forest carbon sinks.
- Mosaic Landscape Restoration: Availability of almost 33% land undergoing degradation and desertification and a significant opportunity to scale up agroforestry, integrating nature as a solution to improve ecosystem services and resilience across mosaic landscapes will yield multiple socio-economic benefits along with carbon sequestration.

The project is proposed with the financial implication of Rs. 6000 crores and to under land degradation neutrality interventions over the 0.6 million hectares in the selected states.



7. Carbon Neutrality Action State for the National Capital Region

The main focus of sustainable environment for any region should be clean air, clean water, calm atmosphere, clean rivers, proper sanitation involving comprehensive solid and liquid waste management, along with conservation of existing natural resources, adequate green cover and ample opportunities for residents to engage with and enjoy nature in its myriad colors and ultimately leading towards the carbon neutral environment.

The term National Capital Region (NCR) is a unique example of inter-state regional planning and development for a region with national capital Delhi as its core. The NCR region has been created under the NCRPB Act, 1985 of Government of India, based on authorization of the Parliament by all the four States/UTs. The region has emerged as the highest GDP contributor to the Indian economy in past few years and contributes substantially about 8% to the national GDP.

The NCR presently includes NCT-Delhi, and many districts from three adjoining states/ currently including 14 districts of Haryana, 8 districts of Uttar Pradesh, 2 districts of Rajasthan. According to Census 2011 the population of NCR was 5.81 crores. The NCR as notified covers the whole of NCT-Delhi and certain districts of Haryana, Uttar Pradesh and Rajasthan, covering an area of about 55,083 sq. kms.

The sub-region wise area details are given in the table below-



Figure 39 : National Capital Region

Table 13 Details of Forest Division in National Capital Region

Sub-Region	Name of the Forest Division in NCR Region
Haryana	Faridabad, Gurugram, Rohtak, Sonepat, Rewari, Jhajjhar, Panipat, Palwal, Bhiwani, Mahendragarh, Jind and Karnal
Uttar Pradesh	Meerut, Ghaziabad, Gautam Budh Nagar, Bulandshahr, Baghpat and Muzaffarnagar
Rajasthan	Alwar and Bharatpur
Delhi	Whole of NCT Delhi.

Recognizing the importance of plantation activities to reduce the harmful impacts of increasing population, pollution and climate change, the efforts and commitments are required at each level including people participation for improving canopy/green cover in Reserve/Protected forests/urban areas/roadsides, etc. through determined plantation activities and conservation programs.

Key Priorities:

- Increase in the green cover
- Water conservation measures
- Improving tree planting and forest management to integrate with watersheds and water resources management
- Selection of drought tolerant species for plantation
- Adaptation of ecosystem approach to evolve mitigative measures and adaptive responses
- Biodiversity enrichment of Ridge, Urban Woodlands, Parks and Gardens
- Creation of embankments and check dams in low lying areas
- Monitoring carbon stock and biodiversity at regular intervals, and
- Development of a Forestry Network of private partners/industry/ CSR funding can be developed for generating the suitable financing as a green funds for taking the suitable eco-restoration/biodiversity conservation activities in the NCR.

An estimated target of **0.15 million hectares** is proposed under the plan to be achieved by 2030.

8. State Plans

Apart from central budget, the states are also taking afforestation activities under their state plans which is overall contributing towards address the forest degradation, land degradation and contributing towards increase forest cover and enhancing the quality of existing forest cover. Under the state plan component, the selected states will be encouraged to take overall 1 mha to treat the degraded and vulnerable landscapes which will ultimately contribute towards achieving the national targets of LDN.

Overall Projected Allocations of Targets under the Revised Plan

Table 14 Overall scheme/initiative wise targets from 2022-2020 for achieving the land degradation targets in India

Scheme/Program	Target Area upto 2030 (in mha)	Basis of Allocation
Green India Mission	0.2	Revised Mission Document and EFC
CAMPA	1.50	Past performance in last ten years
GIM-CAMPA Under Special Projects	1.6	
Watershed Development Component (PMKSY), DoLR, MoRD	1.52	
River Rejuvenation	0.40	DPR Projections
Van Diwar in Aravalis	0.60	DPR Projections
EAP-World Bank Assisted	1.2	Proposal is under Preparation for Sustainable Land Ecosystem Management Practices in selected states
State Specific Program	1	BAU
Total Target	8.00	

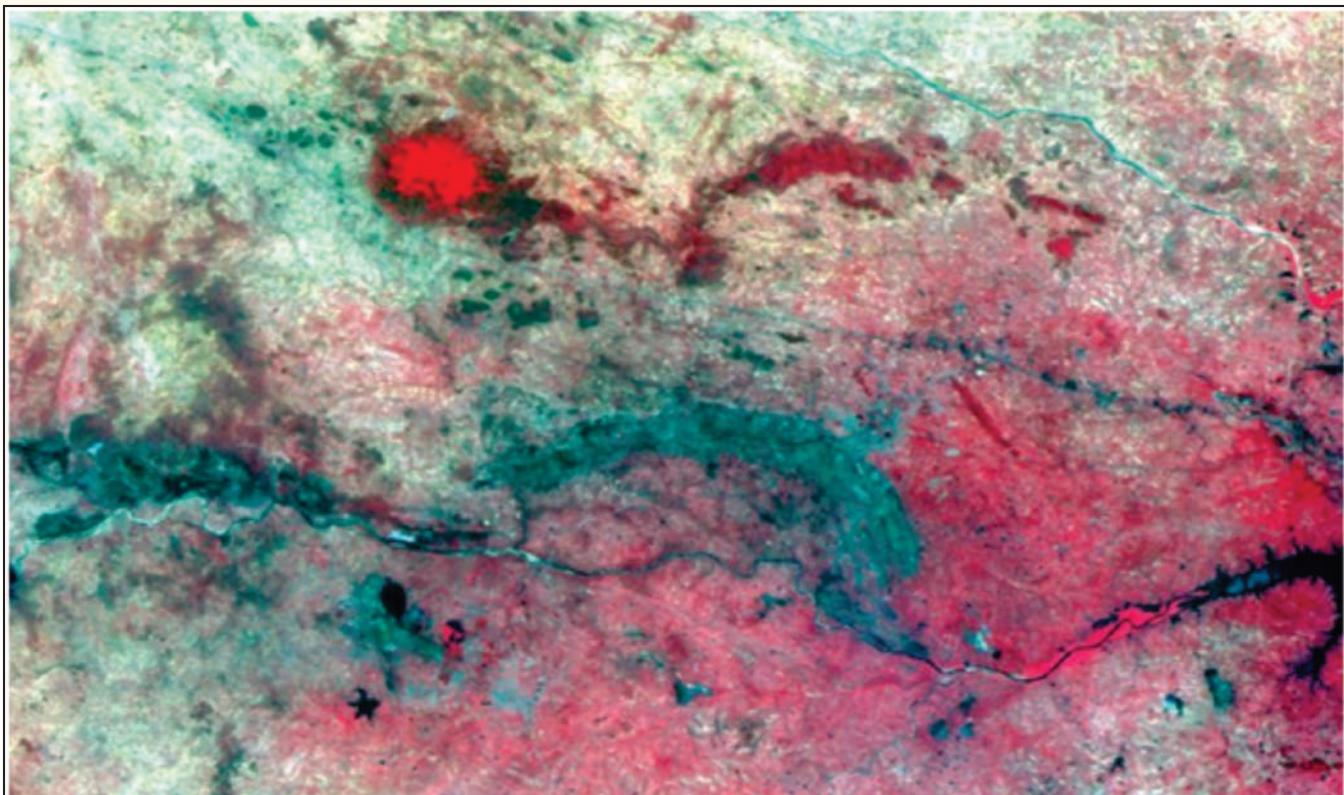


9.6 The Way Forward

The urgent restoration of degraded forests and landscapes in drylands is essential if the global community is to meet the challenges posed by desertification, food insecurity, climate change and biodiversity loss, among other negative trends. The many efforts that have already been made provide lessons that underpin this Action Plan. This plan is tailored to suit regional and local contexts but are intended to be replicable globally in scope. It presents the essential components for the design, implementation and sustainability of restoration initiatives that help build ecological and social resilience and generate benefits for local people. The plan will be promoted, disseminated and translated into other languages as required to make it available to local actors while encouraging their use and adaptation to local, national and regional contexts.

The Action plan reiterates that restoration needs to be considered across the entire market value chain, from seed to end-product. Regional collaboration in establishing a network of regional seed-supply centers is essential for developing value chains for native species suitable for building resilient forests and landscapes in drylands. A major effort is needed to strengthen local governance and develop local leaders and restoration champions, such as by strengthening community-based organizations, local administration, forest producer organizations and small and medium-sized enterprises. Financing opportunities emerging from the various funding instruments need to be further explored and used to advance restoration and the implementation of these guidelines.

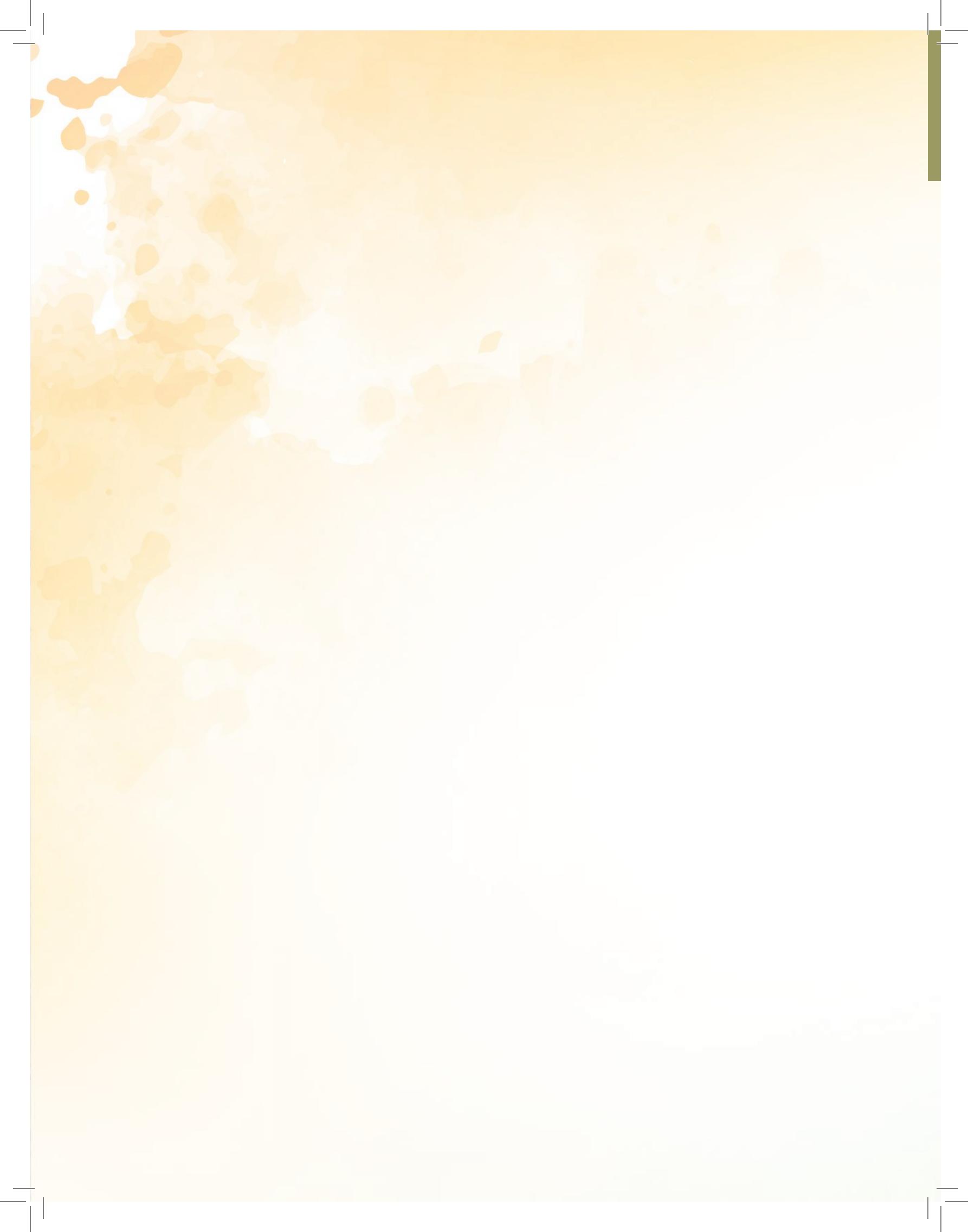
Desertification is a huge problem that needs to be addressed accordingly, and if we take the time to do it now, we can prevent other problems from happening with it in the future. By taking that critical look at desertification, we have the tools that we need in order to get through the processes effectively.



Open cast mining as visible in AWiFS image covering parts of Jharkhand with corresponding field photograph

Source Desertification and Land Degradation Atlas of India





Chapter 10

CONSULTATIVE PROCESS IN THE MAKING OF ACTION PLAN AND INVOLVEMENT OF STAKEHOLDERS

Stakeholders are people or organizations invested in the program, interested in the results of the program or a plan of action, and/or with a stake in what will be done with the results of the plan. Representing their needs and interests throughout the process is fundamental to an effective and efficient program implementation. Stakeholders provide a reality check on the appropriateness and feasibility of the interventions besides providing a detailed insight on and suggest methods to access the target populations, provide ongoing feedback and recommendations, and help make program deliverables actionable.

Numerous eco-restoration schemes catering to the comprehensive development and restoration of the degraded landscapes and those on the threshold of degradation given the continued ecological and anthropogenic pressures, are being implemented under the different initiatives of the Central Government and the respective State governments emphasizing on intensive afforestation and reforestation, soil and moisture conservation, adopting integrated approach for the holistic socio-economic and ecological recovery and restoration of the vulnerable landscapes. All these schemes running parallelly in the same landscape have separate implementation and monitoring mechanisms.

Recognizing the challenges and to enable efficient planning and implementation of the eco-restoration initiatives in the country and also to effectively meet the Land Degradation Neutrality Targets, the Ministry of Environment, Forests and Climate Change has formulated the Guidelines for Convergent Approach for Greening India, to converge all afforestation and eco-restoration schemes to provide the much-needed impetus and focus in addressing the sustainable management of forest and natural resources available in the specific landscape and an effective planning and a wider selection of vulnerable and potentially vulnerable sites capable of supporting progressive and sustainable eco-restoration interventions.

The Ministry of Environment, Forests and Climate Change has also constituted an Inter-Ministerial Working Group involving the different line Ministries to ensure cohesion and synergy and further to provide scientific and technical inputs and establishing necessary linkages for preparing and the effective implementation of the roadmap for achieving Land Degradation Neutrality (LDN) targets of India and combating desertification. Suitable institutional linkages/convergence mechanism are proposed to be developed to achieve the targets of LDN through multisectoral approach.

The preliminary draft of the Action Plan was prepared internally by the Desertification Cell along with the team of experts from the Directorate of Green India Mission and the National Afforestation and Ecodevelopment Board by updating the 2001 Action Plan and was presented to the members of the Inter-Ministerial Working Group for their inputs and suggestions. Comments and inputs were also invited from the identified knowledge partners including UNEP, UNDP, IUCN and ICFRE. Following the discussions, inputs were received from UNDP, IUCN and ICFRE, which were further shared with the ICFRE, who was given the responsibility to refine, enrich and refine the preliminary draft Action Plan.

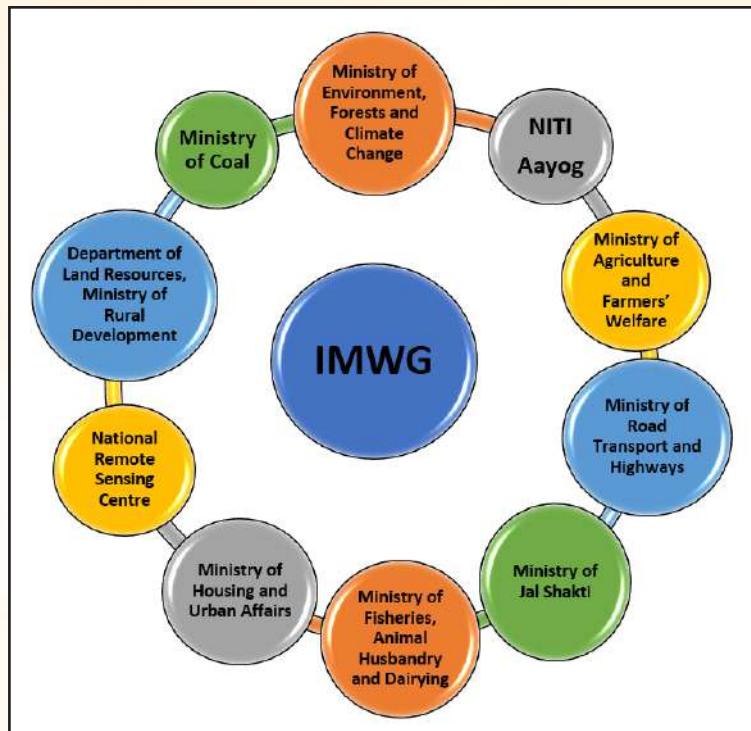


Figure 40 Competition of Inter Ministerial Working Group

The inputs received were consolidated in alignment with the need for syncing the different approaches and strategies with the Land Degradation Neutrality commitments along the following major lines-

- Simplicity and coherence to impart effective comprehensibility
- Ease of implementation to improve implementation efficiency
- Flexibility and Open-ended approach to accommodate and include the highly vulnerable and otherwise neglected landscapes and micro-ecosystems
- Effective Convergence of all the Central and State specific eco-restoration schemes
- Skill Enhancement and Capacity building of the forest dependent communities for augmentation of livelihoods, and
- Inclusive Development along with proactive multi-stakeholder involvement including emphasized role of private players and agencies and corporates etc.

Recognizing the due importance of the stakeholders, the Plan seeks to establish proactive multi-stakeholder engagement in the planning and the implementation process including the Forest Department, line departments of the State Govt., Gram Panchayat/Gram Sabha/ Municipalities, civil society, community groups, academia (Research Organizations and Universities). The officers of various line departments will also be involved as members in the States, which shall have the onus in the preparation of the State/landscape specific plans and their implementation.

The Action Plan thus envisages to foster the spirit and establish workable models of convergence through establishment of multi-stakeholder fora for each of its interventions. Emphasis would be on effective knowledge and expertise sharing to achieve the foremost objective under the Plan.

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ABBREVIATIONS

ADG	Additional Director General of Forests
AMFU	Agro-Met Field Units
ANR	Assisted Natural Regeneration
APO	Annual Plan of Operations
CADWM	Command Area Development and Water Management
CAF	Compensatory Afforestation Fund
CAMPA	Compensatory Afforestation Management Planning Authority
CBD	Convention on Biological Diversity
CWC	Central Water Commission
CoE-SLM	Centre for Excellence- Sustainable Land Management
COP	Conference of Parties
CRIDA	Central Research Institute for Dryland Agriculture
DLDD	Desertification and Land Degradation
DoS	Department of Space
FLR	Forest Landscape Restoration
FSI	Forest Survey of India
FTC	Forest and Tree Cover
GDP	Gross Domestic Product
GIM	Green India Mission
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IGF	Inspector General of Forests
IMD	Indian Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
ISFR	India State of the Forest Report
ISRO	Indian Space Research Organization
IUCN	International Union for Conservation of Nature
IWMP	Integrated Watershed Management Programme
JFMC	Joint Forest Management Committees
LDN	Land Degradation Neutrality
MEA	Ministry of External Affairs
MNCFC	Mahanobis National Crop Forecast Centre
MNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoJS	Ministry of Jal Shakti
MoWR	Ministry of Water Resources
MPTs	Multi-Purpose Tree Species
NADAMS	National Agricultural Drought Assessment and Monitoring System

NAEB	National Afforestation and Ecodevelopment Board
NAP	National Action Plan
NAPCC	National Action Plan on Climate Change
NBM	National Bamboo Mission
NCR	National Capital Region
NCT	National Capital Territory
NFP	National Forest Policy
NMSA	National Mission for Sustainable Agriculture
NRLM	National Rural Livelihoods Misison
NRSC	National Remote Sensing Centre
NTFP	Non-Timber Forest Produce
OECM	Other Effective Conservation measures
PIA	ProjecT Implementation Agency
PMKSY	Prime Minister krishi Sinchayee Yojana
QPM	Quality Planting Material
SAC	Space Applications CEntre
SAUs	State Agricultural Universities
SDG	Sustainable Development Goals
SLM	Sustainable Land Management
SPI	Standardized Precipitation Index
TERI	The Energy and Resources Institute
TGA	Total Geographic Area
ToF	Tree Outside Forests
UN	United Nations
UNCCD	United Nations Conventions to Combat Desertification
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UT	Union Territory
WHO	World Health Organization
WUA	Water User Agency



Ministry of Environment Forest and Climate Change
Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi-110 003