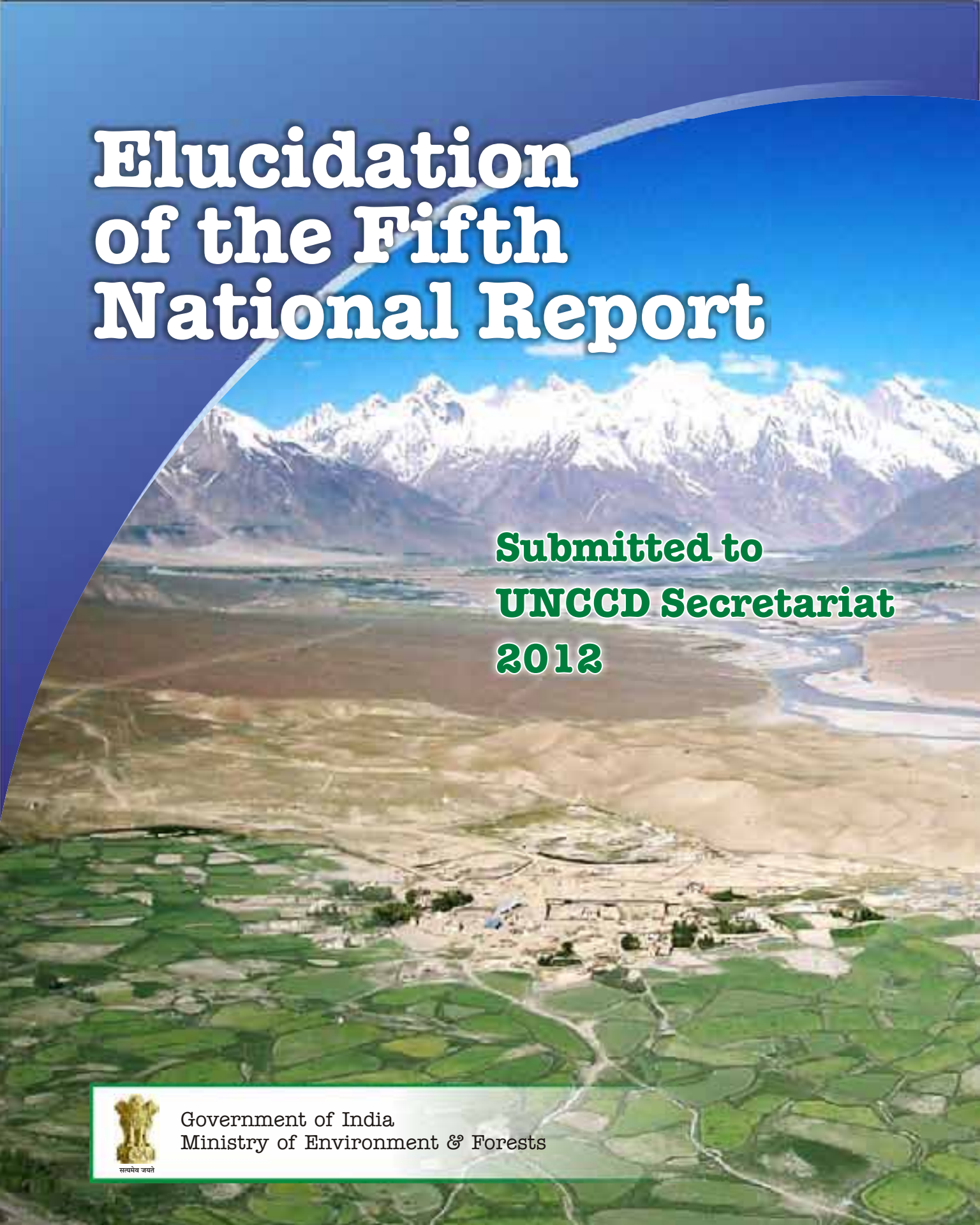
Elucidation of the Fifth National Report



Submitted to UNCCD Secretariat 2012

सत्यमेव जयते

Government of India
Ministry of Environment & Forests

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सत्यमेव जयते

मंत्री
पेट्रोलियम एंव प्राकृतिक गैस
एंव पर्यावरण और वन मंत्रालय
भारत सरकार
MINISTER
PETROLEUM & NATURAL GAS
AND ENVIRONMENT AND FORESTS
GOVERNMENT OF INDIA

MESSAGE

It gives me immense pleasure to introduce India's Fifth National Report submitted to United Nations Convention to Combat Desertification (UNCCD). This report provides a holistic overview capturing India's policies and programmes related to desertification, land degradation and drought in a comprehensive manner.

Desertification, Land Degradation and Drought (DLDD) have severe implications for the livelihood and food security of the country, and, in particular, for the large section of rural poor who are directly dependent on the land resource base for their subsistence. Therefore, with 69% of India's total geographical area under dry lands, there needs to be adequate levels of preparedness, both at the national as well as local level, to effectively tackle the scale of challenge. In order to address the DLDD issues, a number of projects and programmes pertaining to sustainable land and ecosystem management are being implemented in the country.

India has submitted its 5th National Report to the UNCCD Secretariat through Performance Review and Assessment of Implementation System (PRAIS) portal of UNCCD website in October 2012, which covers the information on mandatory impact indicators and performance indicators specified under ten years strategic plan and framework for the implementation of Convention. This elucidation report presents the contents of the 5th National Report in a more simplified and holistic manner.

This document covers the initiatives and contributions of Government of India, Science and Technology Institutions and Civil Society Organisations in addressing the issues of desertification, land degradation and drought. I am confident that this report will enable us to understand the key issues as also the measures undertaken to address these problems; and will be useful for policy makers, planners, academicians, civil society groups and relevant stakeholders involved in such endeavours. Lastly, I would like to congratulate the Indian Council of Forestry Research and Education, Dehradun and the Desertification Cell of Ministry of Environment and Forests for bringing out this elucidation report.

(Dr. M. Veerappa Moily)

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The contributions made in preparation of the Fifth National Report by the Nodal Officers from Planning Commission, Ministry of Agriculture, Ministry of Rural Development, Ministry of Space, Ministry of Information and Broadcasting, Ministry of Non-Renewable Energy, Department of Rural Development, Department of Land Resources, Department of Agriculture & Cooperation, National Afforestation and Eco-Development Board, National Remote Sensing Centre, Space Applications Centre, Forest Survey of India, Madhya Pradesh Forest Department, Himachal Pradesh Forest Department, Indian Council of Agricultural Research, Arid Forest Research Institute, Central Arid Zone Research Institute, Institute of Forest Productivity, National Bureau of Soil Survey and Land Use Planning, Watershed Management Directorate Uttarakhand, Bharathi Integrated Rural Development Society, CMS Environment, Gram Bharati Samiti, Gramin Vikas Trust, insPIRE Network for Environment, Yerala Projects Society, The Energy Resource Institute, Watershed Trust Organisation and all SLEM project partners are highly appreciated and gratefully acknowledged.

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National Report Preparation Team

ABBREVIATIONS

AFRI	Arid Forest Research Institute
AMSR-EOS	Advanced Microwave Scanning Radiometer - Earth Observing System
ASTRP	Association of Scheduled Tribes and Rural Poor
AVHRR	Advanced Very High Resolution Radiometer
AWiFS	Advanced Wide Field Sensor
BIRDS	Bharathi Integrated Rural Development Society
CAZRI	Central Arid Zone Research Institute
CBD	Convention on Biological Diversity
CBOs	Community Based Organisations
CC	Climate Change
CONS	Consdidated Indicators
COP	Conference of Parties
CPP	Country Partnership Programme
CSOs	Civil Society Organizations
DAC	District Advisory Committee
DES	Directorate of Economics and Statistics
DFO	Divisional Forest Officer
DLDD	Desertification, Land Degradation and Drought
DPAP	Drought Prone Areas Programme
DPSIR	Driver-Pressure- State-Impact-Response
DOS	Department of Space
DSM	Desertification Status Monitoring
DWDT	District Watershed Development Team
EC	Electrical Conductivity
EDCs	Eco Development Committees
EQC	External Quality Control
FAO	Food and Agriculture Organization
FDA	Forest Development Agency
FSI	Forest Survey of India
FRI	Forest Research Institute
FYM	Farm Yard Manure
GEF	Global Environmental Facility
GEO	Global Environment Objective
GFD	Geophysical Fluid Dynamics
GIM	Green India Mission
GIS	Geographic Information System
GoI	Government of India
HFRI	Himalayan Forest Research Institute
IAEPS	Integrated Aforestation and Eco-Development Projects Scheme
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IFP	Institute of Forest productivity

IGNP	Indira Gandhi Nahar Pariyojna
IMD	India Meteorological Department
IQC	Internal Quality Control
ISRO	Indian Space Research Organisation
ITC	Indian Tobacco Company
IWDP	Integrated Wasteland Development Programme
IWMP	Integrated Watershed Management Programme
JBIC	Japan Bank for International Corporation
JFMC	Joint Forest Management Committee
JICA	Japan International Cooperation Agency
LADA	Land Degradation Assessment in Dryland Areas
LISS	Linear Imaging Self Scanning
LULC	Land Use, Land Use Change
M&E	Monitoring and Evaluation
MA	Millennium Assessment
MMA	Macro Management of Agriculture
MNCFC	Mahalanobis National Crop Forecast Centre
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MODIS	Moderate Resolution Imaging Spectroradiomete
MoEF	Ministry of Environment and Forests
MPCE	Monthly Per Capita Consumption Expenditure
MREGS	Maharashtra Rural Employment Guarantee Scheme
MWS	Micro Watershed Management
NABARD	National Bank for Agriculture and Rural Development
NADAMS	National Agricultural Drought Assessment and Monitoring System
NAEB	National Afforestation and Eco-development Board
NAIP	National Agricultural Innovation Project
NAP	National Afforestation Programme
NAP-CD	National Action Programme to Combat Desertification
NARS	National Agricultural Research System
NCSA	National Capacity Needs Self-Assessment
NGOs	Non Governmental Organisations
NNRMS	National Natural Resources Management System
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Productivity
NRC	Natural Resources Census
NRSC	National Remote Sensing Centre
NSSO	National Sample Survey Office
NTFPs	Non Timber Forest Products
NWDF	National Watershed Development Fund
NWDPRA	National Watershed Development Project for Rainfed Areas
OBC	Other Backward Classes
OCM	Ocean Circulation Models
PCM	Participatory Climate Monitoring
PDCs	Panchayat Development Committees

PDO	Project Development Objective
PET	Potential Evapo-transpiration
PNP	Participatory Net Plan
PPCP	Public-Private-Civil Society Partnership
PPS	Programme and Project Sheets
PRAIS	Performance Review Assessment Information System
QC	Quality Control
R&D	Research and Development
REDD	Reducing Emissions from Deforestation and Degrdation
RGMWM	Rajiv Gandhi Mission for Watershed Management
RRS	Rapid Reconnaissance Survey
RVP	River Valley Projects
RWH	Rainwater Harvesting
SASI	Shortwave Angle Slope Index
SBFP	Sikkim Biodiversity Conservation and Forest Management Project
SC	Scheduled Caste
SDC	Swiss Agency for Development and Cooperation
SFA	Standard Financial Annexe
SHG	Self Help Group
SLEM CPP	Sustainable Land and Ecosystem Management Country Partnership Program
SLM	Sustainable Land Management
SLNA	State Level Nodal Agency
SLUSI	Soil & Land Use Survey of India
SMS	Sediment Monitoring Station
SMS	Sanyukta Mahila Samiti
SOM	Soil Organic Matter
SPACC	Strategic Pilot on Adaptation to Climate Change
SPR	Sediment Production Rate
STIs	Science and Technology Institutions
SWC	Soil & Water Conservation
SYI	Silt Yield Index
TFO	Technical Facilitation Organisation
TGA	Total Geographical Area
TPN	Thematic Programme Network
UDWDP	Uttarakhand Decentralised Watershed Development Project
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNU-INWEH	United Nations University - Institute for Water, Environment and Health
VDC	Village Development Committees
VSS	Van Sanrakshana Samiti
WADI	Wasteland Agriculture Development Initiative
WOTR	Watershed Trust Organisation
WPRs	Watershed Project Reports



Contents



Executive Summary

The United Nations Convention to Combat Desertification (UNCCD) is one of the Rio Conventions that focuses on Desertification, Land Degradation and Drought (DLDD). During the 1992 Rio Earth Summit, desertification, along with climate change and the loss of biodiversity were identified as the greatest challenges to sustainable development. UNCCD defines desertification as land degradation in the drylands (arid, semi-arid and dry sub-humid regions) resulting from various factors. UNCCD, with 195 Parties, is a unique instrument that recognizes land degradation as an important factor affecting some of the most vulnerable people and ecosystems in the world.

India became a signatory to the UNCCD on 14 October 1994 and ratified it on 17 December 1996. The area under dry lands in India is about 228.3 Mha, which is 69.6 per cent of the total geographical area, and comprises of arid lands (50.8 Mha), semi-arid lands (123.4 Mha) and dry sub-humid areas (54.1 Mha). About 32 per cent of the land is undergoing various forms of degradation and 25 per cent of the geographical area is affected by desertification. Degradation of these lands has severe implications for the livelihood and food security of millions. India has got high stakes on this front and stands strongly committed to implementing the goals of UNCCD. The Ministry of Environment and Forests (MoEF) is the nodal Ministry to co-ordinate all issues pertaining to the Convention. India actively participated in the Convention on desertification and is currently the Chair of the Regional Implementation Annexe for the Asia-Pacific region. MoEF, GoI has designated Indian Council of Forestry Research and Education (ICFRE), Dehradun as the facilitating organisation for preparation of the Fifth National Report to the UNCCD Secretariat.

The process of preparation of the report included data collection and synthesis of important programmes undertaken by the various Ministries and Departments of Government of India, Science and Technology Institutions and Non-Governmental Organisations. National consultations with these were held on 20 April 2012 at MoEF, New Delhi for preparation of the Fifth National Report. Subsequently various consultative meetings were organized, inviting inputs from relevant stakeholder groups for the preparation of the Fifth National Report. A review meeting was held at MoEF, New Delhi on 06 September 2012. The validation meeting was organized on 4 October 2012 and the National Report was finalized for submission. The Fifth National Report was submitted to UNCCD secretariat online through Performance Review and Assessment of Implementation System (PRAIS) portal in October 2012. It was limited in scope as it did not reflect India's initiatives related to desertification, land degradation and drought issues in a holistic form. Therefore, this report is the elucidation' of the 'Fifth National Report submitted to the UNCCD Secretariat' and contains detailed information that could not be incorporated in the on-line report. The chapters in this report are organized according to the reporting format, reflecting background to these initiatives and a summary highlighting the country's commitment to addressing the issues of desertification, land degradation and drought. The Fifth National Report submitted online to

UNCCD Secretariat through PRAIS portal of the Convention can be accessed at http://www.unccd-prais.com/Data/Reports.

Although currently there is no specific policy or legislative framework for combating desertification, India's overarching policy framework is sensitive to the concerns on DLDD challenges and has provisions for arresting and reversing land degradation as well as desertification. Also, India is implementing a number of programmes and schemes pertaining to sustainable land and ecosystem management which include some of the flagship programmes of the Government of India such as the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA), Green India Mission (GIM) and Integrated Watershed Management Programme (IWMP).

It is well recognized that the challenge of Desertification, Land Degradation and Drought (DLDD), left unabated, can have adverse consequences for key aspects of human development and ecological security. The consequences of DLDD will be far reaching and require concerted efforts by all countries. India is very actively engaged in the international processes. As a party to the UNCCD, India formulated and submitted its National Action Programme to Combat Desertification (NAP-CD) to UNCCD in 2001. India also carried out National Capacity Need-Self-Assessment (NCSA) for meeting UNCCD obligations in 2007. Till date, India has submitted five National Reports to the UNCCD Secretariat. In addition, to promote sustainable land management practices, seven projects have been formulated and are under various stages of implementation, as part of joint initiative by the Government of India (GoI) and the Global Environment Facility (GEF), under the GEF Country Partnership Programme (CPP) and GEF-4 funding cycle.

The report elaborates upon India's progress on the strategic objectives and operational objectives of 'The Strategy'. For the strategic objectives, a sub-set of two impact indicators (*i.e.*, Proportion of the population in affected areas living below the poverty line; and Land over status) were identified as the mandatory indicators required for reporting by affected country Parties in 5th National reporting 2012. On these, the report highlights that the major cause of poverty among India's rural people, both individuals and communities, is lack of access to productive assets and financial resources. On the positive side, there has been a decrease in area under degraded lands in the country.

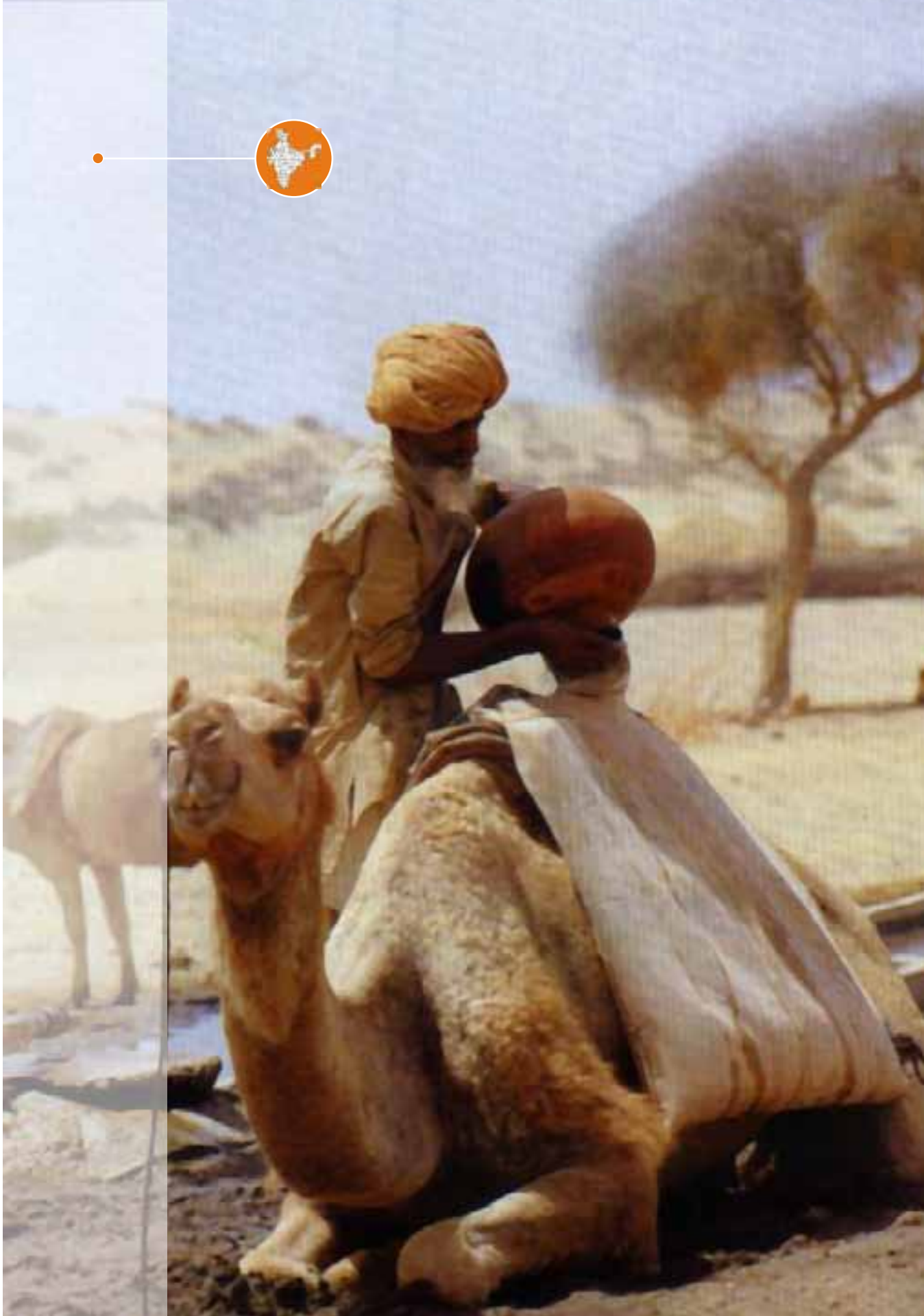
On the five operational objectives: Advocacy, awareness raising and education; Policy framework; Science, technology and knowledge; Capacity-building and Financing and technology transfer, we find that there is an increase in the number of advocacy, awareness raising and education events as well as number of DLDD-related initiatives undertaken by Civil Society Organizations (CSOs) and Science and Technology Institutes (STI). On the policy framework, it can be inferred that despite the on-going efforts in the country for combating desertification which include constitutional, policy and legal measures on the relevant areas for combating desertification; the problem of land degradation continues to be a major environmental concern in India with consequent implications for its sustainable development.

There is an urgent need for strengthening monitoring mechanism of the impacts of all these programmes and schemes in terms of improving the livelihood status and socio-economic conditions of the people as well as improvement of the ecosystem in the affected/vulnerable areas and regions. Further, there is a need to establish synergistic processes for joint implementation of the Rio Conventions at national level supported by the institutions of the Rio Conventions and with adequate capacity and financial provisions. While reporting on Science, technology and knowledge, the report highlights the absence of an independently established and supported monitoring system for DLDD at national level. However, assessment of DLDD-related capacity building activities reveals a positive trend. The country has also been able to raise adequate funds for addressing the issues of DLDD and the funds raised for ongoing projects were to the tune of ₹7370 million during the year 2010-11. It is also worth highlighting that the financing used for the implementation of DLDD-related programmes and projects are 70 per cent from national sources and only 30 per cent from international sources.

Further, this report highlights 47 programmes and projects with their key objectives and achievements. In addition, this report also highlights 15 best practices which are measures, methods or activities that are considered successful in terms of achieving desired outcomes (good performance) and contributing to expected impacts formulated in the 10-year strategic plan and framework to enhance the implementation of the Convention.

Desertification, Land Degradation and Drought in Context of India





1 Desertification, Land Degradation and Drought in Context of India

India is the seventh largest country in the world having total geographic area of 328.73 Mha, which occupies only 2.4 per cent of the world's geographical area but supports over 16.7 per cent of the world's population. It has 0.5 per cent of the world's grazing area but has over 18 per cent of world's cattle population. Land is the most important natural resource for the country, which embodies soil, water, associated flora and fauna involving the total ecosystem and on which all the activities of human beings are based. An ever increasing human and cattle population have enormous demands on land resources. These pressures have led to drastic changes in the proportion of land utilised for agricultural activities, urbanisation and industrial development. 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, natural calamities like drought, floods and earthquakes are major factors responsible for land degradation. Land degradation reduces the productivity of land, and, particularly in drylands, can leave the soil exposed and vulnerable to climatic hazards such as drought.

Desertification refers to land degradation in arid, semi-arid, and dry sub-humid areas, resulting from various factors including climatic variations and human activities. It is one of the most serious problems facing the world today. It is different from the phenomenon of land degradation in other humid areas of the world, because it proceeds under very harsh climatic conditions, and acts adversely on available natural resources. Naturally, there are extents and degrees of desertification but if the process is not arrested, it is merely a question of time before the land inevitably becomes degraded and is abandoned.

Article 1 of the United Nations Convention to Combat Desertification (UNCCD) defines land degradation as a "reduction or loss in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation". Desertification is a subset of land degradation under dry climates (arid, semi-arid and dry sub-humid areas). The latest estimates

indicate that 12 Mha of land is transformed into new man-made deserts every year (UNCCD, 2011) and that one quarter of the world's agricultural land is highly degraded some irreversibly (FAO, 2011).

Desertification, Land Degradation and Drought (DLDD), whether driven by human actions, biophysical factors or a combination thereof, result in loss of or damage to natural capital and social welfare. Land degradation reduces the value of soil, water, plant and animal resources to society, including the contributions of ecosystem function and processes to primary production and related industries. DLDD is considerably limiting land productivity and its ability to provide ecosystem services at local, national and regional scales. About 50.8 Mha land area of India (15.8% of the country's total geographical area) is arid, 123.4 Mha (37.6% of TGA) is semi-arid and 54.1 Mha (16.5% of TGA) area falls in the dry sub-humid region. All put together, about 228 Mha area, *i.e.,* 69% of the total geographic area of the country is dry land (arid, semi-arid and dry sub-humid) and degradation of these lands has severe implications for the livelihood and food security of a large number of the population. The major process of land degradation is soil erosion (due to water and wind erosion), which contributes to over 71% of the land degradation in the country. Soil erosion due to water alone contributes to about 61.7% and that by wind erosion, 10.24%. The other processes include problems of water logging, salinity-alkalinity. Recently, National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Nagpur has published that 146.82 Mha area is reported to be suffering from various kinds of land degradation. It includes water eroded 93.68 Mha, wind eroded 9.48 Mha, water logged/flooded 14.30 Mha, saline/alkaline 5.94 Mha, affected by soil acidity 16.04 Mha and by a combination of complex problems 7.38 Mha (ICAR, 2010). The State-wise details of extent of various kinds of land degradation are given in the Table 1.

Table 1: State-wise area affected by various kind of land degradation in India

S. No.	State	Area affected by various kind of land degradation (Lakh ha)							Geographical Area (Lakh ha)
		Water and Wind erosion*	Water logged	Alkali/ Sodic Soil	Acid Soil	Saline Soil	Mining/ Industrial	Total Degrade	
1.	Andhra Pradesh	88.64	0.36	1.94	0.01	0.60	0.39	91.94	275.05
2.	Arunachal Pradesh	3.80	0.05	0.00	17.69	0.00	0.00	21.54	83.74
3.	Assam	23.66	2.10	0.00	19.95	0.00	0.00	45.71	78.44
4.	Bihar	10.49	1.33	1.06	0.41	0.40	0.02	13.71	94.16
5.	Chhattisgarh	24.22	0.00	0.13	23.42	0.00	0.07	47.84	134.81
6.	Goa	0.01	0.06	0.00	1.03	0.00	0.12	1.22	3.70
7.	Gujarat	10.12	0.01	5.45	0.00	15.59	0.12	31.29	196.03
8.	Haryana	3.03	0.04	1.84	0.02	0.46	0.12	5.51	44.21
9.	Himachal Pradesh	9.84	0.04	0.00	0.76	0.00	0.01	10.65	55.67
10.	Jammu & Kashmir	20.01	0.14	0.00	0.78	0.00	0.01	20.94	222.24
11.	Jharkhand	31.81	0.06	0.00	7.35	0.00	0.21	39.43	79.72
12.	Karnataka	77.99	0.03	1.45	0.93	0.02	0.51	80.93	191.79

13.	Kerala	1.17	0.44	0.00	24.26	0.21	0.01	26.09	38.86
14.	Madhya Pradesh	134.64	0.01	1.24	4.82	0.00	0.24	140.95	308.64
15.	Maharashtra	88.22	0.27	4.21	2.69	1.71	0.16	97.26	307.71
16.	Manipur	1.50	0.21	0.00	15.97	0.00	0.00	17.68	22.33
17.	Meghalaya	7.06	0.03	0.00	10.23	0.00	0.00	17.32	22.43
18.	Mizoram	0.00	0.00	0.00	11.63	0.00	0.00	11.63	21.08
19.	Nagaland	0.31	0.03	0.00	15.16	0.00	0.00	15.50	16.58
20.	Odisha	33.28	0.52	0.00	2.03	1.31	0.08	37.22	155.71
21.	Punjab	3.02	0.34	1.52	0.00	0.00	0.06	4.94	50.36
22.	Rajasthan	201.91	0.00	1.52	0.00	0.82	0.00	204.25	342.24
23.	Sikkim	0.02	0.00	0.00	0.58	0.00	0.00	0.60	7.10
24.	Tamil Nadu	21.34	0.39	3.52	4.27	0.11	0.34	29.97	130.06
25.	Tripura	0.74	0.25	0.00	7.09	0.00	0.00	8.08	10.49
26.	Uttarakhand	10.09	0.25	0.00	4.00	0.00	0.01	14.35	55.84
27.	Uttar Pradesh	128.84	1.76	13.20	0.00	0.22	0.03	144.05	238.57
28.	West Bengal	12.64	0.43	0.00	4.18	4.08	0.07	21.40	88.75
29.	A & N Islands	0.00	0.00	0.00	0.00	0.71	0.00	0.71	8.25
30.	Delhi	0.28	0.00	0.00	0.00	0.00	0.00	0.28	1.48
31.	Chandigarh	0.00	0.00	0.00	0.00		0.00		0.11
32.	D & N Haveli	0.00	0.00	0.00	0.00		0.00		0.49
33.	Daman & Diu	0.00	0.00	0.00	0.00	1.05	0.00	1.05	0.11
24.	Lakshadweep	0.00	0.00	0.00	0.00		0.00		0.03
35.	Pondicherry	0.00	0.00	0.00	0.00		0.00		0.48
Total (Lakh ha)		**948.68**	**9.15**	**37.08**	**179.26**	**27.29**	**2.58**	**1204.04**	**3287.26**
Total (Mha)		**94.87**	**0.91**	**3.70**	**17.93**	**2.73**	**0.26**	**120.40**	**328.73**

**Includes area affected by wind erosion of 115.60 lakh ha (Gujarat-0.01 lakh ha., Rajasthan-115.59 lakh ha).*
Source: Degraded and Wastelands of India-Status and Spatial Distribution published by ICAR (2010).

Land in India suffers from varying degrees and types of degradation stemming mainly from unstable use and inappropriate management practices. Loss of vegetation occurs due to deforestation, cutting beyond the silviculturally permissible limits, unsustainable fuelwood and fodder extraction, shifting cultivation, encroachment into forest lands, forest fires and over-grazing, all of which subject the land to degradational forces. Other important factors responsible for large-scale degradation are the extension of cultivation to lands of low potential or high natural hazards, non-adoption of adequate soil conservation measures, improper crop rotation, indiscriminate use of agro-chemicals such as fertilisers and pesticides, improper

Shifting sand dunes from Thar Desert of western Rajasthan towards eastern side have been a great menace of degradation to good agricultural land by sand deposition. Making of Cheker boards by the locally available shrubs/grasses and plantation of *Acacia tortilis* has checked the movement of sand dunes. About an area of 4 Mha have been forested.

planning and management of irrigation systems and extraction of ground water in excess of the recharge capacity. In addition, there are a few underlying or indirect pressures such as land shortage, short-term or insecure land tenancy, open access resource, low economic status and poverty of the agriculture dependent people, which are also instrumental to a significant extent, in the degradation of the land.

Dry lands cover about 41% of earth's surface and are home to more than 2 billion people. Such lands cover an area of nearly 250 Mha in India. The term 'dryland' refers to hyper-arid, arid, semi-arid and dry sub-humid ecosystems based on the aridity index, the ratio P/PET (where P is the area's mean annual precipitation and PET is the mean potential evapo-transpiration). Drylands are characterized by low and sporadic rainfall with extreme variability, high temperatures showing diurnal variability and recurrent droughts. Thus, special adaptations are required from all species under dryland environment. In India, drylands are represented by hot arid (North-Western India) and cold arid zones (Jammu & Kashmir, Himachal Pradesh).

India requires to achieve a growth rate of 3-4 % per annum in agriculture against less than 2 per cent at present to meet ever growing needs of food, fodder and fibre. At the current nutritional level, about 100 MT of additional food grains are needed by year 2020 to achieve food security. Cropping intensity of 139% registered an increase of 25% since independence, mostly on irrigated land. The total contribution of irrigated agriculture to food grain production from both area expansion and yield improvement put together is likely be around 64 million tons by 2020 leaving a shortfall of 36 million tons. Therefore, the expanded food needs of the future can only be met through intensive agriculture and added productivity from dry lands, spread over 177 districts in 13 states, constituting 68% of net sown area of country. Intensive agriculture and excessive pressure on fragile non resilient dry land ecosystems may cause over exploitation of land and water resources and further aggravate land degradation until land and water conservation issues are not appropriately addressed concurrently.

The aftermath of the 'Green Revolution' led to more than doubling of global grain production in the past 40 years, mitigating hunger for food but at a high environmental cost. During the next 50 years, which is likely to be the final period of rapid agricultural expansion, demand for food by a wealthier and 50% larger global population will be the major driver of land degradation and weakening environmental services. It is estimated that 1,000 Mha of natural ecosystems would be converted to agriculture by 2050 having unbelievable global environmental impact, leading to eutrophication of territorial, freshwater, and near shore marine ecosystem, habitat destruction, loss of biodiversity and decline of ecosystem services.

The major threat to dryland biodiversity appears to be the degradation of ecosystems and habitats caused by strong emerging forces of environmental degradation such as expanding urbanization, growing human settlements, monocultures, industrialization, mining, large scale irrigation of agricultural land, climate change, and poverty-induced over-exploitation of natural resources.

Drylands support highly resilient species adapted to the seasonal pattern of rainfall and recurrent droughts that prevail in these ecosystems. Dryland biodiversity has distinguishable features that are often overlooked. These include heterogeneity, remarkable diversity of micro-organisms, presence of wild relatives of globally important domesticated species, and traditionally adapted land use systems.

One quarter (81.45 Mha) of Total Geographical Area (TGA) is desertified, while 105.48 Mha (32% of TGA) is degraded. Water erosion was the dominant process of desertification accounting for 65 Mha, followed by vegetal degradation covering wind erosion in hot desert and frost shattering in cold deserts.

1.1 Desertification

Natural and anthropogenic factors are the driving forces of desertification. Causes of desertification can be divided into two categories: direct and indirect. Direct causes include climate, and human activities like overgrazing, over-exploitation, deforestation and inappropriate use of irrigation technology. Indirect causes of desertification include population pressure, urbanization, poverty, and inequitable sharing of resources. Desertification affects about one-sixth of the world's population, about 70 % of all dry lands (3.6 billion ha) and one quarter of the total land area of the world. Desertification causes not only deterioration of the environment and productivity of the fragile ecosystems, but also increases poverty among people living in the regions. It is estimated that the annual direct financial losses due to desertification amount to more than US$ 42 billion.

Fig. 1: Land conservation through plantation of *Salix* spp. in cold deserts

Drylands in India comprise a large belt running from the border in the North-West through Peninsular India to the southern tip of the country. The hot arid regions in India occupy major parts of Rajasthan, Gujarat, southern Punjab and Haryana and a small portion of Deccan Peninsula in the States of Andhra Pradesh, Karnataka and Maharashtra. Roughly, three-fourths of the State of Rajasthan, comprising 12 western districts, falls within the hot arid zone. The Great Indian Desert, also known as the 'Thar' Desert, lies in Western Rajasthan and comprises an area of 196,150 sq km. In addition, areas of about 15.2 Mha of cold deserts are located in Jammu and Kashmir and the Lahul-Spiti and Pooh sub-division of District Kinnaur region in Himachal Pradesh (MoEF, 2001). The hot arid region suffers low and erratic rainfall, frequent droughts, high evaporation, intense heat and high winds. The soils are not conducive to intensive cropping. The density of both human and livestock population is high as compared to the national average. A part of this population is nomadic following a pastoral system of living. This has put the scarce natural resources under severe stress. The agricultural season here is very short, hence livestock farming forms an integral part of livelihoods. Poverty and environmental degradation are major problems in dry lands, where forests and trees contribute significantly to rural livelihoods. In order to eradicate poverty in the dry lands, it is important to protect the land from deforestation, fragmentation, degradation and drought.

The Thar Desert of Rajasthan is characterized by erratic, less than 400 mm annual rainfall, high temperature and strong winds with 1800 to 2200 mm annual evapo-transpiration leading to permanent negative water balance. Hence there is acute shortage of fodder, fuel, food and timber due to inhospitable conditions. The adapted endemic plant species of Thar Desert include *Leptadenia pyrotechnica, Calligonum polygonoides* (Polygonaceae), *Prosopis cineraria* (Mimosaceae), *Tecomella undulata* (Bignoniaceae), and *Suaeda fruticosa* (Chenopodiaceae). Khan *et al.* (2003) identified 682 plant species including 107 grasses in the Indian hot desert. Of these, 45 plant species are considered to be rare and/or endangered. The most common plant species in hot deserts are *Prosopis cineraria, P. juliflora, Tecomella undulata, Acacia tortilis, Calligonum polygonoides, Ziziphus mauritiana,* Z. *nummularia, Leptadenia pyrotechnica, Aerva pseudotomentosa, Crotalaria burhia, Calotropis procera, Balanites aegyptiaca, Maytenus emarginata,* etc (Singh, 2005). Common grasses of the hot deserts are *Eragrostis* sp., *Aristida adscensionis, Cenchrus biflorus, Cymbopogon* sp., *Cyperus* sp., *Eleusine* sp., *Panicum* sp., *Lasiurus sindicus, Aeluropus lagopoides* and *Sporobolus* spp. (Mares, 1999).

The Indian cold deserts are delimited by the Great Himalayan and Inner Himalayan ranges having extensive glaciers and snow fields. The areas lie in the rain shadow of the Himalayas and receive less than 300 mm precepitation in the form of snow and misty drizzles. Temperature in cold deserts range from -20°C to -40°C in winters and up to 40°C in summers with occasional dust storms blowing at 49-60 km/hr. The major area is under mountain waste lands and alpine shrubs/pastures, with only 1-2% cultivated lands. Natural vegetation in cold deserts is overwhelmingly herbaceous, comprising of a few tree species and a few shrub species such as *Juniperus, Caragana*, *Artemisea*,

Lonicera, *Potentilla*, *Myricaria*, *Ephedra, Salix, Rosa*, *Rhododendron*, *Hippophae, Colutea, Ribes* and *Betula utilis.* The herbaceous element is comprised of species like *Thymus, Medicago, Trifolium, Anemone, Potentilla, Epilobium, Verbena, Allium, Aconitum, Delphenium, Aquilegia, Primula, Geranium* and *Polygonum.*

1.2 Land degradation:

Land degradation is temporary or permanent lowering of productivity through deterioration of the land's physical, chemical and biological conditions. Land degradation as a reduction in the capacity of land to perform ecosystem functions and services that support society and development. Principal processes of land degradation include wind and water erosion, chemical degradation (acidification, salinization and leaching) and physical degradation (crusting, compaction and, hard-setting) by a single process or a combination of processes. The forces and pressures governing these processes may be biophysical or socio-political, which is reflected in unsustainable utilization or over exploitation of natural resources like land, water, forests, minerals etc. Major causes of land degradation are deforestation, intensive agriculture, encroachments, land use changes and over-exploitation of natural resources. Sustainable land and ecosystem management and adaptation of best management practices seem to be the logical solution to address some of these issues.

Fig. 2: Hot deserts of Rajasthan

Fig. 3: Checking of land degradation in cold deserts

Fig. 4: Checking of land degradation through check dam construction in slope

Fig. 5: Land degradation by water erosion

1.3 Extent of Desertification/Land Degradation:

Many definitions, data sources, classification systems, methodologies and scales of mapping have resulted in diverse assessments of desertification and land degradation in India. The figures have ranged from 53 to 188 Mha as reported by different agencies. Generally extent of 147 to 175 Mha, suggested by the National Commission on Agriculture, and Ministry of Agriculture, have been used. Mapping of wastelands, which refer to mostly the lands having undergone irreversible degradation, by National Remote Sensing Agency at 1:1 million scale are assessed to be 53.28 Mha (Gautam and Narayan, 1982). Desertification map of India on 1:500,000 scale (Fig. 6) published by Space Applications Centre in collaboration with other R&D institutions assessed 81.45 Mha desertified area (25% of total geographical area) and 105.48 Mha degraded lands (32% of total geographical area) in the country (Ajai *et al*., 2009). Water erosion was the most dominant process of desertification accounting for 65 Mha, followed by vegetal degradation covering wind erosion in hot desert and frost shattering in cold deserts. Highest desertified land is found to occur in the state of Rajasthan (23 Mha) followed by Gujarat, Maharashtra and Jammu & Kashmir having 13 Mha in each state while Odisha and Andhra Pradesh revealed 5 Mha under desertification.

Dry land degradation has multiple characteristics and varies in space and time; thus land degradation assessment also varies widely. Harmonized values are therefore recommended to

account for variability in the causes and consequences in dryland degradation. A process-based degradation mapping of agricultural and non-agricultural areas, derived from 1:250,000 soil maps (Fig. 7) prepared from satellite data supported with soil profile studies in association with some ICAR institutes and NRSC have integrated thematic spatial data on degraded and wastelands on a single GIS platform (Majhi *et al.*, 2000). A harmonized value of 120.72 Mha of degraded and wastelands have been settled by several institutes. The detailed harmonized statistics of degraded and wastelands are given in Table 2.

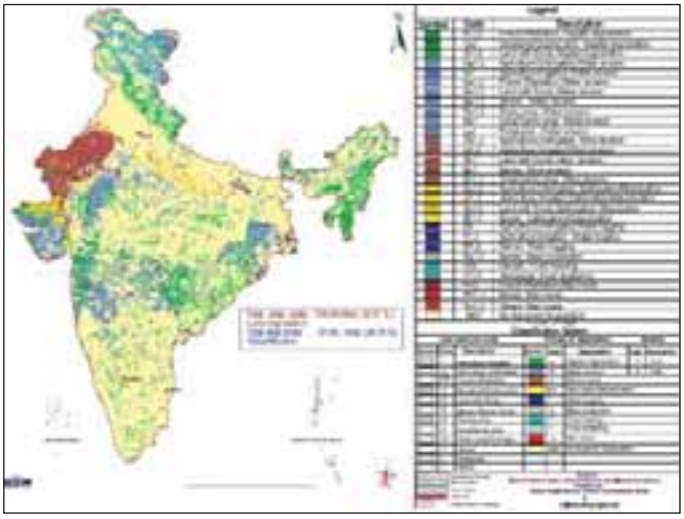


Fig.6: Desertification/land degradation status map of India (Source: Ajai *et. al.*, 2009)

Table 2: Degraded and wastelands of India (Harmonized statistics as per ICAR, 2010)

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

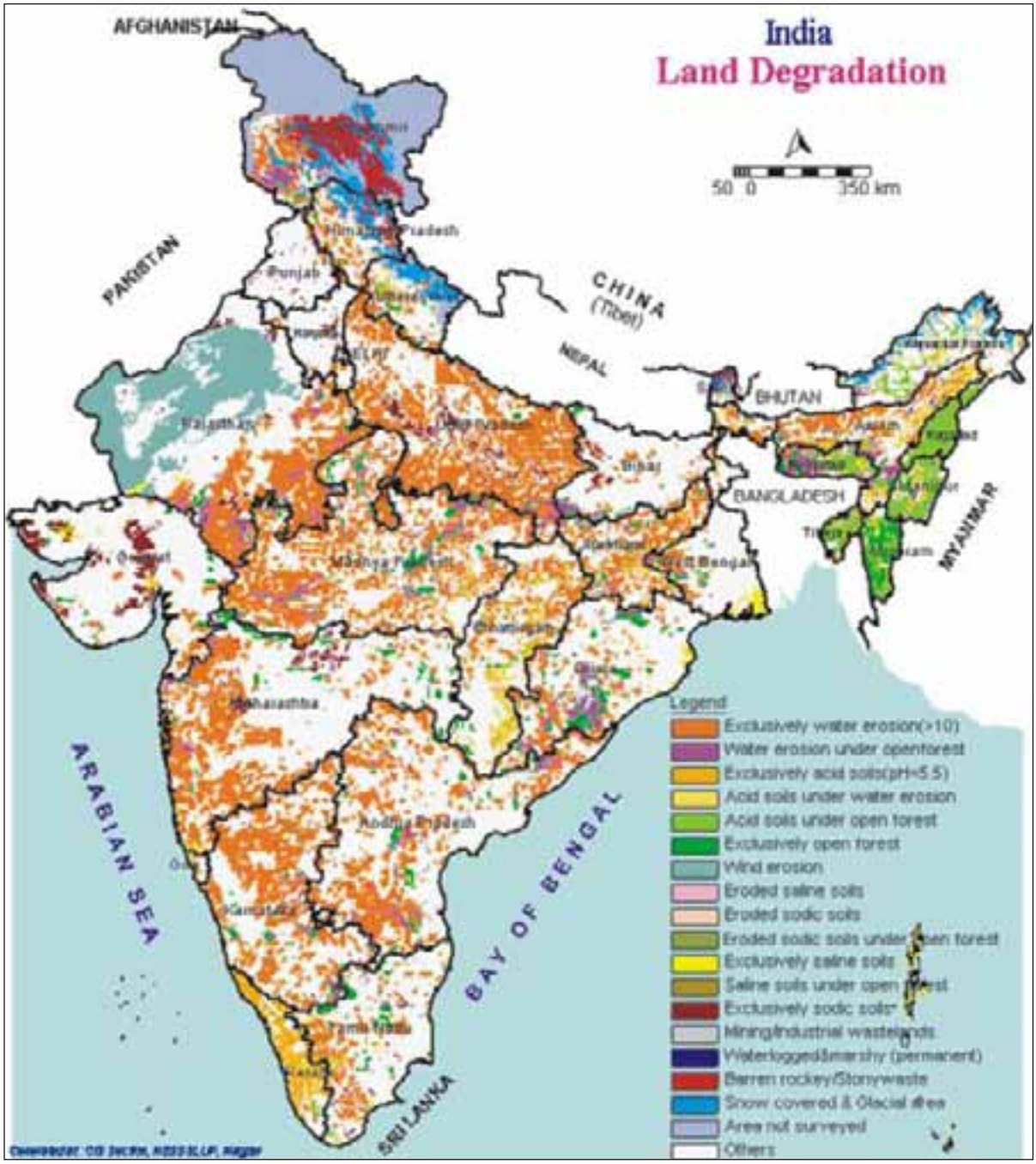


Fig. 7: Degraded and wasteland map of India (Source: ICAR, 2010)

1.4 Drought:

Drought is the major cause of desertification and land degradation particularly under dryland situations. It is a matter of great concern that 68% of the country is prone to drought to varying degrees. The issue of drought will be further accentuated on account of climate change impacts

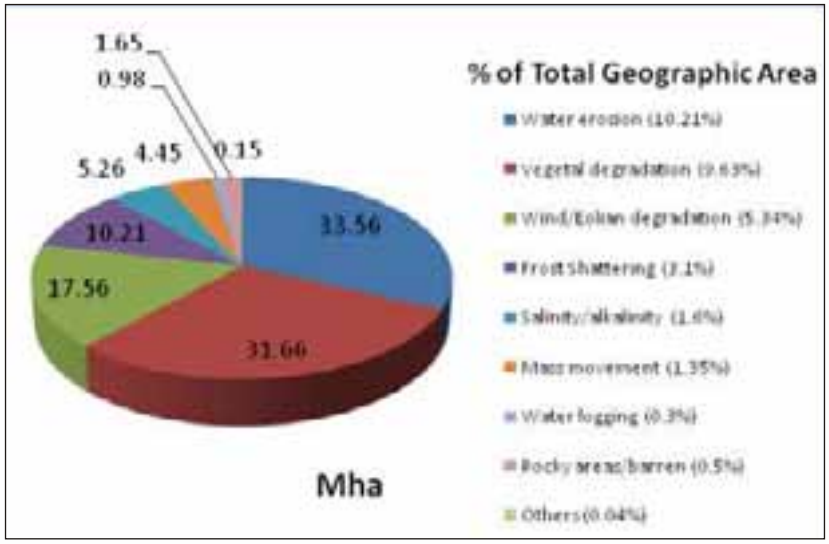


Fig.8: Process-wise status of land degradation in India

particularly in drylands. Drought over a geographic area is a transient condition caused by significantly low rainfall to the extent of deficient for an extended period of time, usually during the rainy season. The deficiency in rainfall is measured relative to the long-period average of rainfall over the area. Of the total area of the country vulnerable to drought, 35% of the area receives rainfall between 750 mm and 1125 mm and is considered as drought prone, while another 33% receives rainfall less than 750 mm (NIDM, 2010).

Most rural communities in drylands rely on a combination of rain-fed agriculture, livestock rearing and other income generating activities that are extremely vulnerable to the climate change impacts expected. Land degradation and depleting water supply are already critical problems. Desertification and loss of biological potential will restrict the transformation of drylands into productive ecosystems. Development in drylands depends on addressing degradation of the ecosystem, mainstreaming sustainable natural resources management and building upon the existing adaptive capacities of community and institutions. Climate change will further challenge the livelihoods of those living in these sensitive ecosystems and may result in higher levels of resource scarcity. Desertification, land degradation and drought issues and livelihoods security have been sought to be addressed by a number of projects and programmes being run by various Government of India agencies. The Government of India has created the enabling constitutional, legal, policy and programme framework for addressing these issues right from the inception of the First Five Year Plan. Over the last decade or so, a large number of new initiatives were taken to strengthen policies and progarmmes in the relevant sectors which include agriculture, environment and forests, rural development, social welfare, poverty alleviation and women's upliftment and empowerment. These include initiatives for enhancing food production; preventing and reversing land degradation as also the associated issue of human development, which are inextricably

interlinked with sustainable development of the country. Systematic efforts were initiated way back in the latter half of the 1950s during the Second Five Year Plan (1956-61) to address the problem. The projects and schemes started during the Second Five Year Plan were further expanded during the Fourth Five Year Plan (1969-74). India has been making constant efforts to develop short and long-term strategies in its Five Year Plans for tackling the problems of drought, desertification, land degradation and deforestation. A number of major programmes addressing the issues of land degradation are: National Afforestation Programme, Drought Prone Area Programme, Desert Development Programme, National Watershed Development Programme for Rain-fed Areas, Indira Gandhi Nahar Pariyojana (Canal Project), Soil and Water Conservation in the Catchment of River Valley Projects and Development of Ravine areas. Various watershed development programmes have been under implementation mainly by three Ministries viz. Ministry of Agriculture, Ministry of Rural Development and Minsitry of Environment and Forests for development of degraded lands. These programmes are: National Watershed Development Project for Rainfed Areas, Soil Conservation for Enhancing Productivity of Degraded Lands in the Catchments of River Valley Project & Flood Prone Rivers, Reclamation of Alkali Soil, Watershed Development Project in Shifting Cultivation Areas, Drought Prone Area Programme, Integrated Wasteland Development Programme and National Afforestation & Eco-development Project. Some of the major programmes and initiatives addressing the desertification, land degradation and drought are discussed in detail in Chapter 5.

Fig. 9: Rain Water Harvesting in Aravali Hills of Rajasthan

India and the United Nations Convention to Combat Desertification

2 India and the United Nations Convention to Combat Desertification

Desertification has long been recognised as a major environmental problem impacting the living conditions of the people in the affected regions in many countries of the world. In 1977, a United Nations Conference on Desertification (UNCOD) was convened in Nairobi, Kenya to formulate an effective, comprehensive and coordinated programme for addressing the problem of land degradation. UNCOD was an outcome of extensive studies and consultations undertaken at the global, regional and local level, involving scientists, policy and decision makers and experts from R&D institutions and other organisations from all over the world (UNEP, 1991). The UNCOD recommended the United Nations Plan of Action to Combat Desertification (PACD).

However, the implementation of PACD was severely hampered by limited resources. Assessments made in 1984, 1987 and 1989 by UNEP indicated that desertification continued to spread. The 1988 Report of the UN Commission for Sustainable Development observed that desertification had become one of the most serious environmental and socio-economic problems of the world. The various assessments by UNEP continued to point out that desertification results from complex interactions among physical, chemical, biological, socio-economic and political problems that were local, national and global in nature.

In 1992, UNEP produced a World Atlas of Desertification (UNEP, 1992). The studies indicated that over the preceding 20 years, the problem of land degradation had continued to worsen. In the past, drylands recovered easily following long droughts and dry periods. Under modern conditions, however, they tend to lose their biological and economic productivity quickly unless they are managed in a sustainable manner. The studies further indicated that over-cultivation, overgrazing, deforestation, and poor irrigation practices are degrading drylands in every continent. The major factors for this are population (human and livestock) pressures, inappropriate land use and agricultural practices, social conflicts and drought. Desertification was recognised as a major global concern affecting over 250 million people directly and with over one billion (more than one-fifth of the world's population) at risk, changing the traditional lifestyles, culture and composition of rural societies.

The UN Conference on Environment and Development (UNCED) also known as the 'Earth Summit'

held in Rio de Janeiro, Brazil in June 1992 provided a platform for addressing a number of major global environmental concerns such as climate change, biodiversity and deforestation. The Rio Summit also highlighted the problem of desertification and recommended that the United Nations General Assembly establish an Inter-Governmental Negotiating Committee (INCD) to prepare a Convention to Combat Desertification in those countries experiencing serious drought and/or desertification. The Committee was established in early 1993. It held five preparatory sessions before adopting the Convention on 17 June 1994 in Paris. The Convention was opened for signature on 14-15 October 1994. The Convention entered into force on 26 December 1996, 90 days after 50 countries had ratified it. As on date, 195 countries have acceded/ratified the Convention. India was an active member of the UNCCD process and became a signatory on 14 October 1994 (the day it was opened for signature) and ratified the Convention on 17 December 1996 and it came into force in our country with effect from 17 March 1997 (90 days after the date of ratification). Agenda 21, which was also an outcome of the Rio Summit, provides a blueprint of the line of action on various issues relating to sustainable development in the 21 century.

The United Nations Convention to Combat Desertification (UNCCD) is one of the Rio Conventions that focuses on Desertification, Land Degradation and Drought (DLDD). The UNCCD provides a legislative framework for DLDD, particularly in the drylands where some of the most vulnerable ecosystems and lower income groups in the world exist. UNCCD is an unique instrument that recognises land degradation as an important factor affecting some of the most vulnerable people and ecosystems in the world. The convention significantly contributes to achieving the Millennium Development Goals (MDGs), as well as sustainable development and poverty reduction by means of arresting and reversing land degradation. The convention promotes sustainable land management (SLM) as a solution to global challenges.

The first regional conference on the implementation of the Convention in Asia was held in New Delhi in August 1996. Subsequently, the ministerial level conference, held at Beijing in May 1997, conceptualized a framework of six Thematic Programme Networks (TPNs) for greater cooperation on the subject among affected countries in Asia-Pacific Region. Government of India, while endorsing the six TPNs, offered to host TPN-2 on "Agroforestry and Soil Conservation in Arid, Semi-arid and Dry Sub-humid Areas". Ministry of Environment and Forests, Government of India as the National Coordinating Body for the UNCCD has been making concerted efforts to develop the TPN-2 Network with a view to building knowledge database on agroforestry and allied subjects to facilitate exchange of information among the member countries. India is participating actively in TPN-1 "Desertification Monitoring and Assessment". India has also joined the TPN-4 "Water Resources Management for Agriculture in Arid, Semi-arid and Dry Sub-humid Areas". The Ministry of Water Resources has been identified as National Task Manager for TPN-4 while TPN-3 on "Range and Pasture Management" has just been launched with Iran as host country. The remaining TPNs, i.e TPN-5 "Drought Praparedness and Mitigation in the Context of Climate Change" and TPN-6 "Strengthening Planning Capacities for Drought management and Controlling Desertification" are

yet to be launched. As host country for the Thematic Programme Network (TPN-2) on Agroforestry for Soil Conservation, Ministry of Environment and Forests has published the "Agroforestry Manual for Asia-Pacific Region" in collaboration with the UNCCD in 2004 (http://moef.nic.in/unccd/book01/books-1.htm). India is a leading country in the work of TPN-1: Desertification Status Monitoring (DSM). Space Applications Centre, Ahmadabad published a DSM Atlas of the country in 2007, which is a globally pioneering work, based on a pilot project sponsored by Ministry of Environment and Forests (http://moef.nic.in/modules/divisions/desertification-cell/contents/desert_atlas.pdf).

Policy Initiatives and Institutional Framework

Though India does not have a specific policy or legislative framework for combating desertification as such, the concern for arresting and reversing land degradation and desertification gets reflected in many of our national policies viz. National Water Policy 1987; 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; National Rainfed Area Authority (NRAA-2007) which have enabling provisions for addressing these problems. It is also implicit in the goals of Sustainable Forest Management (SFM), sustainable agriculture, Sustainable Land Management (SLM) and the overarching goal of sustainable development which the country has been pursuing. The subject has in fact been engaging the attention of planners and policy makers in India since the inception of planning. The First Five Year Plan (1951-1956) had 'land rehabilitation' as one of the thrust areas. In the subsequent five year plans too, high priority has been consistently attached to development of the drylands.

The DLDD issues and livelihood security are addressed by projects and programmes under various Government of India agencies like Ministry of Agriculture (Department of Agriculture & Cooperation, Department of National Rainfed Area Authority, etc), Ministry of Rural Development (Department of Land Resources, MNREGA), Ministry of Water Resources, Ministry of Panchayati Raj, Department of Science & Technology and Planning Commission. A number of programmes and initiatives have been underway over the past 40 years with Drought Prone Areas Programme (DPAP) of 1973-74, followed by Watershed Development Project in Shifting Cultivation Areas (WDPSCA) - 1974-75, Desert Development Programme (DDP) 1977-78, Reclamation & Development of Alkali Soil (RAS) 1985-86, Integrated Wasteland Development Programme (IWDP) 1989, Integrated Afforestation and Eco-Development Projects Scheme (IAEPS) 1989-90, National Watershed Development Project for Rainfed Areas (NWDPRA) - 1990-91, Soil Conservation in the Catchment of River Valley Projects (RVP) 1992, Association of Scheduled Tribes and Rural Poor in Regeneration of Degraded Forests (ASTRP), National Afforestation Programme (NAP) 2002-03 and Integrated Watershed Management Programme (IWMP) 2008.

India formulated and submitted in 2001 a National Action Programme (NAP) to combat desertification, in pursuance of one of the obligations that parties to the Convention (UNCCD) are required to fulfill. A broad road map to combating desertification, NAP recognizes the multi-

sectoral nature of the task, in view of the fact that many of the drivers of desertification have cross-cutting dimensions. The objectives of NAP are community based approach to development, activities to improve the quality of life of the local communities, awareness raising, drought management preparedness and mitigation, R&D initiatives and interventions which are locally suited and strengthening self-governance leading to empowerment of local communities. To address the issues of DLDD and build synergy with other Rio conventions (UNFCCC & CBD), the Sustainable Land and Ecosystem Management Country Partnership Programme (SLEM CPP) was developed. The SLEM programme is a joint initiative between the Government of India (GoI) and the Global Environmental Facility (GEF), under the latter's Country Partnership Programme (CPP).

The Ministry of Environment and Forests is the focal point at the national level, with several other ministries having a number of programmes and policy initiatives related to the DLDD issue. State Governments also have a major role in combating DLDD by implementing central government programmes, schemes, and regulations. Civil Society Organizations (CSOs), grassroots organizations and larger NGOs also undertake grassroots projects on issues pertaining to natural resource management, livelihoods and sustainable land management. Some of the major ministries/departments involved are: Planning Commission, Ministry of Rural Development (Department of Land Resources, Department of Rural Development, Department of Drinking Water Supply), Ministry of Agriculture (Department of Agriculture & Cooperation, Department of Agricultural Research and Education, Indian Council of Agricultural Research, Department of Dairy and Fisheries), Ministry of Water Resources, Ministry of New and Renewable Energy, Ministry of Earth Sciences (India Meteorological Department), Ministry of Science & Technology (Department of Science and Technology), Ministry of Space (Space Applications Centre), Ministry of Consumer Affairs & Public Distribution, Ministry of Panchayati Raj, Ministry of Environment and Forests (National Afforestation and Eco-development Board, Environment Education Division, National Biodiversity Authority, Indian Council of Forestry Research and Education).

In order to provide research support to the various programmes for combating desertification, land degradation and drought, Government of India has established a network of R&D institutions across the country. Some of the major institutions are Indian Council of Forestry Research and Education (Arid Forest Research Institute, Forest Research Institute, Himalayan Forest Research Institute, Institute of Forest Genetics and Tree Breeding, Institute of Forest Productivity, Rain Forest Research Institute and Tropical Forest Research Institute), Indian Council of Agricultural Research (Central Arid Zone Research Institute, Central Research Institute for Dryland Agriculture, Central Soil & Water Conservation Research and Training Institute, National Bureau of Soil Survey and Land Use Planning, and National Research Centre for Agroforestry), India Meteorological Department, Space Applications Centre, National Institute for Rural Development and National Remote Sensing Centre, etc.

The National Action Programme to Combat Desertification

The National Action Programme to Combat Desertification (NAP-CD) formulated and submitted to UNCCD in 2001, identifies the need to address and incorporate the following into integrated planning for sustainable development: natural resource conservation and management, socio-economic issues, strengthening the process of decentralization of governance and formulation of more community driven projects and programmes, gender issues, public participation, strengthening the interface and co-ordination between various stakeholders, and awareness raising. In order to achieve these objectives, NAP-CD mentions a greater shift from centralised mode of governance to more decentralisation; identification of problems/priorities by the local communities and a greater devolution of powers to the local communities; greater integration of existing programmes and activities not only at the national level but a more coordinated approach, particularly at the local level. A step towards 'Single window' implementation of programmes and schemes through local self governments (Panchayats) is emphasised. Water would be made central to all conservation measures and for production systems. Focus would be to improve the quality of life. Local communities should be empowered to take decisions, and implement programmes relating to their livelihood. The approach and strategy to combat desertification under UNCCD is appropriately described in NAP-CD. With reference to UNCCD decision 3/COP.8 the NAP-CD needs to be aligned with the 10-year strategic plan and framework to enhance the implementation of the Convention.

National Capacity Needs Self-Assessment

National Capacity Needs Self-Assessment (NCSA) prepared in 2007 suggested that India has sufficient capacity for meeting UNCCD obligations. Some of the strengths are: address all causes of desertification in implementation of NAP to combat desertification; mainstreaming of combating desertification works for lands that are not yet degraded; provide legislative support pertaining to combating desertification; provide for effective participation at the local, national and regional levels of NGOs; and establish and strengthen early warning system for combating desertification.

Some of the important deficiencies in capacity needs are implementation of NAP to combat desertification, research and development, conceptualization and formulation of policies, legislations, strategies and programmmes, incorporation of traditional knowledge, mobilization of private sector contribution. The above depiction of strengths and deficiencies clearly indicates that the country is strong in a large number of capacities especially in terms of implementation of national plans as well as preventive measures for lands that are yet not degraded, information generation and early warning, and transfer of adaptation and development of technology. There are however a few inadequacies that need immediate attention. Following the Strategy adopted in 2008, follow-up of NCSA in review and follow-up with the Strategy is needed.

Sustainable Land and Ecosystem Management (SLEM) Programme

The Sustainable Land and Ecosystem Management (SLEM) programme is a joint initiative between the Government of India (GoI) and the Global Environmental Facility (GEF), under the latter's Country Partnership Programme (CPP) under GEF four funding cycle. The objective of SLEM programmatic approach is to "promote sustainable land management and use of biodiversity as well as to maintain the capacity of ecosystems to deliver goods and services taking into account the problem of climate change". Under the SLEM programmatic approach, seven projects have been formulated and are under various stages of implementation. SLEM programme is based on:

- Prevention and control of land degradation by restoration of degraded (agricultural and forested) lands and biomass cover to produce, harvest, and utilize biomass in ways that maximize productivity, as well as by carbon sequestration, biodiversity conservation, and sustainable use of natural resources;
- Enhancement of local capacity and institution building to strengthen land and ecosystem management;
- Facilitation of knowledge dissemination and application of national and international good practices in SLEM within and across states;
- Replication and scaling up of successful land and ecosystem management practices and technologies to maximize synergies across the CBD, UNFCCC, UNCCD conventions.

UNCCD 10 Year Strategy (2008-18) and the Fifth National Report

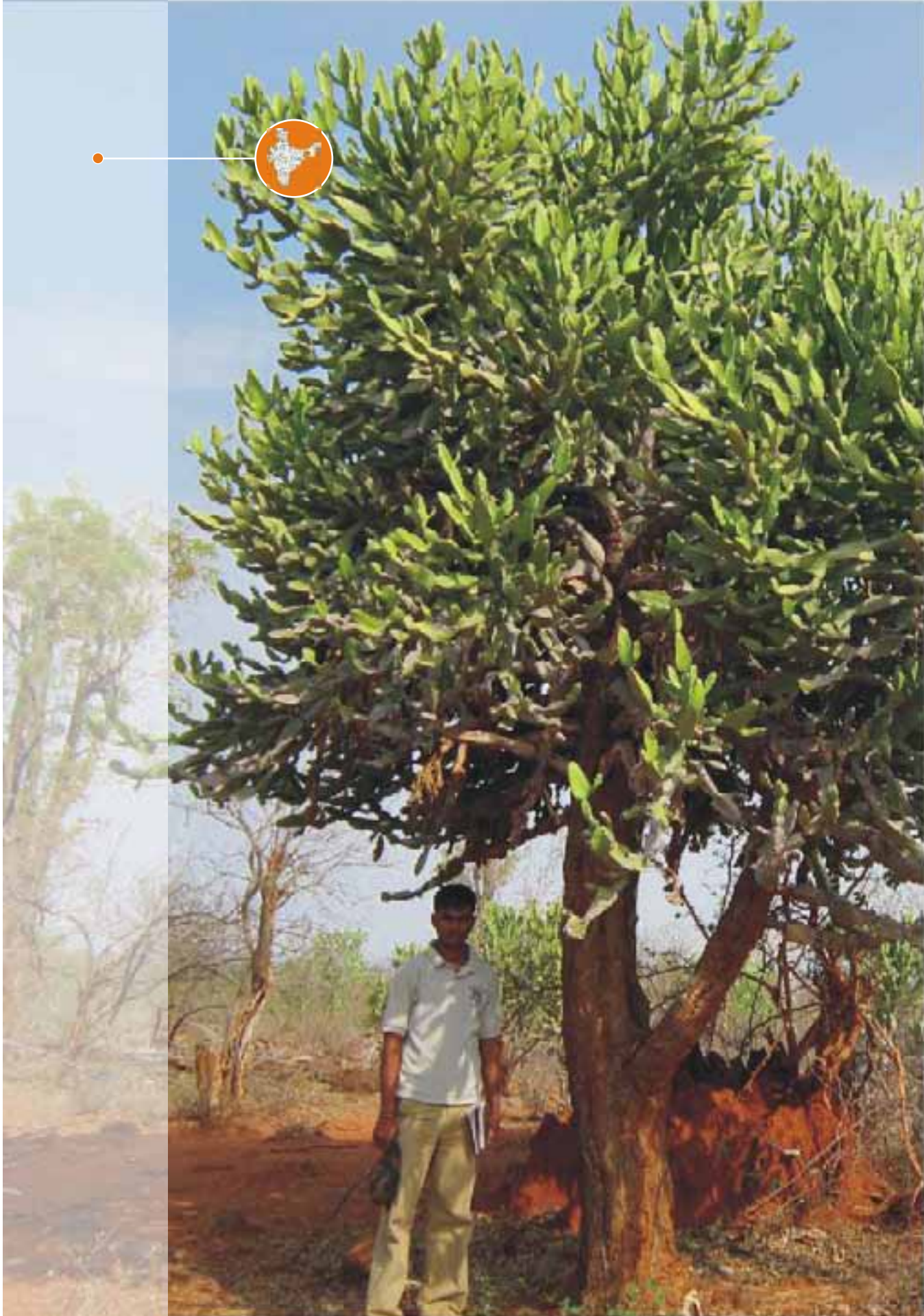
As the Convention entered into its second decade, the Parties unanimously adopted the 10-year strategic plan and framework to enhance the implementation of the Convention for 2008-18 at COP 8, held at Madrid in September 2007. The Strategy provides a unique opportunity to address some of the Convention's key challenges, to capitalize on its strengths, to seize opportunities provided by the new policy and financing environment, and to create a new, revitalized common ground for all UNCCD stakeholders. The Strategy contains the "strategic objectives" to be achieved over the 10 years and the "operational objectives" that guide the actions of short and medium-term effects.

As an integral part of its obligations, India submits a National Report to the UNCCD Secretariat as per COP decisions. Till date five National Reports have been submitted to the UNCCD Secretariat. The first report was submitted in 2000, second report in 2002, the third report in 2006, the fourth report in 2010, and the fifth national report in 2012. The Fifth National Report has a revised reporting format vis-à-vis the previous ones. To support this new result-oriented management structure, UNCCD had Parties at the Ninth Session of the Conference of the Parties (COP 9), decided on a new Performance Review and Assessment of Implementation System (PRAIS). This allows the Committee for the Review of the Implementation of the Convention (CRIC) to effectively review the implementation of the Strategy and the Convention, based on a new methodological approach, which envisages reporting on performance and impact indicators, best practices and financial flows.

The process of preparation of the report included data collection and synthesis of important programmes undertaken by the various Ministries/Departments of Government of India, science and technology institutions and civil society organisations. National consultations with the Ministries, Departments, Science and Technology institutions and CSOs were an ongoing process and first inceptation meeting for preparation of the Fifth National Report was held on 20 April 2012 at MoEF, New Delhi. Subsequently consultative meetings to invite inputs for the National Report were held on 17 July 2012 at ICFRE, Dehradun and 30 July 2012 at MoEF, New Delhi. The review meeting was held on 06 September 2012 at MoEF, New Delhi. The validation meeting was organized on 4 October 2012 and the national report was finalized for submission. The Fifth National Report was submitted to UNCCD secretariat online through Performance Review and Assessment of Implementation System (PRAIS) portal in October 2012, was limited in scope as it did not reflect India's initiatives related to desertification, land degradation and drought issues in a holistic and summarized format. Therefore, this report is the 'Elucidation' of the Fifth National Report submitted to the UNCCD Secretariat' contains detailed information that could not be incorporated in the on-line report and that could be shared widely with multiple stakeholders. Chapters in this report are organized according to the reporting format to reflect background to these initiatives and a summary highlighting the country's commitment to addressing the issues of desertification, land degradation and drought. The original fifth National Report submitted online to UNCCD Secretariat through PRAIS portal of the Convention can be accessed at http://www.unccd-prais.com/Data/Reports.

Fig. 10: Drought affected agricultural land

Reporting on Impact Indicators of Strategic Objectives of the Convention



3 Reporting on Impact Indicators of Strategic Objectives of the Convention

Desertification, along with climate change and the loss of biodiversity were identified as the greatest challenges to sustainable development during the 1992 Rio Earth Summit. United Nations Convention to Combat Desertification (UNCCD) is the sole legally binding international agreement linking environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands. As the Convention enters its second decade, the Parties unanimously adopted the 10-year strategic plan and framework to enhance the implementation of the Convention for 2008-18. The Strategy provides a unique opportunity to address some of the Convention's key challenges, to capitalize on its strengths, to seize opportunities provided by the new policy and financing environment, and to create a new, revitalized common ground for all UNCCD stakeholders. The Strategy contains the "four strategic objectives" to be achieved over the 10 years, and the "five operational objectives" that guide the actions of all UNCCD stakeholders and partners.

The following "strategic objectives" will guide the actions of all UNCCD stakeholders and partners in the period 2008-18, including raising political will. Meeting these long-term objectives will contribute to achieving its vision *"The aim for the future is to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability"*. The "expected impacts" are the long-term effects intended by the following strategic objectives:

Strategic objective 1: To improve the living conditions of affected populations

Expected impact 1.1. People living in areas affected by desertification/land degradation and drought to have an improved and more diversified livelihood base and to benefit from income generated from sustainable land management.

Expected impact 1.2. Affected populations' socio-economic and environmental vulnerability to climate change, climate variability and drought is reduced.

Indicator S-1: Decrease in numbers of people negatively impacted by the processes of desertification/land degradation and drought.

Indicator S-2: Increase in the proportion of households living above the poverty line in affected areas.

Indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.

Strategic objective 2: To improve the condition of affected ecosystems

Expected impact 2.1. Land productivity and other ecosystem goods and services in affected areas are enhanced in a sustainable manner contributing to improved livelihoods.

Expected impact 2.2. The vulnerability of affected ecosystems to climate change, climate variability and drought is reduced.

Indicator S-4*:* Reduction in the total area affected by desertification/land degradation and drought.

Indicator S-5*:* Increase in net primary productivity in affected areas.

Strategic objective 3: To generate global benefits through effective implementation of the UNCCD

Expected impact 3.1. Sustainable land management and combating desertification/land degradation contribute to the conservation and sustainable use of biodiversity and the mitigation of climate change.

Indicator S-6: Increase in carbon stocks (soil and plant biomass) in affected areas.

Indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management.

Strategic objective 4: To mobilize resources to support implementation of the Convention through building effective partnerships between national and international actors

Expected impact 4.1. Increased financial, technical and technological resources are made available to affected developing country Parties, and where appropriate Central and Eastern European countries, to implement the Convention.

Expected impact 4.2. Enabling policy environments are improved for UNCCD implementation at all levels.

Indicator S-8: Increase in the level and diversity of available funding for combating desertification/land degradation and mitigating the effects of drought.

Indicator S-9: Development of policies and measures to address desertification/land degradation and mitigation of the effects of drought.

3.1 General Information on Impact Indicators of Strategic Objectives

The UNCCD impact indicators are to provide insights on the progress made towards the achievement of the following strategic objectives of The Strategy:

- Strategic objective 1: To improve the living conditions of affected populations
- Strategic objective 2: To improve the condition of affected ecosystems
- Strategic objective 3: To generate global benefits through effective implementation of the UNCCD

Impact indicators are for measuring progress against strategic objectives 1, 2 and 3 of The Strategy, in line with decision 3/COP.8. At COP 9, a set of eleven impact indicators was provisionally accepted (decision 17/COP.9) for reporting on these strategic objectives and reporting of the following two impact indicators was mandatory:

- Proportion of the population living below the poverty line
- Land cover status

The remaining nine impact indicators were considered optional for inclusion in reports by affected countries. The whole set of impact indicators is being subject to an interactive, participatory and formative process of refinement, which includes testing through pilot exercises at the national level. As decided by the COP at its tenth session, the process of refinement is being brought forward by an *ad hoc* Advisory Group of Technical Experts (AGTE) which will present its recommendations at CST 11.

National Action Programme (NAP) on Desertification 2001 identified the areas of the country which are affected by land degradation and agricultural drought. Other documents that identify areas affected by DLDD in the country are:

- Ajai *et al.* (2009). Desertification/Land Degrdation Status Mapping of India. *Current Science*, 97: 1478-1483
- NRSC (2011). *NADAMS Report*, National Remote Sensing Centre, Hyderabad, India.
- NRSC (2012). *Land Degradation Atlas of India (Vol.1) India & state maps; Land Degradation Atlas of India (Vol.2) District-wise area statistics*. National Remote Sensing Centre, Hyderabad, India.

The areas in the states of Andhra Pradesh, Arunchal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, West Bengal, and the Union Territories of Andaman & Nicobar Islands, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Lakshadweep, Puducherry, have been considered under land degradation. The estimated extent of the national territory (in square kilometers) having areas affected by degradation is given in Table 3.

3.2 Definition used to identify areas affected by DLDD

Land degradation: Several definitions of land degradation have been suggested by different authorities to express the degree of deterioration of land or land potential. In the study the definition adopted was 'temporary or permanent regression from a higher to a lower status of productivity through deterioration of physical, chemical and biological aspects'. Both human-

Table 3: Status of Land Degradation

S. No.	State	Land Degradation Area (sq.km)	Land Degradation %TGA
1	Andhra Pradesh	90,397	32.9
2	Arunchal Pradesh	9,198	11.0
3	Assam	7,162	9.1
4	Bihar	11,526	12.2
5	Chhattisgarh	36,835	27.2
6	Delhi	70	4.7
7	Goa	403	10.9
8	Gujarat	62,366	31.8
9	Haryana	4,940	11.2
10	Himachal Pradesh	12,570	22.6
11	Jammu & Kashmir*	28,007	27.6
12	Jharkhand	15,230	19.1
13	Karnataka	54,004	28.2
14	Kerala	5,688	14.6
15	Madhya Pradesh	59,017	19.1
16	Maharashtra	113,019	36.7
17	Manipur	8,369	37.5
18	Meghalaya	6,248	27.9
19	Mizoram	6,502	30.8
20	Nagaland	7,661	46.2
21	Odisha	61,474	39.5
22	Punjab	1,640	3.3
23	Rajasthan	124,239	36.3
24	Sikkim	780	11.0
25	Tamil Nadu	21,957	16.9
26	Tripura	1,031	9.8
27	Uttar Pradesh	28,868	54.0
28	Uttarakhand	8,561	3.6
29	West Bengal	3,048	3.4
30	Andaman &Nicobar	569	6.9
31	Chandigarh	0	0.2
32	Dadra Nagar Haveli	58	11.9
33	Daman	10	8.6
34	Lakshadweep	0	1.6
35	Puduchery	27	5.5
Grand Total		**791,475**	**25.0**

Note: *TGA excludes area not mapped in J&K (120,849 sq.km)

induced and natural processes that contribute towards land degradation are addressed. The land degradation classification scheme adopted in the study is hierarchical, consisting of land degradation process (8 major processes are addressed viz., water erosion, wind erosion, waterlogging, salinisation/ alkalization, acidification, glacial, anthropogenic and others) and 32 land degradation types under 5 severity classes.

Agricultural drought: Agricultural drought refers to a situation of constrained availability of water to the crop plants to complete their life cycle satisfactorily. National Agricultural Drought Assessment and Monitoring System (NADAMS) project, conceptualized and developed by National Remote Sensing Centre (NRSC), Indian Space Research Organisation, Department of Space, GoI, provides near real-time information on prevalence, severity level and persistence of agricultural drought at state/district/sub-district level. Satellite data from AWiFS/Resourcesat, OCM-2/Oceansat-2, AVHRR/NOAA, MODIS, AMSR-E, is used in the analysis alongwith the ground information. From the 2012 'Kharif' onwards, the NADAMS project is being implemented by the Mahalanobis National Crop Forecast Centre (MNCFC), Ministry of Agriculture, after the technology was transferred to MNCFC by NRSC**.**

3.3 Methods used to identify areas affected by DLDD

Land degradation assessment: The methodology essentially involved formulation of classification scheme, geo-rectification of satellite data, development of geo-database with uniform plan, delineation of land degradation categories through on-screen visual interpretation, ground truth collection, soil chemical analysis, finalization of land degradation polygon boundaries, quality checking, area estimation and statistics compilation. Multi-temporal geo-rectified LISS-III data acquired during kharif, rabi and zaid season of 2005-2006 was used as satellite database for interpretation of land degradation classes. Besides, topographic maps, existing land use land cover, wasteland and salt-affected soil maps were also used as legacy data. Sample points were identified for various land degradation classes as per classification scheme and data was collected in prescribed formats.

The minimum mapping polygon size of 3 mm x 3 mm on 1:50,000 scale equivalent to 2.25 ha area and two-tier quality checking (QC) mechanism was adopted in land degradation assessment viz., internal QC (IQC) and external QC (EQC). IQC team checked the entire mapping process and EQC team checked 10% of the area randomly. Besides, a cursory overall QC was done by EQC team. Entire data was organized as geo-database for proper organization and retrieval along with appropriate metadata. District-wise land degradation area statistics were generated.

Agriculture drought assessment: The methodology of NADAMS project essentially reflects the integration of satellite derived crop condition/surface wetness indices and their anomalies with ground collected rainfall and crop area progression to evolve decision rules on the prevalence, intensity and persistence of agricultural drought situations. Agricultural drought assessment is

being done with multiple indices as Shortwave Angle Slope Index, Normalized Difference Wetness Index**,** Normalized Difference Vegetation Index**,** Soil Moisture Index and IMD Rainfall data rainfall deviation, number of dry weeks.

During the months of June, July and August, agricultural drought warning information is issued in terms of 'Alert', 'Watch' and in the months of September and October, agricultural drought severity information is provided in terms of 'Mild', 'Moderate' and 'Severe'. 'Alert' category districts are characterised by either delayed sowing time or reduced crop sown area or poor greenness of agricultural vegetation or lack of adequate irrigation infrastructure or all of them. There may not be improvement to the extent of normal agricultural situation in these districts. 'Watch' category districts are characterised by slightly reduced crop sown area or slightly reduced greenness of crops, with scope for significant improvement in subsequent fortnights.

Monthly drought reports of NADAMS project are disseminated to the Ministry of Agriculture, GoI and respective state departments of Agriculture and Relief. The reports are also being sent to IMD, Central Water Commission and other scientific organizations. Agricultural drought information is used in the crop review meetings and for contingency planning during the season.

3.4 Core Indicator: Poverty

Estimates of the human population living in the national areas and rural areas of the country as per the Census of 2011 are given in Table 4. The poverty line describes absolute threshold below which people are considered to be poor. Degradation of natural resources like land, water and vegetation as well as recurrence of drought leads to poverty. The poverty rate describes the percentage of human population living below the poverty line and is the ideal impact indicator for the affected areas using the rural poverty line (poverty line specific to rural areas). Poverty remains a chronic condition for almost 30 % of India's rural population. On the map of poverty in India, the poorest areas are in parts of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, Jharkhand, Orissa, Chhattisgarh and West Bengal. A large proportion of India's poorest people lives in the country's arid and semi-arid regions which also suffer from shortages of water and recurrent droughts inducing Desertification, Land Degradation and Drought (DLDD). A major cause of poverty among India's rural people, both individuals and communities, is lack of access to productive assets and financial resources.

There has been no uniform measure of poverty in India. The Planning Commission of India has accepted estimates of poverty from the large sample surveys on household consumer expenditure carried out by the National Sample Survey Office (NSSO). It defines poverty line on the basis of monthly per capita consumption expenditure (MPCE). The methodology for estimation of poverty followed by the Planning Commission has been based on the recommendations made by experts in the field from time to time. The poverty lines computed for 2004-05 for all India level are MPCE of ₹ 446.68 for rural areas. In the survey conducted in 2009-10, the Planning Commission has updated

the poverty lines and poverty ratios for the year 2009-10 using NSS 66th round (2009-10) data from the Household Consumer Expenditure Survey. It has estimated the poverty lines at all India level as an MPCE of ₹ 672.77 for rural areas in 2010-11. The percentage of population living below the rural poverty line in rural areas has declined from 41.8 % in 2004-05 to 33.8 % in 2010-11 (Table 5).

Table 4: Estimates of the human population living in the national area and rural areas of country

Year	Number of people living in the national area	Number of people living in rural areas	Method used
2001	1028610328	742490639	Nationwide census
2011	1210193422	833087662	Nationwide census

(Source: Ministry of Home Affairs (2011). Census of India 2011 (Provisional). http://censusindia.gov.in/2011census/censusinfodashboard/index.html)

Table 5: Poverty Rate (rural poverty line in India)

Year	Rural poverty line (₹)	Method used	Percentage of population living below rural poverty line
2004	446.68	Consumption survey	41.8
2005	446.68	Consumption survey	41.8
2010	672.77	Consumption survey	33.8
2011	672.77	Consumption survey	33.8

(Source: Planning Commission, Govt. of India 2012 Official Communication http://planningcommission.nic.in)

Fig. 11: Poverty stricken community in drought affected areas

The poverty ratio in Himachal Pradesh, Madhya Pradesh, Maharashtra, Odisha, Sikkim, Tamil Nadu, Karnataka and Uttarakhand has declined by about 10 percentage points and more. In Assam, Meghalaya, Manipur, Mizoram and Nagaland, poverty in 2009-10 has increased. Some of the bigger states such as Bihar, Chhattisgarh and Uttar Pradesh have shown only marginal decline in poverty ratio, particularly in rural areas. Nearly 50% of agricultural labour is below the poverty line in rural areas. In the agriculturally prosperous state of Haryana, 55.9% agricultural labourers are poor, in Punjab the figure is 35.6%. In rural areas, it is seen that households headed by minors have poverty ratio of 16.7% and households headed by females and senior citizens have poverty ratio of 29.4% and 30.3% respectively. State specific poverty lines for the year 2009-10 are given in Table 6.

Table 6: State specific poverty lines for 2009-10

S. No.	States	Monthly per capita (₹)	
		Rural	Urban
1.	Andhra Pradesh	693.8	926.4
2.	Arunachal Pradesh	773.7	925.2
3.	Assam	691.7	871
4.	Bihar	655.6	775.3
5.	Chhattisgarh	617.3	806.7
6.	Delhi	747.8	1040.3
7.	Goa	931	1025.4
8.	Gujarat	725.9	951.4
9.	Haryana	791.6	975.4
10.	Himachal Pradesh	708	888.3
11.	Jammu and Kashmir	722.9	845.4
12.	Jharkhand	616.3	831.2
13.	Karnataka	629.4	908
14.	Kerala	775.3	830.7
15.	Madhya Pradesh	631.9	771.7
16.	Maharashtra	743.7	961.7
17.	Manipur	871	955
18.	Meghalaya	686.9	989.8
19.	Mizoram	850	939.3
20.	Nagaland	1016.8	1147.6
21.	Orissa	567.1	736
22.	Puducherry	641	777.7

23.	Punjab	830	960.8
24.	Rajasthan	755	846
25.	Sikkim	728.9	1035.2
26.	Tamil Nadu	639	800.8
27.	Tripura	663.4	782.7
28.	Uttar Pradesh	663.7	799.9
29.	Uttarakhand	719.5	898.6
30.	West Bengal	643.2	830.6
	All India	**672.8**	**859.6**

(Source: Poverty Estimates, 2009-10, Government of India Planning Commission, March 2012)

Several Acts enacted by Parliament and Policies of GoI such as Indian Forest Act, 1927; Forest (Conservation) Act, 1980; Environment (Protection) Act, 1986; National Forest Policy, 1988; National Agricultural Policy, 2000; Biological Diversity Act, 2002; National Water Policy, 2002; National Environmental Policy, 2006; National Policy for Farmers, 2007; National Green Tribunal Act, 2010 have enabling provisions for addressing DLDD issues as also several National Missions such as National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission for Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for the Green India, National Mission for Sustainable Agriculture, National Mission for Strategic Knowledge for Climate Change.

3.5 Land Cover Status

Land use/land cover is very complex but a universal indicator to monitor land uses such as forest, agriculture, wasteland, water bodies and their major shifts due to biophysical and socio-economic factors, reclamation efforts and land use policies. Land cover can also serve as a proxy for many other indicators such as net primary productivity, off-take of water for agricultural use and standing above ground biomass, reflecting carbon sequestration etc. Land covers types reported in the Fifth National Report are given below:

Agriculture: These are the lands primarily used for farming and for production of food, fibre, and other commercial and horticultural crops. Agriculture comprises areas with standing crop as on the date of satellite overpass. It includes kharif, rabi and zaid crop areas along with areas under double or triple crops. It also includes agricultural plantations including horticultural plantation (like coconut, arecanut, citrus fruits, fruit orchards, ornamental shrubs and trees, vegetable gardens etc) and agro-horticultural plantation.

Fallow: These are the lands, which are taken up for cultivation but are temporarily allowed to rest un-cropped for one or more seasons, but not less than one year.

***Forest*:** The term forest refers to land with a tree canopy cover of more than 10 per cent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m. Forests consist of evergreen/semi-evergreen, deciduous, forest plantation, scrub forest and littoral/swamp /mangrove forest.

Grassland: These are the areas of natural grass along with other vegetation, predominantly grass-like plants (monocots) and non-grass-like herbs (except *Lantana* species which are to be classified as scrub). It includes natural/semi-natural grass/grazing lands of alpine/sub-alpine or temperate or sub-tropical or tropical zones, desertic areas and manmade grasslands.

Water Bodies: All submerged or water-saturated lands, natural or man-made, inland or coastal, permanent or temporary, static or dynamic, vegetated or non-vegetated, which necessarily have a land-water interface, are defined as wetlands. These consist of inland wetlands (seasonal as well as permanent), man-made wetlands (like waterlogged areas - seasonal or perennial), coastal wetland, river stream/canals, water bodies.

Under National Natural Resources Management System - Department of Space (NNRMS-DOS), the Natural Resources Census (NRC) project was initiated to generate a set of thematic maps viz., land use/land cover, soil, land degradation, wetlands, vegetation, snow & glaciers, geomorphology at 1:50,000 scale and land use/land cover at 1:250,000 scale, periodically for monitoring the natural resources. The land use/land cover statistics reported above are from national level Land Use and Land-use Change (LULC) mapping project on 1:250,000 scale using multi-temporal ResourcesaAWiFS datasets had clearly brought out the temporally spatial distribution of the net sown area, on national basis, besides creating spatial databases on other important LULC classes like fallows, plantations, forest, water etc. Comparison of land cover types during 2005-06 and 2010-11 reveals that the area under agriculture increased from 142.56 Mha to 149.33 Mha an increase of 2.0% of total geographical area of the country (Figs. 12, 13). During the same period the area under fallow and water spread (water bodies) class decreased from 11.30 to 9.92% and 2.71 to 2.43%, respectively. The area under forest, grassland and other classes did not show significant changes.

Table 7: Total area covered and the proportion of the total national area covered by each land cover type.

Year	Land Cover Type											
	Agriculture		Fallow		Forest		Grassland		Waterbodies		Others	
	Km^2	% of total	Km^2	% of total	Km^2	% of total	Km^2	% of total	Km^2	% of total	Km^2	% of total
2005	1440390	43.82	398810	12.13	677088	20.62	80810	2.46	85930	2.61	610450	18.57
2011	1516630	46.14	326000	9.92	692027	21.05	80020	2.43	79790	2.43	610520	18.57

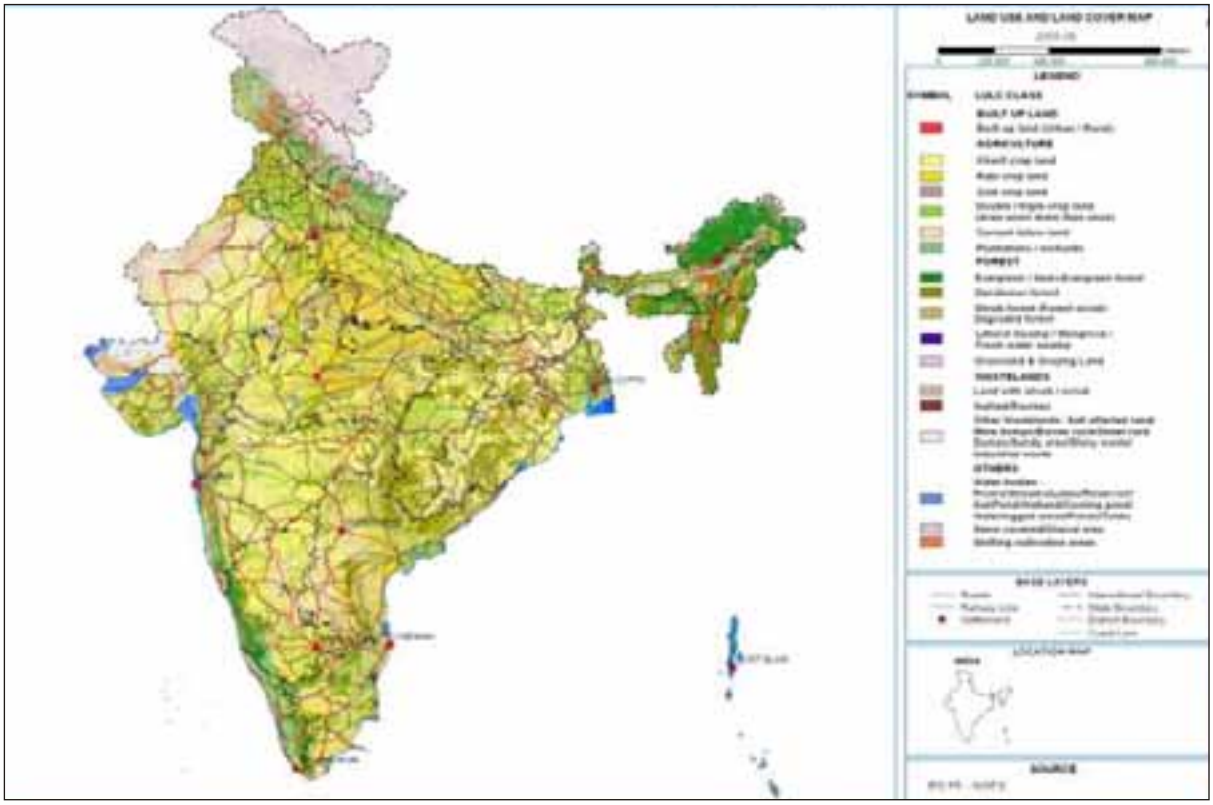


Fig.12: Land Use and Land Cover Map 2005-06

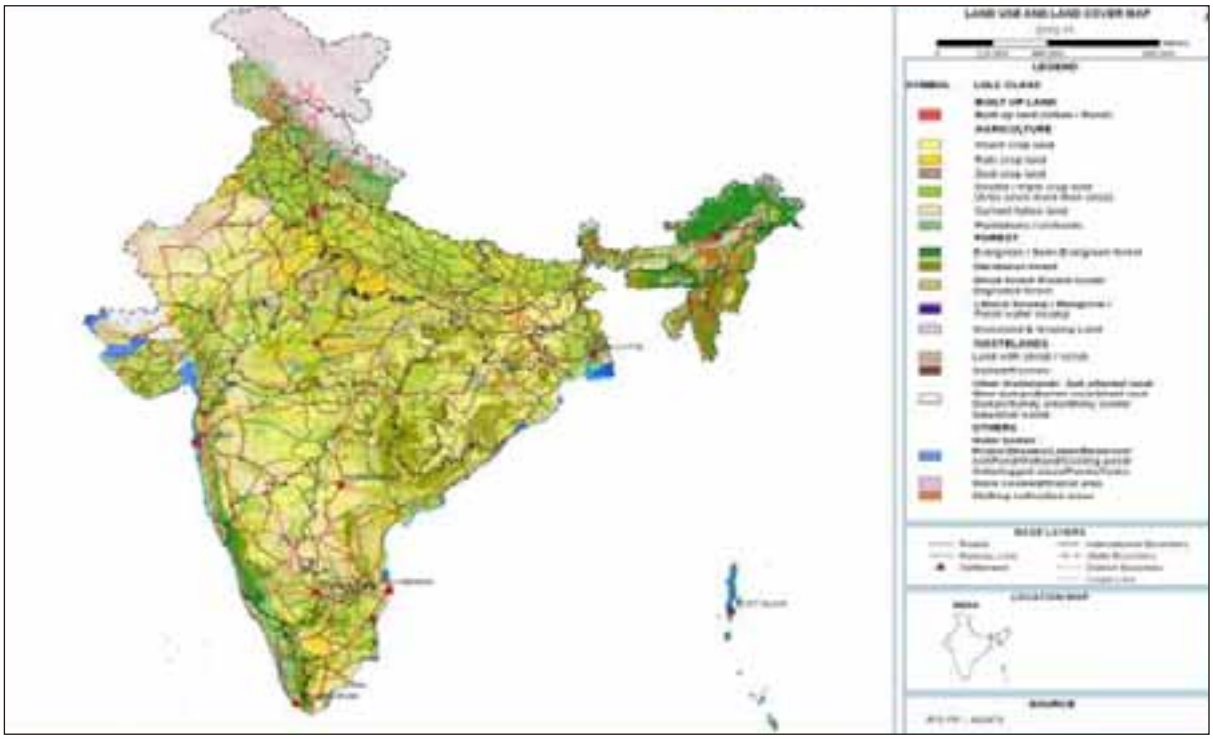


Fig.13: Land Use and Land Cover Map 2010-11

Fig. 14: Soil and Water conservation in degraded lands

Under same project, the land degradation study of 2005-06 to 2010-11 revealed that 25% of total geographical area of the country is being subjected to water erosion (15.93%), wind erosion (2.74%), salinization/alkalization (2.07%), acidification (1.09%), water logging (0.68%), glacial (0.34%), anthropogenic (0.15%) and other processes (2.01%). Comparing statistics available on land degradation/desertification, it is revealed that there is a decrease in area under degraded lands in the country. Land cover-wise analysis had shown that the 42% of agricultural areas suffer from one form or another form of land degradation. This was followed by scrub land (38%) and forest areas (19.5%).

Government of India has launched a massive watershed development programme under various national centrally sponsored schemes and externally funded projects like Drought Prone Area Programme and Desert Develop Programme, National Afforestation and Eco-Development Project to address DLDD by effective soil and water conservation. Integrated farming systems integrated with animal husbandry, medicinal plants and geo-index based cash crops offer diversification and economic returns, which are extremely important in climatic change scenario. Large number of R&D institutes under various Ministries, autonomous bodies and NGOs are engaged in basic, strategic and applied research for development of technologies to address DLDD and promote climate smart agriculture. Policy frame-work for promoting collaboration of R&D institutions, NGOs, industries, and international organisations with dry land farmers is envisaged. Government of India has launched ten National Missions dealing with land, water, afforestation of degraded lands, biodiversity and climate change etc. Some of these missions are on sustainable agriculture, horticulture, water, climate change and 'green India' which have direct bearing on DLDD. During droughts, floods and other calamities, Government has had programmes in place like 'food for work'. Ministry of Rural Development has started a massive livelihood programme under the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) to provide minimum work for 100 days in a year to rural families below poverty line. The programme has now been linked to development of land and water resources as well as agricultural activities like farming systems. Similarly, many other programmes like Rashtriya Krishi Vikas Yojana (RKVY) (National Agriculture Development Programme), National Food Security Mission (NFSM), Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), Rural Electrification Programme and

Backward Region Grant Fund (BRGF) are also addressing DLDD issues and ecosystem management. Convergence of these missions and harnessing synergies amongst various Government schemes could enhance impact several folds. It is esimated that 40% of India's population would be residing in cities and towns by the end of 2050. This will create a serious setback to agricultural due to labour scarcity and shall have an impact on DLDD. Therefore policies of the Government to create facilities in the rural areas by creation of satellite townships and prevent of migration of youth from the rural to the urban areas would address the issue of DLDD.

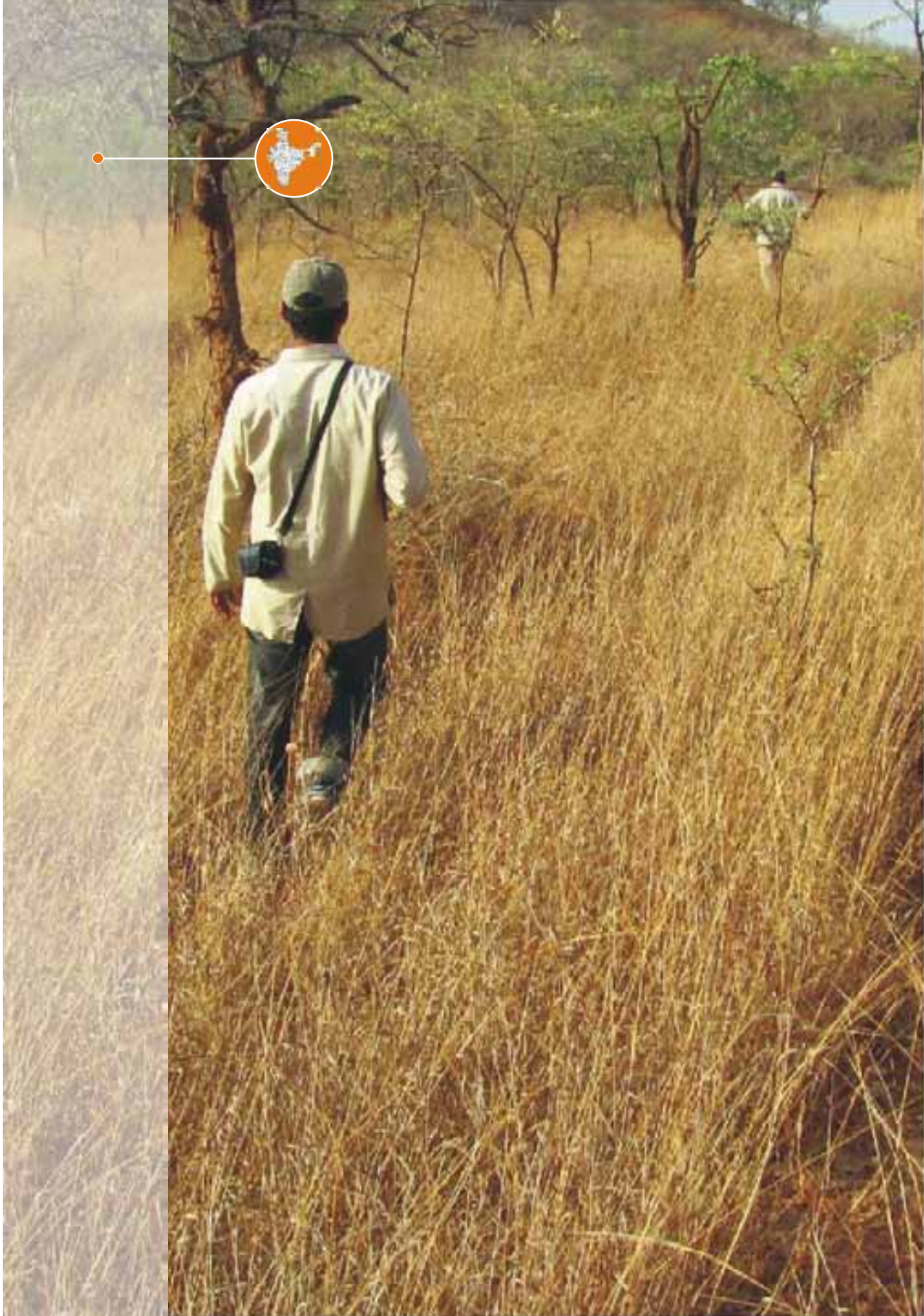
3.6 Land Productivity

Forest carbon was estimated by Forest Survey of India (FSI) for the Second National Communication to UNFCCC. FSI has mapped 'forest Cover' and 'forest types' of the country for the year 2005. FSI also used data from its 'National Forest Inventory (NFI)' to generate carbon stock in all five pools. Since exact boundaries of the target area are not available, FSI used whole districts for proxy of the area of interest. For Net Primary Productivity (NPP) calculation of land cover/type forest, concerned districts were considered and NFI plots in those districts were used to estimate above and below ground biomass carbon. Using this with von Mantel's formula, NPP ($kgCha^{-1}year^{-1}$) was estimated for forest land cover type. For fallow land cover type, the estimates of herbs and shrubs of 'open forest' from NFI were used. Net primary productivity of fallow and forest land cover types is given in the Table 8.

Table 8: Net primary productivity (NPP)

Year (2000-2011)	Land cover type	NPP (kgC ha-1 year-1)
2005	Fallow	199
2005	Forest	814

Reporting on Performance Indicators of Operational Objectives of the Convention



4 Reporting on Performance Indicators of Operational Objectives of the Convention

The 10 year Strategy contains the "four strategic objectives" to be achieved over the 10 years, and the "five operational objectives" that will guide the actions of all UNCCD stakeholders and partners in the short and medium term with a view to supporting the attainment of the above-mentioned vision and strategic objectives. The "outcomes" are the short and medium-term effects intended by the operational objectives. Performance indicators compare actual conditions with a specific set of reference conditions. They measure the distance(s) between the current situation and the desired situation (target). The performance indicators were developed to measure the progress of the five operational objectives of the 10 Year Strategy, in line with decision 3/COP 8. The details of the operational objectives alongwith expected outcomes are given below:

Operational objectives and expected outcomes:

The following "operational objectives":

1. **Advocacy, Awareness Raising and Education:** To actively influence relevant international, national and local processes and actors in adequately addressing desertification/land degradation and drought-related issues.

   Outcome 1.1: Desertification/land degradation and drought issues and the synergies with climate change adaptation/mitigation and biodiversity conservation are effectively communicated among key constituencies at the international, national and local levels.

   Outcome 1.2: Desertification/land degradation and drought issues are addressed in relevant international forums, including those pertaining to agricultural trade, climate change adaptation, biodiversity conservation and sustainable use, rural development, sustainable development and poverty reduction.

   Outcome 1.3: Civil Society Organizations (CSOs) and the scientific community in the North and the South are increasingly engaged as stakeholders in the Convention processes and desertification/land degradation and drought are addressed in their advocacy, awarenessraising and education initiatives.

2. **Policy Framework:** To support the creation of enabling environments for promoting solutions to combat desertification/land degradation and mitigate the effects of drought.

Outcome 2.1: Policy, institutional, financial and socio-economic drivers of desertification/land degradation and barriers to sustainable land management are assessed, and appropriate measures to remove these barriers are recommended.

Outcome 2.2: Affected country Parties revise their National Action Programmes (NAPs) into strategic documents supported by biophysical and socio-economic baseline information and include them in integrated investment frameworks.

Outcome 2.3: Affected country Parties integrate their NAPs and sustainable land management and land degradation issues into development planning and relevant sectoral and investment plans and policies.

Outcome 2.4: Developed country Parties mainstream UNCCD objectives and sustainable land management interventions into their development cooperation programmes/projects in line with their support to national sectoral and investment plans.

Outcome 2.5: Mutually reinforcing measures among desertification/land degradation action programmes and biodiversity and climate change mitigation and adaptation are introduced or strengthened so as to enhance the impact of interventions.

3. **Science, Technology and Knowledge:** To become a global authority on scientific and technical knowledge pertaining to desertification/land degradation and mitigation of the effects of drought.

   Outcome 3.1: National monitoring and vulnerability assessment on biophysical and socio-economic trends in affected countries are supported.

   Outcome 3.2: A baseline based on the most robust data available on biophysical and socio-economic trends is developed and relevant scientific approaches are gradually harmonized.

   Outcome 3.3: Knowledge on biophysical and socio-economic factors and on their interactions in affected areas is improved to enable better decision-making.

   Outcome 3.4: Knowledge of the interactions between climate change adaptation, drought mitigation and restoration of degraded land in affected areas is improved to develop tools to assist decision-making.

   Outcome 3.5: Effective knowledge-sharing systems, including traditional knowledge, are in place at the global, regional, sub-regional and national levels to support policymakers and end users, including through the identification and sharing of best practices and success stories.

   Outcome 3.6: Science and technology networks and institutions relevant to desertification/land degradation and drought are engaged to support UNCCD implementation.

4. **Capacity Building:** To identify and address capacity-building needs to prevent and reverse desertification/land degradation and mitigate the effects of drought.

Outcome 4.1: Countries which have carried out the National Capacity Self Assessment (NCSA) implement the resulting action plans to develop the necessary capacity at the individual, institutional and systemic levels to tackle desertification/land degradation and drought issues at the national and local levels.

Outcome 4.2: Those countries which have not previously undertaken capacity needs assessments engage in relevant assessments processes to identify capacity needs for tackling desertification/land degradation and drought at the national and local levels.

5. **Financing and Technology Transfer:** To mobilize and improve the targeting and coordination of national, bilateral and multilateral financial and technological resources in order to increase their impact and effectiveness.

   Outcome 5.1: Affected country Parties develop integrated investment frameworks for leveraging national, bilateral and multilateral resources with a view to increasing the effectiveness and impact of interventions.

   Outcome 5.2: Developed country Parties provide substantial, adequate, timely and predictable financial resources to support domestic initiatives to reverse and prevent desertification/land degradation and mitigate the effects of drought.

   Outcome 5.3: Parties increase their efforts to mobilize financial resources from international financial institutions, facilities and funds, including the GEF, by promoting the UNCCD/ Sustainable Land Management (SLM) agenda within the governing bodies of these institutions.

   Outcome 5.4: Innovative sources of finance and financing mechanisms are identified to combat desertification/land degradation and mitigate the effects of drought, including from the private sector, market-based mechanisms, trade, foundations and CSOs, and other financing mechanisms for climate change adaptation and mitigation, biodiversity conservation and sustainable use and for hunger and poverty reduction.

   Outcome 5.5: Access to technology by affected country Parties is facilitated through adequate financing, effective economic and policy incentives and technical support, notably within the framework of South-South and North in the framework of South-South and North-South cooperation.

Performance indicators compare actual conditions with a specific set of reference conditions. They measure the 'distance (s)' between the current situation and the desired situation (target). The performance indicators were developed to measure the progress of the five operational objectives of The Strategy, in line with decision 3/COP.8. The affected country Parties were to report on the following fourteen performance indicators out of the eighteen Consolidated Performance Indicators (CONS):

A brief analysis of the information provided on operational objectives of the reporting format is given below:

Table 9: Operational Objectives and Performance Indicators

Operational Objectives	Outcome No.	Indicator No.	Performance Indicator Name
Advocacy, awareness raising and education	1.1	CONS-0-1	Advocacy, awareness raising and education programmes organized by GOI Ministries/ Departments, State Govt. Departments, Science and Technology Institutions and Civil Society Organisations on Desertification, land degradation and drought (DLDD)
	1.1	CONS-0-3	Number of civil society organisations, and science & technology institutions involved in programmes/ projects related to Desertification, land degradation and drought
		CONS-0-4	Number and type of desertification, land degradation and drought (DLDD) related initiatives of civil society organizations (CSOs) and science and technology institutions (STIs) in the field of education.
Policy framework	2.1 2.2 2.3	CONS-0-5	Policy framework: Finalized the formulation/revision of NAPs/SRAPs /RAPs
	2.5	CONS-0-7	Number of initiatives for synergistic planning/ programming of the three Rio Conventions or mechanisms for joint implementation, at all levels
Science, technology and knowledge	3.1 3.2	CONS-0-8	Science, technology and knowledge: Monitoring system for desertification, land degradation and drought
		CONS-0-9	Science technology and knowledge: reporting to the Convention along revised reporting guidelines on the basis of agreed indicators
	3.3 3.4	CONS-0-10	Science technology and knowledge: Number of revised NAPs/ SRAPs/ RAPs reflecting knowledge of DLDD drivers and their interactions, and of the interaction of DLDD with climate change and biodiversity
	3.5	CONS-0-11	Science, technology and knowledge: Type, number and users of Desertification, land degradation and drought (DLDD) related knowledge sharing systems/ processes/networks at the global, regional, subregional and national levels

Capacity Building	4.1 4.2	CONS-0-13	Capacity Building to combat Desertification, Land Degradation and Drought (DLDD) on the basis of National capacity self-assessment (NCSA) or other methodologies and instruments
		CONS-0-14	investment frameworks, established within the Integrated Finance Strategy (IFS) devised by the General Mechanism or within other Integrated Finance Strategy, reflect leveraging national, bilateral and multilateral resources for combating desertification and land degradation
Financing and Technology Transfer	5.2	CONS-0-16	Financing and Technology Transfer: Degree of adequacy, timeliness and predictability of financial resources made available by developed country Parties to combat Desertification, land degradation and drought
	5.3	CONS-0-7	Financing and Technology Transfer: Number of project proposals successfully submitted or in pipeline for financing to international financial institutions, facilities and funds, including the GEF, and number of ongoing projects on desertification, land degradation and drought
		CONS-0-18	Financing and Technology Transfer: Amount of financial resources and type of incentives which have enabled access to technology related to DLDD.

Operational Objective 1: Advocacy, Awareness Raising and Education

Line Ministries and Departments of Government of India, science and technology institutions and the CSOs have placed significant emphasis on the issues of DLDD. Reporting on awareness generation activities and media campaigns have been undertaken across the nation; however, these have not been quantified and inbuilt into the reporting mechanism at the national level. With regard to education, several science and technology institutions operating within dry land regions focus their research on region-specific issues which include DLDD. Additionally, cross cutting agricultural educational institutions focus on systems, methods, technology which can assist in adaptation to these regions. These include awareness generation on methods of combating desertification, improving the water table to reduce impacts of drought and land degradation, etc. A few case studies of the events and activities towards advocacy, awareness raising and education on DLDD are also included in the chapter on programmes and best practices. The numbers of information events organized by various government organisations and CSOs on DLDD and/or DLDD synergies with climate change and biodiversity across the country were 102325 and 170581 during the year 2010 and 2011 respectively (Table 10). Number of media products on DLDD and

DLDD synergies made public through news papers for addressing the issue that reached the key stakeholders were 208 during the year 2010 and 101 during the year 2011. The media outreach programmes on DLDD through radio and television were 7304 during the year 2010 and 24647 during the year 2011 (Table 10).

Participation of CSOs and Science & Technology Institutions (STIs) in DLDD related programmes/projects during the year 2010 and 2011 is given in the Table 11. Number and type of DLDD-related initiatives of CSOs and STIs in the field of education were 463 during the year 2010 and 864 during the year 2011 (Table 12).

Civil Society Organisations involved in DLDD related project activities are: Advanced Centre for Water Resources Development and Management, Agriculture and Rural Fundation, Apeksha Homeo Society, Asian Society for Entrepreneurship, BAIF Development Research Foundation, Bharathi Integrated Rural Development Society, Centre for Applied Research & Extension, Collective Activities for Rejuvenation of Village Arts and Environment, Development Initiatives and People's Action, Development of Humane Action Foundation, Education & Development, Foundation for Ecological Security, Grass Root Action for Reconstruction and Development, Gayatri Mahila Shaikshanik Sanstha, Gram Bharati Samiti, Gram Swaraj Seva Trust, Gram Vikas Samstha, Gramin Vikas Trust, Himalayan Study Circle, insPIRE Network for Environment, Institute of Himalayan Environmental, Jai Bharti Shiksha Kendra, Janseva Pratishthan, Kamyab Yuva Sanskar Samiti, Loksathi Pratishthan, Mahamaya Shiksha evam Samaj Kalyan Samiti, Maharashtra Prabodhan Seva Mandal, Manav Bharti, Nageshwar Charitable Trust, People's Activity and Rural Technology

Table 10: Number and size of information events organized, and media products made public on DLDD and/or DLDD synergies with climate change and biodiversity

Year	Number of information events	Number of participants in the information events	Number of media products made public	
			Newspapers	Radio and TV
2010	102325	5116250	208	7304
2011	170581	8529050	101	24647

Table 11: Number of CSOs and STIs that participated in DLDD related programmes/projects

Year	Number of CSOs	Number of STIs
2010	55	24
2011	55	24

Table 12: DLDD-related initiatives of CSOs and STIs in the field of education

Year	Number of DLDD-related initiatives undertaken by CSOs	Number of DLDD-related initiatives undertaken by STIs
2010	434	29
2011	790	74

Nurturing Ecological Rejuvenation, People's Science Institute, PRADAN, Ram Krishna Mission, Rashtra Vikas Agro Education Sanstha, Research and Education, Rural Foundation, Sadguru Foundation, Samaj Pragati Sahayog, Sampada Trust, Sangam Sansthan, Sanjeevani Institute for Empowerment and Development, Sant Dnyaneshwar Bahuuddesiya Sanstha, Seva kunj Samiti, Social Awareness for Integrated Development, Social Centre, Society for Sustainable Agriculture and Forest Ecology, Star Youth Association, The Energy and Resources Institute, Vagad Jan Jagriti Sansthan, Vanarai Mitra Mandal, Village Uplift Society, Vishwas, Watershed Organisation Trust, Watershed Support Services and Activities Network and Yerala Projects Society.

Science and Technology Institutions (STIs) involved in DLDD related project activities are: Indian Council of Forestry Research and Education (Arid Forest Research Institute, Forest Research Institute, Himalayan Forest Research Institute, Institute of Forest Genetics and Tree Breeding, Institute of Forest Productivity, Rain Forest Research Institute and Tropical Forest Research Institute), Bharti Vidyapith, Indian Council of Agricultural Research (Central Arid Zone Research Institute, Central Research Institute for Dryland Agriculture, Central Soil & Water Conservation Research and Training Institute, National Bureau of Soil Survey and Land Use Planning, National Research Centre for Agroforestry), Indian Institute of Technology Mumbai, Indian Meteorological Department, Space Applications Centre, International Centre for Research on Agriculture and Forestry, International Crops Research Institute for the Semi-Arid Tropics, Mahatma Phule Krishi Vidyapeeth, National Institute for Rural Development and National Remote Sensing Centre.

Operational Objective 2: Policy Framework

India's National Action Programme to Combat Desertification (NAP-CD) was formulated in 2001 which was adopted prior to The Strategy. Alignment of the NAP with The Strategy of UNCCD is under consideration. The process will be expedited, on receipt of GEF funding support for enabling activities. The approach adopted in the country for NAP to combat desertification has been multi-sectoral and it is recognized that the issues need to be addressed in a holistic and cross-sectoral manner in a long term basis by financial and technical support. A number of programmes are also under implementation for conservation of natural resources, improvement of the socio-economic conditions of affected people, delegation of powers to local self governments and encouraging people's participation. Despite the on-going efforts in the country that have been in place for combating desertification including constitutional, policy and legal framework on the relevant areas for combating desertification, the problem of land degradation continues to be a major concern in India with consequent implications for its sustainable development. The major challenges remain in the areas of land use planning, management of wasteland and degraded land and efficient use of water resources. There is an inherent and urgent need for establishing a clear monitoring mechanism of the impacts of all these programmes and schemes in terms of improving the livelihood status and socio-economic conditions of the people as well as improvement of the ecosystem in the affected/vulnerable areas and regions. The country's NAP has to be included in an integrated investment framework and also integrated into national development planning, relevant sectoral and investment plans and policies.

Fig.15: Sustainable land management

India has also not been implementing joint planning/programming initiatives for the three Rio Conventions in the reporting period since operational mechanisms for joint implementation or mutual reinforcement did not exist in India during the reporting period. No synergistic instruments are in place yet, neither the establishment of synergistic processes for joint implementation of the Rio Conventions at national level have been supported by the institutions of the Rio Conventions. The major difficulties experienced in establishing synergistic planning/programming or mechanisms for joint implementation are lack of capacity and financial resources.

Operational Objective 3: Science, Technology and Knowledge

The national level environmental monitoring system of India partially covers the monitoring of DLDD. Consequently India does not have an independently established and supported monitoring system for DLDD at national level. There are monitoring systems at the sub-national levels which contribute to UNCCD reporting. Most of the DLDD performance indicators related to science, technology and knowledge are monitored by these systems, some of which are listed below:

- Desertification Atlas of India (Space Applications Centre, Indian Space Research Organization, GoI) commissioned by National Focal Point, UNCCD, Ministry of Environment *(http://moef.nic.in/modules/divisions/desertification-cell/contents/desert_atlas.pdf)*
- Land Degradation Mapping, Soil and Land Use Survey of India (Department of Agriculture & Cooperation, Ministry of Agricutlture, GoI) *(http://dacnet.nic.in/aislus/index.asp)*
- Detailed Soil Survey, Soil and Land Use Survey of India (Department of Agriculture & Cooperation, Ministry of Agricutlture, GoI) *(http://dacnet.nic.in/aislus/index.asp)*
- Forest Cover Mapping, Forest Inventory and State of the Forest Report (Forest Survey of India, MoEF, GoI) *(http://www.fsi.org.in/)*
- National Agricultural Drought Assessment and Monitoring System (Disaster Management Support Programme, National Remote Sensing Centre, GoI) (*http://dsc.nrsc.gov.in:14000/DSC/Drought /index.jsp*)
- Wasteland Atlas of India (Department of Land Resources, Ministry of Rural Development, GoI) *(http://www.dolr.nic.in/wasteland_atlas.htm)*
- Ground Water Monitoring, State Ground Water Profiles and District Ground Water Brochures (Central Ground Water Board, Ministry of Water Resources, GoI) *(http://cgwb.gov.in/)*.

- Drought Research Unit, India Meteorological Department (IMD) *(http://www.imdpune.gov.in/research/drought/)*

India has created an enabling constitutional, legal, policy and programme framework for addressing DLDD issues through its Five-Year Plans. Over the years a large number of initiatives have been taken to strengthen policies and programmes in the relevant sectors that include agriculture, environment and forests, rural development, social welfare, poverty alleviation and women's empowerment. These include initiatives for addressing food production, preventing and reversing land degradation as also the associated issues of human development, which are inextricably inter-linked with DLDD. India has rich and diversified DLDD-related knowledge-sharing systems and networks at a national level. There is, additionally, adequate scientific and traditional knowledge, including best practices, which is suitably disseminated to end-users. List of the DLDD relevant knowledge sharing systems is given in Table 13.

Table 13: DLDD relevant knowledge-sharing systems

S.No.	Knowledge sharing system	Internet link
1	Agromet Services All India AAS Bulletin	http://www.imdagrimet.gov.in/ALL%20INDIA%20AAS%20BULLETIN/allindia17.09.2010.htm
2	Crop Weather Outlook - All India Coordinated Research Project on Agro Meteorology (AICRPAM)	http://www.cropweatheroutlook.ernet.in/
3	Desertification Cell, Ministry of Environment and Forests	http://moef.nic.in/modules/divisions/desertification-cell/
4	Desicion Support Centre-ISRO	http;//dsc.nrsc.gov.in:14000/DSC/index.jsp
5	District Level Agromet Advisory	Serviceshttp://www.imd.gov.in/section/nhac/dynamic/daasindiact1.htm
6	Drought Management Information System	http://agricoop.nic.in/DroughtMgmt/drought.htm
7	Ecologic - Views from the Watersheds	http://ecologic.wotr.org
8	Environmental Information System acronymed as ENVIS	http://www.moef.nic.in/envis/envis.html
9	Krishi Vigyan Kendra	http://www.icar.org.in/krishi-vigyan-kendra.htm
10	Special Monsoon Report dynamic/SPLNEW.htm	http://www.imd.gov.in/section/nhac/
11	Statewise Composite Agromet Advisory service Bulletin	http://www.imdagrimet.gov.in/COMPOSITE%20BULLETIN/composite%20bulletin21.09.10.htm
12	Sustainable Land and Ecosystem Management - Country Partnership Programme	http://slem-cpp.icfre.gov.in/index.php
13	The Watering Hole - The WOTR Blog	http://blog.wotr.org
14	Watershed Atlas of India	http://cgwb.gov.in/watershed/about-ws.html

15	Watershed Voices: Stories and Experiences from the Watersheds	http://voices.wotr.org
16	Weather Based Agro Advisory	http://www.icar.org.in/en/crop-management-advisory.htm
17	Weather Forecasting District Level Forecast	http://www.imd.gov.in/section/nhac/distforecast/INDIAct.htm

Operational Objective 4: Capacity Building

Assessment of DLDD-related capacity building activities shows a positive trend; it also recognizes the need to focus and strengthen the implementation of NAP-CD across the country. A total of 25 capacity building programmes have been implemented in this period, which fall outside the areas of intervention as mentioned in the National Capacity Needs Self-Assessment (NCSA) report. Consequently, the Ministry of Environment and Forests, Government of India addressed the issues mentioned in the NCSA framework. The NCSA is concerned with a country's capacity the abilities of individuals, groups, organizations and institutions to address priority environmental issues as part of the efforts to achieve sustainable development. The NCSA focuses on India's capacity requirements to implement the three 'Rio Conventions': on biodiversity (CBD), land degradation (UNCCD) and climate change (UNFCCC). In addition, the NCSA process aims to identify cross-cutting capacity issues and foster synergies among these. Capacity building initiatives in the form of training programmes including exposure visits for stakeholders in the different parts of the country on DLDD related activities (natural resource management) were organised as a one of the components under the following projects/programmes:

- Uttarakhand decentralized watershed development project
- Integrated land and ecosystem management to combat land degradation in Madhya Pradesh
- Poverty reduction through community based natural resource management for livelihood opportunities in natural areas
- Participatory natural resource management and village development project in Rajasthan
- Sukhi Baliraja initiatives integrated watershed management projects in Andhra Pradesh
- Public-private-civil society partnership and MREGS in Jalana and Amarawati districts in Maharashtra participatory natural resource management along watershed lines in Rajasthan
- Watershed development fund Community mobilisation for the poverty alleviation through watershed development

Operational Objective 5: Financing and Technology Transfer

Adequate funding has been raised for addressing the DLDD issues. The funds raised for the on-going programme and projects on DLDD issues were to the tune of ₹ 33148.57 million. Eleven programmes and projects have been implemented with bilateral assistance from the World Bank

Group, Global Environment Facility, Food and Agriculture Organization of the United Nations, Karl Kubel Stiftung fur Kind und Familie, Andheri-Hilfe, Bonn; Swiss Agency for Development & Cooperation and Japan International Cooperation Agency. However, all other programmes are funded by the Indian Governmental agencies both central and state.

This operational objective also incorporates information pertaining to the integrated investment framework, which aims to catalyze investments in Sustainable Land and Ecosysem Management (SLEM) from such sources as public expenditure at the national and local levels, private sector investments (including investment by farmers and communities) and funds from international development partners. In India investment in SLEM is across various ministries and departments, and it may not be possible to achieve the level of integration expected. However, the process for integration of programmes to avoid duplicity and for maximum resource utilisation is in place and, in future, will be part of the DLDD-related activities as well.

India actively participates in international events on desertification and is currently the Chair of the Regional Implementation Annexe for the Asia and the Pacific region. The DLDD issues and livelihoods security are addressed by various projects and programmes under various Government of India agencies/Ministries. India formulated and submitted in 2001 a National Action Programme (NAP) to combat desertification. To address the issues of DLDD and build synergy with other Rio conventions (UNFCCC & CBD), the Sustainable Land and Ecosystem Management Country Partnership Program (SLEM CPP) was developed.

The number of DLDD related project proposals successfully submitted for funding was 25 and number of ongoing DLDD related projects was 45 during the year 2010-11. The funds raised for ongoing projects were to the tune of ₹ 7370.03 million during the year 2010-11. Financing used for the implementation of DLDD-related programmes and projects from national sources was 70 %, the remaining 30 % was from from international sources.

Fig. 16: Capacity Building Programme on DLDD

Programmes and Projects

5 Programmes and Projects

This section highlights the 47 programmes and projects reported for the period 2010-2011, and contain information as reported in the Programme and Project Sheets (PPS) and the Standard Financial Annexe (SFA) of the Fifth National Report submitted to the UNCCD Secretariat. It may be noted that though some of these programmes have been implemented over decades, only the relevant components including finances have been reported for the above mentioned period. The programmes and projects reported are as follows:

1. Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges
2. Study of characteristic features pertaining to bio-drainage potential of some selected tree species
3. Mycorrhizal dependency & productivity of economic important medicinal plants (Mehndi & Ashwagandha) of arid zones
4. Development of economically viable and integrated agroforestry models for arid region
5. Effect of fertilizer application on growth and yield of 10 years old *Salvadora persica* and *Acacia ampliceps* plantations under silvipastoral system on arid salt affected soil
6. Productivity and biometrics studies on some important species in semi arid regions of Rajasthan for their sustainable management
7. Enhancing productivity of saline wastelands in Kachchh- through improved tree planting techniques and silvipastoral study
8. Characterization and classification of forest soils of Rajasthan
9. Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli of Rajasthan
10. Impact of *Prosopis juliflora* on biodiversity, rehabilitation of degraded community lands and as a source of livelihood for people in Rajasthan State
11. Enrichment of land degradation datasets with soil datasets of different states of India

12. Policy and institutional reform for mainstreaming and up-scaling sustainable land and ecosystem management in India
13. Nationwide mapping of land degradation at 1:50,000 scale
14. Plantation and green belt development around Chandrapura Thermal Power Station, Chandrapura, Dhanbad
15. Uttarakhand decentralised watershed development project (UDWDP)
16. Sustainable land, water and biodiversity-conservation and management for improved livelihoods in Uttarakhand
17. Reversing environmental degradation and rural poverty through adaptation to climate change in drought stricken areas in Southern India: A hydrological unit pilot project approach
18. Integrated land and eco-system management to combat land degradation and deforestation in Madhya Pradesh
19. Participatory natural resource management project, Madhya Pradesh
20. Poverty reduction through community based natural resource management for livelihood opportunities in rural areas
21. GRAMODAYA sustainable livelihood project
22. Natural resource management along watershed lines
23. Participatory natural resource management and village development project, Rajasthan
24. Wasundhara Sunahara kal participatory village development project based on natural resource management
25. Sukhi Baliraja initiatives
26. Climate change adaptation in rural Maharashtra
27. Integrated watershed management project (Kurnool District, Andhra Pradesh)
28. Integrated watershed management project (Mahaboobnagar District, Andhra Pradesh)
29. Public-Private-Civil Society Partnership (PPCP) under MREGS in Jalna District, Maharashtra
30. Public-Private-Civil Society Partnership (PPCP) under MREGS in Amravati District, Maharashtra
31. Participatory natural resource management along watershed lines in Rajasthan
32. Watershed development fund
33. Climate change adaptation in rural Maharashtra
34. Community mobilisation for the poverty alleviation through integrated watershed development
35. National afforestation programme

36. Integrated watershed management programme (IWMP)
37. Centrally sponsored programme of soil conservation in the catchments of river valley project & flood prone river (RVP&FPR)
38. Centrally sponsored programme of national watershed development project for rainfed areas (NWDPRA)
39. Swan river integrated watershed management project, Una Himachal Pradesh
40. Sustainable participatory management of natural resources to control land degradation in the Thar desert ecosystem
41. Sustainable rural livelihoods security through innovations in land and ecosystem management
42. Gujarat forestry development project - Phase II
43. Odisha forestry sector development project
44. Sikkim biodiversity conservation and forest management project
45. Rajasthan forestry and biodiversity project - Phase-II
46. Tripura forest environmental improvement and poverty alleviation project
47. Indo-German watershed development programme - Phase III

Fig. 17: Sustainable managed agro forestry system

Programme/Project #1: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges

The Aravalli hills are among the oldest mountain ranges of the world and run across the State of Rajasthan from southwest to northeast. These hills cover about 30% of the state's area. Desertification and consequent land degradation in this region is severe with extremes of weather, low and erratic rainfall (100-400 mm) and high evapo-transpiration. Soils are immature, structureless, and very coarse in texture with low water holding capacity and poor nutrient status. Scarcity of water and poor nutrient status are reflected in the form of poor vegetation cover and low productivity in the area. It is further aggravated by high population pressure. The average human and livestock population densities in Indian arid zone are 108 and 137 per square km, respectively. This leads to crop intensification and changes in land use pattern.

Over-exploitation of existing vegetation and over irrigation/use of saline ground water for irrigation have resulted in land degradation as evidenced by the menace of sand drift and secondary salinization. Arid Forest Research Institute (ICFRE), Jodhpur is mandated to work on some of the important aspects to combat desertification and increase productivity in the region. Rajasthan has a rich tradition of water harvesting, which is diminishing with socio-economic changes taking place. Revival of water harvesting structures or developing a proper system of water harvesting can actually help in reviving the complete ecology and therefore the economy of the people living in the region. The current project scientifically studied the impact of various water harvesting structures. A hilly site was selected in Banswara Forest Division, Rajasthan covering slopes of 0-10%, 10-20% and >20%. Rainwater harvesting (RWH) devices are Contour Trench (CT), Gradonie (G), Box Trench (BT), V-ditches (V) along with a control plot. Seventy five plots (three slopes x five treatments x five replicates) in completely randomized block design were laid out. Seventy five run-off measuring devices along with flow control wall fitted with pipes were constructed to control water flow and collect run-off. This project yielded some important observations in terms of impacts of different RWH devices on: overall growth of different plant species, nutrient concentration, species diversity and herbage yield and dry matter production.

Objectives:

- To study the potential of different rainwater harvesting (RWH) devices in controlling run-off losses in different topographical conditions
- To study the effect of different rainwater harvesting devices on biomass productivity
- To study the economic viability of RWH devices for their adoption in large scale utilization of data in assessing land degradation and rehabilitation programme

Achievements:

- Preparation of RWH structures enhanced water availability increasing vegetation production and soil organic carbon. Highest run-off (11.43%) was from the control and lowest was from V-ditch plots (9.33%). There was decreasing trend in soil loss with growth of vegetation in the area. There was significant increase in soil organic carbon particularly in >20% slope area as a result of vegetation growth and litter production. Soil water content (SWC) was highest in August (about 20.0%, w/w) and lowest in June (<2.0%). It was highest in <10% slope except in August when SWC was highest in >20% slope area. Lowest SWC was in 10-20% slope area supporting the result of run-off loss in different slopes. The order of increase in SWC between the treatments was Control< V-ditch< Contour trench< Gradonie< Box trench.
- Based on the effects of RWH treatments on growth performance, the plant species can be categorized into following groups in similar areas: *Dendrocalamus strictus, Phyllanthus emblica, Acacia catechu, Syzygium cumini* performed well in contour trench plots; *Gmelina arborea* and *Hydrangea integrifolia* performed well in box trench plots, and *Acacia indica* and *Ziziphus mauritiana* performed well in V-ditch plots.
- Biological assessment indicated 39, 75 and 81 numbers of herbs/grass species in 2005, 2006 and 2007, respectively in the treated area. Total number of herb/grass species recorded in these years was 131. Among diversity variables, number of species, species population, species diversity and species richness were highest in <10% slope area, whereas species dominance was highest in >20% slope area, and species evenness was highest in 10-20% slope area.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	17 ha
Administrative unit	District Banswara in Rajasthan
Target groups	State Forest Department, Farmers, NGOs, Research Organizations
Project period and status	01 April 2005 - 31 March 2011, Completed
Amount committed	₹1.56 Million
Funding	State Forest Department, Rajasthan

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur 342005,
Web site: http://www.afri.res.in

Fig.18: Enhancing biomass productivity in Aravalli ranges

Programme/Project #2: Study of characteristic features pertaining to bio-drainage potential of some selected tree species

The project aims to study characteristic features pertaining to bio-drainage potential of some selected tree species. Bio-drainage is being considered as one of the economically effective and ecologically benign solutions to the twin problems of water logging and salinity in irrigated command area. Various drainage or traditional reclamation measures such as controlling the intensity of irrigation, providing drainage system, lining, improving natural drainage, preventing seepage or adopting modern technology for application of water are expensive. Therefore, bio-drainage, which is an agronomic solution that provides natural means of drainage for excess water of the area through trees and plant, is considered very effective.

This project was funded by the Ministry of Water Resources, Government of India. It was initiated in 2004 with two field experiments in the Indira Gandhi Nahar Pariyojana (IGNP) in which tree characteristics such as crown spread and girth, transpiration and photosynthesis rate, survival and growth rate etc.were studied. Soil samples were also collected and analysed for pH, electrical conductivity and organic carbon to study the impact on soil salinity and fertility.

Objectives:

- To understand the perspective of trees in providing drainage under given agro-ecological conditions and identify potential tree species for bio-drainage in the region/area.
- To evaluate transpiration and aboveground plant characteristics of some selected tree species having bio-drainage potential in relation to varying surroundings.
- To assess stomatal behaviour and rooting characteristics of tree plants under study.
- To evaluate the capacity of plants to tolerate water logging and soil salinity and understand their adaptability mechanism.
- To determine the relationship of plant water use and biomass characteristics.
- To assess the on-site impact in terms of soil salinity and salt harvest by plants.
- To provide useful data and parameters that can guide planning and design of bio-drainage schemes and their management at region level.

Achievements:

- Performance of *Eucalyptus rudis* has been found to be the best among the tree species with respect to growth, biomass, transpiration rate and overall bio-drainage potential. *E. rudis* maintained uniform transpiration and photosynthesis rate throughout the year. Temporal variation in transpiration and photosynthesis was high in case *E. fastigata* and *E. camaldulensis* plants.
- Soil electrical conductivity, soil organic matter, available nitrogen and available phosphorus varied significantly among different species. All these parameters, except available phosphorus were high in *E. rudis* and low in *E. fastigata*. No significant variation was observed in the soil pH in these species.
- Heavy regeneration of *E. camaldulensis* has been observed.
- *Prosopis juliflora, Tamarix dioica* and *Saccharum munja* also have come up in the area with recession of ground water table as natural succession and contributed significantly for further lowering of ground water table and increasing productivity.

- Transpiration rate was high in *Acacia nilotica* plants followed by *Eucalyptus camaldulensis* and *Tamarix aphylla*. Species wise height, and collar girth was significantly high in *E. camaldulensis* whereas, crown growth was high in *A. nilotica*. With increase in salinity *E. camaldulensis*, *T. aphylla* and *A. nilotica* registered 33%, 20% and 20% reduction in growth respectively as compared to the control. With increase in water logging higher growth was recorded in *E. camaldulensis* however, a decrease in growth parameters was recorded in *A. nilotica* and *T. aphylla*.
- Native species showed higher tolerance towards salinity compared to *E. camaldulensis*. However, under water logging condition at shallow depth *E. camaldulensis* outperformed *A. nilotica* and *T. aphylla*.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	2 ha
Administrative unit	Rajasthan State
Target groups	Rajasthan State Forest Department
Project period and status	01 April 2004 - 31 March 2010, Completed
Amount committed	₹ 4.45 Million
Funding	Ministry of Water Resources, Government of India

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur 342005,
Web site: http://www.afri.res.in

Fig. 19: Growth of different tree species under waterlogged condition in Indira Gandhi Nahar Pariyojana

Programme/Project #3: Mycorrhizal dependency and productivity of economically important medicinal plants (*Lawsonia inermis* and *Withania somnifera*) of arid zones

Biofertilizers (Vesicular-arbuscular mycorrhizal fungi) plays an important role in nitrogen fixation, mineral cycling, energy flow and plant succession in disturbed and undisturbed ecosystems. VAM mycobionts increases the rhizosphere area due to spreading of external mycelium and it can grow to considerable length an average of 12 m per hyphae per gm soil in sub-tropical dune systems. It has been reported that dual inoculation of *Acacia auriculiformis* with *Glomus fasciculatum* and *Rhizobium* increased number of nodules, seedling weight, uptake of nitrogen and phosphorus and acetylene reduction than when these inoculants were used singly. Earlier survey of forest nurseries and plantations of arid and semi-arid tree species showed symbiotic association of VAM fungi in nature, but population of these fungi differs due to temperature, moisture, salinity and soil characters. There is a need to develop specific strains of VAM fungi to suit and enhance productivity of economic important medicinal plants mehndi (Henna, *Lawsonia inermis*) and ashwagandha (Indian ginseng, *Withania somnifera*) of this region.

It is well known fact that soil micro-organisms play a significant role in nitrogen fixation, phosphorous and also provide other essential nutrients to the plants. Manipulation of soil/seedlings with suitable strains of AM fungi and other biofertilizers would ensure better survival and enhance productivity of these species in adverse climatic conditions of arid zones.

Objectives:

- Isolation and identification of AM fungi associated with mehndi and ashwagandha.
- Maintenance of pure cultures of indigenous and non-indigenous strains of biofertilizers.
- Mass production of AM fungi and inoculation in nursery.
- Demonstration trials of VAM on medicinal plants.
- Training on VAM technology to the progressive farmers, NGOs and SFDs.

Achievements:

- Five AMF genera like *Glomus, Gigaspora, Scutellospora, Sclerocystis* and *Acaulospora* species were isolated and identified on *Lawsonia inermis* and *Withania somnifera* from various sites of Rajasthan. *Glomus fasciculatum, G. aggregatum, G. mosseae, G. macrocarpum, G. microcarpum, G. intraradices, G. reticulatum, G. Constrictum, G. multicaulae, G. geosporum* and *G. convolvulus* are the main species.
- The distribution of different VAM species viz., *G. aggregatum* (35%); *G. mosseae* (15%); *G. fasciculatum* (20%); *G. macrocarpum* (10%); *Glomus* sp. (15%); *Scutellospora* (3%) and *Acaulospora* (2%) in *Withania somnifera* whereas, in *Lawsonia inermis* dominanacy of *Glomus fasciculatum* was recorded in all the sites and distribution of AM fungi was recorded as *G. fasciculatum* (55%),

G. aggregatum (20%), *G. macrocarpum* (12%), *Glomus* sp. (8%), *Acaulospora* sp. (5%), *Scutellospora* (3%) and *Sclercystis* (2%).

- The maximum spore population (210/50 g soil) was recorded from Sojat (Pali) and minimum (26 spores/50 g soil) from Pushkar, Ajmer in *Lawsonia inermis*, whereas in *Withania somnifera*, the maximum spore population (129 spores/50 g soil) was recorded from Jodhpur and minimum (27 spores/50 g soil) from Sikar.
- The root infection varied from site to site. The maximum (85%) root infection was recorded from Sojat (Pali) and minimum (46%) in *Lawsonia inermis* from Pushkar, Ajmer. While in *Withania somnifera* maximum root colonization (78%) was recorded from Harima Krihi Farm, Nagaur and minimum (34%) from Ajmer.
- In *Lawsonia inermis*, *Glomus fasciculatum* was found best for plant growth and vigour as compared to other treatments, while in case of, ashwagandha indigenous mixed inoculums with dominancy of *G. aggregatum* was found best for all parameters.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	2 ha
Administrative unit	Rajasthan, Gujarat and Dadar Nagar Hawali
Target groups	Rajasthan, Gujarat and Dadar Nagar Hawali State Forest Departments
Project period and status	01 July 2007 - 31 March 2011, Completed
Amount committed	₹ 0.20 Million
Funding	Indian Council of Forestry Research and Education, Dehradun

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur-342005,
Web site: http://www.afri.res.in

Programme/Project #4: Development of economically viable and integrated agroforestry models for arid region

Agroforestry model established and maintained at farmer's field at village Harsh, Bilara, District Jodhpur (Rajasthan). *Sesbania aculeata* (Dhaincha) was grown during the year in the field for green manuring. Performance of *Ziziphus mauritiana* (grafted ber) species was found the best among horticultural species, while *Colophospermum mopane* was the best in silvicultural species.

Objectives:

- To study the effect of different tree species on the growth and yield of agricultural crops.
- To study the growth and biomass (fodder) of different silvicultural species under different combinations.
- To study interaction effect of silvi- and horti-species.
- To study the effect of different tree species on soil fertility and soil physical characteristics.

Achievements:

- The effect of different tree species on the growth and yield of agricultural crops studied. Wheat crop yield was recorded as 22 Qtl/ha, 18.58 Qtl/ha, 19.6 Qtl/ha and 13.67 Qtl/ha respectively, in 2007, 2008, 2009 and 2010. Effect of different tree species combinations was not significant for wheat yield.
- Height, collar diameter and survival of planted seedlings were observed at six month interval, compiled and analysed. Performance of *Ziziphus mauritiana* (grafted ber) species was found best among horticultural species and *Colophospermum mopane* the best in silvicultural species. Height and collar diameter of *C. mopane* and collar diameter of *Prosopis cineraria, Cordia mixa* and *Z. mauritiana* was significantly higher in agroforestry plot than without crop plot. Survival of planted species is higher in agroforestry plots (81%) as compared to control (59%) as without agriculture crop. Biomass as a form of fodder could not be estimated as the plantation is young and silvicultural species require a long time to produce fodder according to its growth pattern.
- Height and collar diameter of planted seedlings were recorded at six monthly intervals. Wheat crop yields were recorded annually. Tree crop interaction was not significant.
- Initial soil samples collected and analysed in 0-25 and 25-50 cm soil depth in all the plots (36 plots). The baseline soil data on pH, electrical conductivity, organic carbon, available nitrogen and phosphorus of soil was analysed.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	3.67 ha
Administrative unit	Rajasthan
Target groups	Rajasthan State Forest Department
Project period and status	01 April 2006 - 31 March 2012, Completed
Amount committed	₹ 1.06 Million
Funding	Indian Council of Forestry Research and Education, Dehradun

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur 342005
Web site: http://www.afri.res.in

Programme/Project #5: Effect of fertilizer application on growth and yield of 10 years old *Salvadora persica* and *Acacia ampliceps* plantations under silvipastoral system on arid salt affected soil

In India approximately 2 to 10 Mha area suffers from salinity and alkalinity problems in different states. In Rajasthan, Gujarat, Haryana and Punjab states approximately 1.08 Mha is affected with salt problems. There are two major tracts in arid western Rajasthan having exceptionally large and wide occurrence of soil salinity. One is the area of far flood plain deposits of Ghaggar system in the north-west, adjoining Haryana State and the other is in the south-east identified broadly as Bilara-Sumerpur-Jalore triangle. Salinization is the accumulation of soluble salts of sodium, magnesium, and calcium in soils. High levels of soil salinity limit plant growth; the increased osmotic pressure of the soil solution reduces the plant's capacity to withdraw water from the soil. Utilization of these salt affected areas has become necessary owing to increasing need for fodder, fuel and other minor produce. However, there are very few plant species which can perform on salt affected areas.

Salvadora persica, an evergreen multi-purpose tree, is the main salt tolerant indigenous tree species on arid salt-affected lands in India. Its fruit is edible and the seed is rich in oil and contains lauric, myristic and palmitic acids having potential for making soaps, candles and as a substitute for coconut oil. *Acacia ampliceps* (Salt wattle) belonging to family Mimosaceae is native to south-western Australia. It is shrub or small tree, 2-8 m high, and can be found on sandy or loamy alluvial soils with an alkaline reaction. It is highly tolerant to salinity. It is a very good fodder for all animals. Plantations of *Salvadora persica* (1997) and *Acacia ampliceps* (1998) were raised on saline-alkali land located in Jodhpur district of arid Rajasthan. This area is characterized by sandy plain having hard and compact substrata at shallow depth, which is impervious to roots and water. The study area was a hummocky, sandy plain with a shallow, hard and compact substratum, impervious to roots and water, with different levels of gypsum and nitrogen. The soil of the experimental site was classified as lithic, calcid, coarse sandy to loamy sand, with a thick hard pan of calcium carbonate at a depth of 25-100 cm. The soil pH ranged from 8.2 to 9.8 and electrical conductivity from 4.2 to 16 d Sm^{-1}. Salt encrustations were observed at many places with electrical conductivity values as high as 48 d Sm^{-1}. The exchangeable sodium percentage ranged from 30 to 60%.

Objectives:

- To study the effect of fertilizer application to enhance the productivity in terms of growth and yield
- Improvement of productivity of salt affected degraded lands by introduction of silvipastoral system

Achievements:

- In a poor monsoon year in *Salvadora persica* the final fruit setting was in 36% plants only in April 2010; maximum 78% trees produced fruit in T13 and T10 treatments. Most trees have mixed coloured (purple, white and pink) fruits but in a few trees only white fruits were observed.
- In *Acacia ampliceps* flowering was observed in January 2010 in 54% of plants under treatment.
- Oil yield vary from 35.2-43.1%.
- Zinc application influenced the fruit yield and maximum total fruit yield/treatment (971 g) was obtained in T13 and T4 treatments. Yields in other treatments varied from 20-123 g.
- In a good monsoon year both the grasses *Saccharaum* sp. and *Cenchrus ciliaris* produced significantly higher yield on soil structures as compared to control. The yield was 905.6 g/m^2, 893.7g/m^2 (slope) and 464.6g/m^2 (control) for *Saccharaum* sp. and 527g/m^2, 1104g/m^2 (slope) and 169g/m^2 and *C. ciliaris* (control) respectively for *C. ciliaris*. Slope is best for establishment of *C. ciliaris* as salt leaching helped.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	5 ha
Administrative unit	Rajasthan
Target groups	Rajasthan State Forest Department
Project period and status	01 April 2008 - 31 March 2012, Completed
Amount committed	₹ 0.66 Million
Funding	Indian Council of Forestry Research and Education, Dehradun

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur -342005,
Web site: http://www.afri.res.in

Fig.18: Development of silvipastoral system in arid areas

Programme/Project #6: Productivity and biometrics studies on some important species in semi-arid regions of Rajasthan for their sustainable management

The pressures exerted by the rising human populations on uninhabited forest lands are a cause of great concern. Appropriate and effective technologies have to be developed for sustainable management of plantations and forests. The complex interaction between the level of growing stock, timber harvest and tree growth is the guiding theme of forest management. Growth modelling is an essential prerequisite for evaluating the consequences of a particular management action on the future development of forest ecosystem. Measurements of individual tree diameters and heights are commonly obtained in most forest inventory situations in order to estimate tree and stand volume. The development of the height and diameter of trees over a period of time in a stand not only characterizes stand development but also provides insight about the yield potential of the site. Site index has been the most widely used means for estimating potential forest site productivity. Estimating the potential density of forest stands, in terms of the surviving trees per hectare, is a central element of growth modelling. It is also one of the most difficult problems to solve, mainly because suitable data from untreated, densely stocked stands is very rarely found. Populations of trees growing at high densities are subject to density-dependent mortality or self-thinning. The stand basal area is an important density measure, which simultaneously takes into account the average tree size and the number of trees per unit area. The problem of management of plantations is being faced by the State Forest Departments and exhaustive growth and yield studies on the tree species in India are still lacking. The study was conducted in semi-arid tracts on a few species like *Acacia excelsa, A. nilotica, A. tortilis* and *Albizia lebbeck.*

The results of this work will help State Forest Departments and other target groups to plan their future strategy to manage the plantations in a better way. Growth and yield studies are helpful in deciding the type and timing of management strategies and assessing the growth potential and hence the current and future economic value of the forest stands. The outcome of this work, help the State Forest Departments, planters and other interested groups in management and planning. The data and models generated from growth and yield studies are an essential pre-requisite for forest management and hence are of utmost importance for suitable forest development.

Objectives:

- To develop growth and yield models (height, basal area) for sustainable management of plantations of selected species in semi-arid areas of Rajasthan
- Construction of tree volume equations

Achievements:

Reconnaissance surveys of the plantation areas were conducted and 50 plots in Jaipur, Sri Ganganagar, Sikar, Bikaner, Jaisalmer and IGNP areas were selected.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	-
Administrative unit	Rajasthan
Target groups	Rajasthan State Forest Department
Project period and status	01 April 2009 - 31 March 2012, Completed
Amount committed	₹ 0.55 Million
Funding	Rajasthan State Forest Department

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur-342005, Web site: http://www.afri.res.in

Programme/Project #7 Enhancing productivity of saline wastelands in Kachchh - through improved tree planting techniques and silvipastoral study

The project aims to study the relationship between survival rates of different tree and grass species and plantation techniques with reference to highly saline areas. Forests have a major role to play in reversing desertification trends. Forests in these areas provide extremely critical ecological services such as soil and water conservation, providing fodder for livestock rearing, and helping to mitigate climate change impacts. In arid zones, agro-forestry practices help in mitigating the consequences of irregular and unforeseen rainfall and of economic fluctuations through the regular and reliable supply of substitute products for man and livestock, reducing pressure on local resources and encouraging sustainable production. However, afforestation/tree plantation in this area is extremely difficult due to high salinity and extreme weather conditions. Growth is slower; survival rates are lower, and plant protection presents great difficulty. Therefore, holistic scientific knowledge on forest ecology in arid and semi-arid zones is necessary for combating desertification and mitigation of climate change impact in these areas.

Objectives:

- To screen different exotic and indigenous plant species for their survival, growth and biomass production potential.
- *To find out the best planting technique and optimum level of amendments and fertilizers.*
- *Improvement of productivity of degraded lands by introduction of silvipastoral system.*

Achievements:

- *Salvadora persica* proved to be best plant and surviving in the extemely harsh conditions of high salinity, heat stress after two consecutive summers (2009-10) and one drought year (2009) suffering almost no casualties and maintaining nearly the same mean survival (91.5%) after three years of planting as compared to 92.8% at 12 months of age.

- *Acacia bivenosa* was at second place surviving one summer and one drought year with 10.2% decrease in mean survival, 77.3% at 30 months compared to 86.1% in 12 months.
- *Salvadora persica* attained height after pruning and a mean increment of 12.1% was obtained compared to height at 30 months which was 7.9% more than height before pruning.
- Grasses dominate and *Chloris virgata* was the most dominant species followed by *Dactyloctenium aegypticum, Cynodon dactylon, Aristida* sp, *Cyperus* sp. and *Echinochloa colonum*. Among herbs *Zygophyllum simplex* was the most dominant followed by *Taverniera cuneifolia* (Jathi moth), *Suaeda fruticosa, Vernonia cinerea* and *Polygala erioptera*.
- A long heat spell delayed monsoon followed by downpour resulting in water stagnation adversely affected the green grass yield in both the experiments in the year 2010. It was 0.67 and 0.45 kg/m^2 for *Cenchrus ciliaris* and *C. setigerus*.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	5 ha
Administrative unit	Gujarat
Target groups	State Forest Department, Farmers, NGOs, Research Organizations
Project period and status	01 July 2006 - 01 August 2012, Completed
Amount committed	₹ 0.76 Million
Funding	State Forest Department, Gujarat

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur-342005
Web site: http://www.afri.res.in

Fig.19: Development of grasslands in Kachchh region

Programme/Project #8: Characterization and classification of forest soils of Rajasthan

Unlike agriculture lands, forest soils usually draw less attention and are ignored in spite of the fact that they nourish the lungs of the earth. Soil quality is the most important factor in forest management decisions. Soils will determine productivity of a particular forest and the management strategy. Knowing about forest soils can serve as a basis for forest management decisions, including land acquisition, species selection for planting, site preparation requirements, watershed development, fertilization perceptions, stand density/composition, and harvest timing, as well as decisions affecting land ownership and use. Information on distribution, potential and constraints of major forest soils is needed, so that the most appropriate soil management systems can be designed in order to increase the productivity.

Objectives:

- To characterise forest soils of Rajasthan
- To classify forest soils of Rajasthan according to USDA classification
- To estimate carbon stock in forest spoils of Rajasthan

Achievements:

Soil profiles have been studied at 425 places in Pali, Banswara, Pratapgarh, Dungarpur, Jodhpur, Udaipur, Sri Ganganagar, Hanumangarh, Jhunjhunu, Sikar, Bikaner, Nagaur, Barmer, Sirohi, Jalore, Jaisalmer, Chittorgarh, Bhilwara, Baran, Tonk, Alwar, Bharatpur, Jaipur, Dausa and Rajsamand districts covering 377 forest blocks. Physico-chemical characterization of the soils has been done in the field as well as in laboratory. Soil texture, structure, consistency, colour, pH, electrical conductivity, organic carbon, NO_3 and NH_4, nitrogen and phosphorus have been estimated for 1,531 samples. Ecological study in an area of 0.1 ha near each of the soil profile pit has been completed.

In general soils of western districts are poor in nitrogen and phosphorous. Available nitrogen and phosphorous vary between 7 - 42 kg ha^{-1} and 8 - 56 kg ha^{-1}, respectively. Soils of Chitrimata block, Pratapgarh have high nitrogen (86 kg ha^{-1}) and phosphorous (78 kg ha^{-1}) content.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Administrative unit	Rajasthan
Target groups	State Forest Department, Farmers, NGOs, Research Organizations
Project period and status	01 April 2007 - 31 March 2013, Completed
Amount committed	₹ 0.75 Million
Funding	Indian Council of Forestry Research and Education, Dehradun

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur 342005
Web site: http://www.afri.res.in

Programme/Project #9: Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli of Rajasthan

Vegetation composition and environment factors are responsible for soil formation. Soil is the basic component of forest/rangeland ecosystems and is associated with nearly all ecosystem processes including as a medium to support plant growth and home for innumerable insects and microorganisms. In terms of human life-spans, it is a non-renewable resource and should be treated as such. Soil is a product of parent material, climate, living organisms, topography and time. The soil formation processes work slowly, especially in dry areas. It is believed to take several hundred years to replace an inch of top soil lost by erosion. Thus both vegetation and soil are products of the same group of independent variables and both mutually influence each other; neither is the result of the other. A better understanding of the causes of land degradation and its relation with the plant species is necessary in the development and the implementation of a rehabilitation strategy for degraded ecosystems.

The bridging zone of Malwa plateau and lower Aravalli indicated a variety of soils derived from parent material like granite, gneiss, basalt, metamorphic schist, sand stone, phyllite, quartzite, nodular limestone etc and supposed to support varying types of vegetation depending upon soil texture and nutrient supply.

The chemical and physical characteristics of a soil determine its ability to furnish plant nutrients; the rate and depth of water penetration, the amount of water the soil can hold and its availability to plant. Fine-textured soils, especially without plant or residue cover, tend to reduce water infiltration. Coarse-textured soils may have high infiltration rates but dry to deeper depths than the fine-textured soils. In such circumstances, management decisions should not be made without a careful consideration of its impact on the soil. However, soil characters are also dependent upon the type of parent material from which the soil has been derived, as well as climate. Thus, assessment of soil properties derived from different parent material and their relationship with the vegetation, particularly herbs/grasses, is essential. It may help in identifying indicator species suitable for ecosystem health and hillslope hydrology and useful in adopting management strategies in rehabilitation and control of land degradation. There are variations in parent materials and soil types in hilly tracts of lower Aravalli, which face varying degrees of land degradation, and their restoration needs to be based on ecological approach.

Objectives:

- Study of physical properties and nutrient status of soil derived from different parent material
- Study of vegetation structure and indicator species on dominant soil types
- Utilization of data in assessing land degradation and rehabilitation programme

Achievements:

Based on Importance Value Index (IVI), sites were dominated by *Wrightia tinctoria, Tectona grandis, Lannea coromandelica* and *Anogeissus pendula* tree species, respectively. Among shrubs, *Nyctanthes arbor-tristis* dominated at first two sites of Gujarat, whereas *Lantana camara* dominated at Banswara, *Rhus mysorensis* at Rajasamand and *Euphorbia caducifolia* at Pali sites. Among herbs and grasses, *Hyptis suaveolens, Aster lanceolatus, Aristida mutabilis* and *Apluda mutica* dominated the respective sites. Total numbers of species (tree, shrubs and herbs and grasses) were 85, 100, 109, 95 and 87 at the sites in Banaskantha, Sabarkantha, Banswara, Rajasamand and Pali, respectively, in 2011. Height of the herbaceous vegetation was in the order of Rajsamand >Sendra >Banswara >Sabarkantha >Banaskantha, where numbers of herbaceous species were 8.6, 8.4, 9.9, 18.2 and 10.1, respectively. Production of herbaceous biomass was highest at Sabalia site of Rajasamand and the lowest biomass production was at Pali site.

The order of sites in terms of herbaceous biomass production was Rajsamand> Banswara> Sabarkantha> Pali> Banaskantha. Soil Water Content (SWC) was lowest at Pali site throughout the year. SWC was highest at Banswara in June 2011 and February 2012 and at Sabarkantha site in October 2011. In October 2011, soil pH was lowest at Sabarkantha and was associated with the lowest electrical conductivity, nitrogen and highest SWC, and, number of species and their

Fig. 20: Rehabilitation in lower Aravalli of Rajasthan

populations. Concentration of NH4-N was highest at Trisulia forest in Banaskantha, whereas it was lowest in Motimori forest in Sabarkantha division. The highest nitrogen concentration at Rajsamand was related to lowest number of species and highest quantity of herbaceous biomass.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Area covered	500 ha
Administrative unit	Banasknatha, Sabakantha in Gujarat and Banswara, Rajsamand and Pali in Rajasthan
Target groups	State Forest Department, Farmers, NGOs, Research Organizations
Project period and status	01 April 2010 - 31 March 2014, Ongoing
Amount committed	₹ 1.17 Million
Funding	State Forest Department, Rajasthan

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur-342005
Web site: http://www.afri.res.in

Programme/Project #10: Impact of *Prosopis juliflora* on biodiversity, rehabilitation of degraded community lands and as a source of livelihood for people in Rajasthan State

There gaps in the knowledge on various aspects of environmental biology of exotic species especially *Prosopis juliflora.* The fast adaptation and spread in comparison to other species by exotic species is becoming a threat to biological diversity as it is not allowing other species, especially the native species, to perpetuate. They have been introduced at many places, and at many places they get established due to seed dispersal by various abiotic and biotic agents along their migratory route, indirection of wind, flow of water, etc. They are indicators of climate change as they are able to adapt better in the existing habitat, becoming a threat to native species. People of the area have developed their own ways and means of tackling these exotic species. Some are perceived as beneficial and consequently native species are facing eradication. The cause of this fast spread is not fully known and is becoming a challenge to the researchers. *Prosopis juliflora,* once introduced during drought in the early 1950s has now spread throughout Rajasthan and Gujarat, invading grasslands, farmers' fields as well as protected areas. *Acacia tortilis* is another such species being extensively planted on different wastelands by State forest Department under various watershed programmes, etc. Similarly many other exotic tree species are being planted by different organizations. Currently, knowledge and comprehensive data is still lacking on exotic species for desert ecosystem. National Biodiversity Strategy and Action Plan (NBSAP) has laid emphasis on the documentation of these species. Their effects, especially in conserving bio-diversity, need to be systematically documented at one place for holistic environment impact evaluation. Special

emphasis is required on *P. juliflora* and some other species such as *Acacia tortilis, A. auriculiformis, Eucalyptus* sp. *and Leucaena leucocephala.*

Success of the project will result in site sustainable research extension covering all aspects of forestry development and biodiversity conservation. This outcome would not only sensitize planners to formulate the developmental projects and schemes for eco-restoration and rehabilitation of degraded areas but motivate farmers to adopt sound conservation strategies in their fields for utilization of exotic species thus assisting in enriching forest in arid areas and strengthening the Van Vigyan Kendras of AFRI, Jodhpur.

Objectives:

- Inventorization of forest exotic species in different agro-climatic zones of Rajasthan with special emphasis on *Prosopis juliflora*.
- To study the dependent/associated faunal diversity and their economic status with special emphasis on *P. juliflora*.
- To identify exotic species suitable for rehabilitation of degraded community lands.
- Documentation of traditional knowledge on forest exotic species if any.
- To develop strategies for utilization of forest exotic species as source of livelihood.
- Development of awareness material such as informative brochures, booklets, etc.

Achievements:

Survey was carried out in and around Jodhpur, Pali and Bharatpur districts of Rajasthan and associated floral and faunal diversity of the selected sites were recorded in grazed and ungrazed areas*. Prosopis juliflora* density was worked out in sacred groves,grazing lands, protected areas, revenue lands, wastelands, wetlands, saline lands, agriculture fields and urban forestry models. The floral diversity was represented by 29 species of herbs, shrubs and trees belonging to 16 families. The most dominant family recorded was Fabaceae, followed by Salvadoraceae and Poaceae among the associated floral diversity.

Studies on dependant or associated faunal diversity revealed that 22 species were of soil arthropods and entomofaunal invertebrates. Vertebrates accounted for 42 species, directly or associated with *P. juliflora*. The inflorescence of *P. juliflora* attracts large number of bee species and a number of beehives was also observed. One species of Homoptera (*Cicada*) and two species of Coleoptera (*Myllocerus*) were reported for the first time from *P. juliflora* from India.

Studies on utilization aspects revealed that *P. juliflora* tree has given a wide-spread green cover to the xeric environment of the Indian desert, besides providing fuel, fodder and food for man, cattle and wildlife, especially during severe summer and winter months. Studies on utilization of other exotic species associated with *P. juliflora* revealed that *Acacia auriculiformis* leaves were extensively used for amelioration of henna (mehndi) quality for commercial use and its bark for tanning purposes, whereas *Acacia tortilis* was used mainly as fuelwood and *Parkinsonia aculeata* as an ornamental tree.

Facts and Figures:

Nodal/Implementing Agency	Arid Forest Research Institute (AFRI), Jodhpur
Administrative unit	Rajasthan
Target groups	State Forest Department, Farmers, NGOs, Research Organizations
Project period and status	01 April 2010 - 31 March 2013, Completed
Amount committed	₹ 0.80 Million
Funding	Indian Council of Forestry Research and Education, Dehradun

For more information: Arid Forest Research Institute, P.O Krishi Upaz Mandi, New Pali Road, Jodhpur-342005,
Web site: http://www.afri.res.in

Fig.18: Development of silvipastoral system in arid areas

Programme/Project #11: Enrichment of land degradation datasets with soil datasets of different states of India

This inter-institutional project was undertaken to enrich the information of land degradation maps (1:50,000 scale) prepared by National Remote Sensing Centre with the selected soil parameters of soil resource maps of National Bureau of Soil Survey & Land Use Planning and to finalize the state-wise land degradation maps of India. The main activities involved in the project are (i) projection transformation of soil/soil loss datasets to make it compatible with land degradation datasets, (ii) appending the identified ten soil parameters relevant to land degradation to enrich land degradation datasets using the suitable option in Geographical Information System (GIS), (iii) reconciliation of the enriched land degradation datasets, and (iv) finalization of the state-wise enriched land degradation maps with suitable legends. The soil parameters pertinent to land degradation like slope, erosion, parent material, soil depth, surface texture, surface stoniness, particle size, calcareousness, soil reaction (pH) and soil salinity/sodicity have been identified to enrich the land degradation datasets. The GIS based methodology has been standardized to enrich the land degradation datasets with soils datasets of different states of India. Using various GIS techniques, the enriched land degradation (LD) datasets were further processed to generate the

unique land degradation class. The generated enriched datasets were reconciled during the project review meetings. Finally, unique codes were generated at national scale for representation of LD classes at India level. Class-wise area statistics have been generated for each state. By compiling the state-wise legend, the legend at India level has been finalized.

Objectives:

- Enrichment of land degradation maps with soil/soil loss parameters
- Finalization of state-wise enriched land degradation maps of India.

Achievements:

Enriched land degradation maps at state level.

Facts and Figures:

Nodal/Implementing Agency	National Bureau of Soil Survey and Land Use Planning, Nagpur
Area covered	
Administrative unit	Whole country
Target groups	-
Project period and status	01 January 2010 - 31 August 2011, Completed
Amount committed	₹ 0.60 Million
Funding	National Remote Sensing Centre

For more information: National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur - 440 03,
Web site: http://www.nbsslup.in/

Programme/Project #12: Policy and institutional reform for mainstreaming and up-scaling sustainable land and ecosystem management in India

The project has enhanced the institutional and policy framework for harmonization, coordination and monitoring of interventions in agricultural and natural resources management strategies. The aim is to promote sustainable land management and enhance agricultural productivity while minimizing environmental impacts. The Sustainable Land and Ecosystem Management (SLEM) Programme is a joint initiative between the Government of India (GoI) and the Global Environmental Facility (GEF), under the latter's Country Partnership Programme (CPP).

Under the SLEM Programmatic Approach, seven projects have been formulated, and are under various stages of implementation. One of the projects, titled “Policy and Institutional Reform for Mainstreaming and Scaling-up of the Sustainable Land and Ecosystem Management”, led to the setting up of a Technical Facilitation Organisation (TFO), at the Indian Council for Forestry Research and Education (ICFRE), Dehradun to coordinate among the implementing agencies, draw learning experiences from the projects and mainstream the same into the policy environment in the country.

This project is designed to strengthen the institutional and management functions of the Indian institutions responsible for the SLEM CPP. The overall objective of the SLEM partnership is to contribute to poverty alleviation in India by promoting enhanced efficiency of natural resource use, improved land and ecosystem productivity, and reduced vulnerability to extreme weather events, including the effects of climate change.

Under this project a robust implementation, monitoring and oversight framework for the programme has been instituted, which is called Technical Facilitation Organization (TFO). ICFRE Headquarters and its regional research institutes provided the requisite technical support as and when required to SLEM projects located in different parts of the country. The activities to be undertaken by the TFO include coordination, planning, cooperation, outreach, and implementation and monitoring and evaluation (M&E) functions of the programme

The proposed implementation arrangements are designed to ensure that the lessons learnt from these projects are mainstreamed into institutional strategies and scaled up into land management policy. TFO would collate information on knowledge system, best practices and that will enable formulation of recommendations for policy, strategy and approaches for sustainable land and ecosystem management.

Objectives:

The overall objective of the SLEM partnership is to contribute to poverty alleviation in India by promoting enhanced efficiency of natural resource use, improved land and ecosystem productivity, and reduced vulnerability to extreme weather events, including the effect of climate change. The immediate objectives of SLEMCPP are the following:

- *Prevention and/or control of land degradation by restoration of degraded (agricultural and forested) lands and biomass cover and make sustainable use of natural resources in selected project areas;*
- *Enhancement of local capacity and institution building to strengthen land and ecosystem management;*
- *Facilitation of knowledge dissemination and application of national and international good practices in SLEM within and across states; and*
- *Replication and scaling-up of successful land and ecosystem management practices and technologies to maximise synergies across the UN Conventions on Biological Diversity (CBD), Climate Change (FCCC), and Combating Desertification (CCD).*

Achievements:

Institutional and Policy Mainstreaming: A draft report on baseline study at national and eight selected states namely: Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Rajasthan, Nagaland, Uttarakhand, Kerala and Orissa have been finalized. Emerging trends based on baseline study were recorded and interpreted. The draft report of all the thematic areas was prepared for policy and institutional reform mainstreaming and up-scaling sustainable land and ecosystem management

in India. The baseline study will help in drawing inferences on impact of intervention that aim at reversing the process of land degradation through SLEM.

Outreach and knowledge management for scaling-up of sustainable land management solutions: A communication strategy for SLEM-CPP has been developed and conveyed to the SLEM Project Partners and the World Bank and it is currently under review. During the study period newsletters, SLEM brochure, proceedings of workshops and seminars, annual reports and website for the SLEM-CPP project were developed and communicated to the stakeholders.

Partnership programme management and monitoring and evaluation: A monitoring and evaluation framework has been conceptualized which will serve as a tool to monitor the outcomes of the SLEM approaches, policies and strategies at national, state and local level.

Facts and Figures:

Nodal/Implementing Agency	Indian Council of Forestry Research and Education
Area covered	-
Administrative unit	Different states and Union Territories of India
Target groups	-
Project period and status	11 August 2009 - 31 July 2013, Ongoing
Amount committed	1.00 Million USD
Funding	Global Environmental Facility

For more information: Indian Council of Forestry Research and Education, P.O. New Forest, Dehradun, Web site http://www.icfre.gov.in

Fig. 22: Sustainably managed agro-ecosystem

Programme/Project #13: Nationwide mapping of land degradation at 1:50,000 scale

Objective:

Preparation of a land degradation map of the five districts (Jaislamer, Bikaner, Ganganagar, Hanumangarh, Churu districts) of western Rajasthan as a part of Nation wide mapping at 1:50,000 scale.

Achievements:

As a national level mapping, land degradation map for five districts of western Rajasthan (Churu, Hanumangarh, Ganganagar, Bikaner and Jaisalmer) has been prepared using multi-temporal resourcesat -1 LISS-III data of kharif (2005), rabi (2006) and zaid seasons (2006) and field survey. The degraded and barren, rocky lands together cover 72496 km^2 area (70.73% of the total area mapped). The maximum coverage is by wind erosion units (65063 km^2 area; 63.48%), followed by barren rocky/stony areas (5723 km^2 area; 5.58%), mine-degraded lands (514 km^2 area; 0.50%), water erosion units (507 km^2 area; 0.49%), salinity (425 km^2 area; 0.41%), and water logging (264 km^2 area; 0.26%). Thus, only 30004 km^2 area (29.27%) is free from mappable degradation.

Facts and Figures:

Nodal/Implementing Agency	Central Arid Zone Research Institute, Jodhpur
Area covered	10310900 ha
Administrative unit	Jaislamer, Bikaner, Ganganagar, Hanumangarh and Churu districts of Rajasthan
Target groups	-
Project period and status	01 November 2007 - 31 December 2010, Completed
Amount committed	₹ 3.25 Million
Funding	Global Environmental Facility

For more information: Central Arid Zone Research Institute, Jodhpur - 342 003 (Rajasthan), Web site http://www.cazri.res.in

Programme/Project #14: Plantation and green belt development around Chandrapura Thermal Power Station, Chandrapura, Dhanbad

Objectives:

- Establishment of permanent Hi-Tech Nursery.
- Soil amendments (doses per pit) for ash deposits in between ash ponds B, C and D, around ash pond A and fallow areas in the north and east of ash pond A
- Plantation models for green belt area in and around ash ponds A, B, C and D
- Plantation along the ridges
- Plantation along the slopes
- Maintenance of plantations

Fig. 23: Green Belt Development

Achievements:

- Established a high-tech nursery
- Raised planting stocks at Chandrapura of *Acacia mangium, A. auriculiformis, Albizia lebbeck, Alstonia scholaris, Azadirachta indica, Bombax ceiba, Bauhinia variegata, Delonix regia, Dalbergia sissoo, Eucalyptus tereticornis, Gmelina arborea, Melia azedarach, Sesbania grandiflora, Pongamia pinnata, Syzygium cumini, Terminalia arjuna, Swietenia mahagoni, Spathodea campanulata, Peltophorum ferrugineum* and *Anacardium occidentale* etc.
- Plantation on ridges and slope of ash pond areas: A total of 25800 seedlings of the above species have been planted.
- Afforestation on degraded forest lands 20 ha on North-east of ash pond 'A' and 10 ha on north of ash pond 'D'.

Facts and Figures:

Nodal/Implementing Agency	Institute of Forest Productivity
Area covered	23 ha
Administrative unit	Chandrapura region in the district of Dhanbad, Jharkhand
Target groups	-
Project period and status	02 June 2008 - 31 March 2013, Ongoing
Amount committed	₹ 7.30 Million
Funding	Damodar Valley Corporation, Kolkata

For more information: Institute of Forest Productivity, Ranchi,
Web site: http://www.ifpranchi.org

Programme/Project #15: Uttarakhand decentralised watershed development project

Agriculture is the main source of household income in Uttarakhand for over 70% of the population. However agriculture incomes remain low because of: (i) small and scattered land holdings, (ii) subsistence farming and lack of modern pre and post harvest practices, (iii) low productivity of subsistence cereals, (iv) fragile soils with steep slopes and (v) inadequate basic rural infrastructure. In this context, Uttarakhand decentralised watershed development project was conceived with the objective of improving the productive potential of natural resources and increase the incomes of rural inhabitants in selected watersheds through socially inclusive, institutionally and environmentally sustainable approaches.

The Uttarakhand decentralized watershed development project was launched in September, 2004 and ended in March 2012. The project aimed at improving the productive potential of natural resources and increasing incomes of rural inhabitants in selected watersheds through socially inclusive and environmentally sustainable approaches. The project envisages participatory watershed development and management, enhancing livelihood opportunities and institutional strengthening. The total cost for this project was Rs.402.98 crores and the total area covered was 0.234 Mha in 468 Gram Panchayats of 11 districts namely Almora, Champawat, Nainital, Rudraprayag, Uttarkashi, Bageshwar, Dehradun, Pauri Garhwal, Tehri Garhwal, Pithorgarh, and Chamoli.

- Project area includes highly degraded, poverty ridden areas with poor connectivity and infrastructure in the the middle Himalayas.
- A decentralized institutional setup using Gram Panchayat as planning, implementation and monitoring agency.
- Focus on vulnerable groups and sustainability issues.

Expected project outcomes are 10 pen cent increases in household income, 10 per cent increase in biomass, 15 per cent increase in availability of water for drinking and other purposes and 20% increase in institutional capacity of Gram Panchayat.

Objectives:

To improve the productive potential of natural resources and Increase incomes of rural inhabitants in selected watersheds through socially inclusive, institutionally and environmentally sustainable approaches.

Achievements:

- 10% increase in house hold real income due to project intervention in targeted villages.
- 10% increase in vegetative and biomass index of treated Gram Panchayat area.
- 10% increase in percentage of household accessing water for domestic use and 15% increase in irrigated area in treated areas.
- 20% improvement in administrative capacity of Gram Panchayat

Facts and Figures:

Nodal/Implementing Agency	Uttarakhand Watershed Management Directorate
Area covered	2.34 Mha
Administrative unit	Uttarakhand
Target groups	-
Project period and status	24 September 2004 - 31 March 2012, Completed
Amount committed	77.60 Million USD
Funding	World Bank Group

For more information: Watershed Management Directorate, Indira Nagar, Forest Colony, Dehradun-248 006, Website:http://www.iwmp-uttarakhand.in/

Fig. 24: Watershed development in Uttarakhand

Programme/Project #16: Sustainable land, water and biodiversity conservation and management for improved livelihoods in Uttarakhand

The main objective of this project is to improve the productive potential of the natural resources and increase incomes of rural inhabitants in selected watersheds through socially inclusive, institutionally and environmentally sustainable approaches.

Uttarakhand is a mountainous Himalayan state in northern India known for its diverse eco-systems and rich faunal and floral diversity. The state is losing fertile soil at the rate of up to 10 times the national average each year. Growing human and livestock population is resulting in increased demand for food, fuelwood and fodder for livestock. Agriculture is one of the core economic activities for over 80 per cent of population and the role of forests in sustaining agriculture is immense. In order to abate soil erosion and loss of forest biomass, both of which lead to a decline in agricultural production and an expansion of the cultivated area accompanied by loss of biodiversity, it is necessary to increase agricultural productivity in the hills. From the parent Uttarakhand

Decentralised Watershed Development Project which is spread over an area of 2,348 km^2, altitude ranging from 700 m to 2000 m in 76 selected micro-watersheds and covering a population of 254,000 in the middle Himalayas, the current project is focus on the treatment in 20 microwatersheds (MWS). The project encompasses the following three themes:

- Community participation in watershed development and management aimed at integrating land-water use with the objectives of moisture retention and biomass production, while simultaneously enhancing incomes and livelihood options;
- Strengthening administrative capacity of Gram Panchayats to manage project financial resources, implement sub-projects, deliver legally mandated service, and to sustain those services beyond the duration of the project;
- Ensuring equitable participation by all groups, especially the landless and women who rely disproportionately on common resources for fodder, fuel, and other forest products.

Objectives:

- Sustainable watershed management mainstreamed into local governance plans including parts of watershed for which two or more Gram Panchayats have shared governance responsibility.
- Implementation of alternative technologies and approaches for enhancing water availability for agriculture and other domestic use.
- Reduction in community dependence on forest for fuelwood.
- Marketing opportunities for medicinal and aromatic plants.
- Improved knowledge of the impact of climate change on mountain ecosystems translated into coping strategies.
- New and innovative techniques and approaches for sustainable land and ecosystem management up-scaled within the Uttarakhand state.

Achievements:

- Sustainable watershed management mainstreamed into village-level watershed development plans including parts of micro-watersheds lying outside the boundaries of the village;
- Reduced soil erosion, increased bio-mass and enhanced availability of water in the watershed throughout the year;
- Adoption of new technologies, processes and production systems for creation of markets for non-timber forest products;
- Improved biodiversity in qualitative and quantitative terms at watershed level;
- Enhanced understanding of the impacts of climate change on natural resource based mountain economies.; and
- Replication and up-scaling of policies, approaches and guidelines for sustainable land and ecosystem management, including biodiversity conservation and adaptation to climate variability and change in mountain ecosystems.

Facts and Figures:

Nodal/Implementing Agency	Uttarakhand Watershed Management Directorate
Area covered	60000 ha
Administrative unit	Uttarakhand
Target groups	-
Project period and status	12 November 2009 - 31 August 2013, Ongoing
Amount committed	7.49 Million USD
Funding	Global Environment Facility

For more information: Watershed Management Directorate, Indira Nagar, Forest Colony, Dehradun-248 006, Website:http://www.iwmp-uttarakhand.in/

Programme/Project #17: Reversing environmental degradation and rural poverty through adaptation to climate change in drought stricken areas in southern India: A hydrological unit pilot project approach

The geographical boundary of the project is the State of Andhra Pradesh (AP) in India. AP experiences high climate variability and some districts are affected by recurrent droughts, which include Anantapur, Kadapa, Kurnool, Chittoor (in the Rayalaseema region), Mahbubnagar, Nalgonda, (in Telangana region) and Prakasam (in Coastal Andhra region).

Food and Agriculture Organization (FAO) is the Global Environment Facility (GEF) Agency for the project. FAO provides supervision and technical guidance services during project execution. Administration of the GEF grant is in compliance with the rules and procedures of FAO, and in accordance with the agreement between FAO and the GEF trustee.

Bharathi Integrated Rural Development Society (BIRDS) is the project executing agency responsible for implementation of project activities and day-to-day monitoring and financial management in accordance with FAO rules and procedures and GEF requirements as established in the agreement with FAO and with project execution, technical and administration guidelines. Department of Rural Development (Government of Andhra Pradesh) nominated the Chairperson of the Project Steering Committee, who is expected to mainstream the project experiences into the regular governmental programmes and projects.The Ministry of Environment and Forests (MoEF), GoI is the focal point Ministry for GEF. MoEF is responsible for leading the preparation and implementation the preparation of Government policies related to sustainable land management, biodiversity conservation and climate change. Indian Council of Forestry Research and Education (ICFRE) is the Technical Facilitation Organization (TFO) for the sustainable land and ecosystem management (SLEM) project, the umbrella project under which strategic pilot on adaptation to climate change (SPACC) is implemented.

Objectives:

The project has two objectives viz., Global Environment Objective (GEO) and Project Development Objective (PDO). While PDO is expected impact of the project implementation, the assumptions made remaining the same, GEO is the broader objective, at the global level, to which the PDO is expected to contribute.

PDO is stated as “knowledge and capacities of communities in pilot hydrological units in Andhra Pradesh, India are strengthened to respond to climate change impacts”. It is expected that the communities in pilot hydrological units will be equipped to adapt to climate variability and change, as a result of the project intervention.

GEO of the strategic pilot on adaptation to climate change (SPACC) project is stated as “establish a knowledge base for large-scale intervention on climate change adaptation”. It is expected that the project will be able to enrich the global experience through dissemination of its learning.

Achievements:

- Information tools and local institutional capacities developed for farmers and CBOs to make informed decisions on land and water management based on scientific and local knowledge, taking into account impacts of climate variations.
- Pilots on sustainable land and watershed management including climate variability adaptation in farming systems in drought prone areas.
- A platform for land based climate change adaptation measures suitable to drought prone areas developed; adoption of a package of methods, tools and institutional approaches in support of District and State level natural resource management initiatives to address the impacts of drought.

Facts and Figures:

Nodal/Implementing Agency	Bharathi Integrated Rural Development Society
Area covered	128363 ha
Administrative unit	Rudravaram Mandal, Kurnool, Uppununthala Mandal, Mahabubnagar, Markapur Mandal, Prakasam, Racherla Mandal, Prakasam, Ramasamudram Mandal, Chittoor, Kasinayana Mandal, Kadapa, Ardhveedu Mandal, Prakasam, Thiparthy Mandal, Nalgonda, Gooty Mandal, Anantapur Districts
Target groups	-
Project period and status	06 December 2010 - 05 May 2013, Ongoing
Amount committed	1.30 Million USD
Funding	Global Environment Facility

For more information: Bharathi Integrated Rural Development Society, Gnanapuram, Nandyal (RS)-518502, Kurnool District, Andhra Pradesh http:// www.birdsorg.net/

Programme/Project #18: Integrated land and eco-system management to combat land degradation and deforestation in Madhya Pradesh

The project aims to promote community-driven sustainable land and ecosystem management at the landscape level through integration of watershed management, joint forest management, and sustainable livelihood development so as to balance ecological and livelihood needs. The project is being implemented by Ministry of Environment and Forests, Madhya Pradesh Forest Department, Minor Forest Produce Federation, Rajiv Gandhi Mission for Watershed Management (RGMWM), Agriculture Department, and Animal Husbandry Department, as part of sustainable land and ecosystem management (SLEM) programme. The project strategy is to focus on removing barriers such as institutional, economic and financial as also knowledge and technological barriers in promoting sustainable rural livelihoods that are ecologically sustainable and to provide a broader range of livelihood options for the tribal/rural poor.

Madhya Pradesh (MP), a state in central India has about 24.4 per cent of its land area covered with diverse types of forest. The project area is primarily located in dry deciduous zones with rich biodiversity. Two National Parks, three Wildlife Sanctuaries and Pachmarhi Biosphere Reserve are part of the project area. These forests are also basic source of livelihood for about 5.5 million people living in 4 project districts of which 70% are classified as poor; 90% of the population lives in tribal rural areas The rural landscape is highly susceptible to soil erosion, surface soil run-off, and seasonal floods. Thus restoring this ecosystem and its sustainable management is key to providing sustainable livelihood sources for rural and tribal population of the state. It provides ecosystem services beyond its borders such as water and climate regulation, and sustains some of the last remaining habitats for India's threatened biodiversity.

Objectives:

- Address the regulatory and institutional constraints to mainstreaming of biodiversity conservation into agricultural activities surrounding protected areas and integration of biodiversity and land degradation concerns into national level policies and regulatory.
- Contribute to enhanced resilience of land and forest ecosystems and reduced vulnerability of local communities to climate variability and change.
- Strengthen tribal and rural residents, village leadership and communities to take community-based initiatives for the use of their local natural resources, and demonstrate the income-generating potential of sustainable land, forest, and agricultural practices.
- Demonstrate and up-scale innovative community-based and climate resilient approaches to SLEM, such as bamboo regeneration, water harvesting, adjustment of timing of agricultural operations and tillage practices, crop and livestock breed improvement to enhance drought resistance, and the promotion of alternative sources of fuel wood.

Achievements:

- Rehabilitated degraded bamboo forests (11,515 ha) treated so far by 789 poor families
- Plantation in sites prepared in 2011 was taken in 2012 monsoon which completes 200 ha.
- Watershed management has covered 3,000 ha.
- 200,000 medicinal plant species for home garden were distributed.
- Livelihood based activities initiated in the forest divisions along with capacity building exercise.

Facts and Figures:

Nodal/Implementing Agency	Madhya Pradesh Forest Department
Area covered	17900 ha
Administrative unit	Madhya Pradesh Forest Department- Community Forest Management Project, Bhopal and the DFO (T) North Betul, West Betul, South Betul, West Chhindwara, South Chhindwara, East Chhindwara, Sidhi, Singroli & Umariya
Target groups	-
Project period and status	01 September 2010 - 31 December 2014, Ongoing
Amount committed	260.00 Million USD
Funding	Global Environment Facility

For more information: Madhya Pradesh Forest Department, Satpuda Bhavan 1st Floor, Bhopal (M.P.), Website:www.mpforest.org

Programme/Project #19: Participatory natural resource management project, Madhya Pradesh

The goal of the project is to reduce the poverty of communities living in the project area which is affected by drought and dependent on monsoons. To this end it is planned to improve food security and increase the income and the quality of life. Main activities of the project include enhancement of capacities and self-help potential of villagers, strengthening of village development committees, formation and strengthening of women's groups and promoting their savings and credit activities, development of self help capacities of village development committees and women, utilisation of existing expertise - learning from others, creation of new and enahnced income avenues, increase of agricultural production, irrigation development, health - water and sanitation especially for women and children, community awareness and mobilization, and capacity building of community based organizations.

Objectives:

- The enhancement of capacities and self-help potential of the villagers to enable them to manage successfully the implementation and the continuation of the watershed project.
- To create income possibilities for *adivasi* (tribal) families mainly through restoration, conservation and improvement of their livelihood basis (water and soil).

Achievements:

All inhabitants of the area benefited from the regeneration of the ecological balance, from improved working and income possibilities and a strengthening of local markets. Since the project is of model character in the area, many villages in the vicinity and wider surrounding, NGOs and other organisations, which want to implement similar projects, also benefited.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	5058 ha
Administrative unit	4 villages in the district Jabalpur (Kundam and Jabalpur Block), 2 villages in the district Mandala (Niwas Block) and 2 villages in the district Katni (Dheemarkheda Block)
Target groups	-
Project period and status	01 May 2007 - 30 June 2011, Completed
Amount committed	0.67 Million Euro
Funding	Andheri Hilfe, Bonn

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website:www.wotr.org

Programme/Project #20: Poverty reduction through community based natural resource management for livelihood opportunities in rural areas

Objectives:

To improve the quality of life of the family in general, through stabilizing and improving the productivity of their eco-space. This in turn leads to improvement in the socio-economic conditions of the families by providing sustainable livelihood opportunities

Achievements:

- Local institutions in the village (user/interest groups, village development of committee, joint forest management committee, self-help groups and women's organisations were established and built up their capacities.
- Stake holder groups involved in planning, implementation and management of the resources.
- Forest and agriculture production (crops, animal husbandry, horticulture, fodder) increased and diversified through proper soil and water conservation measures and demonstration of new technologies.
- Assured drinking water in the village and irrigated area increased.
- Women organized, trained in managing the resources.
- Villagers made aware about the health and hygiene. There is overall improvement in health and hygiene in the village.
- Villagers are trained and exposed for taking up rural tourism

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	4383 ha
Administrative unit	7 villages from Auragabad District (5 Aurangabad Block and 2 Paithan Block)
Target groups	
Project period and status	01 August 2008 - 31 December 2011, Completed
Amount committed	₹ 28.07 Million
Funding	Karl Kubel Stiftung fur Kind und Familie

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website:www.wotr.org

Programme/Project #21: GRAMODAYA sustainable livelihood project

The objective of the project is to achieve drinking water, food and livelihood security as well as to build up or enhance capacities of groups and local institutions to organise, implement, monitor and maintain the local assets. The followings components are considered in the implementation of the project: agricultural development, horticultural development, soil and water conservation measures, irrigation development, health and water sanitation especially for women, community awareness and mobilization, capacity building of community based organization, livelihood development and project documentation.

1. **Agricultural Production:** As per the recommendation from review team, sustainable resource inventogry technique is being promoted in 7 Gramodaya villages. 15 such demonstration plots have been organised. In addition to the SRI technique, demonstrations of improved varieties have been organised. In 3 villages 19 demonstration plots of improved bajra were taken up. During the reporting period, as per the recommendation urea brackets have been applied in all the demonstrations plot of SRI techniques.
2. **Horticulture Development:** In order to motivate village communities towards horticulture development, project team arranged training for interested farmers at College of Agriculture, Dhule. 98 farmers participated in this training-cum-exposure programme. As a follow up action, field teams with the help of village development committee have planned to promote horticulture species. The suggestions given by review team were considered at the time of execution of the work. The emphasis was given to take to monoculture farming instead of promoting a number of varieties in the project villages. In each village, the species were restricted to two. Around 6,966 plants of mango, aonla and custard apple were planted in 34.12 ha area. The total farmers covered under this activity are 128.
3. **Soil and Water Conservation Measures:** During the reporting period 66 ha area private and common land was treated with soil and water conservation measures. The treatments were carried out as per the participatory net plan. The ridge to valley principle was followed in execution of the treatment. The farm bunds were constructed on private land (agricultural land). Around 53,600 saplings (includes *Eucalyptus tereticornis*, *Dendrocalamus* sp., *Dalbergia sissoo*, *Cassia siamea*, *Acacia catechu*, *Leucaena leucocephala, Hardwickia binata* and *Gliricidia* sp.)

and grass seedings were planted to stabilise the bunds and increase fodder availability in the project villages. 115 families were covered under this activity.

Objectives:

- To achieve drinking water, food and livelihood security
- To improve the quality of life.
- To build up and enhance capacities of groups and local institutions to organise, implement, monitor and maintain the local assets.

Achievements:

At least 20% of the farmers now use improved farm implements as well as improved varieties of crops; mainly food and pulses. About 70% farmers have diversified cropping systems partly to include horticulture, floriculture and vegetable crops in their farms. With increase in availability of groundwater in the village for drinking, domestic and agriculture purposes, drinking water scarcity has been tackled. Area under irrigated crops through groundwater increased by 30% while area under rabi crops increased from almost none to 10% of the cultivable area. Increase in tree/grass cover on private as well as community wasteland. Increase in productivity of waste/forest lands by 50%. The number of patients with water-borne diseases has decreased by 20%. About 60% families now include vegetables and nutritious food in their meals at least for 8 months in the year.

The self help groups, sanyukta mahila samiti (SMS) and village development committees constituted in the project are functioning well for the welfare of their own village in different development sectors. Understanding in the community about their own development and developmental issues has increased. Unemployed youth and members of SHGs are given opportunities for income generation related to service and production sectors. At least two volunteers per village are trained to cater for services to community with regard to development. Linkages of community based organisations with local Government, research and non-government agencies have been established. At least two developmental activities have been mobilized and implemented by each VDC/SMS in its village with the support of these agencies. At least two district level officers or prominent/political personality visiting the village to extend developmental support. Increased opportunities of income for the families have been created especially for the poor due to improved agricultural sector and income generation activities.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	8017 ha
Administrative unit	30 villages from Dhule District (Sakri Block)
Target groups	
Project period and status	01 February 2008 - 31 January 2012, Completed
Amount committed	₹ 75.44 Million
Funding	National Bank for Agriculture and Rural Development, Sri Ratan tata Trust and Government of Maharashtra

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune -411009, Maharashtra, Website:www.wotr.org

Programme/Project #22: Natural resource management along watershed lines

Objectives

To enhance capacities of communities living in the selected cluster of villages for creating income possibilities through restoration, conservation of natural resources and improvement of their livelihood basis.

Achievements

The overall impact of the project interventions at the village level resulted in mitigating the problems of water scarcity, food insufficiency, unemployment, drudgery, low and unstable income flows, absence of local collective leadership, illiteracy and health.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	1151 ha
Administrative unit	4 Villages from Mandala District (Bijadandi block - Kalpi Cluster), Madhya Pradesh
Target groups	
Project period and status	01 January 2009 - 31 December 2012
Amount committed	₹ 16.15 Million
Funding	RBS Foundation, India

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website: www.wotr.org

Programme/Project #23: Participatory natural resource management and village development project, Rajasthan

Objectives:

Through a Panchayati Raj institution led initiative, the standard of living of poor rural populations in 11 project villages of rain-fed areas in Rajasthan has been sought to be improved through stabilization and improvement of the productivity of their eco-space. The impacts will be visible in food security, water availability, increased local employment, biomass availability for fuel and fodder, and household income levels. This has led the Gram Panchayat learning to implement and manage their development projects. It will also lead to reduction in hunger, migration, drudgery and hardships, creative availability of livelihood and employment opportunities, thus contributing to alleviation of poverty of these distressed groups.

Achievements:

- Successful examples of Gram Panchayat managed and people-driven natural resource management along watershed lines that has positively impacted the lives of the people in terms of poverty reduction and increased productivity, are locally available and serve as demonstration and training platforms for the nearby area, the region and state. Villagers are trained and exposed for taking up rural tourism.
- Adoptable and practical approaches, tools and methodologies for participatory natural resource management that have resulted in successful outcomes, are available to policy makers, government agencies and communities of practice for reference and adoption in Rajasthan. Ongoing and future projects are more effectively implemented and benefit from these successful experiences that have been documented and disseminated as well as from the exposure and training imparted to practitioners from different parts of Rajasthan.
- Successful experiences, approaches, strategies, tools and systems of previous and ongoing projects of participatory natural resource regeneration along watershed lines have been assessed, documented as best practices and widely disseminated at regional and state level.
- Local stakeholders have developed an approach of mutual support and cooperation which has resulted in resource convergence as well as stakeholder ownership which can be adopted by similar projects and efforts in other jurisdictions within the region and state.
- Dialogue and relationship building between primary stakeholders, facilitating agencies, Government Departments, academic institutions, opinion leaders and policy makers have resulted in the creation of cooperative and enabling arrangements as well as resource convergence at the local level.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	4548 ha
Administrative unit	11 villages from Udaipur District (6 Jhadol Block and 5 Gogunda Block), Rajasthan
Target groups	
Project period and status	01 March 2009 - 31 December 2012, Ongoing
Amount committed	0.59 Million Euro
Funding	Andheri Hilfe, Bonn

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website:www.wotr.org

Programme/Project #24: WasundharaSunahara Kal participatory village development project based on natural resource management

ITC Ltd. is supporting local village or cluster level communities in nine villages, to promote natural resource management to aid in eliminating land degradation and improving land productivity with the aim of preventing migration.,.

Objectives:

To improve the quality of life of villagers in general, through stabilizing and improving the productivity of their eco-space. This in turn will lead to improvement in the socio-economic conditions of the families by providing sustainable livelihood opportunities.

Achievements:

Availability of potable water within the village year round or for the greater part of the year; increased food security due to increased agricultural productivity; enhancement of income through diversification of assets and diversification of their livelihood portfolio; women organized into self-help groups for solidarity enhancement and undertaking of development activities and social quality enhancing measures, to access and manage credit and undertake possible income generating activities.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	3300 ha
Administrative unit	7 villages, Pune District (Shirur block)
Target groups	
Project period and status	01 December 2007 - 01 November 2012, Ongoing
Amount committed	₹ 35.22 Million
Funding	ITC and National Bank for Agriculture & Rural Development

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website:www.wotr.org

Programme/Project #25: Sukhi Baliraja initiatives

Sukhi Baliraja initiative was taken up from April 2009 in the six distressed districts of Vidarbha to focuses on revitalization of farming system through agriculture and livestock development. The districts are: Amravati, Wardha, Yeotmal, Washim, Buldhana and Akola. The programme aims at covering 15,000 families through agriculture development component and 12,000 families through livestock development component over a period of five years. Sukhi Baliraja initiative comprises of different components viz., cost effective farming, crop diversification, diversified farming system, livestock development, strengthening self-help groups and community mobilization.

Objectives:

- To achieve drinking water, food and livelihood security
- To improve the quality of life through health, sanitation and hygiene promotion
- To build up capacities of groups and local institutions to organise, implement, monitor and maintain assets created under the programme

Achievements:

- Availability of potable water within the village year round or for the greater part of the year.
- Increased food security due to increased agricultural productivity. Agricultural output mainly of small and marginal farmers increased by 15%.
- The family income of target groups enhanced through diversification of assets: dairy, poultry, improved agriculture and access to various livelihood opportunities.
- Women organized into self-help groups for solidarity enhancement, undertaking of development activities and social quality enhancing measures, to access and manage credit and undertake the possible income generating activities.
- Women contribute to rural development, secure sustainable livelihoods and live a life of dignity. Women from these villages are empowered to take decisions in their families and also participate in the institutional life of their villages.
- The capacity of the SMS built up significantly and it works for the overall development of the member families as well as of the village.
- Successful start up, survival and growth of entrepreneurial activities will raise income levels and improve the status of women in their own homes as well as their communities.
- Linkages of the SHGs and SMS established with Banks and other financial institutions.
- Entrepreneurial culture developed in villages and spread in the vicinity thus creating several employment opportunities

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	16879 ha
Administrative unit	24 villages from Wardha District (Arvi block)
Target groups	
Project period and status	01 June 2009 - 31 May 2013, Ongoing
Amount committed	₹ 163.60 Million
Funding	Jamsetji Tata Trust, Sir Ratan Tata Trust, NABARD and Government of Maharashtra

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website: www.wotr.org

Programme/Project #26: Climate change adaptation in rural Maharashtra

The intervention seeks to develop knowledge, strategies, approaches, measures and processes that enable vulnerable communities to cope with and adapt to the impending impacts of climate change in a manner which can be widely adopted, is replicable and scalable. The objective is to improve the adaptive capacities of rural communities to respond to the effects of emerging climate change by regenerating the eco-systems they live in, diversifying livelihood sources in order to reduce risks, and adopting new agricultural and renewable energy technologies. WOTR is supported and partnered in these efforts by the Swiss Agency for Development and Cooperation (SDC) and National Bank for Agriculture and Rural Development (NABARD).

The project aims at enhancing the capacities of rural communities to adapt to climate change effects by adopting a comprehensive, integrated multi-pronged approach including eco-friendly and weather-responsive agriculture, water budgeting to match water availability with demand, "precision farming" that optimises land and water productivity in field conditions, and renewable energy for household cooking and lighting. It also aims at developing practical knowledge, tools and systems that can be widely adopted thus facilitating upscaling.

Objectives:

To build up the capacities of vulnerable communities in clusters, to implement measures that enable them to adapt to climate change and to contribute to mitigating some impacts with a view to reducing poverty and improving well-being on a sustainable and equitable basis.

Achievements:

- Increased productivity of natural resources, contributing to better income, nutritional status and drudgery reduction.
- Enhanced ecosystem services for improved resilience to climate change.
- Improved governance through enhanced capacity of local institutions to sustainably manage natural resources in face of climate change, disaster risk reduction and conflict resolution.
- Increased understanding of climate change issues including climate change adaptation approaches.
- Actionable research results enabled peoples' participation in sustainable resource management towards climate change adaptation.
- Localized climate change information made available and fed into advisory model(s).
- Management practices, tools and appropriate protocols for sustainable agriculture, water and land-use in face of climate change developed.
- Tools to assess the potential of income generation activities within a cluster on basis of economic and ecological criteria developed - Model/Pilot project for carbon neutral village cluster developed.

- Exchange mechanism between local communities (intra + inter) on information flow about climate change adaptation established as part of capacity building process.
- Experience, learning and competencies acquired disseminated and shared with target groups, NGOs, developmental agencies and partners.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	29720 ha
Administrative unit	49 villages from Maharshtra (Ahmednagar and Aurangabad districts), Madhya Pradesh (Mandla district) and Andhra Pradesh (Kurnool and Mahaboobnagar district
Target groups	
Project period and status	01 April 2009 - 31 March 2013
Amount committed	₹ 318.23 Million
Funding	Swiss Agency for Development & Cooperation and National Bank for Agriculture & Rural Development

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website:www.wotr.org

Programme/Project #27: Integrated watershed management project (Kurnool District, Andhra Pradesh)

Objectives:

To improve rural livelihoods through participatory watershed development with focus on integrated farming systems for enhancing income, productivity and livelihood security in a sustainable manner.

Achievements:

- All the works/activities planned for the treatment and development of the drainage lines, arable and non-arable lands in the watershed area completed with the active participation and contribution of the user groups and the community at large.
- The user groups/panchayats have willingly taken over the operation and maintenance of the assets created and made suitable administrative and financial arrangements for their maintenance and further development.
- All members of the Watershed Committee and staff such as Watershed Secretary and volunteers have been given orientation and training to improve their knowledge and upgradation of technical/management and community organisational skills to appropriate levels for the successful discharge of their responsibilities on withdrawal of the watershed development team from the project.
- The village community organised into several, homogeneous self-help groups for savings and other income generation activities which would achieve sufficient commitment from their members and build-up financial resources to be self sustaining.
- Increase in cropping intensity and agricultural productivity reflecting in overall increase in agriculture production.
- Increase in income of farmers/landless labourers in the project area. Increase in groundwater table due to enhanced recharge by watershed interventions.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	9468 ha
Administrative unit	8 Villages from Kurnool district (Atmakur block), Andhra Pradesh
Target groups	
Project period and status	01 April 2011 - 31 March 2016, Ongoing
Amount committed	₹ 126.23 Million
Funding	Government of Andhra Pradesh

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra
Website:www.wotr.org

Programme/Project #28: Integrated watershed management project (Mahaboobnagar District, Andhra Pradesh)

Objectives:

To improve rural livelihoods through participatory watershed development with focus on integrated farming systems for enhancing income, productivity and livelihood security in a sustainable manner.

Achievements:

- All members of the Watershed Committee and staff have been imparted training to improve their knowledge and upgradation of technical/management skills for the successful discharge of their responsibilities.
- The village community have been organised into several self-help groups for income generation activities.
- Increase in cropping intensity and agricultural productivity reflecting in overall increase in agriculture production.
- Increase in groundwater table due to enhanced recharge by watershed interventions.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	8285 ha
Administrative unit	7 Villages from Mahaboobnagar district (Amangal block, Andhra Pradesh)
Target groups	
Project period and status	01 April 2011 - 31 March 2016, Ongoing
Amount committed	₹ 91.80 Million
Funding	Government of Andhra Pradesh

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website:www.wotr.org

Programme/Project #29: Public-private-civil society partnership (PPCP) under Maharashtra Rural Employment Guarantee Scheme (MREGS) in Jalna District, Maharashtra

Objectives:

- To evolve a model for undertaking Maharashtra Rural Employment Guarantee Scheme (MREGS) work that is aimed at employment generation, on integrated watershed development lines for natural resource management and drought proofing.
- Sensitizing and capacity building of community on demand generation.
- Preparation of technical plans of activities decided by Gram Sabha for water resources, watershed, horticulture and afforestation, etc.
- Implementation of the integrated natural resource management activities in the identified villages as per the sanctioned plan.
- Improving operational and financial efficiencies of the programme and build the capacities of local level CBOs to take up other development projects.

Achievements:

- Capacity building activities mentioned in the proposal carried out as per the phase of each village.
- 50 village development committees (VDC) formed and capacitated.
- 426 proposals submitted and work orders from Zila Parishad for the same received by Gram Panchayats.
- PPCP helped Gram Panchayats in treating 3526 ha of land in selected villages through mobilization of Rs. 21.2 million from MREGS.
- Pedagogy or steps for execution of MREGS based on watershed development strategies evolved and documented by the partners.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	40226 ha
Administrative unit	56 villages from Jalna district (Jafrabad and Bhokardan block), Maharashtra
Target groups	
Project period and status	01 August 2008 - 31 March 2011, Completed
Amount committed	₹ 36.54 Million
Funding	ITC and Government of Maharashtra

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website:www.wotr.org

Programme/Project #30: Public-private-civil society partnership (PPCP) under Maharashtra Rural Employment Guarantee Scheme (MREGS) in Amravati District, Maharashtra

Objectives:

- To evolve a model for undertaking Maharashtra Rural Employment Guarantee Scheme (MREGS) work that is aimed at employment generation, on integrated watershed development lines for natural resource management and drought proofing.
- Sensitizing and capacity building of community on demand generation.
- Preparation of technical plans of activities decided by Gram Sabha for water resources, watershed, horticulture and afforestation, etc.
- Implementation of the integrated natural resource management activities in the identified villages as per the sanctioned plan.
- Improving operational and financial efficiencies of the programme and build the capacities of local level CBOs to take up other development projects.

Achievements:

- Capacity building activities mentioned in the proposal are carried out as per the phase of each village.
- Village development committees (VDC) are formed and capacitated

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	18200 ha
Administrative unit	18 Villages from Amravati district (Nandgaon Khandeshwar block), Maharashtra
Target groups	
Project period and status	01 August 2010 - 31 March 2013, Ongoing
Amount committed	₹ 11.67 Million
Funding	ITC and Government of Maharashtra

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website:www.wotr.org

Programme/Project #31: Participatory natural resource management along watershed lines in Rajasthan

Objectives:

- Development of successful models of people-driven natural resource management projects along watershed lines, which can serve as demonstration and training platforms for nearby areas, the region and state.
- To enhance the capacities of the supporting NGOs and their staff to become proactive catalyst in the development endeavours of the village through training and awareness generation.
- Making available new practical approaches, tools and methodologies adaptable to the local area.
- To undertake agriculture extension activities by introducing newer means and approaches.
- To increase the possibilities for income generation through micro enterprise development.
- To improve the health practices and level of education in the village.
- To improve forest management in the village and ensure that the people share in the benefits of the forest produce.

Achievements:

- At Village Level: Overall, the impact of the project interventions at the village level resulted in mitigating the problems of water scarcity, food insufficiency, unemployment, drudgery and low and unstable income flows. This led to reduction in hunger, migration, water borne diseases, drudgery and hardships, created avenues of livelihood and employment opportunities, thus contributing to alleviation of poverty of these distressed village communities. People, NGOs and government agencies/personnel from neighbouring regions and other areas started visiting project villages for inspiration and guidance. The technical and management capacities of target groups were built and project villages have become resource villages for others.
- At Institutional/NGO Level: Project villagers, their CBOs as well as the facilitating NGOs provided training and extension support to similar on projects. Capacities of CBOs and facilitating NGOs together with their networks built up so as to be able to undertake replication of best practices in natural resource management. On-going projects are more effectively implemented and benefit from successful experiences that have been documented and disseminated as well as from the exposure and training imparted to practitioners from Rajasthan.
- At WOTR's Level: This project enabled it to identify and develop new partners and networks, thus enabling it to extend its service outreach to newer regions in Rajasthan.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	1160 ha
Administrative unit	2 villages - Dungarpur District & Block, Rajasthan
Target groups	
Project period and status	01 April 2008- 31 March 2011, Completed
Amount committed	₹ 6.32 Million
Funding	ITC and Government of Maharashtra

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra Website: www.wotr.org

Programme/Project #32 Watershed development fund

Objectives:

To improve rural livelihoods through participatory watershed development with focus on integrated farming systems for enhancing income, productivity and livelihood security in a sustainable manner.

Achievements:

- All the works/activities that are planned for the treatment and development of the drainage lines, arable and non-arable lands in the watershed area are completed with the active participation and contribution of the user groups and the community at large.
- The user groups/panchayats have willingly taken over the operation and maintenance of the assets created and made suitable administrative and financial arrangements for their maintenance and further development.
- All the members of the Watershed Committee and staff such as Watershed Secretary and volunteers have been given orientation and training to improve their knowledge and upgrade technical/management and community organisational skills to a level that is appropriate for the successful discharge of their responsibilities on withdrawal of the watershed development team from the project.
- The village community organised into several, homogeneous self-help groups for savings and other income generation activities achieved sufficient commitment from their members and built up financial resources to be self sustaining.
- Increase in cropping intensity and agricultural productivity reflecting in overall increase in agriculture production.
- Increase in income of farmers/landless labourers in the project area.
- Increase in groundwater table due to enhanced recharge by watershed interventions.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	1456 ha
Administrative unit	3 Villages from Mahaboobnagar district (Narayanpeth block), Andhra Pradesh
Target groups	
Project period and status	01 April 2011- 31 March 2014, Ongoing
Amount committed	₹ 30.85 Million
Funding	National Bank for Agriculture and Rural Development

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra
Website: www.wotr.org

Programme/Project #33: Climate change adaptation in rural Maharashtra

Objectives:

To build up the capacities of vulnerable communities in clusters, to implement measures that enable them to adapt to climate change and to contribute to mitigating some impacts with a view to reducing poverty and improving well being on a sustainable and equitable basis.

Achievements:

- Increased productivity of natural resources that contributes to better income, nutritional status and drudgery reduction.
- Enhanced ecosystem services for improved resilience to climate change.
- Improved governance through enhanced capacity of local institutions to sustainably manage natural resources in face of climate change, disaster risk reduction and conflict resolution.
- Increased understanding of climate change issues including climate change adaptation approaches.
- Action research results enabled peoples' participation in sustainable resource management towards climate change adaptation.
- Localised climate change information made available and fed into advisory model(s).
- Management practices, tools and appropriate protocols for sustainable agriculture, water and land-use in face of climate change developed.
- Tools to assess the potential of income generation activities within a cluster on the basis of economic & ecological criteria developed.
- Model/pilot project for carbon neutral village cluster developed.
- Exchange mechanism between local communities (intra + inter) on information flow about climate change adaptation established as part of capacity building process.
- Experiences, learning and competencies acquired disseminated and shared with target groups, NGOs, developmental agencies and partners.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	18503 ha
Administrative unit	25 villages from Ahmednagar district of Maharshtra (Sangamner and Akole block) Maharashtra
Target groups	
Project period and status	01 April 2010- 31 March 2013, Ongoing
Amount committed	₹ 318.23 Million
Funding	National Bank for Agriculture and Rural Development and Swiss Agency for Development and Cooperation

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune 411009, Maharashtra, Website:www.wotr.org

Programme/Project #34: Community mobilisation for the poverty alleviation through integrated watershed development

Objectives:

To work on community mobilization for alleviating the poverty through integrated watershed development.

Achievements:

Integrated watershed development increased the productivity of natural resources that contributes to better income which was helpful in poverty alleviation.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust, Pune (Maharashtra)
Area covered	1959 ha
Administrative unit	3 villages from Ahmednagar district of Maharshtra (Akole block) Maharashtra
Target groups	
Project period and status	01 April 2011- 31 March 2016, Ongoing
Amount committed	₹ 30.95 Million
Funding	National Bank for Agriculture and Rural Development and Dr. & Mrs S.H.M.Modi Hormus House Benevolence Trust Fund, Mumbai

For more information: Watershed Organisation Trust, Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website:www.wotr.org

Programme/Project #35: National afforestation programme

National Afforestation Programme (NAP) aims to support and accelerate the ongoing process of devolving forest protection, management and development functions to decentralized institutions like Joint Forest Management Committee (JFMC) at the village level, and Forest Development Agency (FDA) at the Forest Division level. NAP is implemented by National Afforestation & Eco-Development Board (NAEB), MoEF, GoI. It has been formulated by the merger of four centrally sponsored afforestation schemes i.e. Integrated Afforestation and Eco-development Project Scheme (IAEPS), Area-Oriented Fuelwood and Fodder Project Scheme (AOFFPS), conservation of non-timber forest produce (NTFPs) including medicinal plants, and association of scheduled tribes and rural poor in regeneration of degraded forests (ASTRPs) during ninth Five Year Plan (19972002).

The problem of developing arid lands and improving the well-being of people living on them is both of great magnitude and complexity; magnitude in terms of the large area involved and complexity because their development cannot be dissociated from their ecological, social and economic characteristics. Afforestation is emerging as a potent tool for arresting the degradation and over-

exploitation of lands and environmental degradation in India. Four centrally sponsored afforestation schemes were merged for reducing multiplicity of schemes with similar objectives, ensuring uniformity in the funding pattern and implementation mechanism, avoiding delays in availability of funds at the field level and institutionalising people's participation in project formulation and implementation. NAP is the flagship scheme of NAEB and it provides support, both in physical and capacity building. It is a 100% Centrally Sponsored Scheme (except for the components of area-oriented fuelwood and fodder projects scheme).

The scheme is being implemented through State agencies by a two-tier set-up, namely Joint Forest Management Committee (JFMC) at the village level, and Forest Development Agencies (FDA) at the Forest Division level. Thus, FDA is the confederation of JFMCs in that Forest Division to undertake holistic development in the forestry sector with people's participation. The experiences with the present institutional framework of FDA at the Forest Division level and JFMC at the village level are encouraging. Some noteworthy features of this framework are as follows:

- The district-level officers of relevant line departments of the State Government and Panchayat Raj Institutions (PRIs) are members of FDA. The institutions of FDAs and JFMCs are highly innovative resource transfer mechanisms whereby Government of India channelizes funds directly to the grassroot level implementing agency for the afforestation activities.
- The structure of FDAs and JFMCs is gender sensitive. Women's membership up to 50% is mandatory in these bodies. Members of scheduled castes and scheduled tribes are the focus groups in JFMCs.
- This decentralized institutional structure allows greater participation of community both in planning and implementation of the appropriate afforestation programmes.
- The village is recognised as a unit of planning and implementation and all activities under the programme are conceptualized at the village level. Under entry point activities, community assets are created with a 'care and share' concept.
- The two-tier approach, apart from building capabilities at the grass-roots level, also empowers the local people to participate in the decision making process.
- Capacity building of FDA and JFMC members is organized by State Forest Departments, as well as by seven regional centres of National Afforestation and Eco-development Board.
- To help and guide the FDAs and JFMCs, there is a National Steering Committee of NAP and at state level one called the State-level Coordination Committee, chaired respectively by the Secretary (Environment and Forests), Government of India, and the Chief Secretary of the representative State Government.

Achievements:

- 42535 Joint Forest Management Committees and 800 Forest Development Agencies have been included in the programme since inception.
- 1888264 hectares area has been afforested at an expenditure of Rs. 29235.7 million.

Some of Activities

- In-situ soil and moisture conservation measures like contour furrows, staggered trenches, mulching, box trenches, bench terracing, vegetative barriers, etc.
- Soil and moisture conservation by construction of small scale engineering structures like gully plugging, check dams, retaining and breast walls, toe walls, spurs and torrent control measures, small water harvesting structures including ponds, tanks and such vegetative measures as may be necessary. In the case of projects implemented in the periphery of national parks and sanctuaries, augmentation of water supply, facilities for bunds, dams, wells and for transporting and/or pumping of water may be permitted.
- Planting and sowing of multi-purpose trees, shrubs, grasses, and legumes, as well as non-timber species.
- Fuelwood and fodder plantations including pasture development for meeting biomass needs of the rural communities.
- In-situ conservation of medicinal plant species and augmenting their plant population by undertaking plantation in the watershed.
- Raising of bamboo, cane plantations and medicinal plants.
- Raising of coastal shelterbelts in problem areas.
- Cultural operations like cutting back of existing root-stocks, tending, coppicing/pollarding, climber cutting, weed removal, soil working to encourage natural regeneration.
- Promotion of agro-forestry and sericulture etc., as appropriate.
- Wood substitution and fuelwood conservation measures such as distribution of fuel-efficient stoves.
- Measures needed to disseminate new technology such as use of root trainers for raising seedling in nurseries, mycorrhizal treatment of soils, clonal propagation of plants, etc.

Facts and Figures (2005 - 2011):

Nodal/Implementing Agency	National Afforestation and Eco Development Board, Ministry of Environment and Forests
Area covered	1888264 ha
Administrative unit	
Target groups	Panchayat, Villagers and Forest Department
Project period and status	01 April 2002, Ongoing
Amount committed	₹ 29235.70 Million
Funding	Ministry of Environment and Forests

For more information: National Afforestation and Eco Development Board, Ministry of Environment and Forests, Wesite www.naeb.nic.in

Programme/Project #36: Integrated watershed management programme

A watershed is defined as a hydro-geological unit of area from which the rainwater drains through a single outlet. Watershed development refers to the conservation, regeneration and judicious use of all the natural resources (like land, water, plants, animals) by human beings. Watershed management brings about the best possible balance between natural resources on the one hand and human beings on the other. Man and ecology are interdependent. Changes in the environment directly affect the lives of people depending on it. A degraded environment means a degraded quality of life of the people. This degradation can be tackled effectively through the holistic development of the watershed. A watershed provides a natural geo-hydrological unit for planning any developmental initiative. The approach would be treatment from "ridge to valley". In order to combat the frequent recurrence of drought in the states, Drought Prone Area Programme (DPAP) was introduced during the year 1975, as a Centrally Sponsored Scheme (CSS) with matching state share of 50:50 and adopted the watershed approach in 1987. The Drought Prone Area Programme concentrated on non-arable lands. Drainage lines for in-situ soil and moisture conservation, agro-forestry, pasture development, horticulture and alternate land use were its main components. Integrated Wasteland Management Programme (IWMP) was introduced during 1992 with 100% Central assistance. The Integrated Wasteland Development Programme made afforestation and soil and moisture conservation in waste lands under Government or community or private control as its predominant activity, without much focus on saturation of complete micro watershed and participation of people.

Objectives:

The main objective of the IWMP is to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. The outcomes are prevention of soil run-off, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities, which help to provide sustainable livelihoods to the people residing in the watershed area.

Achievements:

- 50149 watershed projects sanctioned
- Covered an area of 56.21 Mha
- 33464 watershed projects completed out of 45062 projects due for completion (74%)
- 680 million mandays generated

Facts and Figures:

Nodal/Implementing Agency	Department of Land Resources
Area covered	56210000 ha
Administrative unit	Whole Country
Target groups	
Project period and status	01 April 1994, Ongoing
Amount committed	₹ 161454.20 Million
Funding	Department of Land Resources, Ministry of Rural Development

For more information: Department of Land Resources, Ministry of Rural Development, Website www.dolr.nic.iniwmp_main.htm

Programme/Project #37: Centrally sponsored programme of soil conservation in the catchments of River Valley Project & Flood Prone River (RVP&FPR)

Centrally sponsored programme of soil conservation in the catchments of River Valley Project & Flood Prone River (RVP&FPR) was launched in the Third Five Year Plan (1961-62) and from November, 2000 onwards it is being implemented through Macro-Management of Agriculture (MMA) Scheme in 60 selected inter-state catchments of States (except Goa). Under this programme, 27 States namely; Assam, Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Mizoram, Meghalaya, Manipur, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal are covered. Out of catchment area of 113.51 Mha, about 30.00 Mha (26% of total catchment area) is categorized as priority area in the country.

The Programme envisages holistic treatment and development of all types of lands viz agriculture, waste and forest in an integrated manner on watershed approach with suitable soil and water conservation measures/components. Components include contour vegetative hedges, contour/graded bunding, horticulture plantation, contour/staggered trenching, sowing and plantation, silvi-pasture development, pasture development, afforestation, farm ponds, percolation tanks, drainage line treatment (earthen loose boulders, water harvesting structure, check bund, drop spill-way, sediment detention structure, etc.) and are implemented on watershed approach.

Rapid Reconnaissance Survey (RRS) for inter-state catchments by using Silt Yield Index (SYI) methodology are conducted by Soil & Land Use Survey of India (SLUSI) which has prioritized watersheds into five categories i.e. very high, high, medium, low and very low. Due to resource crunch, priority (very high and high) watersheds are taken up for treatment on priority and other categories of watersheds are also taken up for treatment, if contiguous with watersheds where work is on-going.

Various soil and water conservation interventions are planned in consultation with beneficiaries and watershed project reports (WPRs) are prepared by District Watershed Development Team (DWDT) which are approved by State Level Nodal Agency (SLNA). Programme is being implemented by multi-disciplinary team of State officials and is also being reviewed by organizing annual review meetings.

With view to assess impact of soil and water conservation measures, continuous monitoring of rainfall, runoff and sediment parameters prior to, during and after treatment is undertaken by establishing Sediment Monitoring Station (SMS) at outlet of watershed. For this purpose, 3% of allocated funds are earmarked to meet cost of establishment and operational cost of SMSs.

Objectives: Main objectives of programme are:

- Prevention of land degradation by adopting multi-disciplinary integrated approach for soil conservation and watershed management in catchment areas;
- Improvement of land capability and moisture regime in watersheds;
- Promotion of land uses to match land capability; and
- Prevention of soil loss from catchments to reduce siltation of multipurpose reservoirs and enhancing in-situ moisture conservation and surface rainwater storages in catchments to reduce flood peaks and volume of runoff.

Achievements:

Studies have reported that watershed interventions are effective in prevention of soil erosion, land degradation and conservation of rain water as per details given below:

- Increase in agricultural yield: Increase in yield of agricultural crops varies from 2.7 to 76% in watersheds treated under programme.
- Increase in cropping intensity: Cropping intensity has increased ranging from 85% to 115% in Matatila, Nizamsagar and Ukai catchments.
- Sediment Production Rate (SPR): SPR has reduced ranging from 17% to 94% in Matatila, Nizamsagar and Ukai catchments.
- Peak rate of runoff: Reduction in runoff peak and volume ranging from 46.6 to 1.6% in watersheds of Sahibi catchment.
- Ground water recharge: Water table of selected wells in treated watersheds has increased ranging from 1.0 to 2.5 m.
- Employment generation: Additional employment was created ranging from 0.2 to 0.79 million man-days annually, due to implementation of watershed interventions in on-going as well as treated watersheds.
- Under this programme, since inception upto the Ninth Five Year Plan Plan (2007-12), about 7.76 m ha of degraded lands have been treated at an expenditure of Rs. 34306.8 million.

Facts and Figures:

Nodal/Implementing Agency	Department of Agriculture & Cooperation, Ministry of Agriculture
Area covered	30000000 ha
Administrative unit	27 States namely except Goa
Target groups	
Project period and status	01 April 1961, Ongoing
Amount committed	₹ 34306.84 Million
Funding	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India

More information: Department of Agriculture & Cooperation, Ministry of Agriculture, website www.agricoop.nic.in/Nrm/RVP.pdf

Programme/Project #38: Centrally sponsored programme of national watershed development project for rainfed areas

Rainfed areas constitute about 57% of the total 140.30 Mha cultivated in the country. Rainfed agriculture is characterised by low levels of productivity and low input usage. Variability in rainfall results in wide variation and instability in yields. Majority of the rural poor people live in the rainfed areas. Therefore, Government of India accords highest priority to the holisitc and sustainable development of rainfed areas through watershed development approach. The scheme of National Watershed Development Project for Rainfed Areas (NWDPRA) was launched in 1990-91 in 25 States and 2 Union Territories based on twin concepts of integrated watershed management and sustainable farming systems. During Ninth Five Year Plan, the scheme was extended to the three newly formed States of Uttarakhand, Jharkahand and Chhattisgarh. The scheme of NWDPRA has been subsumed under the Scheme for Macro Management of Agriculture (MMA) from 2000-2001. At present, this scheme is being implemented as a programme of centrally sponsored scheme in all 28 States and 2 Union Territories (UTs). Funds are released to the States based on approved annual work plan. The scheme is presently being implemented on the basis of common guidelines for watershed development projects issued by National Rainfed Area Authority (NRAA).

NWDPRA was thoroughly restructured by retaining technical strength of earlier programme and incorporating lessons learnt from successful projects, especially on community participation. Permissible components include construction of contour/graded, contour bund supported with hedge, horticulture plantation, contour/stagger trenching, sowing and plantation, silvi-pasture development, pasture development, afforestation, farm pond, percolation tank, drainage line treatment (earthen loose boulders, water harvesting structure, check bund, spill-way, sediment detention structure, etc.).

Objective:

- Conservation, upgradation and sustainable utilization of natural resources;
- Enhancement of agricultural productivity in sustainable manner;
- Restoration of ecological balance in the degraded and fragile rainfed eco-systems by greening these areas through appropriate mix of trees, shrubs and grasses;
- Reduction in regional disparity between irrigated and rainfed areas; and
- Creation of sustained employment opportunities for the rural poor.

Achievements:

Since inception upto end of Eleventh Five Year Plan Plan, about 10.863 mha of rainfed area have been developed at an expenditure of Rs. 43207.8 million.

Facts and Figures:

Nodal/Implementing Agency	Department of Agriculture & Cooperation, Ministry of Agriculture
Area covered	10863000 ha
Administrative unit	Programme is being implemented in all the States & two Union Territories (Andaman & Nicibar Islands and Dadra & Nagar Haveli).
Target groups	
Project period and status	01 April 1990, Ongoing
Amount committed	₹ 43207.80 million
Funding	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India

More information: Department of Agriculture & Cooperation, Ministry of Agriculture, Website www.agricoop.nic.in/dacdivision/NWDPRA.pdf

Programme/Project #39: Swan River integrated watershed management project, Una Himachal Pradesh

Catchment areas of the Swan River in Himachal Pradesh are located in the fragile and vulnerable Shivalik hills where the river frequently overflows its banks during the monsoons, causing erosion of soil resources. To protect lands from soil erosion and floods, regenerate the forest cover and enhance agricultural productivity in the Swan river catchment area in Una district, this project is being implemented in selected sub-watersheds of Swan River. The catchment of the Swan river has been divided into 42 sub-watersheds, out of which 22 sub-watersheds with an area of 61,900 ha have been selected for treatment. The project activities include afforestation, civil works for soil and river management, soil protection and land reclamation, and livelihood improvement activities, thereby improving the living conditions of people including the poor in the catchment area. The livelihood activities encompass on-farm production activities, community infrastructure development and income generation activities through Self-Help Groups.

Keeping in view the gravity of situation and to reverse the trend of degradation in the catchment area, the Swan River Integrated Watershed Management Project has come into being since 2006-07 with financial assistance from Japan International Cooperation Agency (JICA). Himachal Pradesh Forest Department is the nodal department; Departments of Agriculture, Horticulture and Animal Husbandry of the State are participating departments in the Project. The project is being implemented through 95 Panchayat Development Committees (PDCs), an authorized body constituted under the Gram Panchayats.

Achievements:

- Enhancement of forest cover and agriculture production.
- Improvement in livelihood condition of the people.
- Reduction in soil erosion and improvement in moisture regimes and thereby improvement in ecological conditions of Swan River Catchment.
- Reduction in and intensity of flooding.
- Reclamation of private & government land.

Facts and Figures:

Nodal/Implementing Agency	Himachal Pradesh Forest Department
Area covered	61900 ha
Administrative unit	District Una, Himachal Pradesh
Target groups	
Project period and status	01 April 2006 - 31 March 2015, Ongoing
Amount committed	₹ 2140.00 Million
Funding	Japan International Cooperation Agency and Government of Himachal Pradesh

For more information: Himachal Pradesh Forest Department, Shimla, Website:www.hpforest.nic.in

Programme/Project #40: Sustainable participatory management of natural resources to control land degradation in the Thar Desert ecosystem

The programme supports the poor and vulnerable communities, living in rural areas of the Thar Desert and depending on land for their survival, through integrated conservation and management of common property land, water and livestock resources. The project seeks to overcome critical barriers, thus helping current and future baseline actions achieve their intended benefits. It is part of the sustainable land and ecosystem management (SLEM) programme being implemented by Rajasthan State Government, UNDP and Jal Bhagirathi Foundation (JBF), Jodhpur, Rajasthan. The Thar Desert, the seventh largest and one of the most densely populated deserts of the world, covers 12 districts of Rajasthan. The climate is extreme, temperatures ranging from near-zero in the winter to more than 500C in the summer with a mere 100-500 mm precipitation. High density of human and livestock population is leading to degradation of land and water resources. Biodiversity is threatened as a result of over grazing of pastures, encroachment and over-harvesting of forests.

Traditional natural resource management in Rajasthan is characterized by community managed lands, consisting of Agors (A) which are areas that traditionally served as catchments for water bodies; Gauchars (G) are areas that served as community grazing lands; and Orans (O) that are areas that served as community forests. Community managed AGO lands are repositories of biodiversity and the source of multiple products such as grass, fodder, fuelwood, timber and non-timber forest products. Protection and management of AGOs are fundamental to the survival of agro-ecosystems in desert areas, as well as maintenance of ecosystem stability, integrity, functions and services in the face of climate change.

In three project districts, community managed AGOs which constitute a traditional system of natural resource management cover 50% of the geographical area. Over the years, the total land area under community managed AGO lands has declined and the level of degradation of remaining AGOs has greatly intensified. The project aims to support an alternative approach to the management and use of land resources. On the ground, intervention for climate-resilient SLEM practices is demonstrated in selected clusters of villages in four ecosystem blocks of the Thar Desert, covering approximately 2,488 km2 in three districts: Jodhpur, Barmer and Pali . These three districts cover approximately 249,000 ha and the project targets 75 villages within these districts spanning 6,000 ha. Rain-fed agriculture along with livestock rearing is the dominant livelihood activity in this region. Some key elements of the project are: decentralized approach to natural resource management that ensures capture of and integration of climate change variables into natural resource management; integrated land-water-livestock planning and management with special attention to climate risks. Development and adoption of sustainable use/harvesting/ management practices of pastures and forests that are climate resilient; empowerment and participation of local communities, particularly women; promotion of livelihoods and equitable sharing of benefits, particularly focusing on women; empowering people through the creation and strengthening of village level institutions.

Objectives:

- Help arrest land degradation that is compromising the functions and service of the Thar Desert ecosystem and the livelihoods of its inhabitants.

- Decrease the trend and severity of degradation in AGO lands, improve biodiversity, promote resilience to climate change including variability, and enhance the carbon stored at above-ground and below-ground levels.
- Provide local benefits to the community in the form of enhanced water storage capacity of land, enhanced grass productivity, and indirectly enhance the cash economy of the otherwise subsistence economy.

- Address climate change adaptation strategies for enhancing water availability in the AGO lands through structural interventions that are mostly grounded in community participation and screened in accordance with climate change resilience. To achieve this, the project will work towards removing barriers - clustered under policy and regulatory; institutional capacities; and capacities at the community level.

Achievements:

- Creation of an enabling environment for climate resilient, sustainable land and ecosystem management.
- Community and institutional capacity development for climate resilient SLEM.
- Participatory climate resilient SLEM demonstration
- Enhanced knowledge management system for replicating good practices in integrated and climate resilient management of community land resources.

Facts and Figures:

Nodal/Implementing Agency	Jal Bhagirathi Foundation
Area covered	Thar Desert, Rajasthan
Administrative unit	
Target groups	Village communities
Project period and status	01 October 2009 - 31 March 2015, Ongoing
Amount committed	14.70 Million USD
Funding	United Nations Development Programme and Government of Rajasthan

For more information: Jal Bhagirathi Foundation, Jaipur (Rajasthan),
Website: www.jalbhagirathi.org

Programme/Project #41: Sustainable rural livelihood security through innovations in land and ecosystem management

The project strives for sustained improvement in the incomes and well-being of farm families in the mainly rain-fed, hilly and mountain, dry land, tribal dominated and coastal areas which have so far been left behind in the development process. It focuses on promoting approaches and techniques for sustainable management of degraded coastal land and water, on conserving and sustainably using local biodiversity for agricultural intensification and livelihood security, and on enhancing community capacity to respond to climate change and variability in drought and flood prone areas.

This project is one of the seven 'Sustainable Land and Ecosystem Management (SLEM)' programmes being implemented across the country. It is complementary to the 'National Agricultural Innovation Project (NAIP)', a parent project of Indian Council of Agricultural Research (ICAR). The NAIP is to facilitate accelerated and sustainable transformation of Indian agriculture in support of poverty alleviation and income generation by collaborative development and application of agricultural innovation by public research organizations in partnership with farmers groups, the private sector, civil society organizations and other stakeholders.

NAIP- Components

Indian National Agricultural Research System (NARS): This component aims at bringing in organizational changes in the NARS so that it becomes a dynamic innovation system capable of responding to the present as well as future needs of Indian agriculture research and development. This component is supported as a sponsored project because it needs to address identified problems for identified stakeholders i.e., the ICAR and the agricultural universities.

Research on Production to Consumption Systems: A production to consumption system (PCS) is a system which involves the entire set of actors, materials, activities, technologies, services, and institutions involved from the stage of supply of inputs to harvesting of a particular commodity and transforming it into a usable product, and storing/marketing the final product. Rural income augmentation and employment generation through post-harvest processing and value addition, building of rural agro-industries, export promotion and import substitution and exploiting the market is given adequate emphasis.

Research on Sustainable Rural Livelihood Security: This component emphasis on research on-farm for improving and developing the most suitable farming systems and allied off-farm activities in the

less favourable environments, regions and groups so that the livelihood of the rural poor improves through assured food, nutrition, employment and income. Particular attention had given to the rainfed, hill and mountain, and coastal and island ecoregions. Partnerships among all the stakeholders such as farming families, farm labourers, input suppliers, rural industry entrepreneurs or researchers, who will share their resources and knowledge and own the changes brought about.

Basic and Strategic Research in the Frontier Areas of Agricultural Sciences: A sustained flow of knowledge and innovations is essential to keep the technology development process responsive to the ever-changing needs of agriculture. This component aims at making investments in frontier science areas of agricultural research that are strategically important for Indian agriculture. The broad theme areas identified are genetic enhancement of plants and animals natural resource management, integrated pest management, novel value addition, processing and storage methods for agricultural products and byproducts, development of state of the art animal disease surveillance and control systems.

Objectives:

- Support the development and implementation of innovations in agriculture in India through collaboration among farmers, private sector, civil society, and public sector organizations.
- Strengthen institutional and community capacity for sustainable land and ecosystem management through approaches and techniques that combine innovative and indigenous techniques for restoring and sustaining the natural resource base, including its biodiversity, while taking account of climate variability and change.
- Assist in strengthening the agricultural research and extension system, with efforts to promote demand-driven, decentralized public agricultural research and extension systems, greater public-private-partnerships, and closer linkages with various domestic and international sources of technologies and knowledge.

Achievements:

- Over 10,000 ha of agricultural land under sustainable land management practices; 2,500 farmers adopted coping mechanism for climate variability and change.
- Improved land and water management practices applied on 500 ha degraded coastal land; productivity in 90 ha of saline land enhanced through land shaping; innovative SLEM approaches and techniques in agriculture.
- Aquaculture demonstrated on 65 ha; increased crop intensity by 20-30%, crop productivity by 30-35%.

- Enhanced knowledge of crop landraces, animal breeds, fish species through characterization of available cultivated gene pool; improved genetic stock of farm animals; 3000 land holders using sustainable land management practices for optimizing biodiversity.
- Best practice notes, operational guidelines and other teaching and capacity building tools related to coping mechanism for climate change variability.
- At least 30 public and private organizations applying SLEM practices and policies to combat land degradation, increase utilization of indigenous biodiversity and adapt to climate variability and change.

Facts and Figures:

Nodal/Implementing Agency	Indian Council of Agricultural Research
Area covered	10000 ha
Administrative unit	Whole country
Target groups	Entire communities
Project period and status	01 July 2009 - 31 July 2013, Ongoing
Amount committed	96.07 Million US Dollar
Funding	Global Environment Facility and Ministry of Agriculture, Government of India

For more information: Indian Council of Agricultural Research, New Delhi, Website:www.naip.icar.org.in

Programme/Project #42: Gujarat forestry development project Phase II

The project includes activities such as: forest development and management, social forestry development and management, wildlife conservation and development, community/tribal development and support activities (preparatory works, strengthening of Gujarat Forest Department: capacity building of project office, forest survey and research, communication and orientation, monitoring and evaluation, phase out works and consultancy services). Community activity includes formation of 1100 Joint Forest Management Committees, 800 State Forest Developemnt Committees and 210 Ecodevelopment Committees. Project area includes 12 tribal and 3 non tribal Districts, 13 territorial Forest Divisions (including 6 PAs and one territorial sub-division), one Wildlife Division (1 PA), and 10 Social Forestry Divisions of Gujarat State.

Objective:

To restore degraded forests and improve livelihood for and empower the local people who are dependent on forests by promoting sustainable forest management including JFM plantation and community/tribal development, thereby improving environment and alleviating poverty.

Achievements:

- Conservation of the existing dense forests with their biodiversity and wildlife in the project area.
- Restoration of the degraded forests and augmenting productivity of forests.
- Protection of forest and forest area from further degradation.
- Mitigation of biotic pressure on forest and forest areas.
- Enhanced tree cover on non-forest areas.
- Enhanced sustainable forest management system and empowerment and improvement of livelihood of the local people who are dependent on forests.

Facts and Figures:

Nodal/Implementing Agency	Gujarat State Forest Department
Area covered	147800 ha
Administrative unit	Gujarat
Target groups	Panchayat, Villagers and Forest Department.
Project period and status	11 July 2007 - 11 July 2017, Ongoing
Amount committed	20923.00 Million Japanese Yen
Funding	Japan Bank for International Cooperation

For more information: Gujarat State Forest Department, Gandhi Nagar,
Website: www. http://gujaratforest.org/

Programme/Project #43: Odisha Forestry Sector Development Project

The Odisha Forestry Sector Development Project (OFSDP) aims to promote sustainable forest management in the state with the larger goal of supporting rural livelihoods. Recognizing the crucial linkage between rural livelihood, particularly in forest fringe villages, and the forest resources in the context of the state, the project specifically focus on conservation and development of forests and their optimal and sustainable use, and on creation of alternative livelihood opportunities based on local skill and other resources. The project is being implemented throughout the state, based in selected project villages through active participation of the village community organized into Vana Samrakshana Samiti (VSS). Biodiversity conservation amidst rising biotic pressure on forest is an important and integral component of the interventions planned under the project.

The project covers forests and forest areas including protected areas in identified 14 Forest and Wildlife Divisions of the state, namely Angul, Balliguda, Bonai, Deogarh, Jeypore, Keonjhar, Koraput, Paralakhemundi, Phulbani, Rayagada, Rourkela, Satkosia Wildlife, Balasore Wildlife, and Bhadrak Wildlife Divisions. The project would provide implementation of activities like restoration of degraded forests both under Joint Forest Management (JFM) mode and non-JFM mode as well as farm forestry, coastal plantation of shelter belt and mangrove, biodiversity management for eco-tourism development and establishment of community reserves. For doing so, it would also undertake programmes of community/tribal development including capacity building of VSS and eco-development committees as well as self-help groups for supporting activities of infrastructure development, publicity communication, monitoring and evaluation, withdrawal etc.

Objective:

The project aims to promote sustainable forest management, and poverty alleviation through creation of livelihood options, infrastructure for income generating activities duly linked with forest conservation in the project area.

Achievements:

The project includes restoration of degraded forests (196,650 ha in 11 divisions), coastal plantations (2,810 ha in 2 divisions), biodiversity management (ecotourism development in five sites, establishment of community reserves/heritage sites), community/tribal development (entry point activities, income generation activities, livelihood improvement and formation of 2,275 VSSs and 4,550 SHGs).

Facts and Figures:

Nodal/Implementing Agency	Odisha Forest Department
Area covered	200000 ha
Administrative unit	Odisha
Target groups	2400 Joint Forest Management Committee and Eco-Development Committees in 72 Ranges, 14 Forest Divisions of 10 Districts
Project period and status	01 April 2006 - 31 March 2015, Ongoing
Amount committed	13937.00 Million Japanese Yen and Rs.1000.80 Million
Funding	Japan Bank for International Cooperation and Government of Odisha

For more information: Odisha Forest and Environment Department, Bhubneshwar,
Website: www. odisha.gov.in/forest & environment

Programme/Project #44: Sikkim biodiversity conservation and forest management project

Government of Japan through Japan International Cooperation Agency (JICA) is providing financial assistance for Sikkim Biodiversity-conservation and Forest-management Project (SBFP) that is being implemented by the Forest, Environment and Wildlife Management Department from year 2010-11. The project aims to strengthen biodiversity conservation activities and forest management capacity and simultaneously improve livelihood of the local people who are dependent on forests and are living in forest fringe areas. Project objectives are to be achieved by promoting sustainable biodiversity conservation, afforestation and income generation activities including eco-tourism for the community development. The project activities will be contributing to environment conservation and harmonized socio-economic development of the state in multifarious ways in the next decade. The project has a financial outlay of Rs 3305.7 Million and is of 10 years duration.

Objectives:

The main components of the project include: forest and biodiversity conservation, inventory and monitoring of biodiversity, study of impacts of climate change and grazing in the Himalayan ecosystem, management plans and conservation of flagship species habitats, enhancement of working plans and establishment of forest management zones, inscription process of Khangchendzonga Biosphere Reserve on the world heritage list, ex-situ conservation and promotion of biodiversity conservation, knowledge generation and dissemination of biodiversity and best practice information; promotion of ecotourism; community participation and joint forest management and organizational strengthening of the Forest Department.

Achievements:

- Inventorization of biodiversity, report on status of flagship wildlife species and their habitats, climate change impacts on vegetation and impacts on biodiversity
- Development of ecotourism in 10 forest fringe villages through formation of a cadre of guides and support staff from within the village community
- Creation of 540 self-help groups to carry out income generation activities
- Strengthening of 180 joint forest management committees in the State, regeneration of forest resources and development of these villages

Facts and Figures:

Nodal/Implementing Agency	Sikkim Forest, Environment and Wildlife Management Department
Area covered	709600 ha
Administrative unit	Sikkim
Target groups	2400 Joint Forest Management Committee and Eco-Development Committee 72 Ranges 14 Forest Divisions 10 Districts
Project period and status	01 August 2010 - 31 March 2020, Ongoing
Amount committed	₹ 2800.00 Million
Funding	Japan Bank for International Cooperation and Government of Sikkim

For more information: Sikkim Forest Department, Gangtok, Website: www. sikkimforest.gov.in/

Programme/Project #45 Rajasthan forestry and biodiversity project (Phase-II)

The Rajasthan Forestry and Biodiversity Project (RFBP) was initiated with the aim of checking desertification, improving ecological status of the Aravalis as well as augmenting the availability of forest produce and thereby improving the socio-economic conditions of the rural poor of Rajasthan. RFBP was implemented with financial assistance from the Japan Bank for International Corporation (JBIC). Massive plantation would be done under this ambitious project in next 8 years. Japan Government will provide financial assistance of Rs 11520 Million for this project. It aims at ecological restoration and biological up-gradation of degraded forests and other lands including community land in Rajasthan. The project was launched with objectives of restoring ecological status of the Aravallis, conserve biodiversity, check desertification, improve moisture regime and protect infrastructure in the desert areas. It also aims at providing fuel/fodder grass, timber and non-timber forest products along with employment generation in the rural areas.

The project area comprises of ten desert districts: Jaisalmer, Barmer, Churu, Jhunjunu, Sikar, Jodhpur, Pali, Jalore, Nagaur and Bikaner; five non-desert districts: Bhilwara, Banswara, Dungarpur, Jaipur and Sirohi; and seven fringe areas: Kumbhal Garh, Phulwari ki nal, Jaisamand, Sitamata, Basi, Kailadevi and Rawali Tadgarh.

The Project has the following major components:

- Poverty alleviation and livelihood improvement
- Promotion of income generating activities through creation and strengthening of Self Help Groups (SHGs), development of adequate market linkages and development of ecotourism sites (7) through EDCs
- Afforestation under various afforestation models in desert as well as non-desert areas.
- Agro-forestry through intensive consultative process in project villages through SHGs
- Water conservation through SMC structures like anicuts, check dams, percolation tanks, contour bunds, restoration of traditional water harvesting structures
- Biodiversity conservation through drainage line treatment works in areas around sanctuaries, creation of biodiversity
- Closures, development of water points, *in-situ* conservation of germplasm, creation of new park at Machia and next phase of work in Sajjangarh and Nahargarh Biological Parks.
- Capacity building, training and research of all stake holder groups of the project
- Community mobilization through dedicated NGO support
- Monitoring and evaluation using traditional as well as GIS technology

Objectives:

To enhance forest area and livelihood opportunities of the forest dependent people and to conserve biodiversity by undertaking afforestation and biodiversity conservation measures through joint forest management approach, thereby contributing to environmental conservation and socio-economic development of Rajasthan.

Achievements:

- Canal Side Plantation: 1750 Rkm
- Sand Dune Stabilization-cum-Pasture Development: 8750 ha
- Silvipastoral Plantation: 8750 ha
- Block Plantation: 1750 ha
- Rehabilitation of degraded Forests I and II: 4200 ha
- Fuel Wood Plantation: 3500 ha
- Assisted Natural Regeneration: 875 ha
- Development Biological Park: 3

Facts and Figures:

Nodal/Implementing Agency	Rajasthan Forest Department
Area covered	86000 ha
Administrative unit	15 Districts of Rajasthan
Target groups	
Project period and status	01 March 2011 - 31 March 2019, Ongoing
Amount committed	15749.00Million Japanese Yen
Funding	Japan Bank for International Cooperation and Government of Sikkim

For more information: Rajasthan Forest Department, Jaipur, Website: www. rajforest.nic.in/

Programme/Project #46: Tripura forest environmental improvement and poverty alleviation project

This project, in Tripura, a north-eastern State of India, focuses on restoring degraded forests and improving the livelihoods of the people, especially the tribal population engaged in traditional shifting cultivation. Afforestation in 51,000 ha of forest land, farm forestry, agro-forestry and soil and moisture conservation are the key components of the project. Community mobilization forms the essence of the project and 456 Joint Forest Management Committees (JFMCs) and Eco Development Committees (EDCs) are to be formed and strengthened under the project. These JFMCs shall play a central role in restoration of forests and socio economic development of their respective villages. The project provides for comprehensive capacity building of these JFMCs as well as development of basic infrastructure for JFMCs. Strong emphasis has also been laid on development of infrastructure as well as capacity building of the personnel of the forest department.

The Tripura Forest Environmental Improvement and Poverty Alleviation Society (TFIPS) aimed at promoting sustainable forest management in the State with a larger goal of supporting rural

livelihoods. Recognizing the crucial linkage between rural livelihood, particularly in forest fringe villages, and the forest resources in the context of the State, the project specifically focussed on the one hand on conservation and development of forests and their optimal and sustainable use and, on the other, on creation of alternative livelihood opportunities based on local skill and other resources. The project was implemented throughout the state in selected project villages through active participation of the village community organized in to Joint Management Committees (JFM). Biodiversity conservation amidst rising biotic pressure on forest was an important and integral component of the interventions planned under the project.

The project covered forests and forest areas including PAs in identified 10 Forest and Wildlife Divisions of the State, namely Sadar, Teliamura, Kailashahar, Kanchanpur, Gumti, Bagafa, Udaipur, Sepahijala, Rowa, and Trishna. The project would provide implementation of activities like restoration of degraded forests both under Joint Forest Management (JFM) mode and non-JFM mode as well as farm forestry, and biodiversity management for eco-tourism development and establishment of community reserves. For doing so, it would also undertake programmes of community/tribal development including capacity building of Van Sanrakshan Samiti and eco-development committees as well as self-help groups for supporting activities of infrastructure development, publicity communication, monitoring and evaluation, etc.

Objectives:

The project aimed to promote sustainable forest management, and poverty alleviation through creation of livelihood options, infrastructure for income generating activities duly linked with forest conservation in the project area.

Achievements:

Several components and sub-components of the project being implemented in earnest. Of the target of 456 JFMCs/EDCs, the project has so far formed 413 JFMCs and 9 EDCs. The project envisages 1400 SHGs of which 413 have been formed/ adopted.

Facts and Figures:

Nodal/Implementing Agency	Tripura Forest Department
Area covered	66180 ha
Administrative unit	Entire state
Target groups	State Forest Department and Communities
Project period and status	01 April 2007 - 31 March 2019, Ongoing
Amount committed	7725.00 Million Japanese Yen
Funding	Japan Bank for International Cooperation and Government of Sikkim

For more information: Tripura Forest Department, Agartalla,
Website: www. forest.tripura.gov.in

Programme/Project #47: Indo-German watershed development programme - Phase III

Three states Andhra Pradesh, Gujarat and Rajasthan invited National Bank for Agriculture and Rural Development to launch a similar programme in their respective states and funded by German Development Cooperation. The programme has made a very important contribution to the way watershed development is being implemented in the country. Several approaches and instruments pioneered under the programme such as capacity building as a prior and integral component of watershed development, participatory net planning (PNP), ridge-to-valley approach, greater emphasis on soil conservation over water harvesting, making village communities responsible for project implementation and providing them with financial resources directly, public accountability mechanisms, civil society public sector partnership, etc., have been widely adopted in donor, state and national watershed development projects.

The Indo-German Watershed Development Programme (IGWDP) provided the basis and template for an important structural initiative, this was supplemented by the National Watershed Development Fund (NWDF) which is a replication fund financed by the Government of India and NABARD. The Fund which is managed by NABARD has supported hundreds of participatory watershed projects across the country.Many of the village youth who were trained in the program (the PLS5) and became key functionaries for project planning and implementation in their own villages have now moved to other regions/states as resource persons and members of Watershed Development Teams (WDTs), thus promoting replication.

In villages where watershed development activities have been successfully undertaken by the people there has been a marked improvement in the ground water regime and net cropped area, increased agricultural diversification and productivity, improvement in numbers and quality of livestock, increase in incomes and local employment especially in the agricultural sector, reduction in migration, increase in school attendance especially of girls and increased food, water and livelihood security. More importantly, there is a noticeable improvement in social relationships in the villages, a sense of hope, greater confidence in dealing with drought and an increased ability to access government officials and schemes - all of which are important constituents of sustainability and long term development.

Facts and Figures:

Nodal/Implementing Agency	Watershed Organisation Trust
Area covered	32567 ha
Administrative unit	29 WS projects (64 villages) from Dhule, Nagpur, Nandurbar, Nashik and Wardha
Target groups	
Project period and status	01 July 2007 - 30 June 2012, Completed
Amount committed	₹ 13.88 Million
Funding	National Bank for Agriculture and Rural Development

For more information: Watershed Organisation Trust, Watershed Organisation Trust (WOTR), Satara, Road, Pune - 411009, Maharashtra, Website: www.wotr.org

Best Practices

6 Best Practices

In the context of the United Nations Convention to Combat Desertification (UNCCD), best practices are measures, methods or activities that are considered successful in terms of achieving desired outcomes (good performance) and contributing to expected impacts formulated in the 10-year strategic plan and framework to enhance the implementation of the Convention (The Strategy). In this segment, there are 15 Best Practices, including the work undertaken by the Ministries, Departments, R&D organizations, UNCCD accredited Civil Society Organisations and non-accredited Civil Society Organisations. There are other best practices emerging from the various programmes of ministries and departments implemented at the local level, that couldn't be incorporated in the fifth National Report submitted to UNCCD Secretariat due to paucity of time and resources.

1. Participatory climate monitoring
2. Pine briquette a source of alternate fuel
3. Gharat (Water Mills) - A traditional eco-friendly practice
4. Comprehensive approach to environmental management through holistic development (by adopting WOTR Wasundhara Approach)
5. Rehabilitation of degraded bamboo forests
6. Afforestation of degraded lands and sustainable resource utilization by the community in sunata village in arunachal pradesh
7. Agro-forestry linked watershed management: best practice to prevent desertification, land degradation and enhance productivity per unit area and time
8. Environmental regeneration through wasteland development
9. Ago-horticultural intervention in the wasteland as a part of desertification, land degradation and drought
10. Soil and water management and livelihood improvement
11. Refined assisted natural regeneration for sustainable and participatory forest management and for biodiversity conservation and livelihoods

12. Plantation and green belt development around Chandrapura Thermal Power Station, Chandrapura, Dhanbad
13. Community managed bio-industrial watershed
14. Farmer's manage ground water system
15. Kari (Stick) for agarbatti preparation from degraded bamboo forests

Best Practice #1: Participatory climate monitoring

Location: Different districts of Andhra Pradesh

Brief description of the natural environment within the specified location:

Climate: Fluctuations are recorded in annual rainfall, particularly in the semi-arid areas of Rayalaseema and Telangana. Both aggregate and district-wise data identifies recurring droughts in the state resulting in crop failures, drinking water shortages, falling groundwater levels, and increased risk of contamination of surface water. Climatic uncertainties necessitate multi-year reservoir storage capacity, for which the state is not well equipped.

Soil: The major soil groups present are red soil, black soil, and alluvial soil. Red soil occupying about 65 per cent, back soil (vertisols) accounts for 25 per cent of the land area. The alluvial soils are marine and riverine deposits occupy 5% and problematic soils like saline and saline-alkali and alkali soils (1%).

Topography: Project area corresponding to 150-600 m contours covers Rayalaseema and most parts of Telangana, which are characterized by hills/hillocks, undulating plains and valleys.

Prevailing socio-economic conditions of those living in the location and/or nearby (Farmers' indebtedness, cost of cultivation, value of production and net income per ha in Andhra Pradesh) : On average 82% of farm household are indebted in Andhra Pradesh vis-à-vis 48.6% at all India level. The difference is even more in marginal and small farmers' categories. One of reasons is that farmers in Andhra Pradesh have better access to financial institutions/banks due to its thriving Self Help Group bank linkage program. Agriculture and allied activities like field crop production, animal husbandry, backyard poultry and horticulture crops are the main income sources. Under common law in India, groundwater extraction rights are chattel to land. Extraction of percolating waters with no limit on quantity is the right of every landowner. Land owners generally regard wells as their own and view others, including the government as having no right to restrict or

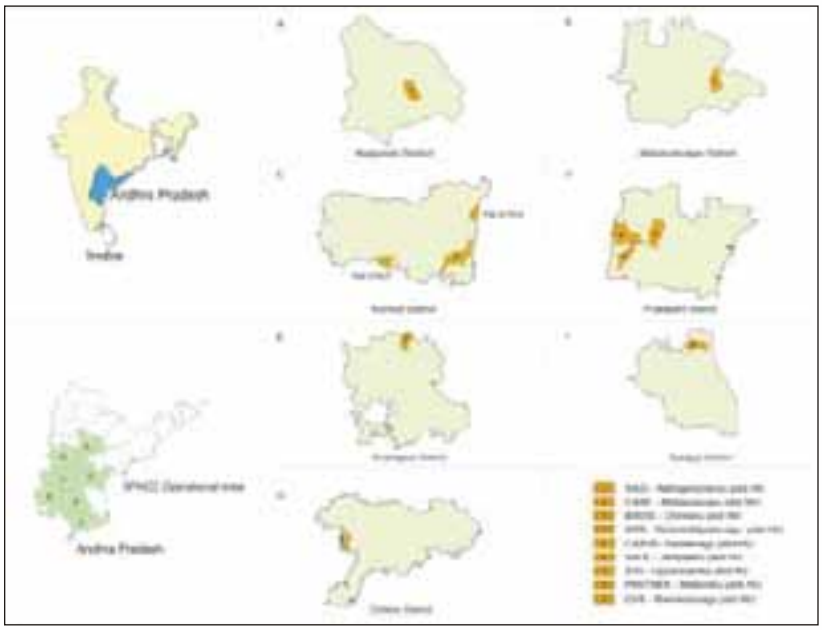


Fig. 21: Location Map

otherwise control their right to extract water. Despite the well-established common law position, the easement and irrigation laws proclaim the absolute rights of government on all natural water.

Short description of the best practice:

Participatory Climate Monitoring (PCM) refers to a set of activities carried out by farmers, with initial support of experts, to monitor climate parameters. It involves recording of rainfall, humidity, temperature, evaporation, wind velocity, wind direction and sunshine hours. PCM is a tool that is intended to trigger discussion on the climate variability and its impact on their land and water resources, thereby triggering household/farm-level adaptation.

Specific land degradation problems addressed by the best practice:

PCM model is able to provide answers to the major issue i.e., scarcity of hydrological data. PCM could help scientific agencies to adapt the scientist-farmer model of data sharing and benefiting from each other. The interval between the stations as evolved in PCM could be adopted by the groundwater agencies to get more representative data, thereby improving the water balance estimations. The design of rain gauge stations, monitoring wells and stream gauge, apart from methodology of construction, data collection, storage, display and dissemination strategies that worked in PCM could solve the issue of access to data and bring in transparency as the data is now available (for a cost) on the public domain. PCM training modules when fully developed should address the issue of community capacity building for sustainable groundwater management.

Objectives of the best practice:

- Farmer volunteers to possess skill of measuring important climate parameters
- Climate data to be documented and disseminated within the hydrological unit community
- Starting point provided for discussion, within the hydrological unit community, on the impact of climate variability on land and water resources, and identification of suitable adaptation options
- A HU level "Community Climate Adaptation Plan (CCAC)"

Brief description of main activities:

- *Identification of PCM volunteers:* The total number of volunteers identified is about 500 in number, about 4 from each of the target 143 habitations. Criteria for selection of PCM volunteers are: 1). experience in data collection; 2). minimum literacy: read and write; 3) resident of the village where the PCM station is established; 4) could be SHG women; and 5) school children (7th/8th standard) selected by school authority.
- *Capacity building of PCM volunteers:* The capacity building of PCM volunteers starts with the master trainer training, of one-day duration. The curriculum includes: technical aspects of equipment; their installation; data collection and recording; and upkeep of PCM stations and equipment. Volunteers are trained at field level at the respective sites for two days. The PCM

volunteer training (PVT) is of two-day duration, mainly aiming at the skill development of volunteers in data collection and recording.

- *Data collection and hand-holding:* Without compromising on the quality of data, the procedures for data collection are kept as simple as possible using simple formats with minimum entries. Data collection starts in June, soon after establishment of PCM stations. PCM volunteers collect data at 08.30 hours, every day. On-field guidance is provided to farmers and volunteers by professional staff.
- *Data storage and dissemination:* PCM data records are designed and printed in the local language. Data recording is done in the PCM data record books provided to the PCM volunteers. The book consists of formats for every day recording for all instruments. There are three formats for three sets of equipment. The data is entered in computers at the field unit office. The field data collection and monitoring assistant (FDCMA), in coordination with the field facilitators ensure that PCM database is updated.
- The dissemination of PCM data at the habitation level is carried out through Display Boards. The design and specifications of display boards is developed by project management office and communicated to partner NGOs, to ensure quality across the project. Display boards are erected at central places of a village so that they are visible to every villager frequenting these. Volunteers use the earmarked columns against each parameter to enter data. Dissemination at the project level is in the form of updating the database and uploading.

Fig.: 23 Field Demonstration of the best practice by stakeholders

- Selection of sites: PCM adopts the technical criteria of the Indian Meteorological Department (IMD), in selection of PCM sites. Based on the technical criteria communicated by the project management office (PMO), the field units identify probable sites, in consultation with their

respective climate change adaptation committee (CCAC). Physical inspection of the sites is then carried out to assess the technical as well as social feasibility of the site proposed.

- The sites conforming to both technical and social criteria are cleared for establishment of PCM stations. Three sites are selected for installation of three sets of PCM equipment viz., a) Rain Gauge and Evaporation Pan; b) Stevenson Screen, consisting of two sets (maximum-minimum and dry-wet bulbs/thermometers); and c) Sunshine recorder, Wind Vane and Anemometer. Opting for three sites instead of one is expected to promote community participation within the hydrological unit, which consists of 10 habitations;
- PCM Station Establishment: After the procurement process is completed, the equipment is delivered at the field unit by the supplier. It is essential that suitable local masons are identified and trained before the establishment process begins, at the field level.
- The training familiarizes the masons on: required site conditions; site plan and sections; construction of platform for equipment installation; specifications and methods of fixing the equipment in the masonry structure; standards of fencing material; and construction of fence.
- Climate change adaptation plan (CCAP) workshop: Climate change adaptation committees (CCACs) play a key role in feasibility study, site selection, establishment of climate monitoring stations, selection of volunteers, data collection and dissemination, safeguard and maintenance of equipment, and serve as a platform to discuss the climate variability factors, their impact on land and water resources, and identify adaptation options. They are also responsible for conducting CCAP workshops, based on the farmer data.

Technical specifications of the technology:

Technical specifications recommended by the Indian Meteorological Department (IMD) are used in the practice to maintain compatibility of farmer collected data with that collected by scientific institutions.

Institutions/actors involved (collaboration, participation, role of stakeholders):

The technology has been developed by Bharathi Integrated Rural Development Society (BIRDS) in partnership of the following:

- Centre for Applied Research and Extension (CARE)
- Collective Activities for rejuvenation of Village Arts and Environment (CARVE)
- Development Initiatives and People's Action (DIPA)
- Gram Vikas Samstha (GVS)
- People's Activity and Rural Technology Nurturing Ecological Rejuvenation (PARTNER)
- Society for Sustainable Agriculture and Forest Ecology (SAFE)
- Social Awareness for Integrated Development (SAID)
- Star Youth Association (SYA)

Following local stakeholders were also involved in developing the technology:

- Chinneru Hydrological Unit Groundwater Management and Climate Change Adoption Committee, Rudravaram Mandal, Kurnool district
- Mallappavagu Neeti Parivahaka Prantha Bhugarbha Jalala Yajamanya Committee, Uppununthala Mandal, Mahabubnagar District
- Yadalavagu Bhoogarbajala Yajamanya Committee, Markapur Mandal, Prakasam District
- Narsireddypallivagu Parivahaka Prantha Bhoogarbha Jala Yajamanya Committee, Racherla Mandal, Prakasam District
- Kadirinayani Cheruvu Prantha Bhoogarbha Jala Yajamanya Committee, Ramasamudram Mandal, Chittoor District
- Bokkineruvagu Neeti Parivahaka Prantha Yajamanya Committee, Kasinayana Mandal, Kadapa District
- Jampaleruvagu Bhugarbhajala Yajamanya Committee, Ardhveedu, Mandal Prakasam District
- Nathigani Cheruvu Bhugarbbajala Yajamanya Committee, Thiparthy, Mandal Nalgonda District
- Uppara Vanka Parevahaka Prantha Bhugarbbajala Yajamanya Committee, Gooty Mandal, Anantapur District

For more information: Bharti Integrated Rural Development Society (BIRDS), Hyderabad (Andhra Pradesh), Website: www.birdsorg.net

Best Practice #2: Pine briquette a source of alternate fuel

Location: Nainital, Bageshwar, Augustyamuni, Chinyalisaur in Uttarakhand

Brief description of the natural environment within the specified location:

Climate: Warm temperate conditions prevail in the middle Himalayan valleys, with summer temperatures usually hovering about the mark of 25° C and cooler winters. Cool temperate conditions dominate the higher areas of the middle Himalayas, where the summer temperatures are usually around 15° to 18° C and winters drop below the freezing point.

Soil: In the north, the soil ranges from gravel (debris from glaciers) to stiff clay. Brown forest soil often shallow, gravelly, and rich in organic content is found farther to the south.

Topography: There are three distinct topographical belts: the Shivaliks in the sub-Himalayan tract (300-600 m amsl), the Himachal ranges in the lower Himalayan region (1,500 - 2,700 m amsl), and the Himadri ranges in the upper Himalayan region (4,800-6,000 m amsl). The Garhwal and Kumaon regions of the State together form approximately 350 km of the 2,500 km long Himalayan range. The middle hill region that lies between 1,800-3,000 m is mostly forested, thinly populated and has poor water supply.

Prevailing socio-economic conditions of those living in the location and/or nearby: Main income sources are through sale of farm produce, livestock products, livestock and other non-farm based activities.

Short description of the best practice:

Pine forests are spread throughout the Himalayan region. These forests are very prone to fire, not only because of the resin content but also because of the massive accumulation of needles on the forest floor. Besides using the pine needles (locally known as 'Pirul') for cattle bedding, other uses are not known. Pine briquetting was introduced by Uttarakhand Decentralized Watershed Development Programme (UDWDP) as an experimental endeavour with the intent of reducing the drudgery of the womenfolk of Himalayan villages in the project area (the daily search for firewood) and also to address the perpetual problem of "forest fires" caused by pine needles. Sustainable land, water and biodiversity conservation and management for improved livelihoods in Uttarakhand watershed sector project (GEF funded) co-financed with UDWDP project has scaled up the pine briquetting activity through various endeavours.

Problems addressed by the best practice:

Main problems addressed by the best practice:

- *Fuelwood requirement:* The average family size in the project area is five adult units, with an annual consumption of fuelwood per rural household of 2.7 MT. This puts a lot of pressure on the forests. The total area of pine forest in reserve forest in Uttarakhand is about 3.43 lakh hectare. These pine forests in Uttarakhand produce about 20.58 lakh tones dry biomass (pine needle) annually. This is now utilised for producing pine briquettes. The average requirement of

pine needle briquettes per household is 1.1 MT per annum. The calorific value recorded for pine needle briquette is 5,885 Kcal/kg, 47% more than that of fuelwood.

- *Drudgery of women:* Shifting out of fuelwood based energy in the beneficiary households will save 110 women days per annum. Given the opportunity, 95% of the rural women engaged in domestic duties would be willing to get engaged in livelihood activities in their household premises. The opportunity cost of saved women labour is therefore high, and even at the current wage rate, its value works out to Rs 8,250 per annum per household.
- *Health of women:* Fuelwood burning causes a lot of smoke, thus leading to many health problems. Pine briquettes are a very clean fuel with no sulphur content and low ash content of <5%. The stove used to cook food using pine briquette is also smokeless. Thus the use of pine briquette fuel would help in reducing the ill effects of fuel burning on women health.

Specific land degradation problems addressed by the best practice: 80% of the project area lies in Chir pine zone and this zone is very prone to forest fires due to deposition of pine needles on the forest floor. These fires cause destruction of biomass available on the surface thus leading to depletion of organic matter from the soil. The soil becomes compact and the percolation of water into the soil decreases. This leads to excessive run off from the surface and causes lot of soil erosion. Pine briquettes serving as an alternate to fuelwood would reduce pressure on forest, therevy helping in reduction of forest degradation.

Objectives of the best practice:

- *Reducing pressure and fuel load in forest:* Pine briquetting would help to replace the demand of fuelwood. This would reduce the dependency of local people on forest for fuelwood. The removal of pine needle would help to reduce inflammable material from the forest.
- *Livelihood option:* Pine briquetting would provide an alternate livelihood option to the local people as the availability of raw material in the adjoining forest is in plenty and the demand for fuel exists in the local markets.
- *Reducing drudgery of woman:* Shifting to pine briquetting as an alternative fuel option would save time of the rural women.
- *Alternate renewable energy source:* Pine needle charcoal briquettes is an ideal fuel as it is eco-friendly and also economical and cheaper than other solid fuels.

Brief description of main activities:

- *Awareness generation and capacity building:* People were made aware about the usage of pine briquettes and significance of the conservation of forests.
- *Organizing into self help groups (SHGs):* Local people were organized into SHGs for ease of mobilization, social interactions and economic interactions. These SHGs facilitated production, marketing and sustainability of the enterprise.

- *Demonstration of technology:* The technology of pine briquetting was demonstrated to the local people to enable them to adopt and use it.
- *Sale of excess produce:* For income generation, excess produce was manufactured and sold in the local market.
- *Record keeping:* Groups were trained on accounting and record keeping.
- *Awareness generation:* Women were made aware about the benefits of using pine briquettes like time saving, less hazardous, energy efficient.
- *Promoting use of smokeless stoves*: Villagers were motivated to use smokeless stoves for house hold purposes because they are less hazardous and energy efficient.
- *Organized collection of raw material:* Villagers were organized into groups for collection of pine needles and production of briquettes.
- *Organized marketing of produce for sale:* Self help groups (SHG's) were motivated to the extent that apart from producing briquettes for self consumption, they analysed the potential market in local and urban areas and started marketing briquettes in these areas.

Short description and technical specifications of the technology:

A charring kiln is used to convert pine needles into charcoal. The needles are fed gradually in a specially designed charring kiln. After the batch is completely fed, the door of the kiln is closed. Due to partial oxidation the needles are charred and not burnt.

Power Operated Briquetting Machine: The char obtained from the charring kiln, is mixed with 10% of suitable binder (cow dung, starch, soil) and the mixture is fed in the hopper of the machine, which is conveyed by the augur to the exit tubes from where the cylindrical briquettes come out and fall on the pan, placed under the machine. The briquetting machine is made of mild steel and works on a 2 horse power motor. The production capacity of the machine is 60 kg/hr.

Biomass Fuel Cooking Stove: Considering the importance of design of cooking stove, a new kind of advanced design of cooking stove for the purpose of using biomass fuel briquettes and in particular to reduce the loss of heat due to radiation and convection, has been developed. The briquettes burn efficiently with less smoke production in this stove.,

Institutions/actors involved (collaboration, participation, role of stakeholders):

The technology was developed by the Watershed Management Directorate, Dehradun.

Major impact of best practice:

1. ***Socio-economic level***
    - Reduced drudgery of women
    - Increase in income of local people

2. ***Environmental level***
   - Controlling land degradation
   - Reduction in pressure on forest
   - Reducing the health hazard of women

3. **Major off-site impacts: Improvement in the eco-system services.**

   Adoption and replicability: The technology can be disseminated/introduced to other locations of Uttarakhand

   Type of incentives to facilitate the take up of the technology provided:
   - Policy or regulatory incentives (for example, related to market requirements and regulations, import/export, foreign investment, research & development support, etc)
   - Financial incentives (for example, preferential rates, State aid, subsidies, cash grants, loan guarantees, etc)

Fig. 30: Preparation of Pine Briquette

Lessons learnt:

Related to human resources:

- Capacity building and awareness generation if adequately provided leads to change in the mind set of local people.
- Organizing the people into self help groups facilitated production and marketing.
- Capacity building facilitates the rural people in accounting and record keeping.

Related to financial aspects:

- Marketing is facilitated by organizing people into groups.
- Incentives in the form of machines and stoves promote easy acceptability.
- Low cost of machinery promotes people for usage.

Related to technical aspects:

- Simple Technology helped in adaptation.
- As the machine runs on electric power so the production capacity is higher than the manually operated ones, hence it is time saving for the local people.
- Easy operation and maintenance cost helps in acceptability of the technique.

For more information: Watershed Management Directorate, Indira Nagar, Forest Colony, Dehradun 248 006, Website:http://www.iwmp-uttarakhand.in/

Best Practice #3: Gharat (Water Mills) - A traditional eco-friendly practice

Locations: Nainital and Augustyamuni in Uttarakhand

Brief description of the natural environment within the specified location:

Climate: Warm temperate conditions prevail with summer temperatures usually about 25° C and cooler winters.

Soil: Soil ranges from gravel to stiff clay.

Topography: The middle hill region that lies between 1,800-3,000 m are mostly forested, thinly populated and has poor water supply.

Prevailing socio-economic conditions of those living in the location and/or nearby: Main income sources are through sale of farm produce, livestock products, livestock and other non farm based activities.

Short description of the best practice:

'Gharats' or water mills run on a stream's kinetic energy to turn the shaft of the grinding mill. The water is diverted from the stream or river along a channel or canal to the water wheel. The force of the water's movement drives the blades of a wheel or turbine, which in turn rotates an axle that drives the mill's other machinery. The water leaves the wheel through the continuation of the channel. This may in turn feed another mill. The passage of water is controlled by sluice gates that allow maintenance. The project undertook the task of rebuilding and rejuvenating these watermills as these gharats had low efficiencies ranging from 10% to 15% only. Under the project this abundant and renewable waterpower resource was exploited more effectively with appropriate and modernized equipment, and concrete structures which required less maintenance cost every year. These changes increased the processing capacity of the gharats from 5-6 kg to 10-15 kg of wheat per hour. This played a key role in driving sustainable economic development in the hilly regions; improving the food quality of the milled cereals available to the inhabitants of this project area was another major concern. Flour from these water mills is rather coarse as compared with that from from the power mills of the plains and has more roughage (fibre content) hence, considered healthy. Operationalization of large number of gharats is an indicator that eco-system services have improved (water flow).

Main problems addressed by the best practice:

- Time saving
- Energy efficient

Specific land degradation problems addressed by the best practice:

The technology involves diverting water from the stream or river along a channel or canal to the water wheel. The water leaves the wheel through the continuation of the channel thus the flow of water is channelized which helps to check soil erosion. The channelized water is used for irrigation purposes which help to increase agriculture productivity.

Objectives of the best practice:

- To revive the traditional practices which are eco-friendly and a source of alternate renewable energy.
- *Health benefits:* The flour from these water mills is a little coarse as compared with that from the power mills, thus health benefits due to more roughage.
- *Livelihood option:* The watermills would be used to harness the natural water flow for grinding purposes which would provide an additional source of income to the local people.

Brief description of main activities:

- *Awareness generation*: People were made aware of the usage of locally available alternate renewable energy sources and significance of this on the ecosystem.
- *Organizing into self help groups (SHGs):* Local people were organized into self help groups for ease of mobilization, social interactions and economic interactions for sustainable use of renewable energy resources and revival of traditional practices.
- *Promoting use of technology:* The technology of floor grinding using gharats is well known to people of Uttarakhand. They had to be encouraged for enhanced usage of this technology.
- *Awareness generation:* People were made aware about the health benefits of using flour from these water mills.
- *Promoting use of watermills:* People were motivated for using watermills for grinding purposes.
- Rejuvenation of gharats: Gharats were rebuild and rejuvenated to enhance their grinding capacity and for health and hygiene purposes.
- *Promoting use of technology:* Local people had to be encouraged for using this technology as a livelihood option.

Short description and technical specifications of the technology:

'Gharats' or water mills run on a stream's kinetic energy to turn the shaft of the grinding mill. The water is diverted from the stream or river along a channel or canal to the water wheel. The force of the water's movement drives the blades of a wheel or turbine, which in turn rotates an axle that drives the mill's other machinery. The water leaves the wheel through the continuation of the

channel. This may in turn feed another mill. The passage of water is controlled by sluice gates that allow maintenance.

Gharats are popular due to its simple and cost effective mechanism, besides this they are eco-friendly. After slight modifications in the technology, gharats are now producing healthier and coarser flour. Maintenance cost of gharats has also reduced very much and their efficiency has increased from 5-6 kg/hr to 10-12 kg/hr.

Institutions/actors involved (collaboration, participation, role of stakeholders): The technology was developed by the Uttarakhand Watershed Management Directorate, Dehradun.

Major impact of best practice:

- *Socio-economic level (including cultural level):* Increase in income of local people.
- *Environmental level:* Controlling land degradation. *It also* promotes use of alternate renewable energy resources like hydro power thus decreasing the use of fossil fuels.

Main conditions that led to the success:

- *Traditional practice of using gharats:* In Uttarakhand people since ages have been using water energy to run these gharats for grinding cereals however it was on decline due to lack of financial resources.
- *Motivated local people:* Local people for want of livelihood options readily adopted the practice as the basic infrastructure and the technical knowhow already existed. People were organized into self help groups to promote the activity on a larger scale.
- Availability of funds under the project facilitated rejuvenation of this age old practice.

Replicability

The best practice/technology can be replicated at sub-national level.

Lessons learnt

Related to human resources:

- Awareness generation leads to change in the mind set of local people.
- Organizing the people into self help groups ensures sustainability of the activity.
- Capacity building facilitates the rural people in accounting and record keeping.

Related to financial aspects:

- Incentives in the form of rejuvenation and rebuilding of these water mills, helped in easy adaptation.
- Low input cost promotes people for usage.

- Organising people into groups helped in promoting the activity for additional income generation.

Related to technical aspects:

- Simple technology helped in adaptation.
- Easy operation and low maintenance cost helps in acceptability of the technique.
- As the machine runs on hydro power so it is eco-friendly which thus reduces the cost of production.

Fig. 31: Gharat/ Water Mill

For more information: Watershed Management Directorate, Indira Nagar, Forest Colony, Dehradun-248 006, Website:http://www.iwmp-uttarakhand.in

Best Practice #4: Comprehensive approach to environmental management through holistic development (by adopting WOTR Wasundhara Approach

Location: Sattechiwadi is hamlet of the Hivargaon main village which is situated at the foothills of the Sahyadari ranges in Sangamner tehsil of Ahmednagar District of Western Maharashtra.

Brief description of the natural environment within the specified location:

Climate: Sattechiwadi is situated in Sangamner Tehsil of Ahmednagar District which is a rain shadow region. The area receives all of its annual precipitation from the Southwest monsoon. The average rainfall in the area is about 450 mm. The monsoon breaks in the first/second week of June, and lasts till the end of September generally and sometimes extends up to the second week of November.

Soil: The watershed is characterized with sandy loam and silty loam soil, having very shallow soil depth.

Topography: The topography of the area is undulating and hilly. The village is encircled by mountains from three sides. The village with an area of roughly 350 ha comprises a well-defined watershed. The entire area in turn is divided in two micro-watersheds with one drainage outlet flowing from north to south.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income level: Average annual income: Rs. 6,000 8,000/-
Main income sources: 83 % of the families have agriculture and allied activities as the main source of income. Backyard poultry and rearing of small ruminants are other supportive income sources especially for landless and very poor families. The villagers are known for expertise in onion and tomato growing.
Land tenure and land use rights: Most of the people in the village own land. Average gross landholding per household in Sattechiwadi is about 2.46 ha of rainfed land; 25.30% families are landless.

Short description of the best practice:

- Climate change proofing and developmental activities implemented
- Soil and water conservation through a systematic ridge to valley area treatment (continuous contour trenches, afforestation, farm bunds) done to prevent soil erosion
- Demonstration and replication of vermi-compost units
- Collaboration with the Forest Department under Joint Forest Management Programme.
- Horticulture plots for mango and chiku plantation
- Improved agricultural equipment
- Growth assessment of the children below 5 years age, followed by establishment of Anganwadi
- Understanding the weather (Agro met station)

- Common lift irrigation schemes
- Drainage line treatments (Gully plugs, Gabions.)
- Plantation in forest area
- Farm ponds
- Alternate livelihoods: Backyard poultry sheds (44 units); barber shop (1); local banjo party group (13 members) and paper plate making (1).

Main problems addressed by the best practice:

- Environmental:
  - o Drinking water security for whole year
  - o Vegetative canopy
  - o Reduction in runoff and zero soil erosion
  - o Regeneration of biodiversity
  - o Increase in wild animals.
- Economic:
  - o Agricultural employment has increased from 2 months/yr to 10 months/yr
  - o Increased fodder and biomass availability
  - o Increase in income due to various livelihood interventions
- Social:
  - o Women's drudgery reduction through promotion of renewable energy products (improved hot water stove, solar home lights)
  - o Improvement in social and human capitals.
- The village community organized in various CBOs, and capacitated to function effectively and efficiently.
- Infrastructure:
  - a) Road construction: Approach road from main road to the village (4 km), constructed through Government funds
  - b) Community hall
  - c) Houses for the homeless below poverty line families through "Indira Awaas Scheme" by the Government of India
  - d) Piped drinking water schemes
  - e) Individual toilets

Specific land degradation problems addressed by the best practice:

Land treatments and plantation: The entire land with appropriate land treatment and drainage line treatment was completed by the Village Development Committee (VDC). Land treatment in the

forest area was completed under the Joint Forest Management through Forest Protection Committee with the collaboration of Forest Department.

Formation of user's group: Promoted common lift irrigation schemes for small groups of farmers on equitable water sharing basis.

Objectives of the best practice:

- Reducing vulnerabilities of project villagers
- Building response capacity
- Managing climate risks by reducing drought impacts
- Managing impacts of climate change

Brief description of main activities:

- Building response capacities, skills, livelihood assets and infrastructure (physical, environmental and ecological) that facilitate adaptation and reduce poverty.
- Promotion of climate proofing livelihood activities
- Enhanced adaptation activities that focus on building robust systems for problem solving.
- Enhancing of climate information to be incorporated in to decisions to reduce negative effects on resources and livelihoods.
- Enhanced actions focus almost exclusively on addressing impacts associated with Climate change. Promotion of climate proofing livelihood activities

Short description and technical specifications of the technology:

The Wasundhara watershed development approach is the basis of this programme. It is simple ridge-to-valley approach that changes lives by reshaping landscapes and combating social injustices. The poorest people hold land on the ridges, where the land is the worst because it fails to collect water. It is believed to uplift them first, and then move down toward the people in the valley who need help less urgently.

Institutions/actors involved (collaboration, participation, role of stakeholders): The best practice was developed by the Watershed Organisation Trust (WOTR), Pune (Maharashtra).

Participation of local stakeholders, including CSOs, fostered in the development of the technology:

- Local Village Development Committee (Satteaai Village Development Committee), comprising of 3 men and 4 women, which is a subcommittee of Gram Panchayat, formed under Wasundhara Approach.
- Sanyukta Mahila Samiti

- Watershed Organisation Trust
- The Agricultural Department
- Soil Conservation Department
- Forest Department
- Hivargaon Grampanchayat (local governance body)
- Zila Parishad
- Agricultural University: Mahatma Phule Krishi Vidyapeeth (MPKV)
- Villagers
- Government of Maharashtra
- Funding Agency: Swiss Agency for Development and Cooperation, Hong-Kong Singapore Banking Corporation (HSBC), Arghyam, Bangalore and Andheri-Hilfe, Bonn (AHB)

Major impact of best practice:

Production or productivity:

- Increase in per acre production (quintals) of pearl millet and wheat from 5-6 bags to 14-15 bags.
- Grass fodder which was available only for six months earlier, now is available throughout the year.

Socio-economic level:

- Wasundhara approach created the necessary dynamics and incentives to the Village Development Committee, the Samyukta Mahila Samiti and the Panchayati Raj Institutions to demonstrate a positive discrimination in the favour of the disadvantaged. Village Development Committee gives special attention to its poor.
- Fuelwood, dung cake and kerosene were earlier used for lighting and cooking purposes and in order to meet this need trees had to be cut down but as a result of women's initiative all the households have solar lamps and 56 hot water chulahs.

Environmental level:

- Water Availability: Before this project, all the wells were seasonal; now 18 of them have water available till the end of June up to the next year. Water from nallahs can be used till January, which otherwise used to go dry immediately after rainy season was over. Water tables have increased.
- Land Use and Agriculture: Wasteland has decreased by 82 per cent in post-project period. Previously only 2 ha of land was perennially irrigated, which has gone up to 45 ha. Overall land use has increased by 85 per cent.

Major off-site impacts:

- The Wasundhara Approach has been adopted by WOTR in its all project areas which number 357 projects, covering more than 243,210 ha area. Also, ridge to valley approach as demonstrated by WOTR has been adopted by NABARD and Government of Maharashtra for their project areas.

- Convergence approach which was adopted for integrated village development and demonstrated successfully in Sattechiwadi village is now being spread to other WOTR project areas in its climate change adaptation project.

Impact on biodiversity and climate change:

- Hot water chullahs (cooking stoves) used for cooking reduced fuelwood consumption by 50%, thus helps reducing carbon emissions and preserving carbon sinks.
- WOTR works for mitigation through promotion practices. All efforts taken in Sattechiwadi led to secure livelihoods of the community which are more climate resilient.
- Planted trees on the agricultural bunds have added into the biodiversity of the region. These trees also act as perching sites for the natural pest control by the trees. Controlled grazing has helped strengthening soil base. Providing livelihood options has minimized pressure on the surrounding ecosystem. Minimized chemical fertilizers usage and more use of organic.

Main conditions that led to the success:

- Wasundhara approach that led to local initiative to take up the activities: Participative nature of all the activities ensured the community's continuous support throughout the project period and after the completion of the project too.
- Addressing the issue of equitable distribution of benefits and involving community to distribute benefits to the poorest of the poor.
- Village envisioning helped villagers to see their future and design their own path for development of their village.

Replicability:

The best practice/technology can be replicated at local level.

Lessons learnt:

Related to human resources:

- Along with the watershed development a lot of other measures need to be taken up to nourish the human capital, one of them being promoting women's welfare under which five Self Help Groups (SHGs) were formed. These groups act as forums of developmental and income generating activities for the women of the village. The apex body of such SHGs is known as Samyukta Mahila Samiti (SMS).
- The members of the SHGs and SMS underwent training and awareness programmes in aspects like basic concept of self help, roles and responsibilities of managing SHGs, social development activities, health and education for children etc.
- The direct impact of empowered women is visible now. Almost every child in Sattechiwadi goes to school, men don't drink inordinately anymore and women are open enough to be a part of the discussions in Village Development Committee's meetings and in the normal course of life.

Related to financial aspects:

- In the pre-watershed period in Sattechiwadi, water was obtained by digging and hitting lower depths successively, year after year. Rain-fed agriculture was certainly not a source of adequate income, neither were cattle and chickens. Primary source of income for the families was wages they used to get by working on others' fields and by working as industrial workers for the units around. It was not enough to feed families of 5-6 members each.
- People in Sattechiwadi used to go to work on other's fields for a mere Rs. 25/- per day irrespective of whether they had land or not; most of he people used to stay out for work, but after WOTR-Wasundhra's implementation, people had work on their own farms.
- The landless have benefitted as landowners need agricultural labour for their farms. Now they get around Rs. 80/- to Rs.100/- as daily wages.
- Agricultural income also increased significantly. The current average figure is around Rs. 30,000-40,000/- annually for each family as compared to none in the pre-watershed period. Almost 95% of families now have bank accounts as compared to 10% earlier.
- Every family earns at least Rs.100-150 per month through poultry and if required they also sell their chickens @ Rs.200 without affecting the poultry production.

Related to technical aspects:

- A systematic ridge to valley approach for watershed development is essential.
- A detailed participatory net planning is important because all structures need to site specific.

For more information: Watershed Organisation Trust (WOTR), Satara, Road, Pune-411009, Maharashtra, Website:www.wotr.org

Best Practice #5: Rehabilitation of degraded bamboo forests

Location: Nainital, Bageshwar, Augustyamuni, Chinyalisaur in Uttarakhand

Location: Nine Forest Divisions North Betul, West Betul, South Betul, West Chhindwara, South Chhindwara, East Chhindwara, Sidhi, Singroli and Umariya in 5 Districts of Madhya Pradesh.

Brief description of the natural environment within the specified location:

Climate: The climate is extreme in the north of Madhya Pradesh. It is cool and breezy in the central parts and humid in the eastern and southern regions. The project districts are primarily located in dry deciduous zones, with high precipitation and temperatures.

Soil: Singroli, Umariya: Red and yellow, medium black and skeletal (medium/light) Betul, Chhindwara: Shallow black (medium), Sidhi: Mixed red and black soils (medium)

Topography: Except for the valleys of the Narmada and the Tapti, Madhya Pradesh consists of a plateau with a mean elevation of 480 m above mean sea level, interspersed with the mountains of the Vindhya and the Satpura ranges. The main river systems are the Chambal, Betwa, Sindh, Narmada, Tapti, Mahanadi and Indravati. Nearly one third of the state's area is covered with tropical forests ranging between the rivers Chambal in the north and Godavari in the south. To the east of Chambal, the area has rocky surface.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income Level: The poor families involved in the project have an average income of Rs. 10,000-15,000 annually with some variations depending on their subsistence living.

Main income sources: Mostly small and marginal farmers, forest dwellers, landless labourers. The poor community depends on forest-based resources as one of the primary sources of income.

Short description of the best practice:

The rehabilitation and co-management of degraded bamboo forest areas offers many opportunities for recovering provisioning services of the local ecosystem thus adding to sustained livelihood security and for securing supporting services such as better soil formation. Through this output, the project plans to enhance the role of bamboo forest areas in maintaining (a) connectivity between relatively undisturbed forest tracts that provide refuge for globally significant biodiversity, and (b) the livelihood system of about 789 families in the 5 project districts. The project worked with the tribal/ rural landless and marginal land holding families who have significant dependency on the surrounding forest areas for socio-economic needs. The aim is to demonstrate a model for addressing poverty alleviation and environmental protection by engaging needy families in

sustainable management of degraded bamboo areas found in forest lands in and around their villages, and sustainable harvest of the resource. Each family was allocated approximately 20 ha of degraded bamboo forest area in and around their village for rehabilitation and sustainable co-management, targeting 5 ha/yr over the time frame of the project. This amounts to coverage of approximately 14,500 ha. The families are provided with financial and technical assistance for sustainable management of degraded bamboo areas, as well as for sustainable harvesting. These families are benefitted in the short-term from an additional source of income for rehabilitation services rendered, broadening their income base. At present each family on a monthly basis is paid Rs. 2,500/- which amounts to Rs. 30,000/- annually as an additional income for the households. Over the long term, sustainable co-management practices undertaken by the families may regenerate the local bamboo forest resources creating opportunities for families to access the resource for income generation, as per the existing joint forest management resolution and Government order of Madhya Pradesh. This will help diversify sources of livelihood in the short and long term, in turn, having a beneficial regional impact by reducing migration under socio-economic duress. Target families will develop skills for managing and protecting degraded bamboo forest areas and sustainable harvesting of bamboo.

Main problems addressed by the best practice:

- Land degradation: Bamboo forest areas degraded due to over-grazing, lack of protection/ management/treatment etc.
- Participation of poor communities dependent on forest low

Specific land degradation problems addressed by the best practice:

- Degraded bamboo forests due to overgrazing and deforestation
- Very low per hectare availability of bamboo culms per clumps
- Congested bamboo clumps with low productivity of good quality bamboo
- Severe soil erosion in those areas
- Poor regeneration capacity of the degraded bamboo forests
- Poor communities in and around the areas with limited livelihood options

Objectives of the best practice:

- Degraded bamboo forests treated for ecological revival
- Increase in per hectare availability of bamboo culms per clumps
- Arresting severe soil erosion in degraded areas
- Assisted natural regeneration leading to growth of other key vegetative spp.
- Ensuring livelihood of the poor communities in and around the degraded bamboo forest areas
- Ensuring the access and benefit sharing of poor communities towards forest resources under the joint forest management scenario.

Brief description of main activities:

- Selection of site and poor families in and around the degraded bamboo forest areas
- Poor families assigned area of degraded bamboo forests
- Orientation and sensitization of poor families towards management of these areas.
- Treatment and management of the degraded bamboo forests (families assigned areas for the management of the sites and families provided certificates to ensure their involvement)

Description and technical specifications of the technology:

In brief, rehabilitation of degraded bamboo forests comprises site identification, cleaning operations like weeding, felling of bamboo in congested clumps, soil work, protection etc. These activities are carried out as a yearly procedure. The cleaning of congested clumps also has a scientific method in which training and orientation is provided.

Institutions/actors involved (collaboration, participation, role of stakeholders): The best practice was developed by the Madhya Pradesh Forest Department.

Major impact of best practice:

1. ***Production or productivity***

- The treatment, management and protection works have resulted in good growth of bamboo culms which indicates increase in productivity of bamboo.
- The areas assigned to the poor families have increased protection and involvement which has resulted in increased natural regeneration capacity of the areas which indicates enrichment of the *in-situ* biodiversity.

2. ***Socio-economic level (including cultural level)***

Each poor family receive a monthly remuneration of Rs. 2500/- or Rs. 30000 annually towards treatment and management of the degraded bamboo forests. This additional household income has provided support to their socio-economic needs, addressing the issues of health, education etc.

Major off-site impacts:

- The involvement of the community has set examples for nearby communities due to exposure to the work being done.
- Protection measures by the community resulted in decreased incidences of forest fires.

Impact on biodiversity and climate change:

The participatory forest management by the local poor communities successfully addresses the revival of the local degraded eco-system. The communities have developed, protected and


Fig. 32: Rehabilitation of Degraded bamboo forests

managed the sites for biodiversity enrichment. Thus, along with ecological revival the increased productivity of bamboo from those areas in the long run has ensured livelihood of the poor families under the access and benefit sharing through the joint forest management. This action leads to climate change mitigation and adaptation at the community level.

Main conditions that led to the success of the presented best practice/technology:

- Sensitization of the poor communities towards their involvement in the treatment of the degraded bamboo forests in the nine Forest Divisions.
- Ecological revival associated with immediate and long term livelihood opportunities realized by the stakeholders.
- The Sate level initiative by the Forest Department to promote bamboo cultivation.

Lessons learnt:

Related to human resources:

- Communities willing to participate in participatory forest management if livelihood systems are well linked with the initiative.
- Ecosystem services possible for communities to deliver if the intervention design promotes livelihood access and benefit sharing mechanisms.

Related to financial aspects:

- The immediate remuneration provided to the communities under a project mode requires continuous revision as per the existing wage rate. This may help in more innovative practices in the identified sites.

Related to technical aspects:

- The communities doing good work should be exposed *in-situ* as well as *ex-situ* through experts/organizations to similar experiences to bring innovativeness and learning's towards the work.
- The learning from the activity should be documented as a climate change component like carbon sequestration and study on the enrichment of the biodiversity, etc.

For more information: Madhya Pradesh Forest Department, Bhopal,
Website: www.mpforest.org

Best Practice #6: Afforestation of degraded lands and sustainable resource utilization by the community in Sunata village in Arunachal Pradesh

Location: District Tawang Arunachal Pradesh

Brief description of the natural environment within the specified location:

Climate: The region is well known for its climatic variations. Tawang District has a geographical area of 2,172 km^2 with a population density of 28 people per km^2. The altitude ranges from 1,800 to 2200 m above mean sea level. The district is divided into three sub divisions Lumla, Jung and Tawang. The mean minimum temperature is -5.5^{0}C and the mean maximum temperature is 29^{0}C. Average rainfall is 2,760 mm.

Soil: The soils are classified as rocky and loamy skeletal texture with soil depth shallow to medium; sandy skeletal, loamy, fine loamy textured with soil depth medium to deep.

Topography: The mountainous belt from 1828 to 3352 m., which contains plateau and narrow valleys and are sparsely populated.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income level: Labour activities mainly through contract works/carpentry are the chief source of livelihood, with income of around Rs.60,000/- per family per year. Agriculture is carried out on a minimal level for meeting some of the daily requirements.

Land tenure and land use rights: There are three types of lands existing in the village viz. private land, community land under lease and community land.

Short description of the best practice:

The village has a lot of degraded area and also follows the practice of annual burning of grazing lands for maintenance. In this initiative, the community members have been trained to remove the young saplings (mostly of *Rhododendron arboreum*) first and collect the seeds before fire is set. These saplings and seeds are maintained in the community nursery and then planted in a 2 ha degraded patch. This area has been declared as a new sacred grove (locally called *nge*), through a village resolution and the *Rinpoche* will perform the ceremony, in accordance with Buddhist traditions, in the month of September 2012. The community has now been trained in sustainable extraction of timber and other forest resources. The nursery which is maintained by the community is not just a source of saplings for planting in the degraded area in the village, but is also now providing the community with additional livelihood benefit through sale of saplings.

Objectives of the best practice:

- Impart training for initiation of restoration of degraded sites by planting indigenous and endemic species at a pilot scale.
- Generate awareness on significance of forest landscape restoration for ecological services and sustainable livelihoods.

Fig. 33: Glimpses of the first community managed nursery established at village Sakpret, Tawang

- Fine tune the seed germination techniques of *Rhododendron arboreum* in order to attain better germination rate.
- Develop a demonstration plot in the area for degraded forest land restoration.

Brief description of main activities:

- Impart training for initiation of restoration of degraded sites by planting indigenous and endemic species on a pilot scale.
- Generate awareness about significance of forest landscape restoration for ecological services and sustainable livelihoods.
- Fine-tune the seed germination techniques of *Rhododendron arboreum* in order to attain better germination rate.
- Develop a demonstration plot in the area for degraded forest land restoration.

Short description and technical specifications of the technology:

The community members have been provided training on different aspects of restoration and monitoring. Germination experiments have been conducted in order to develop the best site-

specific technique. Plantations, using saplings raised in the nursery, have been carried out in degraded forest land and regular monitoring of the same is carried out.

Institutions/actors involved (collaboration, participation, role of stakeholders): The best practice was developed by the InsPIRE Network for Environment, New Delhi. The other local partners and stakeholders involved in developing the practice are NGO-Yuva Arunachal and Village Cooperative Society.

Major impact of best practice:

1. *Socio-economic level (including cultural level)*
   - Declaration of a new sacred grove (locally *nge*), in accordance with the Buddhist tradition in order to blend conservation with veneration and combating degradation of forest lands.
   - The nursery is providing the community members with additional livelihood benefits through sale of the saplings.
2. *Environmental level*
   - Establishment of 2 ha restoration plot with more than 3000 saplings planted from the nursery.
   - Establishment of a community owned nursery for raising saplings and germination of seeds of native forest species.

Major off site impacts:

- Awareness of need for restoration of degraded forest areas and sustainable utilization of resources has spread to the neighbouring villages.
- Restoration activities to combat degradation are being initiated by other villages as well.

Impact on biodiversity and climate change:

The initiative has long term benefits on the biodiversity of the region and will also play a role in climate change mitigation. The degraded forest areas are getting afforested by plantation of native forest species. To keep the initiative going, replace the dried up saplings and carry out plantations in other degraded forest lands, the community is actively maintaining the nursery. This initiative of plantation, coupled with enforcing the practice of sustainable harvest of natural resources is now spreading to other villages in the region. The biodiversity profile of the region as a whole showed improvement and will play a significant role in climate change mitigation.

Main conditions that led to the success of the presented best practice/technology:

- Integration of the initiative with conservation inherent in the religion and culture of the area
- Community involvement at all stages from conceptualization to implementation
- Community deriving economic benefits as well from the initiative

Lessons Learnt:

Related to human resources:

- For ensuring success of any community-based initiative, the community members should be involved in it right from the planning stage.

- Implementation should be carried out in accordance with the traditional practices in the area. The community should be made to sit together and in a participatory manner decide who will carry out the work and in what manner.
- Any village-level committee to be formed for any initiative should be in a participatory and democratic manner wherein all the families of the village are provided a platform to voice their opinion and then arrive at a consensus.

Related to financial aspects:

- For the success of any community-owned livelihood enhancement programme, its administration should be in accordance with the traditional system of benefit sharing existing within the community.
- The economics of the entire initiative should be transparent to the entire community during village level meetings to rule out any possibility of ambiguity.

Related to technical aspects:

- Site-specific technology needs to be developed for the success of any initiative.
- Traditional knowledge should be incorporated while designing the technology.

For more information: InsPIRE Network for Environment, New Delhi, Website: www.inspirenetwork.org

Best Practice #7: Agro-forestry linked watershed management: best practice to prevent desertification, land degradation and enhance productivity per unit area and time

Location: Garhkundar-Dabar Watershed in Tehsil Niwari, District Tikamgarh (Madhya Pradesh)

Brief description of the natural environment within the specified location:

Climate: Semi-arid sub-tropical with750-1150 mm rainfall

Soil: Shallow gravelly soil with rocky hillocks sandwiched

Topography: Undulating with multi-directional complex slopes. Average slope in crop lands with 1-5%,, hillocks steep, community lands with 3-7% slope.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income level: Mixed farming community dominated by other backward classes, schedule castes and scheduled tribes (90%) with small and marginal holdings size. People are poor with less than Rs. 20,000/- per annum income.

Main income sources: Farming, dairying and agricultural activities.

Land tenure and land use rights: Mostly privately owned either through purchase or patta from Panchayat.

Short description of the best practice:

Water harvesting in nallah through series of gabion and check dams ensured availability of surface water till December and perched water in shallow dug wells throughout the year. Water availability led to regular cultivation of crops, increased fodder availability and brought prosperity to the farmers. Regular sensitization of farmers to ever changing climatic conditions and regularity in income from permanent tree cover prompted farmers to grow fruit trees in site fields and Tectona grandis, Dendrocalamus sp. and Acacia senegal on field bunds.

Main problems addressed by the best practice:

- Agriculture productivity
- Drinking water availability
- Poverty

Specific land degradation problems addressed by the best practice:

Soil erosion in semi-arid tropics is responsible for low production on account of low fertility and low water holding capacity. Poor ground water availability limits crop production and drinking water supply.

Objectives of the best practice:

- Increase water availability for drinking and crop production.
- Increase permanent vegetal cover.
- Increase and stabilize productivity and profitability from farming.

Brief description of main activities:

- Reducing run-off and soil loss through gabions, check dams, khadins and field boundary.
- Plantation inside field or in field boundary under agroforestry systems.
- Demonstration of improved package of practices of crop production under agro-forestry system and maintaining changes in crop production, income of farmers.

Short description and technical specifications of the technology:

Depending upon catchment land use slopes, gabions of 3 x 1 x 1 m size were used in first and second order stream. Check dams were constructed in third and fourth order streams. The size of structure varied as per area, land use and slope. Marginal bunding was done along nallah to check silt inflow. Khadins were used to check nallah encroachment into agricultural land. Fruit plants were planted inside field while timber trees on field bunds.

Fig. 34: Agroforestry-linked Watershed Management

Institutions/actors involved (collaboration, participation, role of stakeholders):

The best practice was developed by National Research Centre for Agroforestry, Jhansi (UP).

Major impact of best practice:

- Production or productivity: Productivity increased by 20-60% across the crops and cropping intensity from 69-161%. Area under crops (rabi) increased three-folds and kharif four-folds.
- Socio-economic level: Socio economic level improved as evident from addition of 61 pucca rooms construction, 30 diesel pumps, 3 tractors, 1 motor cycle. Number of school-going children, particularly girls, increased. Migration greatly reduced.
- Environmental level: Due to water availability, greenery increased, crop fields are bunded and leveled to large extent.

Major Off-site Impacts:

Surrounding farmers are now aware and are demanding similar projects from their leadership.

Impact on biodiversity and climate change:

Diversity of crops during rabi (main cropping season) has reduced while that in summer crops has increased. Bioiversity has also increased. The area is more climate resilient due to water management and plantation activity.

Replicability:

The best practice/technology can be replicated at local level.

Lessons learnt:

Related to human resources:

- Capacity building resulted in quality work.
- Institution building benefitted all including women and marginalized groups.

Related to financial aspects:

- Funding from Government for watershed development is sufficient.
- Transparency in fund management is required and accountability should be fixed with individuals be it farmers or anyone else.
- Reward for good work to farmer and implementer as well.

Related to technical aspects:

- Technical expertise available in the country.
- Technology needs to be constantly upgraded.
- Technological flexibility as per site conditions is required.

For more information: National Research Centre for Agroforestry, Jhansi (UP),
Website: http://www.nrcaf.ernet.in/

Best Practice #8: Environmental regeneration through wasteland development

Location: Gandhivan in Block Jamwaramgarh, district Jaipur (Rajasthan)

Short description of the best practice: Sandy, degraded, gullied undulated land was developed through a set of activities in collaboration with the local village communities in order to solve their problem of fuel and fodder and check the process of desertification in the area.

Main problems addressed by the best practice: Scarcity of fuel and fodder faced by nearly 500 families of the villages.

Specific land degradation problems addressed by the best practice: Checked soil erosion, stabilized sand dunes and harvested rain water which was flowing in vain earlier and causing land degradation.

Objectives of the best practice: Solving the problem of the people of the area of fuel and fodder and checking the process of land degradation and desertification.

Brief description of main activities:

- Planted 40,000 trees of fuel and fodder species.
- Plugged 50 deep gullies and stabilized 30 sand dunes.
- Revived 5 old water harvesting structures and erected 3 new ones.

Short description and technical specifications of the best practices:

All the activities were carried out in close collaboration with the community and in consultation with forest officers and engineers for using indigenous knowledge and low cost technologies.

Institutions/actors involved (collaboration, participation, role of stakeholders): The best practice was developed by the Gram Bharati Samiti, Jaipur.

Major impact of best practice:

- *Production and productivity:* Solved the problem of fuel and fodder of nearly 500 families of the neighbouring villages.
- *Socio-economic level:* Provided temporary jobs to nearly 400 people of the area.

Major off-site impacts: Message of planting trees, stopping cutting down existing forests, conserving rain water etc. was disseminated among 20,000 people of neighbouring 20 villages.

Impact on biodiversity and climate change: Helped bird and animal population and protected hundreds of endangered plant species of medicinal value. Level of underground water came up in the wells of the area, moisture could be conserved, vegetation cover came up over sand dunes, etc.

Main conditions that led to the success of the presented best practice/technology:

- *Focus on* solving problems of fuel and fodder which had immediate impact on the community.
- Plugging of gullies and stabilizing sand dunes increased arable area.
- *Restoration/construction* of rain water harvesting structures increased water availability.

Replicability:

The best practice/technology can be replicated at local level.

Lessons learnt:

***Related to human resources*:** Youth and women volunteers should always be involved in such projects.

***Related to financial aspects*:** Finances must be raised from different sources in order to avoid any obstacle.

***Related to technical aspects*:** Indigenous technology is best; own people's knowledge and experience is always beneficial.

For more information: Gram Bharati Samiti, Jaipur - 302 028 Website:www.gbsjpr.org

Workers and volunteers erecting bench terraces and contours for plantation

Tree plantation

Fig. 35: Community participation in wasteland development

Best Practice #9: Agro-horticultural intervention in the wasteland as a part of desertification, land degrdation and drought

Location: Ratlam district in Madhya Pradesh

Brief description of the natural environment within the specified location:

Climate: The area is drought prone and has a sub-tropical climate characterized by high evaporation and low precipitation. Annual rainfall varies between 1100 and 1200 mm. Relative humidity is 75% to 85% in monsoon and 25% to 35% in hot summer. Temperature varies over a wide range from 7^0 C in winter to 52° C in summer.

Soil: The district is covered by mostly residual soil formed by weathering of bed rocks. The soil characteristic of the area is defined as nearly 59% is shallow to moderately deep loamy soils and rest 41% is moderately deep to deep coarse loamy to fine loamy red soils.

Topography: The district is characterized by undulating topography with rugged hilly terrains in the western and southern parts.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income level: The level of income of the people living in the location is low and variations occur due to distress situations like failure of crops, drought, etc. People usually migrate to other parts of the country in search of livelihood and adopt different coping mechanisms to secure cash and food throughout the year.

Main income sources: Agriculture and agricultural labour is the primary source of livelihood for tribal people. Nearly 60% of the income comes from agriculture and 17% income from agricultural labour. Remaining income comes from seasonal migration to urban areas for wage labour, livestock and micro-enterprises.

Land tenure and land use rights: Land ownership is generally in the name of male members. Though in a very few cases women have title, but they have no power to sell the land independently. In most cases the decision makers are male, but in some cases women's view are also taken into consideration.

Description of the best practice: In the location agriculture is rain-fed and the prevailing livelihood pattern is characterized by seasonal employment and consequent seasonal migration to urban areas in search of employment. The dwindling forest resources have jeopardized agriculture and livestock productivity due to shrinking of water resource and poor fuel and fodder supply. The fragmented, un-irrigated and mono-cropped agriculture holdings and low productive livestock population do not offer adequate opportunity for livelihood. Agro-

horticultural interventions (fruit orchards) as a measure of sustainable land management which literally means small orchard with intercropping is the approach taken. The fruit orchards consisted of mango and cashew as fruit crop with forestry species on the periphery of land holdings. While the fruit plants paved the way for income generation in five years, forestry species provide act as wind breaks and shelter belts besides meeting the fuel, fodder and small timbers needs of the participant families. It also helps in reducing the pressure on existing forests. It has ensured the productive utilization of barren/unutilized land. The intercropping supplements incomes. The process of agro-horticultural intervention follows the simple chain of action: 1. Prepare the land 2. Create provision for water 3. Plant trees.

Main problems addressed by the best practice:

- Productive utilization of wasteland through agri-horticulture model. Small orchards are developed in the barren land keeping in view the soil type and climate of the area. Vegetable cultivation as inter-crop is promoted in homestead area with pulses in upland area with the objective of improving the fertility of the land and also cater to their nutritional needs.
- Conservation of soil through development of horticulture land use. The green cover improves the soil health through addition of organic matter into the soil. Conservation of soil moisture improves its availability to the vegetative cover.
- Water conservation through development of small water retention structures. Intensive natural resource management activities are carried out through soil & water conservation and water resource development. Watershed approach follows ridge to valley treatment measures, contour and staggered trenches, gully plugs and check dams.
- Reduction of pressure on existing forest.

Specific land degradation problems addressed by the best practice:

The soil topography being unsuitable for agriculture practices, it is best conserved through fruit orchard concept wherein the planting of trees will address soil conservation and soil moisture retention along with floor management with leafy vegetable crops. This, in long run, will turn the barren wastelands into productive crop fields. Social fencing is given and local & low cost measures adopted to ensure low mortality of the plants. This intervention combines technologies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously address food security, ensure employment, alleviate poverty and prevent migration.

Objectives of the best practice:

- Better use of unproductive land
- Improvement of soil health
- Water resource development and soil & water conservation

Brief description of main activities:

- Better use of unproductive land: 1000 small orchards of one acre for identified tribal farmers of project area were developed. Keeping in view the soil type and the climate of the project area, the following species have been identified for plantation fruits tress: mango and cashew; timber species: *Tectona grandis*, *Dalbergia sissoo*, *Gmalina arborea*, *Ziziphus sp.*, *Moringa* sp. etc; medicinal plants: *Withiana somnifera*, *Phylanthus amblica*.
- Social mobilization is done to protect the plants for increasing the rate of survival. Awareness is created among the farmers to provide low cost measures to check the mortality of the plants.
- To enhance the capability of local communities through intensive training and exposure on improved natural resource management practices and environmental regeneration: 1.Organized awareness campaigns; 2. Imparting pre- and post- technical training programmes; 3. Exposure visits within and outside state.
- Development and implementation of environmentally friendly income generating activities though people's organizations: 1. Establishment of agro-processing centre for value added products in grown horticulture crops; 2. Setting up of power operated equipment for various farming operations as well as income generation activities through self help groups.
- To generate water reservoirs and recharge ground water through best practices of water reservoir development and soil water conservation for increasing irrigation efficiency: 1. Construct farm ponds to develop water storage for lean period; 2. Promote moisture conservation measures to control run off losses; 3. Practice widely suitable micro irrigation model like pitcher or bucket with drip irrigation measure in order to precise use of irrigation water in lean period.

Short description and technical specifications of the best practices:

Within the context of improving land and water productivity, orchards are pivoted around a hardy fruit tree species that has potential for post-harvest processing and marketing linkages. Although WADI (Wasteland Agriculture Development Initiative) encourages farmers' choice of species to be planted, experience indicates that cluster approach provide produce of a `kind' to economize post-harvest processing with viable market potential. This can only be achieved if critical mass of `raw material' of a `kind' is ensured. Typically, an acre of orchard may accommodate 60 plants but to be effective across a large area, experience shows that a minimum of 40 plants per acre should suffice to be an economically viable unit. For each target family one acre of land will be identified for developing an orchard by planting a combination of 40 mango plants, 10 sapodilla plants, and 350 multipurpose forestry plants; this would be a high density cultivation of horticulture crops.

Institutions/actors involved (collaboration, participation, role of stakeholders):

The best practice was developed by the Gramin Vikas Trust, Noida (UP) with the involvement of *following local stakeholders:* Gram Panchayat, Self Help Group and Government Departments like Agriculture, Horticulture, Health, Veterinary etc.

Major impact of best practice:

1. ***Production or productivity***
   - The productivity of the land is enhanced by introduction of cropping practices in the wasteland.
   - Additional farm income generated through horticulture and vegetable crop cultivation, resulted in per unit increase in productivity.
2. ***Socio-economic level (including cultural level)***
   - The tribal communities are characterized by their affection for forest and natural habitats. The technology provided increase in forest area and availability of natural abode to the community, enhancing their cultural values.
   - Per family income enhanced by additional income of Rs. 10,000-15,000 per annum.
3. ***Environmental level***
   - The issues of soil and water erosion appropriately addressed through plantation activity and crop management.
   - The environmental issues of air pollution and carbon sequestration also addressed.
4. ***Other:***

   The widespread problem of mass migration mitigated through adoption of technology.

Fig. 36: Ago-Horticultural Intervention in the Wasteland

Major off-site impacts:

- The problem of soil, water and air pollution is addressed by the technology.
- Farmers in the vicinity of the project area are also adopting the same technologies and developing mini orchards with improved agri- and silviculture system in their backyard spaces.

Impact on biodiversity and climate change:

The cropping pattern introduced acts as resource of enhanced floral biodiversity whereas the man-made forest acts as a niche for faunal diversity. Earlier, tribal communities were not used to take up different crops like fodder trees, vegetable crops, horticulture/medicinal crops due to limited resources and awareness; they used to grow traditional crops like maize, paddy or gram. Gradually with adoption of the orchard model, now farmers are growing different crop combinations with inclusion of horticulture/medicinal/vegetable crops and fodder tree plantations. This leads to increase in biodiversity in the existing cropping system. The planting of horticultural trees and forest trees species act as a sink of carbon thus addressing air pollution caused due to industrialization process in global perspective. The green cover also acts as soil binder and a reason for precipitation. Erratic rainfall occurs in tribal region which leads to crop insecurity and thus forced migration to earn labour wages for compensating farming losses. With orchard intervention, it is found that seasonal migration has certainly reduced as they are found fully engaged with orchard management practices because it gives additional income throughout the year which suffices to meet their day to day requirement in terms of food, fuelwood, fodder, timber etc in the event of total crop failure. Overall, it has been seen that orchard practices were very significant in climate change adaptation.

Main conditions that led to the success of the best practice/technology:

- The replicability of the technology in reclamation of wastelands and fallow lands. The present technology is only confined to poor marginal farmers who have less access of fertile land with limited resources. The orchard technology requires only 1 acre (400 m^2) land in backyard space with limited irrigation sources.
- The technology is replicable with adequate support of awareness and technical knowhow on improved cultivation practices to the beneficiaries so that they are able to fetch good income from orchard intervention.
- Since orchard development is directly dependent on the agro-climatic conditions, replication requires conduciveness.

Lessons learnt:

Related to human resources:

- The individual response in adoption of technology varies from farmer to farmer depending on the level of motivation, resources available and orientation towards the venture.

- The intervention being family-centric, it is easily adaptable and involves equal responsibility of both male and female members of the family.

Related to financial aspects:

- The usual pattern of poverty and migration is appropriately addressed as the family is duly motivated to stay in the village and earn its livelihood through the technology.
- The technology has been a tested cost-effective model of preventing land degradation and earning livelihood.
- The technology addresses both short term & long term income generation activities through adoption of crop cultivation and horticultural produce and its value added products.

Related to technical aspects:

- Adoption of new technology for the promotion of traditional farming activity ensured for the well being of tribal families.
- The technology involves not only agriculture intervention but can encompass animal husbandry, apiary and aquaculture for additional income of the families.
- The technology also takes care of holistic development of villages through development of infrastructure.

For more information: Gramin Vikas Trust, Noida (UP), Website:www.graminvikastrust.org

Best Practice #10: Soil and water management and livelihood improvement

Location: 22 sub-watersheds of Una District, Himachal Pradesh

Brief description of the natural environment within the specified location:

Climate: Sub-tropical hot and humid temperature with average maximum temperature of 45^{0}C and average minimum temperature of 3.5^{0}C. Rainfall 175 mm in rainy season.

Soil: Alluvium type. Degraded loose strata in the catchment area

Topography: Undulated topography in upper catchment area and plain valley area

Prevailing socio-economic conditions of those living in the location and/or nearby:

Agriculture is the primary source of income. Most of the people are marginal farmers having marginal land (< 1 ha).

Short description of the best practice:

Holistic treatment of the catchment area based on watershed approach. Participatory micro-planning and site specific drainage line treatment measures. Linkages of water harvesting structures with the user groups to strengthen their livelihood conditions. Promotion of production activities and IGAs through formation and strengthening of self help groups with more focus on socially disadvantaged sections of society.

Main problems addressed by the best practice:

- Degradation of natural resources.
- Flood and drought
- Soil erosion
- Low agriculture and forest production

Specific land degradation problems addressed by the best practice: Soil erosion due fragile ecology of the area.

Objectives of the best practice:

- Soil and water conservation
- Improvement in agriculture and forest productivity
- Livelihood improvement
- Institution building

Brief description of main activities:

- Afforestation (Government land and private land) in participatory mode.
- Site specific soil protection works

- Civil works for soil and water management.
- Drainage line treatment works: small scale check dam (brush wood, dry stones, crate wire structure and drop structure), large scale check dam (silt detention and water harvesting structures), spur & embankments, ground silt.
- Soil protection and land reclamation: 1. Soil protection in damaged private land; 2. Soil reclamation in damaged private land
- Livelihood Improvement: Implementation of activities through the formation and strengthening of Panchayat level institution- Panchayat Development Committee 1. Production activities (agriculture, horticulture and animal husbandry); 2. Community infrastructures; 3. IGAs
- Institution Building: Training and capacity building of various stakeholders.

Institutions/actors involved (collaboration, participation, role of stakeholders):

- Krishi Vigyan Kendra, Una, Himachal Pradesh
- Regional Research Station of University of Horticulture & Forestry, Jatch, Una, Himachal Pradesh
- Krishi Vigyan Kendra, Tepla, Ambala, Haryana
- National Dairy Research Institute, Karnal, Haryana
- Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh
- BAIF Foundation, Pune

Major impact of best practice:

1. ***Production or productivity***

- Change in cropping pattern. People are adopting new high value crops instead of traditional crops
- Increase in productivity

2. ***Socio-economic level***

- Increase in income level
- Socio-economic empowerment

3. ***Environmental level***

- Improvement in tree cover and ecological improvement in the catchment area
- Soil and water conservation, flood moderation and recharging of aquifers

Major off-site impacts:

- Improvement in biodiversity
- Recharging of traditional water resources

Replicability:

The best practice/technology can be replicated at local and subregional level.

Lessons learnt:

Related to human resources:

- Enhanced skill development resulted in effective planning, implementation and management of natural resources
- Significant role of women in natural resource conservation.

Related to technical aspects:

- Technical aspect is an integral part of watershed management progarmme for the better planning and execution of works. Technical inputs are required right from site selection, designing & costing and improvement in the livelihood conditions of the beneficiaries.

For more information: Himachal Pradesh Forest Department, Shimla, Website www.hpforest.nic.in

Best Practice #11: Refined assisted natural regeneration for sustainable and participatory forest management and for biodiversity conservation and livelihoods

Location: Degraded forests under eight Districts (Koraput, Rayagada, Parlakahemundi, Kandhamal, Keonjhar, Angul, Deogarh ad Sundergarh) of Odisha State

Brief description of the natural environment within the specified location:

Climate: The climate is characterized by high temperature and medium rainfall. Topography, however, modifies the local climate greatly. The average annual rainfall of the state is 1498 mm. Mean annual temperature for the state is 26.2°C. Mean summer temperature from April to June is 30.3°C and mean winter temperature from December to February is 21.3°C. The climate may be classified under hot moist sub-humid and hot and dry sub-humid.

Soil: Soils of Odisha have been divided into eight broad soil groups namely red soils, laterite and lateritic soils, red and yellow soils, coastal salt affected alluvial soils, deltaic alluvial soils, black soils, mixed red and black soils and brown forest soils.

Topography: Odisha is bounded by the Bay of Bengal with a coastline that stretches for about 450 km. According to the physiographic conditions, the topography of Odisha is categorized into the following heads namely, the central plateaus, the eastern coastal plains and the middle mountainous and highlands region. Numerous mountainous springs gush down the mountains of Odisha. The forest areas are mostly located in undulating terrains in middle mountainous and high land.

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income level: In the rural forest fringe areas, the sources of livelihood are agricultural activities, forest products, labour wages, sale of livestock, trading, vending, salary, etc. These sources have been broadly categorized into agricultural income, income from forest, wage income, and other source of income. According to Economic Survey of Orissa 2007, the average monthly family income of a 5 member family is Rs. 1,825/.

Main income sources: The major source of livelihood for the households was wage labour. Agriculture and allied activities are the primary source of livelihood for only 18.44% of the total households. Majority (53.46%) of the households have reported that they rely on wage labour as main source of livelihood and 8.07%, 2.36%, and 1.35% of the total households have reported service and/or pension, trade and business, self employment and others activities respectively as their primary source of livelihood.

Land tenure and land use rights: 26.46% of the households do not own any land. Out of the households having land holdings, 14.07% have land less than 0.4 ha, 44% have land in the range of 0.4-1 ha, 19.85% have more than 1 ha but less than 2 ha land, 15.21% have more than 2 ha and less than 4 haland and remaining 6.87% have more than 4 ha land.

Short description of the best practice:

Assisted/aided natural regeneration forms the major strategy of treating degraded forests in India under different programmes. Unlike its name, it is implemented largely as a plantation model and does not accommodate the current forest policy thrust on community participation, livelihood improvement and biodiversity conservation. Policy envisaged adoption and sustainability of Joint Forest Management (JFM) is dependent upon more community-sensitive, silviculturally apt, aided natural regeneration practices. Recognition of these concerns led Odisha State Forest Department Programme to adopt a refined, assisted natural regeneration process, following a step-by-step 'diagnostic and design' approach with the involvement of the community. The process uses GIS maps, local ecological knowledge and working plan prescriptions to analyze 4 ha-grids from eco-livelihoods perspective and jointly develop grid-wise treatment plans. With formalized involvement of communities and NGOs in forest management, this practice addresses upfront concerns of livelihoods and biodiversity, while reiterating commitment towards enriching forests and enhancing their productivity The steps followed in implementing the practice on ground include formation of a working group (WG) comprising members of the VSS, the Forest Department and local resource persons to take up the tasks. While deciding about the treatments, 'retaining' is given importance over 'planting'; seed dibbling/wilding preferred over planting of seedlings; herbs, shrubs, tubers and climbers are accorded equal importance as tree species; NTFPs get priority over timbers and 'what not to cut' is the concern instead of 'what to cut'. Under soil conservation measures, principles of ridge to valley treatments are followed along with preference for biological or bio-mechanical measures.

Main problems addressed by the best practice:

- Local livelihood needs are subdued in timber/revenue oriented forest management; increasing economic value of non timber forest produce is not considered.
- Accommodating natural regeneration and growth of non-timber livelihood species and biodiversity.
- Current practices prefer planting of nursery raised sapling from outside, neglects seeding and planting of wildling; site-specific treatment through dispersed plantation not followed.
- Focus on tree species doesn't allow promotion of other livelihood species which may be shrubs, climbers, herbs, etc., and slow growing, shade bearers/demanders, browsables, etc.
- No provision to target tending operations to promote natural regeneration of non-timber livelihoods species, e.g., no climber cutting of livelihood species like *Bauhinia vahlii,* no provision for thinning in subsequent years.
- No soil moisture conservation treatment as per site requirement; ridge to valley system not followed; bunding, trenching and use of vegetative options limited
- Lack of focus on participation and biodiversity.

Specific land degradation problems addressed by the best practice:

Project area has predominant red soils in undulating and sloping terrains. This is highly prone to erosion and frequent occurrence of high intensity storms which is a characteristic of local climate. Deep gullies and exposed hard pans with eroded top soil are a common sight in degraded forests of the project region. Cleaning and singling operations aimed at promoting growth of sal and allied species not only exposes soil to erosion, but also leads to timber stands with very limited undergrowth. Soil erosion is often immense under pure crops of sal.

Objectives of the best practice:

- Biodiversity perspective
- Livelihood perspective

Brief description of main activities:

- The first step is comprehensive diagnosis of the forest area to be treated through the use of grid-marked GIS maps, multi-stakeholder grid transact walks and use of silvicultural and community knowledge. Each grid is allotted a unique identity as per its location in the matrix. In this step, the teams take transact walks along marked grid lines to assess and characterize each grid in terms of its canopy density, ecological status, livelihood-important plant species in different storeys.
- The second step involves deciding about species (trees, liana, shrubs, herbs, climbers, tubers) to be augmented in different grids as per rational stakeholder choice (weighted scoring matrix) made through use of local ecological knowledge and species silviculture.
- In the third step the selected species are described in terms of their livelihood uses, regeneration potential based upon local ecological knowledge. This information helps to complement/supplement the available/silvicultural knowledge about the selected species and therefore facilitates nursery/tending operations.
- The treatment plan for all grids gets finalized as per the requirement of species retention/augmentation (through seeding/transplanting of seedling/wildlings), tending operations (cleaning, weeding, singling, thinning, stool cleaning, etc., specific treatment measures for bamboo stock augmentation as per requirement) and soil moisture conservation measures (trenching/bunding/gully control as per the erosion types).

Description and technical specifications of the technology:

With contours of forest management shifting towards livelihoods, biodiversity and ecosystem services from timber/revenue based management, regeneration, tending and harvesting operations need to respond and adapt to the changing paradigms and requirements. Silvicultural operations now need to meet the often conflicting needs of economy (local and global), ecology and society. Forest management processes need to integrate participation, livelihoods, gender equity,

democratization and decentralization agenda and concerns while maintaining technical integrity in harmony with ecological processes. Assisted natural regeneration, the existing dominant forest management practice in India, has to accommodate these needs, concerns and processes to enhance adaptation and resilience of forests to changing contexts. This best practice blends top-down approach of GIS based mapping with bottom-up approach of micro-planning through forest transact and promotes multi-stakeholder forest management through participation of JFMCs, NGOs and Forest Department. It attempts to blend elements of biodiversity conservation and livelihood promotion with the ongoing assisted natural regeneration practice. Different innovations like use of grid-based planning and integrated treatments, leveraging of local ecological knowledge, shifting focus from what-to-cut to what-not-to-cut, augmenting enrichment seeding/wildling, promoting regeneration of forest-foods like tubers, herbs etc. have become part of this approach through interactive demonstrations and stakeholders-feedbacks.

Institutions/actors involved (collaboration, participation, role of stakeholders):

The best practice was developed by the Odisha Forest Department with the involvement of the following *local stakeholders:*

- Members of Joint Forest Management Committees
- Women members of Self Help Groups
- Partner Non Governental Organisations

Major impact of best practice:

1. Production or productivity

- There were 1,331 number of total individuals in assisted natural regeneration versus 1,739 in control on an average. In terms of numbers, the assisted natural regeneration area has less number of individuals across age classes as well as corresponding to years after treatment (or no treatment) except for 0-5 cm and 5-10 cm age classes after 2 years.
- Soil carbon found to be more in assisted natural regeneration area than the control, except after 5 years. The difference is more after 2 and 20 years and marginally more after 10 years. Increased soil carbon indicates increasing productivity of soil and also higher carbon capture in soil.

2. Socio-economic level

- About 200-400 kg of cleaning materials (mostly fuel wood and occasionally small timbers) are generated per ha of assisted natural regeneration operations, which is mostly distributed among villagers or disposed off to earn income. This is a kind of direct immediate return to the community after coming under JFM mode.
- Degraded forests under JFM are usually eco-tone zones with higher biodiversity of NTFP, especially herbs, climbers and tubers, which are frequently relied upon by the forest-dependent communities to meet their food, medicine and income needs.

3. ***Environmental level***

- There is a decrease in diversity of trees and shrubs after assisted natural regeneration operations, indicating increasing dominance of certain species. However, herb diversity seems to be showing a marginal increase after assisted natural regeneration than in control.
- An interesting observation is that after 20 years of assisted natural regeneration, tree and shrub diversity index demonstrate downward trend, while herb diversity showed a marginal increase. In comparison to control, shrub diversity reduction looks quite higher in comparison to reduction in case of trees and herbs.

4. ***Other:***

Assisted natural regeneration operations provide substantial employment (about 82 mandays/ha) to remote forest-fringe village communities (as per OFSDP procedure to the JFM village) during first 4 years of assisted natural regeneration operations.

Impact on biodiversity and climate change:

There has been a surge of consciousness, recognition and activities towards promotion of biodiversity conservation following Earth Summit in Rio, wherein India became a signatory to the Convention on Biodiversity (CBD). Biodiversity conservation as a sustainability strategy, as key to ecosystem services/products and as a potential contributor to local and national economy, has become a main driver of forest management in policy and practice. In the context of tropical forests and their degrading trend, assisted natural regeneration with its ability to arrest retrogressions, facilitate succession, species enrichment and moisture augmentation, has significant implications on the biodiversity regime. Mid-term evaluation of Odisha State Forest Department Project has observed greater evenness and more bio-diverse nature of the forest community (S-W index values 1.86-3.23), better regeneration status in assisted natural regeneration (2204 to 3337 established seedlings/ha- adequately naturally regenerating as per national norm). REDD+ (Reducing Emission from Deforestation and Degradation) under UNFCCC, has assumed significant global importance as a cost effective mitigation strategy in the context of climate change with potential livelihoods and conservation benefits. REDD reddiness processes have begun in many developing countries including India, where significant efforts have been underway to tackle deforestation and rewrite compensatory conservation, sustainable forest management and community participation through assisted natural regeneration like operations in JFM landscapes.

Main conditions that led to the success of the presented best practice/technology:

- Participatory approach: This activity succeeds in field due to collaborative and participatory approach. Apart from Forest Department staff, VSS members are given equal importance in implementation and management process. Local NGOs were also included in the whole process to motivate VSS members and to facilitate the work.
- Focus on forest-based livelihood opportunity: Forest dependant people rely on forests for different needs: for their daily food, to meet their domestic needs and also to earn something

out of forest produce. Their entire livelihood opportunities are confined to their forests. Due to excess dependency on forest and no steps to multiply the available stock, availability of some species is declining day by day.

- Biodiversity Conservation: Biodiversity conservation as a sustainability strategy, as key to ecosystem services/products and as a potential contributor to local and national economy, has become a main driver of forest management in policy and practice. In the context of tropical forests and their degrading trend, assisted natural regeneration with its ability to arrest retrogressions, facilitate succession, species enrichment and moisture augmentation, has significant implications on the biodiversity regime.

Replicability:

The best practice can be replicated at National level.

Lessons learnt:

Related to human resources:

- The evolved process provides an option to the JFM stakeholders in India in the form of a doable and simple tool to carry out assisted natural regeneration, the major forestry operation assigned to them. This practice provides the grassroots staff of Forest Department leverage to avoid peer pressure for showing survival and thereby going only for plantation of fast growing and non-browsable species.
- By providing a strategic space to communities (VSS) and civil society (NGO) in the planning and decision making of assisted natural regeneration operations and hence in the manipulation of forest structure and composition, this process incentivizes and reinforces the concept of JFM.
- Involving women SHGs who are the gatherers and regenerators of the livelihood species in assisted natural regeneration operations will underline the importance of 'feminine forestry'. This will create an example for other states to follow the process in line with the women's nursery scheme (viz. involvement of women directly in regeneration practices). Elsewhere (viz. Uttarakhand) this has demonstrated higher survival and growth.

Related to financial aspects:

- Enhance income generation of NTFP gatherers and SHGs through gap planting and tending of natural NTFP.
- Enhanced institutionalization and transparency of JFMCs through transparency boards in all VSS offices, regular meetings of VSS General Body and Eexcutive Committee, all accounts kept by and at VSSs, all original documents at VSSs, all expenses passed by VSS Eexcutive Committee and annual audit at respective VSSs.

Related to technical aspects:

- This practice has provided opportunity for formal interaction of the stakeholders in manipulation of forest structure and composition. Comparing and contrasting the resulting

forests evolved through such co-management approaches vis-à-vis the forests resulting from management separately by Forest Department and Community in terms of ecological and socio-economic impacts will provide immense learning opportunities about the direction of future forest management in India.

- Given the present capacity and continuing approach towards timber-based and departmental approach of forest management among the cutting edge stakeholders, mainstreaming such paradigm shift is difficult.
- However, since JFM areas have to be treated on participatory lines with prime objective of livelihood augmentation and biodiversity conservation, percolation of the change process through demonstration, piloting and frequent monitoring of actual adoption at VSS level will be absolutely essential.
- Better and effective management of JFM-forest is incumbent upon availability of scientific information on their structure, composition, biodiversity and productivity. However, such information is scarcely available, largely due to lack of scientific research and inquiry.
- Absence of availability of information on sustainable NTFP harvesting, NTFP silviculture and biometry, limited documented knowledge about tubers, climbers and herbs and their ecology affect the adoption and implementation of this practice. On the other hand it also makes it inevitable to follow local ecological knowledge on these aspects, which strengthens community participation and ownership.

For more information: Odisha Forest Department, Bhubneshwar, Website: www.odishafdc.com

Best Practice #12: Plantation and green belt development around Chandrapura Thermal Power Station, Chandrapura, Dhanbad

Location: Chandrapura Thermal Power Station, Chandrapura, Dhanbad.

Brief description of the natural environment within the specified location:

Climate: Temperature varies from lowest minimum of about 8° C in winter and maximum of about 45°C in summer. The average annual rainfall of the area is 55" most of which is precipitated during the rainy season.

Soil: Light coloured, moderate depth, slightly acidic (pH 6.1 to 6.6) and deficient in organic content. The surface soil was sandy and sub-surface soil sandy-clay in texture.

Topography: Undulated area with occasional hills, covered with degraded plantations mainly of *Cassia siamea* with sporadic regeneration of *Butea monosperma* and *Ziziphus* sp. *Lantana camara* was the most prevalent weed. All the sites were highly eroded.

Short description of the best practice:

Soil amendments, plantation along the ridges, slopes, soil moisture conservation and water harvesting were undertaken in the completely degraded and barren land (mostly fly ash in place of soil) for the formation of green belt. Pit ash treated with surface soil, farm yard manure, vermicompost, rice husk, neem oil cake, diammonium phosphate, lime and micronutrients per plant before plantation of suitable tree species. The project has transformed the area into well established green belt leading to improvement in soil quality, afforested area and extent of dust pollution has been reduced substantially.

Main problems addressed by the best practice: Reclamation of stressed site

Specific land degradation problems addressed by the best practice:

The project has been implemented on a highly stressed site where the land was totally degraded. Through the project it was expected to tackle the problem of degraded soil quality, soil erosion, soil moisture conservation and make further amendments in the soil quality. The project area would also be converted into a green belt. This area was totally unproductive, before the project was taken up.

Objectives of the best practice: The technology envisaged developing vegetation through soil amendments, plantation along the ridges, slopes, soil moisture conservation and water harvesting in the degraded land for the formation of green belt around the selected project site.

Brief description of main activities:

- Establishment of permanent Hi-Tech Nursery: A hi-tech nursery equipped with all the modern facilities including mist chambers, green house and root trainers have been established. The

facility has been utilized for raising quality seedlings of *Acacia mangium, A. auriculiformis, Albizia lebbeck, Alstonia scholaris, Azadirachta indica, Bombax ceiba, Bauhinia variegata, Delonix regia, Dalbergia sissoo, Eucalyptus tereticornis, Gmelina arborea, Melia azadirachta, Sesbania grandiflora, Pongamia pinnata, Syzygium cumini, Terminalia arjuna, Swietenia mahagoni, Spathodea campanulata, Peltophorum ferrugineum* and *Anacardium occidentale* etc.

- Afforestation on ridges and slopes of ash pond areas: (i) Site inspection, preparation, alignment and stacking of pits, digging of pits as per standard. (ii) Pit ash treatments with surface soil, farm yard manure, vermicompost, rice husk, neem oil cake, diammonium phosphate, lime and micronutrients per plant before plantation. (iii) A total of 25,800 seedlings have been planted of the above species. (iv) Plantations maintained with proper irrigation, weeding, insecticide treatment and watch & ward.
- Monitoring and evaluation: (a) Growth data at periodic intervals; (b) irrigation of plantations.
- Afforestation on degraded forest lands 20 ha on north-east of ash pond 'A' and 10 ha on north of ash pond 'D': (i) Site inspection, preparation, alignment and stacking of pits, digging of pits as per standard. (ii) Pit soil treatments Good surface earth, vermicompost, rice husk, neem oil cake, diammonium phosphate, lime and micronutrients per plant before plantation.
- A total of 15,000 seedlings have been planted of the above species and maintained with proper irrigation, weeding, insecticide use and watch and ward.

Description and technical specifications of the technology:

With the aim of green belt development around Chandrapura Thermal Power Station, Chandrapura, Dhanbad soil amendments, plantation along the ridges, slopes, soil moisture conservation and water harvesting were undertaken in the completely degraded and barren patch land (mostly fly ash in place of soil) for the formation of green belt. A hi-tech nursery equipped with all the modern facilities was established for raising quality seedlings. Two modes of afforestation were followed. The first was afforestation on ridges and slopes of ash pond areas with pit ash treated with surface soil, farm yard manure, vermicompost, rice husk, neem oil cake, diammonium phosphate, lime and micronutrients per plant before plantation of suitable tree species (28,500 in number). The second was afforestation on degraded forest lands (20 ha). 15,000 seedlings were planted after pit soil treatments of good surface earth, vermicompost, rice husk, neem oil cake, diammonium phosphate, lime and micronutrients per plant before plantation. The project has transformed the area into well established green belt leading to improvement in soil quality, afforested area and extent of dust pollution has been reduced substantially. The transformation of the degraded land has been reflected in excellent growth of tree species and remarkable regeneration of herbs and shrubs; a sign of establishment of the successional process.

Institutions/actors involved (collaboration, participation, role of stakeholders):

The best practice was developed by the Institute of Forest Productivity, Ranchi with the involvement of Damodar Valley Power Corporation, Kolkata.

Major impact of best practice:

- The project has been implemented on unproductive, fly ash site. The site was completely degraded and it was a completely barren patch.
- The project has transformed the area into a well established green belt leading to improvement in soil quality, afforested area and extent of dust pollution has been reduced substantially. The invading species of grasses and herbs has also been increased.

Major off-site impacts: The project led to spread of general awareness among people living in and around the area towards importance of afforestation for improvement of environment.

Impact on biodiversity and climate change: The factors related to climate change has not been assessed but with respect to the biodiversity aspect, the situation has improved as grass, herbs, shrubs and even tree species have started regenerating in the reclaimed site. Due to this fauna including birds have been seen in large numbers in the site.

Replicability: *The best practice can be replicated at local level.*

Lessons learnt: The fly ash affected pockets should be vegetatively rehabilitated to benefit the overall environmental components of the region including improvement in soil quality, development of afforested area and to manage the extent of dust pollution.

For more information: Institute of Forest Productivity, Ranchi, Website:www.ifpranchi.org

Best Practice #13: Community managed bio-industrial watershed

Location: Pudukottai and Villupuram Districts of Tamil Nadu

Short description of the best practice:

The micro-watershed comprises 468 ha land covering wet and dry lands with a major portion of land being utilized as quarries or as casuarinas and eucalypts plantations due to scarcity of water for irrigation. The traditional irrigation tanks (eris) and few smaller tanks had either fallen into disuse or not being utilized to its optimal level due to siltation and damage to the sluice, weirs etc., contributing to decline in land productivity. The community open wells are placed far, so the cost of pumping increases leading the farmer to dig their own wells, but since proper lining is not done, the wells often caved in. Because of uncontrolled grazing, land was being left fallow. Farmers were not able to take advantage of the schemes and subsidies of the Government for drip/sprinkler irrigation systems since the fertile lands are small and split. Granite quarrying has caused land degradation and damaged the aquifers.

Main problem addressed by the best practice:

The project has impacted agriculture production along with positive on-site socio-economic and cultural impacts. The project contributes to the strategic objectives by improving the living conditions of affected populations and improving the conditions of affected ecosystems. It contributes to DLDD measures by prevention of land degradation and mitigation of existing degradation through capacity building and awareness generation, knowledge management and decision support, community participation, collaboration and networking. The project is operative in cropland as well as unproductive land and the majority of the population depends on agriculture activities for livelihood and sustenance. MS Swaminathan Research Foundation, Chennai (Tamil Nadu) is implementing the project with financial support from the Jamsetji Tata Trust, Mumbai.

Specific land degradation problem addressed by the best practice:

The origin of the community managed bio-industrial watershed approach was by Prof. J.S. Bali who called it “Agro-industrial Watershed Management”. The project works on the premise that watershed could go beyond natural resources management, where processing, storage and marketing is integrated with land use system. Thus, the approach builds on the conventional system of watershed management through value addition and creating new markets with appropriate socio-economic and institutional support systems, owned and managed by the community.

This model of watershed management incorporates suitable land and water management through capacity building and awareness, training, exposure visits and most importantly by bridging the digital divides in a rural context through village knowledge centres. Knowledge management is therefore an important component of the model. The implementation also looks at the particpation of all stakeholders through a District Advisory Committee (DAC) ensuring a scaling up with the

participation of the concerned line departments. The participation of local stakeholders is reflected in Women's Federations and Farmers' Producer Groups, Water User Groups, four SHGs, and the Bioindustrial Watershed Committee. Women's Federations and Farmers' Producer Groups formed for enhanced strength to access credit, technology know-how, markets etc. SHGs have been focused only on women and all SHGs are enrolled in the women's federation. Any intervention MSSRF does in the village, it is mandatory that the beneficiaries get approval letter from the federation. The bioindustrial watershed committee plays a pivotal role in ensuring that the community participates in all the watershed interventions and do so, the members have to be given timely and appropriate orientation and training.

Brief Description of the natural environment within the specified location:

The climate of the region is semi-arid, and the average annual rainfall is 1154.14 mm. The Soil texture is black clay. Bulk density ranges between 1.18-1.22 (2007-pre project), particle density ranged from 1.81 2.25 and water holding capacity from 45.95 53.75. In 2011 (post project), the bulk density ranged between 1.15 1.22, particle density ranged from 2.10 2.27 and maximum water holding capacity ranged from 45.80 54.63. Soil samples showed an increase in pH observed (ranging from 7.74 to 8.21) in 2011.

Objectives of the best practice:

- Conservation and Enhancement of Natural Resources: Participatory management of common resources through awareness, infrastructure development and facilitation of community based institutions to ensure equity and rights of the socially and economically marginalized. The project also aims to create convergence with Panchayati Raj Institutions and Government Departments for bringing in synergy.
- Improving On-farm Productivity and Profitability: Adopting a participatory technology development (PTD) approach to improve farm productivity through farmer's field schools and training of trainers, and promoting holistic integrated farming systems for sustainable resource management.
- Generation of Non-farm and Off-farm Market Driven Enterprises: Promoting diversified livelihood options for the watershed community with backward and forward credit, technology and market linkages and using eco-technologies for livelihood security.

Brief description of main activities:

- Participatory technology development (PTD) protocol developed and tested addressing researchable issues related to soils, water, nutrients & pest management, value addition and processing.
- Sustainable farming systems models and/or eco-friendly technologies developed and implemented.
- Effective mechanisms for technology diffusion developed, tested and implemented-information communication technology initiatives..

- Bio-industrial initiatives identified, protocols developed, tested and implemented as alternative livelihood sources.
- Project learning dissemination system established, policy advocacy carried out for agricultural research and planning.

Major impact of best practice:

- Production or productivity: As a result of project intervention there has been the increase in water storage. A number of poor and marginal farmers could benefit by the recharge in their wells. The pumping duration of the wells has risen to one hour from the earlier half an hour. The farmers are cultivating seasonal vegetables, area under cultivation of each farmer has increased, and farmers now raise two crops a year. With the assurance of water, farmers who were earlier unwilling to take the risk of cultivating land have gained confidence enough to go for cultivation.
- Socio-economic level (including cultural level): A large extent of permanent fallow could be brought back under cultivation; water, critical for paddy was made available. Moreover, the farmers could go in for two crops paddy followed by onion and vegetables leading to an increased net sown area and even go in for system for rice intensification (SRI) cultivation.The watershed activities focus upon participation from women and priority is given to them to work in the watershed activities. The bio-industrial watershed committee has given importance to bringing people together across caste, class and gender in an equitable manner. Diversified livelihoods, especially dairy activities, are being promoted to enhance the income of poor and marginal farmers. Crop diversification is also encouraged for income enhancement.
- Environmental level: There has been an improvement of the soil health. Due to the project intervention, the soil analysis-based fertilizer application led to an increase in the phosphorus level during 2009 (6.34 to 70.91 kg/ha). The available potassium ranged between 130.46-1149.04 kg/ha in 2007 which was higher than the recommended level. Organic carbon ranged between 0.2082.179% during 2007 which was higher than the recommended level of 0.5 0.75%. In contrast, the organic carbon decreased in most of the fields and the range was 0.341-1.03% during 2011. The system of rice intensification (SRI) was introduced to substantially improve cultivation practices with reduced cost of cultivation and efficient management of available water. There has been an increase in acreage and number of farmers cultivating paddy. Yields have gradually increased from 6.725 - 8.07 MT/ha for the local variety while that of the improved variety from 8.07 - 8.97 MT/ha. As a result of such efforts, survival rate of the seedlings in the nursery was close to 80%. Casurina plantations are now reverting to food crop cultivation.
- Land and Water Management: Repairing and rejuvenation of traditional water bodies has been undertaken. The sluices and weir of periya eri (big tank) in the village have been repaired, leading to maximium storage of water. Community wells located in the village were also repaired. Work was carried out under convergence of work with MNREGA. Effective water

governance was also facilitated by creation of a water user group. Increase in water storage has benefitted the poor and marginal farmer

- Off-site impacts: Visible water recharge seen in surrounding areas, increased yields and improved productivity has led to prevention of migration of farmers to urban areas.

Adoption and replicability:

The project has shown good results due to highly motivated local governments, farmers being organized into well structured cooperatives, There is participatory management of common resources through awareness, infrastructure development and facilitation of community based institutions to ensure equity and rights of the socially and economically marginalized as well as convergence with Panchayati Raj Institutions and Government Departments for bringing in synergy. The project promotes diversified livelihood options for the watershed community with backward and forward credit, technology and market linkages and using eco-technologies for livelihood security. The model has potential to be replicated at sub-regional level with similar climatic and socio-economic conditions.

For more information: MS Swaminathan Research Foundation, Website:www.mssrf.org

Best Practice #14: Farmer's manage ground water system

Location: Nandyal, Distt. Karnool, Andhra Pradesh

Brief description of the natural environment within the specified location:

Climate: Semi-arid, receiving 650 to 800 mm annual rainfall

Soil: Heavy soils, vertisols with more than 30- 35% clay

Topography: Level land with less than 1-3% slope

Prevailing socio-economic conditions of those living in the location and/or nearby:

Income Level: Farmers are poor; majority of them below poverty line.

Main income sources: Main income sources are agriculture and related activities, agricultural labor, dairying, vegetable cultivation.

Land tenure and land use rights: Many own their land and a few have taken land on lease from big farmers.

Short description of the best practice:

Sustainable ground water management through reducing pumping of the ground water to the extent of recharge was integral part of the cropping system. The net effect of natural groundwater recharge conditions and demand side management of groundwater was visualized through static water level in the monitoring wells. Changing cropping patterns with low water requiring crops was the most crucial issue. Need based watering at critical stages of crop growth, check basin, sprinklers and drips methods in place of flooding Soil moisture conservation practices such as leveling, mulching, weeding, intercultural etc in place. Artificial groundwater recharge by trapping flash floods in abandoned open wells/bore wells or behind check dams, percolation pond and recharge structures also resorted to,

Main problems addressed by the best practice:

- Sustainable ground water management
- Sustainable productivity of food and fodder crops
- Combating DLDD
- Sustainable livelihood of the people

Specific land degradation problems addressed by the best practice:

It addresses rapid depletion of ground water important for combating drought and desertification, which are the main causes of land degradation in dry lands.

Objectives of the best practice:

- Impart drought proofing to the area
- Sustainability productivity from dry lands
- Offers livelihood to the affected people
- Rehabilitation of degraded lands

Brief description of main activities:

- Reducing pumping of the ground water to the extent of recharge.
- Dissemination of groundwater information and farmers decision making
- Utilization of indigenous as well as improved technology
- Changing cropping patterns with low water requiring crops
- Training modules dealing with water management, integrated water management, vermi-composting and pest control
- Improved varieties and farming practices
- Provides income for improved livelihood of people
- Mitigation of deteriorating ground water conditions
- Prevents migration due to degradation of land/water
- Ground water recharge by trapping flash floods in abandoned open wells/bore wells or behind check dams, percolation pond and recharge structures
- Restriction on sanction of unlimited number of tube wells
- Ground water budgeting and matching crop planning

Description and technical specifications of the technology:

Participatory hydrological monitoring by stakeholders: For ground water budgeting and matching crop planning, a rigorous net work was created to monitor daily rainfall, stream-flows, fortnightly water levels, and bore well discharge to provide real time data to community for planning judicious use of available ground water. Efficient water management practices both indigenous as well as improved were utilized in the implementation of the program. It is an innovative approach of behavioral changes of users.

Institutions/actors involved (collaboration, participation, role of stakeholders):

Bharti Integrated Rural Development Society (BIRDS), Hyderabad (Andhra Pradesh)

Major impact of best practice:

1. Production or productivity

- A shift from flood irrigation of crops to check basins, conservation furrow irrigation, sprinklers, drips and rain guns for spray of pesticides

- High water demanding crops such as paddy, sugarcane, groundnut and cotton have been almost replaced by red gram, okra, green gram and short duration variety (TGA37) of ground nut.

2. Socio-economic level (including cultural level)

- Peoples' institutions like mutually aided cooperative societies have been formed, which are acting as ground water monitoring committees.
- A few tractors, bullock-drawn seed drills, threshers and rain guns were made available in the village, which could be utilized by the farmers on custom hire basis.

3. Environmental level

- Improvement of ground water situation and drinking water facilities to people in dry areas.
- Improvement in land cover as well as biomass production helped carbon sequestration and off site impacts.

Major off-site impacts:

- Dissemination of the model to other areas.
- Improvement in land cover has improved carbon sequestration having off site impact and global impacts.

Impact on biodiversity and climate change:

Improvement of land cover and biomass production improves soil biota and the biodiversity of drylands. Since there is higher carbon sequestration it would also effect the climate change. Drought proofing will act as preventive measure for land degradation.

Fig. 37: Farmer managed ground water system

Replicability:

The best practice/technology can be replicated at local, sub-national and national level

Lessons learnt:

R*elated to human resources:*

- Knowledge-based approach is the best way to convince communities if they learn while doing the activity
- Group actions in participatory mode are powerful tools to combat depleting ground water situations

- Indigenous as well innovative techniques are helpful in addressing the issues of ground water management.

Related to financial aspects:

- National or International funding is required to act as a catalyst in any new area
- Local investments are required to be mobilized for expanding the programme to wider areas
- A coordinated approach is a must for synergistic output from the programme

Related to technical aspects:

- The core message of the project is the demystification of science and discerning otherwise invisible issues in easily understandable language to mobilize masses
- Empowering communities with skills and knowledge to collect, collate and understand implications of their actions and triggering discussions on possible options thus initiating safeguard actions at the village level.
- Information-based decision making goes a long way in addressing otherwise complicated issues

For more information: Bharti Integrated Rural Development Society (BIRDS), Hyderabad (Andhra Pradesh), Website: www.birdsorg.net

Best Practice #15: Kari (Stick) for agarbatti (incense sticks) preparation from degraded bamboo forests

Location: Sidhi, Madhya Pradesh

Brief description of the natural environment within the specified location:

Climate: The climate is generally dry except rains during June to September. The cold season is from December to February followed by hot season from March to mid June.

Soil: Red loamy to rocky. The soil moisture control and remain dry in some parts for 90 days or more per year.

Topography: Undulating topography of Satpura range.

Prevailing socio-economic conditions of those living in the location and/or nearby:

***Income level*:** about 80% populations below poverty line including 2/3 of the tribal population.

Main income sources: Earning from brick making and agriculture labour.

Land tenure and land use rights: Most of the families do not have land; 10-15% populations have very small holdings. The area is facing problem of severe erosion and low moisture retention.

Short description of the best practice:

Under the livelihood activities of UNDP project in the Sidhi Forest Division, MP Forest Department identified poor households for preparation of bamboo sticks for Agarbatti making. A large area of degraded bamboo forest exists nearby villages of poor families. Families are involved in rehabilitation of bamboo forest of an area of 640 ha allotted by the MP Forest Department. 32 poor families were allotted 20 ha area of degraded bamboo forests per family nearby their villages. The families involved in making sticks for agarbatti preparation gets bamboo from the nearby forests at nominal cost and earn an additional income for their livelihood.

About 4,200 families from 32 villages are involved in making of Agarbatti from the sticks obtained from the rehabilitation of degraded bamboo forests. The discarded bamboo clumps are normally used for making sticks for Agarbatti preparation. The Forest Department has provided training and necessary infrastructure and equipment. On an average each beneficiary is earning Rs. 100/- per day for working 5-6 hours which is very important for their livelihood.

Main problems addressed by the best practice:

- Increase in wasteland by diminishing bamboo forests
- Decline in forest area and vegetative cover

Specific land degradation problems addressed by the best practice:

The forest based life support system dominates the life style of the undulating land of the area and degradation of these resources adversely affect livelihood of local communities.

Objectives of the best practice:

- Poverty alleviation through rehabilitation of degraded bamboo forest
- Enhancement of income and livelihood option for the poor communities in the area

Brief description of main activities:

- Improvement of living standard of the tribal poor communities
- Characterizing potentials of local resources and scoping exercises for optimal uses of resources

Institutions/actors involved (collaboration, participation, role of stakeholders):

Madhya Pradesh Forest Department, Sidhi Forest Division, PO-Sidhi, District-Sidhi, Madhya Pradesh

Major impact of best practice:

- *Production or productivity:* The degraded areas reclaimed under the development programmes and utilization of discarded bamboo for useful purpose like making sticks for agarbattis.
- *Socio-economic level (including cultural level):* The marginal as well as poor tribal groups got opportunities to improve their livelihood.
- *Environmental level:* Restoration of the ecologically-degraded bamboo forests and sustainable use and management of local resources ensured with community participation.

Fig. 38: Agarbatti preparation from bamboo sticks

Major Off-site impacts:

Bridge the gap between the local communities and Forest Department by articulating the common objectives of both the stakeholders.

Replicability:

The best practice/technology can be replicated at local, regional andf national level.

Lessons learnt:

Related to human resources:

- The local communities have developed capacities to train other communities in agarbatti making, build confidence, marketing knowledge and quality improvement.

Related to financial aspects:

- A separate provision should be made for purchasing of machines for good quality agarbattis.
- Planning with technical backstopping shall help in prioritizing intervention based on social and financial considerations.

For more information: Madhya Pradesh Forest Department, Bhopal, Website:www.mpforest.org

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Financial Commitment (Project wise) along with committed financial outlay

S. No.	Programme /Project	Funded by	Financial outlay (in Million)	
			Rs.	USD
1.	Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges	State Forest Department, Rajasthan	1.56	0.03
2.	Study of characteristic features pertaining to bio-drainage potential of some selected tree species	Ministry of Water Resources, Government of India	4.45	0.08
3.	Mycorrhizal Dependency & Productivity of Economic Important Medicinal Plants (Mehndi & Ashwagandha) of Arid Zones	Indian Council of Forestry Research and Education, Dehradun	0.20	0.01
4.	Development of economically viable and integrated Agroforestry models for arid region	Indian Council of Forestry Research and Education, Dehradun	1.06	0.02
5.	Effect of fertilizer application on growth and yield of 10 years old Salvadora persica and Acacia ampliceps plantations under silvipastoral system on arid salt affected soil	Indian Council of Forestry Research and Education, Dehradun	0.66	0.01
6.	Productivity and biometrics studies on some important species in semi arid regions of Rajasthan for their sustainable management	State Forest Department, Rajasthan	0.55	0.01
7.	Enhancing productivity of saline wastelands in Kachchh- through improved tree planting techniques and silvipastoral study	State Forest Department, Gujarat	0.76	0.01
8.	Characterization and classification of forest soils of Rajasthan	Indian Council of Forestry Research and Education, Dehradun	0.75	0.01
9.	Identification of soil-vegetation relations and indicator species for assessment and rehabilitation in lower Aravalli of Rajasthan	Indian Council of Forestry Research and Education, Dehradun	1.17	0.02
10.	Impact of Prosopis juliflora on biodiversity, rehabilitation of degraded community lands and as a source of livelihood for people in Rajasthan State	Indian Council of Forestry Research and Education, Dehradun	0.80	0.01
11.	Enrichment of land degradation datasets with soil datasets of different states of India	National Remote Sensing Centre	0.60	0.01

12.	Policy and Institutional Reform for Mainstreaming and Upscaling Sustainable Land and Ecosystem Management in India	Global Environment Facility	53.95	1.00
13.	Nationwide mapping of Land degradation at 1:50,000 scale	National Remote Sensing Centre, Hyderabad	3.25	0.06
14.	Plantation and Green Belt Development Around Chandrapura Thermal Power Station, Chandrapura, Dhanbad	Damodar Valley Corporation Kolkata	7.30	0.14
15.	Uttarakhand Decentralised Watershed Development Project (UDWDP)	World Bank Group	4170.21	77.60
16.	Sustainable Land, Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand	Global Environment Facility	402.51	7.49
17.	Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach	Global Environment Facility Food and Agriculture, Organization of the United Nations, Bharathi Integrated Rural Development Society, Hyderabad	69.86	1.30
18.	Integrated Land and Eco-System Management to Combat Land Degradation and Deforestation in Madhya Pradesh	Global Environment Facility	13972.35	260.00
19.	Participatory Natural Resource Management Project, Madhya Pradesh, India	Andheri Hilfe, Bonn	46.54	0.87
20.	Poverty Reduction through Community Based Natural Resource Management for Livelihood Opportunities in Rural Areas	Karl Kubel Stiftung fur Kind und Familie	28.07	0.52
21.	GRAMODAYA Sustainable Livelihood Project	Sir Ratan Tata Trust National Bank for Agriculture & Rural Development Government of Maharashtra	75.44	1.40
22.	Natural Resource Management along Watershed Lines	RBS Foundation, India	16.15	0.30
23.	Participatory Natural Resource Management and Village Development Project, Rajasthan	Andheri Hilfe, Bonn	41.22	0.77
24.	Wasundhara - Sunahara Kal Participatory Village Development Project based on Natural Resource Management	ITC National Bank for Agriculture and Rural Development	35.22	0.65

25.	Sukhi Baliraja Initiatives	Jamsetji Tata Trust Sir Ratan Tata Trust National Bank for Agriculture & Rural Development Government of Maharashtra	163.60	3.04
26.	Climate Change Adaptationin Rural Maharashtra	Swiss Agency for Development & Cooperation National Bank for Agriculture & Rural Development	318.23	5.9
27.		Integrated Watershed Management Project (Kurnool District, Andhra Pradesh) Government of Andhra Pradesh	126.23	2.34
28.	Integrated Watershed Management Project (Mahaboobnagar District, Andhra Pradesh)	Government of Andhra Pradesh	91.80	1.71
29.	Public-Private-Civil Society Partnership (PPCP) Under MREGS in Jalna District, Maharashtra	Government of Maharashtra	36.54	0.68
30.	Public-Private-Civil Society Partnership (PPCP) Under MREGS in Amravati District, Maharashtra	Government of Maharashtra	11.67	0.22
31.	Participatory Natural Resource Management along watershed lines in Rajasthan, India	Concern India Foundation	6.32	0.12
32.	Watershed Development Fund	National Bank for Agriculture and Rural Development	30.85	0.57
33.	Climate Change Adaptation in Rural Maharashtra	National Bank for Agriculture and Rural Development Swiss Agency for Development and Cooperation	318.23	5.92
34.	Community mobilisation for the poverty alleviation through integrated watershed development	National Bank for Agriculture & Rural Development Dr. & Mrs S.H.M.Modi Hormus House Benevolence Trust Fund, Mumbai	30.95	0.58
35.	National Afforestation Programme	India - Federal Institutions India - CCD Focal Point - Ministry of Environment and Forests	29235.70	544.02
36.	Integrated Watershed Management Programme (IWMP)	Department of Land Resources, Ministry of Rural Development	161454.20	3004.37

37.	Centrally Sponsored Programme of Soil Conservation in the Catchments of River Valley Project & Flood Prone River (RVP&FPR)	Department of Agriculture and Cooperation, Ministry of Agriculture	34306.84	638.39
38.	Centrally Sponsored Programme of National Watershed Development Project for Rainfed Areas (NWDPRA)	Department of Agriculture & Cooperation, Ministry of Agriculture	43207.80	804.02
39.	Swan River Integrated Watershed Management Project, Una Himachal Pradesh	Japan International Cooperation Agency Government of Himachal Pradesh	2140.00	39.82
40.	Sustainable Participatory Management of Natural Resources to Control Land Degradation in Thar Desert Ecosystem	United Nations Development Programme and Government of Rajasthan	789.97	14.70
41.	Sustainable Rural Livelihoods Security through Innovations in Land and Ecosystem Management	India - Federal Institutions Global Environment Facility Ministry of Agriculture, Government of India	5162.99	96.07
42.	Gujarat Forestry Development Project - Phase II	Japan Bank for International Cooperation	14056.28	261.56
43.	Odisha Forestry Sector Development Project	India - State Institutions Japan International Cooperation Agency (JICA) Government of Odisha	9363.02	174.23
44.	Sikkim Biodiversity Conservation and Forest Management Project	India - State Institutions Japan International Cooperation Agency Government of Sikkim	2800.00	52.10
45.	Rajasthan Forestry and Biodiversity Project (Phase-II)	Japan International Cooperation Agency	10580.34	196.88
46.	Tripura Forest Environmental Improvement and Poverty Alleviation Project	Japan International Cooperation Agency Tripura Government	5189.73	96.57
47.	Integrated Watershed Development Programme	National Bank for Agriculture and Rural Development	13.88	0.26
	Total Amount	**338369.80**	**6296.41**	

The 10-year strategic plan and framework to enhance the implementation of the Convention (2008-2018)

Introduction: Developed as a result of the Rio Summit, the United Nations Convention to Combat Desertification (UNCCD) is a unique instrument that has brought attention to land degradation in the drylands where exist some of the most vulnerable ecosystems and people in the world. Ten years after its coming into force, the UNCCD benefits from universal membership and is increasingly recognized as an instrument which can make a lasting contribution to the achievement of sustainable development and poverty reduction globally.

The vision: *The aim for the future is to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability.*

Strategic objectives and expected impacts: The following "strategic objectives" will guide the actions of all UNCCD stakeholders and partners in the period 20082018, including raising political will. Meeting these long-term objectives will contribute to achieving the above-mentioned vision. The "expected impacts" are the long-term effects intended by the strategic objectives.

Strategic objective 1: To improve the living conditions of affected populations

Expected impact 1.1. People living in areas affected by desertification/land degradation and drought to have an improved and more diversified livelihood base and to benefit from income generated from sustainable land management.

Expected impact 1.2. Affected populations' socio-economic and environmental vulnerability to climate change, climate variability and drought is reduced.

Indicator S-1: Decrease in numbers of people negatively impacted by the processes of desertification/land degradation and drought.

Indicator S-2: Increase in the proportion of households living above the poverty line in affected areas.

Indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.

Strategic objective 2: To improve the condition of affected ecosystems

Expected impact 2.1. Land productivity and other ecosystem goods and services in affected areas are enhanced in a sustainable manner contributing to improved livelihoods.

Expected impact 2.2. The vulnerability of affected ecosystems to climate change, climate variability and drought is reduced.

Indicator S-4: Reduction in the total area affected by desertification/land degradation and drought.

Indicator S-5: Increase in net primary productivity in affected areas.

Strategic objective 3: To generate global benefits through effective implementation of the UNCCD

Expected impact 3.1. Sustainable land management and combating desertification/land degradation contribute to the conservation and sustainable use of biodiversity and the mitigation of climate change.

Indicator S-6: Increase in carbon stocks (soil and plant biomass) in affected areas.

Indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management.

Strategic objective 4: To mobilize resources to support implementation of the Convention through building effective partnerships between national and international actors

Expected impact 4.1. Increased financial, technical and technological resources are made available to affected developing country Parties, and where appropriate Central and Eastern European countries, to implement the Convention.

Expected impact 4.2. Enabling policy environments are improved for UNCCD implementation at all levels.

Indicator S-8: Increase in the level and diversity of available funding for combating desertification/land degradation and mitigating the effects of drought.

Indicator S-9: Development policies and measures address desertification/land degradation and mitigation of the effects of drought.

The Mission: *To provide a global framework to support the development and implementation of national and regional policies, programmes and measures to prevent, control and reverse desertification/land degradation and mitigate the effects of drought through scientific and technological excellence, raising public awareness, standard setting, advocacy and resource mobilization, thereby contributing to poverty reduction.*

Operational objectives and expected outcomes: The following "operational objectives" will guide the actions of all UNCCD stakeholders and partners in the short and medium term[4] with a view to supporting the attainment of the above-mentioned vision and strategic objectives. The "outcomes" are the short and medium-term effects intended by the operational objectives.

Operational objective 1: Advocacy, awareness raising and education

To actively influence relevant international, national and local processes and actors in adequately addressing desertification/land degradation and drought-related issues.

Outcome 1.1: Desertification/land degradation and drought issues and the synergies with climate change adaptation/mitigation and biodiversity conservation are effectively communicated among key constituencies at the international, national and local levels.

Outcome 1.2: Desertification/land degradation and drought issues are addressed in relevant international forums, including those pertaining to agricultural trade, climate change adaptation, biodiversity conservation and sustainable use, rural development, sustainable development and poverty reduction.

Outcome 1.3: Civil society organizations (CSOs) and the scientific community in the North and the South are increasingly engaged as stakeholders in the Convention processes and desertification/land degradation and drought are addressed in their advocacy, awareness-raising and education initiatives.

Operational objective 2: Policy framework

To support the creation of enabling environments for promoting solutions to combat desertification/land degradation and mitigate the effects of drought.

Outcome 2.1: Policy, institutional, financial and socio-economic drivers of desertification/land degradation and barriers to sustainable land management are assessed, and appropriate measures to remove these barriers are recommended.

Outcome 2.2: Affected country Parties revise their national action programmes (NAPs) into strategic documents supported by biophysical and socio-economic baseline information and include them in integrated investment frameworks.

Outcome 2.3: Affected country Parties integrate their NAPs and sustainable land management and land degradation issues into development planning and relevant sectoral and investment plans and policies

Outcome 2.4: Developed country Parties mainstream UNCCD objectives and sustainable land management interventions into their development cooperation programmes/projects in line with their support to national sectoral and investment plans.

Outcome 2.5: Mutually reinforcing measures among desertification/land degradation action programmes and biodiversity and climate change mitigation and adaptation are introduced or strengthened so as to enhance the impact of interventions.

Operational objective 3: Science, technology and knowledge

To become a global authority on scientific and technical knowledge pertaining to desertification/land degradation and mitigation of the effects of drought.

Outcome 3.1: National monitoring and vulnerability assessment on biophysical and socio-economic trends in affected countries are supported.

Outcome 3.2: A baseline based on the most robust data available on biophysical and socio-economic trends is developed and relevant scientific approaches are gradually harmonized.

Outcome 3.3: Knowledge on biophysical and socio-economic factors and on their interactions in affected areas is improved to enable better decision-making.

Outcome 3.4: Knowledge of the interactions between climate change adaptation, drought mitigation and restoration of degraded land in affected areas is improved to develop tools to assist decision-making.

Outcome 3.5: Effective knowledge-sharing systems, including traditional knowledge, are in place at the global, regional, subregional and national levels to support policymakers and end users, including through the identification and sharing of best practices and success stories.

Outcome 3.6: Science and technology networks and institutions relevant to desertification/land degradation and drought are engaged to support UNCCD implementation.

Operational objective 4: Capacity-building

To identify and address capacity-building needs to prevent and reverse desertification/land degradation and mitigate the effects of drought.

Outcome 4.1: Countries which have carried out the national capacity self assessment (NCSA) implement the resulting action plans to develop the necessary capacity at the individual, institutional and systemic levels[6] to tackle desertification/land degradation and drought issues at the national and local levels.

Outcome 4.2: Those countries which have not previously undertaken capacity needs assessments engage in relevant assessments processes to identify capacity needs for tackling desertification/land degradation and drought at the national and local levels.

Operational objective 5: Financing and technology transfer

To mobilize and improve the targeting and coordination of national, bilateral and multilateral financial and technological resources in order to increase their impact and effectiveness.

Outcome 5.1: Affected country Parties develop integrated investment frameworks for leveraging national, bilateral and multilateral resources with a view to increasing the effectiveness and impact of interventions.

Outcome 5.2: Developed country Parties provide substantial, adequate, timely and predictable financial resources to support domestic initiatives to reverse and prevent desertification/land degradation and mitigate the effects of drought.

Outcome 5.3: Parties increase their efforts to mobilize financial resources from international financial institutions, facilities and funds, including the GEF, by promoting the UNCCD/Sustainable land management (SLM) agenda within the governing bodies of these institutions.

Outcome 5.4: Innovative sources of finance and financing mechanisms are identified to combat desertification/land degradation and mitigate the effects of drought, including from the private sector, market-based mechanisms, trade, foundations and CSOs, and other financing mechanisms for climate change adaptation and mitigation, biodiversity conservation and sustainable use and for hunger and poverty reduction.

Outcome 5.5: Access to technology by affected country Parties is facilitated through adequate financing, effective economic and policy incentives and technical support, notably within the framework of South-South and North-South cooperation.

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