सत्यमेव जयते

GEF India

Enabling Transformations

THE WORLD BANK
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Ministry of Environment, Forest and Climate Change
Government of India

gef

UNDP
Empowered lives.
Resilient nations.

GEF India in Numbers

- Sustainable conservation practices introduced (6 projects) in: over 1,031,378 ha
- Participatory co-management promoted in protected areas including, marine, forestry and agricultural sector
- Total grants (84 projects): 516 million
- Total co-funding leveraged (84 projects): over USD 2.95 billion
- Projects completed: 37
- Projects under implementation: 33
- Number of Indian states covered: 21
- National reporting to Conventions: Initial NATCOM, Second NATCOM and Third NATCOM, BURs, NBSAP, National Reports to CBD and UNCCD, NAP on Desertification and Land Degradation, NIP on POPs and Mercury.
- GEF-6 cycle worth USD 130 million of GEF grant programmed.
- Focus is on promoting climate-smart agricultural in 800,000 ha of globally significant biodiversity-rich areas, 800 MW of installed capacity of grid connected solar rooftop PV systems, 75 MW of solar PV installations in Indian Railways and urban planning and waste management in cities.

SGP India in Numbers

This information showcases the impact of 401 SGP projects funded by GEF

- Land treatment carried out on: approximately 167,000 ha
- Total Grants: USD 10.3 million
- Total Co-financing leveraged: USD 19.6 million
- Number of villages covered: 3,224
- Number of value based products promoting sustainable utilization of local natural resources: 265

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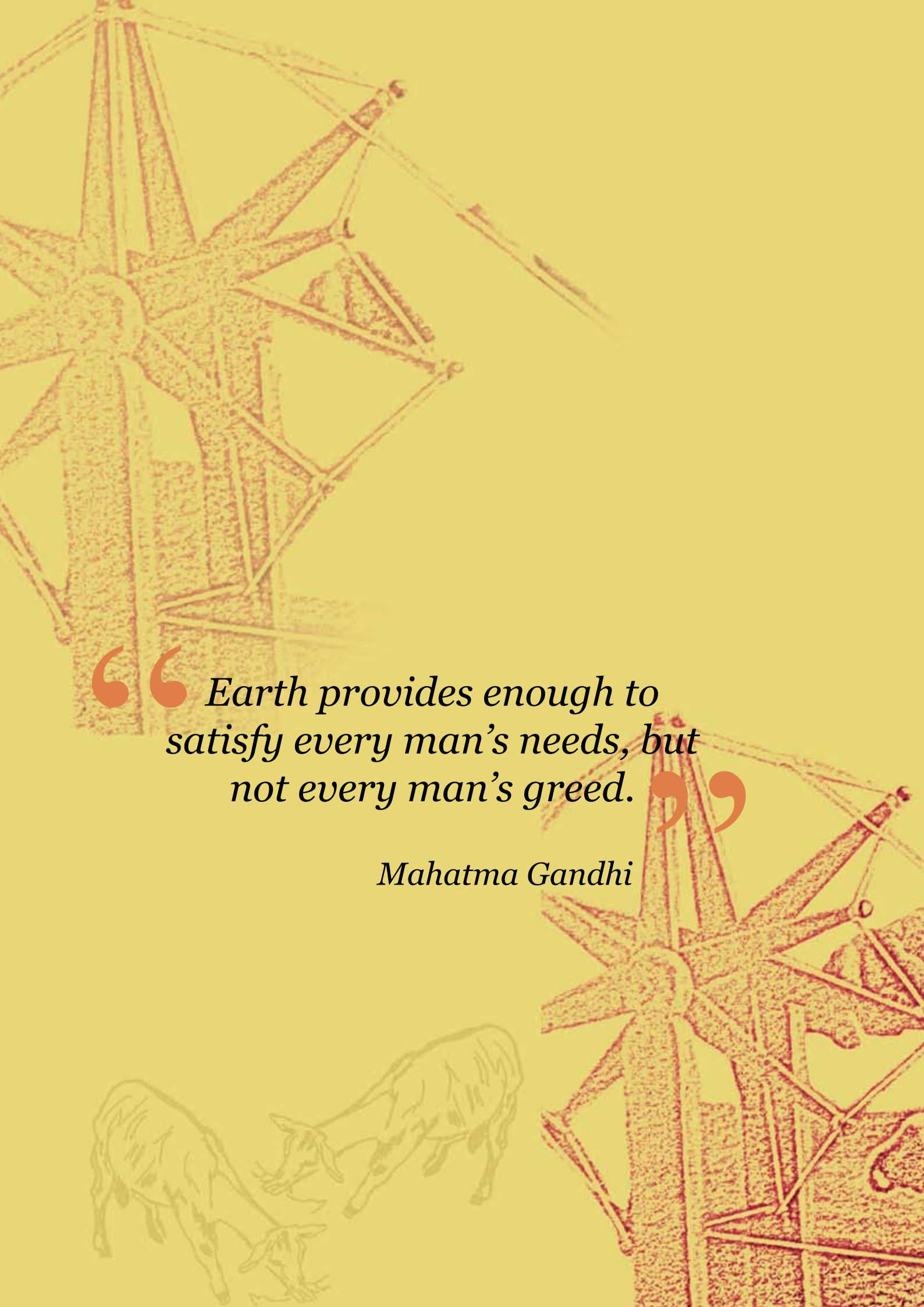
GEF India

Enabling Transformations



“Earth provides enough to satisfy every man’s needs, but not every man’s greed.”

Mahatma Gandhi

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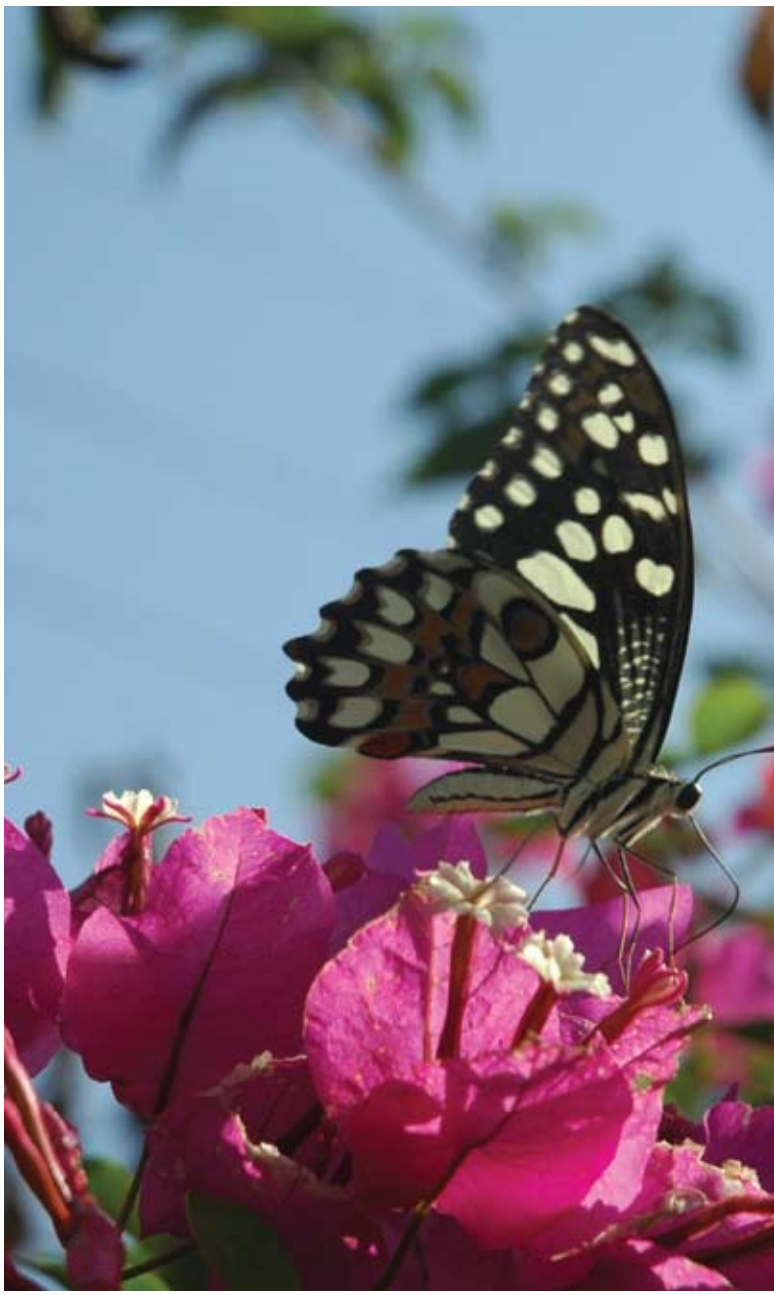


Message

सत्यमेव जयते

Ministry of Environment, Forest and Climate Change
Government of India

The motto of my government is development without destruction. This is not only desirable but also possible as is evident from the Intended Nationally Determined Contribution (INDC) recently released by the Ministry. The INDC document takes forward the vision of our Hon'ble Prime Minister Shri Narendra Modi's of a sustainable lifestyle and climate justice to protect the poor and vulnerable from adverse impacts of climate change. Sustainable development is a national responsibility and international cooperation should be at the core of our efforts for development and climate change as per the principles of equity and Common but Differentiated Responsibilities (CBDR). This principle forms the very basis for the origin of Global Environment Facility (GEF) in 1991. The GEF is the designated funding mechanism of the multilateral environmental conventions, providing incremental finance to developing country Parties for incorporating global environmental benefits into their national developmental efforts. We as founder member of value our relationship as well as our role and responsibility with GEF.

India has been in forefront of environmental protection. The ministry is mandated to protect and improve the environment and to safeguard the forest and wildlife of the country. The principle of sustainable development has been linked to 'right to life' under Article 21 of the Constitution. India is amongst very few countries to have a National Green Tribunal for effective and expeditious disposal of cases related to environmental and forest protection. Real time online monitoring of grossing polluting industrial units has been initiated. We have launched National Air Quality Index and there is an effort to put information on air quality in public domain that could be easily understood by a common person. The National Mission for a Green India managed by the Ministry aims at increasing forest/ tree cover on five million hectares of forest cover, improving ecosystems and services while augmenting the income of about three million households. For scientific evaluation and better compliance, Geographical Information System-based decision support system has been launched. As countries across the globe come together in Paris to strike a new climate change pact, the Ministry along with other partners has launched a 16 coach AC train "Science Express Climate Action Special (SECAS)" travelling across the country, halting at 64 locations in about 20 states, covering about 19,500 km to sensitize people about climate change and its impacts.

As India's Minister of Environment, Forest and Climate Change, I firmly believe that India's policies and programmes as mentioned in INDC will significantly contribute in achieving sustainable growth and shall also help in achieving Sustainable Development Goals.

Our partnership with GEF has been beneficial in promoting and mainstreaming environment-friendly practices in several important developmental sectors as being presented in this book. This compendium of knowledge developed over a considerable time and the real value lies in its mainstreaming the initiatives to ensure transformation. I congratulate Shri Ashok Lavasa, Secretary (EF&CC), Shri Susheel Kumar, Additional Secretary, Shri Arun Kumar Mehta, Joint Secretary and their team in bringing out this useful publication to showcase the impact of completed GEF projects in addressing climate change challenge in India.

Prakash Javadekar
Minister of State (Independent Charge)
Environment, Forest & Climate Change
Government of India

Message

Ministry of Environment, Forest and Climate Change
Government of India

India's partnership with the Global Environment Facility (GEF) started in year 1991 and has grown stronger over the years. GEF is an international partnership of 183 countries, international institutions, civil society organizations, and private sector to address global environmental issues. GEF in particular brings in global environmental benefits which fit well with Government of India as well of pursuing sustainable development.

Environmental conservation is one strong binding force which has brought all the nations to work together. The Sustainable Development Goals, Land Neutrality target and Climate Change architecture are important developmental challenges we face today. GEF being the financial mechanism for the Rio Conventions and other multilateral environmental agreements is uniquely placed to help buttress Earth's life support systems.

This publication documents the impact of completed GEF projects in India. It is a timely initiative. While moving forward, we need to draw lessons from our past experiences. If a project is closely aligned with national priorities, it has a greater chance of success of being mainstreamed. The project outcomes, deliverables and implementation mechanism needs to be clearly defined. There is a need to focus on fewer larger projects with high visibility, high impact and high replicability. The Government has initiated a number of programs which have been linked with GEF-6 cycle programming.

The three strategic area of investment under GEF-6 cycle are sustainable cities, climate resilient agriculture and renewable energy. The '*Swacha Bharat Abhiyan*' and Smart Cities initiative aims at improving and cleaning the cities. The National Air Quality Index (NAQI) launched as part of '*Swacha Bharat Abhiyan*' is the first step to address air pollution issues. In the GEF-6 cycle, we are developing two projects – one focused on addressing urban planning and waste management related issues and second on linking NAQI with health based advisories at the city level. The Government is working to strengthen the agricultural production systems to ensure country's food and nutritional security. In the GEF-6 cycle, working with Ministry of Agriculture, we are developing a program wherein at least 800,000 ha of globally significant biodiversity-rich areas will be brought under climate-smart agricultural practices. As part of GEF-6 cycle programming, we are developing two projects, one promoting 800 MW of installed capacity of grid connected solar rooftop PV systems and second promoting 75 MW of solar PV installations in two states helping Indian Railways to systemize and standardize procedures in achieving 1 GW solar energy installation target.

My Ministry's effort is to promote conservation of environment resources, inter and intra-generational equity, integration of environmental concerns in economic and social development, efficiency in use of natural resources, judicious environmental governance and inclusion of all sections of society in protecting the natural resources. Here, I see the value of our partnership with GEF.

I am pleased to see this publication providing valuable insights into the impacts of GEF investments in India. I am sure that this knowledge product will be useful. I would like to congratulate Shri Susheel Kumar, Additional Secretary, Shri Arun Kumar Mehta, Joint Secretary and their team for this invaluable publication.

Ashok Lavasa
Secretary
Ministry of Environment, Forest and Climate Change
Government of India

Foreword

सत्यमेव जयते

Ministry of Environment, Forest and Climate Change
Government of India

It gives me great pleasure to introduce this collection of project-based stories from the completed GEF project in India.

As India's GEF Operational Focal Point, I believe that the GEF is uniquely positioned to support the protection of the global environmental commons. Since 1991, GEF has accumulated an invaluable body of experience and knowledge, promoted innovations, and continues to play a vital role by serving key multilateral environmental conventions. This foundation provides the GEF with unparalleled influence and capacity to support bolder solutions to address global environmental challenges.

GEF was born to support innovation, by providing incremental financing for global environmental benefits. GEF needs to ensure that its resources and network introduces innovation in the design of programs and projects in a manner that encourages early adoption and scaling up. While designing projects for the GEF-6 cycle, this aspect is being ensured.

GEF's success will depend on its ability to forge productive, trusting and catalytic partnerships with its member countries, the private sector, civil society, the scientific community, and its agencies.

India has received very little funds for adaptation, just about USD 10 million whereas mitigation activities received more than USD 280 million till now. This imbalance needs to be addressed by GEF as adaptation is a higher priority area for us. The Green Climate Fund addresses this balance by keeping the ratio of 50:50.

GEF projects are not standalone. GEF support is provided to activities/ programs that directly or indirectly contribute to the improvement of environmental status and / or address drivers of environmental degradation. Thus, it is crucial that GEF interventions are sustained, mainstreamed, replicated and scaled up leading to market transformation. To ensure this to happen, the post-project monitoring may be beneficial.

This book is a compilation of completed GEF India projects providing an understanding on how GEF support contributes or does not contribute to progress towards impact and ultimately to national and global environmental benefits. It's a timely publication which provides learnings for further improvisation. In a simple manner, it portrays the impact of completed GEF projects in India. The stories also drive home an important message that environmental issues are inter-related thus, an integrated multi-stakeholder approach in addressing environmental challenges will be more cost effective. The relevance and importance of promoting synergy between 3 Rio Conventions is also presented. It is a commendable effort which I am sure will continue and we will see many more knowledge products in the near future.

Susheel Kumar
Special Secretary
Ministry of Environment, Forest and Climate Change
and India's GEF Operational Focal Point

Message

India is one of the most significant country partners for the GEF. It is responsible for our second largest country portfolio, totaling $470 million and has leveraged co-financing of $3.5 billion since its inception.

The portfolio, made available through 71 national and 21 regional projects, has put great emphasis on support to biodiversity, sustainable land management, climate mitigation and adaptation, in addition to coastal and marine conservation and management.

Over the years, GEF's priorities in India have evolved towards dealing with the question of sustainability of the human-ecosystem interface. Furthermore, GEF-funded initiatives are seeking transformative changes to ensure sustainable development pathways that are anchored in sound environmental management.

The GEF's principle is to respect country ownership and to support the directions provided by its leadership. In this regard, the GEF supports Prime Minister Modi's Smart 100 City initiative. India is a key partner in GEF's new Sustainable Cities Initiative that is creating a universal platform dedicated to urban sustainability across all continents and that delivers tangible global environmental benefits.

The GEF also supports the commitment by Prime Minister Modi to rapidly improve energy efficiency and expand solar power to 100 GW by approving projects to accelerate financing for energy efficient lighting and appliances and to improve capacity of local banks to provide capital for rooftop solar photovoltaic (PV). At the same time, the GEF will continue to work in the country on several other strategic programs covering energy, agriculture, and biodiversity issues. These involve the public and private sectors, civil society organizations, indigenous peoples, and others in India.

Building on our strong engagement and commitment to the country, we look forward to a continued strategic partnership with India dedicated to addressing global environment challenges.

Naoko Ishii
CEO and Chairperson,
Global Environment Facility

Preface

सत्यमेव जयते

Ministry of Environment, Forest and Climate Change
Government of India

This book provides a good starting point. It is a compilation of the experiences from the completed GEF projects in India. I hope it shall facilitate in mainstreaming of these experiences.

Sustaining, mainstreaming, replication, scaling-up and market transformation are five mechanisms through which broader adoption takes place. Sustaining is where learnings from pilots continue to be implemented without support through clear budget allocations, implementing structures, and institutional frameworks defined by the government and/or other project stakeholders. Mainstreaming is whereby information, lessons, or specific aspects of a GEF initiative are incorporated into a broader stakeholder initiative. Replication is whereby a GEF intervention is reproduced at a comparable administrative or ecological scale, often in different geographical areas or regions. Scaling-up is where GEF supported initiatives are implemented at a larger geographical scale, often expanded to include new aspects or concerns. Market changes pertain to GEF-supported initiatives catalyzing market transformation by influencing the supply of and/or demand for goods and services that contribute to global environmental benefits.

The insights provided by this book will help us in further improvising the project design, implementation and monitoring of the GEF projects. There is a need to ensure the timely and effective implementation of projects. PERT chart should be developed for each project and email alerts should be sent if there are timeline overruns. There is a need for setting up a mechanism for post-project monitoring where project benefits are projected beyond the implementation period.

The GEF India partners are from Government of India ministries, state governments, international donor agencies, private sector, civil society organizations, technical and research institutes etc as they are the ones, who make what this program is today. It is their efforts and work on ground which has been presented in these stories. Their generous contributions and experiences for this book is sincerely appreciated. This book will be a useful resource for all the stakeholders designing, implementing and monitoring environmental projects.

The book focuses on project experiences related to renewable energy, energy efficiency, biodiversity conservation and sustainable land management as a tool for climate change adaptation, small grants program and national reporting to convention. The stories very clearly highlight one major fact that environmental challenges are inter-linked and multi-sectoral, multi-stakeholder oriented solutions are necessary. The Country Portfolio Evaluation of GEF India project portfolio (1991-2012) done by the Independent Evaluation Office (IEO) of GEF in 2013 found that "GEF support to India is relevant to the country's priorities, needs, and emerging challenges. It found that, at the point of completion, outcomes of GEF projects in India are generally satisfactory. Further, during the post-completion stage, several projects have been able to achieve significant long-term impacts due to support for follow-up action." It is a matter of satisfaction that the projects have been evaluated by the IEO.

The GEF support through these projects has helped in creating an enabling environment in the country for environment-friendly practices and techniques. This has certainly facilitated and expedited the whole process. The innovative approaches piloted by the second generation of GEF projects now have better chances of achieving market transformation. We value this experience and our partnership with GEF.

Finally, I would like to acknowledge and appreciate the hard work put in by Dr Nayanika Singh, GEF Consultant working in the Ministry in bringing out this compendium. We have lots more to do to ensure that GEF India emerges as the best performing program of the Ministry and I am confident of achieving this success with my team working by my side.

Arun Kumar Mehta
Joint Secretary
Ministry of Environment, Forest and Climate Change
Government of India

Acknowledgement

The preparation of this book has been a humbling and a satisfying experience. It helped in strengthening the belief that good work is being done under GEF projects and there are important learnings which need to be taken into account while moving forward.

We would like to express our sincere gratitude to the implementing partners of the completed projects documented in this book for sharing their experiences about the project. It was heartening to know that their association with the respective GEF project was useful and the project learnings are gradually being mainstreamed and scaled up.

The support extended by the program officers of the concerned GEF agencies in completing this documentation was invaluable. We would especially like to thank Shri Jaco Cilliers, UNDP Country Director and his team as well as Shri Onno Ruhl, WB Country Director and his team for providing full support to this endeavour.

This book has benefitted from the contributions of Dr Ajay Mathur, Dr Butchaiah Gadde, Shri Mike Pandey, Dr S N Srinivas, Shri Sandeep Tandon, Shri Sunder Subramaniam, Shri Bhaskar Goswami, Shri Anupam Joshi, Shri A Ramakrishan, Shri Vishal, Shri Sachin, Shri Prabhjot Sodhi, Shri Anil Arora, Dr Preeti Soni and Shri Suneel Padalee. A special and sincere thanks is reserved for Ms Pratibha Rialch and Shri Ravinder Singh Khati.

The Hon'ble Minister of Environment, Forest and Climate Change has been a source of inspiration for providing strategic guidance to the program. GEF India program would not have been what it is without the guidance of Shri Ashok Lavasa, Secretary, MoEFCC. The motivation provided by Shri Susheel Kumar, Special Secretary, MoEFCC and India's GEF Operational Focal Point has been helpful in prioritizing and performing well. Shri Arun Kumar Mehta, Joint Secretary, MoEFCC has infused new energy with a greater sense of focus and purpose to the program This book is his idea and without his guidance, support and trust it would have been impossible to complete it on time.

Lastly, we would like to sincerely acknowledge and appreciate everyone who has directly as well as indirectly contributed in strengthening GEF India portfolio and this publication.

Abbreviations

AGR	Artificial Groundwater Recharge
AHEC	Alternate Hydro Energy Centre
APFAMGS	Andhra Pradesh Farmer Managed Groundwater Systems
APWELL	Andhra Pradesh Bore-Well Irrigation Schemes
APWs	Anti-Poaching Walkers
ARF	Agriculture Revolving Fund
BCCL	Bharat Coking Coal Limited
BEE	Bureau of Energy Efficiency
BIMA	Biogas Induced Mixing Arrangement Reactor
BIRDs	Bharathi Integrated Rural Development Society
CBD	Convention on Bio-Diversity
CBM	Coal-bed Methane
CBM	Community based Biodiversity Management
CBOs	Community Based Organisations
CCACs	Climate Change Adaptation Committees
CEE	Centre for Environment Education
CFS	Climate Field Schools
CIL	Coal India Limited
CIMFR	Central Institute of Mining and Fuel Research
CMPDI	Central Mines Planning and Design Institute Limited
CMR	Copper Motor Rotor
CMS	Centre for Media Studies
COWS	Community Operated Weather Stations
CPB	Cartagena Protocol on Bio-Safety
CRPs	Community Resource Persons
CWB	Crop-Water Budgeting
EDCs	Eco Development Committees
ETC	Enabling Technology Centre
FAO	Food and Agriculture Organisation
FCS	Farmer Climate Schools
FIG	Farmer Interest Group
FPWs	Field Project Workers
FRP	Farmer Resource Persons
FWS	Farmers Water School
GBPIHED	G. B. Pant Institute of Himalayan Environment & Development
GEF SGP	Global Environment Facility's Small Grants Programme
GHG	Green House Gases
GO	Government Order
GoAP	Government of Andhra Pradesh
GoM	Gulf of Mannar
GoMBRT	Gulf of Mannar Biosphere Reserve Trust
HU	Hydrological Unit
HUDCO	Housing and Urban Development Corporation
IBRD	International Bank for Reconstruction and Development
ICA	International Copper Association
ICAR	Indian Council of Agriculutural Research
ICAR-NEH	Indian Council of Agriculutural Research - North Eastern Hill
IDA	International Development Agency
IDBI	Industrial Development Bank of India
IDFC	Infrastructure Development Finance Corporation
IFD	Integrated Farm Development
IIHR	Indian Institute of Horticulture Research
INDCs	Intended Nationally Determined Contributions
IREDA	Indian Renewable Energy Development Agency
ISA	International Solar Alliance
IWMP	Integrated Watershet Management Program
KMTR	Kalakkad Mundanthurai Tiger Reserve
LDN	Land Degradation Neutrality
LTFM	Long-term Funding Mechanism
LUCs	Land Use Committees
METT	Management Effectiveness Tracking Tool
MGNREGA	Mahatma Gandhi National Rural Employment Gurantee Act
MIS	Management Information System
MNRE	Ministry of New and Renewable Energy
MoC	Ministry of Coal
MOEF&CC	Ministry of Environment Forest and Climate Change
MoS	Ministry of Steel
MWDPs	Micro Watershed Development Plans
NABARD	National Bank for Agriculture and Rural Development
NAIP	National Agricultural Innovation Project
NFTDC	Non-Ferrous Material Technology Development Centre
NMEEE	The National Mission for Enhanced Energy Efficiency
NMSHE	National Mission on Sustaining Himalayan Ecosystem
NTPC	National Thermal Power Corporation
PAME	Protected Area Management Effectiveness
PCM	Participatory Climate Monitoring
PCRA	Petroleum Conservation Research Association
PHM	Participatory Hydrological Monitoring
PLUP	Participatory Land Use Planning
POPs	Persistent Organic Pollutants
PPV & FRA	Protection of Plant Varieties & Farmers' Rights Authority
PRIs	Panchayati Raj Instituitions
PTCF	Periyar Tiger Conservation Foundation
PTR	Periyar Tiger Reserve
RDPR	Rural Development and Panchayat Raj Department
RECA	Rajasthan Energy Conservation Award
RTCs	Rural Technology Centres
SFC	Specific Fuel Consumption
SFD	State Forest Department
SHGs	Self-Help Groups
SHP	Small Hydel Power
SLEM	Sustainable Land and Ecosystem Management
SLM	Sustainable Land Management
SLWM	Sustainable Land and Water Management
SMEs	Small and Medium Enerterprises/ Entrepreneurs
SRI	System for Rice Intensification
SRRMs	Steel Re-rolling Mills
SWH	Solar Water Heating
TCM	Trillion Cubic Meters
TIDE	Technology Informatics Desing Endeavour
UASB	Up-flow Anaerobic Sludge Blanket
UNCCD	United Nations Convention to Combat Disertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNOPS	United Nations Office for Project Services
UPWSRP-II	Uttar Pradesh Water Sector Restructuring Project Phase - II
USEPA	United States Environment Projection Agency
VMCEDCs	Village Marine Conservation and Eco-development Committee
VPKAS-ICAR	Vivekananda ParvatiyaKrishiAnusandhanSansthan - ICAR
WB	World Bank

Introduction

"GEF India: Enabling Transformation" is an attempt to capture the impacts and the learnings from the completed Global Environment Facility (GEF) projects in India. Implementation of GEF in India started in 1991. During this period, the environmental challenges and approach of addressal has gone through a paradigm shift, both in India and internationally. This is visibly evident in the evolution of the strategy, policies and institutional mechanisms at both Government of India (GoI) and GEF levels. The projects in this book underline a fundamental fact that environment is a multi-focal and multi-stakeholder concern and an integrated approach is a cost-effective way of ensuring a healthy environment and sustainable development. The publication provides a deeper insight into the incremental role of GEF investments in creating an enabling environment for replication, scaling up and market transformation. The most satisfying outcome of these projects is the impact that they have made on the lives and livelihoods of the concerned people and being remembered by the implementing partners as valuable investments.

GEF is a multi-lateral funding mechanism of the United Nations Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the Stockholm Convention on Persistent Organic Pollutants (POPs), the United Nations Convention to Combat Desertification (UNCCD) and the Minamata Convention on Mercury to provide incremental finance for the activities that developing countries undertake to fulfil their commitments under these conventions. GEF provides grants and concessional funding to address global environmental challenges while promoting national sustainable development initiatives. These investments address policy, technical, financial, market and capacity barriers by facilitating innovation and promoting transformation.

It is a unique partnership of 183 member governments, international institutions, civil society organizations and the private sector working for environmental benefits. The GEF cycle is of a four-year duration. The GEF Trust Fund is replenished every four years by donor countries through a year-long replenishment process which also defines the programmatic and operational direction for the GEF cycle. The GEF partnership includes 18 GEF agencies, of which ten are operational in India namely: the Asian Development Bank (ADB), the United Nations Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), the International Union for Conservation of Nature (IUCN), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the United Nations Industrial Development Organization (UNIDO), the World Bank (WB), the World Wildlife Fund for Nature (WWF-US) and Conservation International. The majority of the projects presented in this book were managed by UNDP and WB.

India is the founder member of GEF. The first GEF Assembly comprising all member countries, taking place once in four years, was hosted by India in 1998. India is both a donor and recipient of GEF resources. India has contributed USD 63 million (m) to GEF Trust Fund (1991 - June 2018). India also chairs the GEF South Asia Constituency comprising Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka in the GEF Council.

The Department of Economic Affairs (DEA), Ministry of Finance is India's GEF Political Focal Point (PFP) responsible for policy and governance related matters. Ministry of Environment, Forest and Climate Change (MoEF&CC) is India's GEF Operational Focal Point (OFP) responsible for all in-country coordination of GEF activities. The GEF Empowered Committee chaired by Secretary, MoEF&CC functions as an empowered body to:(a) determine national priorities to be programmed for GEF funding; (b) streamline eligibility checks; (c) approve GEF India projects; (d) monitor project implementation; and, (e) formulate the country's stand for GEF meetings.

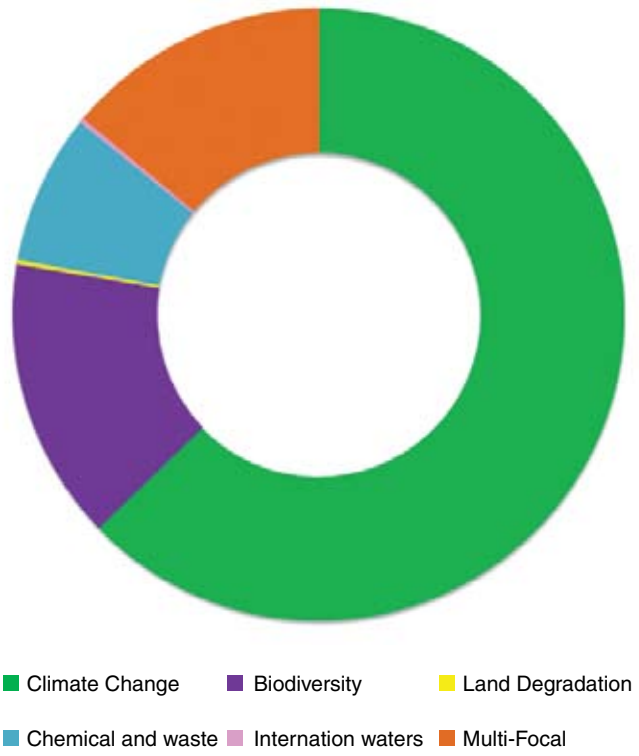
Since the GEF-4 cycle, the GEF OFP office has been following a strategic approach of developing a programming plan for the entire GEF cycle. The programming process follows an extensive consultative approach, mapping, identifying and prioritizing the major national priorities for GEF programming. In GEF-6 cycle, the emphasis has been on developing projects with high impact, high visibility and high replicability. Also, a ratio of 70:30 is maintained – 70% of GEF grant for action on ground and 30% for technical assistance/capacity building activities. The GEF projects are monitored regularly by GEF OFP office through participation in the Project Steering Committee (PSC), review of annual Project Implementation Reports (PIRs) (submitted by GEF agencies to GEF Secretariat for each project) and informal contacts. The poor performing projects are reviewed by GEF OFP India on a need basis.

Since the 4th cycle, GEF has adopted a resource allocation formula for two focal areas: climate change and biodiversity

and from the 5th cycle, it was extended to include land degradation as a focal area. India received USD 106 m (in GEF-4), USD 129.43 m (in GEF-5) and USD 130.58 m (in GEF-6).

So far, India has accessed about USD 516.661 million of GEF grant and leveraged about USD 3 billion as co-funding. A complete list of projects is presented towards the end of the book. The pipeline for GEF-6 cycle includes a project on climate-smart agriculture, developing health advisories linked to National Air Quality Index, promotion of solar grid connected rooftop PV systems, and solar PV installations in Indian Railways. A graphic presentation of GEF grants accessed, focal area wise is presented below:

The growing share of multi-focal area projects in GEF India portfolio is a healthy indication and represents MoEFCC approach towards addressing environmental challenges.



In May 2015, a GEF National Dialogue was organized by MoEF&CC and GEF Secretariat, wherein the implementing partners of all the completed GEF projects had presented the project results and how these results are being scaled up and mainstreamed. This knowledge was supplemented by the information and analysis provided in the project's terminal evaluation reports, Country Portfolio Evaluation (1991 – 2012) done by the GEF Independent Evaluation Office, published reports and information provided by the agencies.

The first chapter in this book showcases five completed projects from the renewable energy sector ranging from GEF interventions made in wind, hydro, biomass and solar energy sectors. Chapter 2 begins with an interesting project which facilitated the development of an enabling environment for energy efficiency in the country, followed by five projects in coal bed methane, steel re-rolling, tea industry, rotor motor and commonwealth games promoting energy efficiency. The chapter 3 documents five stories showcasing biodiversity conservation as an effective tool for climate change resilience. In chapter 4, the focus is on how sustainable land management practices lead to biodiversity conservation while building the resilience of the communities and ecosystem to deal with increasing climate variability. Chapter 5 brings out the strategic yet subdued role of GEF investments in supporting national reporting to the conventions. The book concludes with the showstopper program of our portfolio i.e. GEF Small Grants India program.

This book is first in the series of knowledge products which GEF OFP India office has published, following the premise highlighted by the GEF Council Member of India in his message to this book that, "communicating and sharing results and impacts is as important as implementing the projects successfully".

Chapter 1

Promoting Clean Energy

INTRODUCTORY REMARKS

Dependable and affordable energy supplies are crucial for economic growth of developing countries like India to power homes, improve service delivery, provide cleanwater, and promote economic and human development. Renewable energy has emerged as a viable alternative to meet the basic energy needs. This is also one of the major priorities of Government of India (GoI) as detailed out in Intended Nationally Determined Contributions (INDCs).

GoI has set up a target to increase the renewable capacity of the country to 175 GW by 2022. India is implementing one of the largest renewable capacity expansion programs in the world. Between 2002 and 2015, the share of renewable grid capacity has increased from 3.9 GW to around 36 GW.

Wind energy has been the prominent contributor to India's renewable energy growth accounting for 23.76 GW of the installed renewable capacity, making India the 5th largest wind power producer in the world. With a potential of more than 100 GW, the aim is to install 60 GW of wind power capacity by 2022.

Solar power in India is poised to grow significantly with Solar Mission as a major initiative of the GoI. Solar power installed capacity has increased from 3.7 MW in 2005 to about 4060 MW in 2015 with a future expansion programme to enhance the capacity to 100 GW by 2022. India has also decided to anchor a global solar alliance, Called the 'International solar alliance' (ISA), for countries located between the Tropic of Cancer and the Tropic of Capricorn.

Biomass energy constitutes about 18% of total primary energy use in the country and more than 70% of the country's population depends on it. A seriesof programmes have been initiated for promoting cleaner energy and more efficient use of biomass, including biomass-based electricity generation. GoI is envisaging increasing the biomass installed capacity to 10 GW by 2022 from current capacity of 4.4 GW.

Hydropower contributes about 46 GW to current portfolio of installed capacity, of which 4 GW is small hydro and 42 GW is large hydro generation. With a potential of more than 100 GW, policy initiatives are being undertaken to pursue development of hydro potential.

The Global Environment Facility (GEF), since its inception in 1991, has been instrumental in promoting renewable energy technologies through demonstration, deployment, diffusion, and transfer of technologies. These technologies include cookstoves and lighting for households, mini-grids for communities and solar water heaters.

During the GEF's pilot phase (1991–1994), the strategy was to demonstrate a viable range of technologies useful for stabilizing concentrations of greenhouse gases (GHG) in the atmosphere. After restructuring, between GEF cycle1 to GEF cycle 3, GEF focused on promoting renewable energy technologies that were mature, commercially available, but were prevented from dissemination by informational, institutional, technological, policy, or financial barriers. Projects implemented under this strategy were termed "barrier-removal" projects. During the 4th cycle, GEF committed to two strategic programs on renewable energy. The first promoted market approaches to the supply of and demand for renewable electricity in grid-based systems, and the other promoted sustainable energy production from biomass consisting of wood, crop residues and other biological material. In the 5th GEF cycle, the support covered on-grid renewable energy programs and decentralized production of electric power and heat using new indigenous renewable sources such as biomass, solar, wind, small hydro, and geothermal. In the 6th cycle of GEF, the focus of the climate change mitigation strategy is to support member countries to make transformational shifts towards a low emission development path as per the countries' respective requirements and priorities.

Globally, GEF has invested USD 905 million in over 186 stand alone renewable energy projects in 160 developing countries. In India, till date, more than USD 82.25 million in GEF grants has been for renewable energy related projects in solar, wind, hydro, bio-energy sectors.

The GoI, in collaboration with GEF, has been addressing critical gaps related to policy, regulation, capacity, technology, management and finance. The completed GEF projects are promoting renewable energy projects, addressing critical barriers and developing an enabling environment to promote renewable energy. The GEF support provided a good learning experience.

The following sections provide insight into the completed GEF renewable energy projects in India.

Alternate Energy

Fact File

Focal Area: Climate Change

GEF Grant: USD 26 million

Co-financing: USD 262.1 million (from World Bank, Danish International Development Agency, Swiss Development Cooperation, Indian Renewable Energy Development Agency, Tamil Nadu Power and Lighting and private power developers, Government of Netherland)

Total Financing: USD 288.1 million

GEF Agency: World Bank

National Executing Agency: Indian Renewable Energy Development Agency Limited (IREDA)

Project Period: 1993 - 2001

Project Location: Tamil Nadu, Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan

CO_2 Emission reduction: 6.6 million tonnes over the lifetime

THE PROJECT

The WB/ GEF project aimed at promoting the commercialization of wind energy and solar photovoltaic (SPV) technologies by strengthening the capacity of the Indian Renewable Energy Development Agency (IREDA) to stimulate and finance private investments in the sector. The key components of the project were:

- To strengthen IREDA's capacity to promote renewable energy technologies and attract private sector interest through the provision of technical support and training to IREDA staff, private investors and other stakeholders engaged in RE market development and investment.
- To finance investments through IREDA for wind farms with an aggregate capacity of 85 MW; a marketing and financing program to support the SPV market and install 2.5 to 3.0 MW of PV systems; and support irrigation-based small hydro projects with an aggregate capacity of 100 MW.

The GEF grant was meant to help reduce the project cost comparable to that of conventional alternatives. The SPV component had a high potential for replicability and contribution to the reduction of global warming, but it requires the development of basic market infrastructure.

OUTCOMES

The project was successful in surpassing the targets set at the design stage for the wind and small hydro sectors whereas it lagged behind, though marginally, for the SPV sector. The technical assistance component accomplished fully these two objectives at the design stage.

A total of 27 projects with an aggregate capacity of 87 MW were completed against project target of 85MW. The project also contributed to the development of the wind turbine industry with manufacturing, design, operation and maintenance capabilities.

A total of 78 SPV projects with an aggregate capacity of 2 MW were financed against the target of 2.5 MW.

A total of 35 small hydro projects with an aggregate installed capacity of 118 MW were commissioned against the target of 100 MW.

The technical assistance component supported activities that included technology promotion campaigns, training of IREDA staff and various stakeholders upgrading IREDA facilities and management systems.

IMPACTS

The WB/ GEF project led to capacity enhancement of IREDA in undertaking its dual mandate of technology promotion financing and strengthening institutional capacity for further replication of projects. The project indirectly played an important role in promoting policy and regulatory changes.

The project has led to growth of SPV manufacturing, design and engineering, operation and maintenance capability in India. It contributed to the development of SPV manufacturing base. Commercialization had advanced rapidly in the wind power sector with 90% of the installed capacity of 1510 MW implemented by the private sector, compared to 40 MW of state-owned facilities in 1992. By 2002, the installed capacity reached 1700 MW. The small hydro sector saw installed capacity rising from 93 MW in 1992 to 1516 MW in 2001.These two projects combined have helped in the promotion of the technology at the national level.

The WB/ GEF project led to capacity enhancement of IREDA in its dual mandate of technology promotion and financing. The project helped IREDA attain maturity as a leading financial institution specializing in renewable energy projects. IREDA increased its outreach and client support by establishing a team of business development agents. IREDA also attracted other international lines of credit of USD 350 million.

The GEF support for financing renewable energy projects helped reduce the perceived risks of solar products, thus encouraging other lenders to support the sector. The project led to availability of renewable energy financing from a large number of national and

local banks, non-bank financial institutions, cooperatives, foundations/ trusts as well as government-owned financial institutions.

The project also helped promote a shift in the government's approach to renewable energy development from one that was largely state-administered to a more demand and market driven approach with active involvement from the private sector.

The GEF support led to the promotion of businesses

owned by women and more marginalized sections of society. Positive development impacts from SPV use among poorer consumers included a five-fold increase in income among farmers using SPV pumps.

The project activities led to the establishment of a vibrant industrial base for manufacturing of solar cells with more than 80 companies having aggregate installed capacity of over 1.8 GW producing SPV modules and 15 companies manufacturing solar cells – with over 700 MW installed capacity. India is exporting its SPV manufactured modules to Asia, USA and Europe. Retail sales and service networks have been set up in majority of the states and union territories.

With regard to the wind sector,the investments financed by the project led to the setting up of wind farms in all the states that have high potential for wind power generation. By 2012, the installed capacity of wind energy increased to 18,321 MW.

Since the completion of the project in 2002, IREDA's capacity for lending for renewable energy sector has further strengthened. IREDA has specialized in lending for renewable energy and has established itself as an industry leader.

The number of banks financing solar projects has increased since 2002 with many new players entering the market. Due to the increased generation of renewable energy and its increased share in India's power mix that can be linked to the project, it is contributing to CO_2 emissions reduction.

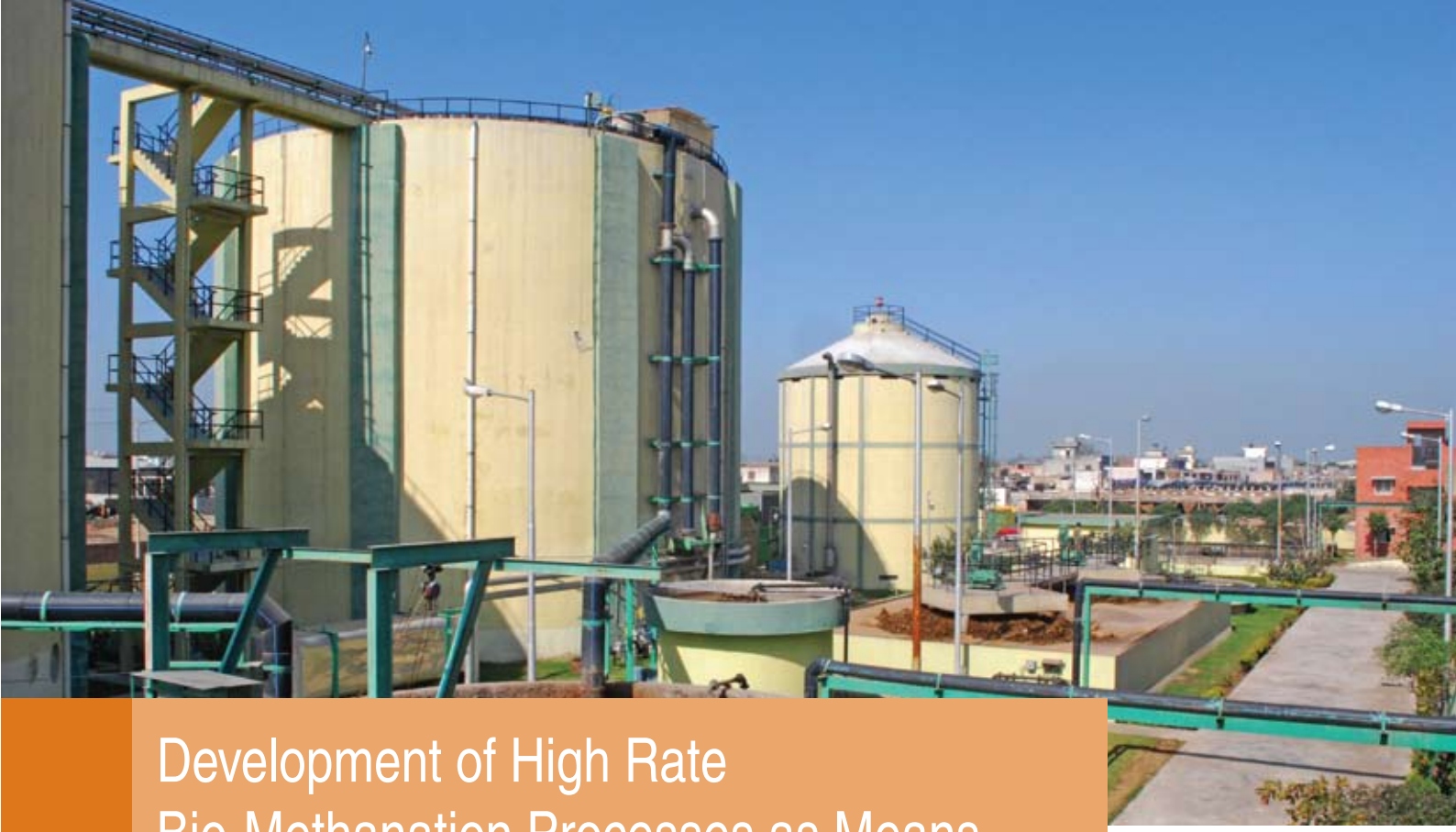
LESSONS LEARNT

Supportive policies and regulatory framework are essential for market development. Wind and hydropower development has progressed fastest in states with favourable policies and regulations.

Delivering rural PV services needs a partnership among key actors. The GEF project experience shows that, rather than expecting PV suppliers to also be credit suppliers, rural financial institutions may be better placed for delivering credit.

Introducing competition among financial institutions may be required for the commercial development of a sector. Multiple product and service delivery agents, as well as technology improvements, are also necessary for success.

From the WB/GEF project, it is evident that affordable financing for rural consumers is essential for market penetration of PV products in rural areas because more consumers in an area can afford the products.



Development of High Rate Bio-Methanation Processes as Means of Reducing GHG Emissions

THE PROJECT

The UNDP/ GEF project aimed to promote the use of waste-to-energy pilots which also control methane emissions; a potent greenhouse gas. When the GEF project was initiated in the mid-90s, the bio-methanation technology did not create much enthusiasm. The project was designed to control emissions of methane in India by applying state-of-art, high-rate,bio-methanation technology utilizing a number of waste types. The project also aimed at creating an alternative clean fuel source that would result in improvement in the quality of the environment, especially air and water to improve health and sanitation. The GEF grant was provided to cover:(a) cost of technology imports; (b) setting up demonstration projects (including 5% of hardware cost borne by GEF and up to 50% by MNRE), technical and institutional assistance for formulating a national strategy; (c) standardization of variety of technologies; and, (d) awareness creation.

To encourage private parties to invest in the pilots, the UNDP/ GEF project developed a cost sharing formula. However, while the approach was adopted to mitigate risks involved in the standardization and commercialization of the process, lack of these made it difficult for the project to obtain funds from the banks.

The GEF project set up its first-of-a-kind pilot by involving municipalities and private sector in the following sectors:-

- Pulp and paper (Punjab and Tamil Nadu)
- Leather and abattoir (Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Madhya Pradesh)
- Vegetable market yard (Punjab, Andhra Pradesh and Tamil Nadu)

Fact File

Focal Area: Climate Change

GEF Grant: USD 5.5 million

Co-financing: USD 16.5 million (MNRE, MoUD, NBB, MoEF&CC and IREDA)

Total Financing: USD 22 million

GEF Agency: UNDP

National Executing Agency: Ministry of New and Renewable Energy (MNRE), GoI

Project Period: 1994 – 2005

Project Sites: Tamil Nadu, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, Punjab, Odisha, Maharashtra, Gujarat and Karnataka

CO_2 Emission reduction: 4.81 million tonnes over the lifetime

- Municipal wastewater and sewage (Odisha and Maharashtra)
- Biogas utilization (Karnataka)
- Animal/agro residues (Punjab)
- Fruit/food processing waste (Tamil Nadu)

OUTCOMES

The implementation targets set out during the project design stage were achieved for most activities. The project contributed significantly to the formulation of a supportive legislative environment. The National Programme on Energy Recovery from Urban, Municipal and Industrial Wastes, the 2000 Municipal Solid Waste Management and Handling Rules and the Electricity Act of 2003 provide support to commercialization of bio-methanation technologies.

The Ministry of New and Renewable Energy (MNRE) formulated incentives in terms of capital subsidy for the promoters of urban and industrial waste-to-energy projects as well as financial assistance for promotional activities, resource assessments and research activities by state nodal agencies, institutions and other organizations. The project indirectly helped in enabling this policy regime through demonstration of technologies and implementation mechanisms and directly by the formulation of the National Master Plan on Waste-to-Energy.

It completed 16 sub-projects, including 14 technology demonstration projects for bio-methanation of a wide range of waste types such as waste from paper and pulp, leather, abattoir and agro-processing industries, vegetable markets and municipal sewage. These projects were set up for different target groups based on state-of-the-art technologies developed indigenously as well as those obtained from abroad. The high-rate bio-methanation project has also had a noticeable impact, especially among the industries generating biodegradable waste. A summary of demonstration projects set up under this project is as follows:

Location	Beneficiary organization	Waste stream	Process/ Technology	Project commissioned	Size (Biogas m3/day)	Fuel displaced	Biogas use	Tonnes of CO_2 avoided annualy
Orissa	RRL, Bhubaneswar	Liquid (municipal wastewater)	Anaerobic fixed film technology	Oct 1997	25	NA	Flared/ Heat in canteen	113
Andhra Pradesh	AKEL, Medak	Solid	Biogas Induced Mixing Arrangement (BIMA)	Nov 2001	1600-1800	Furnace Oil	Steam	4800
Uttar Pradesh	HAIL, Aligarh	Solid	Continuously Stirred Tank Reactor (CSTR)	NA	4,500	Grid Power	Electricity	-
Tamil Nadu	VISHTEC, Melvisharam	Solid	CSTR	Dec 1999	200	Grid Power	Electricity	5800
Madhya Pradesh	TIL, Dewas	Solid	Modified UASB (Upflow Anaerobic Sludge Blanket)	Mar 2000	125	Coal	Heat in canteen	450
Karnataka	Ugar Sugar, Belgaum	Biogas Utilization	Indigenous Biogas Engine	Dec 2000	11,000	Grid Power	Electricity	1500
Gujarat	SMC, Surat	Biogas Utilization	Imported Biogas Engine	Mar 2004	4,500	Grid Power	Electricity	1300
Tamil Nadu	VSIL, Salem	Liquid	Hybrid upflow sludge media anaerobic reactor	Sept 2002	5,000	Furnace oil	Electricity	58000
Tamil Nadu	TNPL, Karur	Liquid	UASB	Mar 2003	15,000	Furnace oil	Heat in Lime kiln	51000
Punjab	Satia Paper, Muktsar	Liquid	UASB	May 1997	10,000	Rice Husk	Boiler fuel	-
Tamil Nadu	CMDA, Chennai	Solid	BIMA	June 2005	2,500	Grid Power	Electricity	5800
Andhra Pradesh	VMC, Vijayawada	Solid and Liquid	Modified UASB	June 2004	1400	Grid Power	Electricity	-
Maharashtra	BARC, Mumbai	Kitchen waste	Bi-phasic	Oct 2005	500	Electricity/ liquefied	Electricity/ Heat	-
Punjab	Haebowal, Ludhiana	Animal manure	BIMA	Dec 2004	10,000	Grid Power	Electricity	-

The project facilitated interaction between project developers such as municipalities, industries, technology institutions, national laboratories and state nodal agencies. Information dissemination and awareness was carried out through the quarterly "Bio Energy Newsletter" which was brought out by the MNRE. Although the cost range for installation of 1MW of bio-methanation potential was about ₹.2.8 million, the project provided insight on how the cost per MW can be reduced. Bio-methanation picked up rapidly in the decade 1995-2005 and according to Terminal Evaluation, the seed money provided by the project was instrumental in bringing about this change.

IMPACTS

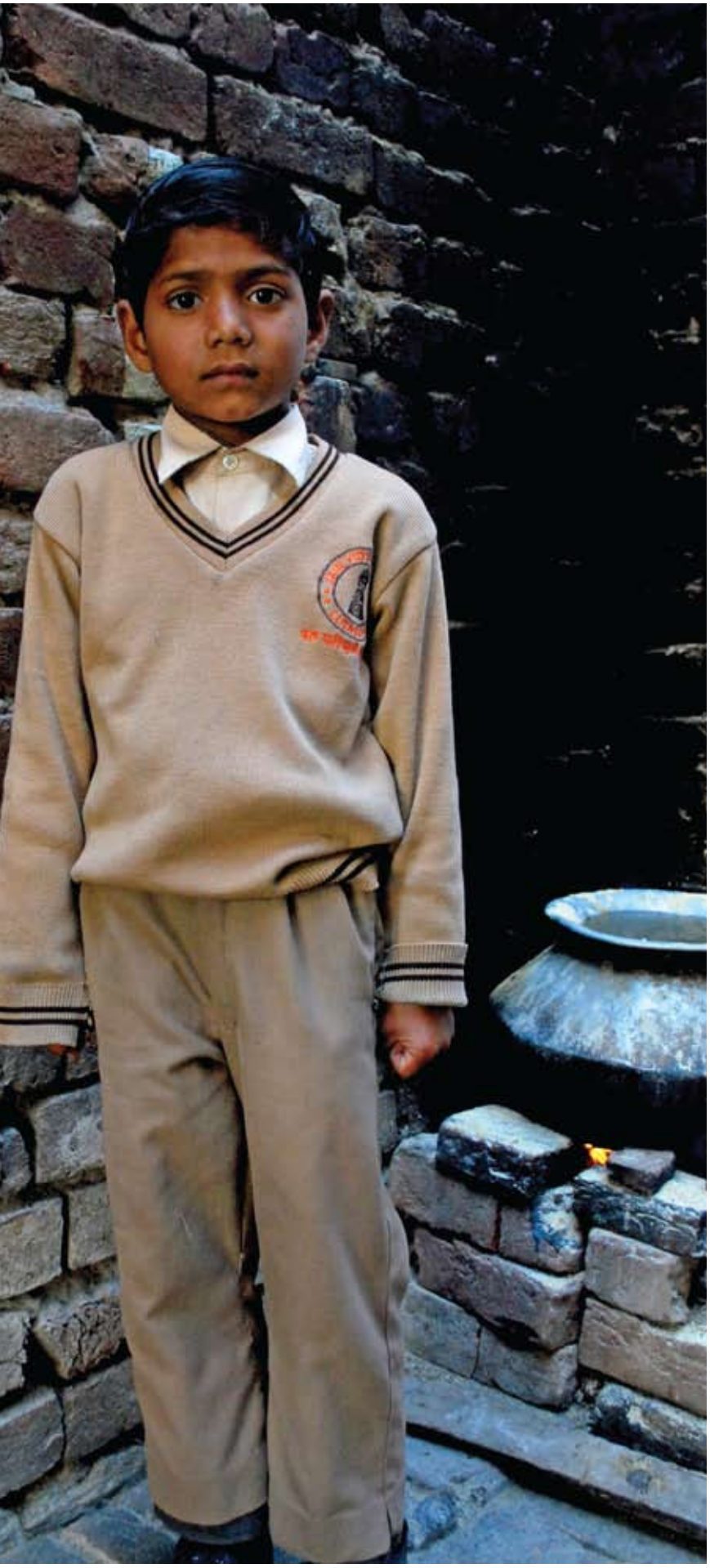
The project has played an important role in the introduction of bio-methanation technologies and demonstrated it in various sectors. Up-flow Anaerobic Sludge Blanket (UASB) technology promoted by the project has become widely popular for the capturing of biogas from distillery effluents and about 150 such units have been installed.

The GoI has taken important steps in addressing some of these complexities and barriers in implementing renewable energy projects:

- Waste-to-energy through different substrates: Different types of wastes are generated from different end uses. These wastes called substrates include cow dung, agro waste, slaughter house waste, tannery waste, sugar mill effluent, municipal waste. These wastes are disposed as land fill. The project piloted using these wastes as resources and facilitated innovation of biogas digesters to process these wastes to generate power in the range of 0.5 to 2 MW capacity.
- BIMA – Biogas Induced Mixing Arrangement Reactor: A market yard in Chennai was producing vegetable waste, primarily organic. An Austrian technology, BIMA an anaerobic digestion system was demonstrated after modification to suit the requirements.

With the increase in private sector participation and initiatives of the government at state and national levels, further growth of the bio-methanation sector seems to be ensured. As of November 2012, capacity installed from waste-to-energy projects running across the country for grid connected and captive power were 93.68 MW and 110.74 MW respectively.

Domestic technology providers, like Cummins India, have developed their own gas engine for biogas utilization. Institutions such as Indian Institute of Technology, Roorkee has developed a bio-methanation technology to generate biogas from distillery effluents. Similarly, The Energy and Resource Institute (TERI) has developed TERI's Enhanced Acidification and Methanation (TEAM) process



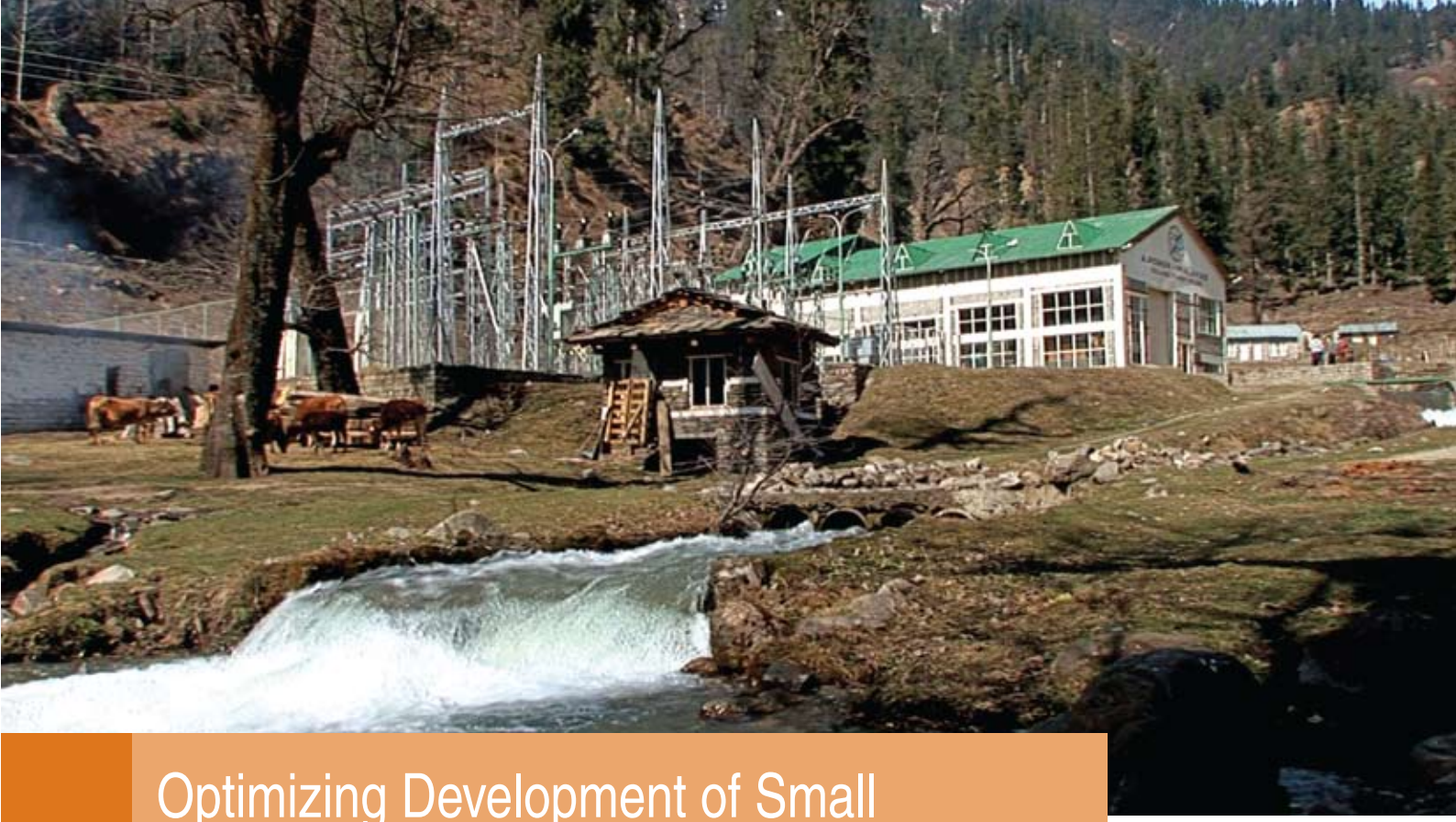
for bio-methanation, and has successfully put it into practice at Sona Steering, Gurgaon and NTPC, Faridabad.

Financial institutions such as the Housing and Urban Development Corporation (HUDCO), Infrastructure Development Finance Corporation (IDFC), Industrial Development Bank of India (IDBI) and several nationalized banks have also been providing loans for such projects.

LESSONS LEARNT

- Despite successful demonstration, the replications have not happened at the desired scale. One of the important lessons to exploit this opportunity to convert waste to energy is that segregation of waste at source into organic and inorganic is essential to convert municipal solid waste.
- Technology transfer projects require extensive consultations with government, private sector, beneficiaries and other stakeholders. Detailed discussion with the participating institutions and cooperating partners is necessary early in the process to create project ownership. Therefore, institutional networking with clearly defined roles for different organizations is highly beneficial for implementing multi-activity projects.
- Local capacity building of technology providers is necessary for project success. Major problems observed with imported equipment were non-availability of spares and skilled labor for maintenance of this equipment.
- Continuous study of the process is necessary for improving the methane content of the biogas. The technology provider needs to be engaged for a longer period, along with the operator responsible for operation and maintenance.

The GoI and GEF are currently supporting a second generation project to promote bio-methanation technology and processes in India. This project builds upon the experiences faced by the GEF-funded project earlier as well as GoI's experience in the sector.



Optimizing Development of Small Hydel Resources in Hilly Areas

THE PROJECT

The UNDP/ GEF project was designed to assist the Government of India in the optimum utilization of small hydro-electric resources in the Himalayan and sub-Himalayan regions. The GEF intervention aimed to provide renewable, perennial energy to the hilly region for lighting, cooking, heating, agricultural and commercial needs, and helping to prevent deforestation in ecologically-fragile areas. Through these interventions, the project had also aimed at reducing population migration to cities by creating local employment opportunities.

The key project components were:

- Establishment of 20 demonstrable stand-alone small hydel power (SHP) projects for power generation at various sites to serve as models for replication throughout the hilly regions of India.
- Up-gradation of water mills at different locations with the new technology for electricity generation, to serve as prototypes for up-gradation of water mills at other locations.
- Institutional and human resource developmentin the sector to promote and develop the SHP sector.

The key assumptions made while designing the project were:

- The small hydropower projects would provide renewable, perennial, and non-fossil fuel based energy in the hilly regions.
- The energy produced through the projects can meet local needs for lighting, heating, cooking, agricultural and commercial needs.
- The local people would switch over from fuel wood to electricity for

Fact File

Focal Area: Climate Change

GEF Grant: USD 7.5 million

Co-financing: USD 224.8 million by Government of India

Total Financing: USD 232.3 million

GEF Agency: UNDP

National Executing Agency: Ministry of New and Renewable Energy (MNRE), Government of India

Project Period: 1991 – 2002

Project Site: Himachal Pradesh

CO_2 Emission reduction: 1.29 million tonnes over the lifetime

cooking and heating, and accept low-wattage appliances.

- The projects would contribute to human development by creating local employment opportunities.
- The projects would generate sufficient interest and confidence in the private sector and the State Government to set up more Small Hydro Power projects.

OUTCOMES

At the time of project start, India had small hydro projects of 5 MW size, the aggregate installed capacity of 63 MW. The private sector had been reluctant to put up small hydro projects of the size of 100 kW to 1 MW since the commercial viability was not established. Demonstration of 17 GEF-funded small hydro projects, especially of 100 kW to 1 MW capacity gave good confidence. The States were convinced to announce policies to invite private sector participation.The project supported preparation of a National Master Plan backed by funding from the Government of India under the Five Year Plan to boost the smallhydro sector. Different states identified project sites under the Zonal Plan and allocated the sites as per the state policies. The project was supported thereafter by the World Bank with soft loans worth USD 200 million in two tranches. India has put up over 1,018 small hydro projects with aggregate installed capacity of 4,400 MW.

It is evident that the implementation target set out during the project design stage has been achieved, and upgraded watermills have exceeded the target.

20 SHPs with a total installed capacity of 5.7 MW were installed in the Himalayan and Sub-Himalayan regions.

Under the project, 143 water mills were upgraded for electricity generation and multi-purpose devices were installed for 24-hour operation. The demonstration of these water mills inspired the government to take on a full-fledged program to promote water mills. Thus, the project target of up-gradation of 100 water mills was exceeded. The project served as a demonstration of the technical and economic feasibility of new technologies and this has paved the way for replication of projects by private developers.

The National Strategy and Master Plan developed in theproject formed the basis of the national strategy to achieve the capacity addition target of 130 MW during the Ninth Five Year Plan. The GoI enacted a number of policies and incentives, and enacted annual and FiveYear Plan targets for installed capacity of SHP power projects. Based on this,15 Indian states have announced policies for setting up of commercial SHP projects through private sector participation.

The project successfully created and enhanced capabilities and facilities for testing, training and applied research. A revolving fund of USD 1.4 million was created to assist

private sector participation. The revolving fund created at Indian Renewable Energy Development Agency (IREDA) was made available to the private sector and NGOs to implement SHP projects. During the project period, IREDA financed SHP projects with an additional 155 MW capacity from other resources.

The project developed the domestic market of small hydro equipment and promoted growth of local manufacturers and consultants. By 2001, 16 small hydro equipment manufacturers, including international joint ventures,were operational in India, compared to 10 inactive firms in 1991.

At the project inception, lack of financing for SHP projects was a major barrier as banks and financial institutions felt it was a high risk sector. The success of the projects financed under the project encouraged several banks to provide lending and this resulted in the development of a robust financing network in the country. The project led to successful demonstration of the technologies and helped to establish technology suppliers.

IMPACTS

Growth of small hydro from 63 MW to 4400 MW:A National Master Plan was prepared and funds were allocated by the Planning Commission in the Five Year Plan for giving a boost to the small hydro sector. At the end of the project, India has put up over 1,018 small hydro projects worth 4,400 MW capacity.

In Himachal Pradesh, 497 private projects with a total capacity of 1,280 MW and 10 government projects with a total capacity of 2.80 MW have been allotted for implementation.

Assumptions made for assessing indirect GHG reduction during re-evaluation (December 2012) were:

- Installed SHP grid-connected capacity in the hilly and non-hilly states are 933 MW and 2110MW respectively.
- SHP capacity installed under this project (5.68 MW) is deducted from the total hilly states SHP capacity and the net SHP capacity comes to be 927.7 MW.
- Capacity Utilization Factor for hilly and non-hilly states is 0.45 and 0.3 respectively.
- GEF contribution to the SHP is substantial in transforming the SHP market in hilly and non-hilly states and favorable market conditions have also favored the same.

The mechanism for the continuation of such activities is in place and significant progress to impact can be observed easily.

To develop skill sets at different levels on small hydro, the Alternate Hydro Energy Centre (AHEC) at the Indian Institute of Technology, Roorkee was developed as a national training centre for small hydro.

LESSONS LEARNT

The lack of adequate transmission and distribution infrastructure in the target areas was a major problem for the development of SHP projects. Adequate financial provisions must be earmarked so that the State Electricity Boards are enabled to actively participate in the small hydel initiatives in future.

Involvement of officials from MNRE and other institutions greatly helped in mainstreaming project activities.

Biomass Energy for Rural India

Fact File

Focal Area: Climate Change

GEF Grant: USD 4.017 million

Co-financing: USD 1.137 million from India-Canada Environment Facility, State Government of Karnataka, MNRE and others

Total Financing: USD 5.154 million

GEF Agency: UNDP

National Executing Agency: Rural Development and Panchayat Raj Department (RDPR), State Government of Karnataka

Duration: April 2001 – December 2012

Project Location: Tumkur district, Karnataka

CO_2 Emission reduction: 0.293 million tonnes over the lifetime

THE PROJECT

As organic matter derived from wood, agricultural residue or animal waste, biomass is an abundant, naturally occurring source of energy, and one that is also carbon-neutral. Bioenergy is produced either through combustion, where biomass is burned to generate heat that is, in turn, used to generate steam and then converted to electricity or through gasification, which is a thermo-chemical conversion of biomass into a combustible gas that is used as a fuel in engine to generate electricity.

Typically, power plants with installed capacities of 2 MW and above, produce electricity through combustion. Gasification to electricity, on the other hand, is a relatively new development that also opens up possibilities to set up kilowatt-scale biomass power projects. Yet, while Indian solution providers are implementing biomass gasification projects in other countries, in India, biomass-based power generation is still at the margin of the country's power generation installed capacity. The bio energy sector has also been unable to achieve standardization of technology. Village-level institutions, in particular, do not possess the skill-sets required to operate or maintain gasifier technology.

The UNDP/GEF project aimed to address the technical barrier to increase the use of bio energy by demonstrating a viable biomass-powered sub-megawatt electricity generation system to serve rural consumers. In the process, it sought to create a model of rural electrification that enabled decentralized operation and maintenance of power plants by local communities. A model where rural communities are not just consumers, but also producers as well as distributors of electricity. The project was implemented in 24 villages of Tumkur district.

OUTCOMES

1000 kW biomass gasifiers were established. This includes six units of 100 to 250 kW modules. 900 kW of this is 100% producer gas based systems and 100 kW is a dual fuel system. This is a shift from the original project design which envisaged installing 60 small gasifiers of 20 kW capacity each, spread in all the project villages to meet the local loads.

The project established generation of biomass through energy plantation in 3,000 acres of village wastelands, farm dykes and forest wastelands. Creating a supply chain of biomass for the power plants was one of the entry-level activities of the project, and by the time the Kabbigere power plant was ready for operations in 2007, the biomass needed to power the plant was ripe for harvesting. The project had launched tree plantation campaigns which included 1,983 ha of forest land and 946 ha of agricultural land (plantations alongside bunds). Village community land and other private plots were also utilized for plantations. Although over 5,000 tonnes of biomass was produced annually in these largely unprotected plantations, these could not be made available to the power generation unit on time. Hence, to ensure that operations run smoothly, the project had to procure biomass from private partners. Tree plantation has also yielded additional benefits, such as an annual sequestration of carbon dioxide by up to 26,500t CO_2.

The participation of local communities was integral to the project design. Households with access to cattle and living in proximity to biogas plants were organized into biogas users' groups (BUGs). These groups were trained in operating a biogas unit, and were also responsible for supplying dung for processing into biogas. The biogas generated was then fed into homes through pipes. The households paid a monthly maintenance charge for using the gas, which was kept in a common account. By 2007, 51 BUGs had been formed, involving 175 households with a population of 843.

The training programmes facilitated by the project covered conceptual, managerial, and operational aspects of bioenergy systems such as gasifier maintenance and biomass handling. In all, over 124 courses were organized, attracting over 3,700 participants. In addition, 159 courses provided management skill development.

The project established a benchmark for electricity generation from biomass gasifiers. 1.36 kg biomass is required to generate 1 kWh of electricity at 85% rated capacity. The average production cost of electricity was ₹ 8.26 per kWh when the cost of biomass is ₹ 2.75 per kg.

The project successfully demonstrated 100% producer gas engines and evacuation of power to grid at small scale, for the first time. Most of the subsequent biomass gasifier based power plants started using 100% producer gas.

The Central Electricity Regulatory Commission used the data generated from this project to discuss differential tariffs for small scale power plants.

IMPACTS

The project demonstrated the technical feasibility of 100% producer gas systems at 100 to 250 kW capacity for the first time in India. The lasting legacy of the project is the demonstrated viability of biomass power generation at sub-megawatt scales, generating 24x7 electricity to meet the energy needs of rural India. The UNDP/GEF project's core technical objective — testing a technology hitherto confined to the laboratory in actual ground conditions —was achieved with over 1.34 million units of electricity generated by the plant thus far. Further, it was a first-of-a-kind project which demonstrated a sub-megawatt system successfully connected to the grid.

Net reduction of 67,923 tonnes of CO_2 have been achieved upto December 31, 2012 (cumulative) through three interventions (biogas, bio-energy generation and forestry/afforestation) and indirect emissons were 300,377 tonnes of CO_2. The project's afforestation and plantation activities made the bulk of the contribution to the emission reduction. Innovative interventions like tree-bund farming and mass movements like 'Green Festival' augmented the extensive plantations raised in forest land.

No direct post-project emission projection were made as per the terminal evaluation report.

LESSONS LEARNT

- The plants faced repeated forced outages and suffered from recurrent unscheduled grid interruptions. This resulted in a low load factor of 19%, indicating that the technology could have performed much better if conditions were optimum. One of the reasons identified for the low performance of the plant, was persistent technical issues with the gas cleaning system and engine.
- The project did not have the arrangement for troubleshooting of the technology and valuable time was wasted in procuring these services.
- The other major technical hurdle impacting the power plants' performance was the tenuous availability of the grid.
- Biomass production and supply network is critical for the sustainability of bio-energy.
- The cost of electricity generated from small scale biomass power units is relatively high when compared to the cost of electricity generation in large scale power plants.
- The project faced commercial challenges in operating the plant by selling power to the grid at a tariff which was much less than the cost of electricity production.

Global Solar Water Heating Market Transformation and Strengthening Initiative

THE PROJECT

Urban and rural India is largely dependent on non-renewable sources of energy for heating water. While water for domestic use is commonly heated with electricity, which costs ₹ 3-4 per kWh, most industrial units depend on oil as fuel to heat water. Bulk consumption of oil adds to India's oil import expenditures. The Ministry of New and Renewable Energy (MNRE) has taken initiatives to support the application of solar thermal systems.

The GEF supported a six-country project which included Albania, Algeria, Chile, India, Lebanon and Mexico, to accelerate and strengthen the growth of solar water heater market, share the experiences and lessons learnt in other countries.

In India, the GEF support aimed at accelerating the market development of solar water heating (SWH) with an objective to facilitate the installation of 5 million m^2 of installed collector area by 2012. In the absence of any intervention, the market was projected to reach 3 million m^2 during this period. Thus the project aimed at:

- Creating an enabling institutional, legal and regulatory framework to support sustainable SWH market development.
- Creating sustainable demand for Solar Water Heaters systems in the targeted end user markets through public awareness raising and marketing support.
- Building capacity of the supply chain to respond to the growing demand with good quality products and services sustaining the market growth.

During the start of the project in 2008, the total installation of Solar Water Heaters was 2.35 million m^2 consisting majorly of flat-plate type collector

Fact File

Focal Area: Climate Change

Global Project: Albania, Algeria, Chile, India, Lebanon and Mexico

GEF Grant: USD 2 million

Co-financing (India): USD 40 million from MNRE and International Copper Promotion Council of India (ICPCI)

Total Financing: USD 42 million

GEF Agency: UNDP

National Executing Agency: MNRE

Duration: Oct 2008 – Dec 2012

CO_2 Emission reduction: 9 million tonnes over the lifetime

design. There was no systematic effort directed towards awareness creation and quality compliance of solar water heaters.

OUTCOMES

Various field studies and market development programs were initiated that covered the Himalayan region, industrial, hospitality, education and healthcare sectors. A number of knowledge documents were developed under the project to promote the solar water heating program in the country. These products are as follows:

- User's Handbook on Solar Water Heaters
- Design handbook for installers and designers
- Online Solar Water Heater Calculator
- Training manuals for installers/technicians in 9 regional languages
- Specific website on Solar Water Heater http://www.solarwaterheater.gov.in
- Toll Free National Helpline number for solar water heater - 1800 2 33 44 77
- Electronic newsletter on a monthly basis and a compendium on the same
- Guidelines on installation of SWH in multi-storey buildings
- Awareness programs/seminars organized in different sectors
- Training programs organized for installers, builders, architects and local consultants
- Fact Sheets and Reference Manuals for the Hospitality sector
- On-line tools for deciding about RE technology in the Hospitality sector
- Case studies in industrial, hospitality and educational/institutional sectors
- Potential Assessment in different sectors under various scenarios
- Software for data management and monitoring of installations of various channel partners
- Building by-laws amended by various Municipal Corporations to favor installation of SWH

Among other initiatives undertaken, two large size projects were developed in the ESCO mode. First, was solar water heater for industrial process heat using 35,000 liters per day capacity at M/s SonaKoya Steering Systems, costing ₹ 5.2 million. Second, installation for 1,05,000 lpd capacity at M/s Wheel India Ltd, for pre-treatment of automobile components in hot water, costing ₹ 16 million. In both these projects, only 25% of the cost was borne by the user and remaining was met by the ESCO. An MoU was signed for a period of 5 years wherein the beneficiary had to pay the amount fixed by both the parties on monthly basis in equal installments. Suppliers ensured required delivery of hot water and the entire installation was handed over to user after a period of 5 years without any additional cost.

For the residential sector, the project developed model regulations on amendments in Building bye-laws to make the installation of solar water heaters mandatory in certain categories of buildings. Based on this, 26 states and around 100 urban local bodies are in the process of amending the bye-laws.

IMPACTS

The project activities enhanced the annual installations by 4 times in 2012-13 (1.6 million sq. m) as compared to that at the time of inception (0.4 million sq. m). This was as a result of greater awareness raising, efforts made in effective implementation of bye-laws on mandatory use of systems in new buildings by local Governments. Quality of products being installed in the field have been ensured by introducing minimum technical requirements backed by 5-years performance guarantee given to users.

The project demonstrated the concept of Energy Service (ESCO) in solar water heater sector in the industrial sector for the first time. Many industrial companies have production processes which use hot water. Typically, water is heated using oil as a fuel. However, these companies focus on maintaining the operation to ensure production and therefore do not want to be burdened by introducing a new technology and its operation, management and maintenance requirements. An ESCO filled the gap by providing energy services based on the concept of guaranteed savings. The required investment in installing solar water heaters of required capacity including all the ancillaries were made by the service provider while the customer paid monthly payments based on the quantity of hot water delivered. The project demonstrated the ESCO concept in two industrial facilities which are operating successfully since the industries saw a major commercial benefit from reduced consumption of oil, which helped to reduce its annual operational cost, since hot water is required throughout the year.

Hilly areas find it difficult to use the solar water heaters which run on thermo-syphon systems. The solar water heaters require an overhead tank from where circulation of water is maintained. Further, transportation of solar water heater and its installation is also a challenge. The project supported the development of an innovative design of a new model of box type 12.5 liters solar water heater which overcame the challenges for use in rural households in hilly regions.

The outreach activities under the project improved sales and installation of solar water heaters by three timesin just four years, and more than doubled the total installation in India. The installation of 4.56 million m^2 of collector area during the project implementation phase took the cumulative installation in India from 2.55 million m^2 in 2008 to 7.01 million m^2 at the end of the project in 2013.The outreach activities included involving more professional expertise to prepare system configurations for commercial establishment, training over 1000 technicians, supporting the municipalities in implementing/ strengthening the Government Order relating to implementation of SWH.

LESSONS LEARNT

- The project developed and demonstrated a new low-cost, box-type solar water heater suited for hilly areas.
- Subsidized electricity tariffs and rates do not promote the use of SWH systems. The major challenge is the subsidy available on conventional fuels to users due to which users get electricity/ fuel oil/ LPG at a low cost for heating water. There is no legal binding mechanism to stop the use of these high grade fuels for heating water.
- Low level of awareness and maintenance support affect the sales of solar water heaters. Easy financing and availability of good quality products and after sales services are the main challenges that need to be overcome.

CONCLUDING REMARKS

Opportunities to deploy certain renewable energy technologies are growing. Clean energy technologies are potential candidates for deployment in the rural areas for expanding rural development. The productive use of renewable energy in rural areas helps to address the issue of energy access and with availability of reliable and affordable energy, can help to raise incomes, improve health and improve the overall conditions of rural economy. Renewable energy technologies can also play crucial roles in employment as these technologies require knowledgeable and dedicated workforce as compared to conventional technologies for the same energy output—employing a mixture of local and decentralized workers.

Strengthening institutional capacities, promoting enabling environments, developing policy frameworks, and improving demand for renewable energy technologies can help reduce barriers, mitigate steep transaction costs, and promote under developed markets. This has been showcased by the completed renewable energy projects from GEF India portfolio.

Even though the cost per unit of energy produced by renewable energy technologies is expected to decline, most renewable energy sources will need initial support in order to compete in electricity markets. While the renewable energy technologies are comparatively costly, they can bring long-term benefits. Energy demand and supply patterns can be altered with the development of renewable energy on a large scale. This is a major challenge that demands comprehensive and sustainable solutions.

Chapter 2

Promoting Energy Efficiency

INTRODUCTORY REMARKS

"India produces about one lakh crore units of electricity, and if a 10% saving (of energy) is made, that can save 10,000 crore units (and) that is equivalent to as much as Rs 50,000 crore savings, which can be utilized for lighting up homes of five crore people who are without electricity."

– Piyush Goyal, Minister of Power, outlining Government of India's vision.

Affordable and clean energy has recently been adopted as Sustainable Development Goal (SDG) no. 7 as sustainable energy is an opportunity which transforms lives, economies and the planet. Energy is a key factor for poverty alleviation and sustainable development.

The urgent needs for an enhanced quality of life, sustainable livelihoods, and rapid economic growth are spurring demand for the increased supply of reliable and affordable energy in India; it is expected that energy demand would double to 1700-2000 million toe by 2030. With the potential to enhance energy access, reduce import dependence, bring down energy costs for consumers, as well as increase energy productivity and mitigate greenhouse gas emissions, the continued and accelerated adoption of energy efficient practices and technologies is an essential component of Government of India's (GoI) energy strategy. This strategy is based on a two pronged approach - on the generation side, the focus is on promoting greater use of renewables and on the demand side, efforts are being made to efficiently use energy through various innovative policy measures under the overall ambit of Energy Conservation Act.

Ministry of Power through Bureau of Energy Efficiency (BEE) has initiated a number of energy efficiency initiatives. The National Mission for Enhanced Energy Efficiency (NMEEE) aims to strengthen the market for energy efficiency by creating a conducive regulatory and policy regime. It seeks to upscale the efforts to unlock the market for energy efficiency and help achieve total avoided capacity addition of 19,598 MW and fuel savings of around 23 million tonnes per year at its full implementation stage. The programs under this mission have resulted in an avoided generation capacity addition of about 10,000 MW between 2005 and 2012 with government targeting to save 10% of current energy consumption by the year 2018-19 through various measures like Efficient Lighting, Standards and Labelling programme for electrical appliances, Partial Risk Guarantee Fund for Energy Efficiency, Energy Conservation Building Code, enhancing energy efficiency in industries through market based energy efficiency trading mechanism known as Perform, Achieve and Trade (PAT), Zero Effect, Zero Defect etc.

India is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and GEF being the financial mechanism of UNFCCC, has been actively supporting GoI's energy efficiency strategy and initiatives since 1991.The GEF's climate change focal area strategy has evolved considerably since the inception of the GEF. In India, more than USD 197. 5 million worth of GEF grant (of the total USD 468.59 million) has been programmed for addressing market, technology, policy, financial and other barriers in achieving greater energy efficiency. The following stories from the completed GEF projects in the country provides a good overview of the work done in this sector.

Energy Efficiency

Fact File

Focal Area: Climate Change

GEF Grant: USD 5 million

Co-financing: USD 252.37 million from GoI, IBRD/IDA and private sector

Total Financing: USD 257.37 million

GEF Agency: The World Bank

National Executing Agency: Indian Renewable Energy Development Agency (IREDA)

Project Period: 2001 - 2008

CO_2 Emission reduction: 9.43 million tonnes over the lifetime

THE PROJECT

The WB/ GEF project was designed to enhance and sustain improved end-use energy efficiencies to reduce carbon emissions. The key project objective was to facilitate development of the energy efficiency services industry in India by addressing market development barriers and helping develop entrepreneurial initiatives including the formation of Energy Services Companies (ESCOs).

OUTCOMES

The project assistance was provided to BEE for various activities like preparation of investor manual, energy efficiency information manual and development of codes and standards for performance evaluation of industrial equipment aimed at identifying the potential areas in energy intensive sectors that needed to be targeted for energy efficiency. The project also contributed in developing the strategic plan for implementation of Energy Conservation Act, 2001. The Act sets out a comprehensive strategy aiming at promoting ESCOs, energy efficiency financing platforms, setting up of partial risk guarantee funds and adoption of robust and credible monitoring and verification protocols.

The project strengthened IREDA for technology and financing promoting in the energy efficiency sector. The competition from the commercial banks had tested IREDA as an institution, and was useful in forcing IREDA to take several steps to improve the attractiveness of its loan offerings. Based on IREDA's experience in energy efficiency financing, several nationalized banks like State Bank of India, Canara Bank, Union Bank of

India, Bank of Baroda and the Bank of India had launched new lending schemes for energy efficiency.

There had been an increase in the number of ESCOs in the country from about 4 – 8 in 2002, the number of ESCOs has increased to 89, as accredited by BEE. There has been an increase in availability and utilization of energy efficiency products and equipment and of ESCO services. The industrial plants in sponge iron, cement, steel and sugar sectors were able to purchase and demonstrate new technologies with good energy efficiency norms.

17 sub-projects with over 90 MW in additional capacity/ avoided peak demand demonstrated technology options like waste heat recovery to the small and medium entrepreneurs (SMEs) and furthermore displayed the financial/ economic viability of such interventions. The enhanced knowledge and awareness on the technologies and its performance increased private investments in energy efficiency. The government introduced several measures to facilitate the entire process.

At the start of the project, the total GHG emission reduction from the energy efficiency portfolio was expected to be 0.67 million tonnes of CO_2 equivalent over a period of 10 years. However, at the project completion, the GHG reduction estimation was increased upwards to 9.4 million tonnes of CO_2 equivalent over a period of 20 years; 0.47 $mtCO_2e$ per year.

IMPACTS

The various technologies demonstrated by the project such as efficient thermal systems (like co-generation with gas turbine and methanation, fluidized bed boiler, steam drives, and economizers) and efficient electrical systems (like variable frequency drives, energy efficient pumps, fans, compressors and cooling towers) are widely deployed in Indian industries. The industry experts indicated in 2013 that over the years, there has been a significant reduction in investment costs of the energy efficient equipment given their increased demand and scale of manufacturing. Apart from that, many commercial banks have come up with attractive and flexible financial packages for such projects.

The Government's emphasis on energy efficiency has enhanced policy environment and institutional support after the project completion.

LESSONS LEARNT

Financial intermediation projects which fund energy efficiency should allow for development of different business models. The GEF project experience shows that different energy efficiency business models should be tried out to allow maximum flexibility in achieving desired outcomes given the constant shifts in market conditions. End-user implemented approaches were more successful when compared to ESCO and DSM type approaches.

Smaller energy efficiency projects face different market barriers and may be best reached through alternative instruments. Unlike larger firms with access to technical and financial resources, smaller energy efficiency projects with SMEs face several additional market constraints and barriers and may be best reached through decentralized means such as working through local financial institutions.

Technical assistance to commercial financial institutions is an important element of building institutional capacity to mainstream knowledge regarding clean energy market development.

Coal Bed Methane Capture and Commercial Utilization

Fact File

Focal Area: Climate Change

GEF Grant: USD 9.2 million

Co-financing: USD 9.8 million from GoI and UNDP

Total Financing: USD 19 million

GEF Agency: UNDP

National Executing Agency: Ministry of Coal, Central Mines Planning and Design Institute Limited (CMPDI) and Bharat Coking Coal Limited (BCCL).

Project Period: 1999 - 2008

Project Location: Sudamdih and Moonidih coal mines, Jharkhand

CO_2 Emission reduction: 0.34 million tonnes over the lifetime

THE PROJECT

Methane and coal are formed together during coalification, a process in which plant biomass is converted by biological and geological forces into coal. Methane is adsorbed in coal seams and the surrounding strata and released during its mining, processing, transport, and storage. As methane is highly explosive, coal mines have faced many explosions. High capacity fans are used to dilute the gas during mining which contributes to global warming. Although the volume of methane's contribution to the global greenhouse gas (GHG) emissions is three times smaller than that of carbon dioxide however, methane's greenhouse potential is 21 times higher than that of carbon dioxide. It is estimated that coal mining accounts for about 10% of all human-induced methane emissions.

If captured, methane forms a remarkably clean fuel when burnt, the combustion process of methane produces no particulates and only about half of the carbon dioxide associated with coal combustion. Coal-bed methane (CBM) extraction involves drilling wells down to target coal beds. Methane recovery technologies include vertical wells drilled from the surface or boreholes drilled horizontally from inside of the mines. Depending on gas quality, methane recovered from underground mines may be sold to natural gas companies, used to generate electricity, used on-site as fuel for drying coal, used to run vehicles or sold to nearby industrial, domestic or commercial facilities. If suitably harnessed, CBM associated with coal reserves could be a significant potential source of energy.

India is the third largest coal producer in the world and has substantial coal reserves. Recoverable CBM reserves are estimated at 800 billion cubic metres with gas production potential of 105 million cubic metres a day over a period of 20 years which could translate into 10,000 MW of installed capacity.

The objective of UNDP/ GEF project was to demonstrate that recovering methane during and after the extraction of coal is commercially feasible and once captured, it could be used as a clean fuel for generating electricity and transportation. The GEF project used recovery drainage technology from strata that released methane to optimize methods of locating and designing coal seam methane drainage potential. The project site, Sudamdih and Moonidih coal mines are part of the Jharia coalfield in Jharkhand.

OUTCOMES

The commercial viability of the extraction and utilization technology in Indian mining scenario was proven. The cost of power generation from the recovered gas was found comparable with that from fossil fuel. The methane gas recovered at two pilot sites was about 11.52 million m^3 or 7,626 tonnes of gas per year resulting in 180,000 tonnes of annual CO_2 emission reduction. The annual CO_2 reduction would significantly increase with the replication of the technology.

The UNDP/GEF project formed the policy on CBM in India. At the time of project closure, the Ministry of Coal had allotted around 184 blocks for captive coal mining with profitable potential for recovery of CBM.

The project had enhanced the national capacity for CBM recovery and utilization by provision of latest international equipment and upgrading the skills of the personnel manning these equipments. The capacities of Coal India Limited and its subsidiaries including Central Mines Planning and Design Institute Limited (CMPDI), Bharat Coking Coal Limited (BCCL) and Central Institute of Mining and Fuel Research (CIMFR) in recovering CBM from the working mines were developed. Lab facilities at CIMFR, Dhanbad were upgraded. The skill sets of the scientific lab personnel were enhanced. The mobile laboratories were provided by the project, which were taken to different sites to analyze the presence and commercial viability of methane extraction from coal mines.

CBM was included as part of the curricula in the Indian School of Mines in Dhanbad to assist widespread replication in the country.

A Memorandum of Understanding was signed in November 2006 between Ministry of Coal, Government of India and United States Environmental Protection Agency (USEPA) for the establishment of Indian CMM (Coal Mine Methane) /CBM clearinghouse in India to be housed at CMPDI. The aim of setting this clearing house mechanism was to contribute to the commercial deployment of CMM/CBM in the country. The website of the clearinghouse is www.cmmclearinghouse.cmpdi.co.in, which is operational and active. This facility imparts training to students from reputed institutes such as IITs, ISM, BHU and others for skill building and imparting knowledge.

The recovery of CBM had positive impacts on health and safety of mine workers. At the time of project closure, energy generated from CBM technology was providing uninterrupted lighting to 400 workers in two mining colonies thus, improving lives and livelihood options for the population.

IMPACTS

The project was cited by the Eleventh Five Year Plan of the Government of India.

The actual cost escalated during the course of the project and there was no mechanism for allocating additional funds by the GEF-UNDP. The Oil and Natural Gas Corporation, a government undertaking, contributed about 2.7m USD to meet the additional costs to ensure that the project progresses smoothly.

According to CMPDI, the CBM production potential in country is approximately 3.4 trillion cubic meters (TCM). As of now, 33 CBM blocks have been allotted with a potential to produce about 1.78 TCM through four rounds of global bidding.

Coal India Limited (CIL) and its subsidiaries have large acreage of coal bearing areas and operate over 470 coal mines. The coal producing companies are putting efforts to increase its production from deeper coal deposits through underground mining in near future to meet increasing energy requirement. Under this scenario, degasification of target coal seams essential as per the technology demonstrated by UNDP/ GEF project.

The project has institutionalized capacity development opportunities on CBM. All these avenues are actively operational, providing requisite customized technical support for selecting appropriate technologies for specific area considering site geological condition.

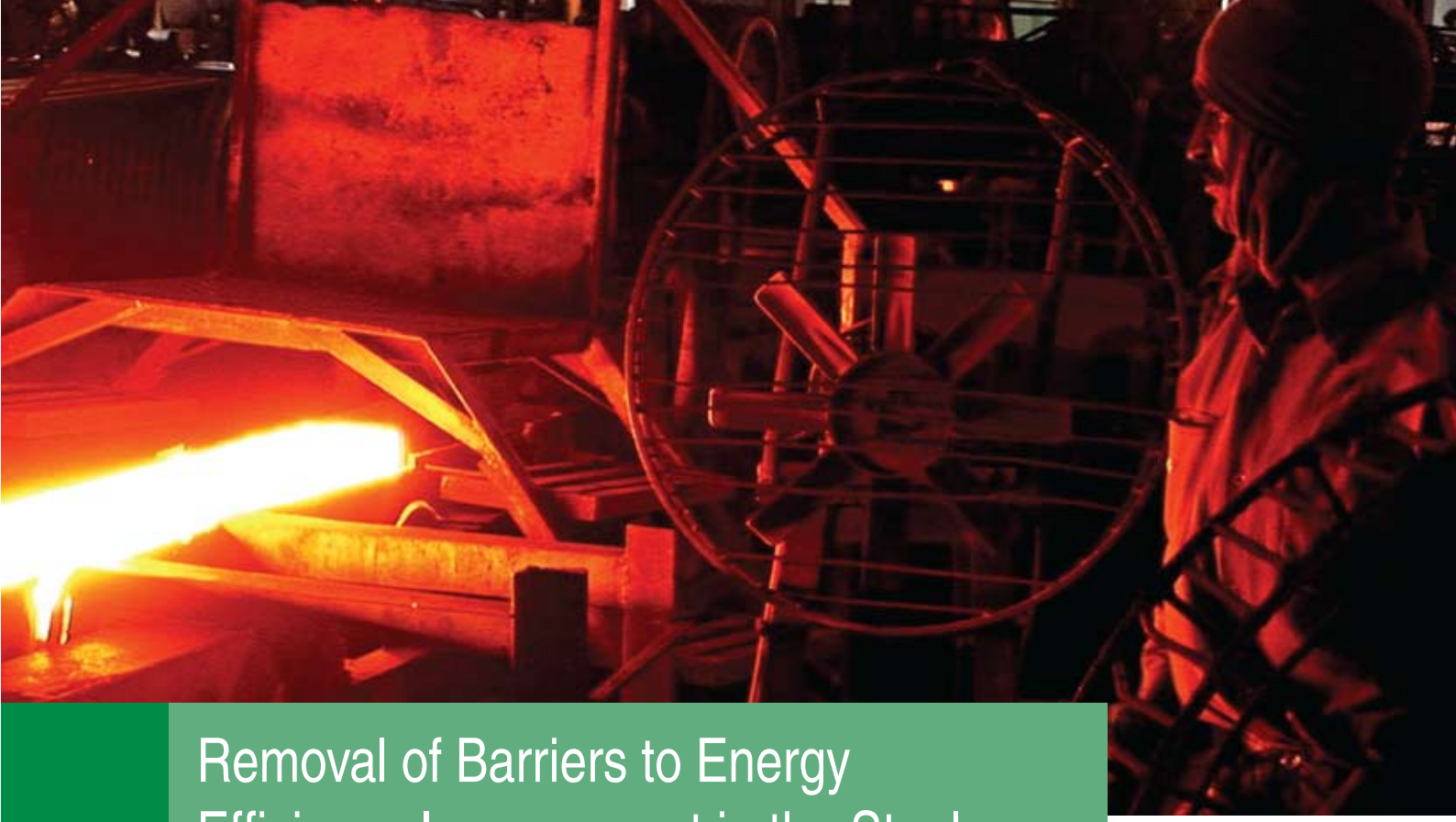
The Ministry of Coal (MoC) has designated CMPDI as the nodal agency for development of CMM in India. Successful implementation of UNDP/ GEF five suitable CMM blocks (3 in BCCL and 2 in CCL) have been identified within CIL mining leasehold areas. To expand the scope of development of CMM in CIL areas, initial studies for "Assessment of CMM Potentiality in CIL Command Area" has been undertaken as approved by CIL to delineate suitable block(s). MoC, through an Office Memorandum dated July 29, 2015 has granted permission for exploration and exploitation of CBM from areas under coal mining lease allotted to CIL.

LESSONS LEARNT

The procedures for procurement under GEF project need to be simplified and streamlined to avoid delays.

The full size project document should be a detailed plan of action with well-defined budget rather than a conceptual document.

Every project management unit should have at least one full time subject expert as part of the team to provide technical support to the project.



Removal of Barriers to Energy Efficiency Improvement in the Steel Re-Rolling Mill Sector

THE PROJECT

The Ministry of Steel (MoS) estimates that secondary steel production plants or steel re-rolling mills (SRRMs) account for more than 35% of all finished steel products in India. It is estimated that in 2013, there were about 1,890 SRRMs producing on a daily average 50 to 100 tonnes of finished steel products. The SRRM clusters are scattered across the country. When this GEF project was conceptualized, the SRRM largely used coal, gas, furnace oil and electricity to operate outdated and low investment technologies. Due to rise of energy prices in 2007 and SRRMs high cost of operation, the sector was at the risk of losing its competitive advantage in the global market.

The UNDP/ GEF support was provided to increase end-use energy efficiency of SRRM sector and reduce associated GHG emissions. It also enabled the penetration of environmentally sustainable energy efficient technologies by affirmative action to remove barriers resulting in market transformation of the sector. The project identified SRRM units in 6 geographical clusters which were serviced by a resident mission organization like National Institute of Secondary Steel Technology, Petroleum Conservation Research Association, National Institute of Secondary Steel Technology and MITCON consultancy services limited.

OUTCOMES

In 2006, the project, through Petroleum Conservation Research Association (PCRA), mapped the geography and the needs of SRRM clusters in India and divided them into six geographical clusters. Of these, 300 SRRM units across the country were further analyzed for finalizing the project strategy. It

Fact File

Focal Area: Climate Change

GEF Grant: USD 6.75 million

Co-financing: USD 4.872 million from Ministry of Steel and financial institutions

Total Financing: USD 11.622 million

GEF Agency: UNDP

National Executing Agency: Ministry of Steel, Government of India

Duration: 2004 – Dec 2012

CO_2 Emission reduction: 2.78 million tonnes over the lifetime

was confirmed that SRRM units were using obsolete and inefficient technology adversely impacting product quality and plant efficiency while adding to environmental stress. Most mills were run by foremen, who were poorly trained and lacked willingness to adopt new practices. It also became evident that though many SRRM units were aware of improved technologies, limited credible information channels and viable credit mechanism was restricting their access to new technologies.

Along with cluster mapping, the awareness and knowledge dissemination programs were also initiated which continued during the project period. The project also regularly participated in trade fairs and industry events. This helped in developing confidence and many SRRM units came forward to become 'model units' under the project - agreeing to adopt and showcase the energy efficiency technology (EET) packages in an actual working environment.

Also, for the first time, this GEF project provided technology solutions which were specifically developed for the needs of the SRRM sector. In association with Metallurgical and Engineering Consultants Limited, a total of 11 technology packages were developed for re-heating furnaces which were complemented by 19 technology options for the rolling process focusing on reducing electricity consumption. These were together marketed as EET package.

The 'model units' received technical support, training and financial incentives to implement their chosen EET package. A rigorous scientific method and process was used for selecting model units. 34 model units were commissioned by the project. In addition, 40 'pipeline units' were provided technical handholding by the project. The performance of model units is presented in the table below:

No.	Unit name	Location	Savings - SEC in MJ/t	Technology intervened
1	M/s Bengal Hammer Industries Ltd.	Howrah, West Bengal	715	Installation of Oil based new Reheating Furnace with high efficiency recuperator
2	M/s Ludhiana Steel Rolling Mills	Ludhina, Punjab	489	New RHF oil fired, with high efficiency recuperator, Modification in Mill.
3	M/s A.R.S. Metals (P) Ltd.	Chennai, TN	475	Installation of new Reheating Furnace oil based with high efficiency recuperator
4	M/s Bhambri Steels (P) Ltd,	Mandi Govindgarh, Punjab	409	Installation of Oil based new Reheating Furnace with high efficiency recuperator
5	M/s Suryadev Alloys & Power (P) Ltd.	Chennai, TN	619	New Reheating Furnace, oil fired, New Energy Efficiency Mill
6	M/s A.C.Strips (P) Ltd.	Raipur, Chharisgarh	1,164	New Re-heating Furnace, Installation of Coal Gasifier Plant, Revamping of Mill
7	M/s Arora Iron & Steel	Ludhina, Punjab	1,050	Modification in RHF Coal Producer Gas, Mill Modification
8	M/s Dhiman Industries (P) Ltd.	Mandi Govindgarh, Punjab	1,358	Modification in RHF, Coal Producer Gas, Mill Modification
9	M/s Orient Steel Re-Rolling Mill	Bhillai, Raipur	1,531	Lump coal fired to pulverized coal Efficient RHF, Modification in Mill
10	M/s Pulkit Steel Rolling Mills	Pondichery	313	Bio-mass Briquette Gasifier, Modification in RHF & Mill
11	M/s Adarsh Ispat Udyog (P) Ltd.	Bhillai, Raipur	1,305	Implementation of new EE Re-heating furnace with pulverized coal and Rolling Mill up-gradation
12	M/s Mahalaxmi Dhatu Udyog (P)Ltd.	Nagpur, Maharashtra	2,465	RHF Modification, Pulverized Coal Fired
13	M/s M.P.K. Steels (I) Pvt. Ltd.	Jaipur, Rajasthan	1,530	New RHF & Mill, Pulverized Coal Fired
14	M/s Shree Prithvi Steel Rolling	Jaipur, Rajasthan	212	New RHF with pulverized coal as fuel. Modification in mills
15	M/s Vivek Re-Rolling Mills	Mandi Govindgarh, Punjab	426	New Reheating Furnace with Pulverised Coal as fuel, high efficiency recuperator

16	M/s T.K. Steel Rolling Mills	Ludhiana, Punjab	619	RHF, mill modification, pulverized coal fired
17	M/s Mongia Hi-Tech (P) Ltd.	Giridih, West Bengal	815	Installation of New Energy Efficient RHF Producer Gas, Modification in Mill
18	M/s First Steel Co. (Pvt) Ltd.	Hubli, Karnataka	885	Implementation of new Energy Efficient Re-heating furnace & high efficiency recuperator , mill modification, Pulverized coal
19	M/s Sujana Metal Products Ltd.	Vishakapatnam, Andhra Pradesh	1,141	Modifications of RHF & Mill, oil fired
20	M/s Adavit Steel Rolling Mills Pvt.	Pondichery	279	Installation of Biomass Based Gasifier & Modification of RHF & mill
21	M/s Premier Bars (P) Ltd.	Jaipur, Rajasthan	393	Modification of RHF, Installation of Biomass Gasifier Plant, Revamping of mill
22	M/s Real Ispat & Power Ltd.,	Raipur, Chharisgarh	984	Direct rolling
23	M/s Indus Smelters Ltd.	Raipur, Chharisgarh	810	Direct rolling
24	M/s Premium Ferro Alloys Ltd.	Ernakulam, Kerala	1,220	Installation of a new energy efficient reheating furnace with pulverized coal firing./ Modification as above
25	M/s Ramsons TMT (P) Ltd.	Nagpur, Maharashtra	2,401	RHF Modification, Pulverized Coal Fired
26	M/s K.L.Rathi Steels Ltd.	Ghaziabad, UP	306	New Re-heating Furnace, N.G. Fired, high efficiency recuperator
27	M/s Someshwar Ispat Pvt. Ltd.,	Mehsana, Gujarat	385	Oxy-fuel combustion system & furnace modifications
28	M/s Sharu Steels (P) Ltd.,	Ludhiana, Punjab	1,349	Pulverized coal
29	M/s Ashok Industries	Mandi Govindgarh, Punjab	711	Installation of a new energy efficient reheating furnace with pulverized coal firing.
30	M/s Lakshmi Steel Rolling Mills	Mandi Govindgarh, Punjab	1,549	Implementation of New E.E. Re-heating furnace, pulverized Coal fired, mill modification
31	M/s Shri Bajrang Metallics	Raipur, Chharisgarh	1,752	Direct rolling
32	M/s Dhiman Iron & Steel	Mandi Govindgarh, Punjab	358	New RHF & Modification in mill
33	M/s Industrial Steel Rolling Mill & Co.	Raipur, Chharisgarh	572	Pulverized coal
34	M/s Bhupendra Steel (P) Limited	Faridabad, Haryana	732	Modification of existing reheating furnace along with adoption of ECO-Tech options in mill.
	Average		921	

Several structured training programs for shop-floor workers and mill management officials were organized to expose them to best practices in modern steel re-rolling operations. These included quality enhancement (such as 5S lean manufacturing system and ISO 9001 and 14001) and training (such as performance improvement training, design-specific modules) programs.

The project also developed innovative financing models:

- First model was a subsidy on interest, where SRRM units availing bank loans could receive subsidized interest rates through a dedicated ₹ 90 million fund set aside by the project. This model was not favored by the industry as they wanted financial support to be more concrete and immediate.
- Second model was a capital subsidy scheme where each model unit, upon achieving a minimum of 10% reduction in specific energy consumption and specific CO_2 emissions, was eligible for a direct 25% capital subsidy. Depending on the investment made, the capital subsidy available was between ₹ 3 million maximum (for low-end EET packages) and ₹ 7.5 million maximum (for high-end EET packages). This scheme elicited interest among SRRM units.
- Third was the Energy Services Company (ESCO) model which was welcomed by the industry associations.

Apart from subsidy schemes, the project also reimbursed consultancy fees (up to a maximum of ₹ 500,000) for the

preparation of bankable feasibility reports (BFRs). The BFR was an attempt to bridge the information gap in financial institutions.

IMPACTS

The project introduced Direct Rolling which eliminates the need for reheating furnace altogether. The additional investment required to convert to direct rolling facility is about ₹ 4 crore for a typical SRRM unit producing 100,000 tonnes of steel per year. The investment could be recovered in 6 months. As of now nearly 10% of the composite SRRMs have converted to direct rolling.

The project interventions resulted into significant savings of fossil fuel and the numbers are as follows:

Furnace Oil: Five model units implemented energy-efficient furnaces fueled by furnace oil. These units achieved a saving of 17%–25% in specific fuel consumption (SFC) (from baselines). Additionally, four model units switched from furnace oil-based furnaces to coal-based producer-gas-fired furnaces. The average SFC saving in these units was 50%. Three units converted their furnace-oil based re-heating furnaces to biomass-based producer-gas-fired furnaces. The average savings in SFC in these units was between 10% and 15%. One unit switched to direct rolling, achieving a 100% saving in SFC.

Coal: Thirteen model units adopted pulverized coal technology as fuel, and achieved savings in SFC between 30% and 50%. Two model units changed over from coal-based producer-gas-based furnaces to direct rolling, achieving 100% savings in SFC.

Natural Gas: Two units implemented energy-efficient furnaces with natural gas as fuel. Savings in SFC achieved by these units were in the range of 20%–30%.

The efforts of model units have been recognized. MPK Steels was felicitated with the Rajasthan Energy Conservation Award (RECA) and Prithvi Steel received the National Energy Conservation Award in 2010. These awards have created an aspirational need in the sector to achieve similar recognition.

After the GEF project, MoS, UNDP and AusAid have taken a follow-up project to scale up energy efficiency in 300 SRRMs with less than one-third the grant provided as financial incentive (by the GEF project) and technical assistance. There are 3500 Secondary steel processing units [including the subsectors of steel rerolling, induction furnace, Electric Arc Furnace and Sponge Iron] in India contributing to 50% of steel production [rest 50% production is from large scale sector]. Scope exists to reduce at least 15% of energy in these units through energy efficiency measures [as demonstrated by GEF pilots and other units]. Approximate investment required in energy efficiency is about half a billion USD [₹ 3500 Crore]. Monetary value of energy saved is half a billion USD [₹3500 Crore] every year. Approximate GHG reduction is 3.5 million tonnes of carbon dioxide.

LESSONS LEARNT

The scaling up of energy efficiency in SRRM sector may require some more push otherwise it might take a longer time. What is essential is to inform the SRRMs of energy efficiency choices and provide knowledge support to make appropriate choices, strengthened supply chain, advanced generation of choices and interventions.

Energy Conservation in Small Sector Tea Processing Units in South India

It is important to do the simple things right. Some of the things that we did right were honest and constant communication with all stakeholders. Identify and address need. You cannot go wrong.

– Svati Bhogle, TIDE

THE PROJECT

India is the second largest tea producing country in the world. Most of the tea is grown in the north eastern states of the country. Nilgiris and other hill ranges in south India account for 24% of the national produce, of which 45% is exported. Tea plantations cover about 89,000 ha of pristine land. There are 300 tea factories, of which 125 fall in the small sector category. The sector employs over a quarter million people.

When the British left India, they transferred their land holdings to the local people who worked in the estates. This is the reason for the high percentage of small tea factories and small tea gardens. Innovation in the tea industry was largely in the plantation sector with no innovation in the tea factories which are located in remote locations. While there was awareness and interest in the tea community about biodiversity and its conservation, there was no precedence in traversing the beautiful region to spread the message of energy conservation.

Fact File

Focal Area: Climate Change

GEF Grant: USD 0.950 million

Co-financing: USD 1.1 million from Tea Board/ Ministry of Commerce, tea factories, Union Bank of India, Central Bank of India and IREDA

Total Financing: USD 2.05 million

GEF Agency: UNDP

National Executing Agency: Tea Board/Ministry of Commerce

Local Executing Agency: Technology Informatics Design Endeavour (TIDE)

Duration: February 2008 – January 2012

Project Location: Nilgiris district, Tamil Nadu and Wayanad, Kerala

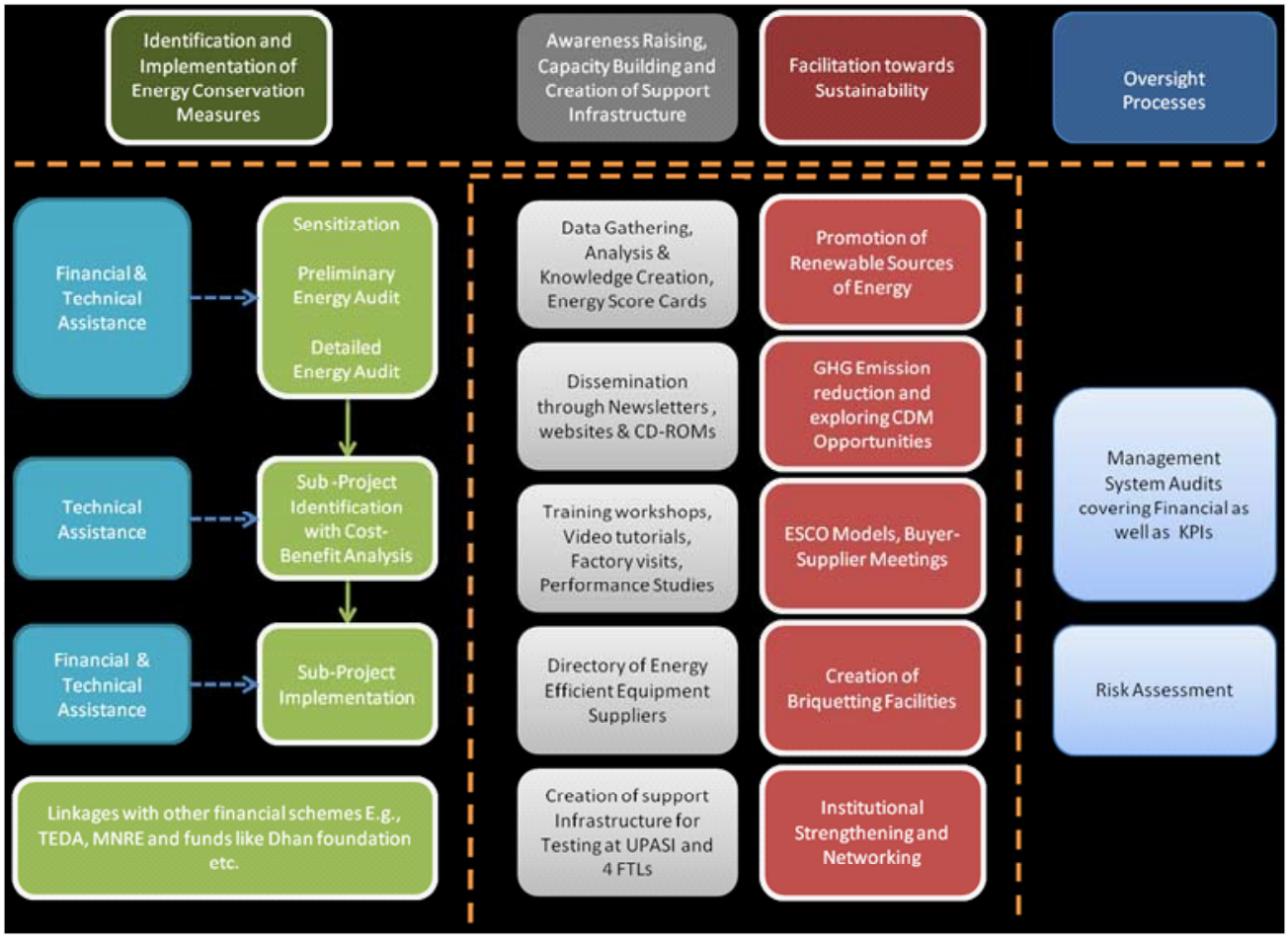
CO_2 Emission reduction: 3.16 million tonnes over the lifetime

Tea processing is an energy-intensive process, and energy costs constitute 30% of the total tea processing cost, second only to the labour costs. Inefficient use of electrical and thermal energy contributes to a high release of CO_2 into the atmosphere. Tea factories require both electrical and thermal energy. They rely heavily on biomass to meet their thermal energy requirements for drying tea. Electricity comes from the grid and large quantities of firewood are used to wither and dry the tea, contributing to deforestation and partially avoidable CO_2 emission. It was estimated that each small tea factory consumes 300,000 kwh of electricity and 900 to 1200 tonnes of firewood annually, releasing 1600 to 2100 tonnes of CO_2. About 112,000 tonnes of firewood is transported into the district from a distance of about 250 kms.

The UNDP/ GEF project aimed at reducing energy consumption from 30 tea processing units in south India cumulatively saving 55,800 tonnes of CO_2 directly.

OUTCOMES

The UNDP/ GEF project made energy efficient recommendations for each section or process in tea making to ensure that the impact on energy conservation and any change in tea quality could be easily detected. In the figure below, the boxes in white in the graphic are the different processes or sections in tea making. The first step is withering where the green leaves are subjected to aeration – air circulation (about 35 degree C) for a few hours to bring down the moisture in the leaf to 60-65%. The next few steps are pre fermentation stages which include rolling, rotovane and roll breaking and sifting. Rolling twists the withered leaf, breaks it up to release the juices (substrates and enzymes). The roto vane stage mixes the leaves thoroughly with the released juices to ensure proper coating of the leaf with the juices for the subsequent fermentation stage. Roll breaking and sifting stage is primarily to break the lumps formed in earlier steps for uniform fermentation. In the fermentation stage, the sifted leaves are spread thinly on trays or in drums to continue the oxidative process. The fermented tea is dried in a blast of hot air, cooled and then graded, sorted and packed. The graphic captures the energy efficient recommendations made in each section for orthodox tea making. The boxes in beige are electrical energy conservation recommendations and the box in red captures the thermal energy conservation recommendations. It can be seen that downsizing motors, use of star delta starters and moving to flat instead of V belts are recommendations made in most sections. Hot air for the withering and drying stages is generated in wood fired furnaces and most of the



thermal energy interventions (shown in red in the graphic) address the generation and circulation of hot air.

The following are the direct impacts of the project intervention:

- 15% reduction in energy consumption was demonstrated.
- Payback period of energy efficient investments ranged from 24 to 30 months.
- Energy efficiency measures were adopted in more than 200 tea processing units against the target of 30 units.
- Over 158,000 tCO_2 emission reduction achieved during the project period against a target of 58,000 tCO_2.

The original project strategy was of following the Energy Service Company (ESCO) approach. However, this approach was not favoured by the tea factories which were also very reluctant to share their data on production and energy costs. Realizing this constraint, the project augmented its own technical competency and started offering implementation assistance with the help of equipment suppliers to tea factories.

The project estimated 33% fuelwood savings with the adoption of rooftop solar air pre-heating systems. This experience was not successful. Low solar intensity and poor solar air heater design for industrial applications were cited as reasons for the poor performance of the solar air pre-heating systems. However, it would be premature to conclude that solar energy has no role in South India's tea industry as recent reports inform about experimentation with solar energy irrigation pumps, solar energy based LED lights, solar water heating etc.

The tea industry is facing a shortage of biomass fuel. As per estimates, growing energy plantations on 5% of the area in tea estates would meet the annual fuelwood demand for tea processing. The project facilitated plantation of Beema bamboo, which yields 40-60 tonnes/acre/year, in 4 tea estates. The biomass production cost is estimated at ₹ 650/ton, which is ¼ th of the current fuelwood cost.

Biomass briquettes made from agriculture residues (rice husk, palm, castor husk, coffee husk, saw dust, groundnut shell, etc.) helped in reducing deforestation while improving thermal energy efficiency in tea industry. Due to demand and supply gaps,the option of using biomass briquettes didn't pick up during the project period.

Tea estates, being located in the hilly regions, offer the potential for harnessing hydro power. A hydropower potential survey was conducted in the region and 12 estates were identified with a potential to generate 3,500 kw of electricity. Due to the number of clearances required to establish a small hydro power plant, not much progress was made during the project period.

IMPACTS

The perceived risk of non-performance of new technologies, such as hot water generators, energy efficient motors was overcome, ensuring wider replication.

The tea industry has become more receptive and open to adopting energy efficiency and renewable energy technologies.

Tea Board proposes to replicate the project learnings in the tea factories of north eastern India, which is a much larger tea growing region than south India. They also plan to undertake similar programs for improving the water and overall resource efficiency in the south Indian tea industry.

The project tried to develop a concept of “Zero Carbon Tea” that would provide global consumers with an environmentally benign tea drink as well as branding (factory, company or country level). It would require a second level of interventions in the form of:(a) renewable energy sources such as micro hydro, wind and solar tapped for electrical and thermal energy requirements of tea processing,and (b) new energy conservation interventions in tea processing and transportation.

LESSONS LEARNT

The technology and financial barriers were not well understood at the time of project conceptualization. Mid-way through the project, it was realized that lack of access to information and technology was the major barrier and no access to finance resulted in modification of the project strategy. This challenge was addressed following an adaptive management approach.

The project worked well with a wide variety of stakeholders and multi-disciplinary implementation teams. The project was able to mobilize a high quality technical team which was based at Coonoor for almost two years. During this time period, it was easily accessible and was highly mobile which ensured uninterrupted availability of the technical services to the tea industry.

The supply of customized HWG equipment, has led to the acceptance of the equipment suppliers from being mere “salesmen of equipment” to value-adding energy service providers amongst tea processing units.

Another probable error of judgment was that of the readiness of the sector to invest. The project recommendations made were relatively low cost (all electrical energy interventions required an investment of less than USD 25,000 or ₹ 10 lakh). Although some factories made higher investments in hot water generators and briquetting units, this was more because of the foresight of the factories. The project accepted the logic of the sector that these were skills already available with the industry and did not focus on the same. But it perhaps missed out on making the sector financially alert and ready to accept other innovations especially in thermal energy.

A large-scale dissemination of renewable energy technologies is still a challenge requiring simplification of approval procedures.

The project developed and implemented its exit strategy halfway through the project period by developing a series of knowledge products and process documentation which proved effective.

Achieving Reduction in GHG emissions through Advanced Energy Efficiency Technology in Electric Motors

THE PROJECT

The ability to effectively address acute electricity shortages in India will depend critically on the increased efficiency of electrical appliances. Supported by the Bureau of Energy Efficiency (BEE), this UNDP/ GEF project aimed at demonstrating greater energy efficiency in one key energy intensive sector viz., electrical motors.

A rotor forms an important part of the electric motor and is made of die-cast aluminum. A small percentage of these are of fabricated copper bar rotor construction, an expensive and time-consuming manufacturing approach. One of the technological advancements brought about by International Copper Association (ICA) was to die-cast copper rotors. This die-cast copper rotor technology had quite a few problems in handling copper initially but has been perfected now. However, the cost of technology is high and commercialization was an issue. In India, one of the manufacturers had developed the capability to supply copper die-cast rotors in small quantities but reliability and consistency was a major issue.

The UNDP/ GEF project aimed at introducing innovative technology for high-pressure copper die casting that was most suitable for the manufacture of rotors of high efficiency motors. The technology was expected to be transferred to manufacturers of rotors, motor pumps and motor systems to achieve an improvement in the efficiency of motors by 5%. Successful commercialization of the CMR (Copper Motor Rotor) technology was expected to be driven by manufacture of cost-effective copper die-cast rotors and motors utilizing such parts. The project also aimed to increase market share of high-efficiency copper rotor motors to 20% in the next 10 years. Non-

Fact File

Focal Area: Climate Change

GEF Grant: USD 0.275 million

Co-financing: USD 1.114 million from Non-Ferrous materials Technology Development Centre (NFTDC), International Copper Association (ICA) and Common Fund for Commodities

Total Financing: USD 1.389 million

GEF Agency: UNDP

National Executing Agency: Bureau of Energy Efficiency (BEE)

Local Executing Agency: International Copper Association (ICA and its Indian arm - ICPCI)

CEO Endorsement: March 2008

Duration: August 2008 – March 2012

Ferrous materials Technology Development Centre (NFTDC) was identified as the technology partner for establishing the Enabling Technology Centre (ETC) on its premises.

OUTCOMES

The CMR technology resulted in 3% increase in motor efficiency when compared to an aluminum die casting rotors which are common in market. Die-casting of rotors for external parties, including rotors for textile application motors, has led to an improvement in efficiency from 78% with aluminum to almost 80% with copper.

The Enabling Technology Centre (ETC) has been set up at NFTDC, Hyderabad with a 50 and 250 tonnes vertical die-casting machines to produce copper motor rotors of varying diameters and capacity of motors ranging from 0.5 to 37.5 horsepower. ETC acts as a demonstration-cum-pilot centre to enable motor manufacturers to understand the technology first-hand and seek technology transfers.

The substitution of aluminum with copper in the rotors calls for redesign of the motor in order to meet the performance requirements other than energy efficiency. Software for motor design (which uses copper rotor) was customized and was installed. Four design engineers were trained in motor design basics to extend support to the interested motor manufacturers.The Centre also started catering to the limited series production requirements and had supplied rotors to the interested parties.The ETC has the following facilities:

- Melt System - To melt copper, handle it in the non-oxidizing conditions and maintain high quality of copper melt.
- Automatic Melt Transfer System -To transfer the molten material to the die casting system in an efficient manner and in a short time to improve productivity and also deliver known quantity of molten copper. This facilitates scalability to 25 kgs (which can be increased to 250 kgs if needed) of transfer of material instead of transfer of 1 to 2 kgs of molten copper with ladles as is in current practice.
- Die casting system - To die cast rotors with modified low tonnage capacity vertical press with associated tooling and human-machine interface for automation.
- Die Technology- For improved die life.
- Rotor Testing facility.
- Vacuum Assist facility.
- Motor testing facility up to 7.5 HP.

The NFTDC has also applied for two patents for the innovative solutions like:

1. Special coatings for the dies in order to increase its life which otherwise is affected due to high temperatures.

2. Innovative gateless process which increases productivity and flexibility in the die casting process.

The technology transfer agreements of the CMR technology were signed with two motor manufacturers in Vadodara and Coimbatore, one primarily producing agricultural pump sets and the other producing general purpose. Reva automobiles and other automobile companies had also approached NFTDC to develop energy efficient motors.

IMPACTS

Low cost indigenous vertical die casting machine to produce copper rotor motor developed. The project played a catalytic role in stimulating the interest in CMR technology.

Achieving consistency in quality and appropriate capacity building on technology transfer is important for uptake by manufacturer. The project developed copper rotor motors for a range of capacities from 5 to 50 kW for different type of motors. Perhaps efforts could have been focused to one or two types and achieved consistent results.
The efforts of technology transfer were not successful as this activity was taken towards the project end.

LESSONS LEARNT

Technology requires to be further perfected to ensure consistency in results.

As the price advantage of using CMR technology is significant on long term operation of the motor, the significant amount as IPR charged by NFTDC is proving to be a deterrent.

The commercialization of technology should be a well-strategized activity requiring time and dedicated human resources. Most importantly, it also requires a detailed understanding of the clientele which was limited. Appropriate awareness creation and capacity building activities should have been organized with SME sector for technology uptake.

Due to the complexities involved in handling copper and the initial capital cost (though reduced), the small motor manufacturers will not be able to adopt the technology on individual basis. However, as these set of manufacturers exist in clusters, it would be useful to address these clusters to set up a common facility for its members. These cluster associations, due to its status of association of small and medium scale manufacturers (SME), also have access to the finance institutions and government grants to set up the facility.

Being a technology project, the industry expects a technology that can satisfy its needs. Moreover, they have to change over from the established system. Hence it had been a challenge to make the system foolproof with acceptable quality and productivity before undertaking market promotion.

Low Carbon Campaign for Commonwealth Games 2010

Fact File

Focal Area: Climate Change

GEF Grant: USD 0.95 million

Co-financing: USD 3.49 million from MoEF&CC, MNRE, BEE

Total Financing: USD 4.44 million

GEF Agency: UNDP

National Executing Agency: Organizing Committee of Commonwealth Games, Delhi 2010

Project Period: 2010

Project Location: National

CO_2 Emission reduction: 1.46 million tonnes over the lifetime

THE PROJECT

The XIX Commonwealth Games (CWG), held in New Delhi from 3 to 14 October 2010, was the largest international multi-sport event to be staged in India to date. As the host of the 2010 CWG, the Government of National Capital Territory of Delhi committed itself to hosting "Green Games" by inducing behavioral change towards low carbon practices. Against this backdrop, a UNDP/ GEF project was conceived at the end of 2009 to use CWG as an opportunity to raise awareness on low carbon practices among athletes, visitors, media and other participants. It also sought to highlight the role of GEF in addressing global environmental challenges in India.

The overall project objective was to develop and promote a low carbon campaign for 2010 CWG as a means of inducing behavioral change amongst Indian citizens, athletes and visitors for the adoption of environmentally sustainable practices.

OUTCOMES

About 30 AV profiles and 10 Shera mascotpop ups on low carbon practices were developed. These were jointly disseminated by MoEF&CC, MNRE and BEE on various TV channels, websites, flights and CWG game venues. The India team at CWG 2010 was shown in real life situations promoting green behavior. The sporting icons who took part in these promos were Saina Nehwal, Vijender Singh, Harinder Pal Sandhu, Tejaswani Sawant, Abhinav Bindra, Samresh Jung, Gayatri Govindraj, Jwala Gutta, Sushil Kumar, Ravinder Singh, Rajender Bishnoi, P Kashyap, Indian cycling team, Indian gymnastics team, Indian rugby team, Indian Netball team and Indian boxing squad. 'Go Green – It Works', was the campaign that inspired the common man to adopt green behavior in his/her everyday life and lifestyle. These promos were also uploaded on youtube.

Five low carbon fairs (comprising documentary screenings, workshops, exposure trips and competitions) were organized by Centre for Media Studies (CMS) to create awareness on low carbon practices, especially among school and college students in Shimla, Hyderabad, Shillong, Port Blair and Trivandrum in the period 30 June to 7 October 2010.

Two green concerts were organized: first in Kolkata on July 31, 2010 and the second in Pune on September 4, 2010. The highlight of the Pune concert was a performance by Euphoria, one of the top rock bands of India. Through their music they encouraged the public to adopt a greener lifestyle to reduce the carbon footprint. The concert ended with a song specially composed for protecting the environment.

Sapling planting along Queen's Baton Relay (QBR) route by State Forest Departments (SFD) and by SGP was undertaken. Around 150,000-160,000 saplings were planted to partly offset GHG emissions associated with the CWG.

A toolkit entitled 'Low Carbon Lifestyles' was published and used as a training tool. About 90,000 toolkits were printed and disseminated. Awareness campaigns on 'Low Carbon Lifestyles' were conducted in about 50 to 60 locations on Queen's Baton Route.

20 low carbon promotion kiosks, looking like an ATM machine were developed, of which 6 were installed at games venues and were later transferred to museums and educational institutes. At the kiosks, one can check one´s carbon footprint in terms of energy, water and transport use and waste production. The software and calculations were based on Indian lifestyle-based standards.

Independent assessments of the low carbon practices was undertaken. The project also developed 'Guideline and best practices manual' for greening future sporting events in the country.

The project also developed and disseminated training kits for 'Training of Trainers' (ToTs). 300 trainers and 29,700 volunteers from Delhi and NCR were trained on low carbon practices.

IMPACTS

The AVs developed during the project were used to promote MNRE's International Conference on Renewable Energy in Nov 2010 and these promos are also being used by the concerned Ministries for awareness generation.

19 of the 20 carbon calculators were donated by CWG Organizing Committee to national institutions such as science centres, natural history museums and the national children's centre.

The 'low carbon lifestyle' toolkit published (in Hindi and English languages) was linked to 2,000 institutions, schools and colleges across 90 Indian cities. About 10 private sector companies adopted this toolkit to bring out energy efficiency messages suited to their industry's needs, for e.g. Indian Institute of Foundrymen developed a booklet on energy efficiency in the Foundry Industry. Titan industries and Steel Authority of India Limited printed 1,000 copies each for distribution among their staff. The Ministry of Railway got the toolkit translated into Malayalam and Tamil languages and printed 1000 copies of each.

A practical approach to measure the savings of CO_2 emission reduction was then adopted on a wider scale in 2011-15 and linked to a specially made user-friendly website supported by INTEL: www.coolcalculator.org. After the project period, 5,000 teachers and 20,000 students in Delhi and about 50,000 students in the entire country were trained to adopt the low carbon practices. The toolkit was also shared with GEF Council members. A new version of the toolkit is under preparation.

Institutional capacity and knowledge built through the project is not lost through the departure of key personnel as there is a proper documentation of the training provided.

LESSONS LEARNT

If the project had started during the planning phase of the CWG, perhaps some of the low carbon practices could have been incorporated into the design and construction of games facilities and structures as well. Advising the policy level changes might also have been possible.

Campaigning for and demonstrating 'green' technologies, practices and lifestyles in front of a national and global audience is an effective communication strategy.

Given the time constraint in project design and implementation, limited attention was given to monitoring and measuring the impact of GEF intervention. The impacts of the project´s intervention have not been quantified, except for the emission reduction associated with tree planting.

CONCLDING REMARKS

The completed GEF energy efficiency projects in India have succeeded in addressing policy, technology, financial, market, capacity and other barriers while ensuring the market transformation of the related sector.

The Energy Efficiency was amongst the first few GEF projects in India which aimed at creating awareness and developing an enabling environment for promoting end-use energy efficiency in various industrial sectors. The project was successful in building capacity of IREDA to provide commercial finance on energy efficiency while encouraging many nationalized banks to introduce lending schemes for the sector. The project provided strategic support to develop the implementation plan of Energy Conservation Act 2001. Several new energy efficient technologies and their financial feasibility was demonstrated, creating confidence of industrial sectors and financial institutions in the concept of energy efficiency. This WB/ GEF project in a way worked with GoI in creating the foundation for energy efficiency in the country.

The projects on coal bed methane recovery & utilization, energy efficiency in steel re-rolling mill and tea processing sector opened up these sectors to the potential of energy efficiency by earning the confidence of the industry, piloting a new emerging technology customized to the needs of the sector while developing the technical and institutional capacities resulting in market transformation. The coal bed methane project unleashed the potential of harnessing 3.4 trillion cubic meter of coal bed methane of which 1.78 TCM is currently being harnessed. In SRRM sector, the UNDP/ GEF project 34 pilots opened the gates for energy efficiency interventions in the sector resulting in massive saving on use of fossil fuel as well as CO_2 emission reduction. Another GEF project in south India started with a humble objective of showcasing the potential and value of energy efficiency measures in 30 tea factories. It took time to create awareness and gain confidence of the Tea Board of India and tea manufacturing units in Coonoor but adaptive management and honest efforts of the project team made a significant difference. Over 200 small tea processing units have implemented a range of energy efficiency measures in both thermal and electrical energy, triggering close to USD 2.5 million of private sector investment. Tea Board plans to scale up this initiative in the north east tea producing areas of the country.

The UNDP/ GEF project on copper rotor motor though was able to develop the technology but fell short in its wider dissemination for commercial use. The GEF-supported low carbon lifestyle campaign during Delhi's Commonwealth Games 2010was successful in creating awareness and knowledge products which were replicated, scaled up and are still in use like the toolkit on low carbon lifestyles.

These initial GEF interventions in the energy efficiency sector were successful in developing an enabling environment in the country. With the policy, financial, capacity, technological advancement - the set of second generation projects under implementation and programming are supporting the government's strategy on low carbon development path. The focus is on piloting innovations which could lead to market transformation. The GEF projects focused more on sectoral and technology-specific interventions earlier but with the growing influence of climate change on other sectors, the present GEF projects also seek to build synergies across focal areas.


Food Security
Water

Chapter 3

Biodiversity Conservation and Climate Resilience

INTRODUCTORY REMARKS

Biodiversity and the ecosystem services it underpins can be the basis for climate change adaptation and disaster risk reduction strategies as they deliver benefits that will increase the resilience of people to the impacts of climate change. This was one of the key messages delivered at the 12th meeting of the Conference of the Parties to the United Nations Convention to Combat Desertification at Ankara, Turkey. The focus of the message is that governments should consider ecosystem-based approaches to climate change adaptation and disaster risk reduction to provide safety nets to communities in times of climate shocks and natural disasters. These findings come in advance of the 21st session of the Conference of the Parties (COP 21, Paris) to the United Nations Framework Convention on Climate Change (UNFCCC).

Biodiversity, through the ecosystem services it supports, makes an important contribution to both climate-change mitigation and adaptation. Biodiversity is also affected by climate change, with negative consequences for human well-being. Consequently, conserving and sustainably managing biodiversity is critical to addressing climate change. This inter-relationship is now being widely recognized.

The Millennium Ecosystem Assessment highlighted the five main direct drivers of biodiversity loss: habitat change, overexploitation or unsustainable use, invasive alien species, climate change, and pollution. Although climate change is an emerging driver, less than 20% of threatened species are affected by climate change and only 10% by pollution. The GEF strategy prioritizes the three principal direct drivers — habitat loss, overexploitation, and invasive alien species — which remain the most critical for the achievement of the Aichi Targets. However, GEF supports ecosystem-based adaptation, which includes “the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change”. Thus, most of the GEF biodiversity projects following the ecosystem approach address the adverse impacts of climate change on the ecosystem as a whole. The project development template of GEF projects has a specific section on exploring linkages of all GEF focal areas with climate resilience. Furthermore, the GEF project design focuses on delivering integrated multi-focal area solutions.

This chapter brings together selected initiative from completed GEF projects under biodiversity focal areas where a successful effort has been made to sustainably conserve the protected areas and marine coastal ecosystems, promote pollination services and conserve and manage the wild varieties of some well-known tropical fruits. This wide range of conservation work helps the local population to address the various drivers of biodiversity loss effectively, which also in turn helps in ensuring adaptation to climate risks/ impacts.

Eco-Development

Fact File

Focal Area: Biodiversity

GEF Grant: USD 20 million

Co-financing: USD 18.63 million from MoEF&CC, State Governments, IDA and project beneficiaries

Total Financing: USD 38.63 million

GEF Agency: The World Bank (WB)

National Executing Agency: MoEF&CC

Project Period: 1996 - 2004

Project Location: Seven Protected Areas (PAs) includingBuxa (West Bengal), Gir (Gujarat), Nagarhole (Karnataka), Palamau (Bihar), Pench (Madhya Pradesh), Periyar (Kerala) and Ranthambhore (Rajasthan).

No. of hectares treated: 602,000 hectares

THE PROJECT

Conceptualized in the early 1990s, this WB/ GEF project was based on the successful experience of a pilot initiative on eco-development strategy in Kalakkad Mundanthurai Tiger Reserve (KMTR) and Great Himalayan National Park. This project aimed to implement the eco-development strategy of the Government of India by: (a) conserving biodiversity in seven critical PAs in India. One of these - Gir - has the world's only population of Asiatic lions and the other six sites support a vital population of tigers. The GEF support was focused on conserving ecosystems of these seven PAs in danger of fragmentation and degradation; and (b) develop innovative and practical means of linking conservation and sustainable resource management. By enabling forest departments to share biodiversity conservation responsibilities with local communities, the GEF intervention aimed at improving the PAs' chances of long-term survival. The project interventions comprised site-specific participatory micro-planning, development of incentives, empowerment of local communities and successful conflict resolution measures. The process-oriented project design required creation of new institutions at the village level and developing new skills among the forest department and villagers.

OUTCOMES

- Strengthened the protection and management of 6,020 sq. km of recognized global importance for biodiversity.
- Species populations of charismatic carnivores stabilized or increased.
- All sites showed a significant reduction in resource use (for fuel wood, grazing) that can be attributed to project interventions.
- The project successfully introduced participatory co-management

Poachers turned Protectors

Periyar was rich in elephants, fauna and dense flora. But the park managers faced difficulties as there was a 96 km long Kerala-Tamil Nadu interstate border and also an inaccessible terrain inside the sanctuary. Due to inaccessibility, many areas inside the sanctuary became the 'territory' for illegal activities like collecting bark of the cinnamon tree locally known as '*vayana*'. Groups of 7-8 people used to operate in the forest for about 10 days to debark, dry, bundle and transport it outside. These people also used to poach wild animals for food. The illegal activities from Kerala side were significantly controlled by Eco Development Committees EDCs acting as a social fence. The fresh charges and difficult operating conditions made them protectors. They not only stopped illegal extraction but also helped park authorities in catching other defaulters. After a surveillance period of 6 months, an eco-tourism-cum-park surveillance program was initiated and the poachers-turned-protectors were recruited as guides. The team has received a number of recognitions and awards like the "Green Guard Award" 2001-2002. The regeneration of '*vayana*' is on the increase.

approaches to park conservation and management. This helped in improving the relationship between forest departments and local people from a high-conflict situation to one of improved cooperation and collaboration.

- Income generation opportunities benefiting poor communities close to the PAs (e.g. the role of Eco Development Committees (EDCs) in pilgrim management at Periyar) increased. It sustained communities under severe drought conditions through wage labour (e.g., Ranthambore Park). Empowered local communities, particularly poor and women groups, by offering voice and choice through participation in planning, implementation and monitoring of eco-development activities. Benefits were provided to tribals and the landless in many of the fringe villages through community infrastructure, wage labour and targeted programmes (e.g. tribal trekkers in Kerala).
- Periyar is a self-sustaining model. The participatory institutions established during the WB/ GEF project period exist even today. The main limitation faced by park management was of generating adequate funds to hire and sustain the services of thematic experts. To mobilize these resources, it was decided to levy surcharge in addition to the entry fee on tourists visiting Periyar Tiger Reserve (PTR). As per the amendment to Wildlife (Protection) Act, 1972, the constitution of Tiger Conservation Foundation was made mandatory in all the Tiger Reserves. Hence, the Periyar Tiger Conservation Foundation (PTCF) was set up as a government-owned Public Trust with the flexibility of an NGO. The income generated within PTR was ploughed back for park conservation activities. The annual budget of PTCF provides 40% of the total income for Village Eco Development activities and in 2014-15, it contributed ₹ 1.98 crore for such works. To address the pressure imposed by stakeholders other than the fringe area community, the park management has formulated professional EDCs like PETS, Ex-Vayana, Tribal Trekkers, Tribal Heritage and Vidiyal EDCs. The community-based tourism programs in PTR cover more than 114 families and generate more than ₹ 3 crore of annual revenue.
- Individual sites have developed strategies to continue and expand eco-development activities through linkages to other state and national government programmes (e.g. Forest Development Agency in Nagarhole Park, Famine Relief programmes in Ranthambore) and/or establishment of new financing mechanisms (e.g. Periyar Foundation).
- Several PAs ran effective educational and media campaigns including: journalists' camps, campaigns through local cable networks, training for teachers, training manuals, education centres, nature camps, eco-development newsletters, eco-clubs and National Green Corps in schools, street plays, nature clubs and local language field guides, etc.

IMPACTS

Diverse activities in education and public information, resulting in greater public awareness and support for the parks.

At the national level, the eco-development strategy was incorporated in the approach to the 10th National Plan documents. Eco-development was institutionalized as a fund delivery and management model at the state and national levels. Many of the eco-development project activities were mainstreamed and are funded through the government budget.

Ecological sustainability was built into PA management

Release from Debt Trap

Pepper cultivation is one of the major sources of income for the tribal families living in PTR. However, at the time of project inception, the tribals involved with pepper cultivation were under heavy debt. The project addressed this problem as an entry point activity which developed rapport between park management and tribals. A centralised value addition unit for pepper and honey processing was started. The pepper and honey are sold through 'Eco shops' run by PTR. Organic certification was obtained for the pepper, resulting in increase of its selling price by 30%. Every year, a pepper nursery is raised to supply improved varieties of pepper vines free of cost to the tribal farmers. All these efforts are funded by PTCF with the objective of making the tribal EDCs active and self-reliant.

plans (e.g. zoning for visitors and wildlife management; habitat restoration and water management; clearance of invasive species; recommendations for an expanded buffer zone at Periyar and creation of the Meghamalai Sanctuary across the border in Tamil Nadu). The improved relationships with villagers and participatory monitoring how that threats from village use of PA resources have been substantially reduce data llPAs.

The success of the Periyar Foundation model pushed the amendment in the Wildlife Act in 2006, whereby it was made mandatory forevery Tiger Reserve in the country to establish a Foundation.

Periyar was also deemed as a Centre of Learning for participatory management.

Based on the experience of applying the Management Effectiveness Tracking Tool (METT) to the WB/ GEF project sites and the authorities' interest in assessing management performance of the country's Tiger Reserves, the Ministry subsequently developed and applied the MEE (a version of the METT designed specifically for Tiger Reserves) systematically throughout the system of Tiger Reserves, thus providing multiple PAME (Protected Area Management Effectiveness) scores over time. The Ministry also developed a MEE for application in all of its other Protected Areas outside theTiger Reserve network.

Pench and Periyar were visited by GEF evaluation team in 2013 to assess the impact of the project, post completion. They observed a steady increase in population numbers of specieswith a simultaneous slow and steady reduction in threats and pressures.

LESSONS LEARNT

- The project engineered participatory co-management approaches that address local livelihood issues can be a good alternative approach for conservation and for building lasting relationships between park authorities and local communities.
- Empowered communities, through local decision making and managing revolving funds, are financially sustainable in the long-term thereby ensuring long-term conservation benefits.
- The long-term sustainability and success of the eco-development programs and individual EDCs can be enhanced through linkages to political processes and government programs. For example, Panchayats can enhance the width and success of eco-development programs through the capacity of the Panchayati Raj Institutions (PRIs) to mobilize funds for village level development.
- There is a need to have a proactive two-way communications strategy in place from preparation on wards to ensure that: (i) good public information is disseminated about the goals and achievements of the project and (ii) constructive feedback influences project interventions.
- To sustain effective eco-development programs, Forest Departments need to retain the skills obtained from training with contractual staff such as Sociologists, Ecologists, Specialist NGOs and build additional capacity to develop an eco-development cadre as well as to strengthen links to capable local and national NGOs.

Conservation and Sustainable Use of the Gulf of Mannar Biosphere Reserve's Coastal Biodiversity

THE PROJECT

The Gulf of Mannar (GoM), located at the southeastern tip of Tamil Nadu state, is the first Marine Biosphere Reserve in south-east Asia. Referred to as the 'biologist's paradise', the GoM is endowed with rich biodiversity of global significance.

The overall objective of this UNDP/ GEF project was to integrate biodiversity conservation concerns and principles into the sustainable development initiatives in the globally significant Gulf of Mannar Biosphere Reserve (BR) region. One of the major challenges of the project was the joint conservation initiatives of different line departments, such as the fisheries, agriculture, rural development, pollution control board, environment and forests, etc. These departments that operate in the region had disparate and often contradictory management objectives. The expected outcomes of the project were: (a) establishment of Gulf of Mannar Biosphere Reserve Trust (GoMBRT) and corresponding appropriate long-term funding mechanism (LTFM); (b) management of the marine national park strengthened; (c) infrastructure of the park strengthened; (d) Gulf of Mannar Biosphere Reserve management plan operationalized; and, (e) alternative sustainable livelihoods introduced.

OUTCOMES

- During the project period, the GoM witnessed 5% increase in live coral cover from 37 to 43% between 2005 and 2009. In addition, the Gulf saw a 7.83% increase in total fish landings between 2008 and 2012.The successfully demonstrated conservation strategies

Fact File

Focal Area: Biodiversity

GEF Grant: USD 7.65 million

Co-financing: USD 16.95 million from Government of Tamil Nadu and UNDP

Total Financing: USD 24.6 million

GEF Agency: UNDP

National Executing Agency: Government of Tamil Nadu

Duration: Dec 2002 – Dec 2012

Project Location: Ramanathpuram and Thoothukudi Districts, Tamil Nadu

are being sustained and scaled up by the state government. However, more recently, the reefs have been affected by natural bleaching due to elevated sea surface temperature.

- Complete cessation of coral mining within the Biosphere Reserve.
- Seasonal ban on collection of seaweed.
- Ceiling on issuance of registrations for bottom trawlers since 2010.
- Establishment of Village Marine Conservation and Eco-development Committees (VMCEDCs) in all 248 villages within the coastal zone of the Reserve, through which awareness and educational activities have been organised for 77,000 fisherfolk.
- More than 2,341 Self-Help Groups (SHGs) have been formed, comprising 34,699 members, mostly women. These SHGs have also set up a revolving fund with a corpus of USD 1.843 million or ₹ 7.5 crore providing access to low-interest micro-credit. More than ₹ 20 crore have been leveraged from this corpus and it has earned a profit of more than ₹ 1.5 crore at the time of project closure. This initiative had eliminated the practice of bonded labour and money lenders from the project villages. The Trust employs 66 Field Project Workers (FPWs), mostly women, from the project villages who play a key role in ensuring proper channelling of funds, once released to a specific VMCEDCs and then to the respective SHG. At the same time, repayment of loans is carefully monitored and deposited in VMCEDCs respective bank accounts. The FPWs are largely instrumental in the successful repayment of loans by the SHGs.
- Helping local communities reduce their dependence on fishing. More than 2500 youth from the fishing communities had undergone short vocational training for employment outside of the fishing industry. Majority of them are well placed in different professions. The socio-economic status of women fisherfolk has improved with the introduction of alternative livelihood activities such as palm weaving, pickle making, tailoring, ornamental fish breeding, etc.
- Two glass bottom boats are operated by VMCEDCs at Pamban in Mandapam zone, a busy tourist area enroute the famous pilgrimage spot of Rameshwaram. This facility provides natural exposure to coral reefs and reef-associated flora and fauna to all who visit the area.
- A first of its kind marine museum-cum-interpretation centre was set up in the GoM region pertaining to coral reefs, marine life and messages on conservation.
- 35 anti-poaching watchers (APWs) from project villages have been engaged for better enforcement to curb poaching and trading of scheduled marine animals.
- As part of infrastructure improvement, the forest department was provided with five anti-poaching sheds, three speed boats for joint patrolling, two *vallams* (traditional country craft) and two boat jetties were constructed. These facilities are maintained by the state forest department.
- Joint patrolling is regularly carried out by the forest department, fisheries and coast guards resulting in drastic decline in illegal activities in the region. Increased intelligence networking among the line departments has also resulted in regular seizures of consignment like dried sea horses and sea cucumbers which are smuggled outside to countries with high demand.
- 24 research projects were completed on documentation of biodiversity, destructive fishing practices and resource availability in GoM region. More than 3600 marine flora and fauna species were recorded in GoMBR region with the support of Marine Research Institute. A pictorial field guide on GoM's marine ornamental fish comprising nearly 100 species was published. Awareness material for students and fishing community was developed. Community awareness programmes on conservation have shown tangible results. Coral mining, a rampant activity prior to the project intervention, has stopped completely in Tuticorin.

- An Integrated Management Plan for the Gulf of Mannar Biosphere Reserve has been prepared. The Plan outlines activities to improve management of the Biosphere Reserve.

IMPACTS

When this project was designed, coastal and marine biodiversity conservation was not a critical priority issue for national and sub-national developmental planning. It was a bold attempt to conceive a project with a vision and strategy that combined:(a) improved management effectiveness of the marine Protected Area; (b) working with local communities on sustainable livelihoods; and, (c) evolving a cross-sectoral approach to conservation. This was a shift from the existing strategy which focused inwards on Protected Areas a decade ago. This was a game changing initiative that had resonances across the country, particularly on coastal and marine biodiversity conservation.

Despite the limited and inflexible framework on coastal and marine conservation to integrate some of the radical aspirational changes suggested, the project negotiated this issue through innovative strategies and succeeded to a large extent on:(a) promotion of sustainable use of coastal and marine resources; (b) introducing supplementary livelihood options to reduce conflict over marine resources, and (c) generating evidence and awareness for science-based management through the project's research program. These are incremental values, in line with GEF's mandate, that influenced the overall thinking on coastal and marine governance, not only within the Forest Department but other economic production sectors (e.g. Fisheries) too.

Mainstreaming biodiversity conservation considerations in economic decision making requires significant effort. The cross-sectoral platform (GoMBRT) developed under the project is in fact a proactive step in this direction, pulling away from typical sectoral planning frameworks. In this perspective, the creation of GoMBRT itself was a milestone achievement though there is room for evolution in its structure and functions.

Influencing upstream policy processes is an uphill task in a country like India, especially in the coastal and marine areas where there are diverse baselines, multitude of stakeholders and differential aspirations that need to be tackled and negotiated. Notwithstanding, this project has definitely contributed to the larger policy processes in the country, including the Coastal Regulation Zone Notification that tries to balance conservation and development in the coastal region.

After the project completion in December 2012, the government of Tamil Nadu allocated USD 2 million to support the Trust in carrying out its mandate and activities to ensure continuity and sustainability of conservation coupled with community livelihood support in the GoM region.

LESSONS LEARNT

- Most coastal and marine biodiversity conservation project sare implemented in areas that face tremendous pressure, including infrastructure and industrial development, unplanned tourism, human habitats and large population that are directly dependent on the coastal resources, especially fishing.
- As an implementation strategy, it is advisable to promote additional livelihoods rather than focusing solely on alternative livelihoods that wean people away from direct dependence on the coastal resources. Large scale diversion of livelihood activities to non-fishing/non-coastal related livelihood patterns might create a vacuum to be filled by unsustainable practices, such as trawlers and other mechanized boats.
- There should be room for flexibility and adaptive management if the project implementation period stretches over 5 years to factor in changes along the years.
- Ensuring the establishment and effective functioning of the institutional cross-sectoral platform on conservation initiatives is a challenge. However, with concerted action and support from all quarters, the combined efforts have paid off and contributed to an improvement of the region's biodiversity.
- Many South and South-east Asian countries facing similar challenges and pressure could draw lessons from this project.

Conservation and Management of Pollinators for Sustainable Agriculture through an Ecosystem Approach

"If bees disappear from the surface of the earth, man would have no more than four years to live."

– Albert Einstein

THE PROJECT

Pollination is a keystone process in both human-managed and natural terrestrial ecosystems. It is critical for food production and human livelihoods, and directly links wild ecosystems with agricultural production systems. Without pollination, many interconnected species and processes functioning within an ecosystem would collapse. In agro-ecosystems, pollinators are essential for orchard, horticultural and forage production, as well as the production of seed for many root and fibre crops.

A seven countries global GEF project was developed with an aim to identify factors that could address the threats to pollinators and to expand global understanding, capacity and awareness of the conservation and sustainable use of pollinators for agriculture. The GEF support was provided to demonstrate how the ecosystem service of pollination can be conserved and sustainably used in agriculture through a set of targeted cropping systems to ensure food security, nutrition and livelihoods. The project outcomes were:

Fact File

Focal Area: Biodiversity

Global Project: Brazil, Ghana, India, Kenya, Nepal, Pakistan and South Africa

GEF Grant: USD 0.334 million (India component)

Co-financing: USD 5.5 million

Total Financing: USD 5.834 million

GEF Agency: FAO

National Executing Agency: G B Pant Institute of Himalayan Environment & Development (GBPIHED)

Duration: January 2009 – December 2014

Project Location: Apple [Himachal Pradesh], Mustard [Uttarakhand], Large Cardamom [Sikkim]

- Integrate knowledge base for management of wild pollination services, for use by farmers and policy makers.
- Enhanced conservation and sustainable use of pollinators.
- Increased capacity of farmers to conserve and use pollinators.
- Mainstreaming of pollinator conservation and its use.

Three sites were identified from across the Indian Himalayan Region for the conservation and sustainable use of pollinators - the Mamlay watershed, Sikkim for large cardamom; Kosi watershed, Uttarakhand for mustard and Kullu watershed, Himachal Pradesh for apples. In Sikkim, the partners were ICAR-NEH, Manipur University and Institute of Integrated Resource Management. The Uttarakhand partners were VPKAS-ICAR and the GB Pant University of Agriculture and Technology, Pantnagar. The Himachal Pradesh partners were Jammu University, Dr YS Parmar University of Horticulture and Forestry, Sanat Apiculture Centre and Himachal Pradesh University.

The basic understanding of the project itself was innovative, which considered improvement of crop yield through ecosystem services provided by biodiversity as a sustainable pathway. In this context, the project focused on generating evidences on the role of natural habitats in maintaining diversity and abundance of wild pollinators, which help in promoting yield and quality of the produce. Therefore, measuring pollination deficits across identified crops, using uniform protocol, in diverse habitat conditions was an innovative approach.

The pollination deficit data sets accompanied by the floral calendar prepared for pollinator foraging plants in agricultural landscapes, provided scope for developing effective pollination management plans in identified sites.

Among others, socio-economic valuation of the best practices was yet another innovation that provides evidences for better articulation. Most of the villages in the identified watersheds followed several agricultural practices which directly or indirectly help sustenance of pollinators. Therefore, their articulation with scientific evidences provides a definite scope of improving farmer's interest on pollinators and their management.

OUTCOMES

- The successful implementation of Pollination Deficit Protocols (PDP) in the three STEP sites for three consecutive years revealed the following broad trends:

i. In the case of large cardamom, the bumblebee (*Bombus* sp.) and honeybee (*Apiscerana*) were the most frequent visitors.The density of pollinators responded positively with flowering phenology of target crop. It was revealed that the increasing density of bumblebee (*Bombus* sp.) resulted in significantly ($p<0.03$) higher yield of the crop (on an average 21-41 gm/plant).

ii. In the case of apple, higher population density of *Apiscerana*, *Bombus* sp., and wild bees was revealed in orchards near the natural habitat. Higher fruit set and fruit yield was observed in orchards supplemented with bee colonies irrespective of relative location of the orchard with respect to natural habitat.

iii. For mustard, although there was a declining trend for pollinator density in the second year, yet no significant impact was revealed when compared with the yield.

FARMER PROFILES

- Khub Singh Negi: An 83-year-old fruit tree farmer from Karadsu village of Himachal Pradesh, Negi has developed several pollination good practices, which he has shared widely and recorded for effective monitoring. Working as a local expert for the GEF project, he has ideas about measures that could support pollination services in the Kullu valley, such as planting patches of *Plectranthus*, an indigenous plant species that is renowned to produce the best honey in India. He believes that formal training holds the key to learning appropriate techniques for planting, pruning and harvesting of apples and other fruit trees.

- Prem Ballabh Pandey: A progressive farmer from Dhari village of Uttarakhand, he has been working towards strengthening the traditional farming system and promoting new livelihood options (dairy farming and apiculture). Such inter-linkages between agriculture and livelihood options are missing in this region. He has harnessed the potential of apiculture and its associated benefits for strengthening pollination services in the region.

- Phurba Tshering Sherpa: Representing a close-knit farming community of about 66 households from Sikkim, he cultivates cardamom under intact forest. He feels that the cardamom yield was better in his grandparents' days. He believes that a mixture of landraces could help in building the resistance of plantations to pests and diseases. According to him, Government programs provide a variety of planting material, including varieties that grow best at differing elevations, and are mostly disease-free. Working as a local expert for the GEF project, he is one of the few farmers who recognizes the value of pollinators in the context of sustaining the yield of cardamom production.

iv. Sites with higher forest cover supported higher insect density, supporting the established hypothesis that insect populations are generally greater in number close to the natural habitat.

v. Farmers' field demonstrations of increased yield in pollinator friendly systems formed an integral part of motivation strategy in apple and large cardamom STEP.

- Socio-economic evaluation of pollination-friendly best practices enabled understanding of societal perception on values of pollination services and contribution of wild pollinators to these values in traditional farming systems in the region. Specifically, it helped in assessing the extent of people's recognition to: (a) proven advantage of traditional systems of agriculture for sustenance of pollinators and, (b) economic importance of pollinator-friendly activities.
- Eight lessons from this project were documented in popular style for wider dissemination. These lessons are:

(i) Stakeholders' knowledge base impacts the learning;

(ii) The commercial returns dominate farmer's practices;

(iii) Scientific evidences provide a base for articulating pollinators need in apple;

(iv) On-site trainings help in reduced and safe use of pesticides;

(v) Exposure and demonstrations promote farmers' interest on bee nesting sites;

(vi) Learning improves pollination management in orchards with less pollinizers;

(vii) Mosaic of natural habitats contribute to diversity and abundance of pollinators; and,

(viii) Diverse traditional cropping practices contribute to survival of the pollinators.

- Volunteers' involvement in multi-site information generation remained a strong component of the project. This activity was considerably strengthened through various co-financing mechanisms, including funding received from Earthwatch Institute to promote volunteer participation focusing on pollination services.
- The project succeeded in effectively using the existing skills and infrastructure of diverse organizations for building capacity and raising awareness on use of animal pollinators. For example, facilities of Apple Growers Association in Himachal Pradesh (Apple STEP), Rural Technology Complex and Nature Interpretation and Learning Centre of GBPIHED in Almora, Uttarakhand (Mustard STEP), and State Apiary Board, Jeolikote, Uttarakhand (Mustard STEP) were used as effective forums for outreach and awareness programs. The platform available through ongoing programs and projects was effectively used for promoting the level of public awareness and capacities.

IMPACTS

- scientific evidence generated by the project providesan adequate base for convincing farmers that they can get improved crop yield with better quality if they

maintain natural habitats around their crop fields. This understanding is a big transformation which would lead to conservation of biodiversity on one hand and improvement in agronomic yield on the other.

- Encouraged with the outcome of the GEF project, the Earthwatch Institute India has entered into collaboration with GBPIHED to further continue with project activities focusing on pollinators and pollination services.
- With the articulation of evidences from the project, at program level, the components of Pollinator Diversity and Pollination Services have been included in the Action Plan for implementation under Task Force on Forest Resources and Plant Diversity under National Mission on Sustaining Himalayan Ecosystem (NMSHE).

LESSONS LEARNT

- Awareness and capacity building material for diverse farming communities needs to be developed according to their knowledge base on the subject. Uniform approach and learning material does not yield desired results.
- Science-based cost benefit analysis on pollinations is required for changing the mind sets of farmers and policy planners.
- The traditional practice of hill farming, which involves mixed cropping, contributes significantly to the survival of pollinators.

Innovative farmer

In the Apple STEP site, most of the farmers hire bee colonies of *Apis mellifera* on a rental basis (@ 600-800/colony) for pollination of their apple crop. However, one innovative farmer - Mr. Deen Dyal from Karadsu - who began with nine colonies, is keeping the indigenous bee (*A. cerana*) in mud hives (25 colonies), modern hives (35 colonies) and wall hives (5 colonies). With this large number of bee colonies near his orchard, he avails a good crop of apple each year. His neighbor, Mr Jagat Ram, who is also an orchardist, reveals that he and other nearby orchardists do not need to hire bee colonies for pollination as the bee colonies being maintained by Deen Dyal are a gift for them. They are quite happy and thankful to this innovative farmer and are also willing to adopt this method of keeping bees. Deen Dyal says that bee colonies from a natural swarm perform much better than the divides he makes himself. He also believes that colonies develop faster in mud hives than modern hives. He has further modified the mud hives by providing a bottom board and keeping the colonies on a hive stand so that he could move the colonies even within the apiary. He also gets an additional income by selling honey @ ₹ 500/kg.

Conservation and Sustainable use of Cultivable Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem Services

Fact File

Focal Area: Biodiversity

Regions: India, Thailand, Malaysia and Indonesia

GEF Grant: USD 1.1 million

Co-financing: USD 6.714 million

Total Financing: USD 7.814 million

GEF Agency: UNEP

National Executing Agency: Indian Council of Agricultural Research (ICAR)

Local Executing Agency: Bioversity International

Duration: Jan 2009 – December 2013

Project Location: Amravati (Maharashtra), Chittor (Andhra Pradesh), Malihabad (Uttar Pradesh), Pusa(Bihar) and Sirsi (Karnataka)

THE PROJECT

Asia is rich in diversity of tropical fruit species which are valued for their wide range of nutritional, health and use values. This genetic diversity is increasingly threatened. Its *ex situ* conservation is difficult because tropical fruit generally possess recalcitrant seeds that cannot be stored in conventional gene banks. In situ/on farm conservation is considered as a viable low cost option, but communities' understanding on conservation strategy was limited. The GEF provided support to conserve tropical fruit tree genetic resources *in situ* through strengthened capacity building of farmers, user groups and institutions to conserve genetic diversity while securing livelihood benefits.

The project focused on two globally important species such as Citrus spp. and Mangifera spp and two regionally important species Garcinia spp and Nephelium spp., and their wild relatives. About 22 sites, 36 communities and over 15,000 households in India, Indonesia, Malaysia and Thailand directly benefitted from the GEF project.

Country	Sites	Communities	Total fruit HHs	Crop species
India	5	18	6,700	Citrus, Garcinia, Mangifera
Indonesia	6	6	3,405	Citrus, Mangifera
Malaysia	6	6	1,328	Garcinia, Mangifera, Nephelium
Thailand	5	6	3,931	Citrus, Garcinia, Mangifera, Nephelium
Total	22	36	15,364	4

OUTCOMES

- About 53 nurseries of indigenous varieties were set up, farmers in all 36 communities were exposed to the grafting techniques and over 77,000 saplings of 75 elite varieties of mango grafts were distributed to the farmers for on-farm conservation. These 75 elite varieties are documented in 27 fruit catalogues which also contain the contact details of the farmer conserving it.
- 50 elite farmers' varieties of mango from Chittoor and Malihabad were identified and were sent for PPV & FRA registration. This process will help farmers reap commercial benefits. The project facilitated in developing DUS guidelines with PPV & FRA for citrus.
- 33 traditional knowledge (TKs) were collected, of which eight were validated for transfer and knowledge sharing through ICAR network.
- The Appe midi mango has received the Geographical Indication (GI) tag for pickling mango varieties.This is a unique pickle mango type from the Western Ghats which is recognized for its aroma and taste apart from color, shape, size, pulp content, shelf life, consistency and season of harvest. There is no commercially released variety of appe. Every variety is a farmer-recognized variety maintained through vegetative propagation.
- Local communities were trained to process these indigenous varieties for value addition and commercial sale. Local preparations such as panna, aamchoor and pickle from mango; soap, candlesand moisturising cream from Garcinia butter; and powder, dip-tea and toffees from Garcinia rind were introduced,which became popular in local markets. In Amravati, which is home to citrus species, orange is a cash crop, hence the project focused on providing quality planting material from National Research Centre for Citrus, Nagpur. Itset up community nurseries, provided rootstock for Rangpur lime and developed capacity of locals in processing mandarin into burfi, squash, etc while developing marketing linkage with Godaveri Gruha Udyog and Samarth Mahila Sanstha.
- Dhan foundation, an NGO, was roped in for awareness creation and capacity building of local communities and institutions on biodiversity, livelihood and conservation options to facilitate market linkages. Support was provided to seven farmer associations and more than 180 self-help groups involved in growing or collecting fruits were established. A number of knowledge products were also developed.

- The project has promoted agro-tourism activities. Indian Institute of Horticulture Research (IIHR) by linking up with Eosta, EU's largest organic fruit importer, supplied about 300 kg of eight different varieties of mangoes to the Netherlands and Germany in 2013. This activity was adversely affected due to EU's ban on importing Indian mango in 2014 and 2015. These varieties are available for domestic market online. More than 61 diversity fairs were organized in India and abroad to promote the indigenous genetic varieties of tropical fruits.
- The strong ownership and coordinated functioning of ICAR and its regional specialized institutes, agricultural universities, KVKs helped the project to achieve better results despite the limited GEF grant allocated to this project.
- 55 custodian farmers were recognized, who are actively maintaining, adapting and promoting agricultural biodiversity and related knowledge over time and space at farm and community levels and are locally recognized for these efforts.

IMPACTS

The concept of custodian farmers and the community-based biodiversity management (CBM) approach piloted successfully by the project were adopted by ICAR and budgetary allocations have been made to support on-farm management of agricultural biodiversity activities including other fruit trees such as jackfruit, tamarind and others.

As a result of improved awareness, a living laboratory for 120 rare fruit trees, 25 roots and tubers and 65 medicinal

plants has opened in Bengaluru with support from the University of Horticultural Science, Karnataka and Bioversity International. It is the country's first genetic garden to safeguard rare species for food and medicine.

The linkages between agriculture and the forestry sector improved; which is important whenworking with wild relative varieties of crops. A forest gene bank has been set up at Sirsi site.

LESSONS LEARNT

The community-based biodiversity conservation approaches work effectively in not only protecting the genetic resources but also in ensuring better nutrition and livelihood benefits for the local communities. The value addition activities and market linkages further strengthen the community's initiative.

Mainstreaming Conservation and Sustainable use of Medicinal Plants Diversity in Three Indian States

THE PROJECT

The aim of this project was to promote sustainable use and conservation of medicinal plants by including management thereof in policy and practices at the national, state and local levels.The project was introduced in the three ecologically-fragile states of Uttarakhand, Chhattisgarh and Arunachal Pradesh. These states represent India's enormous medicinal and aromatic plant (MAP) diversity, including over 87 Globally Significant Medicinal Plants.

OUTCOMES

Through its innovative interventions, the project has had a significant impact on the medicinal plants sector in the three project states.

- A national level policy on the conservation and sustainable use of medicinal plants, along with policies for the states of Arunachal Pradesh, Chhattisgarh and Uttarakhand developed.
- Geographical Indications of some medicinal plants such as Uttarakhand Tejpat (*Cinnamomumtamala*) have been successfully registered, thus protecting therights of local communities.
- About 44 medicinal plants from India enlisted in the IUCN's Red List of Threatened Species.
- Established 20 Medicinal Plants Conservation and Development Areas (MPCDAs) covering an area of 24,047 ha in the three project states.

Fact File

Focal Area: Biodiversity

GEF grant: USD 4.9 million

Co-financing: USD 6.5 million (Government of India, National Medicinal Plant Board, State Governments of Arunachal Pradesh, Chhattisgarh and Uttarakhand)

Total financing: USD11.4 million

GEF agency: UNDP

National Executing Agency: Ministry of Environment, Forest and Climate Change

Duration: March 2008 – June 2015

Project location: Arunachal Pradesh, Chhattisgarh and Uttarakhand

No. of hectares treated: 24047 hectares

- Sustainable harvest protocols based on a mix of traditional practices and scientific techniques have been developed for 12 key species. Community members and forest officers have been trained in the useof these protocols.
- Capacities of over 200 BMC members were built through classroom trainings and learning visits. 16 People's Biodiversity Registers were prepared, 12 Bio-cultural community protocols were developed, which meets the mandate of the Nagoya Protocol.
- Convergence was created with other national and state level institutions, such as the National Biodiversity Authority, State Biodiversity Boards, Horticulture, Agriculture, Rural Development and Health/ AYUSH departments, to promote the cause of medicinal plants' conservation and cultivation.
- Directories of traditional healers were prepared in the three states. Healers were given recognition and platforms were provided for them to exchange knowledge with healers from other states/ countries. The recognition has increased their clientele and enhanced livelihood opportunities.
- Innovative communication tools such as radio programs, wall paintings, street plays, puppet shows, documentaries etc. have been developed and field tested for outreach.

Village Botanist Course

Vaid Sarojini Goyal, from Chhattisgarh, undertook the Village Botanist Course (VBC) in 2013-14 which inspired her to explore entrepreneurship in this sector. She has set up a Self-Help Group (SHG) called 'Sarojini Gramya Vikas Mahila Sansthan', focused on preparing, packing and marketing locally available medicinal plants in a sustainable manner.

IMPACTS

- The National Forest Working Plan Code revised to incorporate sections on medicinal plants.
- The communities were at a risk of losing their traditional knowledge about medicinal plants through non-usage and bio-piracy. The documentation of this knowledge through People's Biodiversity Registers and developed the Biocultural Community Protocols for the Danus and Takulis of Jhuni in Uttarakhand, the Baigas Traditional Healers community of Chhattisgarh and the Monpas of Arunachal Pradesh to help operationalise the Access and Benefit Sharing mechanism in the Biological Diversity Act, 2002.
- Capacity building programmes has ensured greater revenue due to the improved quality ofcollection, grading and marketing.
- The health security of 12,000 households in Chhattisgarh has been enhanced by distribution of medicinal plant saplings.
- There is a resurgence in the vocation of traditional medicine among the new generation.
- The subject of medicinal plants included in the course curriculum of Indira Gandhi National Forest Academy.
- 56 species have been prioritized for cultivation and afforestation through the project in the three project states and shared with stakeholders.
- The Governments of Arunachal Pradesh and Chhattisgarh have provided additional resources from their state budgets for upscaling project learnings.

LESSONS LEARNT

Conservation and management of medicinal plants is a cross-cutting subject and requires convergence of a range of ministries, states and institutions for achievement of outcomes.

CONCLUDING REMARKS

These projects clearly demonstrate that managing natural ecosystems as carbon sinks and resources for adaptation is necessary, efficient and a relatively cost-effective strategy.

Protected Areas are an essential part of the global response to climate change. They are helping address the causes of climate change by reducing greenhouse gas emissions. They are helping society cope with climate change impacts by maintaining essential services upon which people depend. This message is strongly conveyed by the Eco-development project which directly strengthens the park conservation and management effectiveness.This successful pilot was scaled up by the Government of India by mainstreaming the learnings both at the policy level as well as across the country's Protected Area network.

Coastal and marine areas store huge amounts of carbon. Coral reefs support the highest marine biodiversity in the world. Coral reefs do not sequester carbon. Unmanaged reef metabolism is a net CO_2 source, because of side effects from calcium carbonate precipitation. If calcification declines due to climate change, this could in theory reduce CO_2 emissions from corals, because dead corals do not emit CO_2. The role of coral reefs is more of reefs being likely beneficiaries of CO_2 management, and also protecting coastal communities and terrestrial ecosystems from incursions from the sea. In this context, a 6% increase in coral cover through Gulf of Mannar project is yet another example highlighting the causal linkages between biodiversity conservation and climate adaptation.

Wild relatives and traditional crop varieties contain genetic material that can be used to deal with climate variability as has been showcased by the GEF wild tropical fruit project. The positive impact of reconnecting people with traditional knowldege on their lives and livelihoods is highlighted by the medicinal plants project.

Stories of the impact of climate change on pollinators and pollination services are pouring in from both developing as well as the developed world. Flowering plants and pollinators co-evolved. Pollination is the key event for a plant and for the pollinators in the year. That's where pollinators get their food, and that's what determines whether the plant will set fruit. Some species of pollinators have co-evolved with one species of plant, and the two species time their cycles to coincide. Three-quarters of all food crops rely on pollination. Due to climate variability, there could be a breakdown of co-evolved interactions between species. These changes need to be understood by the local farmers to adapt. The GEF's pollinator project made a small though an important contribution in this area which is now being scaled up by various partners.

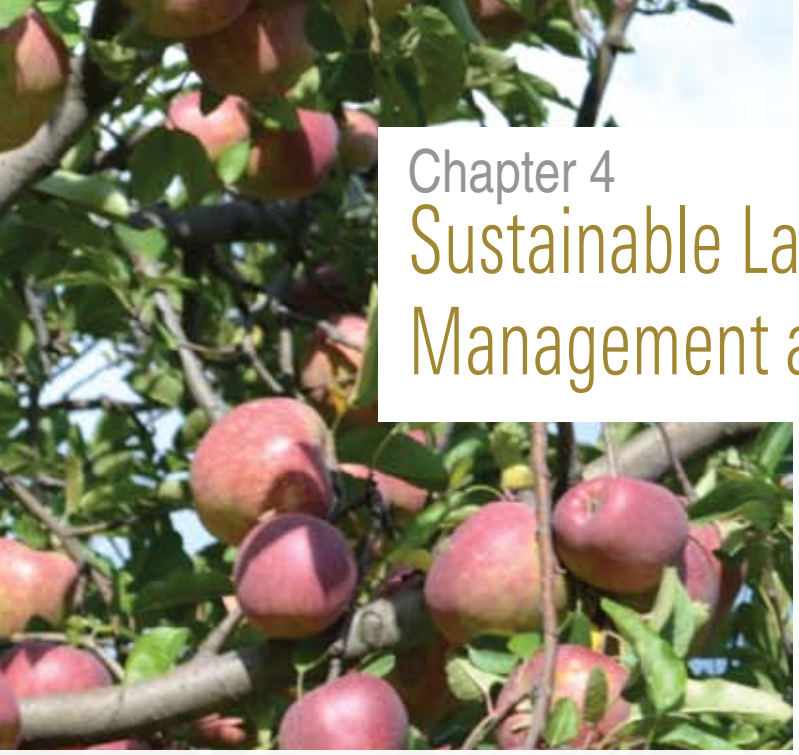
Biodiversity and its ecosystem services conservation is one of the cost effective ways of addressing the adverse impacts of climate change. This is one of the identified focus areas of GEF work in India.

INTRODUCTORY REMARKS

Land matters. The surface of the Earth is 70.9% water and 29.1% land. Healthy land is a finite resource and provides a host of services that are fundamental for sustaining life. Human ignorance of this simple fact, exacerbated by natural processes has led to the degradation of more than 40% of global land mass. This trend is increasing and it is significant to note that land degradation is not happening only in drylands (which are highly vulnerable to climate change and inappropriate soil management practices). Currently, the global estimated cost of land degradation is about USD 490 billion per year, much higher than the cost of action to prevent it. Land degradation directly impacts the health and livelihoods of an estimated 1.5 billion people.

Degraded land can be restored through timely action and the use of sustainable land management technologies and practices. Two recent global events have provided hope. The recent adoption of Land Degradation Neutrality (LDN) target as part of Sustainable Development Goal (SDG) 15 has put the land and soil related issues on the centre stage of the global development agenda. The recently concluded 12th session of the Conference of Parties to United Nations Convention to Combat Desertification (UNCCD) at Turkey in Oct 2015 underlined the importance of sustainable land conservation to help meet the targets for biodiversity conservation and climate change adaptation.

In 2003, the GEF was designated as a funding mechanism of UNCCD and since then the GEF's



Chapter 4

Sustainable Land & Ecosystem Management and Climate Adaptation

role and commitment to sustainable land management (SLM) around the world is well established through its land degradation focal area strategy. While following a landscape approach, this focal area drives an agenda for multiple global environmental benefits, including those related to the protection and sustainable use of biodiversity, climate change mitigation and adaptation, and the protection and sustainable use of international waters.

India with a total world's geographical area of 2.4% hosts over 17% of human and over 18% of livestock population of the world. The per capita land availability has declined from 0.89 ha in 1951 to 0.27 ha in 2011. In India, almost 47% of land is under cultivation, around 70% of the country is dry land. About 72% of India's population is rural and depends mainly on land and water resources and at present, 80% of all Indian farmers are under the poverty line. Millions of households are engaged in subsistence farming. At the same time, the natural resources and ecological foundations essential for sustained advances in the agricultural productivity are rapidly shrinking under anthropogenic and socio-economic pressures and climate change.

In 2007, the Ministry of Environment, Forest and Climate Change (MoEF&CC) developed a multi-sectoral and multi-institutional GEF programmatic approach on sustainable land and ecosystem management (SLEM).This approach provided an opportunity for a diverse group of stakeholders to share their skills and experiences to achieve land and ecosystem management objectives that were in line with both their economic interests and the agreed principles of sustainability reflected through integrating biodiversity conservation in agriculture and other natural resource based production systems, and through adapting farming systems to the consequences of climate change.The program also supported policy reforms for improving incentives for enhanced productivity and SLM. Reforms were also linked to, for example, price incentives for produce and agricultural inputs, micro-financing initiatives, land tenure with an emphasis on efficient use of common lands that are of particular economic importance for the poorest segment of the population, as well as important areas in securing biodiversity and ecosystem services such as water regulation and protection of pollinating insects.

The GEF India SLEM program had seven sub-projects focusing on introducing SLEM approach in watershed development programs in Uttarakhand, agricultural production systems through National Agriculture Innovation Program across the country, bamboo forest regeneration in Madhya Pradesh, shifting cultivation in Nagaland, and developing capacity of local farmers in Andhra Pradesh while mainstreaming SLEM best practices. The total cost of this program was USD 330 million viz GEF grant of USD 30 million including USD 15 million (land degradation), USD 10 million (biodiversity) and USD 5 million (climate change adaptation) while leveraging a co-funding of about USD 300 million. The sub-projects were implemented by Watershed Directorate of Uttarakhand, Indian Council of Agricultural Research, Department of Soil and Water of Nagaland, State Forest Department of Madhya Pradesh and an NGO partner BIRDS with the support of the World Bank, UNDP and FAO.

These projects are complete.The stories from these projects provide rich experience and knowledge on using land-based approach for biodiversity conservation, climate change, economic growth, secure livelihoods, improved nutrition and lives.

Sustainable Land, Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector

Fact File

Focal Area: Multi-focal

Program: SLEM CPP

GEF Grant: USD 7.49 million

Co-financing: USD 106.89 million from IDA

Total Financing: USD 114.38 million

GEF Agency: The World Bank

National Executing Agency: Watershed Management Directorate, Government of Uttarakhand

Duration: 2009 – 2013

No. of hectares treated: 60,823 hectares

THE PROJECT

About 87% of Uttarakhand state area is hilly. Severe soil erosion and land degradation has reduced the flow and capacity of the state's water sources. Land holdings are small and widely dispersed. About 70% of the population practiced low-yielding rain-fed subsistence agriculture.

Drawing on learnings from Uttarakhand Decentralized Watershed Management project, the GEF SLEM project in Uttarakhand aimed to restore and sustain ecosystem functions and biodiversity while simultaneously enhancing income and livelihood functions in selected watersheds, and generating lessons learned in these respects that can be up-scaled and mainstreamed at state and national levels.

The GEF SLEM project covered 20 micro watersheds with a total area of 60,0823 ha in a range from 700 m to 2000 m altitude. 39,056 ha was forest area and 18,057 ha was under agriculture. A total population of 74,256 living in 232 revenue villages, 126 Gram Panchayats (GP) experiencing intense erosion, low socio-economic status, and situated close to the agricultural frontier, formed the project area.

OUTCOMES & IMPACTS

The GEF project supported preparation and implementationof 20 Micro Watershed Development Plans (MWDPs) by GPs in a participatory manner, treating inter-GP area, most of which were reserve forests. Following a ridge-to-valley approach, the GEF project invested more on forestry (natural regeneration of oak forests), off-farm soil conservation (contour trenches and retaining wall), and water source rejuvenation

(rainfall runoff capture and infiltration/ village ponds, which recharges springs and irrigation water).This has resulted in improved sensitization of the community on the issues of sustainable resource management.

The GEF project also developed capacity of Van Panchayats (VPs, village forest councils) in maintaining the investments in reserve forests (RF), including plantations and drainage lines. Though RFs are under the State Forest Department (SFD), a 2009 Government Order (GO) allowed the VPs to work in RFs within the watershed, enabling holistic treatment of micro-watersheds.

830 ha was covered by afforestation. 115 ha of natural oak forest was regenerated. Under drainage line treatment and soil conservation activities, 50875.50 cubic meter (cum) crate wire check dams, 21,569.66 cum dry stone check dams, 91,711 construction of contour bunds and trenches, 22,613.05 cum river bank protection works, retaining wall 12,819.2 cum, road side erosion control work of 4,682.44 cum and 10,755.1 m diversion drain constructed. Under water recharge and harvesting activities, 318 village ponds, 125 roof water harvesting tanks were constructed and 423 water sources were treated. 1,087 water recharge pits and 18 irrigation tanks with delivery systems were constructed. Integrated watershed treatment approach helped in arresting 580 MT of soil loss and providing protection to 15.5 ha of farm land, which is currently cultivated.

The GEF SLEM project provided small grants to the local population especially vulnerable groups to promote entrepreneurial activities, including piloting alternative livelihoods to reduce dependency on natural resource base and financing income generation activities. Some of these activities are as follows:

- The project supported 192 SHGs, 665 briquette-making machines were acquired which produced about 420 MT of briquettes. 80% of the production was consumed at the households (approximately 336 MT), while the remaining 20% was sold for about Rs. 3 million (approximately USD 50,000). The briquettes reduced the fuelwood use by about 6% per producer household, which saved women approximately 11 days per annum in collecting fuelwood in the forests. The project trained women SHGs on pine needle collection, coupled with plantation management and fire control in RFs. Fire-affected areas have reduced by 61%. The dry pine needles that set forests a flame are now fuelling kitchen fires. It has also reduced the household dependence on fuelwood by 22.33% leading to an estimated reduction of 110 women days in fuelwood collection and about 627 kg of CO_2 has been prevented from each kitchen.

Rejuvenation of traditional natural water resources

Residents of Selalekh GP in Nainital district faced water scarcity due to reduced discharge in four traditional natural water sources in the area. Water was available only for seven months annually. Community-led catchment treatment of the area was undertaken by the Van Panchayat. Four village ponds, 1,166 staggered contour trenches, 8 vegetative check dams, 63 dry stone check dams, and 9 crate wire check dams were constructed. Local species, such as oak, bhimal, majnu, tejpat,and lemon grass were planted on 5 ha. These activities assisted in natural regeneration of oak forests which were invaded by pine species. Average water discharge increased from 7.5 to 12.6 lpm, women started getting water in the village throughout the year and improved soil moisture regime affected changes in cropping pattern towards high value seasonal/off-seasonal vegetables.

Business not as usual

Agribusiness activities promoted by the project resulted in 20 diverse crops grown on 7,464 ha with a cumulative annual output of more than 36,000 tonnes. The Farmer Interest Groups (FIG) formed and trained on agribusiness practices, are federating under the Uttarakhand Self Reliant Cooperative Act to establish forward linkages for marketing the farm surplus. 27 agribusiness federations with an annual turnover of about ₹ 430 million have been established by the project. The motivation of profit is sustaining improved farm practices and maintaining the supply chain.

- The GEF project supported 78 SHGs (418 members, 23% women) in renovating gharats (water mills). With rehabilitation and the increase in water availability, the milling capacity of these gharats increased by 32%, and the income of the SHG members increased by 28%. By using water power as an alternative source of energy, the potential savings on diesel was estimated as 78,247 litres per annum. One gharat reported generation of 2.5 KW of clean energy, which was locally distributed. The technical support was provided by Uttarakhand Renewable Energy Development Agency.
- The project installed 66 biogas plants for 990 households in the targeted GPs. The biogas reduced the fuelwood use by about 75% while generating savings of ₹ 5,900 per household (about USD 100). This translated into estimated savings of about 25 MT of biomass in the forest, which was estimated to reduce CO_2 emissions by 140 tonnes. Biogas production is sufficient to meet the household demands except in winter, when fuelwood is used (mid-Nov to mid-Feb).
- The project provided 3,378 solar lanterns, 190 solar street lights, and 69 solar cookers in the targeted GPs.
- The project piloted cultivation of 12 medicinal and aromatic plants including ginger, turmeric, stevia, aloe vera, lemon grass, aonla, cardamom, satavar, sarpgandha, rosemary, and tejpatta. 19 nurseries in 582 ha, including 1.25 ha of barren land were set up and 179 farmer interest groups formed. Market linkages were created for ginger and turmeric. The production of ginger and turmeric reached 1.3 MT and 5.3 MT respectively, which generated net household income of ₹ 15,346 (about USD 256) and ₹ 8,681 (about USD 145) respectively.

As a part of knowledge management, the GEF project produced 11 good practice notes on natural resource conservation and land degradation control, which were distributed at local, division, and state levels. The notes were on: (a) pine needle briquetting, (b) solar lights, (c) solar cookers, (d) biogas plants, (e) gharat renovation, (f) medicinal and aromatic plant cultivation, (g) rejuvenation of nala/khala, (h) roof water harvesting, (i) river bank protection, irrigation tanks and delivery system, (j) village ponds, percolation tank, and contour trenches with bunds, and (k) forest management (fire control, plantation, and assisted natural regeneration).

Involvement of women social mobilization workers, women aam sabhas and involvement of women in governance broadens the envelope.

Participatory monitoring and evaluation were carried out as a social audit process which proved to be an important feedback and learning mechanism for the community.

To ensure proper, effective and efficient management of the project funds,a villager in each GP was appointed as account assistant. This experience would benefit other government programs such as MGNREGA, IWMP etc. as well.

The study on impact of climate change on mountain ecosystems and strategy for managing impact of climate change in mountain ecosystems, which was one of the project outcomes, was not completed.

LESSONS LEARNT

- Fiscal decentralization and community empowerment are necessary but not sufficient to promote improved community management of natural resources.
- Watershed development should balance participation and science in its design and implementation.
- Watershed development projects are a relevant response to the needed increase in rainfed agricultural productivity in India.
- Revival of traditional energy sources can address climate change mitigation, boost resilience and contribute to livelihoods.
- Partnering with NGOs for social mobilization, project implementation and support for agribusiness is a good approach.
- For future sustenance and O&M of common assets, user groups were formed by the project. The members of user groups conducted regular meetings and collected funds on monthly basis or on crop basis depending on the rules followed by the respective user group. This is a useful practice.

Sustainable Rural Livelihood Security through Innovations in Land and Ecosystem Management

Fact File

Focal Area: Multi-focal

Program: SLEM CPP

GEF Grant: USD 7.34 million

Co-financing: USD 88 million by Indian Council of Agricultural Research (ICAR), World Bank and others

Total Financing: USD 95.34 million

GEF Agency: The World Bank

National Executing Agency: ICAR

Duration: September 2009 – June 2014

Project Location: Andhra Pradesh, West Bengal, Andaman Islands, Himachal Pradesh, Rajasthan, Haryana, Madhya Pradesh, Odisha and Maharashtra

No. of hectares treated: 8,371 hectares

THE PROJECT

The Indian agricultural scenario is under transformation. The country has achieved food self-sufficiency however, the natural resources and ecosystem services required for sustaining this self-sufficiency are rapidly shrinking and declining due to anthropogenic and socio-economic pressures and changing climate.

The GEF project is based on the premise that a multi-sectoral approach to land management is required. Linked to WB/ Indian Council of Agricultural Research (ICAR) "National Agricultural Innovation Project" (NAIP) the GEF project aimed at strengthening the institutional and community capacity on SLEM through approaches and techniques that combine innovative and indigenous techniques for restoring and sustaining the natural resource base, including its biodiversity, while taking into account climate variability and change. The project proposed to introduce SLEM practices over 5,000 ha of agricultural land. And over 3,000 farmers were expected to adopt coping mechanisms for climate variability.

The three sub-pilots developed as part of this GEF SLEM project were as follows:

1) 'Strategies for Sustainable Management of Degraded Coastal Land and Water for Enhancing Livelihood Security of Farming Communities' pilot was implemented in north & south 24 Parganas and Andaman Islands by Central Soil Salinity Research Institute and partners to address the problem of high salinity, water logging, drainage congestion, mono cropped area (rice), low productivity,

poor soil health and unscientific soil fertility management.

2) 'Harmonizing biodiversity conservation and agriculture intensification through integration of plant, animal and fish genetic resources for livelihood security in fragile ecosystems' pilot was implemented by the National Bureau of Plant Genetic Resources and partners to address the problem of mainstreaming biodiversity in production landscapes.

3) 'Strategies to enhance adaptive capacity to climate change in vulnerable regions' pilot was implemented in Mewat, Dhar, Ganjam and Raigarh by Indian Agriculture Research Institute and partners to address the problem of adapting to increasing climate variability.

The project followed a consortium approach to facilitate multi-stakeholder participation, which is critical but uncommon under the ICAR system. The project worked in the most vulnerable locations (salt-affected coastal zones, tribal-dominated mountainous region, and drought-prone dryland agriculture) with the marginal and poorer communities (tribal communities, dryland farmers and fishermen).

OUTCOMES AND IMPACTS

- The project has demonstrated that adoption of SLEM approach has the potential to deliver higher economic returns to the disadvantaged and poor communities as presented in the table below:

Land degradation pilot:

8,371 ha of agricultural land were brought under SLEM practices against a target of 5000 ha. 178 public and private organizations are using SLEM approach.

Three land shaping techniques are followed by farmers, depending upon the land size and their interest in the types of vegetation. The GEF project encouraged more than 1000 small and marginal farmers in degraded coastal regions of West Bengal and Andamans to use land shaping techniques, resulting in a 6 to 9 times increase in their average income. Mr Nimai Haider, a paddy-fish farmer had migrated to Kolkata due to low income from his 0.2 ha farm. As part of the GEF project, some portion of the low lying area on his field was raised with excavated soil, and is now free from water logging and salinity. By practicing integrated farming techniques, Mr Haider's net income has improved and he is earning almost daily by selling vegetables in the local market. Government line departments such as the Sundar bans Development Board, Department of Soil and Water Conservation, Department of Agriculture, Department of Fisheries, Department of Animal Husbandry, etc. of West Bengal and Andaman and Nicobar Islands on witnessing the success of the land shaping technological innovation, are integrating this technique with their different schemes for wider dissemination.

Biodiversity conservation pilot:

26 community seed banks were established at project sites with a capacity to store about 15-20 q seed. 3,000 households benefited from community seed banks against the target of 1700 and are using SLEM approach.

More than 1700 accessions of crop species, 4500 local animal breeds and 1862 fish accessions were inventorized and characterized in the project area. Three new fish species were collected. 15 farmer varieties of maize, rice, sorghum, pigeonpea etc. were submitted to PPV& FR Authority for registration to enable farmers reap commercial gains. Breed improvement interventions undertaken and improved genetic stock of 163 breeding bucks, 16 rams, 15 cattle bulls, 1219 native cocks and 6110 chicks

Name of the sub-project	Total budget allocated (In million ₹)	Net Financial benefit accrued (In million ₹)	Economic benefit accrued (In million ₹)	Financial Benefit cost Ratio	Economic Benefit cost Ratio
Strategies to enhance adaptive capacity to climate change in vulnerable regions	146.39	173.9	365.3	1.33	2.79
Strategies for sustainable management of degraded coastal land and water for enhancing livelihood security of the farming communities	175.28	280.0	368.7	2.83	3.72

were supplied to farm households. Promotion of native varieties like 'Sirohi', a goat variety, has not only made local communities climate resilient but has also improved nutrition levels of the households.

On farm conservation of *Rajmash*

The kidney bean (Phaseolous vlugaris) locally known as *Rajmash* in Salooni and Chamba-Doda region of Himachal Pradesh is known for its cooking quality, taste, and attractive red colour and nutritional contents. The GEF project formed Rajmash Growers Association and submitted an application to register at PPV & FRA and obtain Geographical Indications. The production and productivity of this speciality crop was low due to traditional farm practices such as sowing in the sole crops, inter-cropping with maize, use of mature and immature seeds for sowing etc. The GEF project demonstrated the pole varieties to the farmers of the region. The pilot trials revealed that to stop crop damage, grain *amaranth* which is not eaten by black bear and gives better economic returns could be used for intercropping with rajmash. Further more, staking avoided the losses occurring due to rooting of those pods and seeds touching the soil and also improved the quality of seed both in terms of size and colour. Farmers were also trained to clean their produce properly, grade for uniform size and pack in attractive packaging. It has resulted in 30 to 40% increase in price from farmer's field to market – thus helping farmers make a profit.

Climate Change Adaptation pilot

Climate adaptation actions were undertaken by more than 7,000 farmers (covering 2600 ha) and more than 16,000 fishermen (in 56 fisheries societies) by integrating SLEM practices in agriculture, animal husbandry and fisheries, promoting better livelihood interventions and overall growth of the local economy. For example, replacement of local wheat seed with early heat and drought tolerant and late heat tolerant varieties saw a 20% improvement in wheat yield in 450 ha.

Innovative services called mKrishi® Agriculture and mKrishi Fisheries® were developed in the public private partnership mode. The technology is being patented and is capable of providing immediate, short term and long term solutions to the beneficiaries in identified clusters at selected villages. mKrishi® Agriculture has been able to connect 3000 farmers from 62 villages covered by the project. In mKrishi® Fisheries with the use of mobile based advisory, the fishermen of coastal areas in Maharashtra could make a targeted fish catch. It was found that signal was good up to 25 kms off the coast. Services offered by mKrishi® Fisheries were: (a) wind speed and direction advisory, (b) wave height, (c) potential fishing zone advisories, (d) send alert: tsunami, storms, surges, floods and drought, (e) fish rates at major landing centres in Maharashtra, and (f) weather forecast. mKrishi® Fisheries service mobile handsets were distributed to 226 beneficiaries in 56 fishermen cooperative societies, where, for every beneficiary, 10 additional fishermen were sensitized. A co-benefit of promoting this technology is reduction in diesel use. The reduction in use of diesel quota to the fishermen societies has led

to reduction in subsidy amount of about ₹ 69.9 million/year to the Maharashtra government.

15 Rural Technology Centres (RTCs) established under the project have facilitated dissemination of information and knowledge through training and capacity building activities. RTCs contribute to sustaining the land shaping activities and other improved practices by providing a forum for discussion and knowledge sharing in West Bengal. In Saguna Baug, Maharashtra, the Farmers Field School has effectively disseminated and led to adoption of SRT technique, therein creating a strong linkage and strengthening of farmer cooperatives or groups of farmers.

Creation of a sustainability fund is an innovative approach to ensure maintenance and scaling up of SLEM practices after project closure. The guidelines for its operations and maintenance were developed by ICAR. Under land degradation pilot, sustainability fund of about ₹ 1 crore was generated to ensure continued technological upgrading and hand holding of the beneficiary farmers.

14 agricultural scientists were trained abroad. 160 trainings and awareness camps on various aspects of genetic resource use and management were organized benefiting more than 9,000 local farmers. 230 publications including books, research papers, popular articles, manuals, leaflets etc. were made.

LESSONS LEARNT

- Consortia mode of operation promoted pluralism, synergy and value addition. The scientists in ICAR/State Agricultural University system are now progressively working with non-traditional partners like NGOs, private sector and others.
- ICT is an effective information tool facilitating adaptive planning and management in context of increasing climate variability.
- The successful GEF pilots when mainstreamed with government programs enable transformation, e.g. the use of land shaping technology has been integrated with the Government of West Bengal programs. Similarly, the Raigarh district administration in Maharashtra is showing interest in use of mkrishi® Fisheries for disaster management. Also, strong linkage of the project with ICAR and its institution ensures continued transfer of technologies in the region and beyond. This convergence between GEF pilots and government programs is essential.
- High financial returns were observed due to project interventions which act as motivating factors for sustaining the interventions. The post-project period mission has observed that the recommended package of practices is being followed and assets created during the project are maintained. Seeing the financial benefits, the farmers who were not direct project beneficiaries are adopting the SLEM practices. About 400 ha was reclaimed by non-project beneficiaries using land shaping technology in 24 South Parganas.

Sustainable Land Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security

Fact File

Focal Area: Multi-focal

GEF Grant: USD 3.6 million

Co-financing: USD 25.42 million

Total Financing: USD 29.02 million

GEF Agency: UNDP

National Executing Agency: Soil and Water Conservation Department, Government of Nagaland

Project Period: 2009 - 2015

Project Location: Mokokchung, Wokha and Mon districts of Nagaland

No. of hectares treated: 36,137 hectares

THE PROJECT

Nagaland is located at the confluence of the Indo-China and Indo-Myanmar region, and is endowed with great species diversity and endemism in terms of flora and fauna. Shifting cultivation also known as *jhum*, is the main form of agriculture, suitable for the region's climate conditions and steep terrain.The primary use of the forest land is for *jhum* agriculture where 80% of the rural population depends directly on forest resources for their survival. 73% of the population is engaged in agriculture where more than 76% of the total cropped area is under *jhum* using mostly traditional technology.

In recent years, however, the duration of *jhum* cycles have shortened from 14 to 6 years, accelerating soil erosion, disruption of local hydrology, decline in productivity yields, local food security and farmer's income. The major challenge faced by Nagaland was how to adapt to changing land use and production system, to rising populations and changing lifestyles, while also maintaining its ecological sustainability.

The UNDP/ GEF project aimed to develop, demonstrate and upscale SLEM practices for the conservation of *jhum* lands in Nagaland through an ecosystem approach. Wokha, Mon and Mokokchung are among the districts that are primarily reliant on shifting cultivation so the project is of great importance and relevance for these three districts. The project focuses on introducing approaches which:(a) are responsive to community's perceptions of needs and priorities; (b) involve communities more in decision making and planning; (c) make communities more responsible for management of development interventions; and (d) are

consistent with traditional values of community participation and utilize the strengthens of village institutions and other community organizations, thus facilitating the process of mainstreaming land degradation concerns into national level policies and regulatory framework through the SLEM partnership. The project also aimed to address the regulatory and institutional constraints to mainstreaming of biodiversity conservation into livelihood activities that impact forested habitats harbouring globally significant biodiversity.

OUTCOMES AND IMPACTS

Integrated Farm Development (IFD) was successfully introduced in the project districts. This innovative agricultural technique was developed by the GEF SLEM project to address the issues of land degradation and livelihood. The IFD model is based on the concept of complementary integration of all the components of agriculture like crop, livestock, fishery, forestry, horticulture, soil and water conservation and land development works. Horticulture and agro-forestry plantations have been introduced in over 11,000 hectares of land. Over 800 *jhum* practicing households have benefitted from introduction of IFD practices. There has been an increase in average incomes of about 4,000 households by 15 to 20%. Horticulture, agro-forestry plantations and soil and water conservation measures have improved the vegetation cover in over 2000 hectares. The soil erosion rate has decreased from 50 mt/ha/year to 26mt/ha/year in the project sites. These interventions have also strengthened coordination and convergence mechanisms between line departments.

Marketing sheds are constructed on main roads enabling the farmers and women to sell their produce in a more organized manner. On an average, this has led to more than doubled earnings. The marketing sheds which have turned into mini local business centres have been especially useful for women, who sell produce from their kitchen garden and add to the family income. Most interesting, the sheds also turn into social hubs where farmers and women meet, exchange information and sell their produce. With the introduction of IFD, many women benefit directly or indirectly. A 10% increase in women's income as a result of sale of organic farm produce from *jhum* fields has been observed.

Cultivating the same *jhum* field for three consecutive years is a new positive trend. There is an indication that the fallow phase has witnessed an average increase of 8-9 years primarily in Wokha district and to some extent in Mon district. Interestingly, some areas have shown an encouraging trend of increase in fallow period of up to 15-20 years in Mokokchung district.

Participatory Land Use Planning (PLUP): In the past few years, the state has seen a change in land use patterns where terraced farming, orchards, cash crop cultivation such as rubber and cardamom, gardens, tree farming and bamboo groves are seen as fast emerging trends. These trends infuse different dynamics in the traditional-agro-economic systems in place and require a paradigm shift in the way land is being used and managed in Nagaland. To address this challenge, the UNDP/ GEF project introduced "Participatory Land Use Planning" (PLUP) aimed at encouraging better management of 'fallows' by community involvement and supported by the government. PLUP is also essential for the infrastructure development in terms of roads and development of communication and information technology. It has encouraged informed decision making by traditional institutions on land management systems. More than 40 Land Use Committees (LUCs) have been formed in project villages to ensure the implementation of the land use plans and to create an enabling environment for improved local ecosystems and livelihood. For these interventions to be sustained, they need to be mainstreamed into policy, legal and institutional framework applicable to *jhum* land in the state. The project commissioned a study on "Legal Response to Participatory Land Use Planning in Nagaland" and the state government considers PLUP as an important tool in mainstreaming sustainable *jhum* practices in Nagaland.

These initiatives have improved the vegetation cover of *jhum* lands by approximately 34,037 ha across 70 villages. The project has also resulted in converting more than 2100 ha of *jhum* cultivation areas permanently to forest areas, to be conserved by the community. Seed banks have been created in 6 villages for the conservation of local agro biodiversity. Socio-economic and ecological impact studies carried as part of the project have found that the

managed fallow areas had better diversity than the unmanaged fallow areas. The project has also resulted in a marked improvement on the biodiversity and fertility of both the fallow areas and also the *jhum* cultivation areas.

A market assessment study on *jhum* produce was carried out to develop strategies for increasing the income of *jhum* farmers from the sale of their produce. 30 self-help groups have been selected (10 from each district) to promote the agriculture revolving fund concept to enable them to access credit facilities at the micro level.

Through the project, several recommendations have been made to the *Jhum* Land policy of the state as well as necessary amendments suggested to the State Organic farming policy. The state policies on *jhum* were analysed as part of the project and amendments to the same have already been proposed to the state government and consultations are ongoing on how to implement the proposed changes in the state government's policies. The state will review *Jhum* Land policy in the near future. At present, the state water policy is being reviewed and state land use policy is being drafted as follow up to the project's legal response on institutionalizing PLUP in Nagaland.

The project has created a strengthened coordination and convergence mechanisms between line departments through better awareness of linkages between land degradation, forest resources and rural development. Request for technical interventions on SLEM initiatives have been received from 28 villages within the project districts and remaining 8 districts of Nagaland.

The most positive aspect of this project is the strong ownership of the state government. They have provided a cash co-funding of ₹ 2.34 crore for 2015 and a further ₹ 4.5 crore for 2016. The government proposes to include more *jhum* areas in future programs. The project has developed an interesting and highly replicable model of PLUP and it will be the fulcrum of the project activities in the second phase of the project. The project is slated to be implemented through financing provided by the Government of Nagaland along with technical support from UNDP for the next two years.

Gender empowerment

Women self-help groups (SHG) were selected to promote the Agriculture Revolving Fund (ARF) concept to enable them to access credit facilities at the micro level. Several income generating activities have improved the economic status of Naga women. Traditionally, Naga women have no land holding rights in the state, nor are they permitted to participate in Village Council meetings. The inclusion of women in LUCs has been a milestone achievement towards empowering them to contribute in larger decision making processes. Their social standing among their family as well as in the village community has significantly improved, as they are now recognized as contributing towards the family's income.

LESSONS LEARNT

- PLUP is enabling the local communities to plan and sustainably utilize their land resources.
- Improved low cost land use practices like contour bunding and terracing have contributed significantly towards reducing soil erosion.
- Introduction of crops like cardamom, tea, ginger, tapioca, orange and turmeric have improved income levels.
- Construction of marketing sheds in the project districts was another successful intervention. It became an important hub for the village women to not only to sell their produce but also to store the unsold stock.
- Coordination among different line agencies at the district level is a challenge which is being addressed.
- The role of women farmers, when equipped with skills, knowledge, credit access, and voice is crucial in ensuring food/ nutritional security and addressing climate change.

Integrated Land Use Management to Combat Land Degradation in Madhya Pradesh

Fact File

Focal Area: Multi-focal

Program: SLEM CPP

GEF Grant: USD 5.76 million

Co-financing: USD 17.28 million

Total Financing: USD 23.04 million

GEF Agency: UNDP

National Executing Agency: State Forest Department of Madhya Pradesh

Project Period: 2010 - 2015

Project Location: Nine forest divisions in districts of Betul (north, south and west), Chhindwara (east, south and west), Sidhi, Singrauli and Umaria in Madhya Pradesh.

No. of hectares treated: Over 300,000 hectares

THE PROJECT

Madhya Pradesh (MP) lies at the geographical centre of India. It is endowed with rich and diverse forest resources covering 24.4% of the state's land area. There are four main forest formations, namely: Teak forest, Sal forest, Bamboo forest and miscellaneous forest. The total forest area covered by bamboo in the country is about 9.6 million hectares (about 12.8%of the total forest area of the country). In MP, bamboo covers more than 1.8 million hectares. Due to population pressure, natural stands of bamboo were indiscriminately extracted endangering its germplasm. Unsustainable land management practices, especially deforestation and overgrazing, have been both cause and consequence of the livelihoods crisis among tribal and rural communities living in and around forest areas. These trends were expected to be compounded by the effects of climate change and variability.

The GEF SLEM project aimed at making a paradigm shift by piloting an integrated approach to address water, land and natural resource management to enhance the resource base and generate local as well as global benefits. The project was expected to mainstream SLEM approach into forest conservation and livelihood activities to enhance resilience of land and forest ecosystems and reduced vulnerability of local communities to climate variability. The project focuses on five districts – Betul, Chhindwara, Sidhi, Singroli and Umaria and the selected village clusters in these districts have a forest cover of about 45 to 50% of geographical area.

OUTCOMES & IMPACTS

Regeneration of bamboo forest: As part of GEF SLEM project, the state forest department(SFD) of MP piloted a community-based approach for treating degraded bamboo forest areas by allotting 20 ha area for four years (5 ha/year) to the poor tribal families residing near these forests. Each poor family treated 5 ha every year and during the four year period, 20 ha was treated by each of 789 households in more than 4,000 ha area of the project districts. Monthly remuneration of ₹ 2,500 which was later increased to ₹ 3,500, was given directly to the household's bank account, thus providing an additional income of ₹ 30,000/per year. This additional income helped families address issues of health, education, loan payment and additional savings. The families who were allocated degraded bamboo forests carried out weeding, cleaning of congested bamboo clumps, soil work and protection etc.

The input cost in the first year on treatment of degraded bamboo forests to an area of 5 ha is ₹ 30,000 incurred in the form of wages for 12 months. ₹ 30,000 in the second year for another area of 5 ha of treatment and another Rs. 30,000 in third year and also in fourth year will be spent on treatment. A maintenance cost of ₹ 5000/year from 5th to 7th year has also been provided. During the initial four years, the beneficiary would be able to earn a revenue of ₹ 2000 per year in the form of 500 discarded bamboo culms in 5 ha area to be sold @ ₹ 4/ culm or utilized by them in preparing kadi (bamboo sticks). It is expected that clumps would improve from 15 -20 culms (baseline scenario) to 25 – 35 culms through sustainable management of degraded bamboo. Beginning from the 5th year, the harvest of matured bamboo is expected to be 1200 culms/ha (120 clumps and in each clump, 10 culms expected) per year. With each culm selling at a nominal rate of ₹10, the total revenue per hectare per year from bamboo alone worked out to be ₹ 12,000. From an area of 5 ha, the revenue of ₹ 60,000 is expected. Sales of culms increase every year (12-15 culms to a bamboo per year growth), hence marginal increase in revenue is expected.

More than 14,500 ha of degraded bamboo area has been rehabilitated with the following benefits:-

- Improve forest cover in the project area by 20%.
- About 3 – 5 tonnes of biomass/ha generated due to regeneration activities.
- Incidence of forest fires reduced.
- Improved water availability for downstream agriculture activities.
- Time spent in collecting drinking water is reduced by 40%.
- 100-150 tonnes pa of fodder available.
- Income of households engaged in project guided activities has improved by ₹ 2,000 to 6,000/ month.
- Outmigration has stopped.

As a regeneration trend, offshoots of about 2-3 new bamboo species have been reported. Apart from the vegetative increase, the local communities have witnessed the return of many predator species like the hyena, fox, leopard, and in some instances tiger, in the project compartments, specially the ones which are near the buffer of the protected areas.

A front end assessment carried out by the project with the local forest officials has indicated an increase of about 25-30% in the carbon sequestration capacity in forest compartments. This is more from the forest areas of Chhindwara, Betul and Umaria. Sidhi and Singrauli being highly degraded, it may take some time for the capacity of non-project sites to be enhanced. It is estimated that project sites have contributed around 50 tonnes per ha annually of carbon sequestration.

Based on the success of this pilot, the SFD of MP issued circulars in April-May 2014, to all the forest circles of the state to adapt the same strategy for rehabilitating the bamboo forest areas. The Forest Divisions were also issued instructions to conduct training workshops for the families in each of their Divisions to prepare groups for the harvesting exercise. The GEF project supported this initiative and developed harvesting manuals/ formats for monitoring and evaluation etc.

The SFD also issued a circular regarding the norms of benefit sharing from the bamboo harvest for industrial and commercial purposes. According to the circular, after deducting the cost of bamboo cutting, bundling, re-bundling, stocking, transportation and all related taxes, the entire amount will be the income of the beneficiary household. The benefit-sharing mechanism for the bamboo harvest will vary as per local decision. The SFD informs that about 80 to 75 % of the revenue generated from the sale of harvested bamboo goes to the beneficiary household and the remaining is deducted and deposited in the forest committee's account.

The household income in project areas has improved as a result of the combined effort of being involved in the forestry work, developing better skills and enhancement of livelihood options. This has also improved their decision making capacities. Local livelihood choices that emerged out of the Self Help Group (SHG) and micro enterprise initiatives have allowed possibilities for better access to government schemes.

Lac cultivation not only provides livelihood to the communities but also aids in forest conservation and associated biodiversity. Lac cultivation in west and south Chhindwara was re-introduced by the project in 30 ha area which has provided additional income to the local communities.

Agarbatti (incense sticks) commonly known as "*doopbattis*" have been used in religious prayers and as room fresheners. *Agarbatti* production uses traditional skills and renewable resources largely obtained from the forests. This activity was introduced in districts of Betul, Chhindwara, Umaria, Sidhi and Singroli to utilize discarded bamboo for commercial uses. The forest division officials had identified beneficiaries from villages for preparing bamboo sticks for supplying ice cream and incense making small scale industries in the region. In Sidhi, more than 150 participants, both men and women from 10 SHGs were trained by the department and provided with the necessary equipment. These participants after the training became the community resource persons for the forest department for other trainings and sensitization programs for the local communities. A loan of ₹ 3 lakh was also provided for running the *Agarbatti* manufacturing unit. An amount of ₹ 1 lakh has already been returned to the forest

department. Training programs and toolkits on *Agarbatti* making were also done by the forest department. Bamboo-based livelihood on *Agarbatti* promoted by the MP forest department showed a pathway out of poverty. In Sidhi forest division, about 4200 families from 32 villages were involved in making *Agarbatti* from the sticks obtained from the rehabilitation of degraded bamboo forests. Degraded bamboo clumps are normally used for making sticks for *Agarbatti* preparation. On an average each beneficiary is earning ₹ 100 for working 5 to 6 hours per day which was very essential for their livelihood.

The project accessed additional funds from other ongoing government programs which enabled it to bring an additional 300,000 hectares under SLEM practices. Under the bio dynamic farming initiatives, about 100-150 ha of fallow agricultural land was covered with more farmers joining the group. The bio dynamic farming initiative has lowered the cost of inputs by 30%. The productivity has increased by about 30% in the test plots. About 180 small, community-based enterprise plans have been developed and some of these are facilitated by NABARD's consultancy wing in operationalization. The engagement of NABARD in the process is expected to help in mobilizing any further resource required for these enterprises later, from local banks.

A well-planned awareness and capacity building program was facilitated by the project. More than 250 forest department staff along with civil society members were sensitized on SLEM issues. Short term orientation programs for new recruits were also conducted. At regular intervals, the project district officials release theproject's achievements and success stories in the local newspapers. The project has also developed a MIS of the plantation activity and has uploaded the information in the official site (www.mpforest.org). The details of the beneficiaries, plantation journal details, species etc. have been uploaded.

LESSONS LEARNT

- Based on successful pilot experience, the SFD issued circulars to all the respective forest circles of the state to group poor villagers in their region and rehabilitate degraded bamboo forests. The replication of successful initiatives is crucial.
- The payment modes, while appearing to be innovative (such as the use of e-banking) may not be as useful if distances to bank branches are considerable. In many project areas, these were as much as 14 to 25 kms, with no means of transport available to access them easily.
- There is a tendency to change from indigenous to modern crop varieties once water/irrigation facilities are developed, which is not always a feasible approach.
- A sectoral state level policy analysis is in progress to understand how the SLEM practices can be integrated as NRM initiatives with other line department agencies.

Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach

Fact File

Focal Area: Climate Change

Program: SLEM CPP

GEF Grant: USD 0.909 million

Co-financing: USD 2.853 million

Total Financing: USD 3.762 million

GEF Agency: FAO

National Executing Agency: Bharathi Integrated Rural Development Society (BIRDS)

Duration: 2010 – 2014

Project Location: 9 Hydrological Units in 7 districts of Anantapur, Chittoor, Kadapa, Kurnool, Prakasam in Andhra Pradesh and Mahbubnagar and Nalgonda now in Telangana.

THE PROJECT

Participatory groundwater management (PGM), in the then combined Andhra Pradesh state, started with wells for small holders in 1995, in an Indo-Dutch bilateral project called the Andhra Pradesh Bore-well Irrigation Schemes (APWELL project), which provided about 3,500 borewell irrigation systems to small and marginal farmers or small holders in seven drought prone districts. In 2000, with growing global concern about indiscriminate tapping of groundwater, participatory hydrological monitoring (PHM) and artificial groundwater recharge (AGR) were launched as a first step to ensure sustainability of the new smallholder wells. Small holders with new well irrigation systems were the primary PHM stakeholders, who were instrumental in organizing all groundwater farmers in a given hydrological unit (HU). Crop–water budgeting (CWB) was conceived in 2001 as the final rung on the PHM ladder.

Then, as part of Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) project, about half a million small holders in the combined state of Andhra Pradesh showed their capability to manage their groundwater systems sustainably, given the knowledge and skills they accessed through the project. This effort was recognized by the Twelfth Five Year Plan.

The GEF SLEM project, for the first time brought key climate and farm related information, both historical and real-time, to the farmer's doorstep. The information consisted of: (a) historical temperature and rainfall trends; (b) real-time information on 7 climate variables (temperature, humidity, rainfall, evaporation, sunshine hours, wind speed, and wind direction); (c) information on soil (type and classification based on hydrogen ion concentration and percentage of calcium carbonate); (d) real-time information on soil organic carbon, available nutrients (nitrogen, phosphorous, potassium, and sulfur), micro-nutrients (boron, zinc, iron, and manganese); (e) real-time available soil moisture; and (f) historical and real-time groundwater balance.

The project was operational in 9 Hydrological Units (HU), spread across 143 habitations in 7 drought prone districts - Anantapur, Chittoor, Kadapa, Kurnool, Prakasam in Andhra Pradesh and Mahbubnagar, and Nalgonda in Telangana. A network of nine NGOs executed the project, with Bharathi Integrated Rural Development Society (BIRDS) providing overall coordination, in addition to executing a sub-project in Kurnool district. The Project Management Unit (PMU) based at Hyderabad, constituted a team of multi-disciplinary professionals.

OUTCOMES

Baseline Study: The project conducted the baseline study by engaging subject specialists to review and document current scientific understanding of climate variability and its impact on land and water management, specifically in the micro-climates (Hydrological Units – HUs) the project operated in. Another team of sociologists and social workers looked at the community perceptions on number of climate variables and their impact on the society in general and land and water management in particular. This exercise provided access to historical data, which was effectively used in decision making by the farmers.

Institutional Building: The GEF Project facilitated the formation of CBOs, called Climate Change Adaptation Committees (CCACs). The habitation level CCACs federated at the HU level into HU-level CCACs, are key farmers' institutions that manage the climate monitoring

system at the habitation and hydrological unit level and disseminate information and knowledge on climate variability/change. CCACs lead implementation of project activities at the community level—PCM, Sustainable Land and Water Management (SLWM) Pilots, and Climate Field Schools (CFS). For CFS, CCACs did curriculum design, organized village meetings, selected CFS farmer participants, identified Community Resource Persons (CRPs), formed Common Interest Groups (CIGs), conducted CFS sessions, identified pilots to test adaptation measures, selected field sites for pilots, prepared climate change adaptation plans, conducted field days, and disseminated project lessons and results.

Participatory Climate Monitoring (PCM) through Community Operated Weather Stations (COWS): refers to a set of activities carried out by farmers, with initial support of experts, to monitor climate parameters. Six tools were installed using IMD installation standards and using local masons (appropriately trained) as part of COWS that allowed communities to measure: (a)rainfall; (b) evaporation; (c) temperature; (d) humidity; (e) sunshine hours; (f) wind direction; and (g) wind speed. In most cases, farmers donated land for establishing COWS, while in a few others, common land was used. The dissemination of COWS data at the habitation level was carried out through information boards, erected at central places of a village. Communities were encouraged to compare the average of the historical data (rainfall and temperature) with the real-time data to understand the climate variability of that particular year or season. Sustainability of PCM data collection beyond project period was ensured by training a number of volunteers in data collection, recording, dissemination, apart from the CCACs raising an Adaptation Fund (matched by a grant of one lakh rupees each from the project) for sustained O&M of the PCM stations. Each of the 9 HUs have a climate change adaptation plan, developed by CCACs, with support of technical staff and local researchers/officers.

Farmer climate schools (FCS): FCS are a non-formal education medium for probable diagnosis and practical solutions and involves group learning aimed at improving skills and knowledge of farmers through hands-on experiences. FCS provided the platform wherein participants discussed the data on weather parameters, its impact on crop growth, pest and disease infestation, and soil moisture availability. Following the discussion, participants made decisions on various practices to be observed to ensure good crop growth, control the infestation of pests and diseases, and water availability to the plants.

Gender balance: Women's participation was improved by engaging women's Self Help Group (SHG) federations. The project staff participated in the meetings of SHGs to share the goals and objectives of the project and the critical role of women in helping farm families to adapt to climate change. With sufficient encouragement, these strategies ensured good participation of women in project activities. Women's participation was more in exclusive women FCS and their participation in small group discussions improved.

SLWM Pilots: Interactions between farmers, local officers and scientists helped identify locally feasible adaptation options. The SLWM pilots showed that correlation of climate data (both historical and real-time) with SLWM is required to relate climate variability with its impact at different crop stages and searching for suitable adaptation options. Use of soil test results, especially the soil carbon content, enabled the project to pass on the message of soil health/nutrient management effectively.

IMPACTS

The GEF project promoted an innovative approach of natural resource management, focusing on community capacity building and strengthening community based organizations with needed skills and knowledge to adapt to climate variability and change. The field climate data collection and analyses sharpened the farmers' ability to

make critical and informed decisions on crop varieties, planting season, managing pest attacks etc. to cope with climate variability and change. The project helped develop many knowledge products in Telugu, the local lingua franca, for ready use of the state governments of Telangana and Andhra Pradesh.The states will also benefit from 467 (186 men and 281 women) trained farmer resource persons (FRPs) who can be directly involved as resource persons in future state initiatives aiming at climate change adaptation.

The Government of Andhra Pradesh (GoAP) and FAO are using the learnings from the GEF project to design new decentralized strategies to initiate local self-governance for effective management of groundwater resources, its sustainable use, and climate resilience in the five drought prone districts namely Anantapur, Chittoor, Kadapa, Kurnool, and Prakasam. FAO is also exploring possibilities with other State Governments in Southern and Western India for initiating groundwater governance pilots. It is partnering with the Uttar Pradesh Department of Agriculture on the Uttar Pradesh Water Sector Restructuring Project Phase-II (UPWSRP-II) to adapt the Farmers Water School (FWS) and Farmers Climate School (FCS) learning for sustaining agricultural productivity growth rates by improving on-farm crop and water management (through knowledge and skill development) among smallholder farmers.

With the Ministry of Environment, Forest and Climate Change, FAO has also adapted key learnings from the project (SLWM in particular) into the proposed GEF 6 Sustainable Agriculture Program under which initiatives will be taken up in Rajasthan, Uttarakhand, Madhya Pradesh, Odisha, and Mizoram.

LESSONS LEARNT

Setting up PCM structures is easy and inexpensive. Operationalization of PCM is a challenge which could be effectively addressed through a customized capacity and local institution building approach.

Climate change adaptation requires a decentralized approach involving local partner institutions and local populations.

CONCLUDING REMARKS

The sustainable management of land resources is commonsense. It is the starting point to address all other environmental and related socio-economic issues. This has been showcased by GEF India's SLEM program.

The experiences from GEF SLEM projects are being increasingly mainstreamed and scaled up. The projects have shown how communities could transform the development paradigm. The state governments of Uttarakhand and Madhya Pradesh came out with Government Orders to promote community participation in the conservation and management of the forest resources while integrating the SLEM approach. This has improved income, livelihood options, well-being of the local population but also ensured the conservation, regeneration and efficient use of the region's natural resources.

In Andhra Pradesh, the participatory climate monitoring and farmer climate schools have built the capacity and capability of the local farmers to understand the daily climate, seasonal variability governing their cropping pattern and practices as well as water use decisions. This has resulted in improved productivity, food security, smarter management of local natural resources. Knowledge empowers and this fact has been recognized by the 12th Five Year Plan of India as well as by the state government of Andhra Pradesh.

The story from Nagaland is yet another example that building the capacity of local communities to understand and plan their natural resource use is an effective way of ensuring conservation and improved livelihoods and local economy. The state government of Nagaland is scaling up this model across the *jhum* districts of the state.

Lastly, the GEF intervention linked to WB/ ICAR's National Agriculture Innovation Program piloted a number of techniques and management practices to improve the yield, quality of produce, income, resource use etc. across the country. The project also seeded sustainability funds with communities to continue piloting innovative practices.

Chapter 5

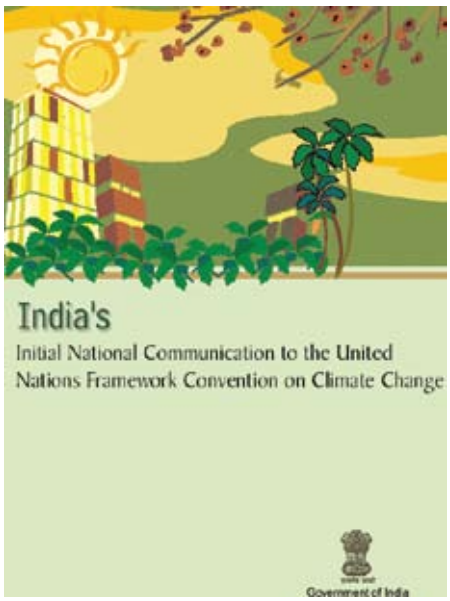
Supporting National Reporting Obligations to MEAs

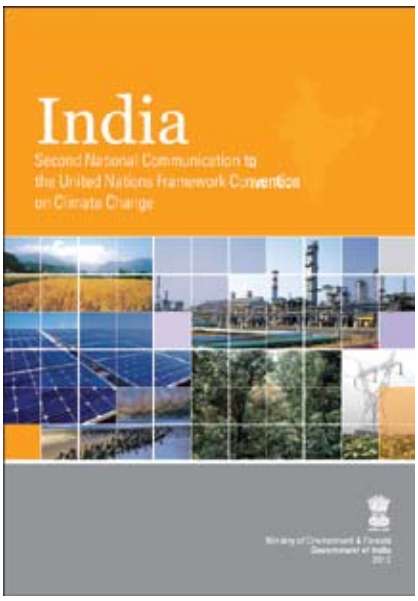
GEF is the funding mechanism of Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD), Stockholm Convention on Persistent Organic Pollutants (POPs) and Minamata Convention on Mercury. Thus, GEF fully supports the national reporting obligations of the member countries towards these conventions.The scope of GEF funding for such activities is defined by convention guidance.

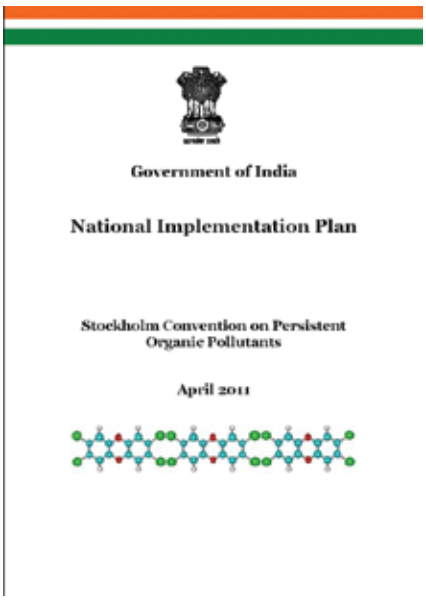
These national reports are important tools integrating convention obligations, strategies and work programs into the national planning process. Hence, this reporting tool has the potential of mainstreaming convention concerns into national development planning, financial frameworks and sector planning processes.

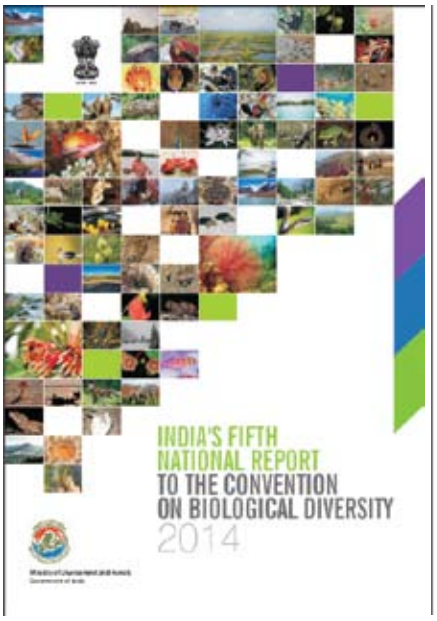
Since 1991, India has accessed GEF grants for the following national reporting requirements:

1. Under CBD for the preparation/ developing of:
   - First, fourth and fifth national report to CBD;
   - First and second national report to Cartagena Protocol on Bio-safety (CPB);
   - National Biodiversity Strategy and Action Plan and then subsequently for its revision/ updation; and,
   - CBD and CPB clearing house mechanism.
2. Under UNFCCC for the preparation of:
   - Initial National Communication (NATCOM);
   - Second NATCOM;
   - Third NATOCM; and,
   - Biennial Update Reports (BURs).
3. Under UNCCD for the preparation of:
   - Fifth and sixth national report to UNCCD; and,
   - Revision of National Action Plan on Desertification and Land Degradation.
4. Preparation of National Implementation Plan (NIP) for Stockholm Convention on POPs.
5. Preparation of NIP for Minamata Convention on Mercury.









The preparation process undertaken for national reports to conventions is rigorous as these reports become a reference point quoted by the international community and are used domestically for developing programs and fundings. Generally, the report preparation involves secondary data review, primary data collection, identification of gaps, resulting in specific studies to develop a better understanding on critical emerging issues, developing national strategies and action plans. For example, the data and information collected for NATCOM also informed the preparation of India's Intended Nationally Determined Contribution.

In the process, it promotes multi-stakeholder consultations, awareness generation and building capacities of a number of institutions and experts on the subject. As these national reports are periodic, most of the ministries have adopted data management practices to meet the requirement of national communications. These national reports, in a way, also define the contour of a country's negotiating positionon various issues.

The GEF grant available for national reporting to the countries is based on their respective requirements. The resources are made available from focal areas set aside (as per the approved ceiling) and from the country's System for Transparent Allocation of Resources (STAR) allocations. The resource available under focal area set aside for national reporting is rather limited for countries like India.

Chapter 6
Communities in Action

INTRODUCTORY REMARKS

Big changes begin with small steps. They originate in small, unreached villages and remote and undulated farms when communities take action towards sustainable utilization of their local natural resources for ensuring better and secure livelihoods. Living in harmony with nature is the mantra as "Nature protects, if she is protected". That is the philosophy that underlies the Global Environment Facility's Small Grants Programme (GEF SGP).

The SGP is a corporate global program of the GEF implemented by UNDP on behalf of the GEF and its agencies. Since its establishment in 1992, the SGP provides financial and technical support directly to community-based organizations (CBOs) and non-governmental organizations (NGOs) for conserving and restoring the environment while enhancing people's well-being and livelihoods. The program provides a grant up to a maximum of USD 50,000.The strategic projects aimed at scaling up and supporting initiatives that cover a large number of communities within a critical landscape or seascape could access USD 150,000 of grant. To date, the GEF SGP globally has invested USD 460 million and leveraged similar levels of co-financing, supporting over 20,000 community-based projects in over 128 countries, including upgraded country programs like India.

Modest funding available under GEF SGP provides support for community-based experimentation of technology or management practices and once proven, efforts are made for its replication and scale up. The program's decentralized approach to grant-making encourages local innovation and community ownership. At the country level, the program

operates through the National Steering Committee (NSC), a multi-sectoral, multi-stakeholder body. The program is governed by a Global Steering Committee chaired by GEF CEO and has members from GEF Secretariat, UNDP and the GEF CSO Network to provide strategic guidance.

In India, the program was launched in 1998 and Development Alternatives was the implementing agency. Since 2000, the Centre for Environment Education (CEE) has been selected as the National Host Institution (NHI) to coordinate the program on behalf of the Ministry. From OP-1 to OP-3, the program received GEF grants from the global core funds.However, after the India program was upgraded in OP-4, the program has been accessing GEF grants from country's allocation.Till OP-3, the program was implemented by UNDP and United Nations Operations for Project Services (UNOPS). However from OP-4, UNDP has been the GEF agency. The NSC is chaired by MoEF&CC, drawing members from different sectors responsible for approving and monitoring all grants. A full time Country Program Manager (CPM) and his team based in Delhi service the program with support from seven regional offices of NHI in the country. Each region is supported through a Regional Committee (RC) and the chairperson of the RC is also a member of the NSC. The RC review and recommend the proposals for the NSC's consideration. After the proposals are approved, the CPM and his team conduct guidance workshops to provide hand-holding to the grantees on various issues. These workshops also encourage cross-cutting learning between the projects. To keep the local authorities involved, the NSC chair writes to the concerned district collectorinforming about the project approved in their respective districts. This also facilitates in mainstreaming.

Fact File

Program period: OP-1 to OP-5 (2000 – 2015)

Focal Areas: Biodiversity, Climate Change, Land Degradation, Chemical & Waste, International Waters

GEF Grant: USD 10.3 million

Co-financing: USD 19.6 million

Total Financing: USD 29.9 million

GEF Agency: United Nations Development Program (UNDP) and United Nations Office for Project Services (UNOPS)

National Executing Agency: Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India

National Host Institution: Centre for Environment Education (CEE)

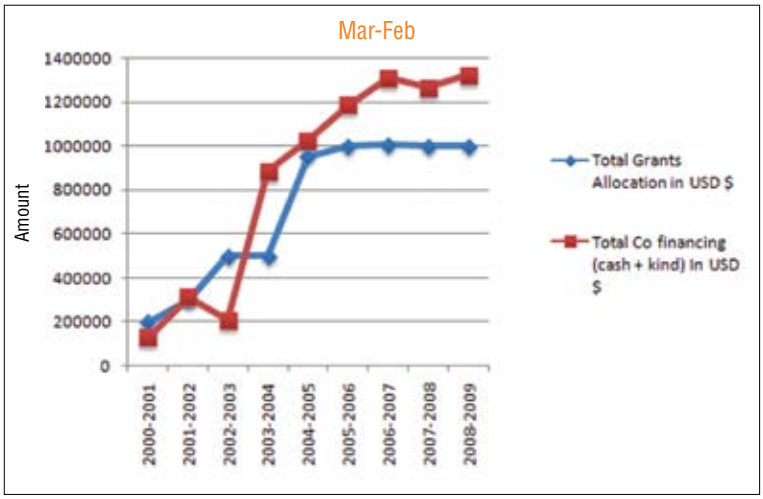
Project Location: Countrywide

Number of Projects: 401

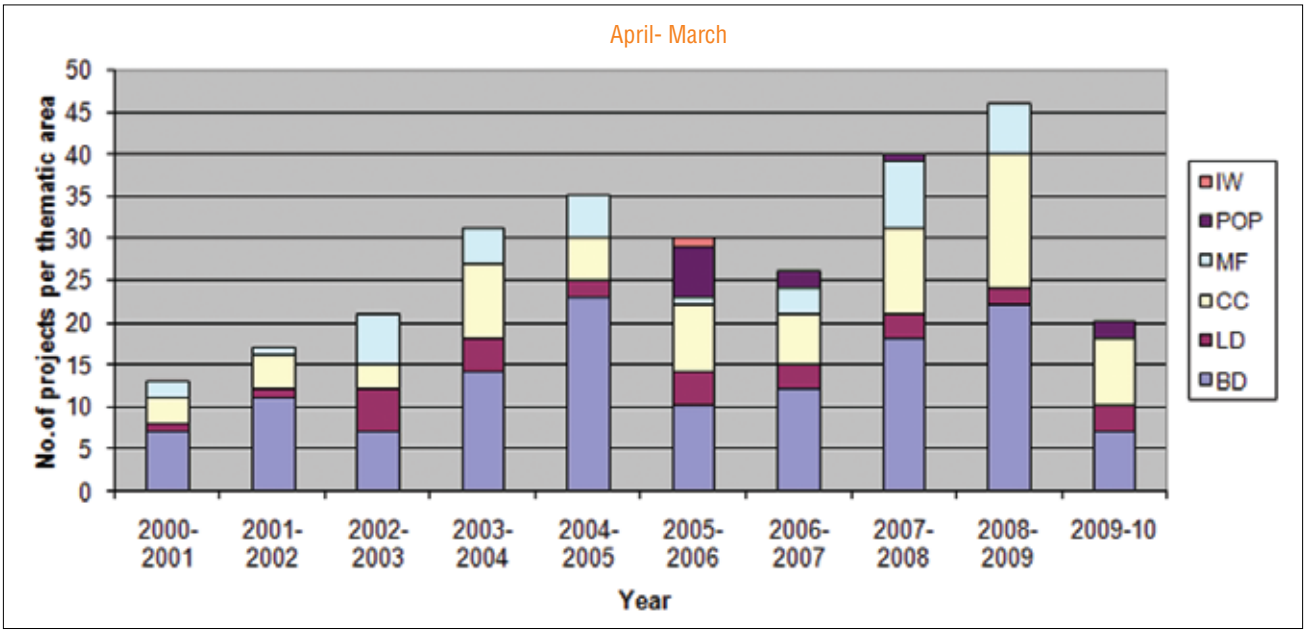
THE PROJECT

From OP-1 to OP-5 phase, the SGP India program had supported a total of 401 projects accessing a grant of USD 10.3 million and leveraging a co-financing of USD 19.6 million. All these projects are complete. This chapter focuses on presenting the impact of these completed projects in conserving local environment while securing livelihoods of local communities.

Grants Recieved Vs. Project Co-financing



Thematic area/year wise projects(2000-2010)



CLIMATE CHANGE

SGP projects and partners have undertaken a range of renewable energy and energy efficiency interventions while developing linkages with government and academia. More than 6,000 smokeless cook-stoves; 45 biomass based driers; two 10 KW micro-hydels; 25 water mills; 2 biogas electrification projects of 30 and 50 cu meters biogas units; 9 solar fish driers; 1600 solar lights/lanterns and 2000 biogas plants and other related technology have been adopted,resulting in 214,000 MTs of CO_2 emission reduction.

Energy Efficient Ovens

In 1700 households from 5 villages located in the fringe areas of B.R. Hills Wildlife Sanctuary, low cost energy efficient ovens were introduced by GEF SGP through Vivekananda Trust, to reduce dependence on forest fuelwood and to improve the health and livelihoods of locals. Over 50 to 60% of reduction in firewood demand resulting in a saving of an average of ₹ 15,000 per annum, per household was achieved. Installation of 1500 energy efficient ovens led to a saving of 2160 kgs of wood and approximately 4,000 MTs of CO_2 emission reduction. The project learnings have been scaled up by the state forest department in Karnataka and by partners in other states like Tamil Nadu, Andhra Pradesh, Telangana, Bihar and Maharashtra.

LAND DEGRADATION

Community-based action to check land degradation has benefitted more than 79,500 ha; increased land productivity in additional 90,000 ha; promoted organic farming in over 35,000 ha; and nearly 11,000 ha land has been brought under agriculture – resulting in livelihood benefits and food security for thousands of households. Many projects have led to better animal husbandry practices and conservation of local breeds.

In Gudalur Block of Nilgiris District, GEF SGP program with Centre for Tribal and Rural Development Trust has supported the construction of 54 biogas plants (22 through GEF grant) and each beneficiary household saves about 8 to 9 kgs of firewood daily resulting in about 2,100 metric tonnes of CO_2 reduction annually.

BIODIVERSITY

Many SGP projects piloted biodiversity-friendly agricultural practices like mixed cropping, System for Rice Intensification (SRI) etc. The focus has been more on dissemination and sharing processes resulting in building social capital. About 26 indigenous rice varieties have been introduced; 221 cultivars of rice conserved and crop gene banks created. Apart from rice, SGP India partners have developed more than 250 products including organically grown indigenous varieties of lentils and minor millets – with medicinal benefits promoting healthy nutritious diets. Pickles, jams, jelly, ketchup are also promoted to add value to the food crops grown by the communities and prevent these from wastage. NGO Sujagrati led to the conservation and increase of the minimum support price for Guggul from ₹ 250/Kg to ₹ 900/Kg in Madhya Pradesh. The Vechur Conservation Trust promoted conservation practices for the Vechur small cow. The turtle conservation pilot has been scaled up by the government in the western coast as the Community Turtle Warrior Program.

Many projects have been centred around Protected Areas, creating better synergy between people, forests and ecosystems. SGP projects have also developed links with National/ State Biodiversity Boards and various technical institutions.

Mountain Bounty

In Kullu, Himachal Pradesh, the GEF SGP grant piloted a robust business model with Jagriti, a women's savings and credit group (WSCG) for sustainable harvest of local natural produce for value addition and commercial sale. The enterprise, comprising more than 67 WSCGs has been institutionalized as 'Mountain Bounties', a community-managed retail outlet in Himachal Pradesh, marketing a range of products worth more than ₹ 20,000 per month. The products are amaranthus flour, apple chips, apricot oil and scrub, beeswax cream,buckwheat flour, corn flour, rose-chip herbal tea, roasted barley, soya bean etc. This initiative has empowered local women.

Since 2011, the GEF SGP India program has organised 15 'Green *Haat*', a market platform to program partners to link up their products with the market mechanism for sustainability. The 'Green *Haat*' was also organized during CBD CoP-11 at Hyderabad wherein the SGP organic products were bought, cooked and served to the delegates as well. In 2014, it was organized in collaboration with partners like UNDP, CMS, GIZ and others. In the last five years, products worth more than ₹ 90 lakh have been sold in these haats.

CHEMICAL AND WASTE

SGP India has been working with ragpickers for promoting a sustainable waste management approach.In Madhya Pradesh, nearly 6/7 Mts of plastic waste less than 40 microns, is picked up every day by more than 1400 rag pickers, bailed and recycled in cement plants as a co-generation in the boilers.

The projects have also informed Policy guidelines. Pilots one-waste management and industrial waste have been successful, coming out with some best practices for wider adoption.

KNOWLEDGE MANAGEMENT

SGP India is communicating results through www.sgpindia.org and brochures. More than 130 brochures, 25 posters, 9 'good practices' booklets have been developed and disseminated within and outside India. The program has been pro-actively participating in public events and workshops, exhibiting practices and products. Cross-country knowledge exchange between SGP programs has also been facilitated.

Some of the awards won by SGP grantees:

- TIDE received the Ashden award, 2008 for introducing energy efficient technologies in textile processing units in Tamil Nadu.
- NIDAN won the Social Entrepreneur of the Year award, 2008 for demonstrating community-based practices for waste management.
- Sujagriti Samaj Seva Sanstha won the Basaman Mama award, 2015 at the state level for planting more than 5 ha of land in one day.

IMPACT

- The SGP program has gained the trust and respect of both the donors and local communities to adopt environment-friendly livelihood practices. In 2005, NSC had approved the scaling-up guidelines based on the premise that good initiatives may require more than a one-time grant to reach a threshold from where they could be self-sustainable. 37 business models developed through scaling-up gave a new direction and creditability while empowering SGP partners to link up with larger programs.
- Since 2011, the MoEF&CC has been organizing a 'Green Haat' every year in Delhi to showcase the products and practices of the SGP India partners, while linking it to wider markets. The communities sell their products directly and earn a huge profit.
- Corporate sector companies like Moser Baer, JSW steel, AVH chemicals, Airbus Corporate Foundation and others are increasingly partnering with SGP India to work with local communities on eco-friendly practices as part of their CSR.

LESSONS LEARNT

- Participatory and gender-sensitive approaches are effective in developing confidence and ownership of local communities.
- Communicating results and impacts to senior authorities, both at the national and state level, could provide opportunities for wider adoption and scale-up.
- A system of content certification, benefit assessment and e-marketing network is required to ensure wider reach and better prices for the products developed by SGP partners.
- The program requires thematic and/or geographical focus for improved visibility and greater impact.
- The program should focus on promoting knowledge and technology interfaces to promote adoption of customised community-based solutions.
- The SGP should try and develop business models for conservation to ensure that after the project, the initiative could be sustained by the local communities without any extra trouble. This could be done by strengthening the forward and backward linkages adding value to the natural resources.

CONCLUDING REMARKS

Presently, the OP-5 phase of GEF SGP India program is operational.A number of learnings from earlier phases have been incorporated, but there is still much more to be done.The SGP India program is one of the GEF's most productive investments in supporting civil society and community initiatives and generating environment and livelihood benefits.

Way Forward

The case studies presented from the completed GEF India portfolio clearly underscore the relevance and importance of incremental financing provided by GEF. GEF has played a catalytic role in promoting innovative projects in the areas of climate change, biodiversity, land degradation, international water and chemical & waste focal area. About 84 national projects have been funded by GEF of which 37 completed, 7 cancelled, 33 under implementation, 2 under GEF approval and 4 are under programming. Of the 37 completed projects, nine projects pertained to national reporting to MEAs. Both completed and ongoing projects have piloted innovative techniques, approaches and management practices creating enabling environment for market transformation. Many of the climate change projects have helped in opening the sectors like coal bed methane, steel re-rolling, tea processing etc to energy efficiency measures resulting in transformation of the respective sector. Most of the biodiversity conservation projects have showcased the impact of conserving the genetic diversity and re-connecting the communities to the concept of sustainable management of their natural resources. Such practices conserve biodiversity while ensuring enhanced income for the local communities. The book also brings out the relevance of addressing environmental issues from multi-focal area and multi-stakeholder perspective.

It is our endeavour to further strengthen the performance of GEF projects in India. The strategic vision guiding the future course for GEF projects India is as follows:

- High impact, high visibility with high replicability potential leading to market transformation, thus making the entire initiative self-sustainable.
- Timely and transparent implementation.
- Ambitious but achievable.
- Country drivenness

GEF-6 cycle programming has followed this strategic vision with focus on three main sectors namely promotion of renewable energy, sustainable cities and climate-smart agriculture. In addition, a project mainstreaming biodiversity conservation into development and financial planning is also envisaged.

The learnings from GEF projects live beyond project period. Thus, there is a need to develop a mechanism to ensure post-project monitoring, ensuring that last mile connectivity is achieved, leading to market transformation and integration with government programs.

Message from GEF Partners

I am pleased to know that the Ministry of Environment, Forest and Climate Change, Government of India, also the GEF Operational Focal Point India, has brought out a compendium showcasing the impacts of completed climate change GEF projects in the country undertaken since 1991. Communicating and sharing results and impacts is as important as implementing the projects successfully. This compendium, I am sure, will facilitate knowledge exchange while also providing good opportunity to learn and improvise.

The GEF is a unique partnership of 183 member governments working for addressing the national as well as global environmental challenge. While the scale of financial resources provided by the GEF are limited, the mandate of GEF to facilitate and promote action over business as usual scenario makes it a valuable partner. We may also remember that GEF investments are for piloting innovative interventions/approaches. This book is full of positive impacts including where last mile effectiveness was also achieved. The book also have stories where although project implementation fell short of expectations, valuable lessons were learnt.

In my short period of association with GEF as Council Member, I realize that there is room for GEF to streamline and improvise its operations and management practices. Transparency and consultative approach, especially with the member countries, will help in better achieving GEF's objectives.

I sincerely hope that this compendium will provide very good opportunity for enabling knowledge exchange between the constituent members of GEF South Asia constituency and all other stakeholders.

Subhash Chandra Garg
Executive Director for Bangladesh, Bhutan, India and Sri Lanka and GEF Council Member for Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka

Global Environment Facility (GEF) is a partnership for international cooperation where 183 countries work together with international institutions, civil society organizations and the private sector, to address national as well as global environmental issues. As GEF's founder member, India values her partnership with the GEF and would like this institution to adapt and grow while remaining relevant in a dynamic world.

The role and value of GEF goes beyond providing finance. The seed money, accompanied by technical and international knowledge, brings value to collaboration with GEF. There is a need to provide more space to the member countries to program and operate as per their respective national priorities. Enhancing transparency in GEF's operations as well as increasing ease of doing business with GEF will create greater confidence in the institution.

I would like to congratulate the Ministry of Environment, Forest and Climate Change for bringing out this publication. The report documents the impact of completed GEF investments in bringing desired transformation in various sectors. The publication also showcases how desertification, land degradation, forest conservation, biodiversity conservation and climate change issues are inter-related. The lessons that emerge from this document should enhance the effectiveness and delivery of subsequent interventions.

Raj Kumar
Joint Secretary, Department of Economic Affairs
Government of India
and India's GEF Political Focal Point

The publication "GEF India: Enabling Transformations" builds on the agreement reached at the 21st Conference of Parties to the United Nations Framework Convention on Climate Change (COP21) in Paris in December 2015. This publication showcases the achievements of the long and successful partnership between GEF and India. While acknowledging the successes, it is a good time to reflect on the outcomes of this partnership, which includes significant contributions from the World Bank, one of the global GEF implementing agencies and a longstanding development partner of the Government of India. GEF support to the World Bank program in India has made it possible to test new approaches, scale up best practices and undertake capacity-building in a wide range of areas, including climate change adaptation, Sustainable Land and Ecosystem Management (SLEM), biodiversity conservation and rural livelihoods,energy efficiency at Medium, Small and Micro Enterprises (MSME) and sustainable transport. While this partnership has already contributed to making India's growth trajectory sustainable at a time of emerging environmental challenges, the global agreement reached at COP 21 presents an important opportunity to pause and reflecton how to make this partnership more strategic, especially in leveraging large-scale co-financing from World Bank resources, and how to work at scales that are needed in the wake of recent climatic incidents and predictions. The world is looking at a historic opportunity to overcome poverty within one generation, and the GEF- World Bank partnership with India makes an important contribution to these efforts by adding the dimension of environmental sustainability. The World Bank, as a global development agency and partner of GEF is committed to supporting India's efforts to deliver smart development solutions that work at scale.

Onno Ruhl
Country Director
The World Bank

The United Nations Development Programme (UNDP) is proud of its long standing partnership with the Ministry of Environment, Forest and Climate Change in its efforts to meet the country's environmental commitments in the implementation of projects supported by the Global Environment Facility (GEF). UNDP anchors one of the largest portfolio of GEF projects in India. We are privileged to work with six Central ministries including Ministries of Steel, Railways, Urban Development, New and Renewable Energy, Commerce, Power, along with several state governments.

UNDP's long standing association with GEF has been extremely rewarding. As demonstrated through our projects, the partnership is well suited to supporting work that requires comprehensive approaches in reaching out to multiple sectors by building strategic partnerships to tackle poverty, inequality and environmental degradation. By serving as the financing mechanism for the five major environmental conventions, GEF support brings convergence among different institutions in the country with GEF executing agencies to find integrated sustainable solutions for environmental and developmental challenges.

Allow us to congratulate the Ministry of Environment, Forest and Climate Change on preparing this excellent publication highlighting achievements of GEF supported projects. This publication focuses on climate change, biodiversity conservation and sustainable land and ecosystem management.

We are delighted to share stories in this compendium from projects executed by UNDP.The stories collated in this publication demonstrate innovations that have the ability to promote new technologies and approaches.These have helped inform policy to catalyse investments for upscaling and replication. This publication provides valuable learnings for sharing with other countries and contributes to opportunities for South-South cooperation.

UNDP values the support of GEF funding in implementing these programmes in Indiaand we would like to affirm our commitment to support the priorities of the Government through the period of GEF 6 and beyond. We look forward to strengthening our portfolio further for overall development and global environmental benefits.

Jaco Cilliers
Country Director
United Nations Development Programme

GEF India: An overview

GEF India Project Portfolio (1991 – As on date)*
(In USD M)

S No	Project	Grant	Co-funding	GEF Phase	Duration	GEF Agency	National Executing Agency
1.	Alternate Energy	26	262.1	**Pilot** (1991-1994)	1993 - 2001	World Bank (WB)	Indian Renewable Energy Development Agency (IREDA)
2.	Development of High Rate Bio-Methanation Processes as Means of Reducing GHG Emissions	5.5	16.5		1994 - 2005	United Nations Development Program (UNDP)	Ministry of New and Renewable Energy (MNRE)
3.	Optimizing Development of Small Hydel Resources in Hilly Areas	7.5	224.8		1991 - 2002	UNDP	MNRE
	TOTAL	**39**	**503.4**				
4.	Selected Options for Stabilizing GHG Emissions for Sustainable Development	1.5	0	**First** (1994 – 1998)	1998 - 2002	UNDP	MNRE
5.	India: Eco Development	20	18.63		1996 – 2004	WB	Ministry of Environment, Forest and Climate Change (MoEF&CC)
6.	First National Report to the CBD	0.025	0		1997 – 1998	UNDP	MoEF&CC
7.	National Biodiversity Strategy and Action Plan	0.968	0		1998 - 2010	UNDP	MoEF&CC
8.	Coal Bed Methane Capture and Commercial Utilization	9.2	9.8		1998 - 2009	UNDP	Ministry of Coal (MoC)
9.	Solar Thermal Power	49	196		Cancelled in 2006	WB	Rajasthan State Electricity Board
10.	India: Energy Efficiency project	5	252.37		1998 - 2008	WB	IREDA
	TOTAL	**36.693**	**280.8**	Total does not includeUSD 49 m of grant and USD 196 m of co-funding cancelled.			
11.	Conservation and Sustainable Use of the Gulf of Mannar Biosphere Reserve's Coastal biodiversity	7.65	16.95	**Second** (1998 – 2002)	2001 – 2012	UNDP	State Forest Department, State Government of Tamil Nadu
12.	Biomass Energy for Rural India	4.017	1.14		2001 -2012	UNDP	State Forest Department, State Government of Karnataka
13.	Sustainable Management of the Bay of Bengal Large Marine Ecosystem (BOBLME)	1.5 (India)	1.3 (India)		1997 -2014	UN Food and Agriculture Organization (FAO)	Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture
14.	Mainstreaming Conservation and Sustainable Use of Medicinal Plant Diversity in 3 Indian States	4.9	6.479		2000 – June 2015	UNDP	MoEF&CC& Foundation for Revitalization of Local Health Traditions (FRLHT)
15.	Enabling Activity for the Preparation of India's Initial Communication to the UNFCCC	2	0.109		2000 - 2004	UNDP	MoEF&CC
16.	Conservation and Sustainable Management of Dryland Biodiversity, Phase 1	1.71	1.795		Cancelled in 2005	UNDP	MoEF&CC
17.	Andaman and Nicobar Islands: Ecologically Sustainable Island Development	3.388	5.98		Cancelled in 2008	UNDP	MoEF&CC
	TOTAL	**20.067**	**25.978**	Total does not include USD 5.098 million of grant and USD 7.775 million of co-funding of two cancelled projects			

18.	Capacity Building for Implementation of the Cartagena Protocol	1	2.070	**Third** (2002 – 2006)	2003 - 2007	WB	MoEF&CC
19.	National Capacity Self Assessment (NCSA) for Global Environment Management	0.2	0.050		2004 - 2009	UNDP	MoEF&CC
20.	Removal of Barriers to Biomass Power Generation I	5.65	33.5		2007 –Mar 2016	UNDP	MNRE
21.	Biodiversity Conservation and Rural Livelihood Improvement	8.14	35.6		2006 - 2016	WB	MoEF&CC
22.	Coal Fired Generation Rehabilitation Project	45.4	258		2006 – Nov 2016	WB	Ministry of Power (MoP)
23.	Enabling activities for Preparing India's Second National Communication to UNFCCC	4.195	6.5		2006 – 2012	UNDP	MoEF&CC
24.	Global Solar Water Heating Market Transformation and Strengthening Initiative	2 (India)	40 (India)		2008 - 2012	UNDP	MNRE
25.	Removal of Barriers to Energy Efficiency Improvement in the Steel Re-Rolling Mill Sector	6.75	4.872		2004 - 2013	UNDP	Ministry of Steel
26.	Development of a National Implementation Plan in India as a First Step to Implement the Stockholm Convention on POPs	3.558	7.080		2002 – 2010	United Nations Industrial Development Organization (UNIDO)	MoEF&CC
27.	Demonstrating and Promoting Best Techniques and Practices for Reducing Health-Care Waste to Avoid Environmental Releases of Dioxins and Mercury	0.8 (India)	13.54 (Global)		2002 – 2012	UNDP	MoEF&CC
28.	Electric 3-Wheeler Market Launch Phase	998,000	2.258		Cancelled in 2008	UNDP	MoEF&CC
29.	Market Transformation through Consumer Awareness Programs for Energy Efficiency Standards and Labelling	5.5	25.9		Cancelled in 2010	UNDP	Bureau of Energy Efficiency (BEE)
	TOTAL	**77.693**	**387.672**	Total does not include USD 6.498 million of grant and USD 28.158 million of co-funding of two cancelled projects and USD 13.54 million of global co-funding for project at S. no 27			
30.	Energy Conservation in Small Sector Tea Processing Units in South India	0.950	1.1	**Fourth** (2006 – 2010)	2009 - 2013	UNDP	Tea Board of India
31.	Achieving Reduction in GHG emissions through Advanced Energy Efficiency Technology in Electric Motors	0.275	1.114		2009 - 2011	UNDP	BEE and International Cooper Association
32.	Mokshda Green Cremation System for Energy and Environment Conservation	1.075	2.335		Cancelled in 2010	UNDP	MoEF&CC
33.	Sustainable Participatory Management of Natural Resources to Control Land Degradation in the Thar Ecosystem	1	14.7		Cancelled in 2013	UNDP	Jal Bhagirathi Foundation
34.	Low Carbon Campaign for Commonwealth Games 2010	0.950	3.49		2010 – 2011	UNDP	Organizing Committee of Commonwealth Games
35.	Conservation and Management of Pollinators for Sustainable Agriculture through an Ecosystem Approach	0.334	5.5		2008 - 2015	FAO	G B Pant Institute of Himalayan Environment and Development

* This table includes only national projects and global/regional projects funded by STAR

36.	2010 Biodiversity Targets National Assessments – India's Fourth National Report to Convention of Biological Diversity	0.02	0.02		2010	UNDP	MoEF&CC
37.	Small Grants India Program	2.4	2.4		2006 - 2010	UNDP	MoEF&CC & Centre for Environment Education (CEE)
38.	Sustainable Land, Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector	7.49	106.89		2009 -2013	WB	Directorate of Watershed, State Government of Uttarakhand
39.	Sustainable Rural Livelihood Security through Innovations in Land and Ecosystem Management (NAIP)	7.34	88		2009 -2014	WB	Indian Council for Agricultural Research (ICAR)
40.	Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach	0.909	2.853		2010 - 2014	FAO	Bharathi Integrated Rural Development Society (BIRDS)
41.	Policy and Institutional Reform for Mainstreaming and Up scaling SLM in India	1.079	1.5		2009 - 2014	WB	Indian Council of Forestry Research and Education (ICFRE)
42.	Conservation and Sustainable Use of Cultivatable Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem services	1.1	6.714		2009 -2014	United Nations Environment Program (UNEP)	ICAR &Bioversity International
43.	Energy Efficiency Improvements in the Indian Brick Industry	0.768	1.99		2009 - 2016	UNDP	MoEF&CC
44.	Sustainable Urban Transport Project	25.157	352.7		2010 –2016	WB & UNDP	Ministry of Urban Development (MoUD)
45.	Chiller Energy Efficiency project	6.93	93.8		Dec 2014	WB	MoEF&CC& IDBI Bank
46.	Improving EE in the Indian Railways System	5.83	21.15		2010-2015	UNDP	Ministry of Railways
47.	Energy Efficiency Improvements in Commercial Buildings	5.819	14.8		2010-2017	UNDP	BEE
48.	Financing Energy Efficiency at SME	12.43	57.5		2010-2015	WB	BEE
49.	Promoting EE and RE in selected SME cluster in India	8	26.1		2010-2017	UNIDO	BEE
50.	Market Development of Solar Assisted Industrial Process Heat Technologies	4.84	19.35		2011 -2017	UNDP	MNRE
51.	Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the Godavari River Estuary, Andhra Pradesh	6.626	17.774		2010-2016	UNDP	State Forest Department of Andhra Pradesh
52.	Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the Malvan Coast, Maharashtra	3.85	10.275		2010-2016	UNDP	State Forest Department ofMaharashtra
53.	Capacity Building for Strengthening the Implementation of Biological Diversity Act and Rules with focus on its Access and Benefit Sharing Provisions	3.917	6.229		2011 - 2015	UNEP	MoEF&CC and National Biodiversity Authority (NBA)
54.	Capacity Building on Bio-safety for Implementation of the Cartagena Protocol – Phase II'	3	6		2011 - 2016	UNEP	MoEF&CC
55.	Environmentally Sound Management and Final Disposal of PCBs in India	15.895	29		2010 - 2014	UNIDO	MoEF&CCand Central Power Research Institute
56.	Sustainable Land Management in Shifting Cultivation Areas of Nagaland for Ecological and Livelihood Security	3.6	25.4		2009 - 2015	UNDP	Department of Soil and Water Conservation, State Government of Nagaland

57.	Integrated Land Use Management to Combat Land Degradation in Madhya Pradesh	5.76	17.28		2009 - 2015	UNDP	State Forest Department of Madhya Pradesh
	TOTAL	**135.269**	**918.929**	Total does not includes USD 2.075 million of grant and USD 17.035 million of co-funding of two cancelled projects			
58.	Preparation of 2nd National Report to Cartagena Protocol on Bio-safety	0.02	0.02	**Fifth** (2010-2014)	2011	UNEP	MoEF&CC
59.	Revision of NBAP and preparation of fifth National Report to CBD	0.242	0.26		2012-2014	GEF Secretariat	MoEF&CC& NBA
60.	Small Grants Program	5.4	6		2012-2016	UNDP	MoEF&CC
61.	Environmentally Sound Management of Medical Wastes in India	10	30.1		2011 - 2017	UNIDO	MoEF&CC
62.	Preparation of Third National Communication to the UNFCCC and Strengthening Institutional and Analytical Capacities on Climate Change	10	26.2		2013 - 2018	UNDP	MoEF&CC
63.	Promoting Clean Energy Technology Innovations and Competitiveness of SMEs in India	1.1	3		2013-2016	UNIDO	Ministry of Micro, Small and Medium Enterprises (MSME)
64.	Revision of NAP and preparation of 5th and 6th NR to UNCCD	0.148	0.184		2013- June 2015	GEF Secretariat	MoEF&CC and ICFRE
65.	Climate Resilient Coastal Protection and Management in India	2	80		2014-2018	Asian Development Bank (ADB)	Ministry of Water Resources
66.	Promoting business models for increasing penetration and scaling up of solar energy in India	5	21.8		2014-2018	UNIDO	MNRE
67.	Developing effective multiple use management framework for conserving biodiversity in the Mountain Landscapes of the High Ranges, Western Ghats	7	30		2014-2018	UNDP	MoEF&CC
68.	India: Sustainable Livelihoods and Adaptation to Climate Change	8	52.2		2014-2018	WB	Ministry of Rural Development (MoRD)
69.	Efficient and Sustainable City Bus Services	9.2	85		2014-2018	WB	MoUD
70.	Scale Up to Access Clean Energy for Rural Productive and Domestic Use	4.006	32.5		2015-2019	UNDP	MNRE
71.	Partial Risk Sharing Facility for EE	18	160		2015-2025	WB	BEE, Small Industries Development Bank (SIDBI), Energy Efficiency Service Limited (EESL)
72.	Ecosystems Service Improvement Project	24.64	132		2015-	WB	MoEFCC
73.	Development and Promotion of Non-POPs alternatives to DDT	10	40		2015-	UNIDO & UNEP	MoEF&CC

74.	Mainstreaming biodiversity conservation and utilization in agricultural sector to secure ecosystem services and reduce vulnerability	3.5	10.295		Under approval	UNEP	ICAR
75.	Promoting market transformation for energy efficiency in MSMEs	4.465	26.86		2015-2019	UNIDO	MSME
76.	Organic Waste Streams for Industrial RE applications in India	3.737	18.215		2015-2019	UNIDO	MNRE
77.	Improving Rural Energy Access in Deficit States	14	To be decided (Tbd)		Under preparation	WB	MNRE
78.	Facility for Low Carbon Technology Deployment	9.54	50.23		2016-	UNIDO	BEE
79.	Market Transformation and Removal of Barriers for Effective Implementation of the State Level Climate Change Action Plans	4.56	12.58		2016-	UNDP	MoEF&CC
80.	Integrated Management of Wetland Biodiversity and Ecosystem Services for Water and Food Security	4.6	20.4		2016-	UNEP	MoEF&CC
	TOTAL	**159.158**	**837.844**				
81.	Secure Himalayas	12.796	Tbd	**Sixth** (2014-2018)	Under preparation	UNDP	MoEF&CC
82.	Improving Mercury Management in India	1.0	Tbd		Under preparation	UNDP	MoEF&CC
83.	Smart cities	13.5	Tbd		Under preparation	UNIDO	MoUD
84.	Creating and Sustaining Energy Efficiency Markets	20.88	Tbd		Under preparation	UNEP & ADB	BEE and EESL
	TOTAL	**48.176**					
	Grand TOTAL	**516.056**	**2954.623**				

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